# Energy Strategy

**2018 Resubmission of APP/X5210/A/14/2218052**

## Gondar Gardens, London Borough of Camden, London

**For**

**July 2018**

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# Contents

# 1.0 Executive Summary

This document has been prepared to present the revised results of an early stage analysis of potential Low and Zero Carbon (LZC) technologies for the proposed new development at Gondar Gardens, London Borough of Camden, London, NW6 1QF, in order to satisfy the Local and Regional Planning Policy requirements relating to energy and $CO_2$ emissions as noted in this document.

The site consists of the redevelopment of the reservoir street frontage to provide 28 residential units (Class C3 use) in two blocks from lower ground to third floors with basement parking, following substantial demolition of the roof and internal structure of the reservoir and its subsequent re-landscaping. The development is situated in the London Borough of Camden and, as such, should comply with the energy requirement of the Camden Local Plan 2017, London Plan 2016 and Part L1A 2013 of Building Regulations.

Therefore, the following objectives have to be achieved for the development:

***Actual Targets:***

- **Ensure the site complies with Part L1A 2013 (Amendments published November 2013, in effect April 2014) of the UK Building Regulations including:**
  - Ensure the Dwelling Emissions Rate (DER) is less than the Target Emissions Rate (TER) (kg/$CO_2$/$m^2$)
  - Ensue the Dwelling Fabric Energy Efficiency Standard (DFEE) is less than the Target Fabric Energy Efficiency Standard (kWh/$m^2$)
- **A target of 35% reduction in onsite regulated $CO_2$ emissions over the Part L 2013 baseline (TER with gas as primary fuel) is in place for all major developments**
- **A cash in lieu payments for residual $CO_2$ to achieve "zero carbon" (100% regulated) shortfall may be subject to a carbon offset payment**
- **A desire for 20% reduction in carbon dioxide emissions from on-site renewable energy generation**

A target of 35% reduction in regulated $CO_2$ emissions over the baseline is placed on all major developments by the London Plan. Major Developments are defined in the London Plan as; for dwellings; where 10 or more are to be constructed (or if number not given, area is more than 0.5 hectares).

The analysis in this report has been conducted by utilising an actual SAP 2012 calculation for each new build dwelling and the strategy embraces the London Plan energy hierarchy throughout.

Based on the information available at this stage and the assumptions detailed in Section 3, the following baseline emissions have been calculated:

**Table 1.1a: Target emission rate**

| Target Site wide emissions | Total ($tCO_2$ /yr) | Equation |
|---|---|---|
| **Part L1A 2013 Baseline** | 48.22 | A |
| **Site 35% $CO_2$ Target DER** | 31.34 | B = A x (1-35%) |
| **$CO_2$ emissions to be offset in total from Part L1A 2013 Baseline** | 16.88 | C = A - B |

The development proposes to satisfy the above targets onsite. This strategy embraces the London Plan's energy hierarchy within the constraints of the site as follows:

- ***Be lean:*** ***use less energy.*** The enhanced building fabric specification outlined in Section 3 will minimise the heat demands of the development through passive design.
- ***Be clean:*** ***supply and use energy efficiently***. The development will include high efficiency gas boilers and heat recovery units for the ventilation to further reduce the fossil fuel demands of the development.
- ***Be green:*** ***use Low or Zero Carbon technologies.*** The development will integrate high efficiency Solar Photovoltaic Panels (PV) to generate renewable energy to further offset the emission of the dwellings.

The outcomes of implementing the preferred option set out in this strategy are detailed below on a site wide basis across the development:

**Table 1.1b: New-Build dwellings total $tCO_2$/yr for each hierarchy stage**

| | | Be Lean | Be Clean | Be Green |
|---|---|---|---|---|
| Regulated $CO_2$ Emissions | Baseline $CO_2$ Emissions | Proposed Gas baseline Building (DER) | Proposed Gas baseline Building (DER) | Proposed Building (DER) |
| **Total Regulated ($tCO_2$/yr)** | 48.22 | 46.91 | 42.76 | 28.60 |
| **%age Reduction over Baseline** | N/A | **2.72%** | **11.32%** | **40.68%** |
| **%age Reduction from LZC** | N/A | N/A | **8.84%** | **33.11%** |

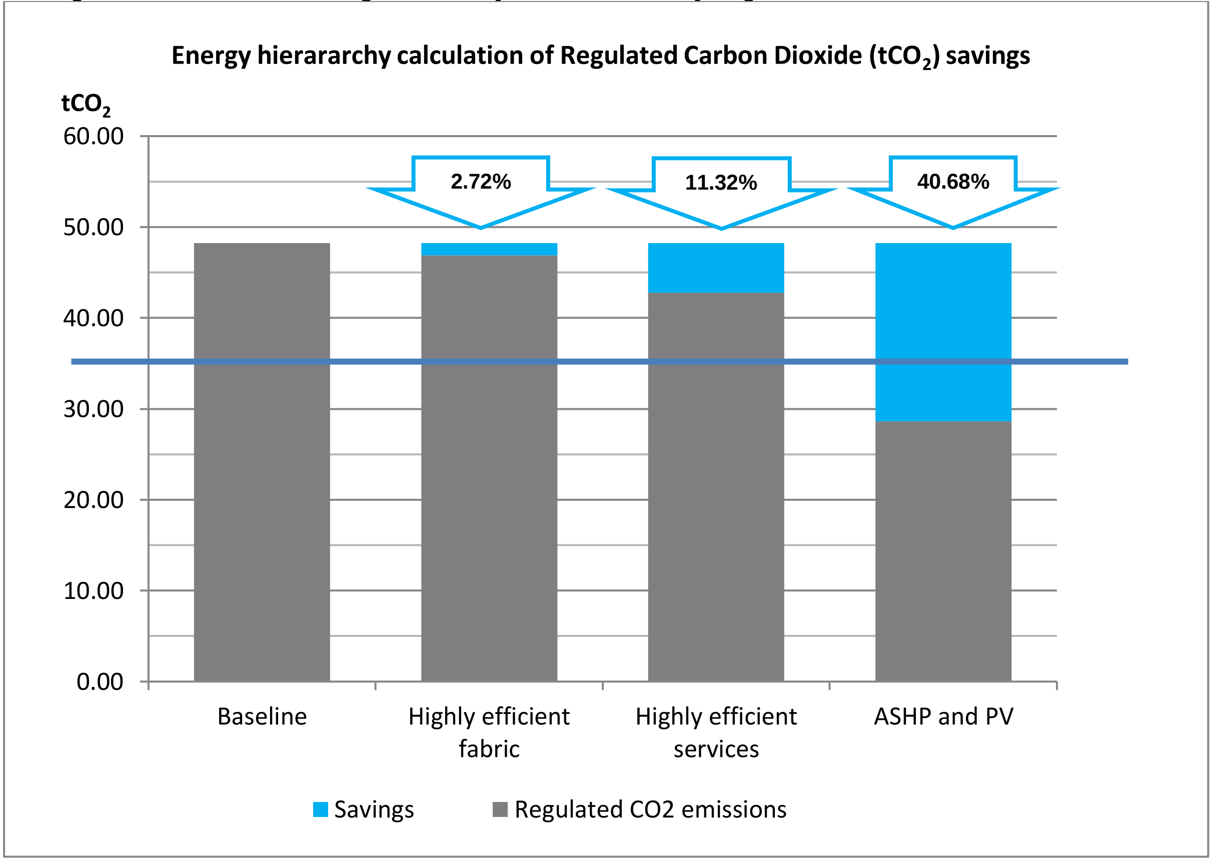
**As shown in the tables above, the implementation of the proposed solution should ensure an improvement of 40.68% for the development.**

In summary, the proposed strategy offers the following savings from enhanced building fabric specifications and Low and Zero Carbon Technologies:

- A **40.68%** reduction in regulated $CO_2$ emissions over the Part L1A 2013 baseline from fabric specifications, energy efficient services and the implementation of Low & Zero Carbon technologies (LZC).
- A **33.11%** reduction in regulated emissions from Low & Zero Carbon technologies (LZC) including the ASHPs and Solar Photovoltaic Panels (PV) in line with the Camden policy
- A **5.75%%** reduction in all site $CO_2$ (regulated & unregulated) emissions from the Part L1A 2013 from improved fabric specification before any Low & Zero Carbon technologies (LZC).
- A **20.65%%** reduction in all site $CO_2$ (regulated & unregulated) emissions from improved fabric specifications and Low & Zero Carbon technologies compared to the Baseline emissions.

**The scheme has incorporated the GLA's guidance and will deliver the target, as far as is feasible on site, the targets set out for Major Developments in the current London Plan.**

**Figure 1.1a: New-Build dwellings total $tCO_2$/yr for each hierarchy stage**



# 2.0 Introduction

The site consists of the redevelopment of the reservoir street frontage to provide 28 residential units (Class C3 use) in two blocks from lower ground to third floors with basement parking, following substantial demolition of the roof and internal structure of the reservoir and its subsequent re-landscaping. The development is situated in the London Borough of Camden and, as such, should comply with the energy requirement of the Camden Local Plan 2017, London Plan 2016 and Part L1A 2013 of Building Regulations.

## 2.1 Building Regulations (Part L)

All new buildings constructed in the UK must meet the minimum requirements of the UK Building Regulations. Specifically, with regards to energy and carbon compliance, all buildings must meet the Building Regulations Part L 'Target Emission Rate' (TER) requirements for the Part L revision which is current at the time of initial construction works. In addition the Part L1A 2013 requirement to meet the new Target Fabric Energy Efficiency (TFEE) standards will be need to be achieved.

The analysis in this report has been conducted using SAP 2012 version 9.9.2.1 which is the current version of SAP used to show compliance with Part L1A 2013.

## 2.2 Camden Local Plan 2017 - Sustainability and climate change

### Policy CC1 Climate change mitigation

The Council require all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation.

- Require all major development to demonstrate **how London Plan targets for carbon dioxide emissions reductions have been met;**
- Requiring all major developments to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible establishing a new network
- The council will expect Major Developments to achieve a 20% reduction in carbon dioxide emissions from on-site renewable energy generation (which can include sources of site related decentralised renewable energy), unless it can be demonstrated that such provision is not feasible.

## 2.3 Camden Planning Guidance: CPG3 - Sustainability

### Camden's Sustainable Design and Construction Supplementary Planning Guidance (SPG)

Published in July 2015 and updated March 2018 this document makes reference to the policies and sets out targets as follows:

- **Section 3** sets out a clear hierarchy of what is to be analysed in any new development in the borough. This section also sets out 'Best Practice' standards for designing Low Carbon Buildings.
- **Section 5** asks that feasible and viable your development will be required to connect to a decentralised energy network or include CHP.
- **Section 6** sets out the Council's expectation that developments of five or more dwellings and/or more than 500 sqm of any gross internal floorspace to achieve a 20% reduction in carbon dioxide emissions from on-site renewable energy generation

## 2.4 Council Planning Meeting

### Camden Borough Council Planning Solutions advice

A meeting was held on the 22/06/2018 at the Council's offices to discuss the resubmission of planning application 2013/7585/P which was allowed at appeal (APP/X5210/A/14/2218052) on the 16/12/2015. The following advice was given regards the scheme:

Energy and Sustainability

- Policy CC1 (Climate change mitigation) now requires all major developments to demonstrate how the London Plan targets for $CO_2$ have been met in developments.
- Following the steps in the energy hierarchy and optimising resource efficiency.
- Monitoring equipment is also now required by this policy in order to ensure the effectiveness of renewable and low carbon technologies.
- As part of an updated Energy Statement, it will therefore be necessary **to demonstrate the residential development is "zero carbon", as defined in the Mayor's Housing SPG**. As the former Sustainability/Energy statements are now out of date, they would need to be updated prior to any formal resubmission.
- The advice also notes withdrawal of Code for Sustainable Homes and the introduction of extended optional building control requirements in relation to accessible design.

## 2.5 Mayor's Housing SPG

**The Mayoral Housing SPG (September 2016)** states that all residential developments are to achieve the Mayor's zero carbon standard. This requires a 35% reduction in regulated carbon dioxide emissions (beyond Part L 2013) on-site or as far as feasible. The remaining regulated carbon emissions, to 100%, are to be off-set through a cash in lieu contribution to the relevant borough; ring fenced to secure delivery of carbon dioxide savings elsewhere (in line with London Plan Policy 5.2E).

## 2.6 The London Plan (2016)

The Mayor of London published the updated London Plan in March 2016 (consolidated with alterations since 2011). Key policies underpinning London's approach to sustainable development include:

- Policy 5.2 – Minimising Carbon Dioxide Emissions
- Policy 5.3 – Sustainable Design and Construction
- Policy 5.4A – Electricity and Gas Supply
- Policy 5.5 – Decentralised Energy Networks
- Policy 5.6 - Decentralised Energy in Development Proposals
- Policy 5.7 – Renewable Energy
- Policy 5.9 – Overheating and cooling

The London Plan sets out policy in the London context and identifies a number of objectives to improve the City as a place to work and live. Policy 5.2 sets out the requirements to minimise $CO_2$ emissions through the application of the energy hierarchy:

- **Be lean:** *use less energy*
- **Be clean:** *supply and use energy efficiently*
- **Be green:** *use low or zero carbon technologies*

The following targets are in effect for all Stage 1 schemes received by the Mayor from 1 October 2016 onwards, as set out in the energy assessment guidance:

- Residential developments – "Zero Carbon" (as defined in section 5.2 of the Housing SPG) against Part L 2013

The Mayoral London Plan requires an assessment of energy demand that demonstrates the steps taken to apply the Mayor's energy hierarchy. The London Plan includes planning policies both for reducing energy consumption within buildings and the use of renewable energy. These policies cover the role of the boroughs in supporting the Mayor's energy strategy and the requirements of planning applications.

## 2.7 Objectives

The development is situated in London Borough of Camden and will have to comply with the energy requirements of Part L1A 2013. Therefore, the following objectives have to be achieved for the development:

***<u>Actual Targets:</u>***

- **Ensure the site complies with Part L1A 2013 (Amendments published November 2013, in effect April 2014) of the UK Building Regulations including:**
    - Ensure the Dwelling Emissions Rate (DER) is less than the Target Emissions Rate (TER) ($kg/CO_2/m^2$)
    - Ensue the Dwelling Fabric Energy Efficiency Standard (DFEE) is less than the Target Fabric Energy Efficiency Standard ($kWh/m^2$)
- **A target of 35% reduction in onsite regulated $CO_2$ emissions over the Part L 2013 baseline (TER with gas as primary fuel) is in place for all major developments**
- **A cash in lieu payments for residual $CO_2$ to achieve "zero carbon" (100% regulated) shortfall may be subject to a carbon offset payment**
- **A desire for 20% reduction in carbon dioxide emissions from on-site renewable energy generation**

# 3.0 Baseline Energy Demands and $CO_2$ Emissions

## 3.1 Context to Approach

The recommendations in this Energy Strategy are proposed to show compliance with the themes outlined in the Mayor's energy hierarchy outlined in the London Plan 2016 (MALP), as well as following the current Zero Carbon trajectory:

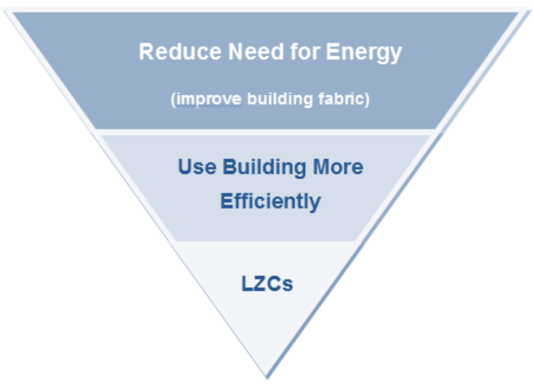
- **Be lean:** *use less energy*
- **Be clean:** *supply and use energy efficiently*
- **Be green:** *use low or zero carbon technologies*

This approach consists of reducing the energy demand and $CO_2$ emissions by improving the energy efficiency of the building envelope and the mechanical and electrical services first. Once the energy demand of the building has been reduced from energy efficiency improvements then Low and Zero Carbon (LZC) technologies can be considered. It is widely accepted that the most effective way to reduce energy consumption (and therefore carbon emissions) is to follow the energy hierarchy (shown below).

This approach is the most appropriate because energy efficiency improvements can be more cost effective than LZC systems and can provide significant energy and $CO_2$ savings especially over the lifetime of a product. In addition, energy efficiency improvements reduce the energy demand of the building and therefore contribute to reducing the size of LZC systems required to achieve low carbon buildings.

The energy efficiency of the dwellings can be improved by adopting passive design measures, such as enhancing the building fabric or designing the dwellings so as to improve passive solar gains through windows.

**Energy Hierarchy:**




Therefore, improving the energy efficiency of the development before implementing Low or Zero Carbon technologies is considered a preferred strategy as this follows the Mayor's energy hierarchy.

## 3.2 Base Specifications

The analysis in this report has been conducted by utilising an actual SAP 2012 calculations for **all** of the new build dwellings as each dwelling is unique in geometry. Once permission has been granted, the findings of this report will be confirmed upon the completion of the detailed design process.

The baseline demands for the New-Build dwellings are represented by the Part L1A 2013 Target Emission Rate (TER), calculated using the specification set out in Appendix R of SAP 2012. Details of the limiting U-Values, Appendix R U Values and the limiting values in Policy CP3 are given in Table 3.1 below:

**Table 3.1 U-Values of building elements for all New-Build dwellings**

| Element | Part L1A 2013 Limiting U-Values ($W/m^2K$) | CP3 Limiting U-Values ($W/m^2K$) | Appendix R Limiting U-Values ($W/m^2K$) |
|---|---|---|---|
| **Walls** | 0.30 | **0.2** | **0.18** |
| **Floors** | 0.25 | **0.2** | **0.13** |
| **Roof** | 0.20 | **0.13** | **0.13** |
| **Windows / Doors** | 2.00 | **1.5 / 1.0** | **1.4 / 1.0** |

For the baseline SAP calculations we have used the following general specifications

| Parameter | Assumptions/Values used for the assessment |
|---|---|
| **Design Air Permeability** | 5.0 $m^3/hr/m^2$ |
| **Heating systems and controls** | Condensing combi with automatic ignition (90% efficient)<br>System with radiators<br>Time and temperature zone control |
| **Domestic Hot Water** | From main heating system<br>Houses – 120L cylinder with 80mm factory fitted insulation |
| **Ventilation** | Natural |
| **Electricity Tariff** | Standard Electricity Tariff |
| **Secondary Heating** | N/A |
| **Low Energy Light Fittings** | 100% |

## 3.3 Setting the targets

As previously noted the strategy in this document shows that the proposed development will comply with all the targets Camden Council and the GLA requires. This corresponds to a 35% regulated $CO_2$ reduction over Part L1A 2013 Building Regulations and a 20% reduction in carbon dioxide emissions from on-site renewable energy generation.

Based on the SAP calculations undertaken at this stage and the assumptions detailed in Section 3.2 of this report, the baseline emissions shown in Table 3.2 have been calculated.

The tables below collate the results of the SAP calculations, in two blocks, A Block and P Block, then a combined Site Wide with the whole development.

A Block consists of the following apartments: A1, A2, A3, A4, A5, A6, A7, A8, A9, A10 and P4

P Block consists of the following apartments: H1, H2, P1, P2, P3, P5, P6, P8, P9, P10, P11, P12, P13, P14, P15, P16, P17 and P18

**Table 3.2: Targets for the site**

| Target Site wide emissions | Total ($tCO_2$ /yr) | Equation |
|---|---|---|
| **Part L1A 2013 Baseline (TER)** | 48.22 | A |
| **Site 35% $CO_2$ Target (DER)** | 31.34 | B = A x (1-35%) |
| **$CO_2$ emissions to be offset** | 16.88 | C = A - B |

## 3.4 Meeting the targets – Improved fabric

Satisfying the 35% $CO_2$ reduction target can be achieved by passive design measures, such as building fabric improvements, or through the implementation of on-site Low and Zero Carbon technologies. However to satisfy the Local Plan target 20% of these savings should as far as feasible be offset by the implementation of Low or Zero Carbon technologies.

The calculations set out herein are based on the following specifications, which may be subject to change during detailed design and is therefore provided for illustration to show that compliance with the targets is achievable. The specifications below are those that have been modelled for the dwellings and are shown to illustrate that the scheme can satisfy the Planning requirements.

One of the primary aims of Part L1A 2013 was to reduce the resultant $CO_2$ emissions of a dwelling by 6% compared to Part L1A 2010, which was expected to roughly reflect a 40% improvement over dwellings built to 2002 standards.

**Outcomes – Improved Fabric $CO_2$ Savings**

Achieving Part L1A 2013 compliance through an enhanced fabric specification, without the reliance on Low or Zero Carbon Technologies, will ensure that the dwellings have low energy demands, helping towards the protection of occupants from energy price rises in the future.

Adopting the proposed Building Fabric Specifications and Energy Efficiency Measures alone follows the Energy Hierarchy of ***"being lean".*** Details of the U-Values used are given in Table 3.3 below.

Table 3.4 shows the outcomes from the Be Lean modelling on a block by block and site wide basis and confirms that this strategy will meet the requirements of Part L of the Building Regulations.

**Table 3.3: U-Value comparison for all New-Building elements**

| Element | New Modelled Values U-Values (W/m2K) | Part L1A 2013 Limiting U-Values (W/m2K) | %age improvement on Part L1A 2013 | Camden CP3 Limiting U-Values (W/m$^2$K) | CP3 compliant ? |
|---|---|---|---|---|---|
| Walls | **0.18** | 0.3 | **33%** | 0.2 | **Improvement** |
| Floors | **0.13** | 0.25 | **40%** | 0.2 | **Improvement** |
| Exposed Roof | **0.13** | 0.2 | **35%** | 0.13 | **Compliant** |
| Windows / Doors | **1.2 / 1.0** | 2.0 | **30%** | 1.5 / 1.0 | **Improvement** |

**Table 3.4: Outcomes of Be Lean scenario in Tonnes $CO_2$ per year**

| | TOTAL DER (Tonnes/$CO_2$/m$^2$) | TOTAL TER (Tonnes/$CO_2$/m$^2$) | % improvement |
|---|---|---|---|
| **A Block** | 13.05 | 13.46 | 3.04% |
| **P Block** | 33.85 | 34.76 | 2.60% |
| **Site wide** | 46.91 | 48.22 | 2.72% |

**Outcomes – Fabric Energy Efficiency Standard (FEES)**

One of the key criteria we needed to achieve was the Part L requirement for Fabric Energy Efficiency Standard (FEES) compliance i.e. that the Dwelling FEE (DFEE) is lower than the Target FEE (TFEE). The FEES target measures the heating required in the dwelling assuming basic services and is denoted in kWh/m$^2$. The following table shows clearly that the FEES Standard is achieved separately in both block by a clear margin using the baseline specifications.

In all scenarios other than the baseline we have modelled the results with an improved air tightness of $3m^3/hr/m^2$ with the inclusion of some form of Mechanical Ventilation. This further improves the DFEE as shown in table 3.5.

**Table 3.5: Impact of Be Lean scenario in Fabric Energy Efficiency Standard**

| | DFEE ($kWh/m^2$) | TFEE ($kWh/m^2$) | % improvement |
|---|---|---|---|
| **A Block** | 47.76 | 56.13 | 14.90% |
| **P Block** | 43.54 | 50.58 | 13.93% |

## 3.5 Meeting the targets – Efficient Specifications

These U values above have been used for each of the scenarios modelled by Carbon Plan Engineering; each of which are detailed in Table 3.6 below.

Adopting these proposed Energy Efficiency Measures in Scenario 1 delivers the next step in the Energy Hierarchy of ***"being clean".***

**Table 3.6: Scenarios modelling in detail**

| | Scenario 1<br>Individual Gas Boilers | Scenario 2<br>Communal Gas Boiler with 6kW(e) CHP | Scenario 3<br>Communal Air Source Heat Pump with Gas Boilers |
|---|---|---|---|
| **Heating System** | High efficiency condensing gas boiler (90% efficient) | Combined Heat and Power<br>Heat Eff = 61%<br>Electrical Eff = 28% | Specialist Air Source heat pumps<br>CoP = 4.25 |
| **Controls** | Improved heating system controls - time and temperature zone control by suitable arrangement of plumbing and electrical services | | |
| **DHW supply** | From main heating system | | |
| **Ventilation** | High efficiency Mechanical Ventilation with Heat Recovery (MVHR) | | |
| **Lighting** | 100% Low Energy Lighting has been specified | | |

Indicative drawings for Photovoltaic Layouts can be found in Appendix A of this document while typical plant room layouts can be seen in Appendix B for CHP and C for the ASHP solutions.

**Outcomes – Scenario 1 – Specifying Efficient Services**

In deploying the efficiency services note in Scenario 1 above we deliver to $CO_2$ savings as noted in table 3.7 below. While providing a significant benefit over Part L compliance this solution is well short of the required targets.

**Table 3.7: Outcomes of Be Clean scenario in Tonnes $CO_2$ per year**

| | TOTAL DER (Tonnes/$CO_2$/$m^2$) | TOTAL TER (Tonnes/$CO_2$/$m^2$) | % improvement |
|---|---|---|---|
| **A Block** | 11.93 | 13.46 | 11.36% |
| **P Block** | 30.83 | 34.82 | 11.48% |
| **Site wide** | 42.76 | 48.29 | 11.44% |

## 3.6 Meeting the targets – Renewable Energy

To meet the proposed targets in all scenarios it will be necessary to install a Photovoltaic (PV) array using high efficiency panels connected to the landlords supply. A total array size of 21 kWp has been used in our modelling to help achieve the $CO_2$ emissions reduction targets required as this is the maximum array size that can be accommodated.

Adopting this proposed low and zero carbon technologies follow the next step in the Energy Hierarchy of **"*being green*".**

**Outcomes – Scenario 1 – With 21 kWp Photovoltaic Electricity Generation**

Appendix A to this report provides an indicative roof layout showing that a maximum of 70 panels can be accommodated. At 300 watts generation capacity per panel this equates to 21kWp and provides the further savings showing in Table 3.8.

**Table 3.8: Outcomes of Be Clean scenario in Tonnes $CO_2$ per year**

| | TOTAL DER (Tonnes/$CO_2$/$m^2$) | TOTAL TER (Tonnes/$CO_2$/$m^2$) | % improvement |
|---|---|---|---|
| **A Block** | 9.73 | 13.46 | 27.74% |
| **P Block** | 24.65 | 34.82 | 29.21% |
| **Site wide** | 34.38 | 48.29 | 28.80% |

**Outcomes – Scenario 2 – Communal CHP system with 21kWp PV**

The use of a communal heating system would not normally be considered on a project of this scale however because of its density and the lack of roof space we have investigated these option as a way to achieve the targets set out be Camden and GLA.

As noted the first communal heating option is to provide a plant area which will house a small circa 6kW (electrical) **:** 22kW (thermal) Combined Heat and Power (CHP) generator delivering baseload thermal loads. The CHP will sit alongside significant thermal storage and peak load gas boilers to provide a robust and consistent supply of heat and hot water to the building.

The outcomes from this modelling provide the first scenario to achieve the 25% reduction target as shown in table 3.9.

**Table 3.8: Outcomes of Be Clean scenario in Tonnes $CO_2$ per year**

| | TOTAL DER (Tonnes/$CO_2$/$m^2$) | TOTAL TER (Tonnes/$CO_2$/$m^2$) | % improvement |
|---|---|---|---|
| **A Block** | 7.84 | 13.46 | 41.75% |
| **P Block** | 19.88 | 34.82 | 42.91% |
| **Site wide** | 27.72 | 48.29 | 42.58% |

NOTE that the use of CHP changes the TER baseline slightly

Overall we anticipate that by running for approximately 6,000 hours per year the CHP system will delivering 43% of the thermal loads as calculated in SAP 2012. This solution however is not the preferred option because of the following:

- The CHP will generate electricity at the same times as the PV system – thereby making one of them less economic
- The CHP system has relatively high maintenance costs for a project of this scale and for little financial benefit and these costs will have to be passed on in some form of service charge or unattractively high bills.

**Outcomes – Scenario 3 – Communal ASHP system with 21kWp PV**

The second, and preferred, communal heating option is to provide a plant area which will house a circa 27kW high efficiency, low temperature Air Source Heat Pump to provide pre-heating into a large buffer which would then be taken up to temperature by the Peak Load gas boilers.

This option is preferred because the maintenance on the ASHP systems is significantly lower than that of the CHP system and also the ASHP will be using electricity at the same time as the PV Array is generating electricity, therefore adding value to both.

The outcomes from this modelling also achieve the 25% reduction target as shown in table 3.10.

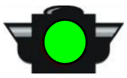
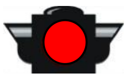
**Table 3.10: Outcomes of Be Clean scenario in Tonnes $CO_2$ per year**

| | TOTAL DER (Tonnes/$CO_2$/$m^2$) | TOTAL TER (Tonnes/$CO_2$/$m^2$) | % improvement |
|---|---|---|---|
| **A Block** | 8.09 | 13.46 | 39.90% |
| **P Block** | 20.51 | 34.82 | 41.10% |
| **Site wide** | 28.60 | 48.29 | 40.77% |

NOTE when modelling Heat Pumps we utilise the original Gas Boiler baseline as a TER as this allows us to compare the system impacts with the same fuel source

## 4.0 Overview of LZC Technologies

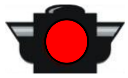
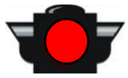
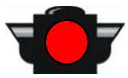
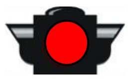
Below is a brief overview of the available LZC Technologies which are commonly used and are accepted as such by DECC and BRE. A traffic light system is used to denote whether the systems are technically appropriate for the development.

| Description | Traffic Light |
|---|---|
| **Technology is technically and economically feasible with few barriers to implementation** |  |
| **Technology is technically and economically feasible, but there are barriers to implementation** |  |
| **Technology is technically or economically unfeasible and has been discounted** |  |

The table below outlines the justification behind the discounting of technologies. A detailed review of each technology can be found in the Appendices.

## 4.1 Discounted technologies

Below is the rationale for discounting each technology.

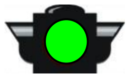
| Technology | Description | Traffic Light |
|---|---|---|
| **Small scale wind** | In light of the configuration of the site and the character of the location, there is a risk that this technology will not receive consent from Local Planning Authorities because of potential noise, flicker and aesthetical issues.<br>Moreover, field trials have shown that small scale wind turbines often achieve much lower performances than expected in urban areas because of local wind turbulences.<br>As well as the maintenance cost of this system, there is also a risk that implementing small wind turbines on this development will be economically unviable.<br>Therefore, this technology has been discounted at this stage. |  |
| **Biomass** | The implementation of a biomass heating system requires a large accessible space for fuel storage and the logistics of delivery could pose an issue in such a residential area. In addition to this the size and scale of the development also makes biomass ineffective.<br>Therefore, this solution has been discounted at this stage. |  |
| **Ground Source Heat Pumps (GSHP)** | The implementation of a GSHP is more risky than the proposed solutions with the ground conditions being unknown. Moreover, a vertical ground loop will probably be required for this development which will be very capital intensive due to drilling costs.<br>Therefore it is discounted at this stage. |  |
| **Photovoltaic Thermal (PVt)** | Hybrid solar systems that combine both photovoltaic cells with solar thermal collectors are an extremely effective technology. PV-t panels can be combined with a water to water heat pump in order to provide additional $CO_2$ offsets.<br>However, as this system is more expensive than the proposed solutions that satisfy the targets it has been discounted at this stage. |  |

## 4.2 LZC Technologies Considered Viable

The table below offers further solutions that are considered as potentially suitable for the development

**Solar Photovoltaic cells (PV)**

Photovoltaic Cells (PV) generate electricity from sunlight using semiconductor cells linked together to form a module. Electricity can still be generated in cloudy and overcast conditions, although more can be generated in direct sunlight.



The conditions that provide optimal generation in the UK are with South facing panels with a 30˚ elevation and no overshadowing which is possible on this site.

PV is considered a good solution for the development and follows the ***"be green"*** element of the London Plan.

**A 21 kWp scheme will be installed on the rooftop.**

### Advantages

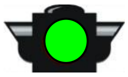
- Costs continue to fall as technology improves
- Many panels are guaranteed for 20-25 year lifetimes but are expected to last for longer
- Maintenance is low as panels are mostly cleaned by rainwater
- The technology has been existence for a long time and is well understood
- Low Planning Risk
- Easier and quicker to install compared to other LZCs
- The technology is currently eligible for the Feed in Tariff (FiT) however this is very low and MCS certification and a registration process is required to receive this

### Disadvantages

- Any shading can seriously impact the efficiency of the system. Careful consideration has been given to the current and future levels of shading (e.g. trees, service pipes/flues).

## Air source heat pump (ASHP)

ASHPs extract heat from the surrounding air using a thermodynamic cycle. A wide range of Air Source Heat Pumps are currently available on the market.



ASHPs work better when the temperature of the air is closer to the temperature of the water they are delivering and so are less effective at delivering higher temperatures

An ASHP system can provide significant improvements above the Part L 2013 Baseline and is considered a good solution in combination with the Peak Load gas boiler for a communal heat system. Following this path for the development and would fulfil the ***"be green"*** element of the London Plan

**For this reason the communal ASHP systems has been recommended**

**A 27 kW communal ASHP is proposed in conjunction with Peak Load gas boiler.**

## Advantages

- Costs continue to fall as technology efficiencies improve
- No Local air pollution issues
- Maintenance is lower than that of CHP
- The technology has been existence for a long time and is well understood
- Low Planning Risk
- Easier and quicker to install compared to other LZCs
- As grid electricity decarbonises these systems will come closer to zero carbon than any other.

## Disadvantages

- Noise considerations need to be looked at carefully in both siting and specification

## Combined Heat & Power (CHP)

CHP generates heat for space heating or hot water requirements whilst simultaneously generating electricity for on-site use or exporting to the grid. The systems are usually 'heat led' with much more heat generated than electricity. CHP works best with buildings that require a high demand of heat for a sustained period of time, such as hospitals, swimming pools and hotels.

Based on the SAP calculations it has been concluded that the size of the development and ultimately the heating loads are not ideal for the efficient operation of a CHP plant. Specifically, the loads are minimal and will not ensure that a CHP unit would operate for the optimal number of hours during the year to be financially feasible over its lifetime.

In the option modelled a small 6kW (electrical) : 22kW (thermal) Combined Heat and Power (CHP) generator

## Advantages

- Electricity generated from existing heating needs.
- Fewer transport/distribution losses than electricity from the grid.

## Disadvantages

- Most suited to buildings with a prolonged high heating demand
- Works best when run for long hours to improve efficiency, therefore requiring a constant heat demand. In this instance, the CHP would not have large enough heat loads throughout the year to justify its implementation
- Regular expensive maintenance required and full overhaul after 10 to 15 years depending on yearly hours run
- Local air pollution should be considered in urban areas, even for a small unit such as this.

# 5.0 Proposed Solutions

As noted in Section 3 we have analysed in detail three potential solutions, all of which are technically feasible, and all of which have been measured against the same gas baseline.

## 5.1 Preferred Option – Communal ASHP, Gas Boiler plus PV

Using data from the SAP calculations with the specifications outlined in Section 3 the high efficiency fabric specification has been chosen to reduce the heat demands of the dwellings in the first instance. Further to that we propose that:

- A high efficient communal ASHPs installed to provide efficient and heat generation in combination with Peak Load gas boilers.
- The dwellings include MVHR units for ventilation, recovering heat to further reduce space heating demands with integral summer bypass to mitigate summer overheating
- Each unit will include a smart meter to support the growth of demand side response.

The resultant savings from all of measures proposed in the preferred solution are presented in Table 5.1 below:

**Table 5.1: Proposed solution for New-Build dwellings – Individual technology $CO_2$ savings**

| | Technology | Details | $tCO_2$ saved |
|---|---|---|---|
| ***being lean*** | **Enhanced Building Fabric** | Highly energy efficient building fabric | 1.31 |
| ***being clean*** | **High efficiency services** | High efficiency services and MVHR | 4.15 |
| ***Being green*** | **Low and Zero Carbon Technology** | High efficiency ASHP to provide HVAC with time and temperature zonal controls and a 21kWp PV array | 13.64 |
| | **TOTAL** | | **19.62** |

**Table 5.1 above shows that the enhanced building fabric with ASHP, the installation MVHR and a 21 kWp PV array provide a saving of over 19.62 $tCO_2$/yr.**

## 5.2 Alternative Option - Communal CHP, Gas Boiler plus PV

In this scenario all fabric specifications remain as with the first, however in this case a Combined Heat and Power (CHP) unit to deliver heat to the communal heating system.

The key issue with the deployment of a CHP system would be the size of the development, 28 units, effectively creating an undersized landlord demand and is therefore not economic. They are also significantly more costly than ASHP systems and would only be pursued where the ASHP system was not shown to be technically feasible.

## 6.0 Recommendations and Results

At this time and with the information we have to hand our recommendation is the implementation of a communal heating system to distribute heat and hot water to each of the 28 flats.

In order to keep the operational costs for this at a reasonable level we recommend that an 27kW ASHP with Peak Load Gas Boilers is implemented in conjunction with a 21kWp Photovoltaic array.

The following tables set out the results from the analysis and are self-explanatory and show that the project at Gondar Gardens is fully compliant with the policy goals we are seeking to achieve.

**Table 6.1: Table to show regulated $CO_2$ emissions**

| Regulated $CO_2$ Emissions | Regulated $CO_2$ emissions ($tCO_2/yr$) | Saved $CO_2$ emissions ($tCO_2/yr$) | % Reduction |
|---|---|---|---|
| **Baseline Emissions (Part L 2013)** | 48.22 | 0.00 | 0.00% |
| **Stage 1 Be Lean** | 46.91 | 1.31 | 2.72% |
| **Stage 2 Be Clean** | 42.76 | 5.46 | 11.32% |
| **Stage 3 Be Green** | 28.60 | 19.62 | 40.68% |

Table 6.1 shows the overall reduction in **regulated** emissions achieved is **19.62 $tCO_2$/yr**.

This is equivalent to a **40.68%** reduction, exceeding the GLA London Plan target of 35%

Table 6.2 shows that is equivalent to an **20.65%** reduction in **regulated and unregulated** emissions

**Table 6.2: Regulated & Unregulated $CO_2$ emissions after each stage of the Energy Hierarchy**

| Un-regulated $CO_2$ Emissions | Regulated $CO_2$ emissions | Saved $CO_2$ emissions | % Reduction (Regulated) | Inc. Unregulated $CO_2$ emissions | % Reduction (Inc Unregulated) |
|---|---|---|---|---|---|
| **Baseline Emissions (Part L1A 2013)** | 48.22 | 0.00 | 0.00% | 94.97 | 0.00% |
| **Be Lean (BER no LZC)** | 46.91 | 1.31 | 2.72% | 93.66 | 1.38% |
| **Be Clean** | 42.76 | 5.46 | 11.32% | 89.52 | 5.75% |
| **Be Green (LZC)** | 28.60 | 19.62 | 40.68% | 75.36 | 20.65% |

The outcomes of implementing the preferred option set out in this strategy are detailed below on a site wide basis across the development:

**Table 1.1b: New-Build dwellings total $tCO_2$/yr for each hierarchy stage**

| | | Be Lean | Be Clean | Be Green |
|---|---|---|---|---|
| Regulated $CO_2$ Emissions | Baseline $CO_2$ Emissions | Proposed Gas baseline Building (DER) | Proposed Gas baseline Building (DER) | Proposed Building (DER) |
| Total Regulated ($tCO_2$/yr) | 48.22 | 46.91 | 42.76 | 28.60 |
| %age Reduction over Baseline | N/A | **2.72%** | **11.32%** | **40.68%** |
| %age Reduction from LZC alone | N/A | N/A | **8.84%** | **33.11%** |

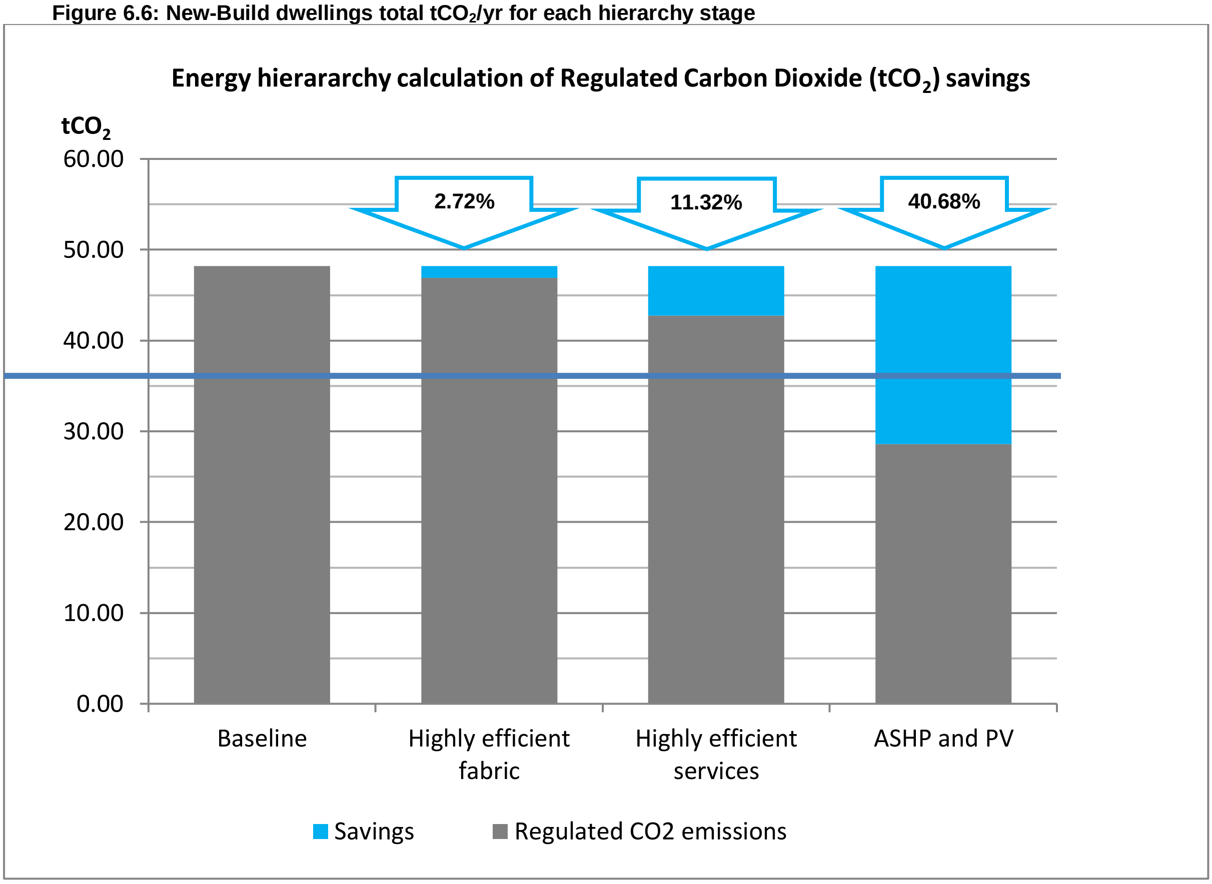
**As shown in the tables above, the implementation of the proposed solution should ensure an improvement of 40.68% for the development.**

In summary, the proposed strategy offers the following savings from enhanced building fabric specifications and Low and Zero Carbon Technologies:

- A **40.68%** reduction in regulated $CO_2$ emissions over the Part L1A 2013 baseline from fabric specifications, energy efficient services and the implementation of Low & Zero Carbon technologies (LZC).
- A **33.11%** reduction in regulated emissions from Low & Zero Carbon technologies (LZC) including the ASHPs and Solar Photovoltaic Panels (PV) in line with the Camden policy
- A **5.75%%** reduction in all site $CO_2$ (regulated & unregulated) emissions from the Part L1A 2013 from improved fabric specification before any Low & Zero Carbon technologies (LZC).
- A **20.65%%** reduction in all site $CO_2$ (regulated & unregulated) emissions from improved fabric specifications and Low & Zero Carbon technologies compared to the Baseline emissions.

**The scheme has incorporated the GLA's guidance and will deliver the target, as far as is feasible on site, the targets set out for Major Developments in the current London Plan.**

**Figure 6.6: New-Build dwellings total $tCO_2$/yr for each hierarchy stage**




The scheme also meets all of the Camden policy targets set out in the recently published Minor Modifications to the Draft Camden Local Plan.

| Target | Target type | Satisfied |
|---|---|---|
| Part L1A 2013 | Actual | YES |
| 19% $CO_2$ reduction over Part L 2013 Building Regulations. | Aspirational | YES |
| 20% reduction in $CO_2$ from on-site renewable energy generation. | Aspirational | YES |

# 7.0 Cash in-lieu

From October 2016 London Plan policy 5.2 requires major residential developments to achieve zero carbon (with at least 35% reduction achieved through on-site measures). The remaining regulated carbon emissions (to 100%) are to be offset through a cash in lieu contribution.

In view of the Viability Assessment undertaken for the Minor Alterations London Plan the Council considers £1,800 per tonne of carbon (30 years) to be appropriate (both residential and non-residential development).

The scheme has incorporated the GLA's guidance and is to deliver the target as far as feasible on site, beyond this negotiations for a 'cash in lieu' payment for any residual tonnes of $CO_2$ that cannot be abated onsite if this is deemed necessary by the Council.

This equates to roughly £51,483 for LB Camden to ring fenced to secure delivery of carbon dioxide savings elsewhere (in line with London Plan policy 5.2E)

# 8.0 Part L overheating

Building Regulations (Part L) Overheating Part L of the Building Regulations focuses on levels of solar gain permitted into a space through facade / glazing. Under Part L1A for residential development this is expressed as a range of risk. To note, this criterion of Part L is not mandatory, i.e. it is not a strict requirement but is seen as good design practice.

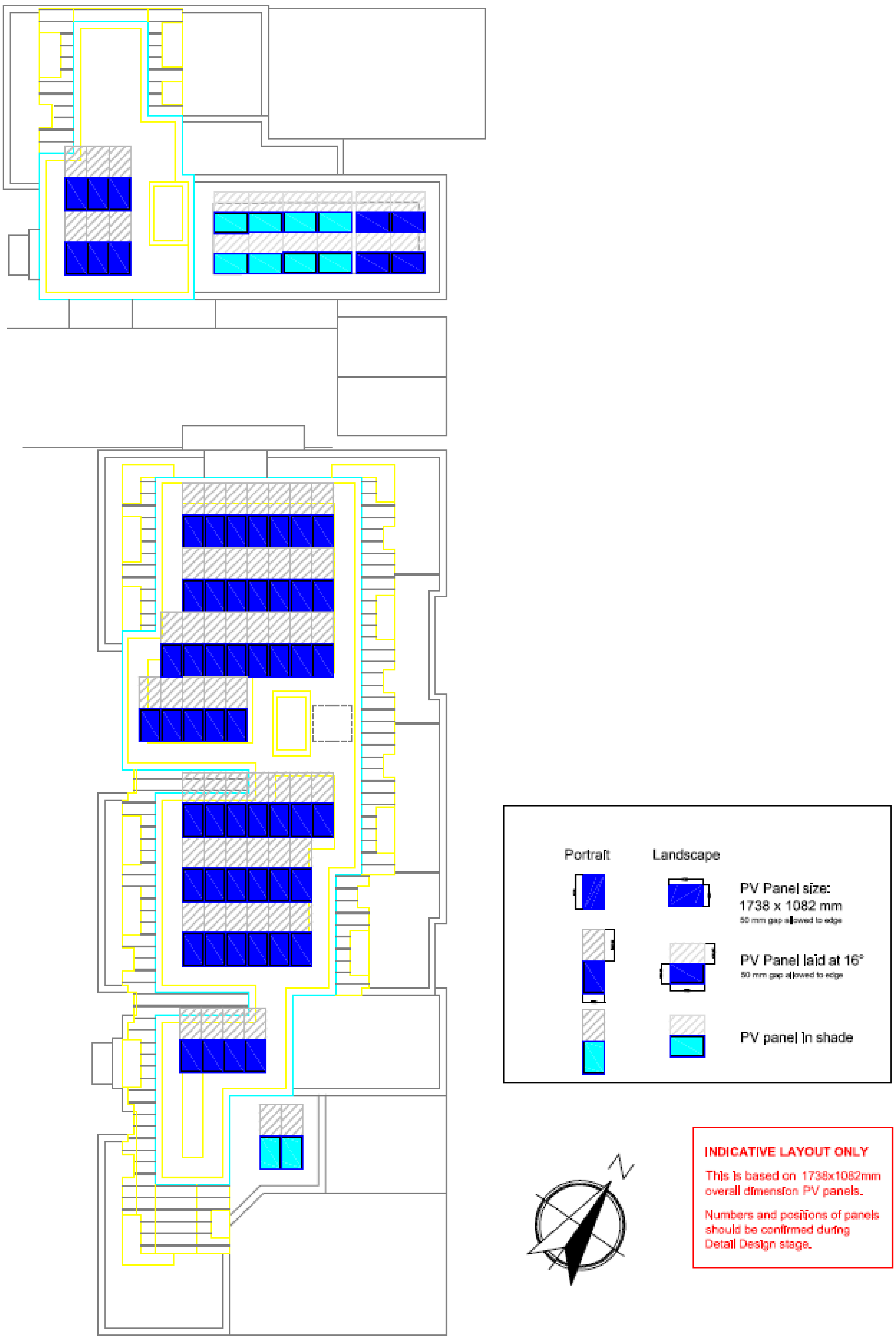
Each apartment is to be mechanically ventilated with Heat recovery. This will be enabled to run in summer bypass at night to create night time cooling.

The window glazing will be installed with this in mind by using a glass with high g-values and Low-E coatings. Purge ventilation through glazing openings is to comply with Building Regulations Part F.

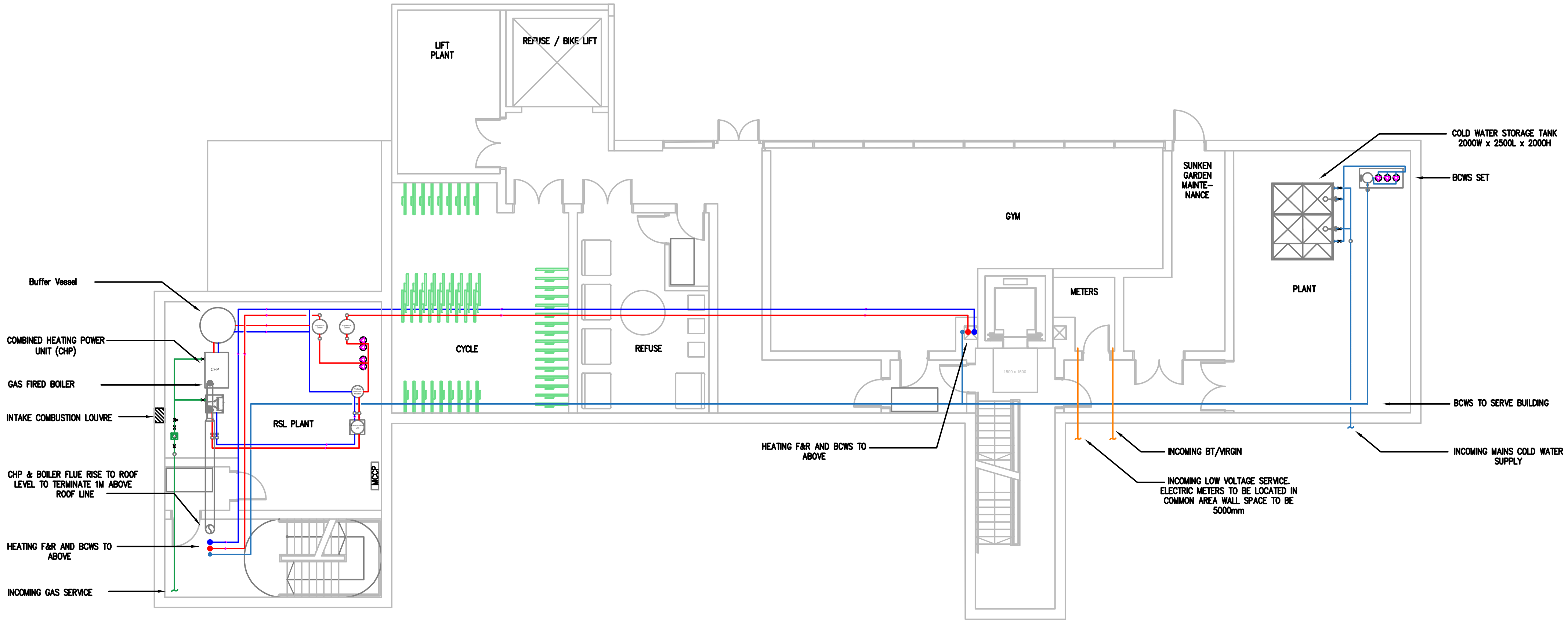
For Building Control and Part L of the Building Regulations the dwellings have a ‘slight’ to ‘medium’ overheating risk, this is acceptable to demonstrate compliance. To be demonstrated through the design development stage

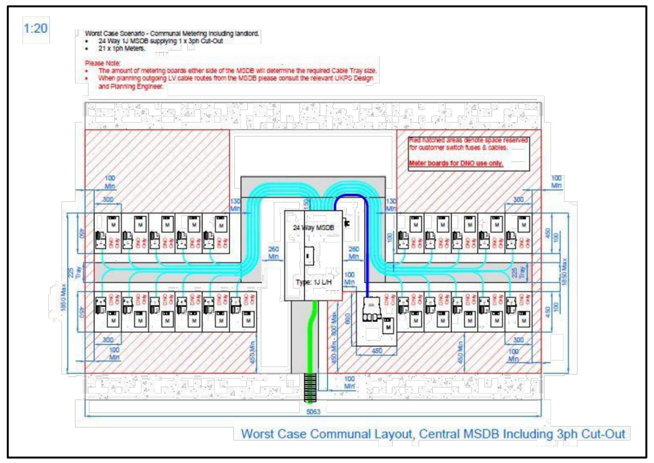
# Appendix A: PV Layout

The indicative drawing below identifies the number of PV Panels that could be accommodated on the top roof of the building.



# Appendix B: CHP Plant room Layout




Notes:

| No | REV DETAILS TO BE ADDED | Name | Date |
|---|---|---|---|
| A | Plant Room Layout | MB | 19/07/2018 |

carbonplan engineering

Woodhead House, Woodhead Road,
Birstall, Leeds,
West Yorkshire, WF17 9TD
Tel: 0113 8155 558
Engineering@carbonplan.co.uk

Gondar Gardens

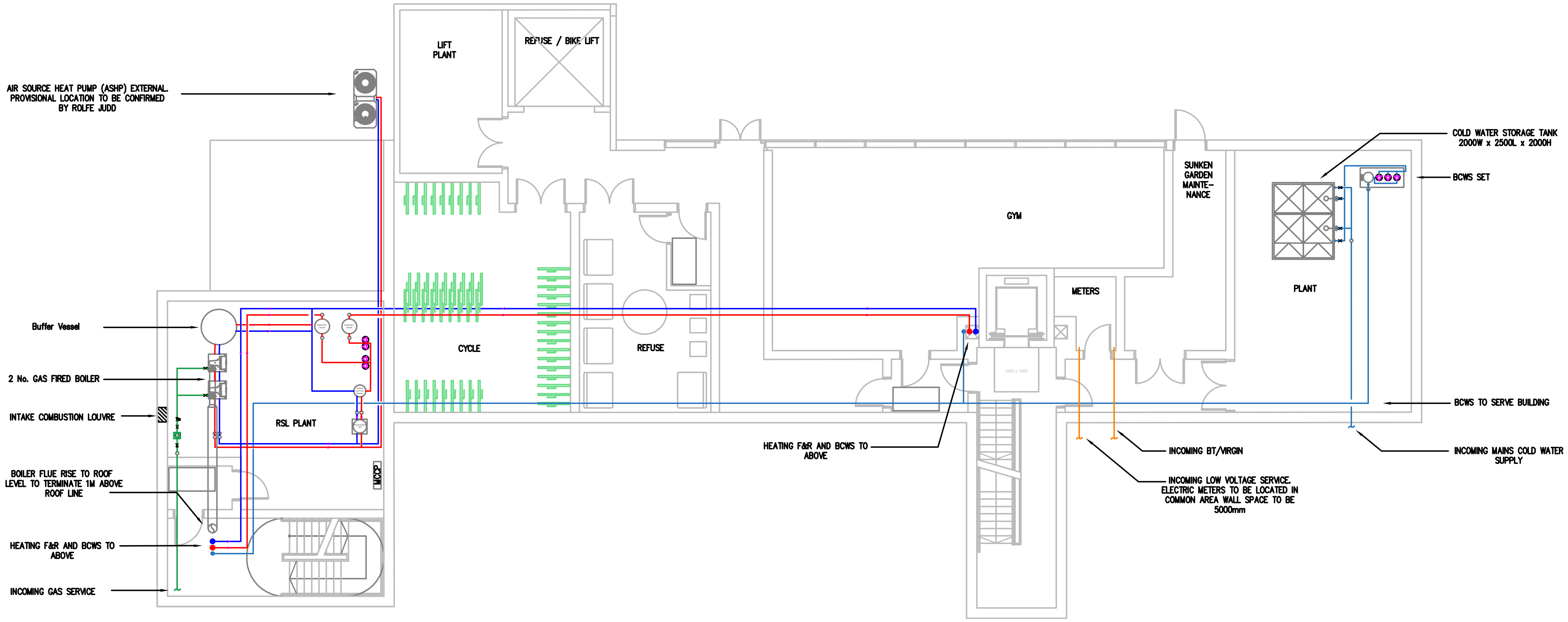
Gondar Gardens Reservoir
Gondar Gardens
London

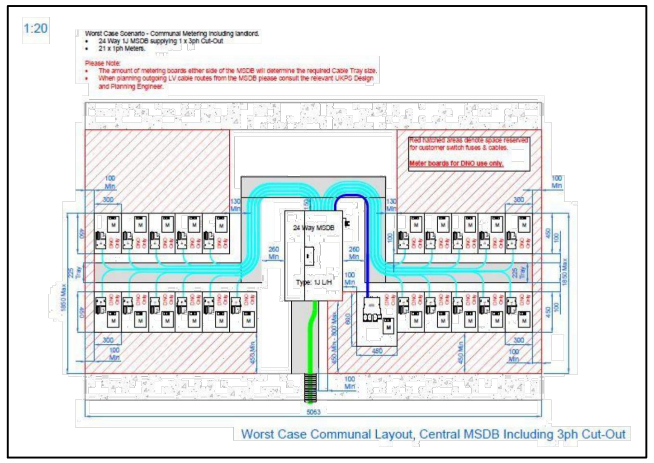
Basement Plant Room Layout – CHP option

| Scale | 19–07–18 | MB | DC |
|---|---|---|---|
| 1:100 @A1 | GG–01–SK01 | | A |

# Appendix C: ASHP Plant room Layout

Notes:




| No | REV DETAILS TO BE ADDED | Name | Date |
|---|---|---|---|
| A | Plant Room Layout | MB | 19/07/2018 |

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Woodhead House, Woodhead Road,
Birstall, Leeds,
West Yorkshire, WF17 9TD
Tel: 0113 8155 558
Engineering@carbonplan.co.uk

Gondar Gardens

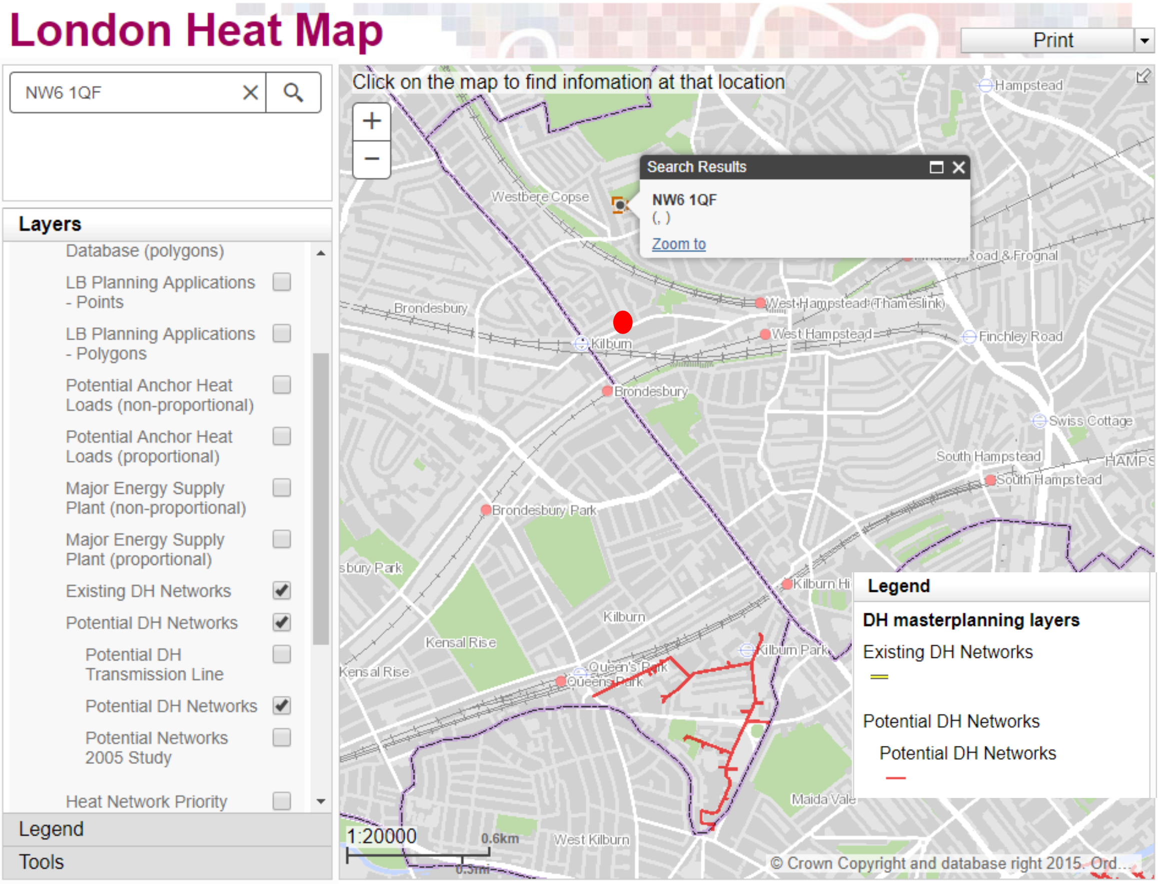
Gondar Gardens Reservoir
Gondar Gardens
London

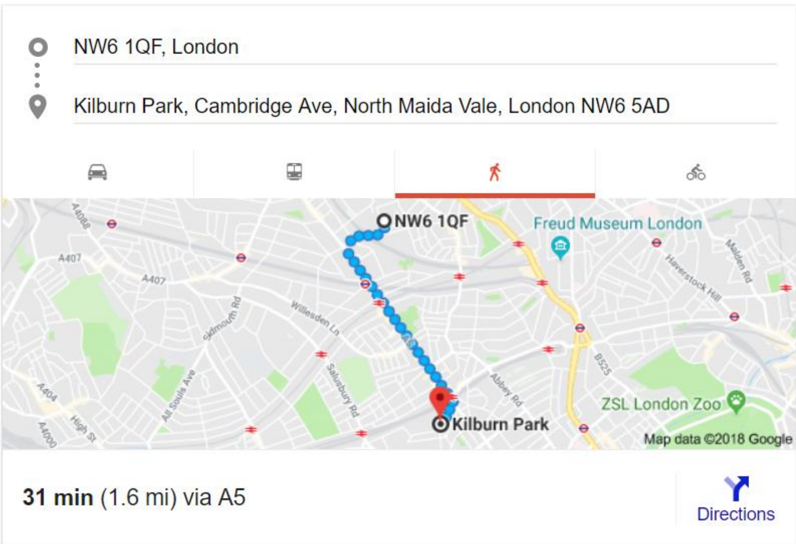
Basement Plant Room Layout – ASHP option

| | | | |
|---|---|---|---|
| Scale | 19–07–18 | MB | DC |
| 1:100 @A1 | GG–01–SK02 | | A |

## Appendix D: Connection to offsite District Heating

As part of the CHP feasibility the London Heat Map tool was consulted and there are at present no existing CHP networks that can feasibly be connected to, as shown in the screen shot below. The potential (red line) is a potential future DH network not currently in existence and is 1.6miles away which would be cost prohibitive to connect to.



# Appendix E: SAP summary worksheets

The following table sets out the details of the SAP calculation based upon the preferred solution of communal ASHP with peak load boilers and Photovoltaic array.

| SAP Name | Total Floor Area | DER | TER | DFEE | TFEE | % improvement |
|---|---|---|---|---|---|---|
| H1 | 228.12 | 10.09 | 16.37 | 58.70 | 67.80 | 38.39% |
| H2 | 215.83 | 8.34 | 13.84 | 47.80 | 54.30 | 39.71% |
| P1 | 119.63 | 8.92 | 15.42 | 38.50 | 47.10 | 42.12% |
| P2 | 107.83 | 9.49 | 16.12 | 39.70 | 48.40 | 41.12% |
| P3 | 74.01 | 10.99 | 23.82 | 42.50 | 81.40 | 53.86% |
| P4 | 94.70 | 8.51 | 13.79 | 32.70 | 34.00 | 38.25% |
| P5 | 97.60 | 8.33 | 13.59 | 32.20 | 33.60 | 38.69% |
| P6 | 83.09 | 9.34 | 14.72 | 34.90 | 35.90 | 36.54% |
| A9 | 88.79 | 9.43 | 15.64 | 37.40 | 43.70 | 39.69% |
| A10 | 83.09 | 11.32 | 18.26 | 45.00 | 53.50 | 38.02% |
| P7 | 49.09 | 11.52 | 18.26 | 35.10 | 39.10 | 36.92% |
| P8 | 54.20 | 10.83 | 17.65 | 33.30 | 38.50 | 38.64% |
| P9 | 94.22 | 9.21 | 15.27 | 37.50 | 43.10 | 39.71% |
| P10 | 74.01 | 10.50 | 16.53 | 39.90 | 43.80 | 36.49% |
| P11 | 119.09 | 9.02 | 15.74 | 40.80 | 50.80 | 42.71% |
| P12 | 116.15 | 10.32 | 17.02 | 47.20 | 56.80 | 39.38% |
| P13 | 134.33 | 9.95 | 16.60 | 48.10 | 58.30 | 40.08% |
| P14 | 115.72 | 10.87 | 18.09 | 50.70 | 63.10 | 39.94% |
| P15 | 78.35 | 11.22 | 18.42 | 44.70 | 54.60 | 39.08% |
| P16 | 54.62 | 14.44 | 22.12 | 55.50 | 63.80 | 34.71% |
| A1 | 85.60 | 10.83 | 17.63 | 43.40 | 51.60 | 38.58% |
| A2 | 166.62 | 9.34 | 15.32 | 48.80 | 56.90 | 39.02% |
| A3 | 68.93 | 11.34 | 17.85 | 41.90 | 47.90 | 36.45% |
| A4 | 93.61 | 10.09 | 16.46 | 42.00 | 49.50 | 38.67% |
| A5 | 94.43 | 10.17 | 16.71 | 42.40 | 50.50 | 39.14% |
| A6 | 92.10 | 10.51 | 17.13 | 44.10 | 52.50 | 38.67% |
| A7 | 77.46 | 12.26 | 20.75 | 49.50 | 66.10 | 40.91% |
| A8 | 71.04 | 14.12 | 22.59 | 59.10 | 74.00 | 37.49% |

# Appendix F: SAP TER worksheets

# TER WorkSheet: New dwelling design stage

User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

Property Address: A1

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Basement | 85.6 | (1a) | x | 2.55 | (2a) | = | 218.28 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 85.6 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | | 218.28 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 3 | x 10 = | 30 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 30 | ÷ (5) = | 0.14 | (8) |
| *If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)* | | | | |
| Number of storeys in the dwelling (ns) | | | 0 | (9) |
| Additional infiltration | | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | | 0 | (13) |
| Percentage of windows and doors draught stripped | | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | | 5 | (17) |
| If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | | | 0.39 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | | |
| Number of sides sheltered | | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | | 0.33 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.42 | 0.41 | 0.4 | 0.36 | 0.35 | 0.31 | 0.31 | 0.3 | 0.33 | 0.35 | 0.37 | 0.39 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.59 | 0.58 | 0.58 | 0.57 | 0.56 | 0.55 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.57 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.59 | 0.58 | 0.58 | 0.57 | 0.56 | 0.55 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.57 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 9.47 | x1/[1/( 1.4 )+ 0.04] | = | 12.55 | | | (27) |
| Windows Type 2 | | | 2.39 | x1/[1/( 1.4 )+ 0.04] | = | 3.17 | | | (27) |
| Windows Type 3 | | | 2.39 | x1/[1/( 1.4 )+ 0.04] | = | 3.17 | | | (27) |
| Floor | | | 85.6 | x 0.13 | = | 11.128 | | | (28) |
| Walls Type1 | 76.14 | 14.25 | 61.89 | x 0.18 | = | 11.14 | | | (29) |
| Walls Type2 | 13.89 | 0 | 13.89 | x 0.18 | = | 2.5 | | | (29) |
| Total area of elements, m² | | | 175.63 | | | | | | (31) |
| Party wall | | | 16.77 | x 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 43.66 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 14717.45 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 10.04 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 53.7 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 42.37 | 42.12 | 41.88 | 40.74 | 40.53 | 39.54 | 39.54 | 39.36 | 39.92 | 40.53 | 40.96 | 41.41 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 96.06 | 95.82 | 95.57 | 94.44 | 94.23 | 93.24 | 93.24 | 93.05 | 93.62 | 94.23 | 94.66 | 95.1 | |

Average = $Sum(39)_{1…12}$ /12= 94.44 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.12 | 1.12 | 1.12 | 1.1 | 1.1 | 1.09 | 1.09 | 1.09 | 1.09 | 1.1 | 1.11 | 1.11 |

Average = Sum(40)$_{1…12}$ /12= 1.1 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.56 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 95.01 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 104.52 | 100.71 | 96.91 | 93.11 | 89.31 | 85.51 | 85.51 | 89.31 | 93.11 | 96.91 | 100.71 | 104.52 |

Total = Sum(44)$_{1…12}$ = 1140.17 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 154.99 | 135.56 | 139.88 | 121.95 | 117.02 | 100.98 | 93.57 | 107.37 | 108.66 | 126.63 | 138.22 | 150.1 |

Total = Sum(45)$_{1…12}$ = 1494.94 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 23.25 | 20.33 | 20.98 | 18.29 | 17.55 | 15.15 | 14.04 | 16.11 | 16.3 | 18.99 | 20.73 | 22.52 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.96 | 46.03 | 49.39 | 45.92 | 45.51 | 42.17 | 43.58 | 45.51 | 45.92 | 49.39 | 49.32 | 50.96 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 205.95 | 181.59 | 189.27 | 167.87 | 162.53 | 143.15 | 137.15 | 152.89 | 154.57 | 176.01 | 187.54 | 201.06 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 205.95 | 181.59 | 189.27 | 167.87 | 162.53 | 143.15 | 137.15 | 152.89 | 154.57 | 176.01 | 187.54 | 201.06 | |

Output from water heater (annual)$_{1...12}$ 2059.58 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 64.27 | 56.58 | 58.86 | 52.03 | 50.29 | 44.12 | 42.01 | 47.08 | 47.61 | 54.45 | 58.29 | 62.65 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 128.03 | 128.03 | 128.03 | 128.03 | 128.03 | 128.03 | 128.03 | 128.03 | 128.03 | 128.03 | 128.03 | 128.03 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 21.3 | 18.92 | 15.38 | 11.65 | 8.71 | 7.35 | 7.94 | 10.32 | 13.86 | 17.59 | 20.53 | 21.89 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 230.75 | 233.14 | 227.11 | 214.26 | 198.05 | 182.81 | 172.63 | 170.23 | 176.26 | 189.11 | 205.33 | 220.57 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 35.8 | 35.8 | 35.8 | 35.8 | 35.8 | 35.8 | 35.8 | 35.8 | 35.8 | 35.8 | 35.8 | 35.8 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -102.42 | -102.42 | -102.42 | -102.42 | -102.42 | -102.42 | -102.42 | -102.42 | -102.42 | -102.42 | -102.42 | -102.42 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 86.39 | 84.2 | 79.11 | 72.26 | 67.59 | 61.27 | 56.46 | 63.28 | 66.12 | 73.19 | 80.96 | 84.21 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 402.84 | 400.66 | 386.01 | 362.58 | 338.75 | 315.84 | 301.44 | 308.24 | 320.65 | 344.3 | 371.22 | 391.07 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 9.47 | x | 19.64 | x | 0.63 | x | 0.7 | = | 56.84 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 19.64 | x | 0.63 | x | 0.7 | = | 14.35 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 19.64 | x | 0.63 | x | 0.7 | = | 14.35 | (76) |
| East | 0.9x | 1 | x | 9.47 | x | 38.42 | x | 0.63 | x | 0.7 | = | 111.19 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 38.42 | x | 0.63 | x | 0.7 | = | 28.06 | (76) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 2.39 | x | 38.42 | x | 0.63 | x | 0.7 | = | 28.06 | (76) |
| East | 0.9x | 1 | x | 9.47 | x | 63.27 | x | 0.63 | x | 0.7 | = | 183.12 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 63.27 | x | 0.63 | x | 0.7 | = | 46.22 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 63.27 | x | 0.63 | x | 0.7 | = | 46.22 | (76) |
| East | 0.9x | 1 | x | 9.47 | x | 92.28 | x | 0.63 | x | 0.7 | = | 267.07 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 92.28 | x | 0.63 | x | 0.7 | = | 67.4 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 92.28 | x | 0.63 | x | 0.7 | = | 67.4 | (76) |
| East | 0.9x | 1 | x | 9.47 | x | 113.09 | x | 0.63 | x | 0.7 | = | 327.31 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 113.09 | x | 0.63 | x | 0.7 | = | 82.6 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 113.09 | x | 0.63 | x | 0.7 | = | 82.6 | (76) |
| East | 0.9x | 1 | x | 9.47 | x | 115.77 | x | 0.63 | x | 0.7 | = | 335.06 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 115.77 | x | 0.63 | x | 0.7 | = | 84.56 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 115.77 | x | 0.63 | x | 0.7 | = | 84.56 | (76) |
| East | 0.9x | 1 | x | 9.47 | x | 110.22 | x | 0.63 | x | 0.7 | = | 318.99 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 110.22 | x | 0.63 | x | 0.7 | = | 80.51 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 110.22 | x | 0.63 | x | 0.7 | = | 80.51 | (76) |
| East | 0.9x | 1 | x | 9.47 | x | 94.68 | x | 0.63 | x | 0.7 | = | 274.01 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 94.68 | x | 0.63 | x | 0.7 | = | 69.15 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 94.68 | x | 0.63 | x | 0.7 | = | 69.15 | (76) |
| East | 0.9x | 1 | x | 9.47 | x | 73.59 | x | 0.63 | x | 0.7 | = | 212.98 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 73.59 | x | 0.63 | x | 0.7 | = | 53.75 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 73.59 | x | 0.63 | x | 0.7 | = | 53.75 | (76) |
| East | 0.9x | 1 | x | 9.47 | x | 45.59 | x | 0.63 | x | 0.7 | = | 131.94 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 45.59 | x | 0.63 | x | 0.7 | = | 33.3 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 45.59 | x | 0.63 | x | 0.7 | = | 33.3 | (76) |
| East | 0.9x | 1 | x | 9.47 | x | 24.49 | x | 0.63 | x | 0.7 | = | 70.88 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 24.49 | x | 0.63 | x | 0.7 | = | 17.89 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 24.49 | x | 0.63 | x | 0.7 | = | 17.89 | (76) |
| East | 0.9x | 1 | x | 9.47 | x | 16.15 | x | 0.63 | x | 0.7 | = | 46.74 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 16.15 | x | 0.63 | x | 0.7 | = | 11.8 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 16.15 | x | 0.63 | x | 0.7 | = | 11.8 | (76) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 85.53 | 167.32 | 275.55 | 401.88 | 492.52 | 504.18 | 480 | 412.31 | 320.48 | 198.54 | 106.65 | 70.34 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 488.38 | 567.98 | 661.56 | 764.46 | 831.27 | 820.02 | 781.44 | 720.55 | 641.13 | 542.84 | 477.87 | 461.41 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 0.99 | 0.96 | 0.86 | 0.68 | 0.52 | 0.58 | 0.84 | 0.98 | 1 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.77 | 19.92 | 20.19 | 20.54 | 20.82 | 20.96 | 20.99 | 20.99 | 20.88 | 20.5 | 20.07 | 19.74 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.98 | 19.99 | 19.99 | 20 | 20 | 20.01 | 20.01 | 20.01 | 20.01 | 20 | 20 | 19.99 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.98 | 0.94 | 0.81 | 0.6 | 0.4 | 0.46 | 0.77 | 0.97 | 1 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.34 | 18.56 | 18.96 | 19.46 | 19.83 | 19.98 | 20.01 | 20.01 | 19.91 | 19.42 | 18.79 | 18.31 | (90) |

fLA = Living area ÷ (4) = 0.36 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.86 | 19.06 | 19.4 | 19.85 | 20.19 | 20.34 | 20.36 | 20.36 | 20.26 | 19.81 | 19.25 | 18.83 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.86 | 19.06 | 19.4 | 19.85 | 20.19 | 20.34 | 20.36 | 20.36 | 20.26 | 19.81 | 19.25 | 18.83 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.98 | 0.94 | 0.82 | 0.63 | 0.45 | 0.5 | 0.79 | 0.97 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 486.93 | 564.19 | 648.85 | 715.52 | 683.49 | 513.78 | 348.07 | 363.28 | 507.98 | 524.15 | 474.93 | 460.38 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1398.29 | 1356.34 | 1233.3 | 1034.55 | 799.75 | 535.01 | 350.98 | 368.67 | 577.05 | 867.87 | 1150.47 | 1391.19 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 678.05 | 532.33 | 434.83 | 229.7 | 86.5 | 0 | 0 | 0 | 0 | 255.73 | 486.39 | 692.53 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3396.06 (98)

Space heating requirement in kWh/m²/year 39.67 (99)

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary system | | 0 | (201) |
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | | | | | | | | | | | | | |
| | 678.05 | 532.33 | 434.83 | 229.7 | 86.5 | 0 | 0 | 0 | 0 | 255.73 | 486.39 | 692.53 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | (211) |
| | 725.96 | 569.95 | 465.55 | 245.93 | 92.62 | 0 | 0 | 0 | 0 | 273.8 | 520.76 | 741.46 | |

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3636.04 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

# TER WorkSheet: New dwelling design stage

**Water heating**

Output from water heater (calculated above)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 205.95 | 181.59 | 189.27 | 167.87 | 162.53 | 143.15 | 137.15 | 152.89 | 154.57 | 176.01 | 187.54 | 201.06 |

Efficiency of water heater 80.3 (216)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 87.83 | 87.6 | 87.08 | 85.84 | 83.54 | 80.3 | 80.3 | 80.3 | 80.3 | 85.99 | 87.34 | 87.91 | (217) |

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 234.5 | 207.29 | 217.36 | 195.56 | 194.55 | 178.27 | 170.79 | 190.39 | 192.5 | 204.69 | 214.72 | 228.71 |

Total = Sum(219a)$_{1...12}$ = 2429.32 (219)

| **Annual totals** | **kWh/year** | **kWh/year** | |
|---|---|---|---|
| Space heating fuel used, main system 1 | | 3636.04 | |
| Water heating fuel used | | 2429.32 | |
| Electricity for pumps, fans and electric keep-hot | | | |
| central heating pump: | 30 | | (230c) |
| boiler with a fan-assisted flue | 45 | | (230e) |
| Total electricity for the above, kWh/year — sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | 376.14 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 785.38 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 524.73 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1310.12 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 195.22 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 1544.26 | (272) |

**TER =** 18.04 (273)

# TER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: A2

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Basement | 87.17 | (1a) | x | 2.55 | (2a) | = | 222.28 | (3a) |
| Ground floor | 79.45 | (1b) | x | 3 | (2b) | = | 238.35 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 166.62 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | | = | 460.63 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 4 | x 10 = | 40 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

| | | | | Air changes per hour | |
|---|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = | (6a)+(6b)+(7a)+(7b)+(7c) = | 40 | ÷ (5) = | 0.09 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.34 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.29 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

# TER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.37 | 0.36 | 0.35 | 0.31 | 0.31 | 0.27 | 0.27 | 0.26 | 0.29 | 0.31 | 0.32 | 0.34 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.57 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.54 | 0.54 | 0.54 | 0.55 | 0.55 | 0.56 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.57 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.54 | 0.54 | 0.54 | 0.55 | 0.55 | 0.56 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.92 | | x1/[1/( 1.4 )+ 0.04] | = | 6.52 | | | (27) |
| Windows Type 2 | | | 4.92 | | x1/[1/( 1.4 )+ 0.04] | = | 6.52 | | | (27) |
| Windows Type 3 | | | 2.39 | | x1/[1/( 1.4 )+ 0.04] | = | 3.17 | | | (27) |
| Windows Type 4 | | | 7.32 | | x1/[1/( 1.4 )+ 0.04] | = | 9.7 | | | (27) |
| Windows Type 5 | | | 4.76 | | x1/[1/( 1.4 )+ 0.04] | = | 6.31 | | | (27) |
| Windows Type 6 | | | 2.39 | | x1/[1/( 1.4 )+ 0.04] | = | 3.17 | | | (27) |
| Windows Type 7 | | | 4.76 | | x1/[1/( 1.4 )+ 0.04] | = | 6.31 | | | (27) |
| Windows Type 8 | | | 2.39 | | x1/[1/( 1.4 )+ 0.04] | = | 3.17 | | | (27) |
| Floor Type 1 | | | 87.17 | x | 0.13 | = | 11.3321 | | | (28) |
| Floor Type 2 | | | 6.96 | x | 0.13 | = | 0.9048 | | | (28) |
| Walls Type1 | 86.29 | 14.46 | 71.83 | x | 0.18 | = | 12.93 | | | (29) |
| Walls Type2 | 81.09 | 24.17 | 56.92 | x | 0.18 | = | 10.25 | | | (29) |
| Walls Type3 | 43.85 | 0 | 43.85 | x | 0.18 | = | 7.89 | | | (29) |
| Roof Type1 | 15.5 | 0 | 15.5 | x | 0.13 | = | 2.01 | | | (30) |
| Roof Type2 | 6.22 | 0 | 6.22 | x | 0.13 | = | 0.81 | | | (30) |
| Total area of elements, m² | | | 327.08 | | | | | | | (31) |
| Party wall | | | 26.4 | x | 0 | = | 0 | | | (32) |

# TER WorkSheet: New dwelling design stage

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 97.34 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 21850.18 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 17.66 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 115 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 86.13 | 85.74 | 85.35 | 83.54 | 83.2 | 81.63 | 81.63 | 81.34 | 82.23 | 83.2 | 83.89 | 84.61 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 201.13 | 200.74 | 200.35 | 198.54 | 198.2 | 196.63 | 196.63 | 196.33 | 197.23 | 198.2 | 198.89 | 199.6 | |

Average = Sum(39)$_{1…12}$ /12= 198.54 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.21 | 1.2 | 1.2 | 1.19 | 1.19 | 1.18 | 1.18 | 1.18 | 1.18 | 1.19 | 1.19 | 1.2 |

Average = Sum(40)$_{1…12}$ /12= 1.19 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.96 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 104.45 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 114.9 | 110.72 | 106.54 | 102.36 | 98.19 | 94.01 | 94.01 | 98.19 | 102.36 | 106.54 | 110.72 | 114.9 |

Total = Sum(44)$_{1…12}$ = 1253.44 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 170.39 | 149.02 | 153.78 | 134.07 | 128.64 | 111.01 | 102.87 | 118.04 | 119.45 | 139.21 | 151.96 | 165.01 |

Total = Sum(45)$_{1…12}$ = 1643.45 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 25.56 | 22.35 | 23.07 | 20.11 | 19.3 | 16.65 | 15.43 | 17.71 | 17.92 | 20.88 | 22.79 | 24.75 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.96 | 46.03 | 50.96 | 49.32 | 50.03 | 46.36 | 47.91 | 50.03 | 49.32 | 50.96 | 49.32 | 50.96 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 221.35 | 195.05 | 204.74 | 183.38 | 178.68 | 157.37 | 150.77 | 168.07 | 168.77 | 190.17 | 201.27 | 215.97 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 221.35 | 195.05 | 204.74 | 183.38 | 178.68 | 157.37 | 150.77 | 168.07 | 168.77 | 190.17 | 201.27 | 215.97 |

Output from water heater (annual)$_{1...12}$ 2235.6 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 69.39 | 61.06 | 63.87 | 56.91 | 55.28 | 48.5 | 46.18 | 51.76 | 52.05 | 59.03 | 62.85 | 67.61 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 147.9 | 147.9 | 147.9 | 147.9 | 147.9 | 147.9 | 147.9 | 147.9 | 147.9 | 147.9 | 147.9 | 147.9 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 30.14 | 26.77 | 21.77 | 16.48 | 12.32 | 10.4 | 11.24 | 14.61 | 19.61 | 24.9 | 29.06 | 30.98 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 338.09 | 341.59 | 332.75 | 313.93 | 290.18 | 267.85 | 252.93 | 249.42 | 258.26 | 277.08 | 300.84 | 323.17 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 37.79 | 37.79 | 37.79 | 37.79 | 37.79 | 37.79 | 37.79 | 37.79 | 37.79 | 37.79 | 37.79 | 37.79 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -118.32 | -118.32 | -118.32 | -118.32 | -118.32 | -118.32 | -118.32 | -118.32 | -118.32 | -118.32 | -118.32 | -118.32 | (71) |

# TER WorkSheet: New dwelling design stage

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 93.27 | 90.86 | 85.85 | 79.04 | 74.3 | 67.36 | 62.07 | 69.57 | 72.29 | 79.34 | 87.3 | 90.87 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 531.87 | 529.6 | 510.74 | 479.82 | 447.17 | 415.98 | 396.61 | 403.97 | 420.53 | 451.69 | 487.57 | 515.39 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.76 | x | 19.64 | x | 0.63 | x | 0.7 | = | 28.57 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 19.64 | x | 0.63 | x | 0.7 | = | 14.35 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 19.64 | x | 0.63 | x | 0.7 | = | 28.57 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 19.64 | x | 0.63 | x | 0.7 | = | 14.35 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 38.42 | x | 0.63 | x | 0.7 | = | 55.89 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 38.42 | x | 0.63 | x | 0.7 | = | 28.06 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 38.42 | x | 0.63 | x | 0.7 | = | 55.89 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 38.42 | x | 0.63 | x | 0.7 | = | 28.06 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 63.27 | x | 0.63 | x | 0.7 | = | 92.04 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 63.27 | x | 0.63 | x | 0.7 | = | 46.22 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 63.27 | x | 0.63 | x | 0.7 | = | 92.04 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 63.27 | x | 0.63 | x | 0.7 | = | 46.22 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 92.28 | x | 0.63 | x | 0.7 | = | 134.24 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 92.28 | x | 0.63 | x | 0.7 | = | 67.4 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 92.28 | x | 0.63 | x | 0.7 | = | 134.24 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 92.28 | x | 0.63 | x | 0.7 | = | 67.4 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 113.09 | x | 0.63 | x | 0.7 | = | 164.52 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 113.09 | x | 0.63 | x | 0.7 | = | 82.6 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 113.09 | x | 0.63 | x | 0.7 | = | 164.52 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 113.09 | x | 0.63 | x | 0.7 | = | 82.6 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 115.77 | x | 0.63 | x | 0.7 | = | 168.41 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 115.77 | x | 0.63 | x | 0.7 | = | 84.56 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 115.77 | x | 0.63 | x | 0.7 | = | 168.41 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 115.77 | x | 0.63 | x | 0.7 | = | 84.56 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 110.22 | x | 0.63 | x | 0.7 | = | 160.34 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 110.22 | x | 0.63 | x | 0.7 | = | 80.51 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 110.22 | x | 0.63 | x | 0.7 | = | 160.34 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 110.22 | x | 0.63 | x | 0.7 | = | 80.51 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 94.68 | x | 0.63 | x | 0.7 | = | 137.73 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 94.68 | x | 0.63 | x | 0.7 | = | 69.15 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 94.68 | x | 0.63 | x | 0.7 | = | 137.73 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 94.68 | x | 0.63 | x | 0.7 | = | 69.15 | (76) |

# TER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.76 | x | 73.59 | x | 0.63 | x | 0.7 | = | 107.05 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 73.59 | x | 0.63 | x | 0.7 | = | 53.75 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 73.59 | x | 0.63 | x | 0.7 | = | 107.05 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 73.59 | x | 0.63 | x | 0.7 | = | 53.75 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 45.59 | x | 0.63 | x | 0.7 | = | 66.32 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 45.59 | x | 0.63 | x | 0.7 | = | 33.3 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 45.59 | x | 0.63 | x | 0.7 | = | 66.32 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 45.59 | x | 0.63 | x | 0.7 | = | 33.3 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 24.49 | x | 0.63 | x | 0.7 | = | 35.62 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 24.49 | x | 0.63 | x | 0.7 | = | 17.89 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 24.49 | x | 0.63 | x | 0.7 | = | 35.62 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 24.49 | x | 0.63 | x | 0.7 | = | 17.89 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 16.15 | x | 0.63 | x | 0.7 | = | 23.5 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 16.15 | x | 0.63 | x | 0.7 | = | 11.8 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 16.15 | x | 0.63 | x | 0.7 | = | 23.5 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 16.15 | x | 0.63 | x | 0.7 | = | 11.8 | (76) |
| South | 0.9x | 0.77 | x | 7.32 | x | 46.75 | x | 0.63 | x | 0.7 | = | 104.59 | (78) |
| South | 0.9x | 0.77 | x | 7.32 | x | 76.57 | x | 0.63 | x | 0.7 | = | 171.29 | (78) |
| South | 0.9x | 0.77 | x | 7.32 | x | 97.53 | x | 0.63 | x | 0.7 | = | 218.19 | (78) |
| South | 0.9x | 0.77 | x | 7.32 | x | 110.23 | x | 0.63 | x | 0.7 | = | 246.6 | (78) |
| South | 0.9x | 0.77 | x | 7.32 | x | 114.87 | x | 0.63 | x | 0.7 | = | 256.98 | (78) |
| South | 0.9x | 0.77 | x | 7.32 | x | 110.55 | x | 0.63 | x | 0.7 | = | 247.31 | (78) |
| South | 0.9x | 0.77 | x | 7.32 | x | 108.01 | x | 0.63 | x | 0.7 | = | 241.63 | (78) |
| South | 0.9x | 0.77 | x | 7.32 | x | 104.89 | x | 0.63 | x | 0.7 | = | 234.66 | (78) |
| South | 0.9x | 0.77 | x | 7.32 | x | 101.89 | x | 0.63 | x | 0.7 | = | 227.93 | (78) |
| South | 0.9x | 0.77 | x | 7.32 | x | 82.59 | x | 0.63 | x | 0.7 | = | 184.75 | (78) |
| South | 0.9x | 0.77 | x | 7.32 | x | 55.42 | x | 0.63 | x | 0.7 | = | 123.97 | (78) |
| South | 0.9x | 0.77 | x | 7.32 | x | 40.4 | x | 0.63 | x | 0.7 | = | 90.37 | (78) |
| West | 0.9x | 0.77 | x | 4.92 | x | 19.64 | x | 0.63 | x | 0.7 | = | 29.53 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 19.64 | x | 0.63 | x | 0.7 | = | 29.53 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 19.64 | x | 0.63 | x | 0.7 | = | 43.04 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 38.42 | x | 0.63 | x | 0.7 | = | 57.77 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 38.42 | x | 0.63 | x | 0.7 | = | 57.77 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 38.42 | x | 0.63 | x | 0.7 | = | 84.19 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 63.27 | x | 0.63 | x | 0.7 | = | 95.14 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 63.27 | x | 0.63 | x | 0.7 | = | 95.14 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 63.27 | x | 0.63 | x | 0.7 | = | 138.65 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 92.28 | x | 0.63 | x | 0.7 | = | 138.75 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 92.28 | x | 0.63 | x | 0.7 | = | 138.75 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 92.28 | x | 0.63 | x | 0.7 | = | 202.21 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 113.09 | x | 0.63 | x | 0.7 | = | 170.05 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 4.92 | x | 113.09 | x | 0.63 | x | 0.7 | = | 170.05 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 113.09 | x | 0.63 | x | 0.7 | = | 247.81 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 115.77 | x | 0.63 | x | 0.7 | = | 174.07 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 115.77 | x | 0.63 | x | 0.7 | = | 174.07 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 115.77 | x | 0.63 | x | 0.7 | = | 253.68 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 110.22 | x | 0.63 | x | 0.7 | = | 165.73 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 110.22 | x | 0.63 | x | 0.7 | = | 165.73 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 110.22 | x | 0.63 | x | 0.7 | = | 241.52 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 94.68 | x | 0.63 | x | 0.7 | = | 142.36 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 94.68 | x | 0.63 | x | 0.7 | = | 142.36 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 94.68 | x | 0.63 | x | 0.7 | = | 207.46 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 73.59 | x | 0.63 | x | 0.7 | = | 110.65 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 73.59 | x | 0.63 | x | 0.7 | = | 110.65 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 73.59 | x | 0.63 | x | 0.7 | = | 161.25 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 45.59 | x | 0.63 | x | 0.7 | = | 68.55 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 45.59 | x | 0.63 | x | 0.7 | = | 68.55 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 45.59 | x | 0.63 | x | 0.7 | = | 99.9 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 24.49 | x | 0.63 | x | 0.7 | = | 36.82 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 24.49 | x | 0.63 | x | 0.7 | = | 36.82 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 24.49 | x | 0.63 | x | 0.7 | = | 53.66 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 16.15 | x | 0.63 | x | 0.7 | = | 24.29 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 16.15 | x | 0.63 | x | 0.7 | = | 24.29 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 16.15 | x | 0.63 | x | 0.7 | = | 35.39 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 292.52 | 538.93 | 823.64 | 1129.61 | 1339.13 | 1355.08 | 1296.28 | 1140.59 | 932.08 | 620.98 | 358.3 | 244.92 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 824.39 | 1068.52 | 1334.38 | 1609.43 | 1786.3 | 1771.06 | 1692.89 | 1544.55 | 1352.61 | 1072.67 | 845.87 | 760.31 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 0.99 | 0.95 | 0.84 | 0.67 | 0.5 | 0.57 | 0.83 | 0.98 | 1 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.59 | 19.79 | 20.11 | 20.51 | 20.81 | 20.96 | 20.99 | 20.98 | 20.87 | 20.43 | 19.93 | 19.55 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.91 | 19.92 | 19.92 | 19.93 | 19.93 | 19.94 | 19.94 | 19.94 | 19.93 | 19.93 | 19.93 | 19.92 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 1 | 0.98 | 0.93 | 0.79 | 0.57 | 0.39 | 0.44 | 0.76 | 0.97 | 1 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.02 | 18.32 | 18.79 | 19.36 | 19.75 | 19.91 | 19.93 | 19.93 | 19.83 | 19.27 | 18.53 | 17.98 | (90) |

fLA = Living area ÷ (4) = | 0.29 | (91)

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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.48 | 18.75 | 19.18 | 19.7 | 20.06 | 20.22 | 20.24 | 20.24 | 20.14 | 19.61 | 18.94 | 18.44 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.48 | 18.75 | 19.18 | 19.7 | 20.06 | 20.22 | 20.24 | 20.24 | 20.14 | 19.61 | 18.94 | 18.44 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.98 | 0.92 | 0.8 | 0.6 | 0.42 | 0.48 | 0.77 | 0.97 | 1 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 822.94 | 1062.09 | 1305.83 | 1488.1 | 1424.92 | 1061.01 | 710.45 | 742.64 | 1046.54 | 1035.41 | 842.19 | 759.4 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 2852.23 | 2780.95 | 2540.58 | 2143.68 | 1657.19 | 1104.27 | 716.48 | 754.07 | 1190.32 | 1785.61 | 2354.41 | 2842.02 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 1509.79 | 1155.07 | 918.65 | 472.02 | 172.81 | 0 | 0 | 0 | 0 | 558.14 | 1088.8 | 1549.47 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 7424.76 (98)

Space heating requirement in kWh/m²/year 44.56 (99)

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary system | | 0 | (201) |
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | | | | | | | | | | | | | | |
| | 1509.79 | 1155.07 | 918.65 | 472.02 | 172.81 | 0 | 0 | 0 | 0 | 558.14 | 1088.8 | 1549.47 | | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | | (211) |
| | 1616.48 | 1236.7 | 983.56 | 505.37 | 185.02 | 0 | 0 | 0 | 0 | 597.58 | 1165.74 | 1658.96 | | |
| Total (kWh/year) =Sum(211)$_{1...5,10....12}$= | | | | | | | | | | | | | 7949.42 | (211) |
| Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) | | | | | | | | | | | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Total (kWh/year) =Sum(215)$_{1...5,10....12}$= | | | | | | | | | | | | | 0 | (215) |

**Water heating**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Output from water heater (calculated above) | | | | | | | | | | | | | | |
| | 221.35 | 195.05 | 204.74 | 183.38 | 178.68 | 157.37 | 150.77 | 168.07 | 168.77 | 190.17 | 201.27 | 215.97 | | |
| Efficiency of water heater | | | | | | | | | | | | | 80.3 | (216) |
| (217)m= | 88.97 | 88.79 | 88.37 | 87.33 | 84.97 | 80.3 | 80.3 | 80.3 | 80.3 | 87.6 | 88.66 | 89.03 | | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m | | | | | | | | | | | | | | |
| (219)m= | 248.79 | 219.69 | 231.67 | 210 | 210.29 | 195.98 | 187.76 | 209.31 | 210.17 | 217.09 | 227.01 | 242.58 | | |
| Total = Sum(219a)$_{1...12}$ = | | | | | | | | | | | | | 2610.34 | (219) |

# TER WorkSheet: New dwelling design stage

| Annual totals | | kWh/year | kWh/year | |
|---|---|---|---|---|
| Space heating fuel used, main system 1 | | | 7949.42 | |
| Water heating fuel used | | | 2610.34 | |
| Electricity for pumps, fans and electric keep-hot | | | | |
| central heating pump: | | 30 | | (230c) |
| boiler with a fan-assisted flue | | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | | 532.29 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | Energy kWh/year | | Emission factor kg CO2/kWh | | Emissions kg CO2/year | |
|---|---|---|---|---|---|---|
| Space heating (main system 1) | (211) | x | 0.216 | = | 1717.08 | (261) |
| Space heating (secondary) | (215) | x | 0.519 | = | 0 | (263) |
| Water heating | (219) | x | 0.216 | = | 563.83 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | 2280.91 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) | x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) | x | 0.519 | = | 276.26 | (268) |
| Total CO2, kg/year | | | sum of (265)…(271) = | | 2596.09 | (272) |

**TER =** 15.58 (273)

# TER WorkSheet: New dwelling design stage

User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

Property Address: A3

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Basement | 68.93 | (1a) | x | 2.55 | (2a) | = | 175.77 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 68.93 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | | 175.77 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 2 | x 10 = | 20 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 20 | ÷ (5) = | 0.11 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.36 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.31 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.39 | 0.39 | 0.38 | 0.34 | 0.33 | 0.29 | 0.29 | 0.29 | 0.31 | 0.33 | 0.35 | 0.36 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.58 | 0.57 | 0.57 | 0.56 | 0.56 | 0.54 | 0.54 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.58 | 0.57 | 0.57 | 0.56 | 0.56 | 0.54 | 0.54 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 8.96 | x1/[1/( 1.4 )+ 0.04] | = | 11.88 | | | (27) |
| Windows Type 2 | | | 2.26 | x1/[1/( 1.4 )+ 0.04] | = | 3 | | | (27) |
| Windows Type 3 | | | 2.26 | x1/[1/( 1.4 )+ 0.04] | = | 3 | | | (27) |
| Walls Type1 | 65.3 | 13.48 | 51.82 | x 0.18 | = | 9.33 | | | (29) |
| Walls Type2 | 15.33 | 0 | 15.33 | x 0.18 | = | 2.76 | | | (29) |
| Walls Type3 | 28.15 | 0 | 28.15 | x 0.18 | = | 5.07 | | | (29) |
| Total area of elements, m² | | | 108.78 | | | | | | (31) |
| Party wall | | | 8.49 | x 0 | = | 0 | | | (32) |

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 35.03 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 6100.28 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 7.41 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 42.44 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 33.51 | 33.34 | 33.16 | 32.36 | 32.21 | 31.5 | 31.5 | 31.37 | 31.78 | 32.21 | 32.51 | 32.83 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 75.95 | 75.77 | 75.6 | 74.79 | 74.64 | 73.94 | 73.94 | 73.81 | 74.21 | 74.64 | 74.95 | 75.27 | |

Average = Sum(39)$_{1…12}$ /12= 74.79 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.1 | 1.1 | 1.1 | 1.09 | 1.08 | 1.07 | 1.07 | 1.07 | 1.08 | 1.08 | 1.09 | 1.09 |

Average = Sum(40)$_{1…12}$ /12= 1.09 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 |

(41)

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.22 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 86.92 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 95.61 | 92.14 | 88.66 | 85.18 | 81.71 | 78.23 | 78.23 | 81.71 | 85.18 | 88.66 | 92.14 | 95.61 |

Total = Sum(44)$_{1…12}$ = 1043.06 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 141.79 | 124.01 | 127.97 | 111.57 | 107.05 | 92.38 | 85.6 | 98.23 | 99.4 | 115.84 | 126.45 | 137.32 |

Total = Sum(45)$_{1…12}$ = 1367.62 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 21.27 | 18.6 | 19.2 | 16.74 | 16.06 | 13.86 | 12.84 | 14.73 | 14.91 | 17.38 | 18.97 | 20.6 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 48.72 | 42.41 | 45.18 | 42.01 | 41.64 | 38.58 | 39.87 | 41.64 | 42.01 | 45.18 | 45.44 | 48.72 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 190.52 | 166.42 | 173.15 | 153.58 | 148.69 | 130.96 | 125.47 | 139.87 | 141.41 | 161.02 | 171.89 | 186.04 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 190.52 | 166.42 | 173.15 | 153.58 | 148.69 | 130.96 | 125.47 | 139.87 | 141.41 | 161.02 | 171.89 | 186.04 | |

Output from water heater (annual)$_{1\ldots12}$ 1889.01 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 59.33 | 51.84 | 53.85 | 47.6 | 46 | 40.36 | 38.43 | 43.07 | 43.55 | 49.81 | 53.4 | 57.84 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 110.99 | 110.99 | 110.99 | 110.99 | 110.99 | 110.99 | 110.99 | 110.99 | 110.99 | 110.99 | 110.99 | 110.99 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 17.53 | 15.57 | 12.66 | 9.59 | 7.17 | 6.05 | 6.54 | 8.5 | 11.41 | 14.48 | 16.9 | 18.02 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 194.79 | 196.81 | 191.71 | 180.87 | 167.18 | 154.32 | 145.72 | 143.7 | 148.8 | 159.64 | 173.33 | 186.19 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 34.1 | 34.1 | 34.1 | 34.1 | 34.1 | 34.1 | 34.1 | 34.1 | 34.1 | 34.1 | 34.1 | 34.1 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -88.79 | -88.79 | -88.79 | -88.79 | -88.79 | -88.79 | -88.79 | -88.79 | -88.79 | -88.79 | -88.79 | -88.79 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 79.74 | 77.14 | 72.37 | 66.11 | 61.83 | 56.06 | 51.65 | 57.89 | 60.49 | 66.95 | 74.17 | 77.74 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 351.36 | 348.82 | 336.05 | 315.86 | 295.48 | 275.72 | 263.21 | 269.39 | 279.99 | 300.37 | 323.7 | 341.25 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 8.96 | x | 19.64 | x | 0.63 | x | 0.7 | = | 53.78 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 19.64 | x | 0.63 | x | 0.7 | = | 13.57 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 19.64 | x | 0.63 | x | 0.7 | = | 13.57 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 38.42 | x | 0.63 | x | 0.7 | = | 105.21 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 38.42 | x | 0.63 | x | 0.7 | = | 26.54 | (76) |

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| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 2.26 | x | 38.42 | x | 0.63 | x | 0.7 | = | 26.54 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 63.27 | x | 0.63 | x | 0.7 | = | 173.26 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 63.27 | x | 0.63 | x | 0.7 | = | 43.7 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 63.27 | x | 0.63 | x | 0.7 | = | 43.7 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 92.28 | x | 0.63 | x | 0.7 | = | 252.69 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 92.28 | x | 0.63 | x | 0.7 | = | 63.74 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 92.28 | x | 0.63 | x | 0.7 | = | 63.74 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 113.09 | x | 0.63 | x | 0.7 | = | 309.68 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 113.09 | x | 0.63 | x | 0.7 | = | 78.11 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 113.09 | x | 0.63 | x | 0.7 | = | 78.11 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 115.77 | x | 0.63 | x | 0.7 | = | 317.01 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 115.77 | x | 0.63 | x | 0.7 | = | 79.96 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 115.77 | x | 0.63 | x | 0.7 | = | 79.96 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 110.22 | x | 0.63 | x | 0.7 | = | 301.81 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 110.22 | x | 0.63 | x | 0.7 | = | 76.13 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 110.22 | x | 0.63 | x | 0.7 | = | 76.13 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 94.68 | x | 0.63 | x | 0.7 | = | 259.25 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 94.68 | x | 0.63 | x | 0.7 | = | 65.39 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 94.68 | x | 0.63 | x | 0.7 | = | 65.39 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 73.59 | x | 0.63 | x | 0.7 | = | 201.51 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 73.59 | x | 0.63 | x | 0.7 | = | 50.83 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 73.59 | x | 0.63 | x | 0.7 | = | 50.83 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 45.59 | x | 0.63 | x | 0.7 | = | 124.84 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 45.59 | x | 0.63 | x | 0.7 | = | 31.49 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 45.59 | x | 0.63 | x | 0.7 | = | 31.49 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 24.49 | x | 0.63 | x | 0.7 | = | 67.06 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 24.49 | x | 0.63 | x | 0.7 | = | 16.91 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 24.49 | x | 0.63 | x | 0.7 | = | 16.91 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 16.15 | x | 0.63 | x | 0.7 | = | 44.23 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 16.15 | x | 0.63 | x | 0.7 | = | 11.16 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 16.15 | x | 0.63 | x | 0.7 | = | 11.16 | (76) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 80.91 | 158.28 | 260.66 | 380.16 | 465.9 | 476.94 | 454.06 | 390.03 | 303.16 | 187.81 | 100.89 | 66.54 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 432.27 | 507.09 | 596.71 | 696.03 | 761.38 | 752.66 | 717.27 | 659.42 | 583.15 | 488.18 | 424.59 | 407.79 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 0.99 | 0.98 | 0.93 | 0.8 | 0.61 | 0.45 | 0.51 | 0.78 | 0.97 | 0.99 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.85 | 20.02 | 20.3 | 20.64 | 20.88 | 20.98 | 21 | 20.99 | 20.92 | 20.58 | 20.15 | 19.82 | (87) |

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20 | 20 | 20 | 20.01 | 20.01 | 20.02 | 20.02 | 20.02 | 20.02 | 20.01 | 20.01 | 20.01 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.97 | 0.9 | 0.74 | 0.52 | 0.35 | 0.4 | 0.7 | 0.95 | 0.99 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.47 | 18.71 | 19.12 | 19.61 | 19.91 | 20.01 | 20.02 | 20.02 | 19.96 | 19.53 | 18.91 | 18.43 | (90) |

fLA = Living area ÷ (4) = 0.4 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 19.02 | 19.24 | 19.59 | 20.03 | 20.3 | 20.4 | 20.42 | 20.41 | 20.35 | 19.96 | 19.41 | 18.99 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 19.02 | 19.24 | 19.59 | 20.03 | 20.3 | 20.4 | 20.42 | 20.41 | 20.35 | 19.96 | 19.41 | 18.99 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.97 | 0.91 | 0.76 | 0.56 | 0.39 | 0.45 | 0.73 | 0.95 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 430.37 | 501.95 | 579.09 | 630.03 | 579.66 | 419.36 | 280.92 | 293.98 | 426.87 | 463.33 | 420.68 | 406.45 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1118.31 | 1086.35 | 989.89 | 832.09 | 641.94 | 428.92 | 282.12 | 296.3 | 463.79 | 698.32 | 922.5 | 1113.21 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 511.83 | 392.72 | 305.64 | 145.48 | 46.34 | 0 | 0 | 0 | 0 | 174.83 | 361.31 | 525.83 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2463.97 (98)

Space heating requirement in kWh/m²/year 35.75 (99)

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary system | | 0 | (201) |
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | | | | | | | | | | | | | |
| | 511.83 | 392.72 | 305.64 | 145.48 | 46.34 | 0 | 0 | 0 | 0 | 174.83 | 361.31 | 525.83 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | (211) |
| | 547.99 | 420.47 | 327.23 | 155.76 | 49.61 | 0 | 0 | 0 | 0 | 187.18 | 386.84 | 562.99 | |

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2638.09 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

# TER WorkSheet: New dwelling design stage

**Water heating**

Output from water heater (calculated above)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 190.52 | 166.42 | 173.15 | 153.58 | 148.69 | 130.96 | 125.47 | 139.87 | 141.41 | 161.02 | 171.89 | 186.04 |

Efficiency of water heater 80.3 (216)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 87.42 | 87.14 | 86.47 | 84.92 | 82.49 | 80.3 | 80.3 | 80.3 | 80.3 | 85.26 | 86.88 | 87.52 | (217) |

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 217.94 | 190.99 | 200.25 | 180.86 | 180.25 | 163.08 | 156.25 | 174.18 | 176.1 | 188.87 | 197.85 | 212.56 |

Total = Sum(219a)$_{1...12}$ = 2239.18 (219)

| **Annual totals** | | **kWh/year** | **kWh/year** | |
|---|---|---|---|---|
| Space heating fuel used, main system 1 | | | 2638.09 | |
| Water heating fuel used | | | 2239.18 | |
| Electricity for pumps, fans and electric keep-hot | | | | |
| central heating pump: | | 30 | | (230c) |
| boiler with a fan-assisted flue | | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | | 309.61 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 569.83 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 483.66 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1053.49 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 160.69 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 1253.1 | (272) |

**TER =** 18.18 (273)

# TER WorkSheet: New dwelling design stage

User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

Property Address: A4

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 93.61 | (1a) x | 2.55 | (2a) = | 238.71 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 93.61 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 238.71 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 3 | x 10 = | 30 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 30 | ÷ (5) = | 0.13 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.38 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.32 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.41 | 0.4 | 0.39 | 0.35 | 0.34 | 0.3 | 0.3 | 0.3 | 0.32 | 0.34 | 0.36 | 0.38 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.58 | 0.58 | 0.58 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.58 | 0.58 | 0.58 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.72 | x1/[1/( 1.4 )+ 0.04] | = | 6.26 | | | (27) |
| Windows Type 2 | | | 2.29 | x1/[1/( 1.4 )+ 0.04] | = | 3.04 | | | (27) |
| Windows Type 3 | | | 4.5 | x1/[1/( 1.4 )+ 0.04] | = | 5.97 | | | (27) |
| Windows Type 4 | | | 2.26 | x1/[1/( 1.4 )+ 0.04] | = | 3 | | | (27) |
| Floor | | | 21.67 | x 0.13 | = | 2.8171 | | | (28) |
| Walls Type1 | 87.82 | 23.07 | 64.75 | x 0.18 | = | 11.66 | | | (29) |
| Walls Type2 | 23.15 | 0 | 23.15 | x 0.18 | = | 4.17 | | | (29) |
| Total area of elements, m² | | | 132.64 | | | | | | (31) |
| Party wall | | | 5.94 | x 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 49.22 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 7166.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 11.57 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 60.79 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 45.92 | 45.66 | 45.41 | 44.25 | 44.03 | 43.01 | 43.01 | 42.82 | 43.4 | 44.03 | 44.47 | 44.93 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 106.71 | 106.46 | 106.21 | 105.04 | 104.82 | 103.81 | 103.81 | 103.62 | 104.2 | 104.82 | 105.26 | 105.73 | |

Average = Sum(39)$_{1…12}$ /12= 105.04 (39)

# TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.14 | 1.14 | 1.13 | 1.12 | 1.12 | 1.11 | 1.11 | 1.11 | 1.11 | 1.12 | 1.12 | 1.13 |

Average = Sum(40)$_{1…12}$ /12= 1.12 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.67 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 97.66 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 107.43 | 103.52 | 99.61 | 95.71 | 91.8 | 87.89 | 87.89 | 91.8 | 95.71 | 99.61 | 103.52 | 107.43 | |

Total = Sum(44)$_{1…12}$ = 1171.91 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 159.31 | 139.33 | 143.78 | 125.35 | 120.28 | 103.79 | 96.18 | 110.36 | 111.68 | 130.15 | 142.07 | 154.28 |

Total = Sum(45)$_{1…12}$ = 1536.56 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 23.9 | 20.9 | 21.57 | 18.8 | 18.04 | 15.57 | 14.43 | 16.55 | 16.75 | 19.52 | 21.31 | 23.14 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

# TER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.96 | 46.03 | 50.76 | 47.2 | 46.78 | 43.34 | 44.79 | 46.78 | 47.2 | 50.76 | 49.32 | 50.96 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 210.27 | 185.36 | 194.54 | 172.55 | 167.06 | 147.13 | 140.97 | 157.14 | 158.88 | 180.92 | 191.39 | 205.24 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 210.27 | 185.36 | 194.54 | 172.55 | 167.06 | 147.13 | 140.97 | 157.14 | 158.88 | 180.92 | 191.39 | 205.24 | |

Output from water heater (annual)$_{1...12}$ 2111.44 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 65.71 | 57.83 | 60.5 | 53.48 | 51.69 | 45.35 | 43.18 | 48.39 | 48.93 | 55.97 | 59.57 | 64.04 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 133.6 | 133.6 | 133.6 | 133.6 | 133.6 | 133.6 | 133.6 | 133.6 | 133.6 | 133.6 | 133.6 | 133.6 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 21.89 | 19.44 | 15.81 | 11.97 | 8.95 | 7.56 | 8.16 | 10.61 | 14.24 | 18.08 | 21.11 | 22.5 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 245.56 | 248.11 | 241.69 | 228.02 | 210.76 | 194.55 | 183.71 | 181.16 | 187.58 | 201.25 | 218.51 | 234.73 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 36.36 | 36.36 | 36.36 | 36.36 | 36.36 | 36.36 | 36.36 | 36.36 | 36.36 | 36.36 | 36.36 | 36.36 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -106.88 | -106.88 | -106.88 | -106.88 | -106.88 | -106.88 | -106.88 | -106.88 | -106.88 | -106.88 | -106.88 | -106.88 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 88.32 | 86.06 | 81.31 | 74.28 | 69.47 | 62.98 | 58.03 | 65.04 | 67.96 | 75.22 | 82.73 | 86.07 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 421.86 | 419.7 | 404.9 | 380.35 | 355.27 | 331.16 | 315.99 | 322.9 | 335.87 | 360.64 | 388.43 | 409.38 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.5 | x | 19.64 | x | 0.63 | x | 0.7 | = | 27.01 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 19.64 | x | 0.63 | x | 0.7 | = | 13.57 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 38.42 | x | 0.63 | x | 0.7 | = | 52.84 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 38.42 | x | 0.63 | x | 0.7 | = | 26.54 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 63.27 | x | 0.63 | x | 0.7 | = | 87.02 | (76) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 2.26 | x | 63.27 | x | 0.63 | x | 0.7 | = | 43.7 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 92.28 | x | 0.63 | x | 0.7 | = | 126.91 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 92.28 | x | 0.63 | x | 0.7 | = | 63.74 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 113.09 | x | 0.63 | x | 0.7 | = | 155.53 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 113.09 | x | 0.63 | x | 0.7 | = | 78.11 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 115.77 | x | 0.63 | x | 0.7 | = | 159.21 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 115.77 | x | 0.63 | x | 0.7 | = | 79.96 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 110.22 | x | 0.63 | x | 0.7 | = | 151.58 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 110.22 | x | 0.63 | x | 0.7 | = | 76.13 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 94.68 | x | 0.63 | x | 0.7 | = | 130.2 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 94.68 | x | 0.63 | x | 0.7 | = | 65.39 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 73.59 | x | 0.63 | x | 0.7 | = | 101.2 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 73.59 | x | 0.63 | x | 0.7 | = | 50.83 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 45.59 | x | 0.63 | x | 0.7 | = | 62.7 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 45.59 | x | 0.63 | x | 0.7 | = | 31.49 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 24.49 | x | 0.63 | x | 0.7 | = | 33.68 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 24.49 | x | 0.63 | x | 0.7 | = | 16.91 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 16.15 | x | 0.63 | x | 0.7 | = | 22.21 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 16.15 | x | 0.63 | x | 0.7 | = | 11.16 | (76) |
| West | 0.9x | 0.77 | x | 4.72 | x | 19.64 | x | 0.63 | x | 0.7 | = | 56.66 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 19.64 | x | 0.63 | x | 0.7 | = | 41.24 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 38.42 | x | 0.63 | x | 0.7 | = | 110.84 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 38.42 | x | 0.63 | x | 0.7 | = | 80.67 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 63.27 | x | 0.63 | x | 0.7 | = | 182.54 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 63.27 | x | 0.63 | x | 0.7 | = | 132.85 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 92.28 | x | 0.63 | x | 0.7 | = | 266.23 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 92.28 | x | 0.63 | x | 0.7 | = | 193.75 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 113.09 | x | 0.63 | x | 0.7 | = | 326.27 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 113.09 | x | 0.63 | x | 0.7 | = | 237.45 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 115.77 | x | 0.63 | x | 0.7 | = | 334 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 115.77 | x | 0.63 | x | 0.7 | = | 243.07 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 110.22 | x | 0.63 | x | 0.7 | = | 317.98 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 110.22 | x | 0.63 | x | 0.7 | = | 231.41 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 94.68 | x | 0.63 | x | 0.7 | = | 273.14 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 94.68 | x | 0.63 | x | 0.7 | = | 198.78 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 73.59 | x | 0.63 | x | 0.7 | = | 212.3 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 73.59 | x | 0.63 | x | 0.7 | = | 154.51 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 45.59 | x | 0.63 | x | 0.7 | = | 131.52 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 45.59 | x | 0.63 | x | 0.7 | = | 95.72 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 24.49 | x | 0.63 | x | 0.7 | = | 70.65 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 24.49 | x | 0.63 | x | 0.7 | = | 51.42 | (80) |

# TER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 4.72 | x | 16.15 | x | 0.63 | x | 0.7 | = | 46.6 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 16.15 | x | 0.63 | x | 0.7 | = | 33.91 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 138.47 | 270.88 | 446.11 | 650.62 | 797.36 | 816.24 | 777.09 | 667.51 | 518.84 | 321.43 | 172.66 | 113.87 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 560.33 | 690.58 | 851 | 1030.97 | 1152.62 | 1147.4 | 1093.08 | 990.41 | 854.71 | 682.07 | 561.09 | 523.26 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 0.99 | 0.98 | 0.91 | 0.76 | 0.56 | 0.42 | 0.48 | 0.76 | 0.96 | 1 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.77 | 19.97 | 20.29 | 20.67 | 20.9 | 20.98 | 21 | 20.99 | 20.93 | 20.56 | 20.09 | 19.74 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.97 | 19.97 | 19.97 | 19.98 | 19.98 | 19.99 | 19.99 | 20 | 19.99 | 19.98 | 19.98 | 19.98 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.97 | 0.88 | 0.7 | 0.48 | 0.32 | 0.37 | 0.68 | 0.95 | 0.99 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.33 | 18.62 | 19.08 | 19.61 | 19.89 | 19.98 | 19.99 | 19.99 | 19.94 | 19.49 | 18.8 | 18.29 | (90) |

fLA = Living area ÷ (4) = 0.32 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.79 | 19.05 | 19.47 | 19.95 | 20.22 | 20.3 | 20.31 | 20.31 | 20.25 | 19.83 | 19.21 | 18.75 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.79 | 19.05 | 19.47 | 19.95 | 20.22 | 20.3 | 20.31 | 20.31 | 20.25 | 19.83 | 19.21 | 18.75 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.97 | 0.88 | 0.72 | 0.51 | 0.35 | 0.41 | 0.7 | 0.94 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 558.23 | 683.35 | 821.22 | 909.23 | 824.19 | 582.45 | 384.34 | 403.09 | 597.36 | 644.21 | 556.35 | 521.84 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1546.23 | 1506.12 | 1377.08 | 1160.24 | 892.67 | 591.94 | 385.47 | 405.44 | 641.17 | 967.55 | 1275.05 | 1538.34 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 735.07 | 552.9 | 413.56 | 180.73 | 50.95 | 0 | 0 | 0 | 0 | 240.57 | 517.47 | 756.27 | |

Total per year (kWh/year) = Sum(98)$_{1…5,9…12}$ = 3447.51 (98)

Space heating requirement in kWh/m²/year 36.83 (99)

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

Fraction of space heat from secondary/supplementary system 0 (201)

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| | | | |
|---|---|---|---|
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | 735.07 | 552.9 | 413.56 | 180.73 | 50.95 | 0 | 0 | 0 | 0 | 240.57 | 517.47 | 756.27 | | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 787.02 | 591.97 | 442.78 | 193.5 | 54.55 | 0 | 0 | 0 | 0 | 257.57 | 554.03 | 809.71 | | (211) |
| Total (kWh/year) =Sum(211)$_{1...5,10...12}$= | | | | | | | | | | | | | 3691.13 | (211) |
| Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Total (kWh/year) =Sum(215)$_{1...5,10...12}$= | | | | | | | | | | | | | 0 | (215) |

**Water heating**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Output from water heater (calculated above) | 210.27 | 185.36 | 194.54 | 172.55 | 167.06 | 147.13 | 140.97 | 157.14 | 158.88 | 180.92 | 191.39 | 205.24 | | |
| Efficiency of water heater | | | | | | | | | | | | | 80.3 | (216) |
| (217)m= | 87.94 | 87.63 | 86.9 | 85.17 | 82.45 | 80.3 | 80.3 | 80.3 | 80.3 | 85.77 | 87.43 | 88.04 | | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m= | 239.1 | 211.52 | 223.86 | 202.6 | 202.61 | 183.23 | 175.55 | 195.7 | 197.86 | 210.93 | 218.9 | 233.13 | | |
| Total = Sum(219a)$_{1...12}$ = | | | | | | | | | | | | | 2494.99 | (219) |

| **Annual totals** | | **kWh/year** | **kWh/year** | |
|---|---|---|---|---|
| Space heating fuel used, main system 1 | | | 3691.13 | |
| Water heating fuel used | | | 2494.99 | |
| Electricity for pumps, fans and electric keep-hot | | | | |
| central heating pump: | | 30 | | (230c) |
| boiler with a fan-assisted flue | | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | | 386.62 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 797.28 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 538.92 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1336.2 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 200.66 | (268) |

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| | | | |
|---|---|---|---|
| Total $CO_2$, kg/year | sum of (265)…(271) = | 1575.78 | (272) |
| **TER =** | | 16.83 | (273) |

# TER WorkSheet: New dwelling design stage

**User Details:**

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

**Property Address: A5**

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 94.43 | (1a) x | 2.55 | (2a) = | 240.8 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 94.43 | (4) | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 240.8 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 3 | x 10 = | 30 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 30 | ÷ (5) = | 0.12 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.37 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.32 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.41 | 0.4 | 0.39 | 0.35 | 0.34 | 0.3 | 0.3 | 0.29 | 0.32 | 0.34 | 0.36 | 0.37 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.58 | 0.58 | 0.58 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.58 | 0.58 | 0.58 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | (25) |

## 3. Heat losses and heat loss parameter:

| **ELEMENT** | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 1.98 | x1/[1/( 1.4 )+ 0.04] | | = | 2.62 | | | (27) |
| Windows Type 2 | | | 7.83 | x1/[1/( 1.4 )+ 0.04] | | = | 10.38 | | | (27) |
| Windows Type 3 | | | 3.93 | x1/[1/( 1.4 )+ 0.04] | | = | 5.21 | | | (27) |
| Windows Type 4 | | | 1.98 | x1/[1/( 1.4 )+ 0.04] | | = | 2.62 | | | (27) |
| Floor | | | 9.17 | x | 0.13 | = | 1.1921 | | | (28) |
| Walls Type1 | 91.51 | 23.61 | 67.9 | x | 0.18 | = | 12.22 | | | (29) |
| Walls Type2 | 15.93 | 0 | 15.93 | x | 0.18 | = | 2.87 | | | (29) |
| Roof | 17.06 | 0 | 17.06 | x | 0.13 | = | 2.22 | | | (30) |
| Total area of elements, m² | | | 133.67 | | | | | | | (31) |
| Party wall | | | 5.86 | x | 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 49.8 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 6134.79 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 16.32 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 66.12 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 46.28 | 46.02 | 45.78 | 44.61 | 44.39 | 43.37 | 43.37 | 43.18 | 43.76 | 44.39 | 44.83 | 45.29 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 112.4 | 112.15 | 111.9 | 110.73 | 110.51 | 109.49 | 109.49 | 109.3 | 109.88 | 110.51 | 110.95 | 111.41 | |

Average = Sum(39)$_{1...12}$ /12= 110.73 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.19 | 1.19 | 1.18 | 1.17 | 1.17 | 1.16 | 1.16 | 1.16 | 1.16 | 1.17 | 1.17 | 1.18 | |

Average = Sum(40)$_{1...12}$ /12= 1.17 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 97.89 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 107.68 | 103.76 | 99.85 | 95.93 | 92.02 | 88.1 | 88.1 | 92.02 | 95.93 | 99.85 | 103.76 | 107.68 | |

Total = Sum(44)$_{1...12}$ = 1174.67 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 159.68 | 139.66 | 144.12 | 125.64 | 120.56 | 104.03 | 96.4 | 110.62 | 111.94 | 130.46 | 142.41 | 154.64 | |

Total = Sum(45)$_{1...12}$ = 1540.17 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 23.95 | 20.95 | 21.62 | 18.85 | 18.08 | 15.6 | 14.46 | 16.59 | 16.79 | 19.57 | 21.36 | 23.2 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

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| | | |
|---|---|---|
| Primary circuit loss (annual) from Table 3 | 0 | (58) |

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.96 | 46.03 | 50.88 | 47.31 | 46.89 | 43.45 | 44.89 | 46.89 | 47.31 | 50.88 | 49.32 | 50.96 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 210.64 | 185.69 | 195 | 172.95 | 167.45 | 147.48 | 141.3 | 157.51 | 159.25 | 181.34 | 191.72 | 205.6 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 210.64 | 185.69 | 195 | 172.95 | 167.45 | 147.48 | 141.3 | 157.51 | 159.25 | 181.34 | 191.72 | 205.6 | |

| | | |
|---|---|---|
| Output from water heater (annual)$_{1...12}$ | 2115.93 | (64) |

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 65.83 | 57.94 | 60.64 | 53.6 | 51.81 | 45.45 | 43.28 | 48.5 | 49.05 | 56.1 | 59.68 | 64.16 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 134.08 | 134.08 | 134.08 | 134.08 | 134.08 | 134.08 | 134.08 | 134.08 | 134.08 | 134.08 | 134.08 | 134.08 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 22.02 | 19.55 | 15.9 | 12.04 | 9 | 7.6 | 8.21 | 10.67 | 14.32 | 18.19 | 21.23 | 22.63 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 247 | 249.56 | 243.1 | 229.35 | 211.99 | 195.68 | 184.78 | 182.22 | 188.68 | 202.43 | 219.78 | 236.1 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 36.41 | 36.41 | 36.41 | 36.41 | 36.41 | 36.41 | 36.41 | 36.41 | 36.41 | 36.41 | 36.41 | 36.41 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -107.27 | -107.27 | -107.27 | -107.27 | -107.27 | -107.27 | -107.27 | -107.27 | -107.27 | -107.27 | -107.27 | -107.27 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 88.49 | 86.23 | 81.5 | 74.45 | 69.63 | 63.13 | 58.17 | 65.19 | 68.12 | 75.4 | 82.89 | 86.24 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 423.72 | 421.56 | 406.73 | 382.06 | 356.85 | 332.63 | 317.38 | 324.31 | 337.35 | 362.24 | 390.12 | 411.19 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 2 | x | 1.98 | x | 19.64 | x | 0.63 | x | 0.7 | = | 23.77 | (76) |
| East | 0.9x | 1 | x | 7.83 | x | 19.64 | x | 0.63 | x | 0.7 | = | 47 | (76) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 2 | x | 1.98 | x | 38.42 | x | 0.63 | x | 0.7 | = | 46.5 | (76) |
| East | 0.9x | 1 | x | 7.83 | x | 38.42 | x | 0.63 | x | 0.7 | = | 91.94 | (76) |
| East | 0.9x | 2 | x | 1.98 | x | 63.27 | x | 0.63 | x | 0.7 | = | 76.57 | (76) |
| East | 0.9x | 1 | x | 7.83 | x | 63.27 | x | 0.63 | x | 0.7 | = | 151.41 | (76) |
| East | 0.9x | 2 | x | 1.98 | x | 92.28 | x | 0.63 | x | 0.7 | = | 111.68 | (76) |
| East | 0.9x | 1 | x | 7.83 | x | 92.28 | x | 0.63 | x | 0.7 | = | 220.82 | (76) |
| East | 0.9x | 2 | x | 1.98 | x | 113.09 | x | 0.63 | x | 0.7 | = | 136.87 | (76) |
| East | 0.9x | 1 | x | 7.83 | x | 113.09 | x | 0.63 | x | 0.7 | = | 270.63 | (76) |
| East | 0.9x | 2 | x | 1.98 | x | 115.77 | x | 0.63 | x | 0.7 | = | 140.11 | (76) |
| East | 0.9x | 1 | x | 7.83 | x | 115.77 | x | 0.63 | x | 0.7 | = | 277.03 | (76) |
| East | 0.9x | 2 | x | 1.98 | x | 110.22 | x | 0.63 | x | 0.7 | = | 133.39 | (76) |
| East | 0.9x | 1 | x | 7.83 | x | 110.22 | x | 0.63 | x | 0.7 | = | 263.75 | (76) |
| East | 0.9x | 2 | x | 1.98 | x | 94.68 | x | 0.63 | x | 0.7 | = | 114.58 | (76) |
| East | 0.9x | 1 | x | 7.83 | x | 94.68 | x | 0.63 | x | 0.7 | = | 226.55 | (76) |
| East | 0.9x | 2 | x | 1.98 | x | 73.59 | x | 0.63 | x | 0.7 | = | 89.06 | (76) |
| East | 0.9x | 1 | x | 7.83 | x | 73.59 | x | 0.63 | x | 0.7 | = | 176.1 | (76) |
| East | 0.9x | 2 | x | 1.98 | x | 45.59 | x | 0.63 | x | 0.7 | = | 55.17 | (76) |
| East | 0.9x | 1 | x | 7.83 | x | 45.59 | x | 0.63 | x | 0.7 | = | 109.09 | (76) |
| East | 0.9x | 2 | x | 1.98 | x | 24.49 | x | 0.63 | x | 0.7 | = | 29.64 | (76) |
| East | 0.9x | 1 | x | 7.83 | x | 24.49 | x | 0.63 | x | 0.7 | = | 58.6 | (76) |
| East | 0.9x | 2 | x | 1.98 | x | 16.15 | x | 0.63 | x | 0.7 | = | 19.55 | (76) |
| East | 0.9x | 1 | x | 7.83 | x | 16.15 | x | 0.63 | x | 0.7 | = | 38.65 | (76) |
| South | 0.9x | 0.54 | x | 3.93 | x | 46.75 | x | 0.63 | x | 0.7 | = | 78.76 | (78) |
| South | 0.9x | 0.54 | x | 1.98 | x | 46.75 | x | 0.63 | x | 0.7 | = | 39.68 | (78) |
| South | 0.9x | 0.54 | x | 3.93 | x | 76.57 | x | 0.63 | x | 0.7 | = | 128.99 | (78) |
| South | 0.9x | 0.54 | x | 1.98 | x | 76.57 | x | 0.63 | x | 0.7 | = | 64.99 | (78) |
| South | 0.9x | 0.54 | x | 3.93 | x | 97.53 | x | 0.63 | x | 0.7 | = | 164.31 | (78) |
| South | 0.9x | 0.54 | x | 1.98 | x | 97.53 | x | 0.63 | x | 0.7 | = | 82.78 | (78) |
| South | 0.9x | 0.54 | x | 3.93 | x | 110.23 | x | 0.63 | x | 0.7 | = | 185.7 | (78) |
| South | 0.9x | 0.54 | x | 1.98 | x | 110.23 | x | 0.63 | x | 0.7 | = | 93.56 | (78) |
| South | 0.9x | 0.54 | x | 3.93 | x | 114.87 | x | 0.63 | x | 0.7 | = | 193.51 | (78) |
| South | 0.9x | 0.54 | x | 1.98 | x | 114.87 | x | 0.63 | x | 0.7 | = | 97.49 | (78) |
| South | 0.9x | 0.54 | x | 3.93 | x | 110.55 | x | 0.63 | x | 0.7 | = | 186.23 | (78) |
| South | 0.9x | 0.54 | x | 1.98 | x | 110.55 | x | 0.63 | x | 0.7 | = | 93.83 | (78) |
| South | 0.9x | 0.54 | x | 3.93 | x | 108.01 | x | 0.63 | x | 0.7 | = | 181.96 | (78) |
| South | 0.9x | 0.54 | x | 1.98 | x | 108.01 | x | 0.63 | x | 0.7 | = | 91.67 | (78) |
| South | 0.9x | 0.54 | x | 3.93 | x | 104.89 | x | 0.63 | x | 0.7 | = | 176.71 | (78) |
| South | 0.9x | 0.54 | x | 1.98 | x | 104.89 | x | 0.63 | x | 0.7 | = | 89.03 | (78) |
| South | 0.9x | 0.54 | x | 3.93 | x | 101.89 | x | 0.63 | x | 0.7 | = | 171.64 | (78) |
| South | 0.9x | 0.54 | x | 1.98 | x | 101.89 | x | 0.63 | x | 0.7 | = | 86.47 | (78) |
| South | 0.9x | 0.54 | x | 3.93 | x | 82.59 | x | 0.63 | x | 0.7 | = | 139.12 | (78) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South | 0.9x | 0.54 | x | 1.98 | x | 82.59 | x | 0.63 | x | 0.7 | = | 70.09 | (78) |
| South | 0.9x | 0.54 | x | 3.93 | x | 55.42 | x | 0.63 | x | 0.7 | = | 93.36 | (78) |
| South | 0.9x | 0.54 | x | 1.98 | x | 55.42 | x | 0.63 | x | 0.7 | = | 47.03 | (78) |
| South | 0.9x | 0.54 | x | 3.93 | x | 40.4 | x | 0.63 | x | 0.7 | = | 68.05 | (78) |
| South | 0.9x | 0.54 | x | 1.98 | x | 40.4 | x | 0.63 | x | 0.7 | = | 34.29 | (78) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 189.21 | 332.41 | 475.07 | 611.76 | 698.5 | 697.2 | 670.77 | 606.87 | 523.27 | 373.48 | 228.63 | 160.54 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 612.93 | 753.97 | 881.8 | 993.83 | 1055.35 | 1029.83 | 988.15 | 931.18 | 860.61 | 735.72 | 618.75 | 571.72 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 0.99 | 0.98 | 0.93 | 0.82 | 0.65 | 0.48 | 0.53 | 0.78 | 0.96 | 0.99 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.75 | 19.96 | 20.25 | 20.59 | 20.84 | 20.96 | 20.99 | 20.99 | 20.91 | 20.56 | 20.08 | 19.71 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.93 | 19.93 | 19.93 | 19.94 | 19.94 | 19.95 | 19.95 | 19.95 | 19.95 | 19.94 | 19.94 | 19.94 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.97 | 0.91 | 0.77 | 0.55 | 0.37 | 0.41 | 0.69 | 0.94 | 0.99 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.27 | 18.57 | 18.99 | 19.47 | 19.79 | 19.93 | 19.95 | 19.95 | 19.88 | 19.45 | 18.76 | 18.22 | (90) |

fLA = Living area ÷ (4) = 0.3 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.72 | 18.99 | 19.37 | 19.81 | 20.11 | 20.24 | 20.27 | 20.27 | 20.19 | 19.78 | 19.16 | 18.67 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.72 | 18.99 | 19.37 | 19.81 | 20.11 | 20.24 | 20.27 | 20.27 | 20.19 | 19.78 | 19.16 | 18.67 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.99 | 0.99 | 0.96 | 0.9 | 0.78 | 0.58 | 0.4 | 0.45 | 0.71 | 0.93 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 609.64 | 743.32 | 849.23 | 896.19 | 818.18 | 597.64 | 398.76 | 417.97 | 614.77 | 687.54 | 611.32 | 569.48 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1620.73 | 1580.16 | 1440.46 | 1208.16 | 929.52 | 617.87 | 401.42 | 422.45 | 669.61 | 1014.93 | 1338.39 | 1612.62 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 752.25 | 562.36 | 439.87 | 224.62 | 82.84 | 0 | 0 | 0 | 0 | 243.58 | 523.49 | 776.09 | |

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 3605.1 (98)

Space heating requirement in kWh/m²/year 38.18 (99)

# TER WorkSheet: New dwelling design stage

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary system | | 0 | (201) |
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | 752.25 | 562.36 | 439.87 | 224.62 | 82.84 | 0 | 0 | 0 | 0 | 243.58 | 523.49 | 776.09 | | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 805.41 | 602.1 | 470.96 | 240.49 | 88.69 | 0 | 0 | 0 | 0 | 260.79 | 560.48 | 830.93 | | (211) |
| Total (kWh/year) =Sum(211)$_{1...5,10...12}$= | | | | | | | | | | | | | 3859.86 | (211) |
| Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) | | | | | | | | | | | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Total (kWh/year) =Sum(215)$_{1...5,10...12}$= | | | | | | | | | | | | | 0 | (215) |

**Water heating**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Output from water heater (calculated above) | 210.64 | 185.69 | 195 | 172.95 | 167.45 | 147.48 | 141.3 | 157.51 | 159.25 | 181.34 | 191.72 | 205.6 | | |
| Efficiency of water heater | | | | | | | | | | | | | 80.3 | (216) |
| (217)m= | 87.98 | 87.66 | 87.04 | 85.71 | 83.38 | 80.3 | 80.3 | 80.3 | 80.3 | 85.79 | 87.45 | 88.08 | | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m | | | | | | | | | | | | | | |
| (219)m= | 239.42 | 211.82 | 224.04 | 201.79 | 200.82 | 183.66 | 175.96 | 196.16 | 198.32 | 211.37 | 219.23 | 233.43 | | |
| Total = Sum(219a)$_{1...12}$ = | | | | | | | | | | | | | 2496.01 | (219) |

| **Annual totals** | | **kWh/year** | **kWh/year** | |
|---|---|---|---|---|
| Space heating fuel used, main system 1 | | | 3859.86 | |
| Water heating fuel used | | | 2496.01 | |
| Electricity for pumps, fans and electric keep-hot | | | | |
| central heating pump: | | 30 | | (230c) |
| boiler with a fan-assisted flue | | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | | 388.81 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 833.73 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 539.14 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1372.87 | (265) |

# TER WorkSheet: New dwelling design stage

| | | | | | |
|---|---|---|---|---|---|
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 201.79 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 1613.58 | (272) |

| | | |
|---|---|---|
| **TER =** | 17.09 | (273) |

# TER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: A6

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 92.1 | (1a) x | 2.55 | (2a) = | 234.85 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 92.1 | (4) | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 234.85 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 3 | x 10 = | 30 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 30 ÷ (5) = | 0.13 | (8) |
| *If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)* | | | |
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.38 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.32 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.41 | 0.4 | 0.39 | 0.35 | 0.35 | 0.31 | 0.31 | 0.3 | 0.32 | 0.35 | 0.36 | 0.38 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.58 | 0.58 | 0.58 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.55 | 0.56 | 0.57 | 0.57 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.58 | 0.58 | 0.58 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.55 | 0.56 | 0.57 | 0.57 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.29 | x1/[1/( 1.4 )+ 0.04] | = | 5.69 | | | (27) |
| Windows Type 2 | | | 2.08 | x1/[1/( 1.4 )+ 0.04] | = | 2.76 | | | (27) |
| Windows Type 3 | | | 4.09 | x1/[1/( 1.4 )+ 0.04] | = | 5.42 | | | (27) |
| Windows Type 4 | | | 2.05 | x1/[1/( 1.4 )+ 0.04] | = | 2.72 | | | (27) |
| Walls Type1 | 92.13 | 23.01 | 69.12 | x 0.18 | = | 12.44 | | | (29) |
| Walls Type2 | 21.51 | 0 | 21.51 | x 0.18 | = | 3.87 | | | (29) |
| Roof | 15.3 | 0 | 15.3 | x 0.13 | = | 1.99 | | | (30) |
| Total area of elements, m² | | | 128.94 | | | | | | (31) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 48.81 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 5575.5 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 15.73 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 64.54 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 45.25 | 44.99 | 44.75 | 43.58 | 43.37 | 42.36 | 42.36 | 42.17 | 42.75 | 43.37 | 43.81 | 44.27 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 109.79 | 109.54 | 109.29 | 108.13 | 107.91 | 106.9 | 106.9 | 106.71 | 107.29 | 107.91 | 108.35 | 108.81 | |

Average = Sum(39)$_{1…12}$ /12= 108.13 (39)

# TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.19 | 1.19 | 1.19 | 1.17 | 1.17 | 1.16 | 1.16 | 1.16 | 1.16 | 1.17 | 1.18 | 1.18 | |

Average = Sum(40)$_{1…12}$ /12= 1.17 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.65 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 97.22 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 106.94 | 103.05 | 99.16 | 95.27 | 91.38 | 87.5 | 87.5 | 91.38 | 95.27 | 99.16 | 103.05 | 106.94 | |

Total = Sum(44)$_{1…12}$ = 1166.62 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 158.59 | 138.7 | 143.13 | 124.78 | 119.73 | 103.32 | 95.74 | 109.86 | 111.18 | 129.57 | 141.43 | 153.58 | |

Total = Sum(45)$_{1…12}$ = 1529.62 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 23.79 | 20.81 | 21.47 | 18.72 | 17.96 | 15.5 | 14.36 | 16.48 | 16.68 | 19.43 | 21.21 | 23.04 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) — 0 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.96 | 46.03 | 50.53 | 46.98 | 46.57 | 43.15 | 44.59 | 46.57 | 46.98 | 50.53 | 49.32 | 50.96 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 209.55 | 184.73 | 193.66 | 171.77 | 166.3 | 146.47 | 140.33 | 156.43 | 158.16 | 180.1 | 190.75 | 204.54 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 209.55 | 184.73 | 193.66 | 171.77 | 166.3 | 146.47 | 140.33 | 156.43 | 158.16 | 180.1 | 190.75 | 204.54 | |

Output from water heater (annual)$_{1...12}$ 2102.78 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 65.47 | 57.63 | 60.22 | 53.24 | 51.45 | 45.14 | 42.98 | 48.17 | 48.71 | 55.71 | 59.35 | 63.81 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 132.67 | 132.67 | 132.67 | 132.67 | 132.67 | 132.67 | 132.67 | 132.67 | 132.67 | 132.67 | 132.67 | 132.67 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 21.65 | 19.23 | 15.64 | 11.84 | 8.85 | 7.47 | 8.07 | 10.5 | 14.09 | 17.89 | 20.88 | 22.26 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 242.89 | 245.41 | 239.06 | 225.54 | 208.47 | 192.43 | 181.71 | 179.19 | 185.54 | 199.06 | 216.13 | 232.17 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 36.27 | 36.27 | 36.27 | 36.27 | 36.27 | 36.27 | 36.27 | 36.27 | 36.27 | 36.27 | 36.27 | 36.27 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -106.14 | -106.14 | -106.14 | -106.14 | -106.14 | -106.14 | -106.14 | -106.14 | -106.14 | -106.14 | -106.14 | -106.14 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 88 | 85.75 | 80.95 | 73.94 | 69.16 | 62.7 | 57.77 | 64.75 | 67.66 | 74.88 | 82.44 | 85.76 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 418.34 | 416.19 | 401.44 | 377.12 | 352.28 | 328.4 | 313.35 | 320.23 | 333.08 | 357.63 | 385.24 | 405.99 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.09 | x | 19.64 | x | 0.63 | x | 0.7 | = | 24.55 | (76) |
| East | 0.9x | 2 | x | 2.05 | x | 19.64 | x | 0.63 | x | 0.7 | = | 24.61 | (76) |
| East | 0.9x | 1 | x | 4.09 | x | 38.42 | x | 0.63 | x | 0.7 | = | 48.02 | (76) |
| East | 0.9x | 2 | x | 2.05 | x | 38.42 | x | 0.63 | x | 0.7 | = | 48.14 | (76) |
| East | 0.9x | 1 | x | 4.09 | x | 63.27 | x | 0.63 | x | 0.7 | = | 79.09 | (76) |

# TER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 2 | x | 2.05 | x | 63.27 | x | 0.63 | x | 0.7 | = | 79.28 | (76) |
| East | 0.9x | 1 | x | 4.09 | x | 92.28 | x | 0.63 | x | 0.7 | = | 115.35 | (76) |
| East | 0.9x | 2 | x | 2.05 | x | 92.28 | x | 0.63 | x | 0.7 | = | 115.63 | (76) |
| East | 0.9x | 1 | x | 4.09 | x | 113.09 | x | 0.63 | x | 0.7 | = | 141.36 | (76) |
| East | 0.9x | 2 | x | 2.05 | x | 113.09 | x | 0.63 | x | 0.7 | = | 141.71 | (76) |
| East | 0.9x | 1 | x | 4.09 | x | 115.77 | x | 0.63 | x | 0.7 | = | 144.71 | (76) |
| East | 0.9x | 2 | x | 2.05 | x | 115.77 | x | 0.63 | x | 0.7 | = | 145.06 | (76) |
| East | 0.9x | 1 | x | 4.09 | x | 110.22 | x | 0.63 | x | 0.7 | = | 137.77 | (76) |
| East | 0.9x | 2 | x | 2.05 | x | 110.22 | x | 0.63 | x | 0.7 | = | 138.1 | (76) |
| East | 0.9x | 1 | x | 4.09 | x | 94.68 | x | 0.63 | x | 0.7 | = | 118.34 | (76) |
| East | 0.9x | 2 | x | 2.05 | x | 94.68 | x | 0.63 | x | 0.7 | = | 118.63 | (76) |
| East | 0.9x | 1 | x | 4.09 | x | 73.59 | x | 0.63 | x | 0.7 | = | 91.98 | (76) |
| East | 0.9x | 2 | x | 2.05 | x | 73.59 | x | 0.63 | x | 0.7 | = | 92.21 | (76) |
| East | 0.9x | 1 | x | 4.09 | x | 45.59 | x | 0.63 | x | 0.7 | = | 56.98 | (76) |
| East | 0.9x | 2 | x | 2.05 | x | 45.59 | x | 0.63 | x | 0.7 | = | 57.12 | (76) |
| East | 0.9x | 1 | x | 4.09 | x | 24.49 | x | 0.63 | x | 0.7 | = | 30.61 | (76) |
| East | 0.9x | 2 | x | 2.05 | x | 24.49 | x | 0.63 | x | 0.7 | = | 30.69 | (76) |
| East | 0.9x | 1 | x | 4.09 | x | 16.15 | x | 0.63 | x | 0.7 | = | 20.19 | (76) |
| East | 0.9x | 2 | x | 2.05 | x | 16.15 | x | 0.63 | x | 0.7 | = | 20.24 | (76) |
| West | 0.9x | 0.77 | x | 4.29 | x | 19.64 | x | 0.63 | x | 0.7 | = | 51.5 | (80) |
| West | 0.9x | 0.77 | x | 2.08 | x | 19.64 | x | 0.63 | x | 0.7 | = | 37.45 | (80) |
| West | 0.9x | 0.77 | x | 4.29 | x | 38.42 | x | 0.63 | x | 0.7 | = | 100.74 | (80) |
| West | 0.9x | 0.77 | x | 2.08 | x | 38.42 | x | 0.63 | x | 0.7 | = | 73.27 | (80) |
| West | 0.9x | 0.77 | x | 4.29 | x | 63.27 | x | 0.63 | x | 0.7 | = | 165.91 | (80) |
| West | 0.9x | 0.77 | x | 2.08 | x | 63.27 | x | 0.63 | x | 0.7 | = | 120.66 | (80) |
| West | 0.9x | 0.77 | x | 4.29 | x | 92.28 | x | 0.63 | x | 0.7 | = | 241.97 | (80) |
| West | 0.9x | 0.77 | x | 2.08 | x | 92.28 | x | 0.63 | x | 0.7 | = | 175.98 | (80) |
| West | 0.9x | 0.77 | x | 4.29 | x | 113.09 | x | 0.63 | x | 0.7 | = | 296.55 | (80) |
| West | 0.9x | 0.77 | x | 2.08 | x | 113.09 | x | 0.63 | x | 0.7 | = | 215.67 | (80) |
| West | 0.9x | 0.77 | x | 4.29 | x | 115.77 | x | 0.63 | x | 0.7 | = | 303.57 | (80) |
| West | 0.9x | 0.77 | x | 2.08 | x | 115.77 | x | 0.63 | x | 0.7 | = | 220.78 | (80) |
| West | 0.9x | 0.77 | x | 4.29 | x | 110.22 | x | 0.63 | x | 0.7 | = | 289.01 | (80) |
| West | 0.9x | 0.77 | x | 2.08 | x | 110.22 | x | 0.63 | x | 0.7 | = | 210.19 | (80) |
| West | 0.9x | 0.77 | x | 4.29 | x | 94.68 | x | 0.63 | x | 0.7 | = | 248.26 | (80) |
| West | 0.9x | 0.77 | x | 2.08 | x | 94.68 | x | 0.63 | x | 0.7 | = | 180.55 | (80) |
| West | 0.9x | 0.77 | x | 4.29 | x | 73.59 | x | 0.63 | x | 0.7 | = | 192.96 | (80) |
| West | 0.9x | 0.77 | x | 2.08 | x | 73.59 | x | 0.63 | x | 0.7 | = | 140.34 | (80) |
| West | 0.9x | 0.77 | x | 4.29 | x | 45.59 | x | 0.63 | x | 0.7 | = | 119.54 | (80) |
| West | 0.9x | 0.77 | x | 2.08 | x | 45.59 | x | 0.63 | x | 0.7 | = | 86.94 | (80) |
| West | 0.9x | 0.77 | x | 4.29 | x | 24.49 | x | 0.63 | x | 0.7 | = | 64.21 | (80) |
| West | 0.9x | 0.77 | x | 2.08 | x | 24.49 | x | 0.63 | x | 0.7 | = | 46.7 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 4.29 | x | 16.15 | x | 0.63 | x | 0.7 | = | 42.35 | (80) |
| West | 0.9x | 0.77 | x | 2.08 | x | 16.15 | x | 0.63 | x | 0.7 | = | 30.8 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 138.11 | 270.18 | 444.95 | 648.93 | 795.29 | 814.12 | 775.07 | 665.78 | 517.49 | 320.59 | 172.21 | 113.58 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 556.45 | 686.37 | 846.39 | 1026.05 | 1147.56 | 1142.51 | 1088.43 | 986.01 | 850.58 | 678.22 | 557.46 | 519.57 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 0.99 | 0.98 | 0.92 | 0.77 | 0.58 | 0.43 | 0.49 | 0.77 | 0.97 | 1 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.71 | 19.91 | 20.23 | 20.62 | 20.88 | 20.98 | 21 | 20.99 | 20.91 | 20.53 | 20.03 | 19.67 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.93 | 19.93 | 19.93 | 19.94 | 19.94 | 19.95 | 19.95 | 19.95 | 19.95 | 19.94 | 19.94 | 19.93 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.97 | 0.89 | 0.71 | 0.49 | 0.33 | 0.38 | 0.69 | 0.95 | 0.99 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.21 | 18.5 | 18.97 | 19.52 | 19.83 | 19.94 | 19.95 | 19.95 | 19.88 | 19.4 | 18.69 | 18.16 | (90) |

fLA = Living area ÷ (4) = 0.33 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.7 | 18.96 | 19.39 | 19.88 | 20.18 | 20.28 | 20.29 | 20.29 | 20.22 | 19.77 | 19.14 | 18.66 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.7 | 18.96 | 19.39 | 19.88 | 20.18 | 20.28 | 20.29 | 20.29 | 20.22 | 19.77 | 19.14 | 18.66 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.97 | 0.89 | 0.73 | 0.52 | 0.36 | 0.42 | 0.71 | 0.95 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 554.25 | 679.02 | 817.1 | 909.39 | 833.35 | 594.76 | 393.33 | 412.24 | 604.29 | 641.48 | 552.61 | 518.07 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1580.95 | 1540.14 | 1408.39 | 1187.68 | 914.96 | 607.19 | 394.93 | 415.46 | 656.89 | 989.64 | 1304.06 | 1573.34 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 763.87 | 578.68 | 439.92 | 200.37 | 60.72 | 0 | 0 | 0 | 0 | 259.03 | 541.04 | 785.12 | |

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 3628.74 (98)

Space heating requirement in kWh/m²/year 39.4 (99)

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

Fraction of space heat from secondary/supplementary system 0 (201)

| | | | |
|---|---|---|---|
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | 763.87 | 578.68 | 439.92 | 200.37 | 60.72 | 0 | 0 | 0 | 0 | 259.03 | 541.04 | 785.12 | | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 817.84 | 619.57 | 471 | 214.53 | 65.01 | 0 | 0 | 0 | 0 | 277.33 | 579.27 | 840.6 | | (211) |
| Total (kWh/year) =Sum(211)$_{1...5,10....12}$= | | | | | | | | | | | | | 3885.16 | (211) |
| Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) | | | | | | | | | | | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Total (kWh/year) =Sum(215)$_{1...5,10....12}$= | | | | | | | | | | | | | 0 | (215) |

**Water heating**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Output from water heater (calculated above) | 209.55 | 184.73 | 193.66 | 171.77 | 166.3 | 146.47 | 140.33 | 156.43 | 158.16 | 180.1 | 190.75 | 204.54 | | |
| Efficiency of water heater | | | | | | | | | | | | | 80.3 | (216) |
| (217)m= | 88.02 | 87.73 | 87.05 | 85.44 | 82.77 | 80.3 | 80.3 | 80.3 | 80.3 | 85.97 | 87.53 | 88.11 | | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m | | | | | | | | | | | | | | |
| (219)m= | 238.08 | 210.57 | 222.46 | 201.04 | 200.91 | 182.4 | 174.75 | 194.81 | 196.96 | 209.5 | 217.92 | 232.15 | | |
| Total = Sum(219a)$_{1...12}$ = | | | | | | | | | | | | | 2481.55 | (219) |

| **Annual totals** | | **kWh/year** | **kWh/year** | |
|---|---|---|---|---|
| Space heating fuel used, main system 1 | | | 3885.16 | |
| Water heating fuel used | | | 2481.55 | |
| Electricity for pumps, fans and electric keep-hot | | | | |
| central heating pump: | | 30 | | (230c) |
| boiler with a fan-assisted flue | | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | | 382.41 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 839.19 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 536.01 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1375.21 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 198.47 | (268) |

# TER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| Total $CO_2$, kg/year | sum of (265)…(271) = | 1612.61 | (272) |
| **TER =** | | 17.51 | (273) |

# TER WorkSheet: New dwelling design stage

**User Details:**

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

**Property Address: A7**

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 77.46 | (1a) x | 2.55 | (2a) = | 197.52 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 77.46 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 197.52 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 3 | x 10 = | 30 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | | |
|---|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = | (6a)+(6b)+(7a)+(7b)+(7c) = | 30 | ÷ (5) = | 0.15 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.4 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.34 | (21) |

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

Wind Factor (22a)m = (22)m ÷ 4

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.44 | 0.43 | 0.42 | 0.38 | 0.37 | 0.32 | 0.32 | 0.32 | 0.34 | 0.37 | 0.38 | 0.4 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.59 | 0.59 | 0.59 | 0.57 | 0.57 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.57 | 0.58 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.59 | 0.59 | 0.59 | 0.57 | 0.57 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.57 | 0.58 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 8.96 | x1/[1/( 1.4 )+ 0.04] = | 11.88 | | | (27) |
| Windows Type 2 | | | 4.5 | x1/[1/( 1.4 )+ 0.04] = | 5.97 | | | (27) |
| Windows Type 3 | | | 2.26 | x1/[1/( 1.4 )+ 0.04] = | 3 | | | (27) |
| Walls Type1 | 83.91 | 17.98 | 65.93 | x 0.18 = | 11.87 | | | (29) |
| Walls Type2 | 14.15 | 0 | 14.15 | x 0.18 = | 2.55 | | | (29) |
| Roof | 77.46 | 0 | 77.46 | x 0.13 = | 10.07 | | | (30) |
| Total area of elements, m² | | | 175.52 | | | | | (31) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 48.32 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 5501.94 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 24.16 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 72.49 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 38.77 | 38.53 | 38.3 | 37.19 | 36.99 | 36.02 | 36.02 | 35.85 | 36.39 | 36.99 | 37.4 | 37.84 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 111.26 | 111.02 | 110.78 | 109.68 | 109.47 | 108.51 | 108.51 | 108.33 | 108.88 | 109.47 | 109.89 | 110.33 | |

Average = Sum(39)$_{1…12}$ /12= 109.68 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.44 | 1.43 | 1.43 | 1.42 | 1.41 | 1.4 | 1.4 | 1.4 | 1.41 | 1.41 | 1.42 | 1.42 |

Average = Sum(40)1…12 /12= 1.42 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.41 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 91.51 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 100.66 | 97 | 93.34 | 89.68 | 86.02 | 82.36 | 82.36 | 86.02 | 89.68 | 93.34 | 97 | 100.66 |

Total = Sum(44)1…12 = 1098.08 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 149.27 | 130.55 | 134.72 | 117.45 | 112.7 | 97.25 | 90.12 | 103.41 | 104.64 | 121.95 | 133.12 | 144.56 |

Total = Sum(45)1…12 = 1439.75 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 22.39 | 19.58 | 20.21 | 17.62 | 16.9 | 14.59 | 13.52 | 15.51 | 15.7 | 18.29 | 19.97 | 21.68 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.96 | 44.65 | 47.56 | 44.22 | 43.83 | 40.61 | 41.97 | 43.83 | 44.22 | 47.56 | 47.83 | 50.96 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 200.23 | 175.2 | 182.28 | 161.68 | 156.53 | 137.86 | 132.08 | 147.24 | 148.87 | 169.52 | 180.96 | 195.52 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 200.23 | 175.2 | 182.28 | 161.68 | 156.53 | 137.86 | 132.08 | 147.24 | 148.87 | 169.52 | 180.96 | 195.52 |

Output from water heater (annual)$_{1...12}$ 1987.97 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 62.37 | 54.57 | 56.69 | 50.11 | 48.43 | 42.49 | 40.46 | 45.34 | 45.85 | 52.44 | 56.22 | 60.81 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 120.64 | 120.64 | 120.64 | 120.64 | 120.64 | 120.64 | 120.64 | 120.64 | 120.64 | 120.64 | 120.64 | 120.64 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 19.14 | 17 | 13.82 | 10.47 | 7.82 | 6.6 | 7.14 | 9.28 | 12.45 | 15.81 | 18.45 | 19.67 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 214.05 | 216.27 | 210.67 | 198.76 | 183.72 | 169.58 | 160.13 | 157.91 | 163.51 | 175.43 | 190.47 | 204.61 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 35.06 | 35.06 | 35.06 | 35.06 | 35.06 | 35.06 | 35.06 | 35.06 | 35.06 | 35.06 | 35.06 | 35.06 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -96.52 | -96.52 | -96.52 | -96.52 | -96.52 | -96.52 | -96.52 | -96.52 | -96.52 | -96.52 | -96.52 | -96.52 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 83.83 | 81.21 | 76.19 | 69.6 | 65.09 | 59.01 | 54.38 | 60.94 | 63.68 | 70.48 | 78.09 | 81.73 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 379.21 | 376.67 | 362.88 | 341.01 | 318.83 | 297.39 | 283.84 | 290.33 | 301.84 | 323.91 | 349.2 | 368.2 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South | 0.9x | 0.54 | x | 4.5 | x | 46.75 | x | 0.63 | x | 0.7 | = | 45.09 | (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 46.75 | x | 0.63 | x | 0.7 | = | 45.29 | (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 76.57 | x | 0.63 | x | 0.7 | = | 73.85 | (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 76.57 | x | 0.63 | x | 0.7 | = | 74.18 | (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 97.53 | x | 0.63 | x | 0.7 | = | 94.07 | (78) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South | 0.9x | 0.54 | x | 2.26 | x | 97.53 | x | 0.63 | x | 0.7 | = | 94.49 (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 110.23 | x | 0.63 | x | 0.7 | = | 106.32 (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 110.23 | x | 0.63 | x | 0.7 | = | 106.79 (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 114.87 | x | 0.63 | x | 0.7 | = | 110.79 (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 114.87 | x | 0.63 | x | 0.7 | = | 111.28 (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 110.55 | x | 0.63 | x | 0.7 | = | 106.62 (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 110.55 | x | 0.63 | x | 0.7 | = | 107.09 (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 108.01 | x | 0.63 | x | 0.7 | = | 104.17 (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 108.01 | x | 0.63 | x | 0.7 | = | 104.64 (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 104.89 | x | 0.63 | x | 0.7 | = | 101.17 (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 104.89 | x | 0.63 | x | 0.7 | = | 101.62 (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 101.89 | x | 0.63 | x | 0.7 | = | 98.27 (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 101.89 | x | 0.63 | x | 0.7 | = | 98.7 (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 82.59 | x | 0.63 | x | 0.7 | = | 79.65 (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 82.59 | x | 0.63 | x | 0.7 | = | 80.01 (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 55.42 | x | 0.63 | x | 0.7 | = | 53.45 (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 55.42 | x | 0.63 | x | 0.7 | = | 53.69 (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 40.4 | x | 0.63 | x | 0.7 | = | 38.96 (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 40.4 | x | 0.63 | x | 0.7 | = | 39.14 (78) |
| West | 0.9x | 0.77 | x | 8.96 | x | 19.64 | x | 0.63 | x | 0.7 | = | 53.78 (80) |
| West | 0.9x | 0.77 | x | 8.96 | x | 38.42 | x | 0.63 | x | 0.7 | = | 105.21 (80) |
| West | 0.9x | 0.77 | x | 8.96 | x | 63.27 | x | 0.63 | x | 0.7 | = | 173.26 (80) |
| West | 0.9x | 0.77 | x | 8.96 | x | 92.28 | x | 0.63 | x | 0.7 | = | 252.69 (80) |
| West | 0.9x | 0.77 | x | 8.96 | x | 113.09 | x | 0.63 | x | 0.7 | = | 309.68 (80) |
| West | 0.9x | 0.77 | x | 8.96 | x | 115.77 | x | 0.63 | x | 0.7 | = | 317.01 (80) |
| West | 0.9x | 0.77 | x | 8.96 | x | 110.22 | x | 0.63 | x | 0.7 | = | 301.81 (80) |
| West | 0.9x | 0.77 | x | 8.96 | x | 94.68 | x | 0.63 | x | 0.7 | = | 259.25 (80) |
| West | 0.9x | 0.77 | x | 8.96 | x | 73.59 | x | 0.63 | x | 0.7 | = | 201.51 (80) |
| West | 0.9x | 0.77 | x | 8.96 | x | 45.59 | x | 0.63 | x | 0.7 | = | 124.84 (80) |
| West | 0.9x | 0.77 | x | 8.96 | x | 24.49 | x | 0.63 | x | 0.7 | = | 67.06 (80) |
| West | 0.9x | 0.77 | x | 8.96 | x | 16.15 | x | 0.63 | x | 0.7 | = | 44.23 (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 144.16 | 253.23 | 361.81 | 465.8 | 531.75 | 530.73 | 510.62 | 462.03 | 398.48 | 284.49 | 174.19 | 122.33 (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 523.38 | 629.9 | 724.7 | 806.81 | 850.58 | 828.12 | 794.46 | 752.36 | 700.31 | 608.41 | 523.39 | 490.52 (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 0.99 | 0.98 | 0.95 | 0.88 | 0.73 | 0.57 | 0.62 | 0.84 | 0.97 | 0.99 | 1 (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.46 | 19.66 | 19.97 | 20.35 | 20.68 | 20.9 | 20.97 | 20.96 | 20.81 | 20.36 | 19.84 | 19.42 (87) |

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.74 | 19.74 | 19.74 | 19.75 | 19.75 | 19.76 | 19.76 | 19.76 | 19.76 | 19.75 | 19.75 | 19.74 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.97 | 0.93 | 0.82 | 0.63 | 0.43 | 0.47 | 0.76 | 0.95 | 0.99 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.72 | 18.01 | 18.45 | 19.01 | 19.45 | 19.7 | 19.75 | 19.75 | 19.61 | 19.03 | 18.27 | 17.67 | (90) |

fLA = Living area ÷ (4) = 0.35 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.33 | 18.59 | 18.99 | 19.48 | 19.89 | 20.12 | 20.19 | 20.18 | 20.04 | 19.5 | 18.83 | 18.29 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.33 | 18.59 | 18.99 | 19.48 | 19.89 | 20.12 | 20.19 | 20.18 | 20.04 | 19.5 | 18.83 | 18.29 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.99 | 0.99 | 0.97 | 0.92 | 0.83 | 0.66 | 0.48 | 0.53 | 0.78 | 0.95 | 0.99 | 0.99 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 519.92 | 620.93 | 701.64 | 745.75 | 706.79 | 549.11 | 379.66 | 395.32 | 544.27 | 575.18 | 516.66 | 488.02 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1561.36 | 1520.19 | 1383.67 | 1160.62 | 896.06 | 599.28 | 389.06 | 409.42 | 646.29 | 974.83 | 1288.59 | 1554.7 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 774.83 | 604.3 | 507.43 | 298.7 | 140.82 | 0 | 0 | 0 | 0 | 297.35 | 555.79 | 793.6 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3972.83 (98)

Space heating requirement in kWh/m²/year 51.29 (99)

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary system | | 0 | (201) |
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | | | | | | | | | | | | | |
| | 774.83 | 604.3 | 507.43 | 298.7 | 140.82 | 0 | 0 | 0 | 0 | 297.35 | 555.79 | 793.6 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | (211) |
| | 829.58 | 647 | 543.29 | 319.81 | 150.77 | 0 | 0 | 0 | 0 | 318.36 | 595.07 | 849.68 | |

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 4253.57 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

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## Water heating

Output from water heater (calculated above)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 200.23 | 175.2 | 182.28 | 161.68 | 156.53 | 137.86 | 132.08 | 147.24 | 148.87 | 169.52 | 180.96 | 195.52 |

Efficiency of water heater 80.3 (216)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 88.12 | 87.91 | 87.49 | 86.58 | 84.79 | 80.3 | 80.3 | 80.3 | 80.3 | 86.45 | 87.69 | 88.21 | (217) |

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 227.21 | 199.28 | 208.34 | 186.74 | 184.62 | 171.69 | 164.49 | 183.37 | 185.39 | 196.08 | 206.36 | 221.66 |

Total = Sum(219a)$_{1...12}$ = 2335.23 (219)

| Annual totals | kWh/year | kWh/year | |
|---|---|---|---|
| Space heating fuel used, main system 1 | | 4253.57 | |
| Water heating fuel used | | 2335.23 | |
| Electricity for pumps, fans and electric keep-hot | | | |
| central heating pump: | 30 | | (230c) |
| boiler with a fan-assisted flue | 45 | | (230e) |
| Total electricity for the above, kWh/year — sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | 337.97 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | | Emissions kg CO2/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 918.77 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 504.41 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1423.18 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 175.41 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 1637.51 | (272) |

**TER =** 21.14 (273)

# TER WorkSheet: New dwelling design stage

**User Details:**

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

**Property Address: A8**

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 71.04 | (1a) x | 2.55 | (2a) = | 181.15 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 71.04 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 181.15 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 3 | x 10 = | 30 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 30 | ÷ (5) = | 0.17 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.42 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.35 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.45 | 0.44 | 0.43 | 0.39 | 0.38 | 0.34 | 0.34 | 0.33 | 0.35 | 0.38 | 0.4 | 0.42 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.6 | 0.6 | 0.59 | 0.58 | 0.57 | 0.56 | 0.56 | 0.55 | 0.56 | 0.57 | 0.58 | 0.59 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.6 | 0.6 | 0.59 | 0.58 | 0.57 | 0.56 | 0.56 | 0.55 | 0.56 | 0.57 | 0.58 | 0.59 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 3.31 | x1/[1/( 1.4 )+ 0.04] = | 4.39 | | | (27) |
| Windows Type 2 | | | 1.61 | x1/[1/( 1.4 )+ 0.04] = | 2.13 | | | (27) |
| Windows Type 3 | | | 3.21 | x1/[1/( 1.4 )+ 0.04] = | 4.26 | | | (27) |
| Windows Type 4 | | | 1.59 | x1/[1/( 1.4 )+ 0.04] = | 2.11 | | | (27) |
| Windows Type 5 | | | 3.16 | x1/[1/( 1.4 )+ 0.04] = | 4.19 | | | (27) |
| Walls Type1 | 85.46 | 17.78 | 67.68 | x 0.18 = | 12.18 | | | (29) |
| Walls Type2 | 22.99 | 0 | 22.99 | x 0.18 = | 4.14 | | | (29) |
| Roof | 71.04 | 0 | 71.04 | x 0.13 = | 9.24 | | | (30) |
| Total area of elements, m² | | | 179.49 | | | | | (31) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 49.13 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 6079.56 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 25.57 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 74.7 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 35.95 | 35.72 | 35.49 | 34.4 | 34.2 | 33.26 | 33.26 | 33.08 | 33.62 | 34.2 | 34.61 | 35.04 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 110.65 | 110.42 | 110.19 | 109.1 | 108.9 | 107.96 | 107.96 | 107.78 | 108.32 | 108.9 | 109.31 | 109.74 |

Average = Sum(39)$_{1…12}$ /12= 109.1 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.56 | 1.55 | 1.55 | 1.54 | 1.53 | 1.52 | 1.52 | 1.52 | 1.52 | 1.53 | 1.54 | 1.54 |

Average = Sum(40)$_{1…12}$ /12= 1.54 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.27 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 88.14 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 96.95 | 93.43 | 89.9 | 86.38 | 82.85 | 79.32 | 79.32 | 82.85 | 86.38 | 89.9 | 93.43 | 96.95 |

Total = Sum(44)$_{1…12}$ = 1057.67 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 143.78 | 125.75 | 129.76 | 113.13 | 108.55 | 93.67 | 86.8 | 99.6 | 100.79 | 117.47 | 128.22 | 139.24 |

Total = Sum(45)$_{1…12}$ = 1386.77 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 21.57 | 18.86 | 19.46 | 16.97 | 16.28 | 14.05 | 13.02 | 14.94 | 15.12 | 17.62 | 19.23 | 20.89 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 49.41 | 43 | 45.81 | 42.6 | 42.22 | 39.12 | 40.42 | 42.22 | 42.6 | 45.81 | 46.07 | 49.41 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 193.18 | 168.75 | 175.57 | 155.73 | 150.77 | 132.79 | 127.22 | 141.82 | 143.39 | 163.28 | 174.3 | 188.65 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 193.18 | 168.75 | 175.57 | 155.73 | 150.77 | 132.79 | 127.22 | 141.82 | 143.39 | 163.28 | 174.3 | 188.65 | |

Output from water heater (annual)$_{1...12}$ | 1915.45 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 60.16 | 52.56 | 54.6 | 48.26 | 46.65 | 40.93 | 38.97 | 43.67 | 44.16 | 50.51 | 54.15 | 58.65 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 113.56 | 113.56 | 113.56 | 113.56 | 113.56 | 113.56 | 113.56 | 113.56 | 113.56 | 113.56 | 113.56 | 113.56 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| (67)m= | 17.8 | 15.81 | 12.86 | 9.74 | 7.28 | 6.14 | 6.64 | 8.63 | 11.58 | 14.71 | 17.17 | 18.3 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| (68)m= | 199.71 | 201.78 | 196.56 | 185.44 | 171.41 | 158.22 | 149.41 | 147.34 | 152.56 | 163.68 | 177.71 | 190.9 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| (69)m= | 34.36 | 34.36 | 34.36 | 34.36 | 34.36 | 34.36 | 34.36 | 34.36 | 34.36 | 34.36 | 34.36 | 34.36 | (69) |
| Pumps and fans gains (Table 5a) | | | | | | | | | | | | | |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| (71)m= | -90.84 | -90.84 | -90.84 | -90.84 | -90.84 | -90.84 | -90.84 | -90.84 | -90.84 | -90.84 | -90.84 | -90.84 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| (72)m= | 80.86 | 78.22 | 73.39 | 67.03 | 62.7 | 56.84 | 52.37 | 58.7 | 61.34 | 67.89 | 75.21 | 78.83 | (72) |
| **Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m | | | | | | | | | | | | | |
| (73)m= | 358.44 | 355.88 | 342.88 | 322.28 | 301.45 | 281.27 | 268.49 | 274.73 | 285.55 | 306.34 | 330.15 | 348.1 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 2 | x | 1.59 | x | 19.64 | x | 0.63 | x | 0.7 | = | 19.09 | (76) |
| East | 0.9x | 1 | x | 3.16 | x | 19.64 | x | 0.63 | x | 0.7 | = | 18.97 | (76) |
| East | 0.9x | 2 | x | 1.59 | x | 38.42 | x | 0.63 | x | 0.7 | = | 37.34 | (76) |
| East | 0.9x | 1 | x | 3.16 | x | 38.42 | x | 0.63 | x | 0.7 | = | 37.1 | (76) |
| East | 0.9x | 2 | x | 1.59 | x | 63.27 | x | 0.63 | x | 0.7 | = | 61.49 | (76) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 3.16 | x | 63.27 | x | 0.63 | x | 0.7 | = | 61.11 | (76) |
| East | 0.9x | 2 | x | 1.59 | x | 92.28 | x | 0.63 | x | 0.7 | = | 89.68 | (76) |
| East | 0.9x | 1 | x | 3.16 | x | 92.28 | x | 0.63 | x | 0.7 | = | 89.12 | (76) |
| East | 0.9x | 2 | x | 1.59 | x | 113.09 | x | 0.63 | x | 0.7 | = | 109.91 | (76) |
| East | 0.9x | 1 | x | 3.16 | x | 113.09 | x | 0.63 | x | 0.7 | = | 109.22 | (76) |
| East | 0.9x | 2 | x | 1.59 | x | 115.77 | x | 0.63 | x | 0.7 | = | 112.51 | (76) |
| East | 0.9x | 1 | x | 3.16 | x | 115.77 | x | 0.63 | x | 0.7 | = | 111.8 | (76) |
| East | 0.9x | 2 | x | 1.59 | x | 110.22 | x | 0.63 | x | 0.7 | = | 107.12 | (76) |
| East | 0.9x | 1 | x | 3.16 | x | 110.22 | x | 0.63 | x | 0.7 | = | 106.44 | (76) |
| East | 0.9x | 2 | x | 1.59 | x | 94.68 | x | 0.63 | x | 0.7 | = | 92.01 | (76) |
| East | 0.9x | 1 | x | 3.16 | x | 94.68 | x | 0.63 | x | 0.7 | = | 91.43 | (76) |
| East | 0.9x | 2 | x | 1.59 | x | 73.59 | x | 0.63 | x | 0.7 | = | 71.52 | (76) |
| East | 0.9x | 1 | x | 3.16 | x | 73.59 | x | 0.63 | x | 0.7 | = | 71.07 | (76) |
| East | 0.9x | 2 | x | 1.59 | x | 45.59 | x | 0.63 | x | 0.7 | = | 44.31 | (76) |
| East | 0.9x | 1 | x | 3.16 | x | 45.59 | x | 0.63 | x | 0.7 | = | 44.03 | (76) |
| East | 0.9x | 2 | x | 1.59 | x | 24.49 | x | 0.63 | x | 0.7 | = | 23.8 | (76) |
| East | 0.9x | 1 | x | 3.16 | x | 24.49 | x | 0.63 | x | 0.7 | = | 23.65 | (76) |
| East | 0.9x | 2 | x | 1.59 | x | 16.15 | x | 0.63 | x | 0.7 | = | 15.7 | (76) |
| East | 0.9x | 1 | x | 3.16 | x | 16.15 | x | 0.63 | x | 0.7 | = | 15.6 | (76) |
| West | 0.9x | 0.77 | x | 3.31 | x | 19.64 | x | 0.63 | x | 0.7 | = | 39.74 | (80) |
| West | 0.9x | 0.77 | x | 1.61 | x | 19.64 | x | 0.63 | x | 0.7 | = | 9.66 | (80) |
| West | 0.9x | 0.77 | x | 3.21 | x | 19.64 | x | 0.63 | x | 0.7 | = | 19.27 | (80) |
| West | 0.9x | 0.77 | x | 3.31 | x | 38.42 | x | 0.63 | x | 0.7 | = | 77.73 | (80) |
| West | 0.9x | 0.77 | x | 1.61 | x | 38.42 | x | 0.63 | x | 0.7 | = | 18.9 | (80) |
| West | 0.9x | 0.77 | x | 3.21 | x | 38.42 | x | 0.63 | x | 0.7 | = | 37.69 | (80) |
| West | 0.9x | 0.77 | x | 3.31 | x | 63.27 | x | 0.63 | x | 0.7 | = | 128.01 | (80) |
| West | 0.9x | 0.77 | x | 1.61 | x | 63.27 | x | 0.63 | x | 0.7 | = | 31.13 | (80) |
| West | 0.9x | 0.77 | x | 3.21 | x | 63.27 | x | 0.63 | x | 0.7 | = | 62.07 | (80) |
| West | 0.9x | 0.77 | x | 3.31 | x | 92.28 | x | 0.63 | x | 0.7 | = | 186.7 | (80) |
| West | 0.9x | 0.77 | x | 1.61 | x | 92.28 | x | 0.63 | x | 0.7 | = | 45.41 | (80) |
| West | 0.9x | 0.77 | x | 3.21 | x | 92.28 | x | 0.63 | x | 0.7 | = | 90.53 | (80) |
| West | 0.9x | 0.77 | x | 3.31 | x | 113.09 | x | 0.63 | x | 0.7 | = | 228.8 | (80) |
| West | 0.9x | 0.77 | x | 1.61 | x | 113.09 | x | 0.63 | x | 0.7 | = | 55.65 | (80) |
| West | 0.9x | 0.77 | x | 3.21 | x | 113.09 | x | 0.63 | x | 0.7 | = | 110.95 | (80) |
| West | 0.9x | 0.77 | x | 3.31 | x | 115.77 | x | 0.63 | x | 0.7 | = | 234.22 | (80) |
| West | 0.9x | 0.77 | x | 1.61 | x | 115.77 | x | 0.63 | x | 0.7 | = | 56.96 | (80) |
| West | 0.9x | 0.77 | x | 3.21 | x | 115.77 | x | 0.63 | x | 0.7 | = | 113.57 | (80) |
| West | 0.9x | 0.77 | x | 3.31 | x | 110.22 | x | 0.63 | x | 0.7 | = | 222.99 | (80) |
| West | 0.9x | 0.77 | x | 1.61 | x | 110.22 | x | 0.63 | x | 0.7 | = | 54.23 | (80) |
| West | 0.9x | 0.77 | x | 3.21 | x | 110.22 | x | 0.63 | x | 0.7 | = | 108.13 | (80) |
| West | 0.9x | 0.77 | x | 3.31 | x | 94.68 | x | 0.63 | x | 0.7 | = | 191.54 | (80) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 1.61 | x | 94.68 | x | 0.63 | x | 0.7 | = | 46.58 | (80) |
| West | 0.9x | 0.77 | x | 3.21 | x | 94.68 | x | 0.63 | x | 0.7 | = | 92.88 | (80) |
| West | 0.9x | 0.77 | x | 3.31 | x | 73.59 | x | 0.63 | x | 0.7 | = | 148.88 | (80) |
| West | 0.9x | 0.77 | x | 1.61 | x | 73.59 | x | 0.63 | x | 0.7 | = | 36.21 | (80) |
| West | 0.9x | 0.77 | x | 3.21 | x | 73.59 | x | 0.63 | x | 0.7 | = | 72.19 | (80) |
| West | 0.9x | 0.77 | x | 3.31 | x | 45.59 | x | 0.63 | x | 0.7 | = | 92.23 | (80) |
| West | 0.9x | 0.77 | x | 1.61 | x | 45.59 | x | 0.63 | x | 0.7 | = | 22.43 | (80) |
| West | 0.9x | 0.77 | x | 3.21 | x | 45.59 | x | 0.63 | x | 0.7 | = | 44.72 | (80) |
| West | 0.9x | 0.77 | x | 3.31 | x | 24.49 | x | 0.63 | x | 0.7 | = | 49.55 | (80) |
| West | 0.9x | 0.77 | x | 1.61 | x | 24.49 | x | 0.63 | x | 0.7 | = | 12.05 | (80) |
| West | 0.9x | 0.77 | x | 3.21 | x | 24.49 | x | 0.63 | x | 0.7 | = | 24.02 | (80) |
| West | 0.9x | 0.77 | x | 3.31 | x | 16.15 | x | 0.63 | x | 0.7 | = | 32.68 | (80) |
| West | 0.9x | 0.77 | x | 1.61 | x | 16.15 | x | 0.63 | x | 0.7 | = | 7.95 | (80) |
| West | 0.9x | 0.77 | x | 3.21 | x | 16.15 | x | 0.63 | x | 0.7 | = | 15.84 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 106.72 | 208.77 | 343.81 | 501.43 | 614.52 | 629.07 | 598.9 | 514.45 | 399.87 | 247.72 | 133.07 | 87.76 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 465.16 | 564.65 | 686.69 | 823.71 | 915.98 | 910.35 | 867.39 | 789.18 | 685.41 | 554.06 | 463.22 | 435.86 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 0.99 | 0.98 | 0.94 | 0.84 | 0.68 | 0.52 | 0.59 | 0.83 | 0.97 | 0.99 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.3 | 19.5 | 19.86 | 20.32 | 20.7 | 20.91 | 20.98 | 20.96 | 20.78 | 20.26 | 19.69 | 19.26 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.64 | 19.65 | 19.65 | 19.66 | 19.66 | 19.67 | 19.67 | 19.67 | 19.67 | 19.66 | 19.66 | 19.65 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.97 | 0.91 | 0.78 | 0.57 | 0.38 | 0.44 | 0.75 | 0.95 | 0.99 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.42 | 17.72 | 18.24 | 18.9 | 19.38 | 19.62 | 19.67 | 19.66 | 19.5 | 18.83 | 18.01 | 17.38 | (90) |

fLA = Living area ÷ (4) = 0.39 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.15 | 18.41 | 18.87 | 19.45 | 19.9 | 20.12 | 20.18 | 20.17 | 20 | 19.39 | 18.66 | 18.11 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.15 | 18.41 | 18.87 | 19.45 | 19.9 | 20.12 | 20.18 | 20.17 | 20 | 19.39 | 18.66 | 18.11 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Utilisation factor for gains, hm:

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (94)m= | 0.99 | 0.99 | 0.97 | 0.91 | 0.79 | 0.61 | 0.44 | 0.5 | 0.77 | 0.95 | 0.99 | 1 | (94) |

Useful gains, hmGm , W = (94)m x (84)m

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (95)m= | 462.31 | 557.24 | 663.76 | 748.58 | 723.85 | 553.98 | 377.73 | 392.19 | 529.54 | 526.38 | 457.94 | 433.78 | (95) |

Monthly average external temperature from Table 8

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (97)m= | 1532.52 | 1492.02 | 1363.09 | 1151.33 | 892.46 | 596.01 | 385.96 | 406.02 | 639.27 | 957.3 | 1263.94 | 1526.45 | (97) |

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 796.23 | 628.17 | 520.3 | 289.97 | 125.44 | 0 | 0 | 0 | 0 | 320.6 | 580.32 | 812.95 |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4074 (98)

Space heating requirement in kWh/m²/year 57.35 (99)

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary system | | 0 | (201) |
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | 796.23 | 628.17 | 520.3 | 289.97 | 125.44 | 0 | 0 | 0 | 0 | 320.6 | 580.32 | 812.95 | | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 852.5 | 672.56 | 557.07 | 310.46 | 134.31 | 0 | 0 | 0 | 0 | 343.26 | 621.33 | 870.4 | | (211) |
| Total (kWh/year) =Sum(211)$_{1...5,10....12}$= | | | | | | | | | | | | | 4361.88 | (211) |
| Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) | | | | | | | | | | | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Total (kWh/year) =Sum(215)$_{1...5,10....12}$= | | | | | | | | | | | | | 0 | (215) |

**Water heating**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Output from water heater (calculated above) | 193.18 | 168.75 | 175.57 | 155.73 | 150.77 | 132.79 | 127.22 | 141.82 | 143.39 | 163.28 | 174.3 | 188.65 | | |
| Efficiency of water heater | | | | | | | | | | | | | 80.3 | (216) |
| (217)m= | 88.23 | 88.05 | 87.62 | 86.59 | 84.59 | 80.3 | 80.3 | 80.3 | 80.3 | 86.72 | 87.85 | 88.31 | | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m | | | | | | | | | | | | | | |
| (219)m= | 218.95 | 191.64 | 200.38 | 179.83 | 178.23 | 165.37 | 158.43 | 176.62 | 178.57 | 188.28 | 198.41 | 213.62 | | |
| Total = Sum(219a)$_{1...12}$ = | | | | | | | | | | | | | 2248.34 | (219) |

| **Annual totals** | **kWh/year** | **kWh/year** | |
|---|---|---|---|
| Space heating fuel used, main system 1 | | 4361.88 | |
| Water heating fuel used | | 2248.34 | |
| Electricity for pumps, fans and electric keep-hot | | | |
| central heating pump: | 30 | | (230c) |

| | | | | |
|---|---|---|---|---|
| boiler with a fan-assisted flue | | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | | 314.43 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 942.17 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 485.64 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1427.81 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 163.19 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 1629.92 | (272) |

| | | |
|---|---|---|
| **TER =** | 22.94 | (273) |

# TER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: A9

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 88.79 | (1a) x | 2.55 | (2a) = | 226.41 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 88.79 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 226.41 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 3 | x 10 = | 30 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 30 | ÷ (5) = | 0.13 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.38 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.33 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.41 | 0.41 | 0.4 | 0.36 | 0.35 | 0.31 | 0.31 | 0.3 | 0.33 | 0.35 | 0.37 | 0.38 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.59 | 0.58 | 0.58 | 0.56 | 0.56 | 0.55 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.57 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.59 | 0.58 | 0.58 | 0.56 | 0.56 | 0.55 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.57 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 5.08 | x1/[1/( 1.4 )+ 0.04] = | 6.73 | | | (27) |
| Windows Type 2 | | | 5.06 | x1/[1/( 1.4 )+ 0.04] = | 6.71 | | | (27) |
| Windows Type 3 | | | 10.85 | x1/[1/( 1.4 )+ 0.04] = | 14.38 | | | (27) |
| Walls Type1 | 65.5 | 20.99 | 44.51 | x 0.18 = | 8.01 | | | (29) |
| Walls Type2 | 24.84 | 0 | 24.84 | x 0.18 = | 4.47 | | | (29) |
| Walls Type3 | 7.37 | 0 | 7.37 | x 0.18 = | 1.33 | | | (29) |
| Total area of elements, m² | | | 97.71 | | | | | (31) |
| Party wall | | | 33.69 | x 0 = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 41.64 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 6119.25 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 7.09 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 48.73 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 43.78 | 43.53 | 43.28 | 42.14 | 41.92 | 40.92 | 40.92 | 40.74 | 41.31 | 41.92 | 42.36 | 42.81 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 92.51 | 92.26 | 92.01 | 90.86 | 90.65 | 89.65 | 89.65 | 89.46 | 90.03 | 90.65 | 91.08 | 91.54 | |

Average = Sum(39)$_{1…12}$ /12= 90.86 (39)

# TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.04 | 1.04 | 1.04 | 1.02 | 1.02 | 1.01 | 1.01 | 1.01 | 1.01 | 1.02 | 1.03 | 1.03 |

Average = Sum(40)$_{1…12}$ /12= 1.02 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.61 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 96.16 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 105.77 | 101.93 | 98.08 | 94.24 | 90.39 | 86.54 | 86.54 | 90.39 | 94.24 | 98.08 | 101.93 | 105.77 |

Total = Sum(44)$_{1…12}$ = 1153.91 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 156.86 | 137.19 | 141.57 | 123.42 | 118.43 | 102.19 | 94.7 | 108.67 | 109.97 | 128.15 | 139.89 | 151.91 |

Total = Sum(45)$_{1…12}$ = 1512.95 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 23.53 | 20.58 | 21.24 | 18.51 | 17.76 | 15.33 | 14.2 | 16.3 | 16.49 | 19.22 | 20.98 | 22.79 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.96 | 46.03 | 49.98 | 46.47 | 46.06 | 42.68 | 44.1 | 46.06 | 46.47 | 49.98 | 49.32 | 50.96 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 207.82 | 183.22 | 191.55 | 169.9 | 164.49 | 144.87 | 138.8 | 154.73 | 156.44 | 178.14 | 189.2 | 202.87 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 207.82 | 183.22 | 191.55 | 169.9 | 164.49 | 144.87 | 138.8 | 154.73 | 156.44 | 178.14 | 189.2 | 202.87 | |

Output from water heater (annual)$_{1...12}$ 2082.02 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 64.9 | 57.12 | 59.57 | 52.66 | 50.89 | 44.65 | 42.51 | 47.65 | 48.18 | 55.11 | 58.84 | 63.25 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 130.44 | 130.44 | 130.44 | 130.44 | 130.44 | 130.44 | 130.44 | 130.44 | 130.44 | 130.44 | 130.44 | 130.44 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 21.11 | 18.75 | 15.25 | 11.55 | 8.63 | 7.29 | 7.87 | 10.23 | 13.74 | 17.44 | 20.36 | 21.7 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 236.83 | 239.29 | 233.1 | 219.91 | 203.27 | 187.63 | 177.18 | 174.72 | 180.92 | 194.1 | 210.74 | 226.38 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 36.04 | 36.04 | 36.04 | 36.04 | 36.04 | 36.04 | 36.04 | 36.04 | 36.04 | 36.04 | 36.04 | 36.04 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -104.35 | -104.35 | -104.35 | -104.35 | -104.35 | -104.35 | -104.35 | -104.35 | -104.35 | -104.35 | -104.35 | -104.35 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 87.23 | 85 | 80.06 | 73.13 | 68.4 | 62.01 | 57.14 | 64.04 | 66.92 | 74.07 | 81.73 | 85.01 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 410.31 | 408.18 | 393.54 | 369.73 | 345.44 | 322.06 | 307.33 | 314.13 | 326.7 | 350.74 | 377.96 | 398.23 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 10.85 | x | 19.64 | x | 0.63 | x | 0.7 | = | 65.13 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 38.42 | x | 0.63 | x | 0.7 | = | 127.4 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 63.27 | x | 0.63 | x | 0.7 | = | 209.81 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 92.28 | x | 0.63 | x | 0.7 | = | 305.99 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 113.09 | x | 0.63 | x | 0.7 | = | 375 | (76) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 10.85 | x | 115.77 | x | 0.63 | x | 0.7 | = | 383.88 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 110.22 | x | 0.63 | x | 0.7 | = | 365.47 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 94.68 | x | 0.63 | x | 0.7 | = | 313.94 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 73.59 | x | 0.63 | x | 0.7 | = | 244.01 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 45.59 | x | 0.63 | x | 0.7 | = | 151.17 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 24.49 | x | 0.63 | x | 0.7 | = | 81.2 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 16.15 | x | 0.63 | x | 0.7 | = | 53.56 | (76) |
| West | 0.9x | 0.77 | x | 5.08 | x | 19.64 | x | 0.63 | x | 0.7 | = | 30.49 | (80) |
| West | 0.9x | 0.77 | x | 5.06 | x | 19.64 | x | 0.63 | x | 0.7 | = | 30.37 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 38.42 | x | 0.63 | x | 0.7 | = | 59.65 | (80) |
| West | 0.9x | 0.77 | x | 5.06 | x | 38.42 | x | 0.63 | x | 0.7 | = | 59.41 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 63.27 | x | 0.63 | x | 0.7 | = | 98.23 | (80) |
| West | 0.9x | 0.77 | x | 5.06 | x | 63.27 | x | 0.63 | x | 0.7 | = | 97.85 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 92.28 | x | 0.63 | x | 0.7 | = | 143.27 | (80) |
| West | 0.9x | 0.77 | x | 5.06 | x | 92.28 | x | 0.63 | x | 0.7 | = | 142.7 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 113.09 | x | 0.63 | x | 0.7 | = | 175.58 | (80) |
| West | 0.9x | 0.77 | x | 5.06 | x | 113.09 | x | 0.63 | x | 0.7 | = | 174.89 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 115.77 | x | 0.63 | x | 0.7 | = | 179.74 | (80) |
| West | 0.9x | 0.77 | x | 5.06 | x | 115.77 | x | 0.63 | x | 0.7 | = | 179.03 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 110.22 | x | 0.63 | x | 0.7 | = | 171.12 | (80) |
| West | 0.9x | 0.77 | x | 5.06 | x | 110.22 | x | 0.63 | x | 0.7 | = | 170.44 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 94.68 | x | 0.63 | x | 0.7 | = | 146.99 | (80) |
| West | 0.9x | 0.77 | x | 5.06 | x | 94.68 | x | 0.63 | x | 0.7 | = | 146.41 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 73.59 | x | 0.63 | x | 0.7 | = | 114.25 | (80) |
| West | 0.9x | 0.77 | x | 5.06 | x | 73.59 | x | 0.63 | x | 0.7 | = | 113.8 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 45.59 | x | 0.63 | x | 0.7 | = | 70.78 | (80) |
| West | 0.9x | 0.77 | x | 5.06 | x | 45.59 | x | 0.63 | x | 0.7 | = | 70.5 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 24.49 | x | 0.63 | x | 0.7 | = | 38.02 | (80) |
| West | 0.9x | 0.77 | x | 5.06 | x | 24.49 | x | 0.63 | x | 0.7 | = | 37.87 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 16.15 | x | 0.63 | x | 0.7 | = | 25.07 | (80) |
| West | 0.9x | 0.77 | x | 5.06 | x | 16.15 | x | 0.63 | x | 0.7 | = | 24.98 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 125.99 | 246.46 | 405.89 | 591.96 | 725.47 | 742.65 | 707.03 | 607.33 | 472.06 | 292.45 | 157.09 | 103.61 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 536.29 | 654.64 | 799.43 | 961.69 | 1070.91 | 1064.71 | 1014.36 | 921.46 | 798.76 | 643.19 | 535.05 | 501.84 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 0.99 | 0.97 | 0.9 | 0.73 | 0.53 | 0.39 | 0.44 | 0.72 | 0.96 | 0.99 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.91 | 20.1 | 20.4 | 20.74 | 20.93 | 20.99 | 21 | 21 | 20.95 | 20.65 | 20.21 | 19.88 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.05 | 20.05 | 20.05 | 20.06 | 20.07 | 20.08 | 20.08 | 20.08 | 20.07 | 20.07 | 20.06 | 20.06 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.97 | 0.87 | 0.67 | 0.46 | 0.31 | 0.36 | 0.65 | 0.94 | 0.99 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.59 | 18.87 | 19.3 | 19.78 | 20.01 | 20.07 | 20.07 | 20.08 | 20.04 | 19.66 | 19.03 | 18.55 | (90) |

fLA = Living area ÷ (4) = 0.38 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 19.1 | 19.34 | 19.72 | 20.15 | 20.36 | 20.42 | 20.43 | 20.43 | 20.39 | 20.04 | 19.48 | 19.06 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 19.1 | 19.34 | 19.72 | 20.15 | 20.36 | 20.42 | 20.43 | 20.43 | 20.39 | 20.04 | 19.48 | 19.06 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.96 | 0.87 | 0.69 | 0.49 | 0.34 | 0.39 | 0.68 | 0.94 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 534.3 | 647.67 | 769.9 | 837.95 | 742.02 | 517.05 | 342.79 | 359.37 | 539.18 | 604.29 | 530.41 | 500.51 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1368.91 | 1332.19 | 1216.8 | 1022.22 | 785.37 | 522.07 | 343.32 | 360.52 | 566.33 | 855.84 | 1127.92 | 1360.42 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 620.95 | 460 | 332.5 | 132.67 | 32.25 | 0 | 0 | 0 | 0 | 187.16 | 430.21 | 639.77 | |

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2835.5 (98)

Space heating requirement in kWh/m²/year 31.93 (99)

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary system | | 0 | (201) |
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | | | | | | | | | | | | | |
| | 620.95 | 460 | 332.5 | 132.67 | 32.25 | 0 | 0 | 0 | 0 | 187.16 | 430.21 | 639.77 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | (211) |
| | 664.82 | 492.5 | 355.99 | 142.05 | 34.53 | 0 | 0 | 0 | 0 | 200.38 | 460.61 | 684.98 | |

Total (kWh/year) =$Sum(211)_{1...5,10....12}$= 3035.87 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Total (kWh/year) =$Sum(215)_{1...5,10....12}$= 0 (215)

# TER WorkSheet: New dwelling design stage

**Water heating**

Output from water heater (calculated above)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 207.82 | 183.22 | 191.55 | 169.9 | 164.49 | 144.87 | 138.8 | 154.73 | 156.44 | 178.14 | 189.2 | 202.87 |

Efficiency of water heater 80.3 (216)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 87.64 | 87.27 | 86.43 | 84.44 | 81.8 | 80.3 | 80.3 | 80.3 | 80.3 | 85.18 | 87.06 | 87.74 | (217) |

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 237.14 | 209.94 | 221.63 | 201.21 | 201.09 | 180.41 | 172.85 | 192.69 | 194.82 | 209.14 | 217.34 | 231.21 |

Total = Sum(219a)$_{1...12}$ = 2469.47 (219)

| **Annual totals** | | **kWh/year** | **kWh/year** | |
|---|---|---|---|---|
| Space heating fuel used, main system 1 | | | 3035.87 | |
| Water heating fuel used | | | 2469.47 | |
| Electricity for pumps, fans and electric keep-hot | | | | |
| central heating pump: | | 30 | | (230c) |
| boiler with a fan-assisted flue | | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | | 372.88 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 655.75 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 533.41 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1189.15 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 193.52 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 1421.6 | (272) |

**TER =** 16.01 (273)

# TER WorkSheet: New dwelling design stage

User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

Property Address: A10

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 83.09 | (1a) | x | 2.55 | (2a) | = | 211.88 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 83.09 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | | = | 211.88 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 3 | x 10 = | 30 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 30 | ÷ (5) = | 0.14 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.39 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.33 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.42 | 0.42 | 0.41 | 0.37 | 0.36 | 0.32 | 0.32 | 0.31 | 0.33 | 0.36 | 0.37 | 0.39 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.59 | 0.59 | 0.58 | 0.57 | 0.56 | 0.55 | 0.55 | 0.55 | 0.56 | 0.56 | 0.57 | 0.58 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.59 | 0.59 | 0.58 | 0.57 | 0.56 | 0.55 | 0.55 | 0.55 | 0.56 | 0.56 | 0.57 | 0.58 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.92 | x1/[1/( 1.4 )+ 0.04] | = | 6.52 | | | (27) |
| Windows Type 2 | | | 4.92 | x1/[1/( 1.4 )+ 0.04] | = | 6.52 | | | (27) |
| Windows Type 3 | | | 2.39 | x1/[1/( 1.4 )+ 0.04] | = | 3.17 | | | (27) |
| Floor | | | 93.36 | x 0.13 | = | 12.1368 | | | (28) |
| Walls Type1 | 74.77 | 12.23 | 62.54 | x 0.18 | = | 11.26 | | | (29) |
| Walls Type2 | 12.35 | 0 | 12.35 | x 0.18 | = | 2.22 | | | (29) |
| Total area of elements, m² | | | 180.48 | | | | | | (31) |
| Party wall | | | 36.38 | x 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 41.83 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 16400.1 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 11.05 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 52.88 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 41.26 | 41.01 | 40.77 | 39.65 | 39.44 | 38.46 | 38.46 | 38.27 | 38.83 | 39.44 | 39.86 | 40.31 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 94.14 | 93.89 | 93.65 | 92.53 | 92.32 | 91.34 | 91.34 | 91.15 | 91.71 | 92.32 | 92.74 | 93.19 | |

Average = Sum(39)$_{1…12}$ /12= 92.53 (39)

# TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.13 | 1.13 | 1.13 | 1.11 | 1.11 | 1.1 | 1.1 | 1.1 | 1.1 | 1.11 | 1.12 | 1.12 |

Average = Sum(40)$_{1…12}$ /12= 1.11 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.52 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 94.02 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 103.43 | 99.66 | 95.9 | 92.14 | 88.38 | 84.62 | 84.62 | 88.38 | 92.14 | 95.9 | 99.66 | 103.43 |

Total = Sum(44)$_{1…12}$ = 1128.28 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 153.38 | 134.14 | 138.43 | 120.68 | 115.8 | 99.92 | 92.6 | 106.25 | 107.52 | 125.31 | 136.78 | 148.54 |

Total = Sum(45)$_{1…12}$ = 1479.35 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 23.01 | 20.12 | 20.76 | 18.1 | 17.37 | 14.99 | 13.89 | 15.94 | 16.13 | 18.8 | 20.52 | 22.28 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) — 0 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.96 | 45.87 | 48.87 | 45.44 | 45.04 | 41.73 | 43.12 | 45.04 | 45.44 | 48.87 | 49.15 | 50.96 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 204.34 | 180.02 | 187.3 | 166.12 | 160.84 | 141.66 | 135.72 | 151.29 | 152.96 | 174.18 | 185.93 | 199.5 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 204.34 | 180.02 | 187.3 | 166.12 | 160.84 | 141.66 | 135.72 | 151.29 | 152.96 | 174.18 | 185.93 | 199.5 | |

Output from water heater (annual)$_{1...12}$ 2039.85 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 63.74 | 56.07 | 58.24 | 51.49 | 49.76 | 43.66 | 41.57 | 46.59 | 47.11 | 53.88 | 57.77 | 62.13 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 21.36 | 18.97 | 15.43 | 11.68 | 8.73 | 7.37 | 7.97 | 10.35 | 13.9 | 17.65 | 20.6 | 21.96 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 225.78 | 228.12 | 222.22 | 209.65 | 193.78 | 178.87 | 168.91 | 166.57 | 172.47 | 185.04 | 200.9 | 215.82 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 85.67 | 83.44 | 78.29 | 71.51 | 66.89 | 60.64 | 55.87 | 62.62 | 65.43 | 72.42 | 80.23 | 83.51 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 396.59 | 394.32 | 379.72 | 356.62 | 333.18 | 310.66 | 296.53 | 303.32 | 315.58 | 338.89 | 365.52 | 385.06 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.92 | x | 19.64 | x | 0.63 | x | 0.7 | = | 29.53 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 38.42 | x | 0.63 | x | 0.7 | = | 57.77 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 63.27 | x | 0.63 | x | 0.7 | = | 95.14 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 92.28 | x | 0.63 | x | 0.7 | = | 138.75 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 113.09 | x | 0.63 | x | 0.7 | = | 170.05 | (76) |

# TER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.92 | x | 115.77 | x | 0.63 | x | 0.7 | = | 174.07 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 110.22 | x | 0.63 | x | 0.7 | = | 165.73 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 94.68 | x | 0.63 | x | 0.7 | = | 142.36 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 73.59 | x | 0.63 | x | 0.7 | = | 110.65 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 45.59 | x | 0.63 | x | 0.7 | = | 68.55 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 24.49 | x | 0.63 | x | 0.7 | = | 36.82 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 16.15 | x | 0.63 | x | 0.7 | = | 24.29 | (76) |
| West | 0.9x | 0.77 | x | 4.92 | x | 19.64 | x | 0.63 | x | 0.7 | = | 29.53 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 19.64 | x | 0.63 | x | 0.7 | = | 14.35 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 38.42 | x | 0.63 | x | 0.7 | = | 57.77 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 38.42 | x | 0.63 | x | 0.7 | = | 28.06 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 63.27 | x | 0.63 | x | 0.7 | = | 95.14 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 63.27 | x | 0.63 | x | 0.7 | = | 46.22 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 92.28 | x | 0.63 | x | 0.7 | = | 138.75 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 92.28 | x | 0.63 | x | 0.7 | = | 67.4 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 113.09 | x | 0.63 | x | 0.7 | = | 170.05 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 113.09 | x | 0.63 | x | 0.7 | = | 82.6 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 115.77 | x | 0.63 | x | 0.7 | = | 174.07 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 115.77 | x | 0.63 | x | 0.7 | = | 84.56 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 110.22 | x | 0.63 | x | 0.7 | = | 165.73 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 110.22 | x | 0.63 | x | 0.7 | = | 80.51 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 94.68 | x | 0.63 | x | 0.7 | = | 142.36 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 94.68 | x | 0.63 | x | 0.7 | = | 69.15 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 73.59 | x | 0.63 | x | 0.7 | = | 110.65 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 73.59 | x | 0.63 | x | 0.7 | = | 53.75 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 45.59 | x | 0.63 | x | 0.7 | = | 68.55 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 45.59 | x | 0.63 | x | 0.7 | = | 33.3 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 24.49 | x | 0.63 | x | 0.7 | = | 36.82 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 24.49 | x | 0.63 | x | 0.7 | = | 17.89 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 16.15 | x | 0.63 | x | 0.7 | = | 24.29 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 16.15 | x | 0.63 | x | 0.7 | = | 11.8 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 73.41 | 143.6 | 236.49 | 344.91 | 422.7 | 432.71 | 411.96 | 353.86 | 275.05 | 170.4 | 91.53 | 60.37 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 470 | 537.92 | 616.21 | 701.53 | 755.88 | 743.37 | 708.49 | 657.19 | 590.63 | 509.29 | 457.05 | 445.43 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 0.99 | 0.96 | 0.89 | 0.72 | 0.55 | 0.61 | 0.87 | 0.98 | 1 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.75 | 19.89 | 20.15 | 20.5 | 20.79 | 20.95 | 20.99 | 20.98 | 20.86 | 20.48 | 20.05 | 19.73 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.97 | 19.98 | 19.98 | 19.99 | 19.99 | 20 | 20 | 20 | 20 | 19.99 | 19.99 | 19.98 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 1 | 0.99 | 0.95 | 0.84 | 0.64 | 0.44 | 0.49 | 0.8 | 0.97 | 1 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.3 | 18.51 | 18.89 | 19.39 | 19.78 | 19.97 | 20 | 20 | 19.88 | 19.37 | 18.75 | 18.28 | (90) |

fLA = Living area ÷ (4) = 0.42 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.9 | 19.09 | 19.41 | 19.85 | 20.2 | 20.37 | 20.41 | 20.41 | 20.29 | 19.83 | 19.29 | 18.88 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.9 | 19.09 | 19.41 | 19.85 | 20.2 | 20.37 | 20.41 | 20.41 | 20.29 | 19.83 | 19.29 | 18.88 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.98 | 0.95 | 0.85 | 0.67 | 0.48 | 0.54 | 0.82 | 0.97 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 468.68 | 534.75 | 606.4 | 665.36 | 644.71 | 498.29 | 343.53 | 357.37 | 485.2 | 494.32 | 454.47 | 444.47 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1374.74 | 1332.05 | 1209.47 | 1013.18 | 784.35 | 527.34 | 347.94 | 365.12 | 567.67 | 852.14 | 1130.86 | 1367.85 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 674.11 | 535.78 | 448.69 | 250.43 | 103.89 | 0 | 0 | 0 | 0 | 266.22 | 487 | 686.99 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3453.1 (98)

Space heating requirement in kWh/m²/year 41.56 (99)

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary system | | 0 | (201) |
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | | | | | | | | | | | | | |
| | 674.11 | 535.78 | 448.69 | 250.43 | 103.89 | 0 | 0 | 0 | 0 | 266.22 | 487 | 686.99 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | (211) |
| | 721.74 | 573.64 | 480.39 | 268.13 | 111.23 | 0 | 0 | 0 | 0 | 285.03 | 521.41 | 735.54 | |

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3697.11 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

# TER WorkSheet: New dwelling design stage

**Water heating**

Output from water heater (calculated above)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 204.34 | 180.02 | 187.3 | 166.12 | 160.84 | 141.66 | 135.72 | 151.29 | 152.96 | 174.18 | 185.93 | 199.5 |

Efficiency of water heater 80.3 (216)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 87.83 | 87.63 | 87.17 | 86.08 | 83.98 | 80.3 | 80.3 | 80.3 | 80.3 | 86.12 | 87.36 | 87.91 | (217) |

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 232.65 | 205.43 | 214.86 | 192.98 | 191.51 | 176.41 | 169.01 | 188.41 | 190.49 | 202.26 | 212.83 | 226.93 |

Total = $Sum(219a)_{1...12}$ = 2403.78 (219)

| **Annual totals** | **kWh/year** | **kWh/year** | |
|---|---|---|---|
| Space heating fuel used, main system 1 | | 3697.11 | |
| Water heating fuel used | | 2403.78 | |
| Electricity for pumps, fans and electric keep-hot | | | |
| central heating pump: | 30 | | (230c) |
| boiler with a fan-assisted flue | 45 | | (230e) |
| Total electricity for the above, kWh/year — sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | 377.27 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 798.58 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 519.22 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1317.79 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 195.8 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 1552.52 | (272) |

**TER =** 18.68 (273)

# TER WorkSheet: New dwelling design stage

**User Details:**

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

**Property Address: H1**

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 88.81 | (1a) | x | 2.55 | (2a) | = | 226.47 | (3a) |
| First floor | 64.98 | (1b) | x | 3 | (2b) | = | 194.94 | (3b) |
| Second floor | 42.74 | (1c) | x | 3 | (2c) | = | 128.22 | (3c) |
| Third floor | 31.59 | (1d) | x | 3 | (2d) | = | 94.77 | (3d) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 228.12 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | | = | 644.4 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 4 | x 10 = | 40 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 40 | ÷ (5) = | 0.06 | (8) |
| *If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)* | | | | |
| Number of storeys in the dwelling (ns) | | | 0 | (9) |
| Additional infiltration | | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | | 0 | (13) |
| Percentage of windows and doors draught stripped | | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | | 5 | (17) |
| If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | | | 0.31 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | | |
| Number of sides sheltered | | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | | 0.27 | (21) |

Infiltration rate modified for monthly wind speed

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|

# TER WorkSheet: New dwelling design stage

Monthly average wind speed from Table 7

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

Wind Factor (22a)m = (22)m ÷ 4

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.34 | 0.33 | 0.32 | 0.29 | 0.29 | 0.25 | 0.25 | 0.25 | 0.27 | 0.29 | 0.3 | 0.31 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.56 | 0.55 | 0.55 | 0.54 | 0.54 | 0.53 | 0.53 | 0.53 | 0.54 | 0.54 | 0.54 | 0.55 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.56 | 0.55 | 0.55 | 0.54 | 0.54 | 0.53 | 0.53 | 0.53 | 0.54 | 0.54 | 0.54 | 0.55 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 1.36 | x1/[1/( 1.4 )+ 0.04] | = | 1.8 | | | (27) |
| Windows Type 2 | | | 2.79 | x1/[1/( 1.4 )+ 0.04] | = | 3.7 | | | (27) |
| Windows Type 3 | | | 2.88 | x1/[1/( 1.4 )+ 0.04] | = | 3.82 | | | (27) |
| Windows Type 4 | | | 1.26 | x1/[1/( 1.4 )+ 0.04] | = | 1.67 | | | (27) |
| Windows Type 5 | | | 1.3 | x1/[1/( 1.4 )+ 0.04] | = | 1.72 | | | (27) |
| Windows Type 6 | | | 2.68 | x1/[1/( 1.4 )+ 0.04] | = | 3.55 | | | (27) |
| Windows Type 7 | | | 2.88 | x1/[1/( 1.4 )+ 0.04] | = | 3.82 | | | (27) |
| Windows Type 8 | | | 1.21 | x1/[1/( 1.4 )+ 0.04] | = | 1.6 | | | (27) |
| Windows Type 9 | | | 2.06 | x1/[1/( 1.4 )+ 0.04] | = | 2.73 | | | (27) |
| Windows Type 10 | | | 2.68 | x1/[1/( 1.4 )+ 0.04] | = | 3.55 | | | (27) |
| Windows Type 11 | | | 2.7 | x1/[1/( 1.4 )+ 0.04] | = | 3.58 | | | (27) |
| Windows Type 12 | | | 2.87 | x1/[1/( 1.4 )+ 0.04] | = | 3.8 | | | (27) |
| Windows Type 13 | | | 2.72 | x1/[1/( 1.4 )+ 0.04] | = | 3.61 | | | (27) |
| Windows Type 14 | | | 4.98 | x1/[1/( 1.4 )+ 0.04] | = | 6.6 | | | (27) |

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| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 15 | | | 1.28 | x1/[1/( 1.4 )+ 0.04] = | | 1.7 | | | (27) |
| Windows Type 16 | | | 2.09 | x1/[1/( 1.4 )+ 0.04] = | | 2.77 | | | (27) |
| Windows Type 17 | | | 2.8 | x1/[1/( 1.4 )+ 0.04] = | | 3.71 | | | (27) |
| Floor | | | 88.81 | x | 0.13 | = 11.5453 | | | (28) |
| Walls | 321.77 | 57.01 | 264.76 | x | 0.18 | = 47.66 | | | (29) |
| Roof Type1 | 23.96 | 0 | 23.96 | x | 0.13 | = 3.11 | | | (30) |
| Roof Type2 | 22.13 | 0 | 22.13 | x | 0.13 | = 2.88 | | | (30) |
| Roof Type3 | 9.98 | 0 | 9.98 | x | 0.13 | = 1.3 | | | (30) |
| Roof Type4 | 31.59 | 0 | 31.59 | x | 0.13 | = 4.11 | | | (30) |
| Total area of elements, m² | | | 498.24 | | | | | | (31) |
| Party wall | | | 65.06 | x | 0 | = 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 146.18 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 29371.34 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 47.66 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 193.84 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 118.49 | 118.02 | 117.55 | 115.38 | 114.97 | 113.08 | 113.08 | 112.73 | 113.81 | 114.97 | 115.79 | 116.65 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 312.33 | 311.86 | 311.39 | 309.22 | 308.81 | 306.92 | 306.92 | 306.57 | 307.65 | 308.81 | 309.64 | 310.5 | |

Average = Sum(39)$_{1…12}$ /12= 309.22 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.37 | 1.37 | 1.37 | 1.36 | 1.35 | 1.35 | 1.35 | 1.34 | 1.35 | 1.35 | 1.36 | 1.36 | |

Average = Sum(40)$_{1…12}$ /12= 1.36 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 3.04 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 106.36 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 117 | 112.75 | 108.49 | 104.24 | 99.98 | 95.73 | 95.73 | 99.98 | 104.24 | 108.49 | 112.75 | 117 |

Total = Sum(44)$_{1…12}$ = 1276.37 (44)

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*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 173.51 | 151.75 | 156.59 | 136.52 | 131 | 113.04 | 104.75 | 120.2 | 121.64 | 141.75 | 154.74 | 168.03 | |

Total = Sum(45)1...12 = 1673.52 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 26.03 | 22.76 | 23.49 | 20.48 | 19.65 | 16.96 | 15.71 | 18.03 | 18.25 | 21.26 | 23.21 | 25.21 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 1.7 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year — (48) x (49) = — 0.92 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = — 0 (54)

Enter (50) or (54) in (55) — 0.92 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 28.48 | 25.73 | 28.48 | 27.57 | 28.48 | 27.57 | 28.48 | 28.48 | 27.57 | 28.48 | 27.57 | 28.48 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 28.48 | 25.73 | 28.48 | 27.57 | 28.48 | 27.57 | 28.48 | 28.48 | 27.57 | 28.48 | 27.57 | 28.48 | (57) |

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 225.25 | 198.49 | 208.34 | 186.6 | 182.74 | 163.12 | 156.49 | 171.95 | 171.71 | 193.5 | 204.81 | 219.78 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 225.25 | 198.49 | 208.34 | 186.6 | 182.74 | 163.12 | 156.49 | 171.95 | 171.71 | 193.5 | 204.81 | 219.78 |

Output from water heater (annual)1...12 — 2282.79 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 99.09 | 87.85 | 93.46 | 85.46 | 84.95 | 77.65 | 76.23 | 81.36 | 80.51 | 88.53 | 91.51 | 97.27 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 151.92 | 151.92 | 151.92 | 151.92 | 151.92 | 151.92 | 151.92 | 151.92 | 151.92 | 151.92 | 151.92 | 151.92 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| (67)m= | 35.4 | 31.44 | 25.57 | 19.36 | 14.47 | 12.22 | 13.2 | 17.16 | 23.03 | 29.24 | 34.13 | 36.38 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| (68)m= | 397.04 | 401.16 | 390.78 | 368.68 | 340.78 | 314.55 | 297.04 | 292.92 | 303.3 | 325.4 | 353.3 | 379.53 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| (69)m= | 38.19 | 38.19 | 38.19 | 38.19 | 38.19 | 38.19 | 38.19 | 38.19 | 38.19 | 38.19 | 38.19 | 38.19 | (69) |
| Pumps and fans gains (Table 5a) | | | | | | | | | | | | | |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| (71)m= | -121.54 | -121.54 | -121.54 | -121.54 | -121.54 | -121.54 | -121.54 | -121.54 | -121.54 | -121.54 | -121.54 | -121.54 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| (72)m= | 133.18 | 130.73 | 125.62 | 118.69 | 114.18 | 107.84 | 102.45 | 109.36 | 111.81 | 118.99 | 127.1 | 130.74 | (72) |
| **Total internal gains =** | | | | | | (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m | | | | | | | |
| (73)m= | 637.2 | 634.91 | 613.55 | 578.3 | 541.01 | 506.19 | 484.27 | 491.01 | 509.72 | 545.21 | 586.11 | 618.22 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.98 | x | 19.64 | x | 0.63 | x | 0.7 | = | 29.89 | (76) |
| East | 0.9x | 4 | x | 1.28 | x | 19.64 | x | 0.63 | x | 0.7 | = | 30.73 | (76) |
| East | 0.9x | 2 | x | 2.09 | x | 19.64 | x | 0.63 | x | 0.7 | = | 25.09 | (76) |
| East | 0.9x | 1 | x | 2.8 | x | 19.64 | x | 0.63 | x | 0.7 | = | 16.81 | (76) |
| East | 0.9x | 1 | x | 4.98 | x | 38.42 | x | 0.63 | x | 0.7 | = | 58.47 | (76) |
| East | 0.9x | 4 | x | 1.28 | x | 38.42 | x | 0.63 | x | 0.7 | = | 60.12 | (76) |
| East | 0.9x | 2 | x | 2.09 | x | 38.42 | x | 0.63 | x | 0.7 | = | 49.08 | (76) |
| East | 0.9x | 1 | x | 2.8 | x | 38.42 | x | 0.63 | x | 0.7 | = | 32.88 | (76) |
| East | 0.9x | 1 | x | 4.98 | x | 63.27 | x | 0.63 | x | 0.7 | = | 96.3 | (76) |
| East | 0.9x | 4 | x | 1.28 | x | 63.27 | x | 0.63 | x | 0.7 | = | 99.01 | (76) |
| East | 0.9x | 2 | x | 2.09 | x | 63.27 | x | 0.63 | x | 0.7 | = | 80.83 | (76) |
| East | 0.9x | 1 | x | 2.8 | x | 63.27 | x | 0.63 | x | 0.7 | = | 54.14 | (76) |
| East | 0.9x | 1 | x | 4.98 | x | 92.28 | x | 0.63 | x | 0.7 | = | 140.45 | (76) |
| East | 0.9x | 4 | x | 1.28 | x | 92.28 | x | 0.63 | x | 0.7 | = | 144.39 | (76) |
| East | 0.9x | 2 | x | 2.09 | x | 92.28 | x | 0.63 | x | 0.7 | = | 117.88 | (76) |
| East | 0.9x | 1 | x | 2.8 | x | 92.28 | x | 0.63 | x | 0.7 | = | 78.97 | (76) |
| East | 0.9x | 1 | x | 4.98 | x | 113.09 | x | 0.63 | x | 0.7 | = | 172.12 | (76) |
| East | 0.9x | 4 | x | 1.28 | x | 113.09 | x | 0.63 | x | 0.7 | = | 176.96 | (76) |
| East | 0.9x | 2 | x | 2.09 | x | 113.09 | x | 0.63 | x | 0.7 | = | 144.47 | (76) |
| East | 0.9x | 1 | x | 2.8 | x | 113.09 | x | 0.63 | x | 0.7 | = | 96.78 | (76) |
| East | 0.9x | 1 | x | 4.98 | x | 115.77 | x | 0.63 | x | 0.7 | = | 176.2 | (76) |

# TER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 4 | x | 1.28 | x | 115.77 | x | 0.63 | x | 0.7 | = | 181.15 | (76) |
| East | 0.9x | 2 | x | 2.09 | x | 115.77 | x | 0.63 | x | 0.7 | = | 147.89 | (76) |
| East | 0.9x | 1 | x | 2.8 | x | 115.77 | x | 0.63 | x | 0.7 | = | 99.07 | (76) |
| East | 0.9x | 1 | x | 4.98 | x | 110.22 | x | 0.63 | x | 0.7 | = | 167.75 | (76) |
| East | 0.9x | 4 | x | 1.28 | x | 110.22 | x | 0.63 | x | 0.7 | = | 172.46 | (76) |
| East | 0.9x | 2 | x | 2.09 | x | 110.22 | x | 0.63 | x | 0.7 | = | 140.8 | (76) |
| East | 0.9x | 1 | x | 2.8 | x | 110.22 | x | 0.63 | x | 0.7 | = | 94.32 | (76) |
| East | 0.9x | 1 | x | 4.98 | x | 94.68 | x | 0.63 | x | 0.7 | = | 144.09 | (76) |
| East | 0.9x | 4 | x | 1.28 | x | 94.68 | x | 0.63 | x | 0.7 | = | 148.14 | (76) |
| East | 0.9x | 2 | x | 2.09 | x | 94.68 | x | 0.63 | x | 0.7 | = | 120.94 | (76) |
| East | 0.9x | 1 | x | 2.8 | x | 94.68 | x | 0.63 | x | 0.7 | = | 81.02 | (76) |
| East | 0.9x | 1 | x | 4.98 | x | 73.59 | x | 0.63 | x | 0.7 | = | 112 | (76) |
| East | 0.9x | 4 | x | 1.28 | x | 73.59 | x | 0.63 | x | 0.7 | = | 115.15 | (76) |
| East | 0.9x | 2 | x | 2.09 | x | 73.59 | x | 0.63 | x | 0.7 | = | 94.01 | (76) |
| East | 0.9x | 1 | x | 2.8 | x | 73.59 | x | 0.63 | x | 0.7 | = | 62.97 | (76) |
| East | 0.9x | 1 | x | 4.98 | x | 45.59 | x | 0.63 | x | 0.7 | = | 69.38 | (76) |
| East | 0.9x | 4 | x | 1.28 | x | 45.59 | x | 0.63 | x | 0.7 | = | 71.34 | (76) |
| East | 0.9x | 2 | x | 2.09 | x | 45.59 | x | 0.63 | x | 0.7 | = | 58.24 | (76) |
| East | 0.9x | 1 | x | 2.8 | x | 45.59 | x | 0.63 | x | 0.7 | = | 39.01 | (76) |
| East | 0.9x | 1 | x | 4.98 | x | 24.49 | x | 0.63 | x | 0.7 | = | 37.27 | (76) |
| East | 0.9x | 4 | x | 1.28 | x | 24.49 | x | 0.63 | x | 0.7 | = | 38.32 | (76) |
| East | 0.9x | 2 | x | 2.09 | x | 24.49 | x | 0.63 | x | 0.7 | = | 31.28 | (76) |
| East | 0.9x | 1 | x | 2.8 | x | 24.49 | x | 0.63 | x | 0.7 | = | 20.96 | (76) |
| East | 0.9x | 1 | x | 4.98 | x | 16.15 | x | 0.63 | x | 0.7 | = | 24.58 | (76) |
| East | 0.9x | 4 | x | 1.28 | x | 16.15 | x | 0.63 | x | 0.7 | = | 25.27 | (76) |
| East | 0.9x | 2 | x | 2.09 | x | 16.15 | x | 0.63 | x | 0.7 | = | 20.63 | (76) |
| East | 0.9x | 1 | x | 2.8 | x | 16.15 | x | 0.63 | x | 0.7 | = | 13.82 | (76) |
| Southeast | 0.9x | 0.77 | x | 2.72 | x | 36.79 | x | 0.63 | x | 0.7 | = | 30.59 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.72 | x | 62.67 | x | 0.63 | x | 0.7 | = | 52.1 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.72 | x | 85.75 | x | 0.63 | x | 0.7 | = | 71.28 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.72 | x | 106.25 | x | 0.63 | x | 0.7 | = | 88.32 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.72 | x | 119.01 | x | 0.63 | x | 0.7 | = | 98.93 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.72 | x | 118.15 | x | 0.63 | x | 0.7 | = | 98.21 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.72 | x | 113.91 | x | 0.63 | x | 0.7 | = | 94.69 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.72 | x | 104.39 | x | 0.63 | x | 0.7 | = | 86.78 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.72 | x | 92.85 | x | 0.63 | x | 0.7 | = | 77.18 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.72 | x | 69.27 | x | 0.63 | x | 0.7 | = | 57.58 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.72 | x | 44.07 | x | 0.63 | x | 0.7 | = | 36.63 | (77) |
| Southeast | 0.9x | 0.77 | x | 2.72 | x | 31.49 | x | 0.63 | x | 0.7 | = | 26.17 | (77) |
| South | 0.9x | 0.77 | x | 1.26 | x | 46.75 | x | 0.63 | x | 0.7 | = | 18 | (78) |
| South | 0.9x | 0.77 | x | 1.21 | x | 46.75 | x | 0.63 | x | 0.7 | = | 17.29 | (78) |

# TER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South | 0.9x | 0.77 | x | 2.68 | x | 46.75 | x | 0.63 | x | 0.7 | = | 38.29 | (78) |
| South | 0.9x | 0.77 | x | 2.7 | x | 46.75 | x | 0.63 | x | 0.7 | = | 38.58 | (78) |
| South | 0.9x | 0.77 | x | 2.87 | x | 46.75 | x | 0.63 | x | 0.7 | = | 41.01 | (78) |
| South | 0.9x | 0.77 | x | 1.26 | x | 76.57 | x | 0.63 | x | 0.7 | = | 29.48 | (78) |
| South | 0.9x | 0.77 | x | 1.21 | x | 76.57 | x | 0.63 | x | 0.7 | = | 28.31 | (78) |
| South | 0.9x | 0.77 | x | 2.68 | x | 76.57 | x | 0.63 | x | 0.7 | = | 62.71 | (78) |
| South | 0.9x | 0.77 | x | 2.7 | x | 76.57 | x | 0.63 | x | 0.7 | = | 63.18 | (78) |
| South | 0.9x | 0.77 | x | 2.87 | x | 76.57 | x | 0.63 | x | 0.7 | = | 67.16 | (78) |
| South | 0.9x | 0.77 | x | 1.26 | x | 97.53 | x | 0.63 | x | 0.7 | = | 37.56 | (78) |
| South | 0.9x | 0.77 | x | 1.21 | x | 97.53 | x | 0.63 | x | 0.7 | = | 36.07 | (78) |
| South | 0.9x | 0.77 | x | 2.68 | x | 97.53 | x | 0.63 | x | 0.7 | = | 79.88 | (78) |
| South | 0.9x | 0.77 | x | 2.7 | x | 97.53 | x | 0.63 | x | 0.7 | = | 80.48 | (78) |
| South | 0.9x | 0.77 | x | 2.87 | x | 97.53 | x | 0.63 | x | 0.7 | = | 85.55 | (78) |
| South | 0.9x | 0.77 | x | 1.26 | x | 110.23 | x | 0.63 | x | 0.7 | = | 42.45 | (78) |
| South | 0.9x | 0.77 | x | 1.21 | x | 110.23 | x | 0.63 | x | 0.7 | = | 40.76 | (78) |
| South | 0.9x | 0.77 | x | 2.68 | x | 110.23 | x | 0.63 | x | 0.7 | = | 90.29 | (78) |
| South | 0.9x | 0.77 | x | 2.7 | x | 110.23 | x | 0.63 | x | 0.7 | = | 90.96 | (78) |
| South | 0.9x | 0.77 | x | 2.87 | x | 110.23 | x | 0.63 | x | 0.7 | = | 96.69 | (78) |
| South | 0.9x | 0.77 | x | 1.26 | x | 114.87 | x | 0.63 | x | 0.7 | = | 44.23 | (78) |
| South | 0.9x | 0.77 | x | 1.21 | x | 114.87 | x | 0.63 | x | 0.7 | = | 42.48 | (78) |
| South | 0.9x | 0.77 | x | 2.68 | x | 114.87 | x | 0.63 | x | 0.7 | = | 94.08 | (78) |
| South | 0.9x | 0.77 | x | 2.7 | x | 114.87 | x | 0.63 | x | 0.7 | = | 94.79 | (78) |
| South | 0.9x | 0.77 | x | 2.87 | x | 114.87 | x | 0.63 | x | 0.7 | = | 100.75 | (78) |
| South | 0.9x | 0.77 | x | 1.26 | x | 110.55 | x | 0.63 | x | 0.7 | = | 42.57 | (78) |
| South | 0.9x | 0.77 | x | 1.21 | x | 110.55 | x | 0.63 | x | 0.7 | = | 40.88 | (78) |
| South | 0.9x | 0.77 | x | 2.68 | x | 110.55 | x | 0.63 | x | 0.7 | = | 90.54 | (78) |
| South | 0.9x | 0.77 | x | 2.7 | x | 110.55 | x | 0.63 | x | 0.7 | = | 91.22 | (78) |
| South | 0.9x | 0.77 | x | 2.87 | x | 110.55 | x | 0.63 | x | 0.7 | = | 96.96 | (78) |
| South | 0.9x | 0.77 | x | 1.26 | x | 108.01 | x | 0.63 | x | 0.7 | = | 41.59 | (78) |
| South | 0.9x | 0.77 | x | 1.21 | x | 108.01 | x | 0.63 | x | 0.7 | = | 39.94 | (78) |
| South | 0.9x | 0.77 | x | 2.68 | x | 108.01 | x | 0.63 | x | 0.7 | = | 88.47 | (78) |
| South | 0.9x | 0.77 | x | 2.7 | x | 108.01 | x | 0.63 | x | 0.7 | = | 89.13 | (78) |
| South | 0.9x | 0.77 | x | 2.87 | x | 108.01 | x | 0.63 | x | 0.7 | = | 94.74 | (78) |
| South | 0.9x | 0.77 | x | 1.26 | x | 104.89 | x | 0.63 | x | 0.7 | = | 40.39 | (78) |
| South | 0.9x | 0.77 | x | 1.21 | x | 104.89 | x | 0.63 | x | 0.7 | = | 38.79 | (78) |
| South | 0.9x | 0.77 | x | 2.68 | x | 104.89 | x | 0.63 | x | 0.7 | = | 85.91 | (78) |
| South | 0.9x | 0.77 | x | 2.7 | x | 104.89 | x | 0.63 | x | 0.7 | = | 86.55 | (78) |
| South | 0.9x | 0.77 | x | 2.87 | x | 104.89 | x | 0.63 | x | 0.7 | = | 92 | (78) |
| South | 0.9x | 0.77 | x | 1.26 | x | 101.89 | x | 0.63 | x | 0.7 | = | 39.23 | (78) |
| South | 0.9x | 0.77 | x | 1.21 | x | 101.89 | x | 0.63 | x | 0.7 | = | 37.68 | (78) |
| South | 0.9x | 0.77 | x | 2.68 | x | 101.89 | x | 0.63 | x | 0.7 | = | 83.45 | (78) |

# TER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South | 0.9x | 0.77 | x | 2.7 | x | 101.89 | x | 0.63 | x | 0.7 | = | 84.07 | (78) |
| South | 0.9x | 0.77 | x | 2.87 | x | 101.89 | x | 0.63 | x | 0.7 | = | 89.36 | (78) |
| South | 0.9x | 0.77 | x | 1.26 | x | 82.59 | x | 0.63 | x | 0.7 | = | 31.8 | (78) |
| South | 0.9x | 0.77 | x | 1.21 | x | 82.59 | x | 0.63 | x | 0.7 | = | 30.54 | (78) |
| South | 0.9x | 0.77 | x | 2.68 | x | 82.59 | x | 0.63 | x | 0.7 | = | 67.64 | (78) |
| South | 0.9x | 0.77 | x | 2.7 | x | 82.59 | x | 0.63 | x | 0.7 | = | 68.15 | (78) |
| South | 0.9x | 0.77 | x | 2.87 | x | 82.59 | x | 0.63 | x | 0.7 | = | 72.44 | (78) |
| South | 0.9x | 0.77 | x | 1.26 | x | 55.42 | x | 0.63 | x | 0.7 | = | 21.34 | (78) |
| South | 0.9x | 0.77 | x | 1.21 | x | 55.42 | x | 0.63 | x | 0.7 | = | 20.49 | (78) |
| South | 0.9x | 0.77 | x | 2.68 | x | 55.42 | x | 0.63 | x | 0.7 | = | 45.39 | (78) |
| South | 0.9x | 0.77 | x | 2.7 | x | 55.42 | x | 0.63 | x | 0.7 | = | 45.73 | (78) |
| South | 0.9x | 0.77 | x | 2.87 | x | 55.42 | x | 0.63 | x | 0.7 | = | 48.61 | (78) |
| South | 0.9x | 0.77 | x | 1.26 | x | 40.4 | x | 0.63 | x | 0.7 | = | 15.56 | (78) |
| South | 0.9x | 0.77 | x | 1.21 | x | 40.4 | x | 0.63 | x | 0.7 | = | 14.94 | (78) |
| South | 0.9x | 0.77 | x | 2.68 | x | 40.4 | x | 0.63 | x | 0.7 | = | 33.09 | (78) |
| South | 0.9x | 0.77 | x | 2.7 | x | 40.4 | x | 0.63 | x | 0.7 | = | 33.33 | (78) |
| South | 0.9x | 0.77 | x | 2.87 | x | 40.4 | x | 0.63 | x | 0.7 | = | 35.43 | (78) |
| West | 0.9x | 0.77 | x | 1.36 | x | 19.64 | x | 0.63 | x | 0.7 | = | 16.33 | (80) |
| West | 0.9x | 0.77 | x | 2.79 | x | 19.64 | x | 0.63 | x | 0.7 | = | 16.75 | (80) |
| West | 0.9x | 0.77 | x | 2.88 | x | 19.64 | x | 0.63 | x | 0.7 | = | 17.29 | (80) |
| West | 0.9x | 0.77 | x | 1.3 | x | 19.64 | x | 0.63 | x | 0.7 | = | 46.82 | (80) |
| West | 0.9x | 0.77 | x | 2.68 | x | 19.64 | x | 0.63 | x | 0.7 | = | 32.17 | (80) |
| West | 0.9x | 0.77 | x | 2.88 | x | 19.64 | x | 0.63 | x | 0.7 | = | 17.29 | (80) |
| West | 0.9x | 0.77 | x | 2.06 | x | 19.64 | x | 0.63 | x | 0.7 | = | 12.36 | (80) |
| West | 0.9x | 0.77 | x | 1.36 | x | 38.42 | x | 0.63 | x | 0.7 | = | 31.94 | (80) |
| West | 0.9x | 0.77 | x | 2.79 | x | 38.42 | x | 0.63 | x | 0.7 | = | 32.76 | (80) |
| West | 0.9x | 0.77 | x | 2.88 | x | 38.42 | x | 0.63 | x | 0.7 | = | 33.82 | (80) |
| West | 0.9x | 0.77 | x | 1.3 | x | 38.42 | x | 0.63 | x | 0.7 | = | 91.59 | (80) |
| West | 0.9x | 0.77 | x | 2.68 | x | 38.42 | x | 0.63 | x | 0.7 | = | 62.94 | (80) |
| West | 0.9x | 0.77 | x | 2.88 | x | 38.42 | x | 0.63 | x | 0.7 | = | 33.82 | (80) |
| West | 0.9x | 0.77 | x | 2.06 | x | 38.42 | x | 0.63 | x | 0.7 | = | 24.19 | (80) |
| West | 0.9x | 0.77 | x | 1.36 | x | 63.27 | x | 0.63 | x | 0.7 | = | 52.6 | (80) |
| West | 0.9x | 0.77 | x | 2.79 | x | 63.27 | x | 0.63 | x | 0.7 | = | 53.95 | (80) |
| West | 0.9x | 0.77 | x | 2.88 | x | 63.27 | x | 0.63 | x | 0.7 | = | 55.69 | (80) |
| West | 0.9x | 0.77 | x | 1.3 | x | 63.27 | x | 0.63 | x | 0.7 | = | 150.83 | (80) |
| West | 0.9x | 0.77 | x | 2.68 | x | 63.27 | x | 0.63 | x | 0.7 | = | 103.65 | (80) |
| West | 0.9x | 0.77 | x | 2.88 | x | 63.27 | x | 0.63 | x | 0.7 | = | 55.69 | (80) |
| West | 0.9x | 0.77 | x | 2.06 | x | 63.27 | x | 0.63 | x | 0.7 | = | 39.83 | (80) |
| West | 0.9x | 0.77 | x | 1.36 | x | 92.28 | x | 0.63 | x | 0.7 | = | 76.71 | (80) |
| West | 0.9x | 0.77 | x | 2.79 | x | 92.28 | x | 0.63 | x | 0.7 | = | 78.68 | (80) |
| West | 0.9x | 0.77 | x | 2.88 | x | 92.28 | x | 0.63 | x | 0.7 | = | 81.22 | (80) |

# TER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 1.3 | x | 92.28 | x | 0.63 | x | 0.7 | = | 219.98 | (80) |
| West | 0.9x | 0.77 | x | 2.68 | x | 92.28 | x | 0.63 | x | 0.7 | = | 151.16 | (80) |
| West | 0.9x | 0.77 | x | 2.88 | x | 92.28 | x | 0.63 | x | 0.7 | = | 81.22 | (80) |
| West | 0.9x | 0.77 | x | 2.06 | x | 92.28 | x | 0.63 | x | 0.7 | = | 58.1 | (80) |
| West | 0.9x | 0.77 | x | 1.36 | x | 113.09 | x | 0.63 | x | 0.7 | = | 94.01 | (80) |
| West | 0.9x | 0.77 | x | 2.79 | x | 113.09 | x | 0.63 | x | 0.7 | = | 96.43 | (80) |
| West | 0.9x | 0.77 | x | 2.88 | x | 113.09 | x | 0.63 | x | 0.7 | = | 99.54 | (80) |
| West | 0.9x | 0.77 | x | 1.3 | x | 113.09 | x | 0.63 | x | 0.7 | = | 269.59 | (80) |
| West | 0.9x | 0.77 | x | 2.68 | x | 113.09 | x | 0.63 | x | 0.7 | = | 185.26 | (80) |
| West | 0.9x | 0.77 | x | 2.88 | x | 113.09 | x | 0.63 | x | 0.7 | = | 99.54 | (80) |
| West | 0.9x | 0.77 | x | 2.06 | x | 113.09 | x | 0.63 | x | 0.7 | = | 71.2 | (80) |
| West | 0.9x | 0.77 | x | 1.36 | x | 115.77 | x | 0.63 | x | 0.7 | = | 96.24 | (80) |
| West | 0.9x | 0.77 | x | 2.79 | x | 115.77 | x | 0.63 | x | 0.7 | = | 98.71 | (80) |
| West | 0.9x | 0.77 | x | 2.88 | x | 115.77 | x | 0.63 | x | 0.7 | = | 101.9 | (80) |
| West | 0.9x | 0.77 | x | 1.3 | x | 115.77 | x | 0.63 | x | 0.7 | = | 275.97 | (80) |
| West | 0.9x | 0.77 | x | 2.68 | x | 115.77 | x | 0.63 | x | 0.7 | = | 189.64 | (80) |
| West | 0.9x | 0.77 | x | 2.88 | x | 115.77 | x | 0.63 | x | 0.7 | = | 101.9 | (80) |
| West | 0.9x | 0.77 | x | 2.06 | x | 115.77 | x | 0.63 | x | 0.7 | = | 72.88 | (80) |
| West | 0.9x | 0.77 | x | 1.36 | x | 110.22 | x | 0.63 | x | 0.7 | = | 91.62 | (80) |
| West | 0.9x | 0.77 | x | 2.79 | x | 110.22 | x | 0.63 | x | 0.7 | = | 93.98 | (80) |
| West | 0.9x | 0.77 | x | 2.88 | x | 110.22 | x | 0.63 | x | 0.7 | = | 97.01 | (80) |
| West | 0.9x | 0.77 | x | 1.3 | x | 110.22 | x | 0.63 | x | 0.7 | = | 262.74 | (80) |
| West | 0.9x | 0.77 | x | 2.68 | x | 110.22 | x | 0.63 | x | 0.7 | = | 180.55 | (80) |
| West | 0.9x | 0.77 | x | 2.88 | x | 110.22 | x | 0.63 | x | 0.7 | = | 97.01 | (80) |
| West | 0.9x | 0.77 | x | 2.06 | x | 110.22 | x | 0.63 | x | 0.7 | = | 69.39 | (80) |
| West | 0.9x | 0.77 | x | 1.36 | x | 94.68 | x | 0.63 | x | 0.7 | = | 78.7 | (80) |
| West | 0.9x | 0.77 | x | 2.79 | x | 94.68 | x | 0.63 | x | 0.7 | = | 80.73 | (80) |
| West | 0.9x | 0.77 | x | 2.88 | x | 94.68 | x | 0.63 | x | 0.7 | = | 83.33 | (80) |
| West | 0.9x | 0.77 | x | 1.3 | x | 94.68 | x | 0.63 | x | 0.7 | = | 225.69 | (80) |
| West | 0.9x | 0.77 | x | 2.68 | x | 94.68 | x | 0.63 | x | 0.7 | = | 155.09 | (80) |
| West | 0.9x | 0.77 | x | 2.88 | x | 94.68 | x | 0.63 | x | 0.7 | = | 83.33 | (80) |
| West | 0.9x | 0.77 | x | 2.06 | x | 94.68 | x | 0.63 | x | 0.7 | = | 59.6 | (80) |
| West | 0.9x | 0.77 | x | 1.36 | x | 73.59 | x | 0.63 | x | 0.7 | = | 61.17 | (80) |
| West | 0.9x | 0.77 | x | 2.79 | x | 73.59 | x | 0.63 | x | 0.7 | = | 62.75 | (80) |
| West | 0.9x | 0.77 | x | 2.88 | x | 73.59 | x | 0.63 | x | 0.7 | = | 64.77 | (80) |
| West | 0.9x | 0.77 | x | 1.3 | x | 73.59 | x | 0.63 | x | 0.7 | = | 175.42 | (80) |
| West | 0.9x | 0.77 | x | 2.68 | x | 73.59 | x | 0.63 | x | 0.7 | = | 120.55 | (80) |
| West | 0.9x | 0.77 | x | 2.88 | x | 73.59 | x | 0.63 | x | 0.7 | = | 64.77 | (80) |
| West | 0.9x | 0.77 | x | 2.06 | x | 73.59 | x | 0.63 | x | 0.7 | = | 46.33 | (80) |
| West | 0.9x | 0.77 | x | 1.36 | x | 45.59 | x | 0.63 | x | 0.7 | = | 37.9 | (80) |
| West | 0.9x | 0.77 | x | 2.79 | x | 45.59 | x | 0.63 | x | 0.7 | = | 38.87 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 2.88 | x | 45.59 | x | 0.63 | x | 0.7 | = | 40.13 | (80) |
| West | 0.9x | 0.77 | x | 1.3 | x | 45.59 | x | 0.63 | x | 0.7 | = | 108.67 | (80) |
| West | 0.9x | 0.77 | x | 2.68 | x | 45.59 | x | 0.63 | x | 0.7 | = | 74.68 | (80) |
| West | 0.9x | 0.77 | x | 2.88 | x | 45.59 | x | 0.63 | x | 0.7 | = | 40.13 | (80) |
| West | 0.9x | 0.77 | x | 2.06 | x | 45.59 | x | 0.63 | x | 0.7 | = | 28.7 | (80) |
| West | 0.9x | 0.77 | x | 1.36 | x | 24.49 | x | 0.63 | x | 0.7 | = | 20.36 | (80) |
| West | 0.9x | 0.77 | x | 2.79 | x | 24.49 | x | 0.63 | x | 0.7 | = | 20.88 | (80) |
| West | 0.9x | 0.77 | x | 2.88 | x | 24.49 | x | 0.63 | x | 0.7 | = | 21.55 | (80) |
| West | 0.9x | 0.77 | x | 1.3 | x | 24.49 | x | 0.63 | x | 0.7 | = | 58.38 | (80) |
| West | 0.9x | 0.77 | x | 2.68 | x | 24.49 | x | 0.63 | x | 0.7 | = | 40.12 | (80) |
| West | 0.9x | 0.77 | x | 2.88 | x | 24.49 | x | 0.63 | x | 0.7 | = | 21.55 | (80) |
| West | 0.9x | 0.77 | x | 2.06 | x | 24.49 | x | 0.63 | x | 0.7 | = | 15.42 | (80) |
| West | 0.9x | 0.77 | x | 1.36 | x | 16.15 | x | 0.63 | x | 0.7 | = | 13.43 | (80) |
| West | 0.9x | 0.77 | x | 2.79 | x | 16.15 | x | 0.63 | x | 0.7 | = | 13.77 | (80) |
| West | 0.9x | 0.77 | x | 2.88 | x | 16.15 | x | 0.63 | x | 0.7 | = | 14.22 | (80) |
| West | 0.9x | 0.77 | x | 1.3 | x | 16.15 | x | 0.63 | x | 0.7 | = | 38.5 | (80) |
| West | 0.9x | 0.77 | x | 2.68 | x | 16.15 | x | 0.63 | x | 0.7 | = | 26.46 | (80) |
| West | 0.9x | 0.77 | x | 2.88 | x | 16.15 | x | 0.63 | x | 0.7 | = | 14.22 | (80) |
| West | 0.9x | 0.77 | x | 2.06 | x | 16.15 | x | 0.63 | x | 0.7 | = | 10.17 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 445.27 | 814.54 | 1233.34 | 1678.23 | 1981.16 | 2001.94 | 1916.17 | 1691.09 | 1390.86 | 935.19 | 544.28 | 373.59 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 1082.48 | 1449.45 | 1846.89 | 2256.53 | 2522.17 | 2508.13 | 2400.44 | 2182.1 | 1900.58 | 1480.4 | 1130.38 | 991.81 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 0.99 | 0.95 | 0.86 | 0.71 | 0.54 | 0.61 | 0.86 | 0.98 | 1 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.36 | 19.58 | 19.93 | 20.37 | 20.73 | 20.92 | 20.98 | 20.97 | 20.8 | 20.3 | 19.74 | 19.32 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.79 | 19.79 | 19.79 | 19.8 | 19.8 | 19.81 | 19.81 | 19.81 | 19.8 | 19.8 | 19.8 | 19.79 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 1 | 0.98 | 0.94 | 0.81 | 0.6 | 0.41 | 0.47 | 0.78 | 0.97 | 1 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.61 | 17.93 | 18.44 | 19.07 | 19.54 | 19.76 | 19.8 | 19.79 | 19.65 | 18.98 | 18.17 | 17.56 | (90) |

fLA = Living area ÷ (4) = 0.29 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.12 | 18.41 | 18.87 | 19.44 | 19.88 | 20.09 | 20.14 | 20.13 | 19.98 | 19.37 | 18.62 | 18.07 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.12 | 18.41 | 18.87 | 19.44 | 19.88 | 20.09 | 20.14 | 20.13 | 19.98 | 19.37 | 18.62 | 18.07 | | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.98 | 0.93 | 0.82 | 0.63 | 0.45 | 0.51 | 0.8 | 0.97 | 1 | 1 | | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | | |
| (95)m= | 1080.58 | 1440.6 | 1808.1 | 2098.13 | 2058.36 | 1578.86 | 1068.86 | 1112.82 | 1511.61 | 1431.98 | 1125.52 | 990.62 | | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | | |
| (97)m= | 4315.28 | 4213.21 | 3853.27 | 3260.4 | 2525.97 | 1685.88 | 1086.71 | 1144.7 | 1809.43 | 2706.85 | 3567.55 | 4306.11 | | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | | |
| (98)m= | 2406.62 | 1863.19 | 1521.61 | 836.84 | 347.9 | 0 | 0 | 0 | 0 | 948.5 | 1758.26 | 2466.73 | | |
| Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | | | | | | | | | | | | | 12149.64 | (98) |
| Space heating requirement in kWh/m²/year | | | | | | | | | | | | | 53.26 | (99) |

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary system | | 0 | (201) |
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.5 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | | | | | | | | | | | | | | |
| | 2406.62 | 1863.19 | 1521.61 | 836.84 | 347.9 | 0 | 0 | 0 | 0 | 948.5 | 1758.26 | 2466.73 | | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | | (211) |
| | 2573.92 | 1992.72 | 1627.39 | 895.01 | 372.08 | 0 | 0 | 0 | 0 | 1014.44 | 1880.49 | 2638.21 | | |
| Total (kWh/year) =Sum(211)$_{1...5,10....12}$= | | | | | | | | | | | | | 12994.27 | (211) |
| Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) | | | | | | | | | | | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Total (kWh/year) =Sum(215)$_{1...5,10....12}$= | | | | | | | | | | | | | 0 | (215) |

**Water heating**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Output from water heater (calculated above) | | | | | | | | | | | | | | |
| | 225.25 | 198.49 | 208.34 | 186.6 | 182.74 | 163.12 | 156.49 | 171.95 | 171.71 | 193.5 | 204.81 | 219.78 | | |
| Efficiency of water heater | | | | | | | | | | | | | 79.8 | (216) |
| (217)m= | 89.47 | 89.35 | 89.06 | 88.34 | 86.51 | 79.8 | 79.8 | 79.8 | 79.8 | 88.49 | 89.25 | 89.52 | | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m | | | | | | | | | | | | | | |
| (219)m= | 251.76 | 222.16 | 233.93 | 211.23 | 211.25 | 204.41 | 196.11 | 215.47 | 215.18 | 218.67 | 229.48 | 245.51 | | |
| Total = Sum(219a)$_{1...12}$ = | | | | | | | | | | | | | 2655.15 | (219) |

| **Annual totals** | **kWh/year** | **kWh/year** |
|---|---|---|
| Space heating fuel used, main system 1 | | 12994.27 |

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| | | | | |
|---|---|---|---|---|
| Water heating fuel used | | | 2655.15 | |
| Electricity for pumps, fans and electric keep-hot | | | | |
| central heating pump: | | 30 | | (230c) |
| boiler with a fan-assisted flue | | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | | 625.12 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | | Emissions kg CO2/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 2806.76 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 573.51 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 3380.28 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 324.44 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 3743.64 | (272) |

**TER =** 16.41 (273)

# TER WorkSheet: New dwelling design stage

User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

Property Address: H2

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 71.45 | (1a) | x | 2.55 | (2a) | = | 182.2 | (3a) |
| First floor | 71.77 | (1b) | x | 3 | (2b) | = | 215.31 | (3b) |
| Second floor | 36.89 | (1c) | x | 3 | (2c) | = | 110.67 | (3c) |
| Third floor | 35.72 | (1d) | x | 3 | (2d) | = | 107.16 | (3d) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 215.83 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | | = | 615.34 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 4 | x 10 = | 40 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 40 | ÷ (5) = | 0.07 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.32 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.27 | (21) |

Infiltration rate modified for monthly wind speed

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|

# TER WorkSheet: New dwelling design stage

Monthly average wind speed from Table 7

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

Wind Factor (22a)m = (22)m ÷ 4

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.34 | 0.33 | 0.33 | 0.29 | 0.29 | 0.25 | 0.25 | 0.25 | 0.27 | 0.29 | 0.3 | 0.31 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.56 | 0.56 | 0.55 | 0.54 | 0.54 | 0.53 | 0.53 | 0.53 | 0.54 | 0.54 | 0.55 | 0.55 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.56 | 0.56 | 0.55 | 0.54 | 0.54 | 0.53 | 0.53 | 0.53 | 0.54 | 0.54 | 0.55 | 0.55 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 1.93 | x1/[1/( 1.4 )+ 0.04] | = | 2.56 | | | (27) |
| Windows Type 2 | | | 3.62 | x1/[1/( 1.4 )+ 0.04] | = | 4.8 | | | (27) |
| Windows Type 3 | | | 1.83 | x1/[1/( 1.4 )+ 0.04] | = | 2.43 | | | (27) |
| Windows Type 4 | | | 1.76 | x1/[1/( 1.4 )+ 0.04] | = | 2.33 | | | (27) |
| Windows Type 5 | | | 1.73 | x1/[1/( 1.4 )+ 0.04] | = | 2.29 | | | (27) |
| Windows Type 6 | | | 1.33 | x1/[1/( 1.4 )+ 0.04] | = | 1.76 | | | (27) |
| Windows Type 7 | | | 1.94 | x1/[1/( 1.4 )+ 0.04] | = | 2.57 | | | (27) |
| Windows Type 8 | | | 1.73 | x1/[1/( 1.4 )+ 0.04] | = | 2.29 | | | (27) |
| Windows Type 9 | | | 3.45 | x1/[1/( 1.4 )+ 0.04] | = | 4.57 | | | (27) |
| Windows Type 10 | | | 6.76 | x1/[1/( 1.4 )+ 0.04] | = | 8.96 | | | (27) |
| Floor | | | 71.45 | x 0.13 | = | 9.288499 | | | (28) |
| Walls | 187.5 | 53.96 | 133.54 | x 0.18 | = | 24.04 | | | (29) |
| Roof Type1 | 35.25 | 0 | 35.25 | x 0.13 | = | 4.58 | | | (30) |
| Roof Type2 | 35.72 | 0 | 35.72 | x 0.13 | = | 4.64 | | | (30) |

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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Total area of elements, m² | 329.92 | | | | | | | (31) |
| Party wall | 190.02 | x | 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

| | | | |
|---|---|---|---|
| Fabric heat loss, W/K = S (A x U) | (26)…(30) + (32) = | 114.09 | (33) |
| Heat capacity Cm = S(A x k ) | ((28)…(30) + (32) + (32a)…(32e) = | 25061.53 | (34) |
| Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K | Indicative Value: Medium | 250 | (35) |

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

| | | | |
|---|---|---|---|
| Thermal bridges : S (L x Y) calculated using Appendix K | | 29.83 | (36) |

*if details of thermal bridging are not known (36) = 0.15 x (31)*

| | | | |
|---|---|---|---|
| Total fabric heat loss | (33) + (36) = | 143.92 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 113.36 | 112.9 | 112.45 | 110.34 | 109.94 | 108.1 | 108.1 | 107.76 | 108.81 | 109.94 | 110.74 | 111.58 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 257.29 | 256.83 | 256.38 | 254.26 | 253.87 | 252.02 | 252.02 | 251.68 | 252.73 | 253.87 | 254.67 | 255.5 | |

Average = $\text{Sum}(39)_{1\ldots12}$ /12= 254.26 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.19 | 1.19 | 1.19 | 1.18 | 1.18 | 1.17 | 1.17 | 1.17 | 1.17 | 1.18 | 1.18 | 1.18 | |

Average = $\text{Sum}(40)_{1\ldots12}$ /12= 1.18 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 3.02 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 105.98 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | | |
| (44)m= | 116.58 | 112.34 | 108.1 | 103.86 | 99.63 | 95.39 | 95.39 | 99.63 | 103.86 | 108.1 | 112.34 | 116.58 | |

Total = $\text{Sum}(44)_{1\ldots12}$ = 1271.81 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 172.89 | 151.21 | 156.04 | 136.04 | 130.53 | 112.64 | 104.37 | 119.77 | 121.2 | 141.25 | 154.18 | 167.43 | |

Total = $\text{Sum}(45)_{1\ldots12}$ = 1667.55 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 25.93 | 22.68 | 23.41 | 20.41 | 19.58 | 16.9 | 15.66 | 17.97 | 18.18 | 21.19 | 23.13 | 25.12 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

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| | | | |
|---|---|---|---|
| a) If manufacturer's declared loss factor is known (kWh/day): | | 1.7 | (48) |
| Temperature factor from Table 2b | | 0.54 | (49) |
| Energy lost from water storage, kWh/year | (48) x (49) = | 0.92 | (50) |
| b) If manufacturer's declared cylinder loss factor is not known: | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | 0 | (51) |
| If community heating see section 4.3 | | | |
| Volume factor from Table 2a | | 0 | (52) |
| Temperature factor from Table 2b | | 0 | (53) |
| Energy lost from water storage, kWh/year | (47) x (51) x (52) x (53) = | 0 | (54) |
| Enter (50) or (54) in (55) | | 0.92 | (55) |

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 28.48 | 25.73 | 28.48 | 27.57 | 28.48 | 27.57 | 28.48 | 28.48 | 27.57 | 28.48 | 27.57 | 28.48 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 28.48 | 25.73 | 28.48 | 27.57 | 28.48 | 27.57 | 28.48 | 28.48 | 27.57 | 28.48 | 27.57 | 28.48 | (57) |

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 224.64 | 197.95 | 207.78 | 186.11 | 182.28 | 162.71 | 156.12 | 171.52 | 171.28 | 193 | 204.26 | 219.18 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 224.64 | 197.95 | 207.78 | 186.11 | 182.28 | 162.71 | 156.12 | 171.52 | 171.28 | 193 | 204.26 | 219.18 |

Output from water heater (annual)$_{1...12}$ — 2276.82 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 98.88 | 87.67 | 93.28 | 85.29 | 84.8 | 77.51 | 76.1 | 81.22 | 80.36 | 88.36 | 91.33 | 97.07 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 151.13 | 151.13 | 151.13 | 151.13 | 151.13 | 151.13 | 151.13 | 151.13 | 151.13 | 151.13 | 151.13 | 151.13 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 34.4 | 30.55 | 24.85 | 18.81 | 14.06 | 11.87 | 12.83 | 16.67 | 22.38 | 28.42 | 33.16 | 35.36 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 385.85 | 389.86 | 379.77 | 358.29 | 331.17 | 305.69 | 288.66 | 284.66 | 294.75 | 316.23 | 343.34 | 368.83 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 38.11 | 38.11 | 38.11 | 38.11 | 38.11 | 38.11 | 38.11 | 38.11 | 38.11 | 38.11 | 38.11 | 38.11 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -120.9 | -120.9 | -120.9 | -120.9 | -120.9 | -120.9 | -120.9 | -120.9 | -120.9 | -120.9 | -120.9 | -120.9 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 132.91 | 130.46 | 125.37 | 118.46 | 113.98 | 107.66 | 102.29 | 109.17 | 111.61 | 118.77 | 126.84 | 130.47 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 624.5 | 622.21 | 601.33 | 566.9 | 530.55 | 496.55 | 475.12 | 481.84 | 500.08 | 534.75 | 574.69 | 605.99 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 1.94 | x | 19.64 | x | 0.63 | x | 0.7 | = | 11.64 | (76) |
| East | 0.9x | 3 | x | 1.73 | x | 19.64 | x | 0.63 | x | 0.7 | = | 31.15 | (76) |
| East | 0.9x | 3 | x | 3.45 | x | 19.64 | x | 0.63 | x | 0.7 | = | 62.12 | (76) |
| East | 0.9x | 1 | x | 1.94 | x | 38.42 | x | 0.63 | x | 0.7 | = | 22.78 | (76) |
| East | 0.9x | 3 | x | 1.73 | x | 38.42 | x | 0.63 | x | 0.7 | = | 60.94 | (76) |
| East | 0.9x | 3 | x | 3.45 | x | 38.42 | x | 0.63 | x | 0.7 | = | 121.53 | (76) |
| East | 0.9x | 1 | x | 1.94 | x | 63.27 | x | 0.63 | x | 0.7 | = | 37.51 | (76) |
| East | 0.9x | 3 | x | 1.73 | x | 63.27 | x | 0.63 | x | 0.7 | = | 100.36 | (76) |
| East | 0.9x | 3 | x | 3.45 | x | 63.27 | x | 0.63 | x | 0.7 | = | 200.14 | (76) |
| East | 0.9x | 1 | x | 1.94 | x | 92.28 | x | 0.63 | x | 0.7 | = | 54.71 | (76) |
| East | 0.9x | 3 | x | 1.73 | x | 92.28 | x | 0.63 | x | 0.7 | = | 146.37 | (76) |
| East | 0.9x | 3 | x | 3.45 | x | 92.28 | x | 0.63 | x | 0.7 | = | 291.89 | (76) |
| East | 0.9x | 1 | x | 1.94 | x | 113.09 | x | 0.63 | x | 0.7 | = | 67.05 | (76) |
| East | 0.9x | 3 | x | 1.73 | x | 113.09 | x | 0.63 | x | 0.7 | = | 179.38 | (76) |
| East | 0.9x | 3 | x | 3.45 | x | 113.09 | x | 0.63 | x | 0.7 | = | 357.72 | (76) |
| East | 0.9x | 1 | x | 1.94 | x | 115.77 | x | 0.63 | x | 0.7 | = | 68.64 | (76) |
| East | 0.9x | 3 | x | 1.73 | x | 115.77 | x | 0.63 | x | 0.7 | = | 183.63 | (76) |
| East | 0.9x | 3 | x | 3.45 | x | 115.77 | x | 0.63 | x | 0.7 | = | 366.19 | (76) |
| East | 0.9x | 1 | x | 1.94 | x | 110.22 | x | 0.63 | x | 0.7 | = | 65.35 | (76) |
| East | 0.9x | 3 | x | 1.73 | x | 110.22 | x | 0.63 | x | 0.7 | = | 174.82 | (76) |
| East | 0.9x | 3 | x | 3.45 | x | 110.22 | x | 0.63 | x | 0.7 | = | 348.63 | (76) |
| East | 0.9x | 1 | x | 1.94 | x | 94.68 | x | 0.63 | x | 0.7 | = | 56.13 | (76) |
| East | 0.9x | 3 | x | 1.73 | x | 94.68 | x | 0.63 | x | 0.7 | = | 150.17 | (76) |
| East | 0.9x | 3 | x | 3.45 | x | 94.68 | x | 0.63 | x | 0.7 | = | 299.47 | (76) |
| East | 0.9x | 1 | x | 1.94 | x | 73.59 | x | 0.63 | x | 0.7 | = | 43.63 | (76) |
| East | 0.9x | 3 | x | 1.73 | x | 73.59 | x | 0.63 | x | 0.7 | = | 116.72 | (76) |
| East | 0.9x | 3 | x | 3.45 | x | 73.59 | x | 0.63 | x | 0.7 | = | 232.77 | (76) |
| East | 0.9x | 1 | x | 1.94 | x | 45.59 | x | 0.63 | x | 0.7 | = | 27.03 | (76) |
| East | 0.9x | 3 | x | 1.73 | x | 45.59 | x | 0.63 | x | 0.7 | = | 72.31 | (76) |
| East | 0.9x | 3 | x | 3.45 | x | 45.59 | x | 0.63 | x | 0.7 | = | 144.2 | (76) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 1.94 | x | 24.49 | x | 0.63 | x | 0.7 | = | 14.52 | (76) |
| East | 0.9x | 3 | x | 1.73 | x | 24.49 | x | 0.63 | x | 0.7 | = | 38.84 | (76) |
| East | 0.9x | 3 | x | 3.45 | x | 24.49 | x | 0.63 | x | 0.7 | = | 77.46 | (76) |
| East | 0.9x | 1 | x | 1.94 | x | 16.15 | x | 0.63 | x | 0.7 | = | 9.58 | (76) |
| East | 0.9x | 3 | x | 1.73 | x | 16.15 | x | 0.63 | x | 0.7 | = | 25.62 | (76) |
| East | 0.9x | 3 | x | 3.45 | x | 16.15 | x | 0.63 | x | 0.7 | = | 51.09 | (76) |
| South | 0.9x | 0.77 | x | 1.73 | x | 46.75 | x | 0.63 | x | 0.7 | = | 24.72 | (78) |
| South | 0.9x | 0.77 | x | 1.33 | x | 46.75 | x | 0.63 | x | 0.7 | = | 19 | (78) |
| South | 0.9x | 0.77 | x | 6.76 | x | 46.75 | x | 0.63 | x | 0.7 | = | 193.17 | (78) |
| South | 0.9x | 0.77 | x | 1.73 | x | 76.57 | x | 0.63 | x | 0.7 | = | 40.48 | (78) |
| South | 0.9x | 0.77 | x | 1.33 | x | 76.57 | x | 0.63 | x | 0.7 | = | 31.12 | (78) |
| South | 0.9x | 0.77 | x | 6.76 | x | 76.57 | x | 0.63 | x | 0.7 | = | 316.37 | (78) |
| South | 0.9x | 0.77 | x | 1.73 | x | 97.53 | x | 0.63 | x | 0.7 | = | 51.57 | (78) |
| South | 0.9x | 0.77 | x | 1.33 | x | 97.53 | x | 0.63 | x | 0.7 | = | 39.64 | (78) |
| South | 0.9x | 0.77 | x | 6.76 | x | 97.53 | x | 0.63 | x | 0.7 | = | 403 | (78) |
| South | 0.9x | 0.77 | x | 1.73 | x | 110.23 | x | 0.63 | x | 0.7 | = | 58.28 | (78) |
| South | 0.9x | 0.77 | x | 1.33 | x | 110.23 | x | 0.63 | x | 0.7 | = | 44.81 | (78) |
| South | 0.9x | 0.77 | x | 6.76 | x | 110.23 | x | 0.63 | x | 0.7 | = | 455.48 | (78) |
| South | 0.9x | 0.77 | x | 1.73 | x | 114.87 | x | 0.63 | x | 0.7 | = | 60.73 | (78) |
| South | 0.9x | 0.77 | x | 1.33 | x | 114.87 | x | 0.63 | x | 0.7 | = | 46.69 | (78) |
| South | 0.9x | 0.77 | x | 6.76 | x | 114.87 | x | 0.63 | x | 0.7 | = | 474.63 | (78) |
| South | 0.9x | 0.77 | x | 1.73 | x | 110.55 | x | 0.63 | x | 0.7 | = | 58.45 | (78) |
| South | 0.9x | 0.77 | x | 1.33 | x | 110.55 | x | 0.63 | x | 0.7 | = | 44.93 | (78) |
| South | 0.9x | 0.77 | x | 6.76 | x | 110.55 | x | 0.63 | x | 0.7 | = | 456.77 | (78) |
| South | 0.9x | 0.77 | x | 1.73 | x | 108.01 | x | 0.63 | x | 0.7 | = | 57.11 | (78) |
| South | 0.9x | 0.77 | x | 1.33 | x | 108.01 | x | 0.63 | x | 0.7 | = | 43.9 | (78) |
| South | 0.9x | 0.77 | x | 6.76 | x | 108.01 | x | 0.63 | x | 0.7 | = | 446.29 | (78) |
| South | 0.9x | 0.77 | x | 1.73 | x | 104.89 | x | 0.63 | x | 0.7 | = | 55.46 | (78) |
| South | 0.9x | 0.77 | x | 1.33 | x | 104.89 | x | 0.63 | x | 0.7 | = | 42.64 | (78) |
| South | 0.9x | 0.77 | x | 6.76 | x | 104.89 | x | 0.63 | x | 0.7 | = | 433.41 | (78) |
| South | 0.9x | 0.77 | x | 1.73 | x | 101.89 | x | 0.63 | x | 0.7 | = | 53.87 | (78) |
| South | 0.9x | 0.77 | x | 1.33 | x | 101.89 | x | 0.63 | x | 0.7 | = | 41.41 | (78) |
| South | 0.9x | 0.77 | x | 6.76 | x | 101.89 | x | 0.63 | x | 0.7 | = | 420.98 | (78) |
| South | 0.9x | 0.77 | x | 1.73 | x | 82.59 | x | 0.63 | x | 0.7 | = | 43.66 | (78) |
| South | 0.9x | 0.77 | x | 1.33 | x | 82.59 | x | 0.63 | x | 0.7 | = | 33.57 | (78) |
| South | 0.9x | 0.77 | x | 6.76 | x | 82.59 | x | 0.63 | x | 0.7 | = | 341.23 | (78) |
| South | 0.9x | 0.77 | x | 1.73 | x | 55.42 | x | 0.63 | x | 0.7 | = | 29.3 | (78) |
| South | 0.9x | 0.77 | x | 1.33 | x | 55.42 | x | 0.63 | x | 0.7 | = | 22.53 | (78) |
| South | 0.9x | 0.77 | x | 6.76 | x | 55.42 | x | 0.63 | x | 0.7 | = | 228.98 | (78) |
| South | 0.9x | 0.77 | x | 1.73 | x | 40.4 | x | 0.63 | x | 0.7 | = | 21.36 | (78) |
| South | 0.9x | 0.77 | x | 1.33 | x | 40.4 | x | 0.63 | x | 0.7 | = | 16.42 | (78) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South | 0.9x | 0.77 | x | 6.76 | x | 40.4 | x | 0.63 | x | 0.7 | = | 166.92 | (78) |
| West | 0.9x | 0.77 | x | 1.93 | x | 19.64 | x | 0.63 | x | 0.7 | = | 11.58 | (80) |
| West | 0.9x | 0.77 | x | 3.62 | x | 19.64 | x | 0.63 | x | 0.7 | = | 65.19 | (80) |
| West | 0.9x | 0.77 | x | 1.83 | x | 19.64 | x | 0.63 | x | 0.7 | = | 10.98 | (80) |
| West | 0.9x | 0.77 | x | 1.76 | x | 19.64 | x | 0.63 | x | 0.7 | = | 31.69 | (80) |
| West | 0.9x | 0.77 | x | 1.93 | x | 38.42 | x | 0.63 | x | 0.7 | = | 22.66 | (80) |
| West | 0.9x | 0.77 | x | 3.62 | x | 38.42 | x | 0.63 | x | 0.7 | = | 127.52 | (80) |
| West | 0.9x | 0.77 | x | 1.83 | x | 38.42 | x | 0.63 | x | 0.7 | = | 21.49 | (80) |
| West | 0.9x | 0.77 | x | 1.76 | x | 38.42 | x | 0.63 | x | 0.7 | = | 62 | (80) |
| West | 0.9x | 0.77 | x | 1.93 | x | 63.27 | x | 0.63 | x | 0.7 | = | 37.32 | (80) |
| West | 0.9x | 0.77 | x | 3.62 | x | 63.27 | x | 0.63 | x | 0.7 | = | 210 | (80) |
| West | 0.9x | 0.77 | x | 1.83 | x | 63.27 | x | 0.63 | x | 0.7 | = | 35.39 | (80) |
| West | 0.9x | 0.77 | x | 1.76 | x | 63.27 | x | 0.63 | x | 0.7 | = | 102.1 | (80) |
| West | 0.9x | 0.77 | x | 1.93 | x | 92.28 | x | 0.63 | x | 0.7 | = | 54.43 | (80) |
| West | 0.9x | 0.77 | x | 3.62 | x | 92.28 | x | 0.63 | x | 0.7 | = | 306.27 | (80) |
| West | 0.9x | 0.77 | x | 1.83 | x | 92.28 | x | 0.63 | x | 0.7 | = | 51.61 | (80) |
| West | 0.9x | 0.77 | x | 1.76 | x | 92.28 | x | 0.63 | x | 0.7 | = | 148.91 | (80) |
| West | 0.9x | 0.77 | x | 1.93 | x | 113.09 | x | 0.63 | x | 0.7 | = | 66.71 | (80) |
| West | 0.9x | 0.77 | x | 3.62 | x | 113.09 | x | 0.63 | x | 0.7 | = | 375.35 | (80) |
| West | 0.9x | 0.77 | x | 1.83 | x | 113.09 | x | 0.63 | x | 0.7 | = | 63.25 | (80) |
| West | 0.9x | 0.77 | x | 1.76 | x | 113.09 | x | 0.63 | x | 0.7 | = | 182.49 | (80) |
| West | 0.9x | 0.77 | x | 1.93 | x | 115.77 | x | 0.63 | x | 0.7 | = | 68.29 | (80) |
| West | 0.9x | 0.77 | x | 3.62 | x | 115.77 | x | 0.63 | x | 0.7 | = | 384.24 | (80) |
| West | 0.9x | 0.77 | x | 1.83 | x | 115.77 | x | 0.63 | x | 0.7 | = | 64.75 | (80) |
| West | 0.9x | 0.77 | x | 1.76 | x | 115.77 | x | 0.63 | x | 0.7 | = | 186.81 | (80) |
| West | 0.9x | 0.77 | x | 1.93 | x | 110.22 | x | 0.63 | x | 0.7 | = | 65.01 | (80) |
| West | 0.9x | 0.77 | x | 3.62 | x | 110.22 | x | 0.63 | x | 0.7 | = | 365.81 | (80) |
| West | 0.9x | 0.77 | x | 1.83 | x | 110.22 | x | 0.63 | x | 0.7 | = | 61.64 | (80) |
| West | 0.9x | 0.77 | x | 1.76 | x | 110.22 | x | 0.63 | x | 0.7 | = | 177.85 | (80) |
| West | 0.9x | 0.77 | x | 1.93 | x | 94.68 | x | 0.63 | x | 0.7 | = | 55.84 | (80) |
| West | 0.9x | 0.77 | x | 3.62 | x | 94.68 | x | 0.63 | x | 0.7 | = | 314.23 | (80) |
| West | 0.9x | 0.77 | x | 1.83 | x | 94.68 | x | 0.63 | x | 0.7 | = | 52.95 | (80) |
| West | 0.9x | 0.77 | x | 1.76 | x | 94.68 | x | 0.63 | x | 0.7 | = | 152.77 | (80) |
| West | 0.9x | 0.77 | x | 1.93 | x | 73.59 | x | 0.63 | x | 0.7 | = | 43.41 | (80) |
| West | 0.9x | 0.77 | x | 3.62 | x | 73.59 | x | 0.63 | x | 0.7 | = | 244.24 | (80) |
| West | 0.9x | 0.77 | x | 1.83 | x | 73.59 | x | 0.63 | x | 0.7 | = | 41.16 | (80) |
| West | 0.9x | 0.77 | x | 1.76 | x | 73.59 | x | 0.63 | x | 0.7 | = | 118.75 | (80) |
| West | 0.9x | 0.77 | x | 1.93 | x | 45.59 | x | 0.63 | x | 0.7 | = | 26.89 | (80) |
| West | 0.9x | 0.77 | x | 3.62 | x | 45.59 | x | 0.63 | x | 0.7 | = | 151.31 | (80) |
| West | 0.9x | 0.77 | x | 1.83 | x | 45.59 | x | 0.63 | x | 0.7 | = | 25.5 | (80) |
| West | 0.9x | 0.77 | x | 1.76 | x | 45.59 | x | 0.63 | x | 0.7 | = | 73.56 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 1.93 | x | 24.49 | x | 0.63 | x | 0.7 | = | 14.44 | (80) |
| West | 0.9x | 0.77 | x | 3.62 | x | 24.49 | x | 0.63 | x | 0.7 | = | 81.28 | (80) |
| West | 0.9x | 0.77 | x | 1.83 | x | 24.49 | x | 0.63 | x | 0.7 | = | 13.7 | (80) |
| West | 0.9x | 0.77 | x | 1.76 | x | 24.49 | x | 0.63 | x | 0.7 | = | 39.52 | (80) |
| West | 0.9x | 0.77 | x | 1.93 | x | 16.15 | x | 0.63 | x | 0.7 | = | 9.53 | (80) |
| West | 0.9x | 0.77 | x | 3.62 | x | 16.15 | x | 0.63 | x | 0.7 | = | 53.61 | (80) |
| West | 0.9x | 0.77 | x | 1.83 | x | 16.15 | x | 0.63 | x | 0.7 | = | 9.03 | (80) |
| West | 0.9x | 0.77 | x | 1.76 | x | 16.15 | x | 0.63 | x | 0.7 | = | 26.06 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 461.26 | 826.88 | 1217.03 | 1612.76 | 1874.01 | 1882.69 | 1806.42 | 1613.07 | 1356.93 | 939.27 | 560.56 | 389.21 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 1085.76 | 1449.09 | 1818.36 | 2179.65 | 2404.56 | 2379.25 | 2281.53 | 2094.9 | 1857.01 | 1474.02 | 1135.25 | 995.2 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 0.98 | 0.94 | 0.82 | 0.64 | 0.48 | 0.54 | 0.8 | 0.97 | 1 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.61 | 19.84 | 20.17 | 20.55 | 20.84 | 20.96 | 20.99 | 20.99 | 20.89 | 20.48 | 19.96 | 19.57 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.93 | 19.93 | 19.93 | 19.94 | 19.94 | 19.95 | 19.95 | 19.95 | 19.94 | 19.94 | 19.94 | 19.93 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.98 | 0.92 | 0.77 | 0.55 | 0.37 | 0.42 | 0.72 | 0.96 | 1 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.07 | 18.4 | 18.88 | 19.43 | 19.78 | 19.92 | 19.94 | 19.94 | 19.86 | 19.33 | 18.58 | 18.02 | (90) |

fLA = Living area ÷ (4) = | 0.14 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.29 | 18.6 | 19.06 | 19.59 | 19.94 | 20.07 | 20.09 | 20.09 | 20.01 | 19.5 | 18.78 | 18.24 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.29 | 18.6 | 19.06 | 19.59 | 19.94 | 20.07 | 20.09 | 20.09 | 20.01 | 19.5 | 18.78 | 18.24 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.97 | 0.91 | 0.77 | 0.56 | 0.38 | 0.44 | 0.73 | 0.95 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 1083.58 | 1437.92 | 1768.48 | 1980.3 | 1848.15 | 1338.93 | 875.78 | 920.15 | 1356.58 | 1406.39 | 1129.11 | 993.87 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 3599.64 | 3519.7 | 3220.6 | 2717.45 | 2090.74 | 1379.17 | 880.58 | 929.32 | 1493.23 | 2258.98 | 2974.14 | 3587.25 | (97) |

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 1871.95 | 1398.96 | 1080.38 | 530.75 | 180.49 | 0 | 0 | 0 | 0 | 634.33 | 1328.42 | 1929.48 | | |
| | | | | | | | | | Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | | | | 8954.75 | (98) |

Space heating requirement in kWh/m²/year — 41.49 (99)

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary system | | 0 | (201) |
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.5 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | 1871.95 | 1398.96 | 1080.38 | 530.75 | 180.49 | 0 | 0 | 0 | 0 | 634.33 | 1328.42 | 1929.48 | | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 2002.09 | 1496.21 | 1155.49 | 567.65 | 193.03 | 0 | 0 | 0 | 0 | 678.43 | 1420.77 | 2063.61 | | (211) |
| Total (kWh/year) =Sum(211)$_{1...5,10...12}$= | | | | | | | | | | | | | 9577.28 | (211) |
| Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) | | | | | | | | | | | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Total (kWh/year) =Sum(215)$_{1...5,10...12}$= | | | | | | | | | | | | | 0 | (215) |

**Water heating**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Output from water heater (calculated above) | 224.64 | 197.95 | 207.78 | 186.11 | 182.28 | 162.71 | 156.12 | 171.52 | 171.28 | 193 | 204.26 | 219.18 | | |
| Efficiency of water heater | | | | | | | | | | | | | 79.8 | (216) |
| (217)m= | 89.22 | 89.02 | 88.58 | 87.46 | 84.79 | 79.8 | 79.8 | 79.8 | 79.8 | 87.76 | 88.91 | 89.28 | | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m | | | | | | | | | | | | | | |
| (219)m= | 251.78 | 222.36 | 234.56 | 212.81 | 214.98 | 203.9 | 195.64 | 214.93 | 214.64 | 219.92 | 229.74 | 245.5 | | |
| Total = Sum(219a)$_{1...12}$ = | | | | | | | | | | | | | 2660.77 | (219) |

| **Annual totals** | **kWh/year** | **kWh/year** | |
|---|---|---|---|
| Space heating fuel used, main system 1 | | 9577.28 | |
| Water heating fuel used | | 2660.77 | |
| Electricity for pumps, fans and electric keep-hot | | | |
| central heating pump: | 30 | | (230c) |
| boiler with a fan-assisted flue | 45 | | (230e) |
| Total electricity for the above, kWh/year — sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | 607.5 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | **Emissions** kg CO2/year |
|---|---|---|---|

# TER WorkSheet: New dwelling design stage

| | | | | | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 2068.69 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 574.73 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 2643.42 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 315.29 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 2997.63 | (272) |

**TER =** 13.89 (273)

# TER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: P1

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 119.63 | (1a) x | 2.55 | (2a) = | 305.06 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 119.63 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 305.06 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 4 | x 10 = | 40 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 40 | ÷ (5) = | 0.13 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.38 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.32 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Monthly average wind speed from Table 7

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

Wind Factor (22a)m = (22)m ÷ 4

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.41 | 0.4 | 0.4 | 0.36 | 0.35 | 0.31 | 0.31 | 0.3 | 0.32 | 0.35 | 0.36 | 0.38 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.59 | 0.58 | 0.58 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.55 | 0.56 | 0.57 | 0.57 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.59 | 0.58 | 0.58 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.55 | 0.56 | 0.57 | 0.57 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.92 | x1/[1/( 1.4 )+ 0.04] | = | 6.52 | | | (27) |
| Windows Type 2 | | | 4.92 | x1/[1/( 1.4 )+ 0.04] | = | 6.52 | | | (27) |
| Windows Type 3 | | | 2.39 | x1/[1/( 1.4 )+ 0.04] | = | 3.17 | | | (27) |
| Floor | | | 119.63 | x 0.13 | = | 15.5519 | | | (28) |
| Walls Type1 | 74.77 | 12.23 | 62.54 | x 0.18 | = | 11.26 | | | (29) |
| Walls Type2 | 12.35 | 0 | 12.35 | x 0.18 | = | 2.22 | | | (29) |
| Total area of elements, m² | | | 206.75 | | | | | | (31) |
| Party wall | | | 36.38 | x 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 45.25 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 19289.8 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 11.05 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 56.3 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 58.92 | 58.59 | 58.26 | 56.73 | 56.44 | 55.1 | 55.1 | 54.85 | 55.62 | 56.44 | 57.02 | 57.63 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 115.22 | 114.88 | 114.56 | 113.02 | 112.73 | 111.4 | 111.4 | 111.15 | 111.91 | 112.73 | 113.32 | 113.92 | |

Average = Sum(39)$_{1…12}$ /12= 113.02 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.96 | 0.96 | 0.96 | 0.94 | 0.94 | 0.93 | 0.93 | 0.93 | 0.94 | 0.94 | 0.95 | 0.95 |

Average = Sum(40)$_{1…12}$ /12= 0.94 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.86 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 102.17 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 112.39 | 108.3 | 104.21 | 100.13 | 96.04 | 91.95 | 91.95 | 96.04 | 100.13 | 104.21 | 108.3 | 112.39 |

Total = Sum(44)$_{1…12}$ = 1226.03 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 166.67 | 145.77 | 150.42 | 131.14 | 125.83 | 108.58 | 100.62 | 115.46 | 116.84 | 136.16 | 148.63 | 161.41 |

Total = Sum(45)$_{1…12}$ = 1607.52 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 25 | 21.87 | 22.56 | 19.67 | 18.87 | 16.29 | 15.09 | 17.32 | 17.53 | 20.42 | 22.3 | 24.21 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.96 | 46.03 | 50.96 | 49.32 | 48.94 | 45.35 | 46.86 | 48.94 | 49.32 | 50.96 | 49.32 | 50.96 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 217.62 | 191.79 | 201.38 | 180.45 | 174.77 | 153.93 | 147.48 | 164.4 | 166.15 | 187.12 | 197.95 | 212.37 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 217.62 | 191.79 | 201.38 | 180.45 | 174.77 | 153.93 | 147.48 | 164.4 | 166.15 | 187.12 | 197.95 | 212.37 | |

Output from water heater (annual)$_{1...12}$ | 2195.42 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 68.16 | 59.97 | 62.75 | 55.93 | 54.07 | 47.44 | 45.17 | 50.63 | 51.18 | 58.01 | 61.75 | 66.41 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 143.09 | 143.09 | 143.09 | 143.09 | 143.09 | 143.09 | 143.09 | 143.09 | 143.09 | 143.09 | 143.09 | 143.09 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| (67)m= | 29.18 | 25.91 | 21.07 | 15.95 | 11.93 | 10.07 | 10.88 | 14.14 | 18.98 | 24.1 | 28.13 | 29.99 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| (68)m= | 284.73 | 287.69 | 280.24 | 264.39 | 244.38 | 225.58 | 213.01 | 210.06 | 217.5 | 233.35 | 253.36 | 272.17 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| (69)m= | 37.31 | 37.31 | 37.31 | 37.31 | 37.31 | 37.31 | 37.31 | 37.31 | 37.31 | 37.31 | 37.31 | 37.31 | (69) |
| Pumps and fans gains (Table 5a) | | | | | | | | | | | | | |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| (71)m= | -114.47 | -114.47 | -114.47 | -114.47 | -114.47 | -114.47 | -114.47 | -114.47 | -114.47 | -114.47 | -114.47 | -114.47 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| (72)m= | 91.61 | 89.25 | 84.35 | 77.68 | 72.68 | 65.89 | 60.71 | 68.05 | 71.08 | 77.98 | 85.76 | 89.26 | (72) |
| **Total internal gains =** | | | | | | (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m | | | | | | | |
| (73)m= | 474.44 | 471.77 | 454.59 | 426.96 | 397.91 | 370.46 | 353.53 | 361.17 | 376.49 | 404.36 | 436.18 | 460.34 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.92 | x | 19.64 | x | 0.63 | x | 0.7 | = | 29.53 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 38.42 | x | 0.63 | x | 0.7 | = | 57.77 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 63.27 | x | 0.63 | x | 0.7 | = | 95.14 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 92.28 | x | 0.63 | x | 0.7 | = | 138.75 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 113.09 | x | 0.63 | x | 0.7 | = | 170.05 | (76) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.92 | x | 115.77 | x | 0.63 | x | 0.7 | = | 174.07 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 110.22 | x | 0.63 | x | 0.7 | = | 165.73 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 94.68 | x | 0.63 | x | 0.7 | = | 142.36 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 73.59 | x | 0.63 | x | 0.7 | = | 110.65 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 45.59 | x | 0.63 | x | 0.7 | = | 68.55 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 24.49 | x | 0.63 | x | 0.7 | = | 36.82 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 16.15 | x | 0.63 | x | 0.7 | = | 24.29 | (76) |
| West | 0.9x | 0.77 | x | 4.92 | x | 19.64 | x | 0.63 | x | 0.7 | = | 29.53 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 19.64 | x | 0.63 | x | 0.7 | = | 14.35 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 38.42 | x | 0.63 | x | 0.7 | = | 57.77 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 38.42 | x | 0.63 | x | 0.7 | = | 28.06 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 63.27 | x | 0.63 | x | 0.7 | = | 95.14 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 63.27 | x | 0.63 | x | 0.7 | = | 46.22 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 92.28 | x | 0.63 | x | 0.7 | = | 138.75 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 92.28 | x | 0.63 | x | 0.7 | = | 67.4 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 113.09 | x | 0.63 | x | 0.7 | = | 170.05 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 113.09 | x | 0.63 | x | 0.7 | = | 82.6 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 115.77 | x | 0.63 | x | 0.7 | = | 174.07 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 115.77 | x | 0.63 | x | 0.7 | = | 84.56 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 110.22 | x | 0.63 | x | 0.7 | = | 165.73 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 110.22 | x | 0.63 | x | 0.7 | = | 80.51 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 94.68 | x | 0.63 | x | 0.7 | = | 142.36 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 94.68 | x | 0.63 | x | 0.7 | = | 69.15 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 73.59 | x | 0.63 | x | 0.7 | = | 110.65 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 73.59 | x | 0.63 | x | 0.7 | = | 53.75 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 45.59 | x | 0.63 | x | 0.7 | = | 68.55 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 45.59 | x | 0.63 | x | 0.7 | = | 33.3 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 24.49 | x | 0.63 | x | 0.7 | = | 36.82 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 24.49 | x | 0.63 | x | 0.7 | = | 17.89 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 16.15 | x | 0.63 | x | 0.7 | = | 24.29 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 16.15 | x | 0.63 | x | 0.7 | = | 11.8 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 73.41 | 143.6 | 236.49 | 344.91 | 422.7 | 432.71 | 411.96 | 353.86 | 275.05 | 170.4 | 91.53 | 60.37 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 547.85 | 615.38 | 691.08 | 771.87 | 820.62 | 803.17 | 765.49 | 715.04 | 651.54 | 574.75 | 527.71 | 520.71 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 1 | 0.98 | 0.94 | 0.8 | 0.62 | 0.68 | 0.92 | 0.99 | 1 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.88 | 20 | 20.21 | 20.5 | 20.77 | 20.94 | 20.99 | 20.98 | 20.86 | 20.51 | 20.15 | 19.87 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.11 | 20.12 | 20.12 | 20.13 | 20.13 | 20.14 | 20.14 | 20.14 | 20.14 | 20.13 | 20.13 | 20.12 | | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 1 | 1 | 0.98 | 0.91 | 0.72 | 0.51 | 0.57 | 0.87 | 0.99 | 1 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.6 | 18.77 | 19.08 | 19.52 | 19.89 | 20.1 | 20.14 | 20.13 | 20.01 | 19.53 | 18.99 | 18.58 | | (90) |
| | | | | | | | | | | fLA = Living area ÷ (4) = | | | 0.26 | (91) |

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.93 | 19.09 | 19.38 | 19.78 | 20.12 | 20.32 | 20.36 | 20.36 | 20.23 | 19.78 | 19.3 | 18.92 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.93 | 19.09 | 19.38 | 19.78 | 20.12 | 20.32 | 20.36 | 20.36 | 20.23 | 19.78 | 19.3 | 18.92 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | | |
| (94)m= | 1 | 1 | 0.99 | 0.98 | 0.91 | 0.74 | 0.54 | 0.6 | 0.88 | 0.99 | 1 | 1 | | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | | |
| (95)m= | 547.31 | 614.05 | 686.65 | 752.64 | 746.53 | 595.95 | 413.63 | 430.24 | 571.57 | 566.74 | 526.59 | 520.33 | | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | | |
| (97)m= | 1686.07 | 1630.06 | 1474.98 | 1229.12 | 949.24 | 637.22 | 418.89 | 439.8 | 686.13 | 1035.36 | 1382.02 | 1676.64 | | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | | |
| (98)m= | 847.24 | 682.76 | 586.52 | 343.06 | 150.82 | 0 | 0 | 0 | 0 | 348.65 | 615.91 | 860.3 | | |
| | | | | | | | | | Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | | | | 4435.25 | (98) |
| Space heating requirement in kWh/m²/year | | | | | | | | | | | | | 37.07 | (99) |

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary system | | 0 | (201) |
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | | | | | | | | | | | | | | |
| | 847.24 | 682.76 | 586.52 | 343.06 | 150.82 | 0 | 0 | 0 | 0 | 348.65 | 615.91 | 860.3 | | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | | (211) |
| | 907.11 | 731 | 627.96 | 367.31 | 161.47 | 0 | 0 | 0 | 0 | 373.29 | 659.43 | 921.09 | | |
| | | | | | | | | | Total (kWh/year) =Sum(211)$_{1...5,10...12}$= | | | | 4748.67 | (211) |
| Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) | | | | | | | | | | | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | | | | | | | | | Total (kWh/year) =Sum(215)$_{1...5,10...12}$= | | | | 0 | (215) |

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**Water heating**

Output from water heater (calculated above)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 217.62 | 191.79 | 201.38 | 180.45 | 174.77 | 153.93 | 147.48 | 164.4 | 166.15 | 187.12 | 197.95 | 212.37 |

Efficiency of water heater 80.3 (216)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 88.13 | 87.97 | 87.58 | 86.64 | 84.68 | 80.3 | 80.3 | 80.3 | 80.3 | 86.6 | 87.72 | 88.2 | (217) |

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 246.92 | 218.01 | 229.92 | 208.27 | 206.38 | 191.69 | 183.66 | 204.73 | 206.92 | 216.09 | 225.67 | 240.77 |

Total = Sum(219a)$_{1...12}$ = 2579.04 (219)

| **Annual totals** | **kWh/year** | **kWh/year** | |
|---|---|---|---|
| Space heating fuel used, main system 1 | | 4748.67 | |
| Water heating fuel used | | 2579.04 | |
| Electricity for pumps, fans and electric keep-hot | | | |
| central heating pump: | 30 | | (230c) |
| boiler with a fan-assisted flue | 45 | | (230e) |
| Total electricity for the above, kWh/year — sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | 515.24 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|---|
| Space heating (main system 1) | (211) | x | 0.216 | = | 1025.71 | (261) |
| Space heating (secondary) | (215) | x | 0.519 | = | 0 | (263) |
| Water heating | (219) | x | 0.216 | = | 557.07 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | 1582.78 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) | x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) | x | 0.519 | = | 267.41 | (268) |
| Total CO2, kg/year | | | sum of (265)…(271) = | | 1889.12 | (272) |

**TER =** 15.79 (273)

# TER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: P2

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Basement | 107.83 | (1a) | x | 2.55 | (2a) | = | 274.97 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 107.83 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | | = | 274.97 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 4 | x 10 = | 40 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | | |
|---|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = | (6a)+(6b)+(7a)+(7b)+(7c) = | 40 | ÷ (5) = | 0.15 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.4 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.34 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.43 | 0.42 | 0.41 | 0.37 | 0.36 | 0.32 | 0.32 | 0.31 | 0.34 | 0.36 | 0.38 | 0.39 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.59 | 0.59 | 0.58 | 0.57 | 0.57 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.57 | 0.58 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.59 | 0.59 | 0.58 | 0.57 | 0.57 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.57 | 0.58 | (25) |

## 3. Heat losses and heat loss parameter:

| **ELEMENT** | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.92 | x1/[1/( 1.4 )+ 0.04] | | = | 6.52 | | | (27) |
| Windows Type 2 | | | 4.92 | x1/[1/( 1.4 )+ 0.04] | | = | 6.52 | | | (27) |
| Windows Type 3 | | | 2.39 | x1/[1/( 1.4 )+ 0.04] | | = | 3.17 | | | (27) |
| Floor | | | 107.83 | x | 0.13 | = | 14.0179 | | | (28) |
| Walls Type1 | 74.77 | 12.23 | 62.54 | x | 0.18 | = | 11.26 | | | (29) |
| Walls Type2 | 12.35 | 0 | 12.35 | x | 0.18 | = | 2.22 | | | (29) |
| Total area of elements, m² | | | 194.95 | | | | | | | (31) |
| Party wall | | | 36.38 | x | 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 43.71 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 17991.8 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 11.05 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 54.76 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 53.7 | 53.38 | 53.06 | 51.57 | 51.29 | 50 | 50 | 49.76 | 50.5 | 51.29 | 51.86 | 52.45 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 108.46 | 108.14 | 107.82 | 106.33 | 106.06 | 104.76 | 104.76 | 104.52 | 105.26 | 106.06 | 106.62 | 107.21 | |

Average = Sum(39)$_{1…12}$ /12= 106.33 (39)

# TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.01 | 1 | 1 | 0.99 | 0.98 | 0.97 | 0.97 | 0.97 | 0.98 | 0.98 | 0.99 | 0.99 |

Average = Sum(40)$_{1...12}$ /12= 0.99 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.8 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 100.73 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 110.8 | 106.77 | 102.74 | 98.71 | 94.68 | 90.65 | 90.65 | 94.68 | 98.71 | 102.74 | 106.77 | 110.8 |

Total = Sum(44)$_{1...12}$ = 1208.73 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 164.31 | 143.71 | 148.3 | 129.29 | 124.05 | 107.05 | 99.2 | 113.83 | 115.19 | 134.24 | 146.54 | 159.13 |

Total = Sum(45)$_{1...12}$ = 1584.83 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 24.65 | 21.56 | 22.24 | 19.39 | 18.61 | 16.06 | 14.88 | 17.07 | 17.28 | 20.14 | 21.98 | 23.87 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

# TER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.96 | 46.03 | 50.96 | 48.68 | 48.25 | 44.71 | 46.2 | 48.25 | 48.68 | 50.96 | 49.32 | 50.96 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 215.27 | 189.74 | 199.25 | 177.97 | 172.3 | 151.76 | 145.39 | 162.08 | 163.87 | 185.2 | 195.85 | 210.09 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 215.27 | 189.74 | 199.25 | 177.97 | 172.3 | 151.76 | 145.39 | 162.08 | 163.87 | 185.2 | 195.85 | 210.09 | |

Output from water heater (annual)$_{1...12}$ 2168.78 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 67.37 | 59.29 | 62.05 | 55.16 | 53.31 | 46.77 | 44.53 | 49.91 | 50.47 | 57.38 | 61.05 | 65.65 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 140.06 | 140.06 | 140.06 | 140.06 | 140.06 | 140.06 | 140.06 | 140.06 | 140.06 | 140.06 | 140.06 | 140.06 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| (67)m= | 26.89 | 23.88 | 19.42 | 14.71 | 10.99 | 9.28 | 10.03 | 13.03 | 17.49 | 22.21 | 25.93 | 27.64 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| (68)m= | 268.4 | 271.19 | 264.17 | 249.23 | 230.36 | 212.64 | 200.8 | 198.01 | 205.03 | 219.97 | 238.83 | 256.56 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| (69)m= | 37.01 | 37.01 | 37.01 | 37.01 | 37.01 | 37.01 | 37.01 | 37.01 | 37.01 | 37.01 | 37.01 | 37.01 | (69) |
| Pumps and fans gains (Table 5a) | | | | | | | | | | | | | |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| (71)m= | -112.05 | -112.05 | -112.05 | -112.05 | -112.05 | -112.05 | -112.05 | -112.05 | -112.05 | -112.05 | -112.05 | -112.05 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| (72)m= | 90.56 | 88.23 | 83.4 | 76.61 | 71.65 | 64.96 | 59.86 | 67.08 | 70.1 | 77.12 | 84.79 | 88.24 | (72) |
| **Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m | | | | | | | | | | | | | |
| (73)m= | 453.87 | 451.32 | 435.01 | 408.56 | 381.03 | 354.89 | 338.7 | 346.15 | 360.64 | 387.32 | 417.57 | 440.45 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.92 | x | 19.64 | x | 0.63 | x | 0.7 | = | 29.53 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 38.42 | x | 0.63 | x | 0.7 | = | 57.77 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 63.27 | x | 0.63 | x | 0.7 | = | 95.14 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 92.28 | x | 0.63 | x | 0.7 | = | 138.75 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 113.09 | x | 0.63 | x | 0.7 | = | 170.05 | (76) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.92 | x | 115.77 | x | 0.63 | x | 0.7 | = | 174.07 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 110.22 | x | 0.63 | x | 0.7 | = | 165.73 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 94.68 | x | 0.63 | x | 0.7 | = | 142.36 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 73.59 | x | 0.63 | x | 0.7 | = | 110.65 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 45.59 | x | 0.63 | x | 0.7 | = | 68.55 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 24.49 | x | 0.63 | x | 0.7 | = | 36.82 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 16.15 | x | 0.63 | x | 0.7 | = | 24.29 | (76) |
| West | 0.9x | 0.77 | x | 4.92 | x | 19.64 | x | 0.63 | x | 0.7 | = | 29.53 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 19.64 | x | 0.63 | x | 0.7 | = | 14.35 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 38.42 | x | 0.63 | x | 0.7 | = | 57.77 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 38.42 | x | 0.63 | x | 0.7 | = | 28.06 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 63.27 | x | 0.63 | x | 0.7 | = | 95.14 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 63.27 | x | 0.63 | x | 0.7 | = | 46.22 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 92.28 | x | 0.63 | x | 0.7 | = | 138.75 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 92.28 | x | 0.63 | x | 0.7 | = | 67.4 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 113.09 | x | 0.63 | x | 0.7 | = | 170.05 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 113.09 | x | 0.63 | x | 0.7 | = | 82.6 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 115.77 | x | 0.63 | x | 0.7 | = | 174.07 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 115.77 | x | 0.63 | x | 0.7 | = | 84.56 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 110.22 | x | 0.63 | x | 0.7 | = | 165.73 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 110.22 | x | 0.63 | x | 0.7 | = | 80.51 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 94.68 | x | 0.63 | x | 0.7 | = | 142.36 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 94.68 | x | 0.63 | x | 0.7 | = | 69.15 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 73.59 | x | 0.63 | x | 0.7 | = | 110.65 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 73.59 | x | 0.63 | x | 0.7 | = | 53.75 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 45.59 | x | 0.63 | x | 0.7 | = | 68.55 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 45.59 | x | 0.63 | x | 0.7 | = | 33.3 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 24.49 | x | 0.63 | x | 0.7 | = | 36.82 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 24.49 | x | 0.63 | x | 0.7 | = | 17.89 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 16.15 | x | 0.63 | x | 0.7 | = | 24.29 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 16.15 | x | 0.63 | x | 0.7 | = | 11.8 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 73.41 | 143.6 | 236.49 | 344.91 | 422.7 | 432.71 | 411.96 | 353.86 | 275.05 | 170.4 | 91.53 | 60.37 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 527.27 | 594.92 | 671.5 | 753.47 | 803.73 | 787.6 | 750.65 | 700.01 | 635.69 | 557.72 | 509.1 | 500.82 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 1 | 0.98 | 0.92 | 0.78 | 0.6 | 0.66 | 0.9 | 0.99 | 1 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.85 | 19.97 | 20.2 | 20.51 | 20.78 | 20.95 | 20.99 | 20.98 | 20.86 | 20.51 | 20.13 | 19.83 | (87) |

# TER WorkSheet: New dwelling design stage

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.08 | 20.08 | 20.08 | 20.09 | 20.1 | 20.11 | 20.11 | 20.11 | 20.1 | 20.1 | 20.09 | 20.09 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 1 | 0.99 | 0.97 | 0.89 | 0.7 | 0.49 | 0.55 | 0.85 | 0.98 | 1 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.53 | 18.71 | 19.04 | 19.49 | 19.87 | 20.07 | 20.1 | 20.1 | 19.98 | 19.49 | 18.94 | 18.51 | (90) |

fLA = Living area ÷ (4) = 0.29 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.91 | 19.08 | 19.38 | 19.79 | 20.13 | 20.32 | 20.36 | 20.36 | 20.24 | 19.79 | 19.29 | 18.89 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.91 | 19.08 | 19.38 | 19.79 | 20.13 | 20.32 | 20.36 | 20.36 | 20.24 | 19.79 | 19.29 | 18.89 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 1 | 0.99 | 0.97 | 0.89 | 0.72 | 0.52 | 0.58 | 0.86 | 0.98 | 1 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 526.53 | 593.13 | 665.64 | 729.31 | 717.21 | 564.35 | 389.4 | 405.33 | 545.75 | 547.61 | 507.59 | 500.3 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1584.89 | 1532.97 | 1388.25 | 1157.73 | 894.38 | 599.65 | 394.01 | 413.68 | 646.09 | 974.48 | 1299.16 | 1575.39 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 787.41 | 631.58 | 537.62 | 308.46 | 131.81 | 0 | 0 | 0 | 0 | 317.6 | 569.93 | 799.86 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4084.27 (98)

Space heating requirement in kWh/m²/year 37.88 (99)

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary system | | 0 | (201) |
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | | | | | | | | | | | | | |
| | 787.41 | 631.58 | 537.62 | 308.46 | 131.81 | 0 | 0 | 0 | 0 | 317.6 | 569.93 | 799.86 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | (211) |
| | 843.05 | 676.21 | 575.61 | 330.26 | 141.12 | 0 | 0 | 0 | 0 | 340.04 | 610.21 | 856.39 | |

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 4372.88 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

# TER WorkSheet: New dwelling design stage

**Water heating**

Output from water heater (calculated above)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 215.27 | 189.74 | 199.25 | 177.97 | 172.3 | 151.76 | 145.39 | 162.08 | 163.87 | 185.2 | 195.85 | 210.09 |

Efficiency of water heater 80.3 (216)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 88.02 | 87.85 | 87.43 | 86.42 | 84.39 | 80.3 | 80.3 | 80.3 | 80.3 | 86.4 | 87.58 | 88.1 | (217) |

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 244.56 | 215.98 | 227.91 | 205.93 | 204.19 | 188.99 | 181.06 | 201.84 | 204.07 | 214.36 | 223.62 | 238.48 |

Total = Sum(219a)$_{1…12}$ = 2550.99 (219)

| **Annual totals** | **kWh/year** | **kWh/year** | |
|---|---|---|---|
| Space heating fuel used, main system 1 | | 4372.88 | |
| Water heating fuel used | | 2550.99 | |
| Electricity for pumps, fans and electric keep-hot | | | |
| central heating pump: | 30 | | (230c) |
| boiler with a fan-assisted flue | 45 | | (230e) |
| Total electricity for the above, kWh/year — sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | 474.91 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 944.54 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 551.01 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1495.56 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 246.48 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 1780.96 | (272) |

**TER =** 16.52 (273)

# TER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: P3

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 74.01 | (1a) x | 2.55 | (2a) = | 188.73 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 74.01 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 188.73 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 3 | x 10 = | 30 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 30 | ÷ (5) = | 0.16 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.41 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.35 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.44 | 0.43 | 0.43 | 0.38 | 0.37 | 0.33 | 0.33 | 0.32 | 0.35 | 0.37 | 0.39 | 0.41 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.6 | 0.59 | 0.59 | 0.57 | 0.57 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.58 | 0.58 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.6 | 0.59 | 0.59 | 0.57 | 0.57 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.58 | 0.58 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 10.11 | x1/[1/( 1.4 )+ 0.04] | | = | 13.4 | | | (27) |
| Windows Type 2 | | | 4.19 | x1/[1/( 1.4 )+ 0.04] | | = | 5.55 | | | (27) |
| Walls Type1 | 34.74 | 18.49 | 16.25 | x | 0.18 | = | 2.93 | | | (29) |
| Walls Type2 | 43.33 | 0 | 43.33 | x | 0.18 | = | 7.8 | | | (29) |
| Total area of elements, m² | | | 78.07 | | | | | | | (31) |
| Party wall | | | 33.58 | x | 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 35.24 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 5085.9 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 51.3 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 86.54 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 37.26 | 37.02 | 36.79 | 35.69 | 35.49 | 34.54 | 34.54 | 34.36 | 34.9 | 35.49 | 35.9 | 36.33 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 123.8 | 123.56 | 123.33 | 122.23 | 122.03 | 121.08 | 121.08 | 120.9 | 121.44 | 122.03 | 122.44 | 122.88 | |

Average = Sum(39)$_{1…12}$ /12= 122.23 (39)

# TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.67 | 1.67 | 1.67 | 1.65 | 1.65 | 1.64 | 1.64 | 1.63 | 1.64 | 1.65 | 1.65 | 1.66 | |

Average = Sum(40)$_{1…12}$ /12= 1.65 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.34 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 89.76 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 98.74 | 95.15 | 91.56 | 87.97 | 84.38 | 80.79 | 80.79 | 84.38 | 87.97 | 91.56 | 95.15 | 98.74 | |

Total = Sum(44)$_{1…12}$ = 1077.13 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 146.42 | 128.06 | 132.15 | 115.21 | 110.55 | 95.39 | 88.4 | 101.44 | 102.65 | 119.63 | 130.58 | 141.8 | |

Total = Sum(45)$_{1…12}$ = 1412.29 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 21.96 | 19.21 | 19.82 | 17.28 | 16.58 | 14.31 | 13.26 | 15.22 | 15.4 | 17.94 | 19.59 | 21.27 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.32 | 43.79 | 46.66 | 43.38 | 43 | 39.84 | 41.17 | 43 | 43.38 | 46.66 | 46.92 | 50.32 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 196.74 | 171.86 | 178.81 | 158.59 | 153.55 | 135.23 | 129.56 | 144.43 | 146.03 | 166.28 | 177.5 | 192.12 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 196.74 | 171.86 | 178.81 | 158.59 | 153.55 | 135.23 | 129.56 | 144.43 | 146.03 | 166.28 | 177.5 | 192.12 | |

Output from water heater (annual)$_{1...12}$ 1950.71 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 61.27 | 53.53 | 55.6 | 49.15 | 47.51 | 41.68 | 39.68 | 44.48 | 44.98 | 51.44 | 55.15 | 59.73 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 18.41 | 16.35 | 13.3 | 10.07 | 7.52 | 6.35 | 6.86 | 8.92 | 11.98 | 15.21 | 17.75 | 18.92 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 206.47 | 208.61 | 203.21 | 191.72 | 177.21 | 163.57 | 154.46 | 152.32 | 157.72 | 169.21 | 183.72 | 197.36 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 82.35 | 79.66 | 74.74 | 68.27 | 63.85 | 57.89 | 53.34 | 59.78 | 62.47 | 69.14 | 76.6 | 80.28 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 368.31 | 365.71 | 352.34 | 331.14 | 309.68 | 288.9 | 275.76 | 282.12 | 293.25 | 314.65 | 339.16 | 357.65 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 10.11 | x | 19.64 | x | 0.63 | x | 0.7 | = | 60.68 | (76) |
| East | 0.9x | 2 | x | 4.19 | x | 19.64 | x | 0.63 | x | 0.7 | = | 50.3 | (76) |
| East | 0.9x | 1 | x | 10.11 | x | 38.42 | x | 0.63 | x | 0.7 | = | 118.71 | (76) |
| East | 0.9x | 2 | x | 4.19 | x | 38.42 | x | 0.63 | x | 0.7 | = | 98.4 | (76) |
| East | 0.9x | 1 | x | 10.11 | x | 63.27 | x | 0.63 | x | 0.7 | = | 195.5 | (76) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 2 | x | 4.19 | x | 63.27 | x | 0.63 | x | 0.7 | = | 162.04 | (76) |
| East | 0.9x | 1 | x | 10.11 | x | 92.28 | x | 0.63 | x | 0.7 | = | 285.12 | (76) |
| East | 0.9x | 2 | x | 4.19 | x | 92.28 | x | 0.63 | x | 0.7 | = | 236.33 | (76) |
| East | 0.9x | 1 | x | 10.11 | x | 113.09 | x | 0.63 | x | 0.7 | = | 349.43 | (76) |
| East | 0.9x | 2 | x | 4.19 | x | 113.09 | x | 0.63 | x | 0.7 | = | 289.63 | (76) |
| East | 0.9x | 1 | x | 10.11 | x | 115.77 | x | 0.63 | x | 0.7 | = | 357.7 | (76) |
| East | 0.9x | 2 | x | 4.19 | x | 115.77 | x | 0.63 | x | 0.7 | = | 296.49 | (76) |
| East | 0.9x | 1 | x | 10.11 | x | 110.22 | x | 0.63 | x | 0.7 | = | 340.55 | (76) |
| East | 0.9x | 2 | x | 4.19 | x | 110.22 | x | 0.63 | x | 0.7 | = | 282.27 | (76) |
| East | 0.9x | 1 | x | 10.11 | x | 94.68 | x | 0.63 | x | 0.7 | = | 292.52 | (76) |
| East | 0.9x | 2 | x | 4.19 | x | 94.68 | x | 0.63 | x | 0.7 | = | 242.47 | (76) |
| East | 0.9x | 1 | x | 10.11 | x | 73.59 | x | 0.63 | x | 0.7 | = | 227.37 | (76) |
| East | 0.9x | 2 | x | 4.19 | x | 73.59 | x | 0.63 | x | 0.7 | = | 188.46 | (76) |
| East | 0.9x | 1 | x | 10.11 | x | 45.59 | x | 0.63 | x | 0.7 | = | 140.86 | (76) |
| East | 0.9x | 2 | x | 4.19 | x | 45.59 | x | 0.63 | x | 0.7 | = | 116.76 | (76) |
| East | 0.9x | 1 | x | 10.11 | x | 24.49 | x | 0.63 | x | 0.7 | = | 75.67 | (76) |
| East | 0.9x | 2 | x | 4.19 | x | 24.49 | x | 0.63 | x | 0.7 | = | 62.72 | (76) |
| East | 0.9x | 1 | x | 10.11 | x | 16.15 | x | 0.63 | x | 0.7 | = | 49.9 | (76) |
| East | 0.9x | 2 | x | 4.19 | x | 16.15 | x | 0.63 | x | 0.7 | = | 41.36 | (76) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 110.98 | 217.11 | 357.54 | 521.45 | 639.06 | 654.19 | 622.82 | 534.99 | 415.84 | 257.61 | 138.38 | 91.27 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 479.3 | 582.82 | 709.88 | 852.6 | 948.74 | 943.1 | 898.58 | 817.11 | 709.09 | 572.27 | 477.54 | 448.92 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 0.99 | 0.98 | 0.94 | 0.86 | 0.71 | 0.56 | 0.62 | 0.85 | 0.97 | 0.99 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.16 | 19.36 | 19.73 | 20.22 | 20.62 | 20.88 | 20.96 | 20.94 | 20.73 | 20.17 | 19.57 | 19.12 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.56 | 19.56 | 19.57 | 19.58 | 19.58 | 19.59 | 19.59 | 19.59 | 19.58 | 19.58 | 19.57 | 19.57 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.97 | 0.92 | 0.8 | 0.59 | 0.4 | 0.46 | 0.77 | 0.96 | 0.99 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.16 | 17.47 | 18 | 18.69 | 19.23 | 19.51 | 19.58 | 19.57 | 19.38 | 18.65 | 17.78 | 17.12 | (90) |

fLA = Living area ÷ (4) = 0.4 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 17.96 | 18.22 | 18.69 | 19.3 | 19.78 | 20.05 | 20.13 | 20.11 | 19.91 | 19.25 | 18.49 | 17.91 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 17.96 | 18.22 | 18.69 | 19.3 | 19.78 | 20.05 | 20.13 | 20.11 | 19.91 | 19.25 | 18.49 | 17.91 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.99 | 0.99 | 0.97 | 0.92 | 0.81 | 0.63 | 0.46 | 0.52 | 0.79 | 0.95 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 476.32 | 575.27 | 687.25 | 780.49 | 765.73 | 598.68 | 413.61 | 427.5 | 560.73 | 545.39 | 472.15 | 446.72 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1690.54 | 1645.83 | 1503.33 | 1270.76 | 986.33 | 660.2 | 426.94 | 449.08 | 705.87 | 1055.65 | 1394.86 | 1685.15 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 903.38 | 719.42 | 607.16 | 352.99 | 164.12 | 0 | 0 | 0 | 0 | 379.63 | 664.35 | 921.39 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4712.44 (98)

Space heating requirement in kWh/m²/year 63.67 (99)

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary system | | 0 | (201) |
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | | | | | | | | | | | | | |
| | 903.38 | 719.42 | 607.16 | 352.99 | 164.12 | 0 | 0 | 0 | 0 | 379.63 | 664.35 | 921.39 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | (211) |
| | 967.22 | 770.25 | 650.06 | 377.93 | 175.72 | 0 | 0 | 0 | 0 | 406.46 | 711.29 | 986.5 | |

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 5045.44 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

**Water heating**

Output from water heater (calculated above)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 196.74 | 171.86 | 178.81 | 158.59 | 153.55 | 135.23 | 129.56 | 144.43 | 146.03 | 166.28 | 177.5 | 192.12 |

Efficiency of water heater 80.3 (216)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 88.41 | 88.26 | 87.89 | 87.01 | 85.22 | 80.3 | 80.3 | 80.3 | 80.3 | 87.06 | 88.06 | 88.48 | (217) |

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 222.53 | 194.72 | 203.45 | 182.27 | 180.18 | 168.41 | 161.35 | 179.87 | 181.85 | 190.99 | 201.56 | 217.13 |

Total = Sum(219a)$_{1...12}$ = 2284.32 (219)

| **Annual totals** | **kWh/year** | **kWh/year** |
|---|---|---|
| Space heating fuel used, main system 1 | | 5045.44 |

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| | | | |
|---|---|---|---|
| Water heating fuel used | | 2284.32 | |
| Electricity for pumps, fans and electric keep-hot | | | |
| central heating pump: | 30 | | (230c) |
| boiler with a fan-assisted flue | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | 75 | (231) |
| Electricity for lighting | | 325.07 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 1089.82 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 493.41 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1583.23 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 168.71 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 1790.87 | (272) |

**TER =** 24.2 (273)

# TER WorkSheet: New dwelling design stage

**User Details:**

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

**Property Address: P4**

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 94.7 | (1a) x | 2.55 | (2a) = | 241.48 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 94.7 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 241.48 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 3 | x 10 = | 30 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 30 | ÷ (5) = | 0.12 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.37 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.32 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.41 | 0.4 | 0.39 | 0.35 | 0.34 | 0.3 | 0.3 | 0.29 | 0.32 | 0.34 | 0.36 | 0.37 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.58 | 0.58 | 0.58 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.58 | 0.58 | 0.58 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.5 | x1/[1/( 1.4 )+ 0.04] = | 5.97 | | | (27) |
| Windows Type 2 | | | 2.26 | x1/[1/( 1.4 )+ 0.04] = | 3 | | | (27) |
| Windows Type 3 | | | 4.72 | x1/[1/( 1.4 )+ 0.04] = | 6.26 | | | (27) |
| Windows Type 4 | | | 2.29 | x1/[1/( 1.4 )+ 0.04] = | 3.04 | | | (27) |
| Floor | | | 33.02 | x 0.13 = | 4.2926 | | | (28) |
| Walls Type1 | 34.82 | 13.77 | 21.05 | x 0.18 = | 3.79 | | | (29) |
| Walls Type2 | 4.02 | 0 | 4.02 | x 0.18 = | 0.72 | | | (29) |
| Total area of elements, m² | | | 71.86 | | | | | (31) |
| Party wall | | | 78.29 | x 0 = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 27.06 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 7503.51 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 5.03 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 32.09 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 46.4 | 46.14 | 45.9 | 44.72 | 44.5 | 43.48 | 43.48 | 43.29 | 43.88 | 44.5 | 44.95 | 45.41 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 78.49 | 78.23 | 77.98 | 76.81 | 76.59 | 75.57 | 75.57 | 75.38 | 75.97 | 76.59 | 77.04 | 77.5 | |

Average = Sum(39)$_{1…12}$ /12= 76.81 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.83 | 0.83 | 0.82 | 0.81 | 0.81 | 0.8 | 0.8 | 0.8 | 0.8 | 0.81 | 0.81 | 0.82 |

Average = Sum(40)$_{1…12}$ /12= 0.81 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 97.96 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 107.76 | 103.84 | 99.92 | 96 | 92.09 | 88.17 | 88.17 | 92.09 | 96 | 99.92 | 103.84 | 107.76 |

Total = Sum(44)$_{1…12}$ = 1175.55 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 159.8 | 139.77 | 144.23 | 125.74 | 120.65 | 104.11 | 96.47 | 110.71 | 112.03 | 130.56 | 142.51 | 154.76 |

Total = Sum(45)$_{1…12}$ = 1541.34 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 23.97 | 20.96 | 21.63 | 18.86 | 18.1 | 15.62 | 14.47 | 16.61 | 16.8 | 19.58 | 21.38 | 23.21 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.96 | 46.03 | 50.92 | 47.34 | 46.93 | 43.48 | 44.93 | 46.93 | 47.34 | 50.92 | 49.32 | 50.96 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 210.76 | 185.79 | 195.14 | 173.08 | 167.58 | 147.59 | 141.4 | 157.63 | 159.37 | 181.48 | 191.83 | 205.72 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 210.76 | 185.79 | 195.14 | 173.08 | 167.58 | 147.59 | 141.4 | 157.63 | 159.37 | 181.48 | 191.83 | 205.72 | |

Output from water heater (annual)$_{1...12}$ 2117.38 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 65.87 | 57.98 | 60.68 | 53.64 | 51.85 | 45.49 | 43.31 | 48.54 | 49.09 | 56.14 | 59.71 | 64.2 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 134.24 | 134.24 | 134.24 | 134.24 | 134.24 | 134.24 | 134.24 | 134.24 | 134.24 | 134.24 | 134.24 | 134.24 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 23.48 | 20.85 | 16.96 | 12.84 | 9.6 | 8.1 | 8.75 | 11.38 | 15.27 | 19.39 | 22.63 | 24.13 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 247.46 | 250.03 | 243.56 | 229.78 | 212.4 | 196.05 | 185.13 | 182.56 | 189.04 | 202.81 | 220.2 | 236.55 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 36.42 | 36.42 | 36.42 | 36.42 | 36.42 | 36.42 | 36.42 | 36.42 | 36.42 | 36.42 | 36.42 | 36.42 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -107.39 | -107.39 | -107.39 | -107.39 | -107.39 | -107.39 | -107.39 | -107.39 | -107.39 | -107.39 | -107.39 | -107.39 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 88.54 | 86.28 | 81.57 | 74.51 | 69.69 | 63.18 | 58.21 | 65.24 | 68.17 | 75.46 | 82.94 | 86.29 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 425.75 | 423.43 | 408.35 | 383.4 | 357.95 | 333.6 | 318.37 | 325.46 | 338.75 | 363.93 | 392.04 | 413.23 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.5 | x | 19.64 | x | 0.63 | x | 0.7 | = | 27.01 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 19.64 | x | 0.63 | x | 0.7 | = | 13.57 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 38.42 | x | 0.63 | x | 0.7 | = | 52.84 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 38.42 | x | 0.63 | x | 0.7 | = | 26.54 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 63.27 | x | 0.63 | x | 0.7 | = | 87.02 | (76) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 2.26 | x | 63.27 | x | 0.63 | x | 0.7 | = | 43.7 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 92.28 | x | 0.63 | x | 0.7 | = | 126.91 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 92.28 | x | 0.63 | x | 0.7 | = | 63.74 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 113.09 | x | 0.63 | x | 0.7 | = | 155.53 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 113.09 | x | 0.63 | x | 0.7 | = | 78.11 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 115.77 | x | 0.63 | x | 0.7 | = | 159.21 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 115.77 | x | 0.63 | x | 0.7 | = | 79.96 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 110.22 | x | 0.63 | x | 0.7 | = | 151.58 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 110.22 | x | 0.63 | x | 0.7 | = | 76.13 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 94.68 | x | 0.63 | x | 0.7 | = | 130.2 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 94.68 | x | 0.63 | x | 0.7 | = | 65.39 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 73.59 | x | 0.63 | x | 0.7 | = | 101.2 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 73.59 | x | 0.63 | x | 0.7 | = | 50.83 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 45.59 | x | 0.63 | x | 0.7 | = | 62.7 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 45.59 | x | 0.63 | x | 0.7 | = | 31.49 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 24.49 | x | 0.63 | x | 0.7 | = | 33.68 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 24.49 | x | 0.63 | x | 0.7 | = | 16.91 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 16.15 | x | 0.63 | x | 0.7 | = | 22.21 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 16.15 | x | 0.63 | x | 0.7 | = | 11.16 | (76) |
| West | 0.9x | 0.77 | x | 4.72 | x | 19.64 | x | 0.63 | x | 0.7 | = | 28.33 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 19.64 | x | 0.63 | x | 0.7 | = | 13.75 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 38.42 | x | 0.63 | x | 0.7 | = | 55.42 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 38.42 | x | 0.63 | x | 0.7 | = | 26.89 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 63.27 | x | 0.63 | x | 0.7 | = | 91.27 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 63.27 | x | 0.63 | x | 0.7 | = | 44.28 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 92.28 | x | 0.63 | x | 0.7 | = | 133.11 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 92.28 | x | 0.63 | x | 0.7 | = | 64.58 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 113.09 | x | 0.63 | x | 0.7 | = | 163.14 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 113.09 | x | 0.63 | x | 0.7 | = | 79.15 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 115.77 | x | 0.63 | x | 0.7 | = | 167 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 115.77 | x | 0.63 | x | 0.7 | = | 81.02 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 110.22 | x | 0.63 | x | 0.7 | = | 158.99 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 110.22 | x | 0.63 | x | 0.7 | = | 77.14 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 94.68 | x | 0.63 | x | 0.7 | = | 136.57 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 94.68 | x | 0.63 | x | 0.7 | = | 66.26 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 73.59 | x | 0.63 | x | 0.7 | = | 106.15 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 73.59 | x | 0.63 | x | 0.7 | = | 51.5 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 45.59 | x | 0.63 | x | 0.7 | = | 65.76 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 45.59 | x | 0.63 | x | 0.7 | = | 31.91 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 24.49 | x | 0.63 | x | 0.7 | = | 35.33 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 24.49 | x | 0.63 | x | 0.7 | = | 17.14 | (80) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 4.72 | x | 16.15 | x | 0.63 | x | 0.7 | = | 23.3 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 16.15 | x | 0.63 | x | 0.7 | = | 11.3 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 82.65 | 161.68 | 266.27 | 388.34 | 475.93 | 487.2 | 463.83 | 398.42 | 309.69 | 191.85 | 103.06 | 67.97 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 508.4 | 585.12 | 674.63 | 771.74 | 833.88 | 820.8 | 782.2 | 723.88 | 648.44 | 555.78 | 495.1 | 481.2 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 0.99 | 0.94 | 0.79 | 0.58 | 0.42 | 0.48 | 0.76 | 0.97 | 1 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 20.15 | 20.29 | 20.51 | 20.78 | 20.95 | 20.99 | 21 | 21 | 20.97 | 20.73 | 20.39 | 20.13 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.23 | 20.23 | 20.23 | 20.24 | 20.25 | 20.26 | 20.26 | 20.26 | 20.25 | 20.25 | 20.24 | 20.24 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 1 | 0.98 | 0.92 | 0.75 | 0.52 | 0.35 | 0.4 | 0.7 | 0.96 | 1 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 19.08 | 19.28 | 19.6 | 19.99 | 20.2 | 20.25 | 20.25 | 20.26 | 20.23 | 19.93 | 19.44 | 19.06 | (90) |

fLA = Living area ÷ (4) = 0.36 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 19.47 | 19.65 | 19.93 | 20.28 | 20.47 | 20.52 | 20.53 | 20.53 | 20.5 | 20.22 | 19.78 | 19.45 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 19.47 | 19.65 | 19.93 | 20.28 | 20.47 | 20.52 | 20.53 | 20.53 | 20.5 | 20.22 | 19.78 | 19.45 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.98 | 0.92 | 0.76 | 0.54 | 0.38 | 0.43 | 0.72 | 0.96 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 507.33 | 581.84 | 661.12 | 708.2 | 634.06 | 444.22 | 296.46 | 310.53 | 466.67 | 532.65 | 492.5 | 480.48 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1190.92 | 1153.64 | 1047.56 | 874 | 671.63 | 447.54 | 296.71 | 311.1 | 486.01 | 736.76 | 977.21 | 1181.93 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 508.59 | 384.25 | 287.51 | 119.38 | 27.95 | 0 | 0 | 0 | 0 | 151.86 | 348.99 | 521.88 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2350.39 (98)

Space heating requirement in kWh/m²/year 24.82 (99)

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

Fraction of space heat from secondary/supplementary system 0 (201)

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| | | | |
|---|---|---|---|
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | 508.59 | 384.25 | 287.51 | 119.38 | 27.95 | 0 | 0 | 0 | 0 | 151.86 | 348.99 | 521.88 | | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 544.53 | 411.4 | 307.82 | 127.81 | 29.92 | 0 | 0 | 0 | 0 | 162.59 | 373.65 | 558.75 | | (211) |
| Total (kWh/year) =Sum(211)$_{1...5,10....12}$= | | | | | | | | | | | | | 2516.48 | (211) |
| Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) | | | | | | | | | | | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Total (kWh/year) =Sum(215)$_{1...5,10....12}$= | | | | | | | | | | | | | 0 | (215) |

**Water heating**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Output from water heater (calculated above) | 210.76 | 185.79 | 195.14 | 173.08 | 167.58 | 147.59 | 141.4 | 157.63 | 159.37 | 181.48 | 191.83 | 205.72 | | |
| Efficiency of water heater | | | | | | | | | | | | | 80.3 | (216) |
| (217)m= | 87.19 | 86.84 | 86.03 | 84.14 | 81.6 | 80.3 | 80.3 | 80.3 | 80.3 | 84.61 | 86.54 | 87.3 | | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m | | | | | | | | | | | | | | |
| (219)m= | 241.74 | 213.95 | 226.85 | 205.72 | 205.35 | 183.8 | 176.09 | 196.3 | 198.47 | 214.5 | 221.67 | 235.66 | | |
| Total = Sum(219a)$_{1...12}$ = | | | | | | | | | | | | | 2520.09 | (219) |

| **Annual totals** | | **kWh/year** | **kWh/year** | |
|---|---|---|---|---|
| Space heating fuel used, main system 1 | | | 2516.48 | |
| Water heating fuel used | | | 2520.09 | |
| Electricity for pumps, fans and electric keep-hot | | | | |
| central heating pump: | | 30 | | (230c) |
| boiler with a fan-assisted flue | | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | | 414.58 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|---|
| Space heating (main system 1) | (211) | x | 0.216 | = | 543.56 | (261) |
| Space heating (secondary) | (215) | x | 0.519 | = | 0 | (263) |
| Water heating | (219) | x | 0.216 | = | 544.34 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | 1087.9 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) | x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) | x | 0.519 | = | 215.17 | (268) |

# TER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| Total CO2, kg/year | sum of (265)…(271) = | 1341.99 | (272) |
| **TER =** | | 14.17 | (273) |

# TER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: P5

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 97.6 | (1a) x | 2.55 | (2a) = | 248.88 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 97.6 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 248.88 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 3 | x 10 = | 30 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 30 | ÷ (5) = | 0.12 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.37 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.31 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Monthly average wind speed from Table 7

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

Wind Factor (22a)m = (22)m ÷ 4

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.4 | 0.39 | 0.39 | 0.35 | 0.34 | 0.3 | 0.3 | 0.29 | 0.31 | 0.34 | 0.35 | 0.37 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.58 | 0.58 | 0.57 | 0.56 | 0.56 | 0.54 | 0.54 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.58 | 0.58 | 0.57 | 0.56 | 0.56 | 0.54 | 0.54 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | (25) |

## 3. Heat losses and heat loss parameter:

| **ELEMENT** | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.5 | x1/[1/( 1.4 )+ 0.04] | = | 5.97 | | | (27) |
| Windows Type 2 | | | 2.26 | x1/[1/( 1.4 )+ 0.04] | = | 3 | | | (27) |
| Windows Type 3 | | | 4.72 | x1/[1/( 1.4 )+ 0.04] | = | 6.26 | | | (27) |
| Windows Type 4 | | | 2.29 | x1/[1/( 1.4 )+ 0.04] | = | 3.04 | | | (27) |
| Floor | | | 33.02 | x 0.13 | = | 4.2926 | | | (28) |
| Walls Type1 | 34.82 | 13.77 | 21.05 | x 0.18 | = | 3.79 | | | (29) |
| Walls Type2 | 4.02 | 0 | 4.02 | x 0.18 | = | 0.72 | | | (29) |
| Total area of elements, m² | | | 71.86 | | | | | | (31) |
| Party wall | | | 78.29 | x 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 27.06 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 7503.51 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 5.03 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 32.09 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 47.69 | 47.43 | 47.18 | 45.99 | 45.77 | 44.74 | 44.74 | 44.55 | 45.14 | 45.77 | 46.22 | 46.69 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 79.78 | 79.52 | 79.27 | 78.08 | 77.86 | 76.83 | 76.83 | 76.64 | 77.23 | 77.86 | 78.31 | 78.78 | |

Average = Sum(39)$_{1…12}$ /12= 78.08 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.82 | 0.81 | 0.81 | 0.8 | 0.8 | 0.79 | 0.79 | 0.79 | 0.79 | 0.8 | 0.8 | 0.81 |

Average = Sum(40)$_{1…12}$ /12= 0.8 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.72 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 98.71 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 108.58 | 104.63 | 100.68 | 96.73 | 92.79 | 88.84 | 88.84 | 92.79 | 96.73 | 100.68 | 104.63 | 108.58 |

Total = Sum(44)$_{1…12}$ = 1184.51 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 161.02 | 140.83 | 145.32 | 126.7 | 121.57 | 104.9 | 97.21 | 111.55 | 112.88 | 131.55 | 143.6 | 155.94 |

Total = Sum(45)$_{1…12}$ = 1553.08 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 24.15 | 21.12 | 21.8 | 19 | 18.24 | 15.74 | 14.58 | 16.73 | 16.93 | 19.73 | 21.54 | 23.39 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.96 | 46.03 | 50.96 | 47.7 | 47.28 | 43.81 | 45.27 | 47.28 | 47.7 | 50.96 | 49.32 | 50.96 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 211.98 | 186.86 | 196.28 | 174.4 | 168.85 | 148.72 | 142.48 | 158.83 | 160.59 | 182.51 | 192.91 | 206.9 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 211.98 | 186.86 | 196.28 | 174.4 | 168.85 | 148.72 | 142.48 | 158.83 | 160.59 | 182.51 | 192.91 | 206.9 | |

Output from water heater (annual)$_{1...12}$ 2131.31 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 66.28 | 58.33 | 61.06 | 54.05 | 52.24 | 45.83 | 43.64 | 48.91 | 49.46 | 56.48 | 60.08 | 64.59 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 135.81 | 135.81 | 135.81 | 135.81 | 135.81 | 135.81 | 135.81 | 135.81 | 135.81 | 135.81 | 135.81 | 135.81 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 24.1 | 21.4 | 17.41 | 13.18 | 9.85 | 8.32 | 8.99 | 11.68 | 15.68 | 19.91 | 23.23 | 24.77 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 252.39 | 255.01 | 248.41 | 234.36 | 216.62 | 199.95 | 188.82 | 186.2 | 192.8 | 206.85 | 224.58 | 241.25 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 36.58 | 36.58 | 36.58 | 36.58 | 36.58 | 36.58 | 36.58 | 36.58 | 36.58 | 36.58 | 36.58 | 36.58 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -108.65 | -108.65 | -108.65 | -108.65 | -108.65 | -108.65 | -108.65 | -108.65 | -108.65 | -108.65 | -108.65 | -108.65 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 89.08 | 86.8 | 82.07 | 75.07 | 70.22 | 63.66 | 58.66 | 65.74 | 68.69 | 75.92 | 83.44 | 86.81 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 432.31 | 429.96 | 414.63 | 389.35 | 363.43 | 338.67 | 323.2 | 330.36 | 343.91 | 369.41 | 398 | 419.58 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.5 | x | 19.64 | x | 0.63 | x | 0.7 | = | 27.01 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 19.64 | x | 0.63 | x | 0.7 | = | 13.57 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 38.42 | x | 0.63 | x | 0.7 | = | 52.84 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 38.42 | x | 0.63 | x | 0.7 | = | 26.54 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 63.27 | x | 0.63 | x | 0.7 | = | 87.02 | (76) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 2.26 | x | 63.27 | x | 0.63 | x | 0.7 | = | 43.7 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 92.28 | x | 0.63 | x | 0.7 | = | 126.91 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 92.28 | x | 0.63 | x | 0.7 | = | 63.74 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 113.09 | x | 0.63 | x | 0.7 | = | 155.53 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 113.09 | x | 0.63 | x | 0.7 | = | 78.11 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 115.77 | x | 0.63 | x | 0.7 | = | 159.21 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 115.77 | x | 0.63 | x | 0.7 | = | 79.96 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 110.22 | x | 0.63 | x | 0.7 | = | 151.58 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 110.22 | x | 0.63 | x | 0.7 | = | 76.13 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 94.68 | x | 0.63 | x | 0.7 | = | 130.2 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 94.68 | x | 0.63 | x | 0.7 | = | 65.39 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 73.59 | x | 0.63 | x | 0.7 | = | 101.2 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 73.59 | x | 0.63 | x | 0.7 | = | 50.83 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 45.59 | x | 0.63 | x | 0.7 | = | 62.7 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 45.59 | x | 0.63 | x | 0.7 | = | 31.49 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 24.49 | x | 0.63 | x | 0.7 | = | 33.68 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 24.49 | x | 0.63 | x | 0.7 | = | 16.91 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 16.15 | x | 0.63 | x | 0.7 | = | 22.21 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 16.15 | x | 0.63 | x | 0.7 | = | 11.16 | (76) |
| West | 0.9x | 0.77 | x | 4.72 | x | 19.64 | x | 0.63 | x | 0.7 | = | 28.33 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 19.64 | x | 0.63 | x | 0.7 | = | 13.75 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 38.42 | x | 0.63 | x | 0.7 | = | 55.42 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 38.42 | x | 0.63 | x | 0.7 | = | 26.89 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 63.27 | x | 0.63 | x | 0.7 | = | 91.27 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 63.27 | x | 0.63 | x | 0.7 | = | 44.28 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 92.28 | x | 0.63 | x | 0.7 | = | 133.11 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 92.28 | x | 0.63 | x | 0.7 | = | 64.58 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 113.09 | x | 0.63 | x | 0.7 | = | 163.14 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 113.09 | x | 0.63 | x | 0.7 | = | 79.15 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 115.77 | x | 0.63 | x | 0.7 | = | 167 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 115.77 | x | 0.63 | x | 0.7 | = | 81.02 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 110.22 | x | 0.63 | x | 0.7 | = | 158.99 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 110.22 | x | 0.63 | x | 0.7 | = | 77.14 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 94.68 | x | 0.63 | x | 0.7 | = | 136.57 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 94.68 | x | 0.63 | x | 0.7 | = | 66.26 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 73.59 | x | 0.63 | x | 0.7 | = | 106.15 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 73.59 | x | 0.63 | x | 0.7 | = | 51.5 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 45.59 | x | 0.63 | x | 0.7 | = | 65.76 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 45.59 | x | 0.63 | x | 0.7 | = | 31.91 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 24.49 | x | 0.63 | x | 0.7 | = | 35.33 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 24.49 | x | 0.63 | x | 0.7 | = | 17.14 | (80) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 4.72 | x | 16.15 | x | 0.63 | x | 0.7 | = | 23.3 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 16.15 | x | 0.63 | x | 0.7 | = | 11.3 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 82.65 | 161.68 | 266.27 | 388.34 | 475.93 | 487.2 | 463.83 | 398.42 | 309.69 | 191.85 | 103.06 | 67.97 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 514.97 | 591.64 | 680.9 | 777.69 | 839.36 | 825.86 | 787.03 | 728.78 | 653.6 | 561.26 | 501.06 | 487.55 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 0.99 | 0.94 | 0.8 | 0.59 | 0.43 | 0.48 | 0.77 | 0.97 | 1 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 20.16 | 20.29 | 20.51 | 20.78 | 20.95 | 20.99 | 21 | 21 | 20.97 | 20.73 | 20.4 | 20.14 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.24 | 20.24 | 20.24 | 20.25 | 20.26 | 20.26 | 20.26 | 20.27 | 20.26 | 20.26 | 20.25 | 20.25 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 1 | 0.98 | 0.92 | 0.75 | 0.52 | 0.36 | 0.41 | 0.7 | 0.96 | 1 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 19.1 | 19.29 | 19.61 | 20 | 20.2 | 20.26 | 20.26 | 20.27 | 20.24 | 19.94 | 19.45 | 19.08 | (90) |

fLA = Living area ÷ (4) = 0.35 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 19.48 | 19.65 | 19.93 | 20.27 | 20.47 | 20.52 | 20.52 | 20.52 | 20.5 | 20.22 | 19.79 | 19.45 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 19.48 | 19.65 | 19.93 | 20.27 | 20.47 | 20.52 | 20.52 | 20.52 | 20.5 | 20.22 | 19.79 | 19.45 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.98 | 0.92 | 0.77 | 0.55 | 0.38 | 0.43 | 0.73 | 0.96 | 1 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 513.97 | 588.6 | 668.21 | 716.75 | 643.55 | 451.44 | 301.24 | 315.56 | 474 | 539.15 | 498.63 | 486.88 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1210.77 | 1172.67 | 1064.58 | 888.11 | 682.54 | 454.84 | 301.5 | 316.13 | 493.92 | 748.74 | 993.43 | 1201.75 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 518.42 | 392.5 | 294.9 | 123.38 | 29.01 | 0 | 0 | 0 | 0 | 155.93 | 356.26 | 531.86 | |

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2402.26 (98)

Space heating requirement in kWh/m²/year 24.61 (99)

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

Fraction of space heat from secondary/supplementary system 0 (201)

# TER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | 518.42 | 392.5 | 294.9 | 123.38 | 29.01 | 0 | 0 | 0 | 0 | 155.93 | 356.26 | 531.86 | | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 555.05 | 420.24 | 315.74 | 132.1 | 31.06 | 0 | 0 | 0 | 0 | 166.95 | 381.43 | 569.44 | | (211) |
| Total (kWh/year) =Sum(211)$_{1...5,10....12}$= | | | | | | | | | | | | | 2572.01 | (211) |
| Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Total (kWh/year) =Sum(215)$_{1...5,10....12}$= | | | | | | | | | | | | | 0 | (215) |

**Water heating**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Output from water heater (calculated above) | 211.98 | 186.86 | 196.28 | 174.4 | 168.85 | 148.72 | 142.48 | 158.83 | 160.59 | 182.51 | 192.91 | 206.9 | | |
| Efficiency of water heater | | | | | | | | | | | | | 80.3 | (216) |
| (217)m= | 87.22 | 86.88 | 86.07 | 84.2 | 81.64 | 80.3 | 80.3 | 80.3 | 80.3 | 84.66 | 86.57 | 87.32 | | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m= | 243.05 | 215.09 | 228.04 | 207.13 | 206.83 | 185.2 | 177.44 | 197.8 | 199.98 | 215.59 | 222.83 | 236.93 | | |
| Total = Sum(219a)$_{1...12}$ = | | | | | | | | | | | | | 2535.91 | (219) |

| **Annual totals** | | **kWh/year** | **kWh/year** | |
|---|---|---|---|---|
| Space heating fuel used, main system 1 | | | 2572.01 | |
| Water heating fuel used | | | 2535.91 | |
| Electricity for pumps, fans and electric keep-hot | | | | |
| central heating pump: | | 30 | | (230c) |
| boiler with a fan-assisted flue | | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | | 425.59 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 555.56 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 547.76 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1103.31 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 220.88 | (268) |

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| | | | |
|---|---|---|---|
| Total CO2, kg/year | sum of (265)…(271) = | 1363.12 | (272) |
| **TER =** | | 13.97 | (273) |

# TER WorkSheet: New dwelling design stage

**User Details:**

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

**Property Address: P6**

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 83.09 | (1a) x | 2.55 | (2a) = | 211.88 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 83.09 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 211.88 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 3 | x 10 = | 30 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 30 | ÷ (5) = | 0.14 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.39 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.33 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.42 | 0.42 | 0.41 | 0.37 | 0.36 | 0.32 | 0.32 | 0.31 | 0.33 | 0.36 | 0.37 | 0.39 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.59 | 0.59 | 0.58 | 0.57 | 0.56 | 0.55 | 0.55 | 0.55 | 0.56 | 0.56 | 0.57 | 0.58 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.59 | 0.59 | 0.58 | 0.57 | 0.56 | 0.55 | 0.55 | 0.55 | 0.56 | 0.56 | 0.57 | 0.58 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.5 | x1/[1/( 1.4 )+ 0.04] | = | 5.97 | | | (27) |
| Windows Type 2 | | | 2.26 | x1/[1/( 1.4 )+ 0.04] | = | 3 | | | (27) |
| Windows Type 3 | | | 4.72 | x1/[1/( 1.4 )+ 0.04] | = | 6.26 | | | (27) |
| Windows Type 4 | | | 2.29 | x1/[1/( 1.4 )+ 0.04] | = | 3.04 | | | (27) |
| Floor | | | 33.02 | x 0.13 | = | 4.2926 | | | (28) |
| Walls Type1 | 34.82 | 13.77 | 21.05 | x 0.18 | = | 3.79 | | | (29) |
| Walls Type2 | 4.02 | 0 | 4.02 | x 0.18 | = | 0.72 | | | (29) |
| Total area of elements, m² | | | 71.86 | | | | | | (31) |
| Party wall | | | 78.29 | x 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 27.06 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 7503.51 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 5.03 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 32.09 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 41.26 | 41.01 | 40.77 | 39.65 | 39.44 | 38.46 | 38.46 | 38.27 | 38.83 | 39.44 | 39.86 | 40.31 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 73.35 | 73.1 | 72.86 | 71.74 | 71.53 | 70.55 | 70.55 | 70.36 | 70.92 | 71.53 | 71.95 | 72.4 | |

Average = Sum(39)$_{1…12}$ /12= 71.74 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.88 | 0.88 | 0.88 | 0.86 | 0.86 | 0.85 | 0.85 | 0.85 | 0.85 | 0.86 | 0.87 | 0.87 |

Average = Sum(40)$_{1...12}$ /12= 0.86 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.52 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 94.02 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 103.43 | 99.66 | 95.9 | 92.14 | 88.38 | 84.62 | 84.62 | 88.38 | 92.14 | 95.9 | 99.66 | 103.43 |

Total = Sum(44)$_{1...12}$ = 1128.28 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 153.38 | 134.14 | 138.43 | 120.68 | 115.8 | 99.92 | 92.6 | 106.25 | 107.52 | 125.31 | 136.78 | 148.54 |

Total = Sum(45)$_{1...12}$ = 1479.35 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 23.01 | 20.12 | 20.76 | 18.1 | 17.37 | 14.99 | 13.89 | 15.94 | 16.13 | 18.8 | 20.52 | 22.28 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) — 0 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.96 | 45.87 | 48.87 | 45.44 | 45.04 | 41.73 | 43.12 | 45.04 | 45.44 | 48.87 | 49.15 | 50.96 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 204.34 | 180.02 | 187.3 | 166.12 | 160.84 | 141.66 | 135.72 | 151.29 | 152.96 | 174.18 | 185.93 | 199.5 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 204.34 | 180.02 | 187.3 | 166.12 | 160.84 | 141.66 | 135.72 | 151.29 | 152.96 | 174.18 | 185.93 | 199.5 | |

Output from water heater (annual)$_{1...12}$ 2039.85 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 63.74 | 56.07 | 58.24 | 51.49 | 49.76 | 43.66 | 41.57 | 46.59 | 47.11 | 53.88 | 57.77 | 62.13 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 20.86 | 18.53 | 15.07 | 11.41 | 8.53 | 7.2 | 7.78 | 10.11 | 13.57 | 17.23 | 20.11 | 21.44 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 225.78 | 228.12 | 222.22 | 209.65 | 193.78 | 178.87 | 168.91 | 166.57 | 172.47 | 185.04 | 200.9 | 215.82 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 85.67 | 83.44 | 78.29 | 71.51 | 66.89 | 60.64 | 55.87 | 62.62 | 65.43 | 72.42 | 80.23 | 83.51 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 396.09 | 393.87 | 379.35 | 356.35 | 332.98 | 310.49 | 296.34 | 303.08 | 315.25 | 338.47 | 365.03 | 384.54 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.5 | x | 19.64 | x | 0.63 | x | 0.7 | = | 27.01 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 19.64 | x | 0.63 | x | 0.7 | = | 13.57 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 38.42 | x | 0.63 | x | 0.7 | = | 52.84 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 38.42 | x | 0.63 | x | 0.7 | = | 26.54 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 63.27 | x | 0.63 | x | 0.7 | = | 87.02 | (76) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 2.26 | x | 63.27 | x | 0.63 | x | 0.7 | = | 43.7 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 92.28 | x | 0.63 | x | 0.7 | = | 126.91 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 92.28 | x | 0.63 | x | 0.7 | = | 63.74 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 113.09 | x | 0.63 | x | 0.7 | = | 155.53 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 113.09 | x | 0.63 | x | 0.7 | = | 78.11 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 115.77 | x | 0.63 | x | 0.7 | = | 159.21 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 115.77 | x | 0.63 | x | 0.7 | = | 79.96 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 110.22 | x | 0.63 | x | 0.7 | = | 151.58 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 110.22 | x | 0.63 | x | 0.7 | = | 76.13 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 94.68 | x | 0.63 | x | 0.7 | = | 130.2 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 94.68 | x | 0.63 | x | 0.7 | = | 65.39 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 73.59 | x | 0.63 | x | 0.7 | = | 101.2 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 73.59 | x | 0.63 | x | 0.7 | = | 50.83 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 45.59 | x | 0.63 | x | 0.7 | = | 62.7 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 45.59 | x | 0.63 | x | 0.7 | = | 31.49 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 24.49 | x | 0.63 | x | 0.7 | = | 33.68 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 24.49 | x | 0.63 | x | 0.7 | = | 16.91 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 16.15 | x | 0.63 | x | 0.7 | = | 22.21 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 16.15 | x | 0.63 | x | 0.7 | = | 11.16 | (76) |
| West | 0.9x | 0.77 | x | 4.72 | x | 19.64 | x | 0.63 | x | 0.7 | = | 28.33 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 19.64 | x | 0.63 | x | 0.7 | = | 13.75 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 38.42 | x | 0.63 | x | 0.7 | = | 55.42 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 38.42 | x | 0.63 | x | 0.7 | = | 26.89 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 63.27 | x | 0.63 | x | 0.7 | = | 91.27 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 63.27 | x | 0.63 | x | 0.7 | = | 44.28 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 92.28 | x | 0.63 | x | 0.7 | = | 133.11 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 92.28 | x | 0.63 | x | 0.7 | = | 64.58 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 113.09 | x | 0.63 | x | 0.7 | = | 163.14 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 113.09 | x | 0.63 | x | 0.7 | = | 79.15 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 115.77 | x | 0.63 | x | 0.7 | = | 167 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 115.77 | x | 0.63 | x | 0.7 | = | 81.02 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 110.22 | x | 0.63 | x | 0.7 | = | 158.99 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 110.22 | x | 0.63 | x | 0.7 | = | 77.14 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 94.68 | x | 0.63 | x | 0.7 | = | 136.57 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 94.68 | x | 0.63 | x | 0.7 | = | 66.26 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 73.59 | x | 0.63 | x | 0.7 | = | 106.15 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 73.59 | x | 0.63 | x | 0.7 | = | 51.5 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 45.59 | x | 0.63 | x | 0.7 | = | 65.76 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 45.59 | x | 0.63 | x | 0.7 | = | 31.91 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 24.49 | x | 0.63 | x | 0.7 | = | 35.33 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 24.49 | x | 0.63 | x | 0.7 | = | 17.14 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 4.72 | x | 16.15 | x | 0.63 | x | 0.7 | = | 23.3 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 16.15 | x | 0.63 | x | 0.7 | = | 11.3 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 82.65 | 161.68 | 266.27 | 388.34 | 475.93 | 487.2 | 463.83 | 398.42 | 309.69 | 191.85 | 103.06 | 67.97 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 478.74 | 555.55 | 645.62 | 744.69 | 808.9 | 797.68 | 760.17 | 701.5 | 624.94 | 530.33 | 468.09 | 452.51 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 0.98 | 0.92 | 0.77 | 0.56 | 0.41 | 0.46 | 0.74 | 0.96 | 1 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 20.11 | 20.26 | 20.5 | 20.78 | 20.95 | 20.99 | 21 | 21 | 20.97 | 20.72 | 20.36 | 20.09 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.18 | 20.18 | 20.19 | 20.2 | 20.2 | 20.21 | 20.21 | 20.21 | 20.21 | 20.2 | 20.2 | 20.19 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.98 | 0.9 | 0.72 | 0.49 | 0.33 | 0.38 | 0.67 | 0.95 | 0.99 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.99 | 19.2 | 19.55 | 19.95 | 20.15 | 20.21 | 20.21 | 20.21 | 20.18 | 19.88 | 19.36 | 18.96 | (90) |

fLA = Living area ÷ (4) = 0.42 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 19.45 | 19.64 | 19.94 | 20.3 | 20.48 | 20.53 | 20.54 | 20.54 | 20.51 | 20.23 | 19.78 | 19.43 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 19.45 | 19.64 | 19.94 | 20.3 | 20.48 | 20.53 | 20.54 | 20.54 | 20.51 | 20.23 | 19.78 | 19.43 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.97 | 0.9 | 0.74 | 0.52 | 0.37 | 0.41 | 0.7 | 0.95 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 477.32 | 551.27 | 628.74 | 670.95 | 595.07 | 415.48 | 277.56 | 290.65 | 436.88 | 503.39 | 464.76 | 451.54 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1111.49 | 1077.49 | 979.41 | 817.53 | 628.16 | 418.61 | 277.83 | 291.23 | 454.58 | 688.78 | 912.27 | 1102.58 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 471.82 | 353.62 | 260.9 | 105.54 | 24.62 | 0 | 0 | 0 | 0 | 137.93 | 322.21 | 484.37 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2161.01 (98)

Space heating requirement in kWh/m²/year 26.01 (99)

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

Fraction of space heat from secondary/supplementary system 0 (201)

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| | | | |
|---|---|---|---|
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | | | | | | | | | | | | | | |
| | 471.82 | 353.62 | 260.9 | 105.54 | 24.62 | 0 | 0 | 0 | 0 | 137.93 | 322.21 | 484.37 | | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | | (211) |
| | 505.16 | 378.61 | 279.33 | 112.99 | 26.36 | 0 | 0 | 0 | 0 | 147.68 | 344.97 | 518.6 | | |
| Total (kWh/year) =Sum(211)$_{1...5,10....12}$= | | | | | | | | | | | | | 2313.72 | (211) |
| Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) | | | | | | | | | | | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Total (kWh/year) =Sum(215)$_{1...5,10....12}$= | | | | | | | | | | | | | 0 | (215) |

**Water heating**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Output from water heater (calculated above) | 204.34 | 180.02 | 187.3 | 166.12 | 160.84 | 141.66 | 135.72 | 151.29 | 152.96 | 174.18 | 185.93 | 199.5 | | |
| Efficiency of water heater | | | | | | | | | | | | | 80.3 | (216) |
| (217)m= | 87.09 | 86.72 | 85.89 | 83.94 | 81.51 | 80.3 | 80.3 | 80.3 | 80.3 | 84.47 | 86.42 | 87.2 | | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m | | | | | | | | | | | | | | |
| (219)m= | 234.63 | 207.58 | 218.08 | 197.9 | 197.32 | 176.41 | 169.01 | 188.41 | 190.49 | 206.2 | 215.14 | 228.78 | | |
| Total = Sum(219a)$_{1...12}$ = | | | | | | | | | | | | | 2429.96 | (219) |

| **Annual totals** | | **kWh/year** | **kWh/year** | |
|---|---|---|---|---|
| Space heating fuel used, main system 1 | | | 2313.72 | |
| Water heating fuel used | | | 2429.96 | |
| Electricity for pumps, fans and electric keep-hot | | | | |
| central heating pump: | | 30 | | (230c) |
| boiler with a fan-assisted flue | | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | | 368.35 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 499.76 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 524.87 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1024.63 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 191.17 | (268) |

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| | | | |
|---|---|---|---|
| Total CO2, kg/year | sum of (265)…(271) = | 1254.73 | (272) |
| **TER =** | | 15.1 | (273) |

# TER WorkSheet: New dwelling design stage

**User Details:**

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

**Property Address: P7**

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 49.09 | (1a) x | 2.55 | (2a) = | 125.18 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 49.09 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 125.18 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 2 | x 10 = | 20 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 20 | ÷ (5) = | 0.16 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.41 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.35 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.44 | 0.44 | 0.43 | 0.38 | 0.37 | 0.33 | 0.33 | 0.32 | 0.35 | 0.37 | 0.39 | 0.41 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.6 | 0.59 | 0.59 | 0.57 | 0.57 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.58 | 0.58 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.6 | 0.59 | 0.59 | 0.57 | 0.57 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.58 | 0.58 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.72 | x1/[1/( 1.4 )+ 0.04] | | = | 6.26 | | | (27) |
| Windows Type 2 | | | 2.29 | x1/[1/( 1.4 )+ 0.04] | | = | 3.04 | | | (27) |
| Walls Type1 | 21.99 | 7.01 | 14.98 | x | 0.18 | = | 2.7 | | | (29) |
| Walls Type2 | 32.46 | 0 | 32.46 | x | 0.18 | = | 5.84 | | | (29) |
| Total area of elements, m² | | | 54.45 | | | | | | | (31) |
| Party wall | | | 23.76 | x | 0 | = | 0 | | | (32) |

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 17.83 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 3915.6 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 4.21 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 22.05 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 24.73 | 24.57 | 24.41 | 23.69 | 23.55 | 22.92 | 22.92 | 22.8 | 23.16 | 23.55 | 23.83 | 24.11 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 46.77 | 46.62 | 46.46 | 45.73 | 45.6 | 44.96 | 44.96 | 44.85 | 45.21 | 45.6 | 45.87 | 46.16 | |

Average = Sum(39)$_{1…12}$ /12= 45.73 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.95 | 0.95 | 0.95 | 0.93 | 0.93 | 0.92 | 0.92 | 0.91 | 0.92 | 0.93 | 0.93 | 0.94 |

Average = Sum(40)$_{1…12}$ /12= 0.93 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.66 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 73.7 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 81.07 | 78.13 | 75.18 | 72.23 | 69.28 | 66.33 | 66.33 | 69.28 | 72.23 | 75.18 | 78.13 | 81.07 |

Total = Sum(44)$_{1…12}$ = 884.45 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 120.23 | 105.16 | 108.51 | 94.6 | 90.77 | 78.33 | 72.58 | 83.29 | 84.29 | 98.23 | 107.22 | 116.44 |

Total = Sum(45)$_{1…12}$ = 1159.66 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 18.03 | 15.77 | 16.28 | 14.19 | 13.62 | 11.75 | 10.89 | 12.49 | 12.64 | 14.73 | 16.08 | 17.47 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 41.31 | 35.96 | 38.31 | 35.62 | 35.31 | 32.71 | 33.8 | 35.31 | 35.62 | 38.31 | 38.53 | 41.31 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 161.55 | 141.12 | 146.82 | 130.22 | 126.08 | 111.04 | 106.39 | 118.6 | 119.91 | 136.54 | 145.75 | 157.75 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 161.55 | 141.12 | 146.82 | 130.22 | 126.08 | 111.04 | 106.39 | 118.6 | 119.91 | 136.54 | 145.75 | 157.75 | |

Output from water heater (annual)$_{1...12}$ 1601.76 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 50.31 | 43.95 | 45.66 | 40.36 | 39.01 | 34.22 | 32.59 | 36.52 | 36.93 | 42.24 | 45.28 | 49.04 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 83.17 | 83.17 | 83.17 | 83.17 | 83.17 | 83.17 | 83.17 | 83.17 | 83.17 | 83.17 | 83.17 | 83.17 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 13.8 | 12.25 | 9.97 | 7.54 | 5.64 | 4.76 | 5.14 | 6.69 | 8.98 | 11.4 | 13.3 | 14.18 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 144.87 | 146.37 | 142.59 | 134.52 | 124.34 | 114.77 | 108.38 | 106.88 | 110.67 | 118.73 | 128.91 | 138.48 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 31.32 | 31.32 | 31.32 | 31.32 | 31.32 | 31.32 | 31.32 | 31.32 | 31.32 | 31.32 | 31.32 | 31.32 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -66.53 | -66.53 | -66.53 | -66.53 | -66.53 | -66.53 | -66.53 | -66.53 | -66.53 | -66.53 | -66.53 | -66.53 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 67.62 | 65.41 | 61.37 | 56.06 | 52.43 | 47.53 | 43.8 | 49.09 | 51.29 | 56.77 | 62.89 | 65.92 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 277.23 | 274.99 | 264.87 | 249.07 | 233.36 | 218.02 | 208.27 | 213.6 | 221.88 | 237.85 | 256.06 | 269.53 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 4.72 | x | 19.64 | x | 0.63 | x | 0.7 | = | 28.33 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 19.64 | x | 0.63 | x | 0.7 | = | 13.75 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 38.42 | x | 0.63 | x | 0.7 | = | 55.42 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 38.42 | x | 0.63 | x | 0.7 | = | 26.89 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 63.27 | x | 0.63 | x | 0.7 | = | 91.27 | (80) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 2.29 | x | 63.27 | x | 0.63 | x | 0.7 | = | 44.28 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 92.28 | x | 0.63 | x | 0.7 | = | 133.11 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 92.28 | x | 0.63 | x | 0.7 | = | 64.58 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 113.09 | x | 0.63 | x | 0.7 | = | 163.14 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 113.09 | x | 0.63 | x | 0.7 | = | 79.15 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 115.77 | x | 0.63 | x | 0.7 | = | 167 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 115.77 | x | 0.63 | x | 0.7 | = | 81.02 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 110.22 | x | 0.63 | x | 0.7 | = | 158.99 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 110.22 | x | 0.63 | x | 0.7 | = | 77.14 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 94.68 | x | 0.63 | x | 0.7 | = | 136.57 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 94.68 | x | 0.63 | x | 0.7 | = | 66.26 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 73.59 | x | 0.63 | x | 0.7 | = | 106.15 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 73.59 | x | 0.63 | x | 0.7 | = | 51.5 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 45.59 | x | 0.63 | x | 0.7 | = | 65.76 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 45.59 | x | 0.63 | x | 0.7 | = | 31.91 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 24.49 | x | 0.63 | x | 0.7 | = | 35.33 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 24.49 | x | 0.63 | x | 0.7 | = | 17.14 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 16.15 | x | 0.63 | x | 0.7 | = | 23.3 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 16.15 | x | 0.63 | x | 0.7 | = | 11.3 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 42.08 | 82.31 | 135.55 | 197.7 | 242.28 | 248.02 | 236.13 | 202.83 | 157.65 | 97.67 | 52.46 | 34.6 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 319.31 | 357.3 | 400.42 | 446.77 | 475.64 | 466.04 | 444.4 | 416.43 | 379.54 | 335.52 | 308.52 | 304.13 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 0.99 | 0.98 | 0.93 | 0.8 | 0.6 | 0.44 | 0.49 | 0.76 | 0.96 | 0.99 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 20.08 | 20.21 | 20.44 | 20.73 | 20.92 | 20.99 | 21 | 21 | 20.95 | 20.7 | 20.34 | 20.06 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.12 | 20.13 | 20.13 | 20.14 | 20.14 | 20.15 | 20.15 | 20.16 | 20.15 | 20.14 | 20.14 | 20.13 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.97 | 0.91 | 0.75 | 0.53 | 0.36 | 0.4 | 0.69 | 0.94 | 0.99 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.9 | 19.09 | 19.42 | 19.83 | 20.06 | 20.15 | 20.15 | 20.15 | 20.12 | 19.8 | 19.29 | 18.87 | (90) |

fLA = Living area ÷ (4) = 0.5 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 19.49 | 19.65 | 19.93 | 20.27 | 20.49 | 20.56 | 20.57 | 20.57 | 20.53 | 20.24 | 19.81 | 19.46 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 19.49 | 19.65 | 19.93 | 20.27 | 20.49 | 20.56 | 20.57 | 20.57 | 20.53 | 20.24 | 19.81 | 19.46 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.99 | 0.99 | 0.97 | 0.91 | 0.77 | 0.57 | 0.4 | 0.45 | 0.72 | 0.94 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 317.68 | 353.59 | 389.38 | 407.85 | 368.28 | 264.08 | 178.22 | 186.34 | 274.65 | 316.95 | 305.2 | 302.93 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 710.27 | 687.56 | 623.88 | 520.13 | 400.7 | 268.17 | 178.65 | 187.15 | 290.78 | 439.7 | 583.01 | 704.58 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 292.09 | 224.43 | 174.47 | 80.84 | 24.12 | 0 | 0 | 0 | 0 | 91.33 | 200.03 | 298.82 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1386.12 (98)

Space heating requirement in kWh/m²/year 28.24 (99)

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary system | | 0 | (201) |
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | | | | | | | | | | | | | |
| | 292.09 | 224.43 | 174.47 | 80.84 | 24.12 | 0 | 0 | 0 | 0 | 91.33 | 200.03 | 298.82 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | (211) |
| | 312.73 | 240.29 | 186.79 | 86.55 | 25.82 | 0 | 0 | 0 | 0 | 97.78 | 214.16 | 319.94 | |

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1484.07 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

**Water heating**

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Output from water heater (calculated above) | | | | | | | | | | | | | |
| | 161.55 | 141.12 | 146.82 | 130.22 | 126.08 | 111.04 | 106.39 | 118.6 | 119.91 | 136.54 | 145.75 | 157.75 | |
| Efficiency of water heater | | | | | | | | | | | | 80.3 | (216) |
| (217)m= | 86.52 | 86.21 | 85.49 | 83.89 | 81.77 | 80.3 | 80.3 | 80.3 | 80.3 | 84.06 | 85.85 | 86.64 | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m | | | | | | | | | | | | | |
| (219)m= | 186.71 | 163.68 | 171.75 | 155.23 | 154.19 | 138.29 | 132.49 | 147.69 | 149.32 | 162.42 | 169.78 | 182.09 | |

Total = Sum(219a)$_{1...12}$ = 1913.64 (219)

| **Annual totals** | **kWh/year** | **kWh/year** |
|---|---|---|
| Space heating fuel used, main system 1 | | 1484.07 |

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| | | | | |
|---|---|---|---|---|
| Water heating fuel used | | | 1913.64 | |
| Electricity for pumps, fans and electric keep-hot | | | | |
| central heating pump: | | 30 | | (230c) |
| boiler with a fan-assisted flue | | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | | 243.65 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | | Emissions kg CO2/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 320.56 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 413.35 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 733.9 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 126.45 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 899.28 | (272) |

**TER =** 18.32 (273)

# TER WorkSheet: New dwelling design stage

**User Details:**

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

**Property Address: P8**

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 54.2 | (1a) | x | 2.55 | (2a) | = | 138.21 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 54.2 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | | = | 138.21 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 2 | x 10 = | 20 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 20 | ÷ (5) = | 0.14 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.39 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.34 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Monthly average wind speed from Table 7** | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| **Wind Factor (22a)m = (22)m ÷ 4** | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.43 | 0.42 | 0.41 | 0.37 | 0.36 | 0.32 | 0.32 | 0.31 | 0.34 | 0.36 | 0.38 | 0.39 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.59 | 0.59 | 0.58 | 0.57 | 0.57 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.57 | 0.58 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.59 | 0.59 | 0.58 | 0.57 | 0.57 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.57 | 0.58 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.72 | x1/[1/( 1.4 )+ 0.04] = | 6.26 | | | (27) |
| Windows Type 2 | | | 2.29 | x1/[1/( 1.4 )+ 0.04] = | 3.04 | | | (27) |
| Floor | | | 4.31 | x 0.13 = | 0.5603 | | | (28) |
| Walls Type1 | 20.2 | 7.01 | 13.19 | x 0.18 = | 2.37 | | | (29) |
| Walls Type2 | 31.46 | 0 | 31.46 | x 0.18 = | 5.66 | | | (29) |
| Total area of elements, m² | | | 55.97 | | | | | (31) |
| Party wall | | | 26.04 | x 0 = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 17.89 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 4174.05 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 5.27 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 23.17 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 26.98 | 26.82 | 26.66 | 25.91 | 25.77 | 25.12 | 25.12 | 25 | 25.37 | 25.77 | 26.05 | 26.35 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 50.14 | 49.98 | 49.82 | 49.08 | 48.94 | 48.29 | 48.29 | 48.17 | 48.54 | 48.94 | 49.22 | 49.51 | |

Average = Sum(39)$_{1…12}$ /12= 49.08 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.93 | 0.92 | 0.92 | 0.91 | 0.9 | 0.89 | 0.89 | 0.89 | 0.9 | 0.9 | 0.91 | 0.91 |

Average = Sum(40)1…12 /12= 0.91 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.81 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 77.28 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | |
| (44)m= | 85.01 | 81.92 | 78.83 | 75.73 | 72.64 | 69.55 | 69.55 | 72.64 | 75.73 | 78.83 | 81.92 | 85.01 |

Total = Sum(44)1…12 = 927.36 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 126.06 | 110.26 | 113.77 | 99.19 | 95.18 | 82.13 | 76.11 | 87.33 | 88.38 | 102.99 | 112.42 | 122.09 |

Total = Sum(45)1…12 = 1215.91 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 18.91 | 16.54 | 17.07 | 14.88 | 14.28 | 12.32 | 11.42 | 13.1 | 13.26 | 15.45 | 16.86 | 18.31 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 43.32 | 37.7 | 40.17 | 37.35 | 37.02 | 34.3 | 35.44 | 37.02 | 37.35 | 40.17 | 40.4 | 43.32 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 169.38 | 147.96 | 153.94 | 136.54 | 132.19 | 116.43 | 111.55 | 124.35 | 125.72 | 143.16 | 152.82 | 165.41 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 169.38 | 147.96 | 153.94 | 136.54 | 132.19 | 116.43 | 111.55 | 124.35 | 125.72 | 143.16 | 152.82 | 165.41 | |

Output from water heater (annual)$_{1...12}$ 1679.46 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 52.75 | 46.09 | 47.87 | 42.32 | 40.9 | 35.88 | 34.17 | 38.29 | 38.72 | 44.29 | 47.48 | 51.42 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 90.69 | 90.69 | 90.69 | 90.69 | 90.69 | 90.69 | 90.69 | 90.69 | 90.69 | 90.69 | 90.69 | 90.69 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| (67)m= | 15.39 | 13.67 | 11.12 | 8.42 | 6.29 | 5.31 | 5.74 | 7.46 | 10.01 | 12.71 | 14.84 | 15.82 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| (68)m= | 158.12 | 159.76 | 155.63 | 146.83 | 135.71 | 125.27 | 118.29 | 116.65 | 120.79 | 129.59 | 140.7 | 151.14 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| (69)m= | 32.07 | 32.07 | 32.07 | 32.07 | 32.07 | 32.07 | 32.07 | 32.07 | 32.07 | 32.07 | 32.07 | 32.07 | (69) |
| Pumps and fans gains (Table 5a) | | | | | | | | | | | | | |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| (71)m= | -72.56 | -72.56 | -72.56 | -72.56 | -72.56 | -72.56 | -72.56 | -72.56 | -72.56 | -72.56 | -72.56 | -72.56 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| (72)m= | 70.9 | 68.58 | 64.34 | 58.78 | 54.97 | 49.84 | 45.92 | 51.47 | 53.78 | 59.53 | 65.95 | 69.12 | (72) |
| **Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m | | | | | | | | | | | | | |
| (73)m= | 297.61 | 295.22 | 284.3 | 267.22 | 250.19 | 233.63 | 223.16 | 228.79 | 237.79 | 255.04 | 274.69 | 289.29 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 4.72 | x | 19.64 | x | 0.63 | x | 0.7 | = | 28.33 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 19.64 | x | 0.63 | x | 0.7 | = | 13.75 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 38.42 | x | 0.63 | x | 0.7 | = | 55.42 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 38.42 | x | 0.63 | x | 0.7 | = | 26.89 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 63.27 | x | 0.63 | x | 0.7 | = | 91.27 | (80) |

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| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 2.29 | x | 63.27 | x | 0.63 | x | 0.7 | = | 44.28 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 92.28 | x | 0.63 | x | 0.7 | = | 133.11 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 92.28 | x | 0.63 | x | 0.7 | = | 64.58 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 113.09 | x | 0.63 | x | 0.7 | = | 163.14 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 113.09 | x | 0.63 | x | 0.7 | = | 79.15 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 115.77 | x | 0.63 | x | 0.7 | = | 167 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 115.77 | x | 0.63 | x | 0.7 | = | 81.02 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 110.22 | x | 0.63 | x | 0.7 | = | 158.99 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 110.22 | x | 0.63 | x | 0.7 | = | 77.14 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 94.68 | x | 0.63 | x | 0.7 | = | 136.57 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 94.68 | x | 0.63 | x | 0.7 | = | 66.26 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 73.59 | x | 0.63 | x | 0.7 | = | 106.15 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 73.59 | x | 0.63 | x | 0.7 | = | 51.5 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 45.59 | x | 0.63 | x | 0.7 | = | 65.76 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 45.59 | x | 0.63 | x | 0.7 | = | 31.91 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 24.49 | x | 0.63 | x | 0.7 | = | 35.33 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 24.49 | x | 0.63 | x | 0.7 | = | 17.14 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 16.15 | x | 0.63 | x | 0.7 | = | 23.3 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 16.15 | x | 0.63 | x | 0.7 | = | 11.3 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 42.08 | 82.31 | 135.55 | 197.7 | 242.28 | 248.02 | 236.13 | 202.83 | 157.65 | 97.67 | 52.46 | 34.6 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 339.69 | 377.53 | 419.85 | 464.92 | 492.47 | 481.65 | 459.29 | 431.62 | 395.44 | 352.7 | 327.16 | 323.89 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 0.99 | 0.98 | 0.94 | 0.82 | 0.63 | 0.46 | 0.51 | 0.78 | 0.96 | 0.99 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 20.1 | 20.22 | 20.44 | 20.72 | 20.91 | 20.99 | 21 | 21 | 20.95 | 20.69 | 20.35 | 20.08 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.15 | 20.15 | 20.15 | 20.16 | 20.17 | 20.18 | 20.18 | 20.18 | 20.17 | 20.17 | 20.16 | 20.16 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.98 | 0.92 | 0.78 | 0.55 | 0.38 | 0.42 | 0.71 | 0.95 | 0.99 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.94 | 19.12 | 19.44 | 19.83 | 20.08 | 20.17 | 20.17 | 20.18 | 20.13 | 19.81 | 19.32 | 18.92 | (90) |

fLA = Living area ÷ (4) = 0.52 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 19.55 | 19.7 | 19.96 | 20.3 | 20.52 | 20.6 | 20.61 | 20.61 | 20.56 | 20.27 | 19.86 | 19.53 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 19.55 | 19.7 | 19.96 | 20.3 | 20.52 | 20.6 | 20.61 | 20.61 | 20.56 | 20.27 | 19.86 | 19.53 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.98 | 0.93 | 0.8 | 0.59 | 0.42 | 0.47 | 0.74 | 0.95 | 0.99 | 1 | | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | | |
| (95)m= | 338.24 | 374.28 | 410.21 | 430.26 | 392.48 | 284.5 | 192.94 | 201.63 | 294.52 | 335.82 | 324.19 | 322.83 | | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | | |
| (97)m= | 764.57 | 739.74 | 670.79 | 559.3 | 431.39 | 289.56 | 193.47 | 202.61 | 313.7 | 473.43 | 627.93 | 758.89 | | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | | |
| (98)m= | 317.19 | 245.59 | 193.87 | 92.91 | 28.95 | 0 | 0 | 0 | 0 | 102.38 | 218.69 | 324.43 | | |
| Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | | | | | | | | | | | | | 1524.01 | (98) |
| Space heating requirement in kWh/m²/year | | | | | | | | | | | | | 28.12 | (99) |

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary system | | 0 | (201) |
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | | | | | | | | | | | | | | |
| | 317.19 | 245.59 | 193.87 | 92.91 | 28.95 | 0 | 0 | 0 | 0 | 102.38 | 218.69 | 324.43 | | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | | (211) |
| | 339.6 | 262.95 | 207.57 | 99.47 | 30.99 | 0 | 0 | 0 | 0 | 109.62 | 234.15 | 347.36 | | |
| Total (kWh/year) =Sum(211)$_{1...5,10....12}$= | | | | | | | | | | | | | 1631.7 | (211) |
| Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) | | | | | | | | | | | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Total (kWh/year) =Sum(215)$_{1...5,10....12}$= | | | | | | | | | | | | | 0 | (215) |

**Water heating**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Output from water heater (calculated above) | | | | | | | | | | | | | | |
| | 169.38 | 147.96 | 153.94 | 136.54 | 132.19 | 116.43 | 111.55 | 124.35 | 125.72 | 143.16 | 152.82 | 165.41 | | |
| Efficiency of water heater | | | | | | | | | | | | | 80.3 | (216) |
| (217)m= | 86.61 | 86.32 | 85.63 | 84.1 | 81.94 | 80.3 | 80.3 | 80.3 | 80.3 | 84.22 | 85.95 | 86.72 | | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m | | | | | | | | | | | | | | |
| (219)m= | 195.57 | 171.41 | 179.77 | 162.34 | 161.32 | 144.99 | 138.91 | 154.86 | 156.57 | 169.98 | 177.8 | 190.74 | | |
| Total = Sum(219a)$_{1...12}$ = | | | | | | | | | | | | | 2004.27 | (219) |

| **Annual totals** | **kWh/year** | **kWh/year** |
|---|---|---|
| Space heating fuel used, main system 1 | | 1631.7 |

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| | | | | |
|---|---|---|---|---|
| Water heating fuel used | | | 2004.27 | |
| Electricity for pumps, fans and electric keep-hot | | | | |
| central heating pump: | | 30 | | (230c) |
| boiler with a fan-assisted flue | | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | | 271.77 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 352.45 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 432.92 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 785.37 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 141.05 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 965.35 | (272) |

**TER =** 17.81 (273)

# TER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: P9

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 94.22 | (1a) | x | 2.55 | (2a) | = | 240.26 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 94.22 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | | 240.26 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 3 | x 10 = | 30 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 30 | ÷ (5) = | 0.12 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.37 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.32 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.41 | 0.4 | 0.39 | 0.35 | 0.34 | 0.3 | 0.3 | 0.29 | 0.32 | 0.34 | 0.36 | 0.37 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.58 | 0.58 | 0.58 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.58 | 0.58 | 0.58 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.14 | x1/[1/( 1.4 )+ 0.04] | = | 5.49 | | | (27) |
| Windows Type 2 | | | 1.95 | x1/[1/( 1.4 )+ 0.04] | = | 2.59 | | | (27) |
| Windows Type 3 | | | 4 | x1/[1/( 1.4 )+ 0.04] | = | 5.3 | | | (27) |
| Windows Type 4 | | | 1.93 | x1/[1/( 1.4 )+ 0.04] | = | 2.56 | | | (27) |
| Windows Type 5 | | | 3.84 | x1/[1/( 1.4 )+ 0.04] | = | 5.09 | | | (27) |
| Windows Type 6 | | | 3.84 | x1/[1/( 1.4 )+ 0.04] | = | 5.09 | | | (27) |
| Windows Type 7 | | | 1.93 | x1/[1/( 1.4 )+ 0.04] | = | 2.56 | | | (27) |
| Walls Type1 | 72.92 | 23.56 | 49.36 | x 0.18 | = | 8.88 | | | (29) |
| Walls Type2 | 4.01 | 0 | 4.01 | x 0.18 | = | 0.72 | | | (29) |
| Total area of elements, m² | | | 76.93 | | | | | | (31) |
| Party wall | | | 42.45 | x 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 40.84 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 5112.45 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 7.06 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 47.9 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 46.19 | 45.93 | 45.68 | 44.51 | 44.29 | 43.28 | 43.28 | 43.09 | 43.67 | 44.29 | 44.74 | 45.2 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 94.08 | 93.83 | 93.58 | 92.41 | 92.19 | 91.17 | 91.17 | 90.99 | 91.57 | 92.19 | 92.64 | 93.1 | |

Average = Sum(39)$_{1...12}$ /12= 92.41 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1 | 1 | 0.99 | 0.98 | 0.98 | 0.97 | 0.97 | 0.97 | 0.97 | 0.98 | 0.98 | 0.99 | |

Average = Sum(40)$_{1...12}$ /12= 0.98 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.68 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 97.83 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 107.61 | 103.7 | 99.79 | 95.87 | 91.96 | 88.05 | 88.05 | 91.96 | 95.87 | 99.79 | 103.7 | 107.61 | |

Total = Sum(44)$_{1...12}$ = 1173.97 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 159.59 | 139.58 | 144.03 | 125.57 | 120.49 | 103.97 | 96.34 | 110.56 | 111.88 | 130.38 | 142.32 | 154.55 | |

Total = Sum(45)$_{1...12}$ = 1539.26 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 23.94 | 20.94 | 21.6 | 18.84 | 18.07 | 15.6 | 14.45 | 16.58 | 16.78 | 19.56 | 21.35 | 23.18 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.96 | 46.03 | 50.85 | 47.28 | 46.86 | 43.42 | 44.87 | 46.86 | 47.28 | 50.85 | 49.32 | 50.96 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 210.55 | 185.6 | 194.88 | 172.85 | 167.35 | 147.39 | 141.21 | 157.42 | 159.16 | 181.23 | 191.64 | 205.51 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 210.55 | 185.6 | 194.88 | 172.85 | 167.35 | 147.39 | 141.21 | 157.42 | 159.16 | 181.23 | 191.64 | 205.51 |

Output from water heater (annual)$_{1...12}$ | 2114.8 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 65.8 | 57.92 | 60.6 | 53.57 | 51.78 | 45.43 | 43.25 | 48.48 | 49.02 | 56.06 | 59.65 | 64.13 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 133.96 | 133.96 | 133.96 | 133.96 | 133.96 | 133.96 | 133.96 | 133.96 | 133.96 | 133.96 | 133.96 | 133.96 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| (67)m= | 21.99 | 19.53 | 15.88 | 12.02 | 8.99 | 7.59 | 8.2 | 10.66 | 14.3 | 18.16 | 21.2 | 22.6 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| (68)m= | 246.63 | 249.19 | 242.74 | 229.01 | 211.68 | 195.39 | 184.51 | 181.95 | 188.4 | 202.13 | 219.46 | 235.75 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| (69)m= | 36.4 | 36.4 | 36.4 | 36.4 | 36.4 | 36.4 | 36.4 | 36.4 | 36.4 | 36.4 | 36.4 | 36.4 | (69) |
| Pumps and fans gains (Table 5a) | | | | | | | | | | | | | |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| (71)m= | -107.17 | -107.17 | -107.17 | -107.17 | -107.17 | -107.17 | -107.17 | -107.17 | -107.17 | -107.17 | -107.17 | -107.17 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| (72)m= | 88.44 | 86.18 | 81.46 | 74.41 | 69.59 | 63.09 | 58.13 | 65.16 | 68.08 | 75.36 | 82.85 | 86.19 | (72) |
| **Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m | | | | | | | | | | | | | |
| (73)m= | 423.25 | 421.09 | 406.27 | 381.63 | 356.45 | 332.26 | 317.03 | 323.95 | 336.97 | 361.84 | 389.69 | 410.73 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | Access Factor Table 6d | Area m² | Flux Table 6a | g_ Table 6b | FF Table 6c | Gains (W) |
|---|---|---|---|---|---|---|

# TER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North | 0.9x | 0.77 | x | 4 | x | 10.63 | x | 0.63 | x | 0.7 | = | 13 | (74) |
| North | 0.9x | 0.77 | x | 1.93 | x | 10.63 | x | 0.63 | x | 0.7 | = | 12.54 | (74) |
| North | 0.9x | 0.77 | x | 3.84 | x | 10.63 | x | 0.63 | x | 0.7 | = | 12.48 | (74) |
| North | 0.9x | 0.77 | x | 4 | x | 20.32 | x | 0.63 | x | 0.7 | = | 24.84 | (74) |
| North | 0.9x | 0.77 | x | 1.93 | x | 20.32 | x | 0.63 | x | 0.7 | = | 23.97 | (74) |
| North | 0.9x | 0.77 | x | 3.84 | x | 20.32 | x | 0.63 | x | 0.7 | = | 23.85 | (74) |
| North | 0.9x | 0.77 | x | 4 | x | 34.53 | x | 0.63 | x | 0.7 | = | 42.21 | (74) |
| North | 0.9x | 0.77 | x | 1.93 | x | 34.53 | x | 0.63 | x | 0.7 | = | 40.73 | (74) |
| North | 0.9x | 0.77 | x | 3.84 | x | 34.53 | x | 0.63 | x | 0.7 | = | 40.52 | (74) |
| North | 0.9x | 0.77 | x | 4 | x | 55.46 | x | 0.63 | x | 0.7 | = | 67.8 | (74) |
| North | 0.9x | 0.77 | x | 1.93 | x | 55.46 | x | 0.63 | x | 0.7 | = | 65.43 | (74) |
| North | 0.9x | 0.77 | x | 3.84 | x | 55.46 | x | 0.63 | x | 0.7 | = | 65.09 | (74) |
| North | 0.9x | 0.77 | x | 4 | x | 74.72 | x | 0.63 | x | 0.7 | = | 91.34 | (74) |
| North | 0.9x | 0.77 | x | 1.93 | x | 74.72 | x | 0.63 | x | 0.7 | = | 88.14 | (74) |
| North | 0.9x | 0.77 | x | 3.84 | x | 74.72 | x | 0.63 | x | 0.7 | = | 87.68 | (74) |
| North | 0.9x | 0.77 | x | 4 | x | 79.99 | x | 0.63 | x | 0.7 | = | 97.78 | (74) |
| North | 0.9x | 0.77 | x | 1.93 | x | 79.99 | x | 0.63 | x | 0.7 | = | 94.36 | (74) |
| North | 0.9x | 0.77 | x | 3.84 | x | 79.99 | x | 0.63 | x | 0.7 | = | 93.87 | (74) |
| North | 0.9x | 0.77 | x | 4 | x | 74.68 | x | 0.63 | x | 0.7 | = | 91.29 | (74) |
| North | 0.9x | 0.77 | x | 1.93 | x | 74.68 | x | 0.63 | x | 0.7 | = | 88.09 | (74) |
| North | 0.9x | 0.77 | x | 3.84 | x | 74.68 | x | 0.63 | x | 0.7 | = | 87.64 | (74) |
| North | 0.9x | 0.77 | x | 4 | x | 59.25 | x | 0.63 | x | 0.7 | = | 72.43 | (74) |
| North | 0.9x | 0.77 | x | 1.93 | x | 59.25 | x | 0.63 | x | 0.7 | = | 69.89 | (74) |
| North | 0.9x | 0.77 | x | 3.84 | x | 59.25 | x | 0.63 | x | 0.7 | = | 69.53 | (74) |
| North | 0.9x | 0.77 | x | 4 | x | 41.52 | x | 0.63 | x | 0.7 | = | 50.75 | (74) |
| North | 0.9x | 0.77 | x | 1.93 | x | 41.52 | x | 0.63 | x | 0.7 | = | 48.98 | (74) |
| North | 0.9x | 0.77 | x | 3.84 | x | 41.52 | x | 0.63 | x | 0.7 | = | 48.72 | (74) |
| North | 0.9x | 0.77 | x | 4 | x | 24.19 | x | 0.63 | x | 0.7 | = | 29.57 | (74) |
| North | 0.9x | 0.77 | x | 1.93 | x | 24.19 | x | 0.63 | x | 0.7 | = | 28.54 | (74) |
| North | 0.9x | 0.77 | x | 3.84 | x | 24.19 | x | 0.63 | x | 0.7 | = | 28.39 | (74) |
| North | 0.9x | 0.77 | x | 4 | x | 13.12 | x | 0.63 | x | 0.7 | = | 16.04 | (74) |
| North | 0.9x | 0.77 | x | 1.93 | x | 13.12 | x | 0.63 | x | 0.7 | = | 15.47 | (74) |
| North | 0.9x | 0.77 | x | 3.84 | x | 13.12 | x | 0.63 | x | 0.7 | = | 15.39 | (74) |
| North | 0.9x | 0.77 | x | 4 | x | 8.86 | x | 0.63 | x | 0.7 | = | 10.84 | (74) |
| North | 0.9x | 0.77 | x | 1.93 | x | 8.86 | x | 0.63 | x | 0.7 | = | 10.46 | (74) |
| North | 0.9x | 0.77 | x | 3.84 | x | 8.86 | x | 0.63 | x | 0.7 | = | 10.4 | (74) |
| East | 0.9x | 1 | x | 3.84 | x | 19.64 | x | 0.63 | x | 0.7 | = | 23.05 | (76) |
| East | 0.9x | 1 | x | 1.93 | x | 19.64 | x | 0.63 | x | 0.7 | = | 11.58 | (76) |
| East | 0.9x | 1 | x | 3.84 | x | 38.42 | x | 0.63 | x | 0.7 | = | 45.09 | (76) |
| East | 0.9x | 1 | x | 1.93 | x | 38.42 | x | 0.63 | x | 0.7 | = | 22.66 | (76) |
| East | 0.9x | 1 | x | 3.84 | x | 63.27 | x | 0.63 | x | 0.7 | = | 74.25 | (76) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 1.93 | x | 63.27 | x | 0.63 | x | 0.7 | = | 37.32 | (76) |
| East | 0.9x | 1 | x | 3.84 | x | 92.28 | x | 0.63 | x | 0.7 | = | 108.3 | (76) |
| East | 0.9x | 1 | x | 1.93 | x | 92.28 | x | 0.63 | x | 0.7 | = | 54.43 | (76) |
| East | 0.9x | 1 | x | 3.84 | x | 113.09 | x | 0.63 | x | 0.7 | = | 132.72 | (76) |
| East | 0.9x | 1 | x | 1.93 | x | 113.09 | x | 0.63 | x | 0.7 | = | 66.71 | (76) |
| East | 0.9x | 1 | x | 3.84 | x | 115.77 | x | 0.63 | x | 0.7 | = | 135.86 | (76) |
| East | 0.9x | 1 | x | 1.93 | x | 115.77 | x | 0.63 | x | 0.7 | = | 68.29 | (76) |
| East | 0.9x | 1 | x | 3.84 | x | 110.22 | x | 0.63 | x | 0.7 | = | 129.35 | (76) |
| East | 0.9x | 1 | x | 1.93 | x | 110.22 | x | 0.63 | x | 0.7 | = | 65.01 | (76) |
| East | 0.9x | 1 | x | 3.84 | x | 94.68 | x | 0.63 | x | 0.7 | = | 111.11 | (76) |
| East | 0.9x | 1 | x | 1.93 | x | 94.68 | x | 0.63 | x | 0.7 | = | 55.84 | (76) |
| East | 0.9x | 1 | x | 3.84 | x | 73.59 | x | 0.63 | x | 0.7 | = | 86.36 | (76) |
| East | 0.9x | 1 | x | 1.93 | x | 73.59 | x | 0.63 | x | 0.7 | = | 43.41 | (76) |
| East | 0.9x | 1 | x | 3.84 | x | 45.59 | x | 0.63 | x | 0.7 | = | 53.5 | (76) |
| East | 0.9x | 1 | x | 1.93 | x | 45.59 | x | 0.63 | x | 0.7 | = | 26.89 | (76) |
| East | 0.9x | 1 | x | 3.84 | x | 24.49 | x | 0.63 | x | 0.7 | = | 28.74 | (76) |
| East | 0.9x | 1 | x | 1.93 | x | 24.49 | x | 0.63 | x | 0.7 | = | 14.44 | (76) |
| East | 0.9x | 1 | x | 3.84 | x | 16.15 | x | 0.63 | x | 0.7 | = | 18.95 | (76) |
| East | 0.9x | 1 | x | 1.93 | x | 16.15 | x | 0.63 | x | 0.7 | = | 9.53 | (76) |
| West | 0.9x | 0.77 | x | 4.14 | x | 19.64 | x | 0.63 | x | 0.7 | = | 24.85 | (80) |
| West | 0.9x | 0.77 | x | 1.95 | x | 19.64 | x | 0.63 | x | 0.7 | = | 11.7 | (80) |
| West | 0.9x | 0.77 | x | 4.14 | x | 38.42 | x | 0.63 | x | 0.7 | = | 48.61 | (80) |
| West | 0.9x | 0.77 | x | 1.95 | x | 38.42 | x | 0.63 | x | 0.7 | = | 22.9 | (80) |
| West | 0.9x | 0.77 | x | 4.14 | x | 63.27 | x | 0.63 | x | 0.7 | = | 80.06 | (80) |
| West | 0.9x | 0.77 | x | 1.95 | x | 63.27 | x | 0.63 | x | 0.7 | = | 37.71 | (80) |
| West | 0.9x | 0.77 | x | 4.14 | x | 92.28 | x | 0.63 | x | 0.7 | = | 116.76 | (80) |
| West | 0.9x | 0.77 | x | 1.95 | x | 92.28 | x | 0.63 | x | 0.7 | = | 54.99 | (80) |
| West | 0.9x | 0.77 | x | 4.14 | x | 113.09 | x | 0.63 | x | 0.7 | = | 143.09 | (80) |
| West | 0.9x | 0.77 | x | 1.95 | x | 113.09 | x | 0.63 | x | 0.7 | = | 67.4 | (80) |
| West | 0.9x | 0.77 | x | 4.14 | x | 115.77 | x | 0.63 | x | 0.7 | = | 146.48 | (80) |
| West | 0.9x | 0.77 | x | 1.95 | x | 115.77 | x | 0.63 | x | 0.7 | = | 68.99 | (80) |
| West | 0.9x | 0.77 | x | 4.14 | x | 110.22 | x | 0.63 | x | 0.7 | = | 139.45 | (80) |
| West | 0.9x | 0.77 | x | 1.95 | x | 110.22 | x | 0.63 | x | 0.7 | = | 65.68 | (80) |
| West | 0.9x | 0.77 | x | 4.14 | x | 94.68 | x | 0.63 | x | 0.7 | = | 119.79 | (80) |
| West | 0.9x | 0.77 | x | 1.95 | x | 94.68 | x | 0.63 | x | 0.7 | = | 56.42 | (80) |
| West | 0.9x | 0.77 | x | 4.14 | x | 73.59 | x | 0.63 | x | 0.7 | = | 93.11 | (80) |
| West | 0.9x | 0.77 | x | 1.95 | x | 73.59 | x | 0.63 | x | 0.7 | = | 43.86 | (80) |
| West | 0.9x | 0.77 | x | 4.14 | x | 45.59 | x | 0.63 | x | 0.7 | = | 57.68 | (80) |
| West | 0.9x | 0.77 | x | 1.95 | x | 45.59 | x | 0.63 | x | 0.7 | = | 27.17 | (80) |
| West | 0.9x | 0.77 | x | 4.14 | x | 24.49 | x | 0.63 | x | 0.7 | = | 30.98 | (80) |
| West | 0.9x | 0.77 | x | 1.95 | x | 24.49 | x | 0.63 | x | 0.7 | = | 14.59 | (80) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 4.14 | x | 16.15 | x | 0.63 | x | 0.7 | = | 20.44 | (80) |
| West | 0.9x | 0.77 | x | 1.95 | x | 16.15 | x | 0.63 | x | 0.7 | = | 9.63 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 109.21 | 211.92 | 352.81 | 532.8 | 677.07 | 705.62 | 666.51 | 555 | 415.18 | 251.73 | 135.67 | 90.24 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 532.46 | 633.01 | 759.07 | 914.43 | 1033.52 | 1037.88 | 983.54 | 878.96 | 752.15 | 613.57 | 525.36 | 500.97 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 0.98 | 0.92 | 0.76 | 0.55 | 0.41 | 0.47 | 0.77 | 0.97 | 1 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.93 | 20.1 | 20.37 | 20.72 | 20.93 | 20.99 | 21 | 21 | 20.94 | 20.63 | 20.21 | 19.91 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.08 | 20.09 | 20.09 | 20.1 | 20.1 | 20.11 | 20.11 | 20.11 | 20.11 | 20.1 | 20.1 | 20.09 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.98 | 0.9 | 0.71 | 0.48 | 0.33 | 0.38 | 0.69 | 0.96 | 1 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.65 | 18.89 | 19.29 | 19.78 | 20.04 | 20.1 | 20.11 | 20.11 | 20.07 | 19.67 | 19.07 | 18.62 | (90) |

fLA = Living area ÷ (4) = 0.34 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 19.08 | 19.3 | 19.66 | 20.09 | 20.34 | 20.4 | 20.41 | 20.41 | 20.36 | 19.99 | 19.46 | 19.05 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 19.08 | 19.3 | 19.66 | 20.09 | 20.34 | 20.4 | 20.41 | 20.41 | 20.36 | 19.99 | 19.46 | 19.05 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.97 | 0.9 | 0.72 | 0.5 | 0.35 | 0.41 | 0.72 | 0.96 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 530.99 | 628.33 | 739.46 | 821.43 | 746.66 | 523.74 | 346.75 | 363.47 | 539.42 | 586 | 522.01 | 499.97 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1390.98 | 1350.94 | 1231.24 | 1034.48 | 796.21 | 529.06 | 347.3 | 364.78 | 573.33 | 865.65 | 1144.65 | 1382.85 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 639.83 | 485.59 | 365.88 | 153.39 | 36.87 | 0 | 0 | 0 | 0 | 208.06 | 448.3 | 656.86 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2994.77 (98)

Space heating requirement in kWh/m²/year 31.78 (99)

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

Fraction of space heat from secondary/supplementary system 0 (201)

# TER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | 639.83 | 485.59 | 365.88 | 153.39 | 36.87 | 0 | 0 | 0 | 0 | 208.06 | 448.3 | 656.86 | | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 685.04 | 519.9 | 391.74 | 164.23 | 39.47 | 0 | 0 | 0 | 0 | 222.76 | 479.98 | 703.27 | | (211) |
| Total (kWh/year) =Sum(211)$_{1...5,10....12}$= | | | | | | | | | | | | | 3206.4 | (211) |
| Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) | | | | | | | | | | | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Total (kWh/year) =Sum(215)$_{1...5,10....12}$= | | | | | | | | | | | | | 0 | (215) |

**Water heating**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Output from water heater (calculated above) | 210.55 | 185.6 | 194.88 | 172.85 | 167.35 | 147.39 | 141.21 | 157.42 | 159.16 | 181.23 | 191.64 | 205.51 | | |
| Efficiency of water heater | | | | | | | | | | | | | 80.3 | (216) |
| (217)m= | 87.67 | 87.36 | 86.61 | 84.75 | 81.95 | 80.3 | 80.3 | 80.3 | 80.3 | 85.4 | 87.12 | 87.77 | | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m | | | | | | | | | | | | | | |
| (219)m= | 240.16 | 212.46 | 225 | 203.95 | 204.2 | 183.55 | 175.86 | 196.04 | 198.2 | 212.22 | 219.97 | 234.15 | | |
| Total = Sum(219a)$_{1...12}$ = | | | | | | | | | | | | | 2505.76 | (219) |

| **Annual totals** | | **kWh/year** | **kWh/year** | |
|---|---|---|---|---|
| Space heating fuel used, main system 1 | | | 3206.4 | |
| Water heating fuel used | | | 2505.76 | |
| Electricity for pumps, fans and electric keep-hot | | | | |
| central heating pump: | | 30 | | (230c) |
| boiler with a fan-assisted flue | | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | | 388.3 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 692.58 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 541.24 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1233.82 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 201.53 | (268) |

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| | | | |
|---|---|---|---|
| Total CO2, kg/year | sum of (265)…(271) = | 1474.28 | (272) |
| **TER =** | | 15.65 | (273) |

# TER WorkSheet: New dwelling design stage

User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

Property Address: P10

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 74.01 | (1a) x | 2.55 | (2a) = | 188.73 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 74.01 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 188.73 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 3 | x 10 = | 30 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 30 | ÷ (5) = | 0.16 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.41 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.35 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.44 | 0.43 | 0.43 | 0.38 | 0.37 | 0.33 | 0.33 | 0.32 | 0.35 | 0.37 | 0.39 | 0.41 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.6 | 0.59 | 0.59 | 0.57 | 0.57 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.58 | 0.58 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.6 | 0.59 | 0.59 | 0.57 | 0.57 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.58 | 0.58 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 10.11 | x1/[1/( 1.4 )+ 0.04] | | = | 13.4 | | | (27) |
| Windows Type 2 | | | 4.19 | x1/[1/( 1.4 )+ 0.04] | | = | 5.55 | | | (27) |
| Walls Type1 | 34.74 | 18.49 | 16.25 | x | 0.18 | = | 2.93 | | | (29) |
| Walls Type2 | 45.63 | 0 | 45.63 | x | 0.18 | = | 8.21 | | | (29) |
| Total area of elements, m² | | | 80.37 | | | | | | | (31) |
| Party wall | | | 31.28 | x | 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 35.65 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 5120.4 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 6.14 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 41.79 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 37.26 | 37.02 | 36.79 | 35.69 | 35.49 | 34.54 | 34.54 | 34.36 | 34.9 | 35.49 | 35.9 | 36.33 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 79.05 | 78.81 | 78.58 | 77.49 | 77.28 | 76.33 | 76.33 | 76.15 | 76.7 | 77.28 | 77.7 | 78.13 | |

Average = Sum(39)$_{1…12}$ /12= 77.49 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.07 | 1.06 | 1.06 | 1.05 | 1.04 | 1.03 | 1.03 | 1.03 | 1.04 | 1.04 | 1.05 | 1.06 |

Average = Sum(40)$_{1…12}$ /12= 1.05 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.34 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 89.76 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 98.74 | 95.15 | 91.56 | 87.97 | 84.38 | 80.79 | 80.79 | 84.38 | 87.97 | 91.56 | 95.15 | 98.74 |

Total = Sum(44)$_{1…12}$ = 1077.13 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 146.42 | 128.06 | 132.15 | 115.21 | 110.55 | 95.39 | 88.4 | 101.44 | 102.65 | 119.63 | 130.58 | 141.8 |

Total = Sum(45)$_{1…12}$ = 1412.29 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 21.96 | 19.21 | 19.82 | 17.28 | 16.58 | 14.31 | 13.26 | 15.22 | 15.4 | 17.94 | 19.59 | 21.27 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.32 | 43.79 | 46.66 | 43.38 | 43 | 39.84 | 41.17 | 43 | 43.38 | 46.66 | 46.92 | 50.32 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 196.74 | 171.86 | 178.81 | 158.59 | 153.55 | 135.23 | 129.56 | 144.43 | 146.03 | 166.28 | 177.5 | 192.12 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 196.74 | 171.86 | 178.81 | 158.59 | 153.55 | 135.23 | 129.56 | 144.43 | 146.03 | 166.28 | 177.5 | 192.12 | |

Output from water heater (annual)$_{1...12}$ 1950.71 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 61.27 | 53.53 | 55.6 | 49.15 | 47.51 | 41.68 | 39.68 | 44.48 | 44.98 | 51.44 | 55.15 | 59.73 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 18.41 | 16.35 | 13.3 | 10.07 | 7.52 | 6.35 | 6.86 | 8.92 | 11.98 | 15.21 | 17.75 | 18.92 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 206.47 | 208.61 | 203.21 | 191.72 | 177.21 | 163.57 | 154.46 | 152.32 | 157.72 | 169.21 | 183.72 | 197.36 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 82.35 | 79.66 | 74.74 | 68.27 | 63.85 | 57.89 | 53.34 | 59.78 | 62.47 | 69.14 | 76.6 | 80.28 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 368.31 | 365.71 | 352.34 | 331.14 | 309.68 | 288.9 | 275.76 | 282.12 | 293.25 | 314.65 | 339.16 | 357.65 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 10.11 | x | 19.64 | x | 0.63 | x | 0.7 | = | 60.68 | (76) |
| East | 0.9x | 2 | x | 4.19 | x | 19.64 | x | 0.63 | x | 0.7 | = | 50.3 | (76) |
| East | 0.9x | 1 | x | 10.11 | x | 38.42 | x | 0.63 | x | 0.7 | = | 118.71 | (76) |
| East | 0.9x | 2 | x | 4.19 | x | 38.42 | x | 0.63 | x | 0.7 | = | 98.4 | (76) |
| East | 0.9x | 1 | x | 10.11 | x | 63.27 | x | 0.63 | x | 0.7 | = | 195.5 | (76) |

# TER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 2 | x | 4.19 | x | 63.27 | x | 0.63 | x | 0.7 | = | 162.04 | (76) |
| East | 0.9x | 1 | x | 10.11 | x | 92.28 | x | 0.63 | x | 0.7 | = | 285.12 | (76) |
| East | 0.9x | 2 | x | 4.19 | x | 92.28 | x | 0.63 | x | 0.7 | = | 236.33 | (76) |
| East | 0.9x | 1 | x | 10.11 | x | 113.09 | x | 0.63 | x | 0.7 | = | 349.43 | (76) |
| East | 0.9x | 2 | x | 4.19 | x | 113.09 | x | 0.63 | x | 0.7 | = | 289.63 | (76) |
| East | 0.9x | 1 | x | 10.11 | x | 115.77 | x | 0.63 | x | 0.7 | = | 357.7 | (76) |
| East | 0.9x | 2 | x | 4.19 | x | 115.77 | x | 0.63 | x | 0.7 | = | 296.49 | (76) |
| East | 0.9x | 1 | x | 10.11 | x | 110.22 | x | 0.63 | x | 0.7 | = | 340.55 | (76) |
| East | 0.9x | 2 | x | 4.19 | x | 110.22 | x | 0.63 | x | 0.7 | = | 282.27 | (76) |
| East | 0.9x | 1 | x | 10.11 | x | 94.68 | x | 0.63 | x | 0.7 | = | 292.52 | (76) |
| East | 0.9x | 2 | x | 4.19 | x | 94.68 | x | 0.63 | x | 0.7 | = | 242.47 | (76) |
| East | 0.9x | 1 | x | 10.11 | x | 73.59 | x | 0.63 | x | 0.7 | = | 227.37 | (76) |
| East | 0.9x | 2 | x | 4.19 | x | 73.59 | x | 0.63 | x | 0.7 | = | 188.46 | (76) |
| East | 0.9x | 1 | x | 10.11 | x | 45.59 | x | 0.63 | x | 0.7 | = | 140.86 | (76) |
| East | 0.9x | 2 | x | 4.19 | x | 45.59 | x | 0.63 | x | 0.7 | = | 116.76 | (76) |
| East | 0.9x | 1 | x | 10.11 | x | 24.49 | x | 0.63 | x | 0.7 | = | 75.67 | (76) |
| East | 0.9x | 2 | x | 4.19 | x | 24.49 | x | 0.63 | x | 0.7 | = | 62.72 | (76) |
| East | 0.9x | 1 | x | 10.11 | x | 16.15 | x | 0.63 | x | 0.7 | = | 49.9 | (76) |
| East | 0.9x | 2 | x | 4.19 | x | 16.15 | x | 0.63 | x | 0.7 | = | 41.36 | (76) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 110.98 | 217.11 | 357.54 | 521.45 | 639.06 | 654.19 | 622.82 | 534.99 | 415.84 | 257.61 | 138.38 | 91.27 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 479.3 | 582.82 | 709.88 | 852.6 | 948.74 | 943.1 | 898.58 | 817.11 | 709.09 | 572.27 | 477.54 | 448.92 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 0.99 | 0.97 | 0.88 | 0.71 | 0.51 | 0.37 | 0.43 | 0.7 | 0.95 | 0.99 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.92 | 20.11 | 20.42 | 20.76 | 20.94 | 20.99 | 21 | 21 | 20.96 | 20.66 | 20.22 | 19.88 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.03 | 20.03 | 20.03 | 20.04 | 20.05 | 20.06 | 20.06 | 20.06 | 20.05 | 20.05 | 20.04 | 20.04 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.96 | 0.85 | 0.65 | 0.44 | 0.29 | 0.34 | 0.62 | 0.93 | 0.99 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.58 | 18.87 | 19.31 | 19.78 | 19.99 | 20.05 | 20.06 | 20.06 | 20.02 | 19.67 | 19.03 | 18.54 | (90) |

fLA = Living area ÷ (4) = 0.4 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 19.11 | 19.36 | 19.75 | 20.17 | 20.37 | 20.43 | 20.43 | 20.43 | 20.39 | 20.06 | 19.5 | 19.08 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 19.11 | 19.36 | 19.75 | 20.17 | 20.37 | 20.43 | 20.43 | 20.43 | 20.39 | 20.06 | 19.5 | 19.08 | | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | | |
| (94)m= | 0.99 | 0.99 | 0.96 | 0.85 | 0.67 | 0.47 | 0.32 | 0.37 | 0.65 | 0.93 | 0.99 | 1 | | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | | |
| (95)m= | 476.87 | 574.81 | 678.1 | 728.28 | 636.72 | 440.81 | 291.98 | 306.1 | 462.24 | 530.9 | 472.08 | 447.27 | | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | | |
| (97)m= | 1170.84 | 1139.62 | 1041.11 | 873.21 | 670 | 444.63 | 292.39 | 306.98 | 482.78 | 731.33 | 963.71 | 1162.22 | | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | | |
| (98)m= | 516.31 | 379.55 | 270.08 | 104.35 | 24.77 | 0 | 0 | 0 | 0 | 149.13 | 353.97 | 531.92 | | |
| Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | | | | | | | | | | | | | 2330.07 | (98) |
| Space heating requirement in kWh/m²/year | | | | | | | | | | | | | 31.48 | (99) |

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary system | | 0 | (201) |
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | | | | | | | | | | | | | | |
| | 516.31 | 379.55 | 270.08 | 104.35 | 24.77 | 0 | 0 | 0 | 0 | 149.13 | 353.97 | 531.92 | | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | | (211) |
| | 552.79 | 406.37 | 289.16 | 111.73 | 26.52 | 0 | 0 | 0 | 0 | 159.66 | 378.98 | 569.51 | | |
| Total (kWh/year) =Sum(211)$_{1...5,10...12}$= | | | | | | | | | | | | | 2494.72 | (211) |
| Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) | | | | | | | | | | | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Total (kWh/year) =Sum(215)$_{1...5,10...12}$= | | | | | | | | | | | | | 0 | (215) |

**Water heating**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Output from water heater (calculated above) | | | | | | | | | | | | | | |
| | 196.74 | 171.86 | 178.81 | 158.59 | 153.55 | 135.23 | 129.56 | 144.43 | 146.03 | 166.28 | 177.5 | 192.12 | | |
| Efficiency of water heater | | | | | | | | | | | | | 80.3 | (216) |
| (217)m= | 87.37 | 86.99 | 86.09 | 84.03 | 81.57 | 80.3 | 80.3 | 80.3 | 80.3 | 84.78 | 86.76 | 87.48 | | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m | | | | | | | | | | | | | | |
| (219)m= | 225.19 | 197.56 | 207.7 | 188.74 | 188.25 | 168.41 | 161.35 | 179.87 | 181.85 | 196.14 | 204.6 | 219.61 | | |
| Total = Sum(219a)$_{1...12}$ = | | | | | | | | | | | | | 2319.28 | (219) |

| **Annual totals** | **kWh/year** | **kWh/year** |
|---|---|---|
| Space heating fuel used, main system 1 | | 2494.72 |

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| | | | |
|---|---|---|---|
| Water heating fuel used | | 2319.28 | |
| Electricity for pumps, fans and electric keep-hot | | | |
| central heating pump: | 30 | | (230c) |
| boiler with a fan-assisted flue | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | 75 | (231) |
| Electricity for lighting | | 325.07 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 538.86 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 500.96 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1039.82 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 168.71 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 1247.46 | (272) |

| | | |
|---|---|---|
| **TER =** | 16.86 | (273) |

# TER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: P11

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 56.61 | (1a) | x | 2.55 | (2a) | = | 144.36 | (3a) |
| First floor | 62.48 | (1b) | x | 3 | (2b) | = | 187.44 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 119.09 | (4) | | | | | | |
| Dwelling volume | | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | = | 331.8 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 4 | x 10 = | 40 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 40 | ÷ (5) = | 0.12 | (8) |
| *If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)* | | | | |
| Number of storeys in the dwelling (ns) | | | 0 | (9) |
| Additional infiltration | | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | | 0 | (13) |
| Percentage of windows and doors draught stripped | | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | | 5 | (17) |
| If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | | | 0.37 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | | |
| Number of sides sheltered | | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | | 0.31 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

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Wind Factor (22a)m = (22)m ÷ 4

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.4 | 0.39 | 0.39 | 0.35 | 0.34 | 0.3 | 0.3 | 0.29 | 0.31 | 0.34 | 0.35 | 0.37 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.58 | 0.58 | 0.57 | 0.56 | 0.56 | 0.54 | 0.54 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.58 | 0.58 | 0.57 | 0.56 | 0.56 | 0.54 | 0.54 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.72 | x1/[1/( 1.4 )+ 0.04] | | = | 6.26 | | | (27) |
| Windows Type 2 | | | 2.29 | x1/[1/( 1.4 )+ 0.04] | | = | 3.04 | | | (27) |
| Windows Type 3 | | | 4.51 | x1/[1/( 1.4 )+ 0.04] | | = | 5.98 | | | (27) |
| Windows Type 4 | | | 2.26 | x1/[1/( 1.4 )+ 0.04] | | = | 3 | | | (27) |
| Walls Type1 | 70.79 | 20.79 | 50 | x | 0.18 | = | 9 | | | (29) |
| Walls Type2 | 4.01 | 0 | 4.01 | x | 0.18 | = | 0.72 | | | (29) |
| Roof Type1 | 6.58 | 0 | 6.58 | x | 0.13 | = | 0.86 | | | (30) |
| Roof Type2 | 62.48 | 0 | 62.48 | x | 0.13 | = | 8.12 | | | (30) |
| Total area of elements, m² | | | 143.86 | | | | | | | (31) |
| Party wall | | | 109.79 | x | 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 46.26 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 8802.69 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 19.49 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 65.75 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 63.58 | 63.23 | 62.9 | 61.32 | 61.02 | 59.65 | 59.65 | 59.39 | 60.18 | 61.02 | 61.62 | 62.24 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 129.32 | 128.98 | 128.64 | 127.07 | 126.77 | 125.4 | 125.4 | 125.14 | 125.92 | 126.77 | 127.37 | 127.99 |

Average = Sum(39)$_{1…12}$ /12= 127.06 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.09 | 1.08 | 1.08 | 1.07 | 1.06 | 1.05 | 1.05 | 1.05 | 1.06 | 1.06 | 1.07 | 1.07 |

Average = Sum(40)$_{1…12}$ /12= 1.07 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.86 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 102.12 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | |
| (44)m= | 112.33 | 108.25 | 104.16 | 100.08 | 95.99 | 91.91 | 91.91 | 95.99 | 100.08 | 104.16 | 108.25 | 112.33 |

Total = Sum(44)$_{1…12}$ = 1225.42 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 166.58 | 145.69 | 150.34 | 131.07 | 125.77 | 108.53 | 100.57 | 115.4 | 116.78 | 136.1 | 148.56 | 161.33 |

Total = Sum(45)$_{1…12}$ = 1606.72 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 24.99 | 21.85 | 22.55 | 19.66 | 18.87 | 16.28 | 15.09 | 17.31 | 17.52 | 20.41 | 22.28 | 24.2 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.96 | 46.03 | 50.96 | 49.32 | 48.92 | 45.32 | 46.83 | 48.92 | 49.32 | 50.96 | 49.32 | 50.96 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 217.54 | 191.72 | 201.3 | 180.39 | 174.68 | 153.85 | 147.4 | 164.32 | 166.1 | 187.06 | 197.88 | 212.29 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 217.54 | 191.72 | 201.3 | 180.39 | 174.68 | 153.85 | 147.4 | 164.32 | 166.1 | 187.06 | 197.88 | 212.29 |

Output from water heater (annual)$_{1…12}$ 2194.52 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 68.13 | 59.95 | 62.73 | 55.91 | 54.05 | 47.42 | 45.15 | 50.6 | 51.16 | 57.99 | 61.72 | 66.38 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 142.99 | 142.99 | 142.99 | 142.99 | 142.99 | 142.99 | 142.99 | 142.99 | 142.99 | 142.99 | 142.99 | 142.99 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 25.99 | 23.09 | 18.78 | 14.21 | 10.63 | 8.97 | 9.69 | 12.6 | 16.91 | 21.47 | 25.06 | 26.72 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 284.02 | 286.97 | 279.54 | 263.73 | 243.77 | 225.02 | 212.48 | 209.54 | 216.96 | 232.77 | 252.73 | 271.49 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 37.3 | 37.3 | 37.3 | 37.3 | 37.3 | 37.3 | 37.3 | 37.3 | 37.3 | 37.3 | 37.3 | 37.3 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -114.39 | -114.39 | -114.39 | -114.39 | -114.39 | -114.39 | -114.39 | -114.39 | -114.39 | -114.39 | -114.39 | -114.39 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 91.57 | 89.21 | 84.31 | 77.65 | 72.64 | 65.86 | 60.68 | 68.01 | 71.05 | 77.95 | 85.73 | 89.22 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 470.48 | 468.17 | 451.53 | 424.5 | 395.94 | 368.74 | 351.75 | 359.04 | 373.82 | 401.09 | 432.42 | 456.32 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

# TER WorkSheet: New dwelling design stage

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.51 | x | 19.64 | x | 0.63 | x | 0.7 | = | 27.07 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 19.64 | x | 0.63 | x | 0.7 | = | 13.57 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 38.42 | x | 0.63 | x | 0.7 | = | 52.96 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 38.42 | x | 0.63 | x | 0.7 | = | 26.54 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 63.27 | x | 0.63 | x | 0.7 | = | 87.21 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 63.27 | x | 0.63 | x | 0.7 | = | 43.7 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 92.28 | x | 0.63 | x | 0.7 | = | 127.19 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 92.28 | x | 0.63 | x | 0.7 | = | 63.74 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 113.09 | x | 0.63 | x | 0.7 | = | 155.88 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 113.09 | x | 0.63 | x | 0.7 | = | 78.11 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 115.77 | x | 0.63 | x | 0.7 | = | 159.57 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 115.77 | x | 0.63 | x | 0.7 | = | 79.96 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 110.22 | x | 0.63 | x | 0.7 | = | 151.92 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 110.22 | x | 0.63 | x | 0.7 | = | 76.13 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 94.68 | x | 0.63 | x | 0.7 | = | 130.49 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 94.68 | x | 0.63 | x | 0.7 | = | 65.39 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 73.59 | x | 0.63 | x | 0.7 | = | 101.43 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 73.59 | x | 0.63 | x | 0.7 | = | 50.83 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 45.59 | x | 0.63 | x | 0.7 | = | 62.84 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 45.59 | x | 0.63 | x | 0.7 | = | 31.49 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 24.49 | x | 0.63 | x | 0.7 | = | 33.75 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 24.49 | x | 0.63 | x | 0.7 | = | 16.91 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 16.15 | x | 0.63 | x | 0.7 | = | 22.26 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 16.15 | x | 0.63 | x | 0.7 | = | 11.16 | (76) |
| West | 0.9x | 0.77 | x | 4.72 | x | 19.64 | x | 0.63 | x | 0.7 | = | 56.66 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 19.64 | x | 0.63 | x | 0.7 | = | 27.49 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 38.42 | x | 0.63 | x | 0.7 | = | 110.84 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 38.42 | x | 0.63 | x | 0.7 | = | 53.78 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 63.27 | x | 0.63 | x | 0.7 | = | 182.54 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 63.27 | x | 0.63 | x | 0.7 | = | 88.56 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 92.28 | x | 0.63 | x | 0.7 | = | 266.23 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 92.28 | x | 0.63 | x | 0.7 | = | 129.17 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 113.09 | x | 0.63 | x | 0.7 | = | 326.27 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 113.09 | x | 0.63 | x | 0.7 | = | 158.3 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 115.77 | x | 0.63 | x | 0.7 | = | 334 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 115.77 | x | 0.63 | x | 0.7 | = | 162.04 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 110.22 | x | 0.63 | x | 0.7 | = | 317.98 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 110.22 | x | 0.63 | x | 0.7 | = | 154.27 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 94.68 | x | 0.63 | x | 0.7 | = | 273.14 | (80) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 2.29 | x | 94.68 | x | 0.63 | x | 0.7 | = | 132.52 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 73.59 | x | 0.63 | x | 0.7 | = | 212.3 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 73.59 | x | 0.63 | x | 0.7 | = | 103 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 45.59 | x | 0.63 | x | 0.7 | = | 131.52 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 45.59 | x | 0.63 | x | 0.7 | = | 63.81 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 24.49 | x | 0.63 | x | 0.7 | = | 70.65 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 24.49 | x | 0.63 | x | 0.7 | = | 34.28 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 16.15 | x | 0.63 | x | 0.7 | = | 46.6 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 16.15 | x | 0.63 | x | 0.7 | = | 22.61 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 124.79 | 244.11 | 402.02 | 586.32 | 718.56 | 735.57 | 700.29 | 601.54 | 467.56 | 289.66 | 155.6 | 102.62 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 595.27 | 712.28 | 853.55 | 1010.82 | 1114.5 | 1104.31 | 1052.05 | 960.58 | 841.39 | 690.75 | 588.02 | 558.94 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 0.99 | 0.96 | 0.87 | 0.69 | 0.52 | 0.58 | 0.86 | 0.98 | 1 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.75 | 19.91 | 20.19 | 20.55 | 20.83 | 20.96 | 20.99 | 20.99 | 20.88 | 20.49 | 20.05 | 19.73 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.01 | 20.01 | 20.02 | 20.03 | 20.03 | 20.04 | 20.04 | 20.04 | 20.04 | 20.03 | 20.03 | 20.02 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 1 | 0.99 | 0.95 | 0.82 | 0.6 | 0.41 | 0.47 | 0.79 | 0.98 | 1 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.33 | 18.57 | 18.97 | 19.49 | 19.86 | 20.02 | 20.04 | 20.04 | 19.94 | 19.42 | 18.78 | 18.3 | (90) |

fLA = Living area ÷ (4) = 0.23 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.66 | 18.88 | 19.25 | 19.74 | 20.09 | 20.24 | 20.26 | 20.26 | 20.16 | 19.67 | 19.08 | 18.63 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.66 | 18.88 | 19.25 | 19.74 | 20.09 | 20.24 | 20.26 | 20.26 | 20.16 | 19.67 | 19.08 | 18.63 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 1 | 0.98 | 0.94 | 0.82 | 0.62 | 0.43 | 0.5 | 0.8 | 0.97 | 1 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 594.26 | 709.05 | 840.37 | 950.74 | 916.05 | 682.39 | 455.84 | 476.76 | 672.31 | 671.92 | 585.76 | 558.26 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1857.27 | 1802.76 | 1640.38 | 1376.86 | 1063.07 | 706.66 | 458.79 | 482.65 | 762.67 | 1149.43 | 1525.57 | 1847.45 | (97) |

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 939.68 | 734.97 | 595.21 | 306.81 | 109.39 | 0 | 0 | 0 | 0 | 355.26 | 676.66 | 959.15 |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4677.13 (98)

Space heating requirement in kWh/m²/year 39.27 (99)

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary system | | 0 | (201) |
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | 939.68 | 734.97 | 595.21 | 306.81 | 109.39 | 0 | 0 | 0 | 0 | 355.26 | 676.66 | 959.15 | | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 1006.08 | 786.9 | 637.27 | 328.49 | 117.12 | 0 | 0 | 0 | 0 | 380.37 | 724.48 | 1026.93 | | (211) |
| Total (kWh/year) =Sum(211)$_{1...5,10...12}$= | | | | | | | | | | | | | 5007.63 | (211) |
| Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) | | | | | | | | | | | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Total (kWh/year) =Sum(215)$_{1...5,10...12}$= | | | | | | | | | | | | | 0 | (215) |

**Water heating**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Output from water heater (calculated above) | 217.54 | 191.72 | 201.3 | 180.39 | 174.68 | 153.85 | 147.4 | 164.32 | 166.1 | 187.06 | 197.88 | 212.29 | | |
| Efficiency of water heater | | | | | | | | | | | | | 80.3 | (216) |
| (217)m= | 88.31 | 88.11 | 87.61 | 86.38 | 83.91 | 80.3 | 80.3 | 80.3 | 80.3 | 86.64 | 87.9 | 88.39 | | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m | | | | | | | | | | | | | | |
| (219)m= | 246.33 | 217.6 | 229.76 | 208.84 | 208.18 | 191.6 | 183.56 | 204.63 | 206.84 | 215.9 | 225.12 | 240.18 | | |
| Total = Sum(219a)$_{1...12}$ = | | | | | | | | | | | | | 2578.54 | (219) |

| **Annual totals** | | **kWh/year** | **kWh/year** | |
|---|---|---|---|---|
| Space heating fuel used, main system 1 | | | 5007.63 | |
| Water heating fuel used | | | 2578.54 | |
| Electricity for pumps, fans and electric keep-hot | | | | |
| central heating pump: | | 30 | | (230c) |
| boiler with a fan-assisted flue | | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | | 459.05 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | **Emissions** kg CO2/year |
|---|---|---|---|

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| | | | | | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 1081.65 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 556.96 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1638.61 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 238.25 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 1915.78 | (272) |

**TER =** 16.09 (273)

# TER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

Property Address: P12

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 45.01 | (1a) | x | 2.55 | (2a) | = | 114.78 | (3a) |
| First floor | 71.14 | (1b) | x | 3 | (2b) | = | 213.42 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 116.15 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | | = | 328.2 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 4 | x 10 = | 40 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 40 | ÷ (5) = | 0.12 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.37 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.32 | (21) |

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

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Wind Factor (22a)m = (22)m ÷ 4

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.4 | 0.4 | 0.39 | 0.35 | 0.34 | 0.3 | 0.3 | 0.29 | 0.32 | 0.34 | 0.36 | 0.37 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.58 | 0.58 | 0.57 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.58 | 0.58 | 0.57 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.72 | x1/[1/( 1.4 )+ 0.04] | | = | 6.26 | | | (27) |
| Windows Type 2 | | | 2.29 | x1/[1/( 1.4 )+ 0.04] | | = | 3.04 | | | (27) |
| Windows Type 3 | | | 4.51 | x1/[1/( 1.4 )+ 0.04] | | = | 5.98 | | | (27) |
| Windows Type 4 | | | 2.26 | x1/[1/( 1.4 )+ 0.04] | | = | 3 | | | (27) |
| Walls Type1 | 67.29 | 20.79 | 46.5 | x | 0.18 | = | 8.37 | | | (29) |
| Walls Type2 | 55.89 | 0 | 55.89 | x | 0.18 | = | 10.06 | | | (29) |
| Roof Type1 | 4.24 | 0 | 4.24 | x | 0.13 | = | 0.55 | | | (30) |
| Roof Type2 | 71.14 | 0 | 71.14 | x | 0.13 | = | 9.25 | | | (30) |
| Total area of elements, m² | | | 198.56 | | | | | | | (31) |
| Party wall | | | 69.63 | x | 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 55.79 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 9955.17 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 18.71 (36)

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*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 74.5 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 62.95 | 62.61 | 62.27 | 60.7 | 60.41 | 59.04 | 59.04 | 58.78 | 59.56 | 60.41 | 61 | 61.62 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 137.45 | 137.11 | 136.77 | 135.2 | 134.91 | 133.54 | 133.54 | 133.28 | 134.07 | 134.91 | 135.5 | 136.13 | |

Average = $Sum(39)_{1…12}$ /12= 135.2 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.18 | 1.18 | 1.18 | 1.16 | 1.16 | 1.15 | 1.15 | 1.15 | 1.15 | 1.16 | 1.17 | 1.17 | |

Average = $Sum(40)_{1…12}$ /12= 1.16 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.85 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 101.82 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 112 | 107.93 | 103.86 | 99.78 | 95.71 | 91.64 | 91.64 | 95.71 | 99.78 | 103.86 | 107.93 | 112 | |

Total = $Sum(44)_{1…12}$ = 1221.83 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 166.09 | 145.27 | 149.9 | 130.69 | 125.4 | 108.21 | 100.27 | 115.06 | 116.44 | 135.7 | 148.12 | 160.85 | |

Total = $Sum(45)_{1…12}$ = 1602.01 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 24.91 | 21.79 | 22.49 | 19.6 | 18.81 | 16.23 | 15.04 | 17.26 | 17.47 | 20.35 | 22.22 | 24.13 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.96 | 46.03 | 50.96 | 49.21 | 48.77 | 45.19 | 46.7 | 48.77 | 49.21 | 50.96 | 49.32 | 50.96 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 217.05 | 191.29 | 200.86 | 179.9 | 174.17 | 153.4 | 146.97 | 163.84 | 165.65 | 186.66 | 197.44 | 211.81 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 217.05 | 191.29 | 200.86 | 179.9 | 174.17 | 153.4 | 146.97 | 163.84 | 165.65 | 186.66 | 197.44 | 211.81 |

Output from water heater (annual)$_{1...12}$ 2189.04 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 67.97 | 59.81 | 62.58 | 55.76 | 53.89 | 47.28 | 45.01 | 50.45 | 51.02 | 57.86 | 61.58 | 66.22 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 142.36 | 142.36 | 142.36 | 142.36 | 142.36 | 142.36 | 142.36 | 142.36 | 142.36 | 142.36 | 142.36 | 142.36 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 25.53 | 22.67 | 18.44 | 13.96 | 10.44 | 8.81 | 9.52 | 12.37 | 16.61 | 21.09 | 24.61 | 26.24 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 280.11 | 283.02 | 275.69 | 260.1 | 240.42 | 221.92 | 209.56 | 206.65 | 213.98 | 229.57 | 249.25 | 267.75 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -113.89 | -113.89 | -113.89 | -113.89 | -113.89 | -113.89 | -113.89 | -113.89 | -113.89 | -113.89 | -113.89 | -113.89 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 91.35 | 89 | 84.12 | 77.44 | 72.43 | 65.66 | 60.5 | 67.81 | 70.86 | 77.77 | 85.53 | 89.01 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 465.7 | 463.4 | 446.96 | 420.21 | 391.99 | 365.1 | 348.29 | 355.54 | 370.15 | 397.13 | 428.1 | 451.71 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.51 | x | 19.64 | x | 0.63 | x | 0.7 | = | 27.07 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 19.64 | x | 0.63 | x | 0.7 | = | 13.57 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 38.42 | x | 0.63 | x | 0.7 | = | 52.96 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 38.42 | x | 0.63 | x | 0.7 | = | 26.54 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 63.27 | x | 0.63 | x | 0.7 | = | 87.21 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 63.27 | x | 0.63 | x | 0.7 | = | 43.7 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 92.28 | x | 0.63 | x | 0.7 | = | 127.19 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 92.28 | x | 0.63 | x | 0.7 | = | 63.74 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 113.09 | x | 0.63 | x | 0.7 | = | 155.88 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 113.09 | x | 0.63 | x | 0.7 | = | 78.11 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 115.77 | x | 0.63 | x | 0.7 | = | 159.57 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 115.77 | x | 0.63 | x | 0.7 | = | 79.96 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 110.22 | x | 0.63 | x | 0.7 | = | 151.92 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 110.22 | x | 0.63 | x | 0.7 | = | 76.13 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 94.68 | x | 0.63 | x | 0.7 | = | 130.49 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 94.68 | x | 0.63 | x | 0.7 | = | 65.39 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 73.59 | x | 0.63 | x | 0.7 | = | 101.43 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 73.59 | x | 0.63 | x | 0.7 | = | 50.83 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 45.59 | x | 0.63 | x | 0.7 | = | 62.84 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 45.59 | x | 0.63 | x | 0.7 | = | 31.49 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 24.49 | x | 0.63 | x | 0.7 | = | 33.75 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 24.49 | x | 0.63 | x | 0.7 | = | 16.91 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 16.15 | x | 0.63 | x | 0.7 | = | 22.26 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 16.15 | x | 0.63 | x | 0.7 | = | 11.16 | (76) |
| West | 0.9x | 0.77 | x | 4.72 | x | 19.64 | x | 0.63 | x | 0.7 | = | 56.66 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 19.64 | x | 0.63 | x | 0.7 | = | 27.49 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 38.42 | x | 0.63 | x | 0.7 | = | 110.84 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 38.42 | x | 0.63 | x | 0.7 | = | 53.78 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 63.27 | x | 0.63 | x | 0.7 | = | 182.54 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 63.27 | x | 0.63 | x | 0.7 | = | 88.56 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 92.28 | x | 0.63 | x | 0.7 | = | 266.23 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 92.28 | x | 0.63 | x | 0.7 | = | 129.17 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 113.09 | x | 0.63 | x | 0.7 | = | 326.27 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 113.09 | x | 0.63 | x | 0.7 | = | 158.3 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 115.77 | x | 0.63 | x | 0.7 | = | 334 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 115.77 | x | 0.63 | x | 0.7 | = | 162.04 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 110.22 | x | 0.63 | x | 0.7 | = | 317.98 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 110.22 | x | 0.63 | x | 0.7 | = | 154.27 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 94.68 | x | 0.63 | x | 0.7 | = | 273.14 | (80) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 2.29 | x | 94.68 | x | 0.63 | x | 0.7 | = | 132.52 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 73.59 | x | 0.63 | x | 0.7 | = | 212.3 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 73.59 | x | 0.63 | x | 0.7 | = | 103 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 45.59 | x | 0.63 | x | 0.7 | = | 131.52 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 45.59 | x | 0.63 | x | 0.7 | = | 63.81 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 24.49 | x | 0.63 | x | 0.7 | = | 70.65 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 24.49 | x | 0.63 | x | 0.7 | = | 34.28 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 16.15 | x | 0.63 | x | 0.7 | = | 46.6 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 16.15 | x | 0.63 | x | 0.7 | = | 22.61 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 124.79 | 244.11 | 402.02 | 586.32 | 718.56 | 735.57 | 700.29 | 601.54 | 467.56 | 289.66 | 155.6 | 102.62 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 590.49 | 707.51 | 848.98 | 1006.53 | 1110.55 | 1100.67 | 1048.58 | 957.08 | 837.71 | 686.79 | 583.7 | 554.33 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 0.99 | 0.96 | 0.88 | 0.71 | 0.55 | 0.61 | 0.87 | 0.99 | 1 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.63 | 19.79 | 20.08 | 20.46 | 20.78 | 20.94 | 20.99 | 20.98 | 20.84 | 20.41 | 19.95 | 19.6 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.93 | 19.94 | 19.94 | 19.95 | 19.95 | 19.96 | 19.96 | 19.96 | 19.96 | 19.95 | 19.95 | 19.94 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 1 | 0.99 | 0.95 | 0.83 | 0.62 | 0.42 | 0.49 | 0.81 | 0.98 | 1 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.1 | 18.34 | 18.76 | 19.31 | 19.73 | 19.92 | 19.96 | 19.95 | 19.83 | 19.25 | 18.58 | 18.07 | (90) |

fLA = Living area ÷ (4) = 0.26 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.5 | 18.72 | 19.11 | 19.62 | 20.01 | 20.19 | 20.23 | 20.23 | 20.1 | 19.56 | 18.94 | 18.47 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.5 | 18.72 | 19.11 | 19.62 | 20.01 | 20.19 | 20.23 | 20.23 | 20.1 | 19.56 | 18.94 | 18.47 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 1 | 0.98 | 0.94 | 0.84 | 0.64 | 0.46 | 0.52 | 0.82 | 0.97 | 1 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 589.33 | 704.03 | 835.7 | 950.01 | 929.19 | 709.14 | 479.24 | 499.64 | 683.52 | 668.48 | 581.25 | 553.53 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1952.3 | 1895.3 | 1724.77 | 1449.05 | 1120.66 | 747.01 | 484.68 | 509.88 | 803.78 | 1208.87 | 1604.64 | 1943.17 | (97) |

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 1014.05 | 800.53 | 661.47 | 359.31 | 142.45 | 0 | 0 | 0 | 0 | 402.06 | 736.84 | 1033.89 |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 5150.6 (98)

Space heating requirement in kWh/m²/year 44.34 (99)

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

Fraction of space heat from secondary/supplementary system 0 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 93.4 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | 1014.05 | 800.53 | 661.47 | 359.31 | 142.45 | 0 | 0 | 0 | 0 | 402.06 | 736.84 | 1033.89 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 1085.7 | 857.1 | 708.21 | 384.7 | 152.52 | 0 | 0 | 0 | 0 | 430.47 | 788.91 | 1106.95 | (211) |

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 5514.56 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

**Water heating**

Output from water heater (calculated above)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 217.05 | 191.29 | 200.86 | 179.9 | 174.17 | 153.4 | 146.97 | 163.84 | 165.65 | 186.66 | 197.44 | 211.81 |

Efficiency of water heater 80.3 (216)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 88.44 | 88.26 | 87.83 | 86.76 | 84.55 | 80.3 | 80.3 | 80.3 | 80.3 | 86.93 | 88.06 | 88.51 | (217) |

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 245.43 | 216.74 | 228.7 | 207.35 | 206 | 191.03 | 183.03 | 204.03 | 206.28 | 214.71 | 224.21 | 239.32 |

Total = Sum(219a)$_{1...12}$ = 2566.84 (219)

| **Annual totals** | **kWh/year** | **kWh/year** | |
|---|---|---|---|
| Space heating fuel used, main system 1 | | 5514.56 | |
| Water heating fuel used | | 2566.84 | |
| Electricity for pumps, fans and electric keep-hot | | | |
| central heating pump: | 30 | | (230c) |
| boiler with a fan-assisted flue | 45 | | (230e) |
| Total electricity for the above, kWh/year sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | 450.84 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | **Emissions** kg CO2/year |
|---|---|---|---|

# TER WorkSheet: New dwelling design stage

| | | | | |
|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = 1191.15 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = 0 | (263) |
| Water heating | (219) x | 0.216 | = 554.44 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | 1745.58 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = 233.99 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | 2018.5 | (272) |

| | | |
|---|---|---|
| **TER =** | 17.38 | (273) |

# TER WorkSheet: New dwelling design stage

User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

Property Address: P13

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 45.86 | (1a) | x | 2.55 | (2a) | = | 116.94 | (3a) |
| First floor | 88.47 | (1b) | x | 3 | (2b) | = | 265.41 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 134.33 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | | = | 382.35 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 4 | x 10 = | 40 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | | |
|---|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = | (6a)+(6b)+(7a)+(7b)+(7c) = | 40 | ÷ (5) = | 0.1 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.35 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.3 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

# TER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.38 | 0.38 | 0.37 | 0.33 | 0.32 | 0.29 | 0.29 | 0.28 | 0.3 | 0.32 | 0.34 | 0.35 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.57 | 0.57 | 0.57 | 0.55 | 0.55 | 0.54 | 0.54 | 0.54 | 0.55 | 0.55 | 0.56 | 0.56 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.57 | 0.57 | 0.57 | 0.55 | 0.55 | 0.54 | 0.54 | 0.54 | 0.55 | 0.55 | 0.56 | 0.56 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.72 | x1/[1/( 1.4 )+ 0.04] | | = | 6.26 | | | (27) |
| Windows Type 2 | | | 2.29 | x1/[1/( 1.4 )+ 0.04] | | = | 3.04 | | | (27) |
| Windows Type 3 | | | 4.51 | x1/[1/( 1.4 )+ 0.04] | | = | 5.98 | | | (27) |
| Windows Type 4 | | | 2.26 | x1/[1/( 1.4 )+ 0.04] | | = | 3 | | | (27) |
| Floor | | | 16.08 | x | 0.13 | = | 2.0904 | | | (28) |
| Walls Type1 | 66.62 | 25.51 | 41.11 | x | 0.18 | = | 7.4 | | | (29) |
| Walls Type2 | 65.03 | 0 | 65.03 | x | 0.18 | = | 11.71 | | | (29) |
| Roof Type1 | 4 | 0 | 4 | x | 0.13 | = | 0.52 | | | (30) |
| Roof Type2 | 88.47 | 0 | 88.47 | x | 0.13 | = | 11.5 | | | (30) |
| Total area of elements, m² | | | 240.2 | | | | | | | (31) |
| Party wall | | | 51.82 | x | 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 67.04 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 10738.53 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

# TER WorkSheet: New dwelling design stage

Thermal bridges : S (L x Y) calculated using Appendix K | 20.67 | (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = | 87.7 | (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 72.41 | 72.04 | 71.69 | 70.02 | 69.71 | 68.26 | 68.26 | 67.99 | 68.82 | 69.71 | 70.34 | 71 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 160.11 | 159.75 | 159.39 | 157.73 | 157.42 | 155.97 | 155.97 | 155.7 | 156.52 | 157.42 | 158.05 | 158.71 | |

Average = $Sum(39)_{1...12}$ /12= | 157.73 | (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.19 | 1.19 | 1.19 | 1.17 | 1.17 | 1.16 | 1.16 | 1.16 | 1.17 | 1.17 | 1.18 | 1.18 |

Average = $Sum(40)_{1...12}$ /12= | 1.17 | (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 2.91 | (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 | 103.2 | (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | |
| (44)m= | 113.52 | 109.4 | 105.27 | 101.14 | 97.01 | 92.88 | 92.88 | 97.01 | 101.14 | 105.27 | 109.4 | 113.52 |

Total = $Sum(44)_{1...12}$ = | 1238.44 | (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 168.35 | 147.24 | 151.94 | 132.47 | 127.1 | 109.68 | 101.64 | 116.63 | 118.02 | 137.54 | 150.14 | 163.04 |

Total = $Sum(45)_{1...12}$ = | 1623.79 | (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 25.25 | 22.09 | 22.79 | 19.87 | 19.07 | 16.45 | 15.25 | 17.49 | 17.7 | 20.63 | 22.52 | 24.46 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 0 | (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): | 0 | (48)

Temperature factor from Table 2b | 0 | (49)

Energy lost from water storage, kWh/year (48) x (49) = | 0 | (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 0 | (52)

Temperature factor from Table 2b | 0 | (53)

| | | | |
|---|---|---|---|
| Energy lost from water storage, kWh/year | (47) x (51) x (52) x (53) = | 0 | (54) |
| Enter (50) or (54) in (55) | | 0 | (55) |

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.96 | 46.03 | 50.96 | 49.32 | 49.44 | 45.81 | 47.33 | 49.44 | 49.32 | 50.96 | 49.32 | 50.96 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 219.31 | 193.27 | 202.9 | 181.78 | 176.54 | 155.49 | 148.97 | 166.06 | 167.34 | 188.5 | 199.45 | 214 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 219.31 | 193.27 | 202.9 | 181.78 | 176.54 | 155.49 | 148.97 | 166.06 | 167.34 | 188.5 | 199.45 | 214 | |

Output from water heater (annual)$_{1...12}$ | 2213.61 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 68.72 | 60.46 | 63.26 | 56.37 | 54.62 | 47.92 | 45.63 | 51.14 | 51.57 | 58.47 | 62.25 | 66.95 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 145.27 | 145.27 | 145.27 | 145.27 | 145.27 | 145.27 | 145.27 | 145.27 | 145.27 | 145.27 | 145.27 | 145.27 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| (67)m= | 27.36 | 24.3 | 19.76 | 14.96 | 11.18 | 9.44 | 10.2 | 13.26 | 17.8 | 22.6 | 26.38 | 28.12 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| (68)m= | 302.87 | 306.01 | 298.09 | 281.23 | 259.95 | 239.94 | 226.58 | 223.44 | 231.36 | 248.22 | 269.5 | 289.5 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| (69)m= | 37.53 | 37.53 | 37.53 | 37.53 | 37.53 | 37.53 | 37.53 | 37.53 | 37.53 | 37.53 | 37.53 | 37.53 | (69) |
| Pumps and fans gains (Table 5a) | | | | | | | | | | | | | |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| (71)m= | -116.22 | -116.22 | -116.22 | -116.22 | -116.22 | -116.22 | -116.22 | -116.22 | -116.22 | -116.22 | -116.22 | -116.22 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| (72)m= | 92.36 | 89.98 | 85.03 | 78.3 | 73.42 | 66.56 | 61.33 | 68.73 | 71.63 | 78.59 | 86.46 | 89.99 | (72) |
| **Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m | | | | | | | | | | | | | |
| (73)m= | 492.17 | 489.87 | 472.46 | 444.07 | 414.13 | 385.52 | 367.69 | 375.01 | 390.36 | 418.99 | 451.92 | 477.19 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.51 | x | 19.64 | x | 0.63 | x | 0.7 | = | 27.07 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 19.64 | x | 0.63 | x | 0.7 | = | 13.57 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 38.42 | x | 0.63 | x | 0.7 | = | 52.96 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 38.42 | x | 0.63 | x | 0.7 | = | 26.54 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 63.27 | x | 0.63 | x | 0.7 | = | 87.21 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 63.27 | x | 0.63 | x | 0.7 | = | 43.7 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 92.28 | x | 0.63 | x | 0.7 | = | 127.19 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 92.28 | x | 0.63 | x | 0.7 | = | 63.74 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 113.09 | x | 0.63 | x | 0.7 | = | 155.88 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 113.09 | x | 0.63 | x | 0.7 | = | 78.11 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 115.77 | x | 0.63 | x | 0.7 | = | 159.57 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 115.77 | x | 0.63 | x | 0.7 | = | 79.96 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 110.22 | x | 0.63 | x | 0.7 | = | 151.92 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 110.22 | x | 0.63 | x | 0.7 | = | 76.13 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 94.68 | x | 0.63 | x | 0.7 | = | 130.49 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 94.68 | x | 0.63 | x | 0.7 | = | 65.39 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 73.59 | x | 0.63 | x | 0.7 | = | 101.43 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 73.59 | x | 0.63 | x | 0.7 | = | 50.83 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 45.59 | x | 0.63 | x | 0.7 | = | 62.84 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 45.59 | x | 0.63 | x | 0.7 | = | 31.49 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 24.49 | x | 0.63 | x | 0.7 | = | 33.75 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 24.49 | x | 0.63 | x | 0.7 | = | 16.91 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 16.15 | x | 0.63 | x | 0.7 | = | 22.26 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 16.15 | x | 0.63 | x | 0.7 | = | 11.16 | (76) |
| West | 0.9x | 0.77 | x | 4.72 | x | 19.64 | x | 0.63 | x | 0.7 | = | 84.99 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 19.64 | x | 0.63 | x | 0.7 | = | 27.49 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 38.42 | x | 0.63 | x | 0.7 | = | 166.26 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 38.42 | x | 0.63 | x | 0.7 | = | 53.78 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 63.27 | x | 0.63 | x | 0.7 | = | 273.81 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 63.27 | x | 0.63 | x | 0.7 | = | 88.56 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 92.28 | x | 0.63 | x | 0.7 | = | 399.34 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 92.28 | x | 0.63 | x | 0.7 | = | 129.17 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 113.09 | x | 0.63 | x | 0.7 | = | 489.41 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 113.09 | x | 0.63 | x | 0.7 | = | 158.3 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 115.77 | x | 0.63 | x | 0.7 | = | 500.99 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 115.77 | x | 0.63 | x | 0.7 | = | 162.04 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 110.22 | x | 0.63 | x | 0.7 | = | 476.97 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 110.22 | x | 0.63 | x | 0.7 | = | 154.27 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 94.68 | x | 0.63 | x | 0.7 | = | 409.71 | (80) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 2.29 | x | 94.68 | x | 0.63 | x | 0.7 | = | 132.52 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 73.59 | x | 0.63 | x | 0.7 | = | 318.46 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 73.59 | x | 0.63 | x | 0.7 | = | 103 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 45.59 | x | 0.63 | x | 0.7 | = | 197.29 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 45.59 | x | 0.63 | x | 0.7 | = | 63.81 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 24.49 | x | 0.63 | x | 0.7 | = | 105.98 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 24.49 | x | 0.63 | x | 0.7 | = | 34.28 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 16.15 | x | 0.63 | x | 0.7 | = | 69.89 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 16.15 | x | 0.63 | x | 0.7 | = | 22.61 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 153.12 | 299.53 | 493.29 | 719.43 | 881.69 | 902.57 | 859.28 | 738.11 | 573.72 | 355.42 | 190.92 | 125.92 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 645.29 | 789.4 | 965.75 | 1163.5 | 1295.82 | 1288.09 | 1226.97 | 1113.12 | 964.08 | 774.41 | 642.84 | 603.11 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 0.99 | 0.96 | 0.88 | 0.71 | 0.55 | 0.62 | 0.88 | 0.99 | 1 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.59 | 19.76 | 20.06 | 20.45 | 20.77 | 20.94 | 20.99 | 20.98 | 20.84 | 20.39 | 19.92 | 19.57 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.93 | 19.93 | 19.93 | 19.94 | 19.94 | 19.95 | 19.95 | 19.95 | 19.95 | 19.94 | 19.94 | 19.93 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 1 | 0.99 | 0.95 | 0.83 | 0.62 | 0.42 | 0.49 | 0.81 | 0.98 | 1 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.04 | 18.29 | 18.72 | 19.29 | 19.72 | 19.91 | 19.95 | 19.94 | 19.81 | 19.22 | 18.52 | 18.01 | (90) |

fLA = Living area ÷ (4) = 0.29 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.49 | 18.72 | 19.11 | 19.63 | 20.03 | 20.22 | 20.25 | 20.25 | 20.11 | 19.56 | 18.93 | 18.46 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.49 | 18.72 | 19.11 | 19.63 | 20.03 | 20.22 | 20.25 | 20.25 | 20.11 | 19.56 | 18.93 | 18.46 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 1 | 0.99 | 0.95 | 0.84 | 0.64 | 0.46 | 0.53 | 0.82 | 0.98 | 1 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 644.3 | 786.09 | 951.78 | 1099.59 | 1084.24 | 830.33 | 562.77 | 586.07 | 792.71 | 755.95 | 640.67 | 602.45 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 2272.46 | 2207.52 | 2010.75 | 1692.68 | 1310.88 | 875.76 | 569.47 | 598.9 | 940.8 | 1410.48 | 1870 | 2263.45 | (97) |

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 1211.35 | 955.2 | 787.87 | 427.02 | 168.62 | 0 | 0 | 0 | 0 | 486.97 | 885.12 | 1235.78 |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 6157.94 (98)

Space heating requirement in kWh/m²/year 45.84 (99)

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary system | | 0 | (201) |
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | 1211.35 | 955.2 | 787.87 | 427.02 | 168.62 | 0 | 0 | 0 | 0 | 486.97 | 885.12 | 1235.78 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) (211) | 1296.95 | 1022.7 | 843.55 | 457.2 | 180.54 | 0 | 0 | 0 | 0 | 521.38 | 947.66 | 1323.11 | |

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 6593.08 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

**Water heating**

Output from water heater (calculated above)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 219.31 | 193.27 | 202.9 | 181.78 | 176.54 | 155.49 | 148.97 | 166.06 | 167.34 | 188.5 | 199.45 | 214 |

Efficiency of water heater 80.3 (216)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 88.69 | 88.53 | 88.13 | 87.13 | 84.94 | 80.3 | 80.3 | 80.3 | 80.3 | 87.33 | 88.36 | 88.75 |

(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 247.28 | 218.32 | 230.23 | 208.64 | 207.85 | 193.63 | 185.51 | 206.8 | 208.39 | 215.84 | 225.74 | 241.12 |

Total = Sum(219a)$_{1...12}$ = 2589.35 (219)

| **Annual totals** | | **kWh/year** | **kWh/year** | |
|---|---|---|---|---|
| Space heating fuel used, main system 1 | | | 6593.08 | |
| Water heating fuel used | | | 2589.35 | |
| Electricity for pumps, fans and electric keep-hot | | | | |
| central heating pump: | | 30 | | (230c) |
| boiler with a fan-assisted flue | | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | | 483.19 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | **Emissions** kg CO2/year |
|---|---|---|---|

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| | | | | | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 1424.11 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 559.3 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1983.4 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 250.78 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 2273.11 | (272) |

**TER =** 16.92 (273)

# TER WorkSheet: New dwelling design stage

User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

Property Address: P14

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 57.38 | (1a) | x | 2.55 | (2a) | = | 146.32 | (3a) |
| First floor | 58.34 | (1b) | x | 3 | (2b) | = | 175.02 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 115.72 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | | = | 321.34 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 4 | x 10 = | 40 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 40 | ÷ (5) = | 0.12 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.37 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.32 | (21) |

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

# TER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.41 | 0.4 | 0.39 | 0.35 | 0.34 | 0.3 | 0.3 | 0.29 | 0.32 | 0.34 | 0.36 | 0.37 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.58 | 0.58 | 0.58 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.58 | 0.58 | 0.58 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.46 | x1/[1/( 1.4 )+ 0.04] | | = | 5.91 | | | (27) |
| Windows Type 2 | | | 1.93 | x1/[1/( 1.4 )+ 0.04] | | = | 2.56 | | | (27) |
| Windows Type 3 | | | 4.4 | x1/[1/( 1.4 )+ 0.04] | | = | 5.83 | | | (27) |
| Windows Type 4 | | | 4.59 | x1/[1/( 1.4 )+ 0.04] | | = | 6.09 | | | (27) |
| Windows Type 5 | | | 1.99 | x1/[1/( 1.4 )+ 0.04] | | = | 2.64 | | | (27) |
| Windows Type 6 | | | 5.43 | x1/[1/( 1.4 )+ 0.04] | | = | 7.2 | | | (27) |
| Windows Type 7 | | | 2.08 | x1/[1/( 1.4 )+ 0.04] | | = | 2.76 | | | (27) |
| Walls Type1 | 118.9 | 28.95 | 89.95 | x | 0.18 | = | 16.19 | | | (29) |
| Walls Type2 | 4.02 | 0 | 4.02 | x | 0.18 | = | 0.72 | | | (29) |
| Roof Type1 | 6.82 | 0 | 6.82 | x | 0.13 | = | 0.89 | | | (30) |
| Roof Type2 | 58.34 | 0 | 58.34 | x | 0.13 | = | 7.58 | | | (30) |
| Total area of elements, m² | | | 188.08 | | | | | | | (31) |
| Party wall | | | 72.21 | x | 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 63.77 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 9473.85 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f* *can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K | 24.74 | (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = | 88.51 | (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 61.75 | 61.41 | 61.08 | 59.52 | 59.23 | 57.87 | 57.87 | 57.62 | 58.39 | 59.23 | 59.82 | 60.44 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 150.26 | 149.92 | 149.59 | 148.03 | 147.74 | 146.38 | 146.38 | 146.12 | 146.9 | 147.74 | 148.33 | 148.94 |

Average = Sum(39)1…12 /12= | 148.03 | (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.3 | 1.3 | 1.29 | 1.28 | 1.28 | 1.26 | 1.26 | 1.26 | 1.27 | 1.28 | 1.28 | 1.29 |

Average = Sum(40)1…12 /12= | 1.28 | (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 2.85 | (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 | 101.77 | (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | | |
| (44)m= | 111.95 | 107.88 | 103.81 | 99.74 | 95.67 | 91.59 | 91.59 | 95.67 | 99.74 | 103.81 | 107.88 | 111.95 | |
| | | | | | | | | | | Total = Sum(44)1…12 = | | 1221.27 | (44) |
| *Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)* | | | | | | | | | | | | | |
| (45)m= | 166.02 | 145.2 | 149.83 | 130.63 | 125.34 | 108.16 | 100.23 | 115.01 | 116.38 | 135.63 | 148.06 | 160.78 | |
| | | | | | | | | | | Total = Sum(45)1…12 = | | 1601.27 | (45) |
| *If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)* | | | | | | | | | | | | | |
| (46)m= | 24.9 | 21.78 | 22.48 | 19.59 | 18.8 | 16.22 | 15.03 | 17.25 | 17.46 | 20.35 | 22.21 | 24.12 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 0 | (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): | 0 | (48)

Temperature factor from Table 2b | 0 | (49)

Energy lost from water storage, kWh/year (48) x (49) = | 0 | (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 0 | (52)

Temperature factor from Table 2b | 0 | (53)

# TER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| Energy lost from water storage, kWh/year | (47) x (51) x (52) x (53) = | 0 | (54) |
| Enter (50) or (54) in (55) | | 0 | (55) |

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.96 | 46.03 | 50.96 | 49.19 | 48.75 | 45.17 | 46.68 | 48.75 | 49.19 | 50.96 | 49.32 | 50.96 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 216.98 | 191.23 | 200.79 | 179.81 | 174.09 | 153.33 | 146.9 | 163.76 | 165.57 | 186.59 | 197.37 | 211.74 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 216.98 | 191.23 | 200.79 | 179.81 | 174.09 | 153.33 | 146.9 | 163.76 | 165.57 | 186.59 | 197.37 | 211.74 |

Output from water heater (annual)$_{1...12}$ | 2188.17 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 67.94 | 59.79 | 62.56 | 55.73 | 53.86 | 47.26 | 44.99 | 50.43 | 50.99 | 57.84 | 61.56 | 66.2 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 142.26 | 142.26 | 142.26 | 142.26 | 142.26 | 142.26 | 142.26 | 142.26 | 142.26 | 142.26 | 142.26 | 142.26 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 24.92 | 22.13 | 18 | 13.63 | 10.19 | 8.6 | 9.29 | 12.08 | 16.21 | 20.59 | 24.03 | 25.61 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 279.53 | 282.43 | 275.12 | 259.56 | 239.92 | 221.46 | 209.12 | 206.22 | 213.53 | 229.09 | 248.74 | 267.2 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 37.23 | 37.23 | 37.23 | 37.23 | 37.23 | 37.23 | 37.23 | 37.23 | 37.23 | 37.23 | 37.23 | 37.23 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -113.81 | -113.81 | -113.81 | -113.81 | -113.81 | -113.81 | -113.81 | -113.81 | -113.81 | -113.81 | -113.81 | -113.81 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 91.32 | 88.97 | 84.09 | 77.4 | 72.4 | 65.63 | 60.48 | 67.78 | 70.83 | 77.74 | 85.5 | 88.98 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 464.45 | 462.21 | 445.89 | 419.27 | 391.18 | 364.37 | 347.57 | 354.76 | 369.25 | 396.1 | 426.94 | 450.47 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

# TER WorkSheet: New dwelling design stage

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North | 0.9x | 0.77 | x | 4.4 | x | 10.63 | x | 0.63 | x | 0.7 | = | 14.3 | (74) |
| North | 0.9x | 0.77 | x | 4.59 | x | 10.63 | x | 0.63 | x | 0.7 | = | 14.92 | (74) |
| North | 0.9x | 0.77 | x | 5.43 | x | 10.63 | x | 0.63 | x | 0.7 | = | 17.65 | (74) |
| North | 0.9x | 0.77 | x | 4.4 | x | 20.32 | x | 0.63 | x | 0.7 | = | 27.33 | (74) |
| North | 0.9x | 0.77 | x | 4.59 | x | 20.32 | x | 0.63 | x | 0.7 | = | 28.51 | (74) |
| North | 0.9x | 0.77 | x | 5.43 | x | 20.32 | x | 0.63 | x | 0.7 | = | 33.72 | (74) |
| North | 0.9x | 0.77 | x | 4.4 | x | 34.53 | x | 0.63 | x | 0.7 | = | 46.43 | (74) |
| North | 0.9x | 0.77 | x | 4.59 | x | 34.53 | x | 0.63 | x | 0.7 | = | 48.44 | (74) |
| North | 0.9x | 0.77 | x | 5.43 | x | 34.53 | x | 0.63 | x | 0.7 | = | 57.3 | (74) |
| North | 0.9x | 0.77 | x | 4.4 | x | 55.46 | x | 0.63 | x | 0.7 | = | 74.58 | (74) |
| North | 0.9x | 0.77 | x | 4.59 | x | 55.46 | x | 0.63 | x | 0.7 | = | 77.8 | (74) |
| North | 0.9x | 0.77 | x | 5.43 | x | 55.46 | x | 0.63 | x | 0.7 | = | 92.04 | (74) |
| North | 0.9x | 0.77 | x | 4.4 | x | 74.72 | x | 0.63 | x | 0.7 | = | 100.47 | (74) |
| North | 0.9x | 0.77 | x | 4.59 | x | 74.72 | x | 0.63 | x | 0.7 | = | 104.81 | (74) |
| North | 0.9x | 0.77 | x | 5.43 | x | 74.72 | x | 0.63 | x | 0.7 | = | 123.99 | (74) |
| North | 0.9x | 0.77 | x | 4.4 | x | 79.99 | x | 0.63 | x | 0.7 | = | 107.56 | (74) |
| North | 0.9x | 0.77 | x | 4.59 | x | 79.99 | x | 0.63 | x | 0.7 | = | 112.2 | (74) |
| North | 0.9x | 0.77 | x | 5.43 | x | 79.99 | x | 0.63 | x | 0.7 | = | 132.73 | (74) |
| North | 0.9x | 0.77 | x | 4.4 | x | 74.68 | x | 0.63 | x | 0.7 | = | 100.42 | (74) |
| North | 0.9x | 0.77 | x | 4.59 | x | 74.68 | x | 0.63 | x | 0.7 | = | 104.75 | (74) |
| North | 0.9x | 0.77 | x | 5.43 | x | 74.68 | x | 0.63 | x | 0.7 | = | 123.92 | (74) |
| North | 0.9x | 0.77 | x | 4.4 | x | 59.25 | x | 0.63 | x | 0.7 | = | 79.67 | (74) |
| North | 0.9x | 0.77 | x | 4.59 | x | 59.25 | x | 0.63 | x | 0.7 | = | 83.11 | (74) |
| North | 0.9x | 0.77 | x | 5.43 | x | 59.25 | x | 0.63 | x | 0.7 | = | 98.32 | (74) |
| North | 0.9x | 0.77 | x | 4.4 | x | 41.52 | x | 0.63 | x | 0.7 | = | 55.83 | (74) |
| North | 0.9x | 0.77 | x | 4.59 | x | 41.52 | x | 0.63 | x | 0.7 | = | 58.24 | (74) |
| North | 0.9x | 0.77 | x | 5.43 | x | 41.52 | x | 0.63 | x | 0.7 | = | 68.9 | (74) |
| North | 0.9x | 0.77 | x | 4.4 | x | 24.19 | x | 0.63 | x | 0.7 | = | 32.53 | (74) |
| North | 0.9x | 0.77 | x | 4.59 | x | 24.19 | x | 0.63 | x | 0.7 | = | 33.93 | (74) |
| North | 0.9x | 0.77 | x | 5.43 | x | 24.19 | x | 0.63 | x | 0.7 | = | 40.14 | (74) |
| North | 0.9x | 0.77 | x | 4.4 | x | 13.12 | x | 0.63 | x | 0.7 | = | 17.64 | (74) |
| North | 0.9x | 0.77 | x | 4.59 | x | 13.12 | x | 0.63 | x | 0.7 | = | 18.4 | (74) |
| North | 0.9x | 0.77 | x | 5.43 | x | 13.12 | x | 0.63 | x | 0.7 | = | 21.77 | (74) |
| North | 0.9x | 0.77 | x | 4.4 | x | 8.86 | x | 0.63 | x | 0.7 | = | 11.92 | (74) |
| North | 0.9x | 0.77 | x | 4.59 | x | 8.86 | x | 0.63 | x | 0.7 | = | 12.43 | (74) |
| North | 0.9x | 0.77 | x | 5.43 | x | 8.86 | x | 0.63 | x | 0.7 | = | 14.71 | (74) |
| East | 0.9x | 2 | x | 2.08 | x | 19.64 | x | 0.63 | x | 0.7 | = | 24.97 | (76) |
| East | 0.9x | 2 | x | 2.08 | x | 38.42 | x | 0.63 | x | 0.7 | = | 48.85 | (76) |
| East | 0.9x | 2 | x | 2.08 | x | 63.27 | x | 0.63 | x | 0.7 | = | 80.44 | (76) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 2 | x | 2.08 | x | 92.28 | x | 0.63 | x | 0.7 | = | 117.32 | (76) |
| East | 0.9x | 2 | x | 2.08 | x | 113.09 | x | 0.63 | x | 0.7 | = | 143.78 | (76) |
| East | 0.9x | 2 | x | 2.08 | x | 115.77 | x | 0.63 | x | 0.7 | = | 147.18 | (76) |
| East | 0.9x | 2 | x | 2.08 | x | 110.22 | x | 0.63 | x | 0.7 | = | 140.13 | (76) |
| East | 0.9x | 2 | x | 2.08 | x | 94.68 | x | 0.63 | x | 0.7 | = | 120.37 | (76) |
| East | 0.9x | 2 | x | 2.08 | x | 73.59 | x | 0.63 | x | 0.7 | = | 93.56 | (76) |
| East | 0.9x | 2 | x | 2.08 | x | 45.59 | x | 0.63 | x | 0.7 | = | 57.96 | (76) |
| East | 0.9x | 2 | x | 2.08 | x | 24.49 | x | 0.63 | x | 0.7 | = | 31.13 | (76) |
| East | 0.9x | 2 | x | 2.08 | x | 16.15 | x | 0.63 | x | 0.7 | = | 20.53 | (76) |
| West | 0.9x | 0.77 | x | 4.46 | x | 19.64 | x | 0.63 | x | 0.7 | = | 26.77 | (80) |
| West | 0.9x | 0.77 | x | 1.93 | x | 19.64 | x | 0.63 | x | 0.7 | = | 11.58 | (80) |
| West | 0.9x | 0.77 | x | 1.99 | x | 19.64 | x | 0.63 | x | 0.7 | = | 23.89 | (80) |
| West | 0.9x | 0.77 | x | 4.46 | x | 38.42 | x | 0.63 | x | 0.7 | = | 52.37 | (80) |
| West | 0.9x | 0.77 | x | 1.93 | x | 38.42 | x | 0.63 | x | 0.7 | = | 22.66 | (80) |
| West | 0.9x | 0.77 | x | 1.99 | x | 38.42 | x | 0.63 | x | 0.7 | = | 46.73 | (80) |
| West | 0.9x | 0.77 | x | 4.46 | x | 63.27 | x | 0.63 | x | 0.7 | = | 86.24 | (80) |
| West | 0.9x | 0.77 | x | 1.93 | x | 63.27 | x | 0.63 | x | 0.7 | = | 37.32 | (80) |
| West | 0.9x | 0.77 | x | 1.99 | x | 63.27 | x | 0.63 | x | 0.7 | = | 76.96 | (80) |
| West | 0.9x | 0.77 | x | 4.46 | x | 92.28 | x | 0.63 | x | 0.7 | = | 125.78 | (80) |
| West | 0.9x | 0.77 | x | 1.93 | x | 92.28 | x | 0.63 | x | 0.7 | = | 54.43 | (80) |
| West | 0.9x | 0.77 | x | 1.99 | x | 92.28 | x | 0.63 | x | 0.7 | = | 112.24 | (80) |
| West | 0.9x | 0.77 | x | 4.46 | x | 113.09 | x | 0.63 | x | 0.7 | = | 154.15 | (80) |
| West | 0.9x | 0.77 | x | 1.93 | x | 113.09 | x | 0.63 | x | 0.7 | = | 66.71 | (80) |
| West | 0.9x | 0.77 | x | 1.99 | x | 113.09 | x | 0.63 | x | 0.7 | = | 137.56 | (80) |
| West | 0.9x | 0.77 | x | 4.46 | x | 115.77 | x | 0.63 | x | 0.7 | = | 157.8 | (80) |
| West | 0.9x | 0.77 | x | 1.93 | x | 115.77 | x | 0.63 | x | 0.7 | = | 68.29 | (80) |
| West | 0.9x | 0.77 | x | 1.99 | x | 115.77 | x | 0.63 | x | 0.7 | = | 140.82 | (80) |
| West | 0.9x | 0.77 | x | 4.46 | x | 110.22 | x | 0.63 | x | 0.7 | = | 150.23 | (80) |
| West | 0.9x | 0.77 | x | 1.93 | x | 110.22 | x | 0.63 | x | 0.7 | = | 65.01 | (80) |
| West | 0.9x | 0.77 | x | 1.99 | x | 110.22 | x | 0.63 | x | 0.7 | = | 134.06 | (80) |
| West | 0.9x | 0.77 | x | 4.46 | x | 94.68 | x | 0.63 | x | 0.7 | = | 129.05 | (80) |
| West | 0.9x | 0.77 | x | 1.93 | x | 94.68 | x | 0.63 | x | 0.7 | = | 55.84 | (80) |
| West | 0.9x | 0.77 | x | 1.99 | x | 94.68 | x | 0.63 | x | 0.7 | = | 115.16 | (80) |
| West | 0.9x | 0.77 | x | 4.46 | x | 73.59 | x | 0.63 | x | 0.7 | = | 100.3 | (80) |
| West | 0.9x | 0.77 | x | 1.93 | x | 73.59 | x | 0.63 | x | 0.7 | = | 43.41 | (80) |
| West | 0.9x | 0.77 | x | 1.99 | x | 73.59 | x | 0.63 | x | 0.7 | = | 89.51 | (80) |
| West | 0.9x | 0.77 | x | 4.46 | x | 45.59 | x | 0.63 | x | 0.7 | = | 62.14 | (80) |
| West | 0.9x | 0.77 | x | 1.93 | x | 45.59 | x | 0.63 | x | 0.7 | = | 26.89 | (80) |
| West | 0.9x | 0.77 | x | 1.99 | x | 45.59 | x | 0.63 | x | 0.7 | = | 55.45 | (80) |
| West | 0.9x | 0.77 | x | 4.46 | x | 24.49 | x | 0.63 | x | 0.7 | = | 33.38 | (80) |
| West | 0.9x | 0.77 | x | 1.93 | x | 24.49 | x | 0.63 | x | 0.7 | = | 14.44 | (80) |

# TER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 1.99 | x | 24.49 | x | 0.63 | x | 0.7 | = | 29.79 | (80) |
| West | 0.9x | 0.77 | x | 4.46 | x | 16.15 | x | 0.63 | x | 0.7 | = | 22.01 | (80) |
| West | 0.9x | 0.77 | x | 1.93 | x | 16.15 | x | 0.63 | x | 0.7 | = | 9.53 | (80) |
| West | 0.9x | 0.77 | x | 1.99 | x | 16.15 | x | 0.63 | x | 0.7 | = | 19.65 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 134.07 | 260.16 | 433.14 | 654.2 | 831.46 | 866.58 | 818.53 | 681.51 | 509.74 | 309.04 | 166.55 | 110.79 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 598.52 | 722.37 | 879.03 | 1073.47 | 1222.64 | 1230.94 | 1166.09 | 1036.27 | 878.98 | 705.14 | 593.49 | 561.25 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) — 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 1 | 0.99 | 0.96 | 0.87 | 0.7 | 0.54 | 0.62 | 0.88 | 0.99 | 1 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.49 | 19.66 | 19.97 | 20.4 | 20.75 | 20.94 | 20.99 | 20.97 | 20.81 | 20.33 | 19.84 | 19.46 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.84 | 19.84 | 19.85 | 19.86 | 19.86 | 19.87 | 19.87 | 19.87 | 19.86 | 19.86 | 19.86 | 19.85 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 1 | 0.99 | 0.94 | 0.82 | 0.6 | 0.41 | 0.48 | 0.81 | 0.98 | 1 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.83 | 18.08 | 18.54 | 19.15 | 19.62 | 19.83 | 19.86 | 19.86 | 19.71 | 19.07 | 18.35 | 17.8 | (90) |

fLA = Living area ÷ (4) = 0.23 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.22 | 18.45 | 18.87 | 19.44 | 19.88 | 20.09 | 20.13 | 20.12 | 19.96 | 19.37 | 18.69 | 18.19 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.22 | 18.45 | 18.87 | 19.44 | 19.88 | 20.09 | 20.13 | 20.12 | 19.96 | 19.37 | 18.69 | 18.19 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.98 | 0.94 | 0.82 | 0.62 | 0.44 | 0.51 | 0.81 | 0.97 | 1 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 597.11 | 718.25 | 863.56 | 1005.69 | 999.64 | 761.26 | 509.56 | 530.47 | 715.86 | 685.19 | 590.61 | 560.26 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 2091.45 | 2031.78 | 1851.02 | 1560.54 | 1208.95 | 803.17 | 516.07 | 543.54 | 861.24 | 1294.96 | 1719.71 | 2083.31 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 1111.79 | 882.69 | 734.67 | 399.5 | 155.73 | 0 | 0 | 0 | 0 | 453.67 | 812.96 | 1133.15 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 5684.16 (98)

Space heating requirement in kWh/m²/year — 49.12 (99)

# TER WorkSheet: New dwelling design stage

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary system | | 0 | (201) |
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | 1111.79 | 882.69 | 734.67 | 399.5 | 155.73 | 0 | 0 | 0 | 0 | 453.67 | 812.96 | 1133.15 | | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | 1190.36 | 945.07 | 786.59 | 427.73 | 166.74 | 0 | 0 | 0 | 0 | 485.73 | 870.4 | 1213.22 | | (211) |
| Total (kWh/year) =Sum(211)$_{1...5,10....12}$= | | | | | | | | | | | | | 6085.82 | (211) |
| Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) | | | | | | | | | | | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Total (kWh/year) =Sum(215)$_{1...5,10....12}$= | | | | | | | | | | | | | 0 | (215) |

**Water heating**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Output from water heater (calculated above) | 216.98 | 191.23 | 200.79 | 179.81 | 174.09 | 153.33 | 146.9 | 163.76 | 165.57 | 186.59 | 197.37 | 211.74 | | |
| Efficiency of water heater | | | | | | | | | | | | | 80.3 | (216) |
| (217)m= | 88.58 | 88.42 | 88.02 | 87 | 84.77 | 80.3 | 80.3 | 80.3 | 80.3 | 87.2 | 88.23 | 88.64 | | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m | | | | | | | | | | | | | | |
| (219)m= | 244.95 | 216.27 | 228.11 | 206.67 | 205.36 | 190.95 | 182.94 | 203.94 | 206.19 | 213.98 | 223.7 | 238.86 | | |
| Total = Sum(219a)$_{1...12}$ = | | | | | | | | | | | | | 2561.92 | (219) |

| **Annual totals** | | **kWh/year** | **kWh/year** | |
|---|---|---|---|---|
| Space heating fuel used, main system 1 | | | 6085.82 | |
| Water heating fuel used | | | 2561.92 | |
| Electricity for pumps, fans and electric keep-hot | | | | |
| central heating pump: | | 30 | | (230c) |
| boiler with a fan-assisted flue | | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | | 440.1 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 1314.54 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 553.37 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1867.91 | (265) |

# TER WorkSheet: New dwelling design stage

| | | | | | |
|---|---|---|---|---|---|
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 228.41 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 2135.25 | (272) |

**TER =** 18.45 (273)

# TER WorkSheet: New dwelling design stage

**User Details:**

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

**Property Address: P15**

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 78.35 | (1a) x | 2.55 | (2a) = | 199.79 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 78.35 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 199.79 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 3 | x 10 = | 30 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 30 | ÷ (5) = | 0.15 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.4 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.34 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.43 | 0.43 | 0.42 | 0.37 | 0.37 | 0.32 | 0.32 | 0.31 | 0.34 | 0.37 | 0.38 | 0.4 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.59 | 0.59 | 0.59 | 0.57 | 0.57 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.57 | 0.58 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.59 | 0.59 | 0.59 | 0.57 | 0.57 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.57 | 0.58 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 9.61 | x1/[1/( 1.4 )+ 0.04] | = | 12.74 | | | (27) |
| Windows Type 2 | | | 3.99 | x1/[1/( 1.4 )+ 0.04] | = | 5.29 | | | (27) |
| Windows Type 3 | | | 2 | x1/[1/( 1.4 )+ 0.04] | = | 2.65 | | | (27) |
| Windows Type 4 | | | 3.99 | x1/[1/( 1.4 )+ 0.04] | = | 5.29 | | | (27) |
| Walls Type1 | 52.24 | 19.59 | 32.65 | x 0.18 | = | 5.88 | | | (29) |
| Walls Type2 | 24.99 | 0 | 24.99 | x 0.18 | = | 4.5 | | | (29) |
| Roof | 35.68 | 0 | 35.68 | x 0.13 | = | 4.64 | | | (30) |
| Total area of elements, m² | | | 112.91 | | | | | | (31) |
| Party wall | | | 24.69 | x 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 40.99 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 4890.57 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 14.87 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 55.85 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 39.17 | 38.92 | 38.69 | 37.58 | 37.37 | 36.41 | 36.41 | 36.23 | 36.78 | 37.37 | 37.79 | 38.23 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 95.02 | 94.78 | 94.54 | 93.43 | 93.23 | 92.26 | 92.26 | 92.08 | 92.63 | 93.23 | 93.65 | 94.08 | |

Average = Sum(39)$_{1…12}$ /12= 93.43 (39)

# TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.21 | 1.21 | 1.21 | 1.19 | 1.19 | 1.18 | 1.18 | 1.18 | 1.18 | 1.19 | 1.2 | 1.2 |

Average = Sum(40)$_{1…12}$ /12= 1.19 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.43 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 91.93 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | |
| (44)m= | 101.12 | 97.45 | 93.77 | 90.09 | 86.42 | 82.74 | 82.74 | 86.42 | 90.09 | 93.77 | 97.45 | 101.12 |

Total = Sum(44)$_{1…12}$ = 1103.18 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 149.97 | 131.16 | 135.35 | 118 | 113.22 | 97.7 | 90.54 | 103.89 | 105.13 | 122.52 | 133.74 | 145.23 |

Total = Sum(45)$_{1…12}$ = 1446.44 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 22.49 | 19.67 | 20.3 | 17.7 | 16.98 | 14.66 | 13.58 | 15.58 | 15.77 | 18.38 | 20.06 | 21.78 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.96 | 44.85 | 47.78 | 44.43 | 44.04 | 40.8 | 42.16 | 44.04 | 44.43 | 47.78 | 48.06 | 50.96 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 200.92 | 176.01 | 183.13 | 162.43 | 157.26 | 138.5 | 132.7 | 147.93 | 149.56 | 170.3 | 181.8 | 196.19 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 200.92 | 176.01 | 183.13 | 162.43 | 157.26 | 138.5 | 132.7 | 147.93 | 149.56 | 170.3 | 181.8 | 196.19 | |

Output from water heater (annual)$_{1...12}$ 1996.74 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 62.6 | 54.82 | 56.95 | 50.34 | 48.66 | 42.69 | 40.64 | 45.55 | 46.06 | 52.68 | 56.48 | 61.03 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 121.54 | 121.54 | 121.54 | 121.54 | 121.54 | 121.54 | 121.54 | 121.54 | 121.54 | 121.54 | 121.54 | 121.54 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 19.25 | 17.1 | 13.91 | 10.53 | 7.87 | 6.64 | 7.18 | 9.33 | 12.53 | 15.9 | 18.56 | 19.79 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 215.96 | 218.2 | 212.55 | 200.53 | 185.35 | 171.09 | 161.56 | 159.32 | 164.97 | 176.99 | 192.17 | 206.43 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 35.15 | 35.15 | 35.15 | 35.15 | 35.15 | 35.15 | 35.15 | 35.15 | 35.15 | 35.15 | 35.15 | 35.15 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -97.23 | -97.23 | -97.23 | -97.23 | -97.23 | -97.23 | -97.23 | -97.23 | -97.23 | -97.23 | -97.23 | -97.23 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 84.14 | 81.58 | 76.54 | 69.92 | 65.4 | 59.29 | 54.63 | 61.23 | 63.98 | 70.81 | 78.45 | 82.03 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 381.82 | 379.34 | 365.46 | 343.44 | 321.08 | 299.48 | 285.83 | 292.34 | 303.93 | 326.17 | 351.64 | 370.71 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North | 0.9x | 0.54 | x | 3.99 | x | 10.63 | x | 0.63 | x | 0.7 | = | 9.09 | (74) |
| North | 0.9x | 0.54 | x | 3.99 | x | 20.32 | x | 0.63 | x | 0.7 | = | 17.38 | (74) |
| North | 0.9x | 0.54 | x | 3.99 | x | 34.53 | x | 0.63 | x | 0.7 | = | 29.53 | (74) |
| North | 0.9x | 0.54 | x | 3.99 | x | 55.46 | x | 0.63 | x | 0.7 | = | 47.43 | (74) |
| North | 0.9x | 0.54 | x | 3.99 | x | 74.72 | x | 0.63 | x | 0.7 | = | 63.89 | (74) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North | 0.9x | 0.54 | x | 3.99 | x | 79.99 | x | 0.63 | x | 0.7 | = | 68.4 | (74) |
| North | 0.9x | 0.54 | x | 3.99 | x | 74.68 | x | 0.63 | x | 0.7 | = | 63.86 | (74) |
| North | 0.9x | 0.54 | x | 3.99 | x | 59.25 | x | 0.63 | x | 0.7 | = | 50.67 | (74) |
| North | 0.9x | 0.54 | x | 3.99 | x | 41.52 | x | 0.63 | x | 0.7 | = | 35.5 | (74) |
| North | 0.9x | 0.54 | x | 3.99 | x | 24.19 | x | 0.63 | x | 0.7 | = | 20.69 | (74) |
| North | 0.9x | 0.54 | x | 3.99 | x | 13.12 | x | 0.63 | x | 0.7 | = | 11.22 | (74) |
| North | 0.9x | 0.54 | x | 3.99 | x | 8.86 | x | 0.63 | x | 0.7 | = | 7.58 | (74) |
| East | 0.9x | 1 | x | 9.61 | x | 19.64 | x | 0.63 | x | 0.7 | = | 57.68 | (76) |
| East | 0.9x | 1 | x | 3.99 | x | 19.64 | x | 0.63 | x | 0.7 | = | 23.95 | (76) |
| East | 0.9x | 1 | x | 2 | x | 19.64 | x | 0.63 | x | 0.7 | = | 12 | (76) |
| East | 0.9x | 1 | x | 9.61 | x | 38.42 | x | 0.63 | x | 0.7 | = | 112.84 | (76) |
| East | 0.9x | 1 | x | 3.99 | x | 38.42 | x | 0.63 | x | 0.7 | = | 46.85 | (76) |
| East | 0.9x | 1 | x | 2 | x | 38.42 | x | 0.63 | x | 0.7 | = | 23.48 | (76) |
| East | 0.9x | 1 | x | 9.61 | x | 63.27 | x | 0.63 | x | 0.7 | = | 185.83 | (76) |
| East | 0.9x | 1 | x | 3.99 | x | 63.27 | x | 0.63 | x | 0.7 | = | 77.15 | (76) |
| East | 0.9x | 1 | x | 2 | x | 63.27 | x | 0.63 | x | 0.7 | = | 38.67 | (76) |
| East | 0.9x | 1 | x | 9.61 | x | 92.28 | x | 0.63 | x | 0.7 | = | 271.02 | (76) |
| East | 0.9x | 1 | x | 3.99 | x | 92.28 | x | 0.63 | x | 0.7 | = | 112.53 | (76) |
| East | 0.9x | 1 | x | 2 | x | 92.28 | x | 0.63 | x | 0.7 | = | 56.4 | (76) |
| East | 0.9x | 1 | x | 9.61 | x | 113.09 | x | 0.63 | x | 0.7 | = | 332.15 | (76) |
| East | 0.9x | 1 | x | 3.99 | x | 113.09 | x | 0.63 | x | 0.7 | = | 137.9 | (76) |
| East | 0.9x | 1 | x | 2 | x | 113.09 | x | 0.63 | x | 0.7 | = | 69.13 | (76) |
| East | 0.9x | 1 | x | 9.61 | x | 115.77 | x | 0.63 | x | 0.7 | = | 340.01 | (76) |
| East | 0.9x | 1 | x | 3.99 | x | 115.77 | x | 0.63 | x | 0.7 | = | 141.17 | (76) |
| East | 0.9x | 1 | x | 2 | x | 115.77 | x | 0.63 | x | 0.7 | = | 70.76 | (76) |
| East | 0.9x | 1 | x | 9.61 | x | 110.22 | x | 0.63 | x | 0.7 | = | 323.7 | (76) |
| East | 0.9x | 1 | x | 3.99 | x | 110.22 | x | 0.63 | x | 0.7 | = | 134.4 | (76) |
| East | 0.9x | 1 | x | 2 | x | 110.22 | x | 0.63 | x | 0.7 | = | 67.37 | (76) |
| East | 0.9x | 1 | x | 9.61 | x | 94.68 | x | 0.63 | x | 0.7 | = | 278.06 | (76) |
| East | 0.9x | 1 | x | 3.99 | x | 94.68 | x | 0.63 | x | 0.7 | = | 115.45 | (76) |
| East | 0.9x | 1 | x | 2 | x | 94.68 | x | 0.63 | x | 0.7 | = | 57.87 | (76) |
| East | 0.9x | 1 | x | 9.61 | x | 73.59 | x | 0.63 | x | 0.7 | = | 216.13 | (76) |
| East | 0.9x | 1 | x | 3.99 | x | 73.59 | x | 0.63 | x | 0.7 | = | 89.73 | (76) |
| East | 0.9x | 1 | x | 2 | x | 73.59 | x | 0.63 | x | 0.7 | = | 44.98 | (76) |
| East | 0.9x | 1 | x | 9.61 | x | 45.59 | x | 0.63 | x | 0.7 | = | 133.89 | (76) |
| East | 0.9x | 1 | x | 3.99 | x | 45.59 | x | 0.63 | x | 0.7 | = | 55.59 | (76) |
| East | 0.9x | 1 | x | 2 | x | 45.59 | x | 0.63 | x | 0.7 | = | 27.87 | (76) |
| East | 0.9x | 1 | x | 9.61 | x | 24.49 | x | 0.63 | x | 0.7 | = | 71.92 | (76) |
| East | 0.9x | 1 | x | 3.99 | x | 24.49 | x | 0.63 | x | 0.7 | = | 29.86 | (76) |
| East | 0.9x | 1 | x | 2 | x | 24.49 | x | 0.63 | x | 0.7 | = | 14.97 | (76) |
| East | 0.9x | 1 | x | 9.61 | x | 16.15 | x | 0.63 | x | 0.7 | = | 47.44 | (76) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 3.99 | x | 16.15 | x | 0.63 | x | 0.7 | = | 19.69 | (76) |
| East | 0.9x | 1 | x | 2 | x | 16.15 | x | 0.63 | x | 0.7 | = | 9.87 | (76) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 102.73 | 200.55 | 331.19 | 487.38 | 603.07 | 620.34 | 589.33 | 502.04 | 386.34 | 238.04 | 127.97 | 84.58 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 484.55 | 579.89 | 696.65 | 830.82 | 924.15 | 919.83 | 875.16 | 794.38 | 690.28 | 564.2 | 479.61 | 455.29 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 0.99 | 0.98 | 0.93 | 0.8 | 0.61 | 0.46 | 0.52 | 0.8 | 0.97 | 1 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.69 | 19.87 | 20.18 | 20.57 | 20.85 | 20.97 | 20.99 | 20.99 | 20.89 | 20.5 | 20.02 | 19.66 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.91 | 19.91 | 19.91 | 19.93 | 19.93 | 19.94 | 19.94 | 19.94 | 19.93 | 19.93 | 19.92 | 19.92 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 1 | 0.99 | 0.97 | 0.91 | 0.74 | 0.52 | 0.35 | 0.41 | 0.72 | 0.95 | 0.99 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.17 | 18.44 | 18.89 | 19.44 | 19.79 | 19.92 | 19.94 | 19.94 | 19.85 | 19.35 | 18.66 | 18.14 | (90) |

fLA = Living area ÷ (4) = 0.39 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.77 | 19 | 19.39 | 19.88 | 20.2 | 20.33 | 20.35 | 20.35 | 20.26 | 19.8 | 19.19 | 18.73 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.77 | 19 | 19.39 | 19.88 | 20.2 | 20.33 | 20.35 | 20.35 | 20.26 | 19.8 | 19.19 | 18.73 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.97 | 0.9 | 0.76 | 0.56 | 0.39 | 0.45 | 0.74 | 0.95 | 0.99 | 1 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 482.48 | 574.01 | 675.93 | 751.52 | 703.28 | 513.33 | 343.67 | 359.2 | 513.16 | 536.98 | 475.38 | 453.83 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1374.51 | 1336.3 | 1219.1 | 1026.2 | 792.81 | 528.52 | 345.83 | 363.39 | 570.56 | 857.44 | 1132.3 | 1367.19 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 663.67 | 512.26 | 404.12 | 197.77 | 66.61 | 0 | 0 | 0 | 0 | 238.43 | 472.98 | 679.54 | |

Total per year (kWh/year) = Sum(98)$_{1…5,9…12}$ = 3235.38 (98)

Space heating requirement in kWh/m²/year 41.29 (99)

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

Fraction of space heat from secondary/supplementary system 0 (201)

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| | | | |
|---|---|---|---|
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | | | | | | | | | | | | | | |
| | 663.67 | 512.26 | 404.12 | 197.77 | 66.61 | 0 | 0 | 0 | 0 | 238.43 | 472.98 | 679.54 | | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | | (211) |
| | 710.57 | 548.46 | 432.67 | 211.75 | 71.31 | 0 | 0 | 0 | 0 | 255.27 | 506.41 | 727.56 | | |
| Total (kWh/year) =Sum(211)$_{1...5,10....12}$= | | | | | | | | | | | | | 3464 | (211) |
| Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) | | | | | | | | | | | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Total (kWh/year) =Sum(215)$_{1...5,10....12}$= | | | | | | | | | | | | | 0 | (215) |
| **Water heating** | | | | | | | | | | | | | | |
| Output from water heater (calculated above) | | | | | | | | | | | | | | |
| | 200.92 | 176.01 | 183.13 | 162.43 | 157.26 | 138.5 | 132.7 | 147.93 | 149.56 | 170.3 | 181.8 | 196.19 | | |
| Efficiency of water heater | | | | | | | | | | | | | 80.3 | (216) |
| (217)m= | 87.83 | 87.58 | 86.99 | 85.55 | 83.06 | 80.3 | 80.3 | 80.3 | 80.3 | 85.9 | 87.35 | 87.92 | | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m | | | | | | | | | | | | | | |
| (219)m= | 228.76 | 200.97 | 210.52 | 189.87 | 189.33 | 172.48 | 165.25 | 184.22 | 186.25 | 198.26 | 208.13 | 223.14 | | |
| Total = Sum(219a)$_{1...12}$ = | | | | | | | | | | | | | 2357.18 | (219) |

| **Annual totals** | | **kWh/year** | **kWh/year** | |
|---|---|---|---|---|
| Space heating fuel used, main system 1 | | | 3464 | |
| Water heating fuel used | | | 2357.18 | |
| Electricity for pumps, fans and electric keep-hot | | | | |
| central heating pump: | | 30 | | (230c) |
| boiler with a fan-assisted flue | | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | | 340.01 | (232) |

## 12a. $CO_2$ emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|---|
| Space heating (main system 1) | (211) | x | 0.216 | = | 748.22 | (261) |
| Space heating (secondary) | (215) | x | 0.519 | = | 0 | (263) |
| Water heating | (219) | x | 0.216 | = | 509.15 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | 1257.38 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) | x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) | x | 0.519 | = | 176.47 | (268) |

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| | | | |
|---|---|---|---|
| Total CO2, kg/year | sum of (265)…(271) = | 1472.77 | (272) |
| **TER =** | | 18.8 | (273) |

# TER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: P16

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 54.62 | (1a) x | 2.55 | (2a) = | 139.28 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 54.62 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 139.28 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 2 | x 10 = | 20 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 20 | ÷ (5) = | 0.14 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 5 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.39 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.33 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.43 | 0.42 | 0.41 | 0.37 | 0.36 | 0.32 | 0.32 | 0.31 | 0.33 | 0.36 | 0.38 | 0.39 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.59 | 0.59 | 0.58 | 0.57 | 0.56 | 0.55 | 0.55 | 0.55 | 0.56 | 0.56 | 0.57 | 0.58 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.59 | 0.59 | 0.58 | 0.57 | 0.56 | 0.55 | 0.55 | 0.55 | 0.56 | 0.56 | 0.57 | 0.58 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 3.03 | x1/[1/( 1.4 )+ 0.04] = | 4.02 | | | (27) |
| Windows Type 2 | | | 1.52 | x1/[1/( 1.4 )+ 0.04] = | 2.02 | | | (27) |
| Windows Type 3 | | | 3.03 | x1/[1/( 1.4 )+ 0.04] = | 4.02 | | | (27) |
| Walls Type1 | 50.09 | 13.64 | 36.45 | x 0.18 = | 6.56 | | | (29) |
| Walls Type2 | 25.36 | 0 | 25.36 | x 0.18 = | 4.56 | | | (29) |
| Roof | 44.8 | 0 | 44.8 | x 0.13 = | 5.82 | | | (30) |
| Total area of elements, m² | | | 120.25 | | | | | (31) |
| Party wall | | | 24.73 | x 0 = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 35.03 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 5224.65 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 15.42 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 50.45 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 27.16 | 27 | 26.84 | 26.09 | 25.95 | 25.3 | 25.3 | 25.18 | 25.55 | 25.95 | 26.24 | 26.53 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 77.61 | 77.45 | 77.29 | 76.55 | 76.41 | 75.75 | 75.75 | 75.63 | 76.01 | 76.41 | 76.69 | 76.98 | |

Average = Sum(39)$_{1…12}$ /12= 76.54 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.42 | 1.42 | 1.42 | 1.4 | 1.4 | 1.39 | 1.39 | 1.38 | 1.39 | 1.4 | 1.4 | 1.41 |

Average = Sum(40)$_{1...12}$ /12= 1.4 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.83 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 77.57 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 85.33 | 82.23 | 79.12 | 76.02 | 72.92 | 69.82 | 69.82 | 72.92 | 76.02 | 79.12 | 82.23 | 85.33 |

Total = Sum(44)$_{1...12}$ = 930.87 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 126.54 | 110.67 | 114.21 | 99.57 | 95.54 | 82.44 | 76.39 | 87.66 | 88.71 | 103.38 | 112.85 | 122.55 |

Total = Sum(45)$_{1...12}$ = 1220.52 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 18.98 | 16.6 | 17.13 | 14.94 | 14.33 | 12.37 | 11.46 | 13.15 | 13.31 | 15.51 | 16.93 | 18.38 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 43.48 | 37.85 | 40.32 | 37.49 | 37.16 | 34.43 | 35.58 | 37.16 | 37.49 | 40.32 | 40.55 | 43.48 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 170.02 | 148.52 | 154.53 | 137.06 | 132.7 | 116.87 | 111.97 | 124.82 | 126.2 | 143.7 | 153.4 | 166.03 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 170.02 | 148.52 | 154.53 | 137.06 | 132.7 | 116.87 | 111.97 | 124.82 | 126.2 | 143.7 | 153.4 | 166.03 | |

Output from water heater (annual)$_{1...12}$ 1685.83 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 52.95 | 46.26 | 48.05 | 42.48 | 41.06 | 36.02 | 34.3 | 38.44 | 38.87 | 44.46 | 47.66 | 51.62 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 91.31 | 91.31 | 91.31 | 91.31 | 91.31 | 91.31 | 91.31 | 91.31 | 91.31 | 91.31 | 91.31 | 91.31 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 14.19 | 12.61 | 10.25 | 7.76 | 5.8 | 4.9 | 5.29 | 6.88 | 9.23 | 11.72 | 13.68 | 14.59 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 159.21 | 160.86 | 156.69 | 147.83 | 136.64 | 126.13 | 119.1 | 117.45 | 121.62 | 130.48 | 141.67 | 152.18 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 32.13 | 32.13 | 32.13 | 32.13 | 32.13 | 32.13 | 32.13 | 32.13 | 32.13 | 32.13 | 32.13 | 32.13 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -73.05 | -73.05 | -73.05 | -73.05 | -73.05 | -73.05 | -73.05 | -73.05 | -73.05 | -73.05 | -73.05 | -73.05 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 71.16 | 68.84 | 64.59 | 59 | 55.18 | 50.03 | 46.1 | 51.66 | 53.98 | 59.75 | 66.2 | 69.38 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 297.96 | 295.7 | 284.93 | 267.98 | 251.02 | 234.45 | 223.89 | 229.39 | 238.23 | 255.35 | 274.94 | 289.54 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 3 | x | 3.03 | x | 19.64 | x | 0.63 | x | 0.7 | = | 54.56 | (76) |
| East | 0.9x | 1 | x | 1.52 | x | 19.64 | x | 0.63 | x | 0.7 | = | 9.12 | (76) |
| East | 0.9x | 3 | x | 3.03 | x | 38.42 | x | 0.63 | x | 0.7 | = | 106.73 | (76) |
| East | 0.9x | 1 | x | 1.52 | x | 38.42 | x | 0.63 | x | 0.7 | = | 17.85 | (76) |
| East | 0.9x | 3 | x | 3.03 | x | 63.27 | x | 0.63 | x | 0.7 | = | 175.77 | (76) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 1.52 | x | 63.27 | x | 0.63 | x | 0.7 | = | 29.39 | (76) |
| East | 0.9x | 3 | x | 3.03 | x | 92.28 | x | 0.63 | x | 0.7 | = | 256.36 | (76) |
| East | 0.9x | 1 | x | 1.52 | x | 92.28 | x | 0.63 | x | 0.7 | = | 42.87 | (76) |
| East | 0.9x | 3 | x | 3.03 | x | 113.09 | x | 0.63 | x | 0.7 | = | 314.17 | (76) |
| East | 0.9x | 1 | x | 1.52 | x | 113.09 | x | 0.63 | x | 0.7 | = | 52.54 | (76) |
| East | 0.9x | 3 | x | 3.03 | x | 115.77 | x | 0.63 | x | 0.7 | = | 321.61 | (76) |
| East | 0.9x | 1 | x | 1.52 | x | 115.77 | x | 0.63 | x | 0.7 | = | 53.78 | (76) |
| East | 0.9x | 3 | x | 3.03 | x | 110.22 | x | 0.63 | x | 0.7 | = | 306.19 | (76) |
| East | 0.9x | 1 | x | 1.52 | x | 110.22 | x | 0.63 | x | 0.7 | = | 51.2 | (76) |
| East | 0.9x | 3 | x | 3.03 | x | 94.68 | x | 0.63 | x | 0.7 | = | 263.01 | (76) |
| East | 0.9x | 1 | x | 1.52 | x | 94.68 | x | 0.63 | x | 0.7 | = | 43.98 | (76) |
| East | 0.9x | 3 | x | 3.03 | x | 73.59 | x | 0.63 | x | 0.7 | = | 204.43 | (76) |
| East | 0.9x | 1 | x | 1.52 | x | 73.59 | x | 0.63 | x | 0.7 | = | 34.18 | (76) |
| East | 0.9x | 3 | x | 3.03 | x | 45.59 | x | 0.63 | x | 0.7 | = | 126.65 | (76) |
| East | 0.9x | 1 | x | 1.52 | x | 45.59 | x | 0.63 | x | 0.7 | = | 21.18 | (76) |
| East | 0.9x | 3 | x | 3.03 | x | 24.49 | x | 0.63 | x | 0.7 | = | 68.03 | (76) |
| East | 0.9x | 1 | x | 1.52 | x | 24.49 | x | 0.63 | x | 0.7 | = | 11.38 | (76) |
| East | 0.9x | 3 | x | 3.03 | x | 16.15 | x | 0.63 | x | 0.7 | = | 44.87 | (76) |
| East | 0.9x | 1 | x | 1.52 | x | 16.15 | x | 0.63 | x | 0.7 | = | 7.5 | (76) |
| South | 0.9x | 0.77 | x | 3.03 | x | 46.75 | x | 0.63 | x | 0.7 | = | 43.29 | (78) |
| South | 0.9x | 0.77 | x | 3.03 | x | 76.57 | x | 0.63 | x | 0.7 | = | 70.9 | (78) |
| South | 0.9x | 0.77 | x | 3.03 | x | 97.53 | x | 0.63 | x | 0.7 | = | 90.32 | (78) |
| South | 0.9x | 0.77 | x | 3.03 | x | 110.23 | x | 0.63 | x | 0.7 | = | 102.08 | (78) |
| South | 0.9x | 0.77 | x | 3.03 | x | 114.87 | x | 0.63 | x | 0.7 | = | 106.37 | (78) |
| South | 0.9x | 0.77 | x | 3.03 | x | 110.55 | x | 0.63 | x | 0.7 | = | 102.37 | (78) |
| South | 0.9x | 0.77 | x | 3.03 | x | 108.01 | x | 0.63 | x | 0.7 | = | 100.02 | (78) |
| South | 0.9x | 0.77 | x | 3.03 | x | 104.89 | x | 0.63 | x | 0.7 | = | 97.13 | (78) |
| South | 0.9x | 0.77 | x | 3.03 | x | 101.89 | x | 0.63 | x | 0.7 | = | 94.35 | (78) |
| South | 0.9x | 0.77 | x | 3.03 | x | 82.59 | x | 0.63 | x | 0.7 | = | 76.47 | (78) |
| South | 0.9x | 0.77 | x | 3.03 | x | 55.42 | x | 0.63 | x | 0.7 | = | 51.32 | (78) |
| South | 0.9x | 0.77 | x | 3.03 | x | 40.4 | x | 0.63 | x | 0.7 | = | 37.41 | (78) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 106.98 | 195.48 | 295.48 | 401.3 | 473.08 | 477.76 | 457.41 | 404.12 | 332.96 | 224.3 | 130.72 | 89.78 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 404.93 | 491.18 | 580.41 | 669.29 | 724.1 | 712.21 | 681.29 | 633.51 | 571.19 | 479.65 | 405.66 | 379.32 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 1 | 0.99 | 0.97 | 0.92 | 0.8 | 0.63 | 0.48 | 0.53 | 0.78 | 0.95 | 0.99 | 1 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.54 | 19.75 | 20.09 | 20.49 | 20.79 | 20.94 | 20.99 | 20.98 | 20.87 | 20.44 | 19.91 | 19.5 | (87) |

# TER WorkSheet: New dwelling design stage

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.75 | 19.75 | 19.75 | 19.76 | 19.76 | 19.77 | 19.77 | 19.78 | 19.77 | 19.76 | 19.76 | 19.76 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.99 | 0.98 | 0.96 | 0.89 | 0.74 | 0.53 | 0.35 | 0.4 | 0.68 | 0.93 | 0.99 | 1 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.84 | 18.15 | 18.63 | 19.19 | 19.57 | 19.74 | 19.77 | 19.77 | 19.67 | 19.15 | 18.39 | 17.78 | (90) |

fLA = Living area ÷ (4) = 0.58 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.82 | 19.08 | 19.47 | 19.94 | 20.28 | 20.44 | 20.47 | 20.47 | 20.36 | 19.9 | 19.27 | 18.78 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.82 | 19.08 | 19.47 | 19.94 | 20.28 | 20.44 | 20.47 | 20.47 | 20.36 | 19.9 | 19.27 | 18.78 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.99 | 0.98 | 0.96 | 0.89 | 0.77 | 0.59 | 0.42 | 0.47 | 0.73 | 0.93 | 0.98 | 0.99 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 401.6 | 482.27 | 555.35 | 597.39 | 556.89 | 419.2 | 289.12 | 300.77 | 418.03 | 446.93 | 399.19 | 376.91 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1126.98 | 1098.03 | 1002.66 | 845.11 | 655.3 | 442.22 | 293.49 | 307.8 | 476.08 | 710.51 | 933.1 | 1122.1 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 539.68 | 413.79 | 332.8 | 178.36 | 73.22 | 0 | 0 | 0 | 0 | 196.11 | 384.41 | 554.42 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2672.79 (98)

Space heating requirement in kWh/m²/year 48.93 (99)

## 9a. Energy requirements – Individual heating systems including micro-CHP)

**Space heating:**

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary system | | 0 | (201) |
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93.4 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | | | | | | | | | | | | | |
| | 539.68 | 413.79 | 332.8 | 178.36 | 73.22 | 0 | 0 | 0 | 0 | 196.11 | 384.41 | 554.42 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | (211) |
| | 577.82 | 443.03 | 356.31 | 190.96 | 78.39 | 0 | 0 | 0 | 0 | 209.97 | 411.58 | 593.6 | |

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2861.66 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

# TER WorkSheet: New dwelling design stage

**Water heating**

Output from water heater (calculated above)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 170.02 | 148.52 | 154.53 | 137.06 | 132.7 | 116.87 | 111.97 | 124.82 | 126.2 | 143.7 | 153.4 | 166.03 |

Efficiency of water heater | 80.3 | (216)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 87.76 | 87.49 | 86.93 | 85.72 | 83.62 | 80.3 | 80.3 | 80.3 | 80.3 | 85.83 | 87.27 | 87.85 | (217) |

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 193.75 | 169.75 | 177.75 | 159.9 | 158.68 | 145.54 | 139.44 | 155.44 | 157.16 | 167.42 | 175.78 | 188.99 |

Total = $Sum(219a)_{1...12}$ = | 1989.61 | (219)

| **Annual totals** | **kWh/year** | **kWh/year** | |
|---|---|---|---|
| Space heating fuel used, main system 1 | | 2861.66 | |
| Water heating fuel used | | 1989.61 | |
| Electricity for pumps, fans and electric keep-hot | | | |
| central heating pump: | 30 | | (230c) |
| boiler with a fan-assisted flue | 45 | | (230e) |
| Total electricity for the above, kWh/year — sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | 250.66 | (232) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 618.12 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 429.76 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1047.88 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 130.09 | (268) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 1216.89 | (272) |

**TER =** 22.28 (273)

# Appendix G: SAP DER worksheets for proposed solution

# DER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: A1

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 85.6 | (1a) x | 2.55 | (2a) = | 218.28 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 85.6 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 218.28 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| **ELEMENT** | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 9.47 | x1/[1/( 1.2 )+ 0.04] | | = | 10.84 | | | (27) |
| Windows Type 2 | | | 2.39 | x1/[1/( 1.2 )+ 0.04] | | = | 2.74 | | | (27) |
| Windows Type 3 | | | 2.39 | x1/[1/( 1.2 )+ 0.04] | | = | 2.74 | | | (27) |
| Floor | | | 85.6 | x | 0.13 | = | 11.128 | | | (28) |
| Walls Type1 | 76.14 | 14.25 | 61.89 | x | 0.18 | = | 11.14 | | | (29) |
| Walls Type2 | 13.89 | 0 | 13.89 | x | 0.23 | = | 3.14 | | | (29) |
| Total area of elements, m² | | | 175.63 | | | | | | | (31) |
| Party wall | | | 16.77 | x | 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 41.72 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 14717.45 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 12.5 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 54.22 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 22.93 | 22.7 | 22.47 | 21.32 | 21.09 | 19.94 | 19.94 | 19.71 | 20.4 | 21.09 | 21.55 | 22.01 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 77.15 | 76.92 | 76.69 | 75.54 | 75.31 | 74.17 | 74.17 | 73.94 | 74.63 | 75.31 | 75.77 | 76.23 | |

Average = Sum(39)$_{1…12}$ /12= 75.49 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.9 | 0.9 | 0.9 | 0.88 | 0.88 | 0.87 | 0.87 | 0.86 | 0.87 | 0.88 | 0.89 | 0.89 |

Average = Sum(40)$_{1...12}$ /12= 0.88 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.56 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 95.01 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 104.52 | 100.71 | 96.91 | 93.11 | 89.31 | 85.51 | 85.51 | 89.31 | 93.11 | 96.91 | 100.71 | 104.52 |

Total = Sum(44)$_{1...12}$ = 1140.17 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 154.99 | 135.56 | 139.88 | 121.95 | 117.02 | 100.98 | 93.57 | 107.37 | 108.66 | 126.63 | 138.22 | 150.1 |

Total = Sum(45)$_{1...12}$ = 1494.94 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 23.25 | 20.33 | 20.98 | 18.29 | 17.55 | 15.15 | 14.04 | 16.11 | 16.3 | 18.99 | 20.73 | 22.52 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

# DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 210.27 | 185.49 | 195.16 | 175.45 | 172.29 | 154.47 | 148.85 | 162.65 | 162.15 | 181.9 | 191.72 | 205.38 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 210.27 | 185.49 | 195.16 | 175.45 | 172.29 | 154.47 | 148.85 | 162.65 | 162.15 | 181.9 | 191.72 | 205.38 | |

Output from water heater (annual)$_{1...12}$ 2145.78 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 95.76 | 85.01 | 90.73 | 83.34 | 83.13 | 76.37 | 75.33 | 79.92 | 78.92 | 86.33 | 88.75 | 94.13 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 128.03 | 128.03 | 128.03 | 128.03 | 128.03 | 128.03 | 128.03 | 128.03 | 128.03 | 128.03 | 128.03 | 128.03 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 21.3 | 18.92 | 15.38 | 11.65 | 8.71 | 7.35 | 7.94 | 10.32 | 13.86 | 17.59 | 20.53 | 21.89 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 230.75 | 233.14 | 227.11 | 214.26 | 198.05 | 182.81 | 172.63 | 170.23 | 176.26 | 189.11 | 205.33 | 220.57 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 35.8 | 35.8 | 35.8 | 35.8 | 35.8 | 35.8 | 35.8 | 35.8 | 35.8 | 35.8 | 35.8 | 35.8 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -102.42 | -102.42 | -102.42 | -102.42 | -102.42 | -102.42 | -102.42 | -102.42 | -102.42 | -102.42 | -102.42 | -102.42 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 128.71 | 126.51 | 121.95 | 115.76 | 111.73 | 106.07 | 101.25 | 107.42 | 109.62 | 116.03 | 123.27 | 126.52 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 442.16 | 439.98 | 425.85 | 403.07 | 379.89 | 357.63 | 343.23 | 349.39 | 361.15 | 384.14 | 410.54 | 430.38 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 9.47 | x | 19.64 | x | 0.5 | x | 0.7 | = | 45.11 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 19.64 | x | 0.5 | x | 0.7 | = | 11.39 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 19.64 | x | 0.5 | x | 0.7 | = | 11.39 | (76) |
| East | 0.9x | 1 | x | 9.47 | x | 38.42 | x | 0.5 | x | 0.7 | = | 88.25 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 38.42 | x | 0.5 | x | 0.7 | = | 22.27 | (76) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 2.39 | x | 38.42 | x | 0.5 | x | 0.7 | = | 22.27 | (76) |
| East | 0.9x | 1 | x | 9.47 | x | 63.27 | x | 0.5 | x | 0.7 | = | 145.34 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 63.27 | x | 0.5 | x | 0.7 | = | 36.68 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 63.27 | x | 0.5 | x | 0.7 | = | 36.68 | (76) |
| East | 0.9x | 1 | x | 9.47 | x | 92.28 | x | 0.5 | x | 0.7 | = | 211.96 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 92.28 | x | 0.5 | x | 0.7 | = | 53.49 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 92.28 | x | 0.5 | x | 0.7 | = | 53.49 | (76) |
| East | 0.9x | 1 | x | 9.47 | x | 113.09 | x | 0.5 | x | 0.7 | = | 259.77 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 113.09 | x | 0.5 | x | 0.7 | = | 65.56 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 113.09 | x | 0.5 | x | 0.7 | = | 65.56 | (76) |
| East | 0.9x | 1 | x | 9.47 | x | 115.77 | x | 0.5 | x | 0.7 | = | 265.92 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 115.77 | x | 0.5 | x | 0.7 | = | 67.11 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 115.77 | x | 0.5 | x | 0.7 | = | 67.11 | (76) |
| East | 0.9x | 1 | x | 9.47 | x | 110.22 | x | 0.5 | x | 0.7 | = | 253.17 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 110.22 | x | 0.5 | x | 0.7 | = | 63.89 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 110.22 | x | 0.5 | x | 0.7 | = | 63.89 | (76) |
| East | 0.9x | 1 | x | 9.47 | x | 94.68 | x | 0.5 | x | 0.7 | = | 217.47 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 94.68 | x | 0.5 | x | 0.7 | = | 54.88 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 94.68 | x | 0.5 | x | 0.7 | = | 54.88 | (76) |
| East | 0.9x | 1 | x | 9.47 | x | 73.59 | x | 0.5 | x | 0.7 | = | 169.03 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 73.59 | x | 0.5 | x | 0.7 | = | 42.66 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 73.59 | x | 0.5 | x | 0.7 | = | 42.66 | (76) |
| East | 0.9x | 1 | x | 9.47 | x | 45.59 | x | 0.5 | x | 0.7 | = | 104.72 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 45.59 | x | 0.5 | x | 0.7 | = | 26.43 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 45.59 | x | 0.5 | x | 0.7 | = | 26.43 | (76) |
| East | 0.9x | 1 | x | 9.47 | x | 24.49 | x | 0.5 | x | 0.7 | = | 56.25 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 24.49 | x | 0.5 | x | 0.7 | = | 14.2 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 24.49 | x | 0.5 | x | 0.7 | = | 14.2 | (76) |
| East | 0.9x | 1 | x | 9.47 | x | 16.15 | x | 0.5 | x | 0.7 | = | 37.1 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 16.15 | x | 0.5 | x | 0.7 | = | 9.36 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 16.15 | x | 0.5 | x | 0.7 | = | 9.36 | (76) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 67.88 | 132.79 | 218.69 | 318.95 | 390.89 | 400.14 | 380.95 | 327.23 | 254.35 | 157.57 | 84.64 | 55.82 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 510.04 | 572.77 | 644.55 | 722.02 | 770.78 | 757.78 | 724.18 | 676.62 | 615.49 | 541.71 | 495.18 | 486.21 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.96 | 0.95 | 0.91 | 0.84 | 0.72 | 0.56 | 0.43 | 0.47 | 0.69 | 0.87 | 0.95 | 0.97 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.18 | 19.41 | 19.8 | 20.29 | 20.66 | 20.89 | 20.96 | 20.95 | 20.79 | 20.29 | 19.66 | 19.14 | (87) |

# DER WorkSheet: New dwelling design stage

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.17 | 20.17 | 20.17 | 20.18 | 20.18 | 20.2 | 20.2 | 20.2 | 20.19 | 20.18 | 20.18 | 20.18 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.96 | 0.94 | 0.9 | 0.81 | 0.68 | 0.51 | 0.36 | 0.4 | 0.63 | 0.85 | 0.94 | 0.96 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.71 | 18.04 | 18.6 | 19.29 | 19.8 | 20.09 | 20.17 | 20.16 | 19.97 | 19.31 | 18.41 | 17.66 | (90) |

fLA = Living area ÷ (4) = 0.36 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.24 | 18.54 | 19.03 | 19.65 | 20.11 | 20.38 | 20.46 | 20.45 | 20.27 | 19.66 | 18.86 | 18.2 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.24 | 18.54 | 19.03 | 19.65 | 20.11 | 20.38 | 20.46 | 20.45 | 20.27 | 19.66 | 18.86 | 18.2 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.94 | 0.92 | 0.88 | 0.8 | 0.68 | 0.52 | 0.38 | 0.42 | 0.64 | 0.84 | 0.92 | 0.95 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 481.19 | 528.13 | 566.96 | 576.59 | 522.62 | 394.29 | 276.58 | 286.05 | 393.24 | 452.69 | 455.86 | 461.69 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1075.59 | 1048.87 | 961.34 | 812.35 | 633.69 | 428.74 | 286.19 | 299.36 | 460.29 | 682.53 | 891.13 | 1067.02 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 442.24 | 349.93 | 293.42 | 169.75 | 82.64 | 0 | 0 | 0 | 0 | 171 | 313.39 | 450.37 | |

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2272.74 (98)

Space heating requirement in kWh/m²/year 26.55 (99)

## 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |

**Space heating** **kWh/year**

Annual space heating requirement 2272.74

# DER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 1193.19 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 1193.19 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |

**Water heating**

| | | | |
|---|---|---|---|
| Annual water heating requirement | | 2145.78 | |
| If DHW from community scheme: Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1126.53 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1126.53 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 46.39 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside | | 279.62 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 279.62 | (331) |
| Energy for lighting (calculated in Appendix L) | | 376.14 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -522.83 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | | Energy kWh/year | Emission factor kg CO2/kWh | | Emissions kg CO2/year | |
|---|---|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 91 | (367b) |
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.52 | = | 283.28 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.22 | = | 550.62 | (368) |
| Electrical energy for heat distribution | [(313) x | | 0.52 | = | 24.08 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | | = | 857.97 | (373) |
| CO2 associated with space heating (secondary) | (309) x | | 0 | = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | | 0.52 | = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | | 857.97 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | | 0.52 | = | 145.12 | (378) |
| CO2 associated with electricity for lighting | (332))) x | | 0.52 | = | 195.22 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable Item 1 | | 0.52 | x 0.01 = | | -271.35 | (380) |

# DER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| **Total CO2, kg/year** | sum of (376)…(382) = | 926.96 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | 10.83 | (384) |
| **EI rating (section 14)** | | 90.49 | (385) |

# DER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: A2

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Basement | 87.17 | (1a) | x | 2.55 | (2a) | = | 222.28 | (3a) |
| Ground floor | 79.45 | (1b) | x | 3 | (2b) | = | 238.35 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 166.62 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | | = | 460.63 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

| | | | | Air changes per hour | |
|---|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = | (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

# DER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.92 | x1/[1/( 1.2 )+ 0.04] | | = | 5.63 | | | (27) |
| Windows Type 2 | | | 4.92 | x1/[1/( 1.2 )+ 0.04] | | = | 5.63 | | | (27) |
| Windows Type 3 | | | 2.39 | x1/[1/( 1.2 )+ 0.04] | | = | 2.74 | | | (27) |
| Windows Type 4 | | | 7.32 | x1/[1/( 1.2 )+ 0.04] | | = | 8.38 | | | (27) |
| Windows Type 5 | | | 4.76 | x1/[1/( 1.2 )+ 0.04] | | = | 5.45 | | | (27) |
| Windows Type 6 | | | 2.39 | x1/[1/( 1.2 )+ 0.04] | | = | 2.74 | | | (27) |
| Windows Type 7 | | | 4.76 | x1/[1/( 1.2 )+ 0.04] | | = | 5.45 | | | (27) |
| Windows Type 8 | | | 2.39 | x1/[1/( 1.2 )+ 0.04] | | = | 2.74 | | | (27) |
| Floor Type 1 | | | 87.17 | x | 0.13 | = | 11.3321 | | | (28) |
| Floor Type 2 | | | 6.96 | x | 0.13 | = | 0.9048 | | | (28) |
| Walls Type1 | 86.29 | 14.46 | 71.83 | x | 0.18 | = | 12.93 | | | (29) |
| Walls Type2 | 81.09 | 24.17 | 56.92 | x | 0.18 | = | 10.25 | | | (29) |
| Walls Type3 | 43.85 | 0 | 43.85 | x | 0.23 | = | 9.97 | | | (29) |
| Roof Type1 | 15.5 | 0 | 15.5 | x | 0.13 | = | 2.01 | | | (30) |
| Roof Type2 | 6.22 | 0 | 6.22 | x | 0.13 | = | 0.81 | | | (30) |
| Total area of elements, m² | | | 327.08 | | | | | | | (31) |
| Party wall | | | 26.4 | x | 0 | = | 0 | | | (32) |

# DER WorkSheet: New dwelling design stage

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

| | | | |
|---|---|---|---|
| Fabric heat loss, W/K = S (A x U) | (26)…(30) + (32) = | 92.43 | (33) |
| Heat capacity Cm = S(A x k ) | ((28)…(30) + (32) + (32a)…(32e) = | 21850.18 | (34) |
| Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K | Indicative Value: Low | 100 | (35) |

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

| | | | |
|---|---|---|---|
| Thermal bridges : S (L x Y) calculated using Appendix K | | 25.28 | (36) |

*if details of thermal bridging are not known (36) = 0.15 x (31)*

| | | | |
|---|---|---|---|
| Total fabric heat loss | (33) + (36) = | 117.71 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 48.39 | 47.9 | 47.42 | 44.99 | 44.51 | 42.09 | 42.09 | 41.6 | 43.06 | 44.51 | 45.48 | 46.45 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 166.1 | 165.61 | 165.13 | 162.71 | 162.22 | 159.8 | 159.8 | 159.32 | 160.77 | 162.22 | 163.19 | 164.16 | |

Average = Sum(39)1…12 /12= 162.59 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1 | 0.99 | 0.99 | 0.98 | 0.97 | 0.96 | 0.96 | 0.96 | 0.96 | 0.97 | 0.98 | 0.99 | |

Average = Sum(40)1…12 /12= 0.98 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.96 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 104.45 (43)
*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | | |
| (44)m= | 114.9 | 110.72 | 106.54 | 102.36 | 98.19 | 94.01 | 94.01 | 98.19 | 102.36 | 106.54 | 110.72 | 114.9 | |
| | | | | | | | | | | Total = Sum(44)1…12 = | | 1253.44 | (44) |
| *Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)* | | | | | | | | | | | | | |
| (45)m= | 170.39 | 149.02 | 153.78 | 134.07 | 128.64 | 111.01 | 102.87 | 118.04 | 119.45 | 139.21 | 151.96 | 165.01 | |
| | | | | | | | | | | Total = Sum(45)1…12 = | | 1643.45 | (45) |
| *If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)* | | | | | | | | | | | | | |
| (46)m= | 25.56 | 22.35 | 23.07 | 20.11 | 19.3 | 16.65 | 15.43 | 17.71 | 17.92 | 20.88 | 22.79 | 24.75 | (46) |

Water storage loss:

| | | |
|---|---|---|
| Storage volume (litres) including any solar or WWHRS storage within same vessel | 0 | (47) |

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:

| | | |
|---|---|---|
| a) If manufacturer's declared loss factor is known (kWh/day): | 0 | (48) |
| Temperature factor from Table 2b | 0 | (49) |

| | | | |
|---|---|---|---|
| Energy lost from water storage, kWh/year | (48) x (49) = | 110 | (50) |
| b) If manufacturer's declared cylinder loss factor is not known: | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | 0.02 | (51) |
| If community heating see section 4.3 | | | |
| Volume factor from Table 2a | | 1.03 | (52) |
| Temperature factor from Table 2b | | 0.6 | (53) |
| Energy lost from water storage, kWh/year | (47) x (51) x (52) x (53) = | 1.03 | (54) |
| Enter (50) or (54) in (55) | | 1.03 | (55) |
| Water storage loss calculated for each month | ((56)m = (55) × (41)m | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 225.67 | 198.95 | 209.06 | 187.56 | 183.92 | 164.5 | 158.14 | 173.32 | 172.94 | 194.48 | 205.45 | 220.29 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 225.67 | 198.95 | 209.06 | 187.56 | 183.92 | 164.5 | 158.14 | 173.32 | 172.94 | 194.48 | 205.45 | 220.29 |

Output from water heater (annual)1…12 — 2294.29 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 100.88 | 89.49 | 95.35 | 87.37 | 87 | 79.71 | 78.42 | 83.47 | 82.51 | 90.51 | 93.32 | 99.09 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 147.9 | 147.9 | 147.9 | 147.9 | 147.9 | 147.9 | 147.9 | 147.9 | 147.9 | 147.9 | 147.9 | 147.9 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| (67)m= | 30.14 | 26.77 | 21.77 | 16.48 | 12.32 | 10.4 | 11.24 | 14.61 | 19.61 | 24.9 | 29.06 | 30.98 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| (68)m= | 338.09 | 341.59 | 332.75 | 313.93 | 290.18 | 267.85 | 252.93 | 249.42 | 258.26 | 277.08 | 300.84 | 323.17 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| (69)m= | 37.79 | 37.79 | 37.79 | 37.79 | 37.79 | 37.79 | 37.79 | 37.79 | 37.79 | 37.79 | 37.79 | 37.79 | (69) |
| Pumps and fans gains (Table 5a) | | | | | | | | | | | | | |
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| (71)m= | -118.32 | -118.32 | -118.32 | -118.32 | -118.32 | -118.32 | -118.32 | -118.32 | -118.32 | -118.32 | -118.32 | -118.32 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 135.59 | 133.17 | 128.16 | 121.35 | 116.93 | 110.7 | 105.41 | 112.19 | 114.6 | 121.65 | 129.61 | 133.18 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 571.18 | 568.91 | 550.06 | 519.14 | 486.8 | 456.32 | 436.95 | 443.59 | 459.84 | 491 | 526.88 | 554.7 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.76 | x | 19.64 | x | 0.5 | x | 0.7 | = | 22.68 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 19.64 | x | 0.5 | x | 0.7 | = | 11.39 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 19.64 | x | 0.5 | x | 0.7 | = | 22.68 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 19.64 | x | 0.5 | x | 0.7 | = | 11.39 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 38.42 | x | 0.5 | x | 0.7 | = | 44.36 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 38.42 | x | 0.5 | x | 0.7 | = | 22.27 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 38.42 | x | 0.5 | x | 0.7 | = | 44.36 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 38.42 | x | 0.5 | x | 0.7 | = | 22.27 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 63.27 | x | 0.5 | x | 0.7 | = | 73.05 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 63.27 | x | 0.5 | x | 0.7 | = | 36.68 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 63.27 | x | 0.5 | x | 0.7 | = | 73.05 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 63.27 | x | 0.5 | x | 0.7 | = | 36.68 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 92.28 | x | 0.5 | x | 0.7 | = | 106.54 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 92.28 | x | 0.5 | x | 0.7 | = | 53.49 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 92.28 | x | 0.5 | x | 0.7 | = | 106.54 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 92.28 | x | 0.5 | x | 0.7 | = | 53.49 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 113.09 | x | 0.5 | x | 0.7 | = | 130.57 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 113.09 | x | 0.5 | x | 0.7 | = | 65.56 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 113.09 | x | 0.5 | x | 0.7 | = | 130.57 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 113.09 | x | 0.5 | x | 0.7 | = | 65.56 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 115.77 | x | 0.5 | x | 0.7 | = | 133.66 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 115.77 | x | 0.5 | x | 0.7 | = | 67.11 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 115.77 | x | 0.5 | x | 0.7 | = | 133.66 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 115.77 | x | 0.5 | x | 0.7 | = | 67.11 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 110.22 | x | 0.5 | x | 0.7 | = | 127.25 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 110.22 | x | 0.5 | x | 0.7 | = | 63.89 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 110.22 | x | 0.5 | x | 0.7 | = | 127.25 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 110.22 | x | 0.5 | x | 0.7 | = | 63.89 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 94.68 | x | 0.5 | x | 0.7 | = | 109.31 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 94.68 | x | 0.5 | x | 0.7 | = | 54.88 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 94.68 | x | 0.5 | x | 0.7 | = | 109.31 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 94.68 | x | 0.5 | x | 0.7 | = | 54.88 | (76) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.76 | x | 73.59 | x | 0.5 | x | 0.7 | = | 84.96 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 73.59 | x | 0.5 | x | 0.7 | = | 42.66 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 73.59 | x | 0.5 | x | 0.7 | = | 84.96 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 73.59 | x | 0.5 | x | 0.7 | = | 42.66 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 45.59 | x | 0.5 | x | 0.7 | = | 52.63 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 45.59 | x | 0.5 | x | 0.7 | = | 26.43 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 45.59 | x | 0.5 | x | 0.7 | = | 52.63 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 45.59 | x | 0.5 | x | 0.7 | = | 26.43 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 24.49 | x | 0.5 | x | 0.7 | = | 28.27 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 24.49 | x | 0.5 | x | 0.7 | = | 14.2 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 24.49 | x | 0.5 | x | 0.7 | = | 28.27 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 24.49 | x | 0.5 | x | 0.7 | = | 14.2 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 16.15 | x | 0.5 | x | 0.7 | = | 18.65 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 16.15 | x | 0.5 | x | 0.7 | = | 9.36 | (76) |
| East | 0.9x | 1 | x | 4.76 | x | 16.15 | x | 0.5 | x | 0.7 | = | 18.65 | (76) |
| East | 0.9x | 1 | x | 2.39 | x | 16.15 | x | 0.5 | x | 0.7 | = | 9.36 | (76) |
| South | 0.9x | 0.77 | x | 7.32 | x | 46.75 | x | 0.5 | x | 0.7 | = | 83.01 | (78) |
| South | 0.9x | 0.77 | x | 7.32 | x | 76.57 | x | 0.5 | x | 0.7 | = | 135.94 | (78) |
| South | 0.9x | 0.77 | x | 7.32 | x | 97.53 | x | 0.5 | x | 0.7 | = | 173.17 | (78) |
| South | 0.9x | 0.77 | x | 7.32 | x | 110.23 | x | 0.5 | x | 0.7 | = | 195.72 | (78) |
| South | 0.9x | 0.77 | x | 7.32 | x | 114.87 | x | 0.5 | x | 0.7 | = | 203.95 | (78) |
| South | 0.9x | 0.77 | x | 7.32 | x | 110.55 | x | 0.5 | x | 0.7 | = | 196.27 | (78) |
| South | 0.9x | 0.77 | x | 7.32 | x | 108.01 | x | 0.5 | x | 0.7 | = | 191.77 | (78) |
| South | 0.9x | 0.77 | x | 7.32 | x | 104.89 | x | 0.5 | x | 0.7 | = | 186.24 | (78) |
| South | 0.9x | 0.77 | x | 7.32 | x | 101.89 | x | 0.5 | x | 0.7 | = | 180.89 | (78) |
| South | 0.9x | 0.77 | x | 7.32 | x | 82.59 | x | 0.5 | x | 0.7 | = | 146.63 | (78) |
| South | 0.9x | 0.77 | x | 7.32 | x | 55.42 | x | 0.5 | x | 0.7 | = | 98.39 | (78) |
| South | 0.9x | 0.77 | x | 7.32 | x | 40.4 | x | 0.5 | x | 0.7 | = | 71.73 | (78) |
| West | 0.9x | 0.77 | x | 4.92 | x | 19.64 | x | 0.5 | x | 0.7 | = | 23.44 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 19.64 | x | 0.5 | x | 0.7 | = | 23.44 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 19.64 | x | 0.5 | x | 0.7 | = | 34.16 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 38.42 | x | 0.5 | x | 0.7 | = | 45.85 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 38.42 | x | 0.5 | x | 0.7 | = | 45.85 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 38.42 | x | 0.5 | x | 0.7 | = | 66.82 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 63.27 | x | 0.5 | x | 0.7 | = | 75.51 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 63.27 | x | 0.5 | x | 0.7 | = | 75.51 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 63.27 | x | 0.5 | x | 0.7 | = | 110.04 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 92.28 | x | 0.5 | x | 0.7 | = | 110.12 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 92.28 | x | 0.5 | x | 0.7 | = | 110.12 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 92.28 | x | 0.5 | x | 0.7 | = | 160.48 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 113.09 | x | 0.5 | x | 0.7 | = | 134.96 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 4.92 | x | 113.09 | x | 0.5 | x | 0.7 | = | 134.96 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 113.09 | x | 0.5 | x | 0.7 | = | 196.68 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 115.77 | x | 0.5 | x | 0.7 | = | 138.15 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 115.77 | x | 0.5 | x | 0.7 | = | 138.15 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 115.77 | x | 0.5 | x | 0.7 | = | 201.33 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 110.22 | x | 0.5 | x | 0.7 | = | 131.53 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 110.22 | x | 0.5 | x | 0.7 | = | 131.53 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 110.22 | x | 0.5 | x | 0.7 | = | 191.68 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 94.68 | x | 0.5 | x | 0.7 | = | 112.98 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 94.68 | x | 0.5 | x | 0.7 | = | 112.98 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 94.68 | x | 0.5 | x | 0.7 | = | 164.65 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 73.59 | x | 0.5 | x | 0.7 | = | 87.82 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 73.59 | x | 0.5 | x | 0.7 | = | 87.82 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 73.59 | x | 0.5 | x | 0.7 | = | 127.98 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 45.59 | x | 0.5 | x | 0.7 | = | 54.4 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 45.59 | x | 0.5 | x | 0.7 | = | 54.4 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 45.59 | x | 0.5 | x | 0.7 | = | 79.28 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 24.49 | x | 0.5 | x | 0.7 | = | 29.22 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 24.49 | x | 0.5 | x | 0.7 | = | 29.22 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 24.49 | x | 0.5 | x | 0.7 | = | 42.59 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 16.15 | x | 0.5 | x | 0.7 | = | 19.27 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 16.15 | x | 0.5 | x | 0.7 | = | 19.27 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 16.15 | x | 0.5 | x | 0.7 | = | 28.09 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 232.16 | 427.72 | 653.68 | 896.51 | 1062.8 | 1075.46 | 1028.8 | 905.23 | 739.75 | 492.84 | 284.37 | 194.38 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 803.34 | 996.63 | 1203.74 | 1415.65 | 1549.6 | 1531.78 | 1465.74 | 1348.82 | 1199.59 | 983.84 | 811.25 | 749.08 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.98 | 0.96 | 0.93 | 0.85 | 0.73 | 0.58 | 0.45 | 0.5 | 0.72 | 0.9 | 0.97 | 0.98 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 18.75 | 19.06 | 19.55 | 20.13 | 20.58 | 20.85 | 20.95 | 20.93 | 20.71 | 20.09 | 19.31 | 18.7 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.09 | 20.09 | 20.09 | 20.1 | 20.11 | 20.12 | 20.12 | 20.12 | 20.11 | 20.11 | 20.1 | 20.1 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.98 | 0.96 | 0.91 | 0.83 | 0.69 | 0.52 | 0.37 | 0.42 | 0.66 | 0.88 | 0.96 | 0.98 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.04 | 17.49 | 18.19 | 19.02 | 19.62 | 19.98 | 20.08 | 20.07 | 19.82 | 18.98 | 17.86 | 16.97 | (90) |

fLA = Living area ÷ (4) = 0.29 (91)

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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 17.54 | 17.96 | 18.59 | 19.34 | 19.9 | 20.23 | 20.34 | 20.32 | 20.08 | 19.3 | 18.29 | 17.48 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 17.54 | 17.96 | 18.59 | 19.34 | 19.9 | 20.23 | 20.34 | 20.32 | 20.08 | 19.3 | 18.29 | 17.48 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.96 | 0.94 | 0.89 | 0.81 | 0.68 | 0.53 | 0.39 | 0.44 | 0.66 | 0.86 | 0.94 | 0.97 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 774.06 | 935.04 | 1073.34 | 1142.16 | 1061.09 | 811.02 | 570.85 | 587.95 | 789.03 | 845.45 | 766.1 | 726.03 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 2199.33 | 2162.2 | 1996.33 | 1699.23 | 1330.88 | 900.22 | 597.07 | 624.71 | 961.61 | 1411.69 | 1825.44 | 2180.13 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 1060.4 | 824.65 | 686.71 | 401.09 | 200.72 | 0 | 0 | 0 | 0 | 421.28 | 762.73 | 1081.85 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 5439.42 | (98)

Space heating requirement in kWh/m²/year | 32.65 | (99)

## 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |
| **Space heating** | | **kWh/year** | |
| Annual space heating requirement | | 5439.42 | |
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 2855.7 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 2855.7 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |
| **Water heating** | | | |
| Annual water heating requirement | | 2294.29 | |
| If DHW from community scheme:<br>Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1204.5 | (310a) |

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| | | | |
|---|---|---|---|
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1204.5 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 81.2 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f):<br>mechanical ventilation - balanced, extract or positive input from outside | | 590.07 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 590.07 | (331) |
| Energy for lighting (calculated in Appendix L) | | 532.29 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -1016.84 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | | Energy kWh/year | Emission factor kg CO2/kWh | | Emissions kg CO2/year | |
|---|---|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP)<br>Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 91 | (367b) |
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.52 | = | 495.82 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.22 | = | 963.74 | (368) |
| Electrical energy for heat distribution | [(313) x | | 0.52 | = | 42.14 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | | = | 1501.71 | (373) |
| CO2 associated with space heating (secondary) | (309) x | | 0 | = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | | 0.52 | = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | | 1501.71 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | | 0.52 | = | 306.25 | (378) |
| CO2 associated with electricity for lighting | (332))) x | | 0.52 | = | 276.26 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable<br>Item 1 | | 0.52 | | x 0.01 = | -527.74 | (380) |
| **Total CO2, kg/year** | sum of (376)…(382) = | | | | 1556.48 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | | | | 9.34 | (384) |
| **EI rating (section 14)** | | | | | 90.14 | (385) |

# DER WorkSheet: New dwelling design stage

**User Details:**

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

**Property Address: A3**

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 68.93 | (1a) x | 2.55 | (2a) = | 175.77 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 68.93 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 175.77 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

Wind Factor (22a)m = (22)m ÷ 4

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

| | | |
|---|---|---|
| If mechanical ventilation: | 0.5 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) | 0.5 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 68.85 | (23c) |

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 8.96 | x1/[1/( 1.2 )+ 0.04] | | = | 10.26 | | | (27) |
| Windows Type 2 | | | 2.26 | x1/[1/( 1.2 )+ 0.04] | | = | 2.59 | | | (27) |
| Windows Type 3 | | | 2.26 | x1/[1/( 1.2 )+ 0.04] | | = | 2.59 | | | (27) |
| Walls Type1 | 65.3 | 13.48 | 51.82 | x | 0.18 | = | 9.33 | | | (29) |
| Walls Type2 | 15.33 | 0 | 15.33 | x | 0.23 | = | 3.46 | | | (29) |
| Walls Type3 | 28.15 | 0 | 28.15 | x | 0.2 | = | 5.63 | | | (29) |
| Total area of elements, m² | | | 108.78 | | | | | | | (31) |
| Party wall | | | 8.49 | x | 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

| | | | |
|---|---|---|---|
| Fabric heat loss, W/K = S (A x U) | (26)…(30) + (32) = | 33.85 | (33) |
| Heat capacity Cm = S(A x k ) | ((28)…(30) + (32) + (32a)…(32e) = | 6100.28 | (34) |
| Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K | Indicative Value: Low | 100 | (35) |

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

| | | | |
|---|---|---|---|
| Thermal bridges : S (L x Y) calculated using Appendix K | | 10.04 | (36) |
| *if details of thermal bridging are not known (36) = 0.15 x (31)* | | | |
| Total fabric heat loss | (33) + (36) = | 43.89 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 18.46 | 18.28 | 18.09 | 17.17 | 16.98 | 16.06 | 16.06 | 15.88 | 16.43 | 16.98 | 17.35 | 17.72 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 62.36 | 62.17 | 61.99 | 61.06 | 60.88 | 59.95 | 59.95 | 59.77 | 60.32 | 60.88 | 61.25 | 61.62 | |

Average = Sum(39)$_{1…12}$ /12= 61.02 (39)

# DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.9 | 0.9 | 0.9 | 0.89 | 0.88 | 0.87 | 0.87 | 0.87 | 0.88 | 0.88 | 0.89 | 0.89 |

Average = Sum(40)1…12 /12= 0.89 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 |

(41)

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.22 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 86.92 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 95.61 | 92.14 | 88.66 | 85.18 | 81.71 | 78.23 | 78.23 | 81.71 | 85.18 | 88.66 | 92.14 | 95.61 |

Total = Sum(44)1…12 = 1043.06 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 141.79 | 124.01 | 127.97 | 111.57 | 107.05 | 92.38 | 85.6 | 98.23 | 99.4 | 115.84 | 126.45 | 137.32 |

Total = Sum(45)1…12 = 1367.62 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 21.27 | 18.6 | 19.2 | 16.74 | 16.06 | 13.86 | 12.84 | 14.73 | 14.91 | 17.38 | 18.97 | 20.6 |

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 |

(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 |

(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 |

(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 197.07 | 173.94 | 183.25 | 165.06 | 162.33 | 145.87 | 140.88 | 153.51 | 152.9 | 171.12 | 179.95 | 192.6 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 197.07 | 173.94 | 183.25 | 165.06 | 162.33 | 145.87 | 140.88 | 153.51 | 152.9 | 171.12 | 179.95 | 192.6 | |

Output from water heater (annual)$_{1...12}$ 2018.46 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 91.37 | 81.18 | 86.77 | 79.89 | 79.82 | 73.51 | 72.68 | 76.88 | 75.85 | 82.74 | 84.84 | 89.88 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 110.99 | 110.99 | 110.99 | 110.99 | 110.99 | 110.99 | 110.99 | 110.99 | 110.99 | 110.99 | 110.99 | 110.99 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 17.53 | 15.57 | 12.66 | 9.59 | 7.17 | 6.05 | 6.54 | 8.5 | 11.41 | 14.48 | 16.9 | 18.02 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 194.79 | 196.81 | 191.71 | 180.87 | 167.18 | 154.32 | 145.72 | 143.7 | 148.8 | 159.64 | 173.33 | 186.19 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 34.1 | 34.1 | 34.1 | 34.1 | 34.1 | 34.1 | 34.1 | 34.1 | 34.1 | 34.1 | 34.1 | 34.1 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -88.79 | -88.79 | -88.79 | -88.79 | -88.79 | -88.79 | -88.79 | -88.79 | -88.79 | -88.79 | -88.79 | -88.79 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 122.81 | 120.8 | 116.63 | 110.96 | 107.28 | 102.1 | 97.69 | 103.34 | 105.34 | 111.21 | 117.83 | 120.81 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 391.42 | 389.48 | 377.3 | 357.72 | 337.93 | 318.76 | 306.25 | 311.83 | 321.84 | 341.63 | 364.36 | 381.32 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 8.96 | x | 19.64 | x | 0.5 | x | 0.7 | = | 42.68 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 19.64 | x | 0.5 | x | 0.7 | = | 10.77 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 19.64 | x | 0.5 | x | 0.7 | = | 10.77 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 38.42 | x | 0.5 | x | 0.7 | = | 83.5 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 38.42 | x | 0.5 | x | 0.7 | = | 21.06 | (76) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 2.26 | x | 38.42 | x | 0.5 | x | 0.7 | = | 21.06 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 63.27 | x | 0.5 | x | 0.7 | = | 137.51 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 63.27 | x | 0.5 | x | 0.7 | = | 34.68 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 63.27 | x | 0.5 | x | 0.7 | = | 34.68 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 92.28 | x | 0.5 | x | 0.7 | = | 200.55 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 92.28 | x | 0.5 | x | 0.7 | = | 50.58 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 92.28 | x | 0.5 | x | 0.7 | = | 50.58 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 113.09 | x | 0.5 | x | 0.7 | = | 245.78 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 113.09 | x | 0.5 | x | 0.7 | = | 61.99 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 113.09 | x | 0.5 | x | 0.7 | = | 61.99 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 115.77 | x | 0.5 | x | 0.7 | = | 251.6 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 115.77 | x | 0.5 | x | 0.7 | = | 63.46 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 115.77 | x | 0.5 | x | 0.7 | = | 63.46 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 110.22 | x | 0.5 | x | 0.7 | = | 239.53 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 110.22 | x | 0.5 | x | 0.7 | = | 60.42 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 110.22 | x | 0.5 | x | 0.7 | = | 60.42 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 94.68 | x | 0.5 | x | 0.7 | = | 205.75 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 94.68 | x | 0.5 | x | 0.7 | = | 51.9 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 94.68 | x | 0.5 | x | 0.7 | = | 51.9 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 73.59 | x | 0.5 | x | 0.7 | = | 159.93 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 73.59 | x | 0.5 | x | 0.7 | = | 40.34 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 73.59 | x | 0.5 | x | 0.7 | = | 40.34 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 45.59 | x | 0.5 | x | 0.7 | = | 99.08 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 45.59 | x | 0.5 | x | 0.7 | = | 24.99 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 45.59 | x | 0.5 | x | 0.7 | = | 24.99 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 24.49 | x | 0.5 | x | 0.7 | = | 53.22 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 24.49 | x | 0.5 | x | 0.7 | = | 13.42 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 24.49 | x | 0.5 | x | 0.7 | = | 13.42 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 16.15 | x | 0.5 | x | 0.7 | = | 35.1 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 16.15 | x | 0.5 | x | 0.7 | = | 8.85 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 16.15 | x | 0.5 | x | 0.7 | = | 8.85 | (76) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 64.22 | 125.62 | 206.88 | 301.72 | 369.77 | 378.52 | 360.37 | 309.55 | 240.61 | 149.06 | 80.07 | 52.81 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 455.64 | 515.09 | 584.18 | 659.43 | 707.69 | 697.28 | 666.62 | 621.38 | 562.45 | 490.69 | 444.43 | 434.12 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.95 | 0.93 | 0.89 | 0.8 | 0.67 | 0.51 | 0.38 | 0.42 | 0.63 | 0.84 | 0.93 | 0.96 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.28 | 19.52 | 19.92 | 20.39 | 20.73 | 20.92 | 20.97 | 20.96 | 20.83 | 20.37 | 19.75 | 19.24 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.16 | 20.17 | 20.17 | 20.18 | 20.18 | 20.19 | 20.19 | 20.2 | 20.19 | 20.18 | 20.18 | 20.17 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.95 | 0.92 | 0.87 | 0.77 | 0.63 | 0.45 | 0.32 | 0.36 | 0.58 | 0.82 | 0.92 | 0.95 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.85 | 18.2 | 18.76 | 19.43 | 19.88 | 20.12 | 20.18 | 20.17 | 20.02 | 19.42 | 18.54 | 17.8 | (90) |

fLA = Living area ÷ (4) = 0.4 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.43 | 18.73 | 19.23 | 19.82 | 20.22 | 20.44 | 20.5 | 20.49 | 20.35 | 19.8 | 19.03 | 18.38 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.43 | 18.73 | 19.23 | 19.82 | 20.22 | 20.44 | 20.5 | 20.49 | 20.35 | 19.8 | 19.03 | 18.38 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.93 | 0.9 | 0.85 | 0.76 | 0.63 | 0.47 | 0.34 | 0.38 | 0.59 | 0.8 | 0.9 | 0.94 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 423.93 | 465.72 | 498.41 | 500.91 | 445.26 | 328.65 | 227.91 | 236.36 | 332.57 | 394.27 | 401.19 | 407.07 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 880.95 | 860.03 | 789.14 | 666.62 | 518.82 | 350.07 | 233.7 | 244.49 | 376.74 | 560.31 | 730.73 | 873.7 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 340.02 | 264.98 | 216.3 | 119.31 | 54.73 | 0 | 0 | 0 | 0 | 123.53 | 237.27 | 347.17 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1703.32 (98)

Space heating requirement in kWh/m²/year 24.71 (99)

## 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |

| **Space heating** | **kWh/year** |
|---|---|
| Annual space heating requirement | 1703.32 |

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| | | | |
|---|---|---|---|
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 894.24 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 894.24 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |

**Water heating**

| | | | |
|---|---|---|---|
| Annual water heating requirement | | 2018.46 | |
| If DHW from community scheme: Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1059.69 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1059.69 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 39.08 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside | | 225.16 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 225.16 | (331) |
| Energy for lighting (calculated in Appendix L) | | 309.61 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -420.73 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | | Energy kWh/year | Emission factor kg CO2/kWh | | Emissions kg CO2/year | |
|---|---|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP) | | | | | | |
| Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 91 | (367b) |
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.52 | = | 238.61 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.22 | = | 463.79 | (368) |
| Electrical energy for heat distribution | [(313) x | | 0.52 | = | 20.28 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | | = | 722.68 | (373) |
| CO2 associated with space heating (secondary) | (309) x | | 0 | = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | | 0.52 | = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | | 722.68 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | | 0.52 | = | 116.86 | (378) |
| CO2 associated with electricity for lighting | (332))) x | | 0.52 | = | 160.69 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable Item 1 | | 0.52 | | x 0.01 = | -218.36 | (380) |

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| | | | |
|---|---|---|---|
| **Total CO2, kg/year** | sum of (376)…(382) = | 781.87 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | 11.34 | (384) |
| **EI rating (section 14)** | | 90.8 | (385) |

# DER WorkSheet: New dwelling design stage

| User Details: | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

Property Address: A4

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 93.61 | (1a) x | 2.55 | (2a) = | 238.71 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 93.61 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 238.71 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.72 | x1/[1/( 1.2 )+ 0.04] | = | 5.4 | | | (27) |
| Windows Type 2 | | | 2.29 | x1/[1/( 1.2 )+ 0.04] | = | 2.62 | | | (27) |
| Windows Type 3 | | | 4.5 | x1/[1/( 1.2 )+ 0.04] | = | 5.15 | | | (27) |
| Windows Type 4 | | | 2.26 | x1/[1/( 1.2 )+ 0.04] | = | 2.59 | | | (27) |
| Floor | | | 21.67 | x 0.13 | = | 2.8171 | | | (28) |
| Walls Type1 | 87.82 | 23.07 | 64.75 | x 0.18 | = | 11.66 | | | (29) |
| Walls Type2 | 23.15 | 0 | 23.15 | x 0.23 | = | 5.26 | | | (29) |
| Total area of elements, m² | | | 132.64 | | | | | | (31) |
| Party wall | | | 5.94 | x 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 46.15 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 7166.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 14.04 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 60.19 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 25.07 | 24.82 | 24.57 | 23.32 | 23.07 | 21.81 | 21.81 | 21.56 | 22.31 | 23.07 | 23.57 | 24.07 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 85.26 | 85.01 | 84.76 | 83.5 | 83.25 | 82 | 82 | 81.75 | 82.5 | 83.25 | 83.76 | 84.26 | |

Average = Sum(39)$_{1…12}$ /12= 83.44 (39)

# DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.91 | 0.91 | 0.91 | 0.89 | 0.89 | 0.88 | 0.88 | 0.87 | 0.88 | 0.89 | 0.89 | 0.9 |

Average = Sum(40)$_{1…12}$ /12= 0.89 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.67 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 97.66 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | | |
| (44)m= | 107.43 | 103.52 | 99.61 | 95.71 | 91.8 | 87.89 | 87.89 | 91.8 | 95.71 | 99.61 | 103.52 | 107.43 | |
| Total = Sum(44)$_{1…12}$ = | | | | | | | | | | | | 1171.91 | (44) |
| *Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)* | | | | | | | | | | | | | |
| (45)m= | 159.31 | 139.33 | 143.78 | 125.35 | 120.28 | 103.79 | 96.18 | 110.36 | 111.68 | 130.15 | 142.07 | 154.28 | |
| Total = Sum(45)$_{1…12}$ = | | | | | | | | | | | | 1536.56 | (45) |
| *If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)* | | | | | | | | | | | | | |
| (46)m= | 23.9 | 20.9 | 21.57 | 18.8 | 18.04 | 15.57 | 14.43 | 16.55 | 16.75 | 19.52 | 21.31 | 23.14 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = — 110 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a — 1.03 (52)

Temperature factor from Table 2b — 0.6 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = — 1.03 (54)

Enter (50) or (54) in (55) — 1.03 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 214.59 | 189.26 | 199.06 | 178.84 | 175.55 | 157.28 | 151.45 | 165.64 | 165.18 | 185.43 | 195.57 | 209.56 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 214.59 | 189.26 | 199.06 | 178.84 | 175.55 | 157.28 | 151.45 | 165.64 | 165.18 | 185.43 | 195.57 | 209.56 | |

Output from water heater (annual)$_{1...12}$ 2187.4 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 97.19 | 86.27 | 92.03 | 84.47 | 84.21 | 77.3 | 76.2 | 80.92 | 79.93 | 87.5 | 90.03 | 95.52 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 133.6 | 133.6 | 133.6 | 133.6 | 133.6 | 133.6 | 133.6 | 133.6 | 133.6 | 133.6 | 133.6 | 133.6 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 21.89 | 19.44 | 15.81 | 11.97 | 8.95 | 7.56 | 8.16 | 10.61 | 14.24 | 18.08 | 21.11 | 22.5 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 245.56 | 248.11 | 241.69 | 228.02 | 210.76 | 194.55 | 183.71 | 181.16 | 187.58 | 201.25 | 218.51 | 234.73 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 36.36 | 36.36 | 36.36 | 36.36 | 36.36 | 36.36 | 36.36 | 36.36 | 36.36 | 36.36 | 36.36 | 36.36 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -106.88 | -106.88 | -106.88 | -106.88 | -106.88 | -106.88 | -106.88 | -106.88 | -106.88 | -106.88 | -106.88 | -106.88 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 130.63 | 128.38 | 123.69 | 117.32 | 113.19 | 107.37 | 102.42 | 108.76 | 111.01 | 117.6 | 125.05 | 128.39 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 461.17 | 459.02 | 444.28 | 420.4 | 395.98 | 372.55 | 357.37 | 363.61 | 375.92 | 400.02 | 427.75 | 448.7 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.5 | x | 19.64 | x | 0.5 | x | 0.7 | = | 21.44 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 19.64 | x | 0.5 | x | 0.7 | = | 10.77 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 38.42 | x | 0.5 | x | 0.7 | = | 41.94 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 38.42 | x | 0.5 | x | 0.7 | = | 21.06 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 63.27 | x | 0.5 | x | 0.7 | = | 69.06 | (76) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 2.26 | x | 63.27 | x | 0.5 | x | 0.7 | = | 34.68 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 92.28 | x | 0.5 | x | 0.7 | = | 100.72 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 92.28 | x | 0.5 | x | 0.7 | = | 50.58 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 113.09 | x | 0.5 | x | 0.7 | = | 123.44 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 113.09 | x | 0.5 | x | 0.7 | = | 61.99 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 115.77 | x | 0.5 | x | 0.7 | = | 126.36 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 115.77 | x | 0.5 | x | 0.7 | = | 63.46 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 110.22 | x | 0.5 | x | 0.7 | = | 120.3 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 110.22 | x | 0.5 | x | 0.7 | = | 60.42 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 94.68 | x | 0.5 | x | 0.7 | = | 103.34 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 94.68 | x | 0.5 | x | 0.7 | = | 51.9 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 73.59 | x | 0.5 | x | 0.7 | = | 80.32 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 73.59 | x | 0.5 | x | 0.7 | = | 40.34 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 45.59 | x | 0.5 | x | 0.7 | = | 49.76 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 45.59 | x | 0.5 | x | 0.7 | = | 24.99 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 24.49 | x | 0.5 | x | 0.7 | = | 26.73 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 24.49 | x | 0.5 | x | 0.7 | = | 13.42 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 16.15 | x | 0.5 | x | 0.7 | = | 17.63 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 16.15 | x | 0.5 | x | 0.7 | = | 8.85 | (76) |
| West | 0.9x | 0.77 | x | 4.72 | x | 19.64 | x | 0.5 | x | 0.7 | = | 44.97 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 19.64 | x | 0.5 | x | 0.7 | = | 32.73 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 38.42 | x | 0.5 | x | 0.7 | = | 87.97 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 38.42 | x | 0.5 | x | 0.7 | = | 64.02 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 63.27 | x | 0.5 | x | 0.7 | = | 144.87 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 63.27 | x | 0.5 | x | 0.7 | = | 105.43 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 92.28 | x | 0.5 | x | 0.7 | = | 211.29 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 92.28 | x | 0.5 | x | 0.7 | = | 153.77 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 113.09 | x | 0.5 | x | 0.7 | = | 258.95 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 113.09 | x | 0.5 | x | 0.7 | = | 188.45 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 115.77 | x | 0.5 | x | 0.7 | = | 265.08 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 115.77 | x | 0.5 | x | 0.7 | = | 192.91 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 110.22 | x | 0.5 | x | 0.7 | = | 252.36 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 110.22 | x | 0.5 | x | 0.7 | = | 183.66 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 94.68 | x | 0.5 | x | 0.7 | = | 216.78 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 94.68 | x | 0.5 | x | 0.7 | = | 157.76 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 73.59 | x | 0.5 | x | 0.7 | = | 168.5 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 73.59 | x | 0.5 | x | 0.7 | = | 122.62 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 45.59 | x | 0.5 | x | 0.7 | = | 104.38 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 45.59 | x | 0.5 | x | 0.7 | = | 75.97 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 24.49 | x | 0.5 | x | 0.7 | = | 56.07 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 24.49 | x | 0.5 | x | 0.7 | = | 40.81 | (80) |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 4.72 | x | 16.15 | x | 0.5 | x | 0.7 | = | 36.98 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 16.15 | x | 0.5 | x | 0.7 | = | 26.91 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 109.9 | 214.99 | 354.05 | 516.37 | 632.82 | 647.81 | 616.74 | 529.77 | 411.78 | 255.1 | 137.03 | 90.38 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 571.07 | 674 | 798.33 | 936.76 | 1028.81 | 1020.36 | 974.11 | 893.38 | 787.7 | 655.12 | 564.78 | 539.07 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.96 | 0.94 | 0.89 | 0.78 | 0.64 | 0.48 | 0.36 | 0.4 | 0.62 | 0.85 | 0.94 | 0.97 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.18 | 19.47 | 19.91 | 20.42 | 20.76 | 20.93 | 20.98 | 20.97 | 20.84 | 20.35 | 19.68 | 19.13 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.16 | 20.16 | 20.16 | 20.17 | 20.18 | 20.19 | 20.19 | 20.19 | 20.18 | 20.18 | 20.17 | 20.17 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.96 | 0.93 | 0.87 | 0.76 | 0.6 | 0.43 | 0.3 | 0.34 | 0.57 | 0.82 | 0.93 | 0.96 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.7 | 18.11 | 18.75 | 19.46 | 19.91 | 20.12 | 20.17 | 20.17 | 20.02 | 19.38 | 18.43 | 17.64 | (90) |

fLA = Living area ÷ (4) = 0.32 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.17 | 18.55 | 19.12 | 19.77 | 20.18 | 20.38 | 20.43 | 20.42 | 20.28 | 19.69 | 18.83 | 18.12 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.17 | 18.55 | 19.12 | 19.77 | 20.18 | 20.38 | 20.43 | 20.42 | 20.28 | 19.69 | 18.83 | 18.12 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.94 | 0.91 | 0.85 | 0.74 | 0.6 | 0.44 | 0.32 | 0.36 | 0.58 | 0.81 | 0.91 | 0.95 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 536.81 | 612.96 | 678.61 | 695.54 | 617.43 | 449.52 | 307.71 | 319.52 | 453.74 | 528.42 | 515.71 | 510.79 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1182.92 | 1160 | 1069.8 | 907.36 | 705.75 | 473.84 | 314.04 | 328.86 | 509.81 | 757 | 982.19 | 1172.45 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 480.7 | 367.61 | 291.04 | 152.51 | 65.71 | 0 | 0 | 0 | 0 | 170.06 | 335.86 | 492.27 | |

Total per year (kWh/year) = Sum(98)1...5,9...12 = 2355.77 (98)

Space heating requirement in kWh/m²/year 25.17 (99)

## 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

# DER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |

| **Space heating** | | **kWh/year** | |
|---|---|---|---|
| Annual space heating requirement | | 2355.77 | |
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 1236.78 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 1236.78 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |

| **Water heating** | | | |
|---|---|---|---|
| Annual water heating requirement | | 2187.4 | |
| If DHW from community scheme:<br>Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1148.39 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1148.39 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 47.7 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f):<br>mechanical ventilation - balanced, extract or positive input from outside | | 305.78 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 305.78 | (331) |
| Energy for lighting (calculated in Appendix L) | | 386.62 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -571.4 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | **Energy kWh/year** | **Emission factor kg CO2/kWh** | **Emissions kg CO2/year** | |
|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP)<br>Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | 91 | (367b) |

# DER WorkSheet: New dwelling design stage

| | | | | | |
|---|---|---|---|---|---|
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | 0.52 | = | 291.27 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | 0.22 | = | 566.15 | (368) |
| Electrical energy for heat distribution | [(313) x | 0.52 | = | 24.76 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | = | 882.18 | (373) |
| CO2 associated with space heating (secondary) | (309) x | 0 | = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | 0.52 | = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | 882.18 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | 0.52 | = | 158.7 | (378) |
| CO2 associated with electricity for lighting | (332))) x | 0.52 | = | 200.66 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable<br>Item 1 | | 0.52 | x 0.01 = | -296.56 | (380) |
| **Total CO2, kg/year** | sum of (376)…(382) = | | | 944.98 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | | | 10.09 | (384) |
| **EI rating (section 14)** | | | | 90.86 | (385) |

# DER WorkSheet: New dwelling design stage

**User Details:**

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

**Property Address: A5**

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 94.43 | (1a) x | 2.55 | (2a) = | 240.8 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 94.43 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 240.8 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 2.26 | x1/[1/( 1.2 )+ 0.04] | | = | 2.59 | | | (27) |
| Windows Type 2 | | | 8.96 | x1/[1/( 1.2 )+ 0.04] | | = | 10.26 | | | (27) |
| Windows Type 3 | | | 4.5 | x1/[1/( 1.2 )+ 0.04] | | = | 5.15 | | | (27) |
| Windows Type 4 | | | 2.26 | x1/[1/( 1.2 )+ 0.04] | | = | 2.59 | | | (27) |
| Floor | | | 9.17 | x | 0.13 | = | 1.1921 | | | (28) |
| Walls Type1 | 91.51 | 27 | 64.51 | x | 0.18 | = | 11.61 | | | (29) |
| Walls Type2 | 15.93 | 0 | 15.93 | x | 0.23 | = | 3.62 | | | (29) |
| Roof | 17.06 | 0 | 17.06 | x | 0.13 | = | 2.22 | | | (30) |
| Total area of elements, m² | | | 133.67 | | | | | | | (31) |
| Party wall | | | 5.86 | x | 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 49.56 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 5931.39 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 15.87 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 65.42 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 25.29 | 25.04 | 24.79 | 23.52 | 23.27 | 22 | 22 | 21.75 | 22.51 | 23.27 | 23.77 | 24.28 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 90.72 | 90.46 | 90.21 | 88.94 | 88.69 | 87.43 | 87.43 | 87.17 | 87.93 | 88.69 | 89.2 | 89.7 | |

Average = $Sum(39)_{1...12}$ /12= 88.88 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.96 | 0.96 | 0.96 | 0.94 | 0.94 | 0.93 | 0.93 | 0.92 | 0.93 | 0.94 | 0.94 | 0.95 | |

Average = $Sum(40)_{1...12}$ /12= 0.94 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 97.89 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 107.68 | 103.76 | 99.85 | 95.93 | 92.02 | 88.1 | 88.1 | 92.02 | 95.93 | 99.85 | 103.76 | 107.68 |

Total = $Sum(44)_{1...12}$ = 1174.67 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 159.68 | 139.66 | 144.12 | 125.64 | 120.56 | 104.03 | 96.4 | 110.62 | 111.94 | 130.46 | 142.41 | 154.64 |

Total = $Sum(45)_{1...12}$ = 1540.17 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 23.95 | 20.95 | 21.62 | 18.85 | 18.08 | 15.6 | 14.46 | 16.59 | 16.79 | 19.57 | 21.36 | 23.2 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

# DER WorkSheet: New dwelling design stage

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 214.96 | 189.59 | 199.39 | 179.14 | 175.84 | 157.53 | 151.68 | 165.9 | 165.44 | 185.74 | 195.9 | 209.92 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 214.96 | 189.59 | 199.39 | 179.14 | 175.84 | 157.53 | 151.68 | 165.9 | 165.44 | 185.74 | 195.9 | 209.92 |

Output from water heater (annual)$_{1...12}$ | 2191.01 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 97.32 | 86.38 | 92.14 | 84.57 | 84.31 | 77.39 | 76.28 | 81 | 80.02 | 87.6 | 90.15 | 95.64 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 134.08 | 134.08 | 134.08 | 134.08 | 134.08 | 134.08 | 134.08 | 134.08 | 134.08 | 134.08 | 134.08 | 134.08 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 22.02 | 19.56 | 15.91 | 12.04 | 9 | 7.6 | 8.21 | 10.67 | 14.33 | 18.19 | 21.23 | 22.63 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 247 | 249.56 | 243.1 | 229.35 | 211.99 | 195.68 | 184.78 | 182.22 | 188.68 | 202.43 | 219.78 | 236.1 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 36.41 | 36.41 | 36.41 | 36.41 | 36.41 | 36.41 | 36.41 | 36.41 | 36.41 | 36.41 | 36.41 | 36.41 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -107.27 | -107.27 | -107.27 | -107.27 | -107.27 | -107.27 | -107.27 | -107.27 | -107.27 | -107.27 | -107.27 | -107.27 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 130.8 | 128.54 | 123.84 | 117.46 | 113.32 | 107.48 | 102.52 | 108.88 | 111.13 | 117.74 | 125.2 | 128.55 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 463.04 | 460.88 | 446.07 | 422.08 | 397.54 | 373.98 | 358.74 | 364.99 | 377.36 | 401.58 | 429.44 | 450.5 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 2 | x | 2.26 | x | 19.64 | x | 0.5 | x | 0.7 | = | 21.53 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 19.64 | x | 0.5 | x | 0.7 | = | 42.68 | (76) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 2 | x | 2.26 | x | 38.42 | x | 0.5 | x | 0.7 | = | 42.12 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 38.42 | x | 0.5 | x | 0.7 | = | 83.5 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 63.27 | x | 0.5 | x | 0.7 | = | 69.37 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 63.27 | x | 0.5 | x | 0.7 | = | 137.51 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 92.28 | x | 0.5 | x | 0.7 | = | 101.17 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 92.28 | x | 0.5 | x | 0.7 | = | 200.55 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 113.09 | x | 0.5 | x | 0.7 | = | 123.99 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 113.09 | x | 0.5 | x | 0.7 | = | 245.78 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 115.77 | x | 0.5 | x | 0.7 | = | 126.92 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 115.77 | x | 0.5 | x | 0.7 | = | 251.6 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 110.22 | x | 0.5 | x | 0.7 | = | 120.84 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 110.22 | x | 0.5 | x | 0.7 | = | 239.53 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 94.68 | x | 0.5 | x | 0.7 | = | 103.8 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 94.68 | x | 0.5 | x | 0.7 | = | 205.75 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 73.59 | x | 0.5 | x | 0.7 | = | 80.68 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 73.59 | x | 0.5 | x | 0.7 | = | 159.93 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 45.59 | x | 0.5 | x | 0.7 | = | 49.98 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 45.59 | x | 0.5 | x | 0.7 | = | 99.08 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 24.49 | x | 0.5 | x | 0.7 | = | 26.85 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 24.49 | x | 0.5 | x | 0.7 | = | 53.22 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 16.15 | x | 0.5 | x | 0.7 | = | 17.71 | (76) |
| East | 0.9x | 1 | x | 8.96 | x | 16.15 | x | 0.5 | x | 0.7 | = | 35.1 | (76) |
| South | 0.9x | 0.54 | x | 4.5 | x | 46.75 | x | 0.5 | x | 0.7 | = | 71.57 | (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 46.75 | x | 0.5 | x | 0.7 | = | 35.95 | (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 76.57 | x | 0.5 | x | 0.7 | = | 117.22 | (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 76.57 | x | 0.5 | x | 0.7 | = | 58.87 | (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 97.53 | x | 0.5 | x | 0.7 | = | 149.31 | (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 97.53 | x | 0.5 | x | 0.7 | = | 74.99 | (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 110.23 | x | 0.5 | x | 0.7 | = | 168.76 | (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 110.23 | x | 0.5 | x | 0.7 | = | 84.75 | (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 114.87 | x | 0.5 | x | 0.7 | = | 175.86 | (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 114.87 | x | 0.5 | x | 0.7 | = | 88.32 | (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 110.55 | x | 0.5 | x | 0.7 | = | 169.24 | (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 110.55 | x | 0.5 | x | 0.7 | = | 84.99 | (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 108.01 | x | 0.5 | x | 0.7 | = | 165.36 | (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 108.01 | x | 0.5 | x | 0.7 | = | 83.05 | (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 104.89 | x | 0.5 | x | 0.7 | = | 160.58 | (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 104.89 | x | 0.5 | x | 0.7 | = | 80.65 | (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 101.89 | x | 0.5 | x | 0.7 | = | 155.98 | (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 101.89 | x | 0.5 | x | 0.7 | = | 78.33 | (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 82.59 | x | 0.5 | x | 0.7 | = | 126.43 | (78) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South | 0.9x | 0.54 | x | 2.26 | x | 82.59 | x | 0.5 | x | 0.7 | = | 63.5 | (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 55.42 | x | 0.5 | x | 0.7 | = | 84.84 | (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 55.42 | x | 0.5 | x | 0.7 | = | 42.61 | (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 40.4 | x | 0.5 | x | 0.7 | = | 61.85 | (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 40.4 | x | 0.5 | x | 0.7 | = | 31.06 | (78) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 171.73 | 301.71 | 431.18 | 555.23 | 633.94 | 632.75 | 608.77 | 550.78 | 474.92 | 338.98 | 207.51 | 145.71 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 634.78 | 762.59 | 877.25 | 977.31 | 1031.48 | 1006.74 | 967.51 | 915.77 | 852.28 | 740.57 | 636.96 | 596.22 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.95 | 0.92 | 0.87 | 0.78 | 0.66 | 0.51 | 0.38 | 0.42 | 0.61 | 0.82 | 0.93 | 0.96 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.16 | 19.47 | 19.9 | 20.37 | 20.71 | 20.9 | 20.97 | 20.96 | 20.83 | 20.36 | 19.68 | 19.1 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.12 | 20.12 | 20.12 | 20.13 | 20.13 | 20.15 | 20.15 | 20.15 | 20.14 | 20.13 | 20.13 | 20.13 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.95 | 0.91 | 0.86 | 0.76 | 0.62 | 0.45 | 0.31 | 0.35 | 0.56 | 0.8 | 0.92 | 0.95 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.64 | 18.1 | 18.7 | 19.36 | 19.81 | 20.06 | 20.12 | 20.12 | 19.97 | 19.37 | 18.4 | 17.57 | (90) |

fLA = Living area ÷ (4) = 0.3 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.1 | 18.51 | 19.06 | 19.66 | 20.08 | 20.31 | 20.38 | 20.37 | 20.23 | 19.67 | 18.79 | 18.03 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.1 | 18.51 | 19.06 | 19.66 | 20.08 | 20.31 | 20.38 | 20.37 | 20.23 | 19.67 | 18.79 | 18.03 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.93 | 0.89 | 0.83 | 0.74 | 0.62 | 0.46 | 0.33 | 0.37 | 0.56 | 0.78 | 0.89 | 0.94 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 588.75 | 678.67 | 730.25 | 723.23 | 635.43 | 466.77 | 321.73 | 334.58 | 478.91 | 576.34 | 569.81 | 558.46 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1252.11 | 1231.65 | 1133.28 | 957.17 | 743.12 | 499.48 | 330.53 | 346.41 | 538.9 | 804.35 | 1042.68 | 1240.69 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 493.54 | 371.61 | 299.86 | 168.44 | 80.12 | 0 | 0 | 0 | 0 | 169.64 | 340.47 | 507.58 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2431.26 (98)

Space heating requirement in kWh/m²/year 25.75 (99)

# DER WorkSheet: New dwelling design stage

## 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |
| **Space heating** | | **kWh/year** | |
| Annual space heating requirement | | 2431.26 | |
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 1276.41 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 1276.41 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |
| **Water heating** | | | |
| Annual water heating requirement | | 2191.01 | |
| If DHW from community scheme: Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1150.28 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1150.28 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 48.53 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside | | 308.46 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 308.46 | (331) |
| Energy for lighting (calculated in Appendix L) | | 388.88 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -576.34 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP) | | | | |
| Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | 425 | (367a) |

# DER WorkSheet: New dwelling design stage

| | | | | | |
|---|---|---|---|---|---|
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | 91 | (367b) |
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | 0.52 | = | 296.34 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | 0.22 | = | 576.01 | (368) |
| Electrical energy for heat distribution | [(313) x | 0.52 | = | 25.19 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | = | 897.54 | (373) |
| CO2 associated with space heating (secondary) | (309) x | 0 | = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | 0.52 | = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | 897.54 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | 0.52 | = | 160.09 | (378) |
| CO2 associated with electricity for lighting | (332))) x | 0.52 | = | 201.83 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable<br>Item 1 | | 0.52 | x 0.01 = | -299.12 | (380) |
| **Total CO2, kg/year** | sum of (376)…(382) = | | | 960.33 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | | | 10.17 | (384) |
| **EI rating (section 14)** | | | | 90.77 | (385) |

# DER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: A6

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 92.1 | (1a) x | 2.55 | (2a) = | 234.85 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 92.1 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 234.85 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

| | | | Air changes per hour | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

Wind Factor (22a)m = (22)m ÷ 4

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.72 | x1/[1/( 1.2 )+ 0.04] | | = | 5.4 | | | (27) |
| Windows Type 2 | | | 2.29 | x1/[1/( 1.2 )+ 0.04] | | = | 2.62 | | | (27) |
| Windows Type 3 | | | 4.5 | x1/[1/( 1.2 )+ 0.04] | | = | 5.15 | | | (27) |
| Windows Type 4 | | | 2.26 | x1/[1/( 1.2 )+ 0.04] | | = | 2.59 | | | (27) |
| Walls Type1 | 92.13 | 25.33 | 66.8 | x | 0.18 | = | 12.02 | | | (29) |
| Walls Type2 | 21.51 | 0 | 21.51 | x | 0.23 | = | 4.89 | | | (29) |
| Roof | 15.3 | 0 | 15.3 | x | 0.13 | = | 1.99 | | | (30) |
| Total area of elements, m² | | | 128.94 | | | | | | | (31) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 47.91 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 5436.3 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 16.33 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 64.24 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 24.67 | 24.42 | 24.18 | 22.94 | 22.69 | 21.46 | 21.46 | 21.21 | 21.95 | 22.69 | 23.19 | 23.68 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 88.91 | 88.66 | 88.41 | 87.18 | 86.93 | 85.69 | 85.69 | 85.45 | 86.19 | 86.93 | 87.42 | 87.92 | |

Average = Sum(39)1…12 /12= 87.12 (39)

# DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.97 | 0.96 | 0.96 | 0.95 | 0.94 | 0.93 | 0.93 | 0.93 | 0.94 | 0.94 | 0.95 | 0.95 |

Average = Sum(40)$_{1…12}$ /12= 0.95 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.65 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 97.22 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | | |
| (44)m= | 106.94 | 103.05 | 99.16 | 95.27 | 91.38 | 87.5 | 87.5 | 91.38 | 95.27 | 99.16 | 103.05 | 106.94 | |
| Total = Sum(44)$_{1…12}$ = | | | | | | | | | | | | 1166.62 | (44) |
| *Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)* | | | | | | | | | | | | | |
| (45)m= | 158.59 | 138.7 | 143.13 | 124.78 | 119.73 | 103.32 | 95.74 | 109.86 | 111.18 | 129.57 | 141.43 | 153.58 | |
| Total = Sum(45)$_{1…12}$ = | | | | | | | | | | | | 1529.62 | (45) |
| *If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)* | | | | | | | | | | | | | |
| (46)m= | 23.79 | 20.81 | 21.47 | 18.72 | 17.96 | 15.5 | 14.36 | 16.48 | 16.68 | 19.43 | 21.21 | 23.04 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 110 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a — 1.03 (52)

Temperature factor from Table 2b — 0.6 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) — 1.03 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

# DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 213.87 | 188.63 | 198.41 | 178.28 | 175.01 | 156.81 | 151.02 | 165.14 | 164.67 | 184.84 | 194.92 | 208.86 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 213.87 | 188.63 | 198.41 | 178.28 | 175.01 | 156.81 | 151.02 | 165.14 | 164.67 | 184.84 | 194.92 | 208.86 | |

Output from water heater (annual)$_{1…12}$ 2180.46 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 96.95 | 86.06 | 91.81 | 84.29 | 84.03 | 77.15 | 76.06 | 80.75 | 79.76 | 87.3 | 89.82 | 95.29 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 132.67 | 132.67 | 132.67 | 132.67 | 132.67 | 132.67 | 132.67 | 132.67 | 132.67 | 132.67 | 132.67 | 132.67 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 21.65 | 19.23 | 15.64 | 11.84 | 8.85 | 7.47 | 8.07 | 10.5 | 14.09 | 17.89 | 20.88 | 22.26 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 242.89 | 245.41 | 239.06 | 225.54 | 208.47 | 192.43 | 181.71 | 179.19 | 185.54 | 199.06 | 216.13 | 232.17 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 36.27 | 36.27 | 36.27 | 36.27 | 36.27 | 36.27 | 36.27 | 36.27 | 36.27 | 36.27 | 36.27 | 36.27 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -106.14 | -106.14 | -106.14 | -106.14 | -106.14 | -106.14 | -106.14 | -106.14 | -106.14 | -106.14 | -106.14 | -106.14 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 130.31 | 128.07 | 123.4 | 117.06 | 112.95 | 107.15 | 102.22 | 108.54 | 110.78 | 117.34 | 124.75 | 128.08 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 457.66 | 455.51 | 440.9 | 417.24 | 393.07 | 369.85 | 354.81 | 361.02 | 373.21 | 397.09 | 424.56 | 445.3 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.5 | x | 19.64 | x | 0.5 | x | 0.7 | = | 21.44 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 19.64 | x | 0.5 | x | 0.7 | = | 21.53 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 38.42 | x | 0.5 | x | 0.7 | = | 41.94 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 38.42 | x | 0.5 | x | 0.7 | = | 42.12 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 63.27 | x | 0.5 | x | 0.7 | = | 69.06 | (76) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 2 | x | 2.26 | x | 63.27 | x | 0.5 | x | 0.7 | = | 69.37 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 92.28 | x | 0.5 | x | 0.7 | = | 100.72 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 92.28 | x | 0.5 | x | 0.7 | = | 101.17 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 113.09 | x | 0.5 | x | 0.7 | = | 123.44 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 113.09 | x | 0.5 | x | 0.7 | = | 123.99 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 115.77 | x | 0.5 | x | 0.7 | = | 126.36 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 115.77 | x | 0.5 | x | 0.7 | = | 126.92 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 110.22 | x | 0.5 | x | 0.7 | = | 120.3 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 110.22 | x | 0.5 | x | 0.7 | = | 120.84 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 94.68 | x | 0.5 | x | 0.7 | = | 103.34 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 94.68 | x | 0.5 | x | 0.7 | = | 103.8 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 73.59 | x | 0.5 | x | 0.7 | = | 80.32 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 73.59 | x | 0.5 | x | 0.7 | = | 80.68 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 45.59 | x | 0.5 | x | 0.7 | = | 49.76 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 45.59 | x | 0.5 | x | 0.7 | = | 49.98 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 24.49 | x | 0.5 | x | 0.7 | = | 26.73 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 24.49 | x | 0.5 | x | 0.7 | = | 26.85 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 16.15 | x | 0.5 | x | 0.7 | = | 17.63 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 16.15 | x | 0.5 | x | 0.7 | = | 17.71 | (76) |
| West | 0.9x | 0.77 | x | 4.72 | x | 19.64 | x | 0.5 | x | 0.7 | = | 44.97 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 19.64 | x | 0.5 | x | 0.7 | = | 32.73 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 38.42 | x | 0.5 | x | 0.7 | = | 87.97 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 38.42 | x | 0.5 | x | 0.7 | = | 64.02 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 63.27 | x | 0.5 | x | 0.7 | = | 144.87 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 63.27 | x | 0.5 | x | 0.7 | = | 105.43 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 92.28 | x | 0.5 | x | 0.7 | = | 211.29 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 92.28 | x | 0.5 | x | 0.7 | = | 153.77 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 113.09 | x | 0.5 | x | 0.7 | = | 258.95 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 113.09 | x | 0.5 | x | 0.7 | = | 188.45 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 115.77 | x | 0.5 | x | 0.7 | = | 265.08 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 115.77 | x | 0.5 | x | 0.7 | = | 192.91 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 110.22 | x | 0.5 | x | 0.7 | = | 252.36 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 110.22 | x | 0.5 | x | 0.7 | = | 183.66 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 94.68 | x | 0.5 | x | 0.7 | = | 216.78 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 94.68 | x | 0.5 | x | 0.7 | = | 157.76 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 73.59 | x | 0.5 | x | 0.7 | = | 168.5 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 73.59 | x | 0.5 | x | 0.7 | = | 122.62 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 45.59 | x | 0.5 | x | 0.7 | = | 104.38 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 45.59 | x | 0.5 | x | 0.7 | = | 75.97 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 24.49 | x | 0.5 | x | 0.7 | = | 56.07 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 24.49 | x | 0.5 | x | 0.7 | = | 40.81 | (80) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 4.72 | x | 16.15 | x | 0.5 | x | 0.7 | = | 36.98 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 16.15 | x | 0.5 | x | 0.7 | = | 26.91 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 120.67 | 236.05 | 388.74 | 566.95 | 694.82 | 711.27 | 677.16 | 581.67 | 452.12 | 280.09 | 150.46 | 99.23 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 578.32 | 691.56 | 829.64 | 984.19 | 1087.89 | 1081.12 | 1031.97 | 942.69 | 825.32 | 677.18 | 575.01 | 544.53 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.96 | 0.93 | 0.88 | 0.77 | 0.63 | 0.47 | 0.35 | 0.4 | 0.62 | 0.84 | 0.94 | 0.97 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.07 | 19.38 | 19.85 | 20.39 | 20.74 | 20.92 | 20.97 | 20.96 | 20.82 | 20.3 | 19.59 | 19.02 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.11 | 20.11 | 20.12 | 20.13 | 20.13 | 20.14 | 20.14 | 20.14 | 20.14 | 20.13 | 20.13 | 20.12 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.95 | 0.93 | 0.86 | 0.75 | 0.59 | 0.42 | 0.29 | 0.33 | 0.56 | 0.82 | 0.93 | 0.96 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.52 | 17.96 | 18.64 | 19.38 | 19.84 | 20.07 | 20.12 | 20.12 | 19.96 | 19.29 | 18.28 | 17.45 | (90) |

fLA = Living area ÷ (4) = 0.33 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.03 | 18.43 | 19.04 | 19.71 | 20.14 | 20.35 | 20.4 | 20.4 | 20.24 | 19.62 | 18.71 | 17.97 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.03 | 18.43 | 19.04 | 19.71 | 20.14 | 20.35 | 20.4 | 20.4 | 20.24 | 19.62 | 18.71 | 17.97 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.94 | 0.9 | 0.84 | 0.73 | 0.59 | 0.43 | 0.31 | 0.35 | 0.57 | 0.8 | 0.91 | 0.95 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 541.99 | 625.39 | 698.21 | 719.24 | 639.45 | 465.94 | 318.84 | 330.92 | 468.43 | 541.5 | 522.91 | 514.63 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1220.86 | 1199.35 | 1108.37 | 942.35 | 733.55 | 492.68 | 326.03 | 341.49 | 529.44 | 784.4 | 1015.18 | 1210.4 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 505.08 | 385.7 | 305.16 | 160.64 | 70.01 | 0 | 0 | 0 | 0 | 180.72 | 354.43 | 517.65 | |

Total per year (kWh/year) = Sum(98)$_{1…5,9…12}$ = 2479.4 (98)

Space heating requirement in kWh/m²/year 26.92 (99)

## 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

# DER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |
| **Space heating** | | **kWh/year** | |
| Annual space heating requirement | | 2479.4 | |
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 1301.68 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 1301.68 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |
| **Water heating** | | | |
| Annual water heating requirement | | 2180.46 | |
| If DHW from community scheme:<br>Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1144.74 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1144.74 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 48.93 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f):<br>mechanical ventilation - balanced, extract or positive input from outside | | 300.85 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 300.85 | (331) |
| Energy for lighting (calculated in Appendix L) | | 382.41 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -562.35 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP)<br>Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | 91 | (367b) |

# DER WorkSheet: New dwelling design stage

| | | | | | |
|---|---|---|---|---|---|
| $CO_2$ associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | 0.52 | = | 298.75 | (367) |
| $CO_2$ associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | 0.22 | = | 580.69 | (368) |
| Electrical energy for heat distribution | [(313) x | 0.52 | = | 25.39 | (372) |
| Total $CO_2$ associated with community systems | (363)…(366) + (368)...(372) | | = | 904.84 | (373) |
| $CO_2$ associated with space heating (secondary) | (309) x | 0 | = | 0 | (374) |
| $CO_2$ associated with water from immersion heater or instantaneous heater | (312) x | 0.52 | = | 0 | (375) |
| Total $CO_2$ associated with space and water heating | (373) + (374) + (375) = | | | 904.84 | (376) |
| $CO_2$ associated with electricity for pumps and fans within dwelling | (331)) x | 0.52 | = | 156.14 | (378) |
| $CO_2$ associated with electricity for lighting | (332))) x | 0.52 | = | 198.47 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable<br>Item 1 | | 0.52 | x 0.01 = | -291.86 | (380) |
| **Total $CO_2$, kg/year** | sum of (376)…(382) = | | | 967.59 | (383) |
| **Dwelling $CO_2$ Emission Rate** | (383) ÷ (4) = | | | 10.51 | (384) |
| **EI rating (section 14)** | | | | 90.54 | (385) |

# DER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: A7

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 77.46 | (1a) | x | 2.55 | (2a) | = | 197.52 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 77.46 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | | = | 197.52 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Monthly average wind speed from Table 7

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

Wind Factor (22a)m = (22)m ÷ 4

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 8.96 | x1/[1/( 1.2 )+ 0.04] | | = | 10.26 | | | (27) |
| Windows Type 2 | | | 4.5 | x1/[1/( 1.2 )+ 0.04] | | = | 5.15 | | | (27) |
| Windows Type 3 | | | 2.26 | x1/[1/( 1.2 )+ 0.04] | | = | 2.59 | | | (27) |
| Walls Type1 | 83.91 | 17.98 | 65.93 | x | 0.18 | = | 11.87 | | | (29) |
| Walls Type2 | 14.15 | 0 | 14.15 | x | 0.23 | = | 3.22 | | | (29) |
| Roof | 77.46 | 0 | 77.46 | x | 0.13 | = | 10.07 | | | (30) |
| Total area of elements, m² | | | 175.52 | | | | | | | (31) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 45.74 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 5501.94 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 17.44 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 63.18 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 20.75 | 20.54 | 20.33 | 19.29 | 19.09 | 18.05 | 18.05 | 17.84 | 18.46 | 19.09 | 19.5 | 19.92 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 83.93 | 83.72 | 83.51 | 82.48 | 82.27 | 81.23 | 81.23 | 81.02 | 81.64 | 82.27 | 82.68 | 83.1 | |

Average = Sum(39)$_{1…12}$ /12= 82.42 (39)

# DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.08 | 1.08 | 1.08 | 1.06 | 1.06 | 1.05 | 1.05 | 1.05 | 1.05 | 1.06 | 1.07 | 1.07 |

Average = Sum(40)$_{1…12}$ /12= 1.06 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.41 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 91.51 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | | |
| (44)m= | 100.66 | 97 | 93.34 | 89.68 | 86.02 | 82.36 | 82.36 | 86.02 | 89.68 | 93.34 | 97 | 100.66 | |
| | | | | | | | | | | Total = Sum(44)$_{1…12}$ = | | 1098.08 | (44) |
| *Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)* | | | | | | | | | | | | | |
| (45)m= | 149.27 | 130.55 | 134.72 | 117.45 | 112.7 | 97.25 | 90.12 | 103.41 | 104.64 | 121.95 | 133.12 | 144.56 | |
| | | | | | | | | | | Total = Sum(45)$_{1…12}$ = | | 1439.75 | (45) |
| *If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)* | | | | | | | | | | | | | |
| (46)m= | 22.39 | 19.58 | 20.21 | 17.62 | 16.9 | 14.59 | 13.52 | 15.51 | 15.7 | 18.29 | 19.97 | 21.68 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 204.55 | 180.48 | 190 | 170.95 | 167.97 | 150.74 | 145.39 | 158.69 | 158.14 | 177.23 | 186.62 | 199.84 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 204.55 | 180.48 | 190 | 170.95 | 167.97 | 150.74 | 145.39 | 158.69 | 158.14 | 177.23 | 186.62 | 199.84 |

Output from water heater (annual)$_{1...12}$ 2090.59 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 93.85 | 83.35 | 89.02 | 81.85 | 81.69 | 75.13 | 74.19 | 78.61 | 77.59 | 84.77 | 87.06 | 92.29 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 120.64 | 120.64 | 120.64 | 120.64 | 120.64 | 120.64 | 120.64 | 120.64 | 120.64 | 120.64 | 120.64 | 120.64 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 19.14 | 17 | 13.82 | 10.47 | 7.82 | 6.6 | 7.14 | 9.28 | 12.45 | 15.81 | 18.45 | 19.67 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 214.05 | 216.27 | 210.67 | 198.76 | 183.72 | 169.58 | 160.13 | 157.91 | 163.51 | 175.43 | 190.47 | 204.61 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 35.06 | 35.06 | 35.06 | 35.06 | 35.06 | 35.06 | 35.06 | 35.06 | 35.06 | 35.06 | 35.06 | 35.06 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -96.52 | -96.52 | -96.52 | -96.52 | -96.52 | -96.52 | -96.52 | -96.52 | -96.52 | -96.52 | -96.52 | -96.52 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 126.15 | 124.03 | 119.64 | 113.68 | 109.8 | 104.35 | 99.71 | 105.65 | 107.76 | 113.94 | 120.91 | 124.04 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 418.53 | 416.5 | 403.34 | 382.09 | 360.54 | 339.73 | 326.18 | 332.04 | 342.92 | 364.37 | 389.03 | 407.51 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South | 0.9x | 0.54 | x | 4.5 | x | 46.75 | x | 0.5 | x | 0.7 | = | 35.79 | (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 46.75 | x | 0.5 | x | 0.7 | = | 35.95 | (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 76.57 | x | 0.5 | x | 0.7 | = | 58.61 | (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 76.57 | x | 0.5 | x | 0.7 | = | 58.87 | (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 97.53 | x | 0.5 | x | 0.7 | = | 74.66 | (78) |

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| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South | 0.9x | 0.54 | x | 2.26 | x | 97.53 | x | 0.5 | x | 0.7 | = | 74.99 | (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 110.23 | x | 0.5 | x | 0.7 | = | 84.38 | (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 110.23 | x | 0.5 | x | 0.7 | = | 84.75 | (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 114.87 | x | 0.5 | x | 0.7 | = | 87.93 | (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 114.87 | x | 0.5 | x | 0.7 | = | 88.32 | (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 110.55 | x | 0.5 | x | 0.7 | = | 84.62 | (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 110.55 | x | 0.5 | x | 0.7 | = | 84.99 | (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 108.01 | x | 0.5 | x | 0.7 | = | 82.68 | (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 108.01 | x | 0.5 | x | 0.7 | = | 83.05 | (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 104.89 | x | 0.5 | x | 0.7 | = | 80.29 | (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 104.89 | x | 0.5 | x | 0.7 | = | 80.65 | (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 101.89 | x | 0.5 | x | 0.7 | = | 77.99 | (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 101.89 | x | 0.5 | x | 0.7 | = | 78.33 | (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 82.59 | x | 0.5 | x | 0.7 | = | 63.22 | (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 82.59 | x | 0.5 | x | 0.7 | = | 63.5 | (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 55.42 | x | 0.5 | x | 0.7 | = | 42.42 | (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 55.42 | x | 0.5 | x | 0.7 | = | 42.61 | (78) |
| South | 0.9x | 0.54 | x | 4.5 | x | 40.4 | x | 0.5 | x | 0.7 | = | 30.92 | (78) |
| South | 0.9x | 0.54 | x | 2.26 | x | 40.4 | x | 0.5 | x | 0.7 | = | 31.06 | (78) |
| West | 0.9x | 0.77 | x | 8.96 | x | 19.64 | x | 0.5 | x | 0.7 | = | 42.68 | (80) |
| West | 0.9x | 0.77 | x | 8.96 | x | 38.42 | x | 0.5 | x | 0.7 | = | 83.5 | (80) |
| West | 0.9x | 0.77 | x | 8.96 | x | 63.27 | x | 0.5 | x | 0.7 | = | 137.51 | (80) |
| West | 0.9x | 0.77 | x | 8.96 | x | 92.28 | x | 0.5 | x | 0.7 | = | 200.55 | (80) |
| West | 0.9x | 0.77 | x | 8.96 | x | 113.09 | x | 0.5 | x | 0.7 | = | 245.78 | (80) |
| West | 0.9x | 0.77 | x | 8.96 | x | 115.77 | x | 0.5 | x | 0.7 | = | 251.6 | (80) |
| West | 0.9x | 0.77 | x | 8.96 | x | 110.22 | x | 0.5 | x | 0.7 | = | 239.53 | (80) |
| West | 0.9x | 0.77 | x | 8.96 | x | 94.68 | x | 0.5 | x | 0.7 | = | 205.75 | (80) |
| West | 0.9x | 0.77 | x | 8.96 | x | 73.59 | x | 0.5 | x | 0.7 | = | 159.93 | (80) |
| West | 0.9x | 0.77 | x | 8.96 | x | 45.59 | x | 0.5 | x | 0.7 | = | 99.08 | (80) |
| West | 0.9x | 0.77 | x | 8.96 | x | 24.49 | x | 0.5 | x | 0.7 | = | 53.22 | (80) |
| West | 0.9x | 0.77 | x | 8.96 | x | 16.15 | x | 0.5 | x | 0.7 | = | 35.1 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 114.41 | 200.98 | 287.15 | 369.68 | 422.03 | 421.21 | 405.25 | 366.69 | 316.25 | 225.79 | 138.25 | 97.08 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 532.94 | 617.47 | 690.49 | 751.77 | 782.56 | 760.94 | 731.43 | 698.73 | 659.17 | 590.16 | 527.27 | 504.59 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.95 | 0.93 | 0.89 | 0.83 | 0.72 | 0.58 | 0.45 | 0.49 | 0.67 | 0.85 | 0.93 | 0.96 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 18.89 | 19.17 | 19.59 | 20.1 | 20.53 | 20.82 | 20.94 | 20.92 | 20.72 | 20.16 | 19.44 | 18.84 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.01 | 20.02 | 20.02 | 20.03 | 20.03 | 20.04 | 20.04 | 20.05 | 20.04 | 20.03 | 20.03 | 20.02 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.95 | 0.92 | 0.88 | 0.8 | 0.68 | 0.52 | 0.37 | 0.4 | 0.61 | 0.82 | 0.92 | 0.95 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.2 | 17.61 | 18.21 | 18.93 | 19.51 | 19.88 | 20 | 19.99 | 19.76 | 19.02 | 18 | 17.13 | (90) |

fLA = Living area ÷ (4) = 0.35 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 17.8 | 18.16 | 18.7 | 19.35 | 19.87 | 20.21 | 20.33 | 20.32 | 20.1 | 19.42 | 18.51 | 17.73 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 17.8 | 18.16 | 18.7 | 19.35 | 19.87 | 20.21 | 20.33 | 20.32 | 20.1 | 19.42 | 18.51 | 17.73 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.93 | 0.9 | 0.85 | 0.78 | 0.67 | 0.53 | 0.39 | 0.42 | 0.62 | 0.8 | 0.9 | 0.93 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 493.98 | 554.57 | 589.36 | 586.62 | 528.12 | 403.96 | 286.95 | 296.91 | 407.16 | 474.22 | 473.8 | 471.64 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1132.87 | 1110.2 | 1018.82 | 861.53 | 671.92 | 455.76 | 303.05 | 317.42 | 489.62 | 725.98 | 943.29 | 1124.68 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 475.34 | 373.38 | 319.51 | 197.94 | 106.98 | 0 | 0 | 0 | 0 | 187.31 | 338.04 | 485.86 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2484.36 (98)

Space heating requirement in kWh/m²/year 32.07 (99)

## 9b. Energy requirements – Community heating scheme

| | | | |
|---|---|---|---|
| This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |

| | |
|---|---|
| **Space heating** | **kWh/year** |
| Annual space heating requirement | 2484.36 |

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| | | | |
|---|---|---|---|
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 1304.29 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 1304.29 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |

**Water heating**

| | | | |
|---|---|---|---|
| Annual water heating requirement | | 2090.59 | |
| If DHW from community scheme: Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1097.56 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1097.56 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 48.04 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside | | 253.03 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 253.03 | (331) |
| Energy for lighting (calculated in Appendix L) | | 337.97 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -472.6 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | | Energy kWh/year | Emission factor kg CO2/kWh | | Emissions kg CO2/year | |
|---|---|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP) | | | | | | |
| Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 91 | (367b) |
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.52 | = | 293.31 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.22 | = | 570.11 | (368) |
| Electrical energy for heat distribution | [(313) x | | 0.52 | = | 24.93 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | | = | 888.35 | (373) |
| CO2 associated with space heating (secondary) | (309) x | | 0 | = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | | 0.52 | = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | | 888.35 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | | 0.52 | = | 131.32 | (378) |
| CO2 associated with electricity for lighting | (332))) x | | 0.52 | = | 175.41 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable Item 1 | | 0.52 | | x 0.01 = | -245.28 | (380) |

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| | | | |
|---|---|---|---|
| **Total CO2, kg/year** | sum of (376)…(382) = | 949.8 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | 12.26 | (384) |
| **EI rating (section 14)** | | 89.61 | (385) |

# DER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: A8

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 71.04 | (1a) x | 2.55 | (2a) = | 181.15 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 71.04 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 181.15 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

Wind Factor (22a)m = (22)m ÷ 4

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.72 | x1/[1/( 1.2 )+ 0.04] | | = | 5.4 | | | (27) |
| Windows Type 2 | | | 2.29 | x1/[1/( 1.2 )+ 0.04] | | = | 2.62 | | | (27) |
| Windows Type 3 | | | 4.57 | x1/[1/( 1.2 )+ 0.04] | | = | 5.23 | | | (27) |
| Windows Type 4 | | | 2.26 | x1/[1/( 1.2 )+ 0.04] | | = | 2.59 | | | (27) |
| Windows Type 5 | | | 4.5 | x1/[1/( 1.2 )+ 0.04] | | = | 5.15 | | | (27) |
| Walls Type1 | 85.46 | 25.32 | 60.14 | x | 0.18 | = | 10.83 | | | (29) |
| Walls Type2 | 22.99 | 0 | 22.99 | x | 0.23 | = | 5.22 | | | (29) |
| Roof | 71.04 | 0 | 71.04 | x | 0.13 | = | 9.24 | | | (30) |
| Total area of elements, m² | | | 179.49 | | | | | | | (31) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 54.28 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 5627.16 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 20.73 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 75.01 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 19.03 | 18.84 | 18.65 | 17.69 | 17.5 | 16.55 | 16.55 | 16.36 | 16.93 | 17.5 | 17.89 | 18.27 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 94.04 | 93.85 | 93.66 | 92.7 | 92.51 | 91.56 | 91.56 | 91.37 | 91.94 | 92.51 | 92.89 | 93.27 | |

Average = Sum(39)$_{1…12}$ /12= 92.65 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.32 | 1.32 | 1.32 | 1.3 | 1.3 | 1.29 | 1.29 | 1.29 | 1.29 | 1.3 | 1.31 | 1.31 |

Average = Sum(40)$_{1…12}$ /12= 1.3 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.27 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 88.14 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 96.95 | 93.43 | 89.9 | 86.38 | 82.85 | 79.32 | 79.32 | 82.85 | 86.38 | 89.9 | 93.43 | 96.95 |

Total = Sum(44)$_{1…12}$ = 1057.67 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 143.78 | 125.75 | 129.76 | 113.13 | 108.55 | 93.67 | 86.8 | 99.6 | 100.79 | 117.47 | 128.22 | 139.24 |

Total = Sum(45)$_{1…12}$ = 1386.77 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 21.57 | 18.86 | 19.46 | 16.97 | 16.28 | 14.05 | 13.02 | 14.94 | 15.12 | 17.62 | 19.23 | 20.89 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 199.05 | 175.68 | 185.04 | 166.62 | 163.83 | 147.16 | 142.08 | 154.88 | 154.29 | 172.74 | 181.72 | 194.52 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 199.05 | 175.68 | 185.04 | 166.62 | 163.83 | 147.16 | 142.08 | 154.88 | 154.29 | 172.74 | 181.72 | 194.52 | |

Output from water heater (annual)1…12 | 2037.61 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 92.03 | 81.75 | 87.37 | 80.41 | 80.31 | 73.94 | 73.08 | 77.34 | 76.31 | 83.28 | 85.43 | 90.52 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 113.56 | 113.56 | 113.56 | 113.56 | 113.56 | 113.56 | 113.56 | 113.56 | 113.56 | 113.56 | 113.56 | 113.56 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 17.8 | 15.81 | 12.86 | 9.74 | 7.28 | 6.14 | 6.64 | 8.63 | 11.58 | 14.71 | 17.17 | 18.3 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 199.71 | 201.78 | 196.56 | 185.44 | 171.41 | 158.22 | 149.41 | 147.34 | 152.56 | 163.68 | 177.71 | 190.9 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 34.36 | 34.36 | 34.36 | 34.36 | 34.36 | 34.36 | 34.36 | 34.36 | 34.36 | 34.36 | 34.36 | 34.36 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -90.84 | -90.84 | -90.84 | -90.84 | -90.84 | -90.84 | -90.84 | -90.84 | -90.84 | -90.84 | -90.84 | -90.84 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 123.69 | 121.66 | 117.43 | 111.68 | 107.95 | 102.7 | 98.23 | 103.95 | 105.98 | 111.93 | 118.65 | 121.67 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 398.28 | 396.32 | 383.92 | 363.93 | 343.7 | 324.13 | 311.34 | 316.98 | 327.19 | 347.38 | 370.59 | 387.93 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 2 | x | 2.26 | x | 19.64 | x | 0.5 | x | 0.7 | = | 21.53 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 19.64 | x | 0.5 | x | 0.7 | = | 21.44 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 38.42 | x | 0.5 | x | 0.7 | = | 42.12 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 38.42 | x | 0.5 | x | 0.7 | = | 41.94 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 63.27 | x | 0.5 | x | 0.7 | = | 69.37 | (76) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.5 | x | 63.27 | x | 0.5 | x | 0.7 | = | 69.06 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 92.28 | x | 0.5 | x | 0.7 | = | 101.17 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 92.28 | x | 0.5 | x | 0.7 | = | 100.72 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 113.09 | x | 0.5 | x | 0.7 | = | 123.99 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 113.09 | x | 0.5 | x | 0.7 | = | 123.44 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 115.77 | x | 0.5 | x | 0.7 | = | 126.92 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 115.77 | x | 0.5 | x | 0.7 | = | 126.36 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 110.22 | x | 0.5 | x | 0.7 | = | 120.84 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 110.22 | x | 0.5 | x | 0.7 | = | 120.3 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 94.68 | x | 0.5 | x | 0.7 | = | 103.8 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 94.68 | x | 0.5 | x | 0.7 | = | 103.34 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 73.59 | x | 0.5 | x | 0.7 | = | 80.68 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 73.59 | x | 0.5 | x | 0.7 | = | 80.32 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 45.59 | x | 0.5 | x | 0.7 | = | 49.98 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 45.59 | x | 0.5 | x | 0.7 | = | 49.76 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 24.49 | x | 0.5 | x | 0.7 | = | 26.85 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 24.49 | x | 0.5 | x | 0.7 | = | 26.73 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 16.15 | x | 0.5 | x | 0.7 | = | 17.71 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 16.15 | x | 0.5 | x | 0.7 | = | 17.63 | (76) |
| West | 0.9x | 0.77 | x | 4.72 | x | 19.64 | x | 0.5 | x | 0.7 | = | 44.97 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 19.64 | x | 0.5 | x | 0.7 | = | 10.91 | (80) |
| West | 0.9x | 0.77 | x | 4.57 | x | 19.64 | x | 0.5 | x | 0.7 | = | 21.77 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 38.42 | x | 0.5 | x | 0.7 | = | 87.97 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 38.42 | x | 0.5 | x | 0.7 | = | 21.34 | (80) |
| West | 0.9x | 0.77 | x | 4.57 | x | 38.42 | x | 0.5 | x | 0.7 | = | 42.59 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 63.27 | x | 0.5 | x | 0.7 | = | 144.87 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 63.27 | x | 0.5 | x | 0.7 | = | 35.14 | (80) |
| West | 0.9x | 0.77 | x | 4.57 | x | 63.27 | x | 0.5 | x | 0.7 | = | 70.14 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 92.28 | x | 0.5 | x | 0.7 | = | 211.29 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 92.28 | x | 0.5 | x | 0.7 | = | 51.26 | (80) |
| West | 0.9x | 0.77 | x | 4.57 | x | 92.28 | x | 0.5 | x | 0.7 | = | 102.29 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 113.09 | x | 0.5 | x | 0.7 | = | 258.95 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 113.09 | x | 0.5 | x | 0.7 | = | 62.82 | (80) |
| West | 0.9x | 0.77 | x | 4.57 | x | 113.09 | x | 0.5 | x | 0.7 | = | 125.36 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 115.77 | x | 0.5 | x | 0.7 | = | 265.08 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 115.77 | x | 0.5 | x | 0.7 | = | 64.3 | (80) |
| West | 0.9x | 0.77 | x | 4.57 | x | 115.77 | x | 0.5 | x | 0.7 | = | 128.33 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 110.22 | x | 0.5 | x | 0.7 | = | 252.36 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 110.22 | x | 0.5 | x | 0.7 | = | 61.22 | (80) |
| West | 0.9x | 0.77 | x | 4.57 | x | 110.22 | x | 0.5 | x | 0.7 | = | 122.17 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 94.68 | x | 0.5 | x | 0.7 | = | 216.78 | (80) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 2.29 | x | 94.68 | x | 0.5 | x | 0.7 | = | 52.59 | (80) |
| West | 0.9x | 0.77 | x | 4.57 | x | 94.68 | x | 0.5 | x | 0.7 | = | 104.94 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 73.59 | x | 0.5 | x | 0.7 | = | 168.5 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 73.59 | x | 0.5 | x | 0.7 | = | 40.87 | (80) |
| West | 0.9x | 0.77 | x | 4.57 | x | 73.59 | x | 0.5 | x | 0.7 | = | 81.57 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 45.59 | x | 0.5 | x | 0.7 | = | 104.38 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 45.59 | x | 0.5 | x | 0.7 | = | 25.32 | (80) |
| West | 0.9x | 0.77 | x | 4.57 | x | 45.59 | x | 0.5 | x | 0.7 | = | 50.53 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 24.49 | x | 0.5 | x | 0.7 | = | 56.07 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 24.49 | x | 0.5 | x | 0.7 | = | 13.6 | (80) |
| West | 0.9x | 0.77 | x | 4.57 | x | 24.49 | x | 0.5 | x | 0.7 | = | 27.15 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 16.15 | x | 0.5 | x | 0.7 | = | 36.98 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 16.15 | x | 0.5 | x | 0.7 | = | 8.97 | (80) |
| West | 0.9x | 0.77 | x | 4.57 | x | 16.15 | x | 0.5 | x | 0.7 | = | 17.9 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 120.62 | 235.95 | 388.58 | 566.73 | 694.54 | 710.99 | 676.89 | 581.44 | 451.94 | 279.98 | 150.4 | 99.19 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 518.89 | 632.28 | 772.5 | 930.65 | 1038.25 | 1035.12 | 988.23 | 898.42 | 779.13 | 627.36 | 520.99 | 487.12 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.95 | 0.92 | 0.87 | 0.77 | 0.64 | 0.49 | 0.38 | 0.43 | 0.63 | 0.84 | 0.93 | 0.96 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 18.45 | 18.8 | 19.37 | 20.03 | 20.53 | 20.82 | 20.93 | 20.91 | 20.66 | 19.96 | 19.08 | 18.38 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.82 | 19.82 | 19.83 | 19.84 | 19.84 | 19.85 | 19.85 | 19.85 | 19.85 | 19.84 | 19.83 | 19.83 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.94 | 0.91 | 0.85 | 0.74 | 0.59 | 0.42 | 0.29 | 0.33 | 0.56 | 0.81 | 0.92 | 0.95 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 16.45 | 16.96 | 17.77 | 18.69 | 19.34 | 19.7 | 19.81 | 19.79 | 19.53 | 18.62 | 17.37 | 16.36 | (90) |

fLA = Living area ÷ (4) = 0.39 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 17.23 | 17.68 | 18.39 | 19.21 | 19.8 | 20.14 | 20.25 | 20.23 | 19.97 | 19.14 | 18.04 | 17.15 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 17.23 | 17.68 | 18.39 | 19.21 | 19.8 | 20.14 | 20.25 | 20.23 | 19.97 | 19.14 | 18.04 | 17.15 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Utilisation factor for gains, hm:

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (94)m= | 0.92 | 0.89 | 0.82 | 0.72 | 0.59 | 0.44 | 0.32 | 0.36 | 0.57 | 0.78 | 0.89 | 0.93 | (94) |

# DER WorkSheet: New dwelling design stage

Useful gains, hmGm , W = (94)m x (84)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (95)m= | 478.06 | 559.8 | 634.63 | 667.28 | 608.73 | 457.22 | 317.8 | 327.52 | 444.88 | 491.97 | 464.69 | 453.01 | (95) |

Monthly average external temperature from Table 8

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (97)m= | 1215.82 | 1199.08 | 1113.79 | 956.09 | 749.64 | 506.91 | 333.9 | 349.77 | 539.74 | 790.22 | 1015.9 | 1207.77 | (97) |

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 548.89 | 429.59 | 356.49 | 207.94 | 104.84 | 0 | 0 | 0 | 0 | 221.9 | 396.88 | 561.54 | |

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2828.07 (98)

Space heating requirement in kWh/m²/year 39.81 (99)

## 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.
Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |
| **Space heating** | | **kWh/year** | |
| Annual space heating requirement | | 2828.07 | |
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 1484.74 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 1484.74 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |
| **Water heating** | | | |
| Annual water heating requirement | | 2037.61 | |
| If DHW from community scheme:<br>Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1069.74 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1069.74 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 51.09 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f):<br>mechanical ventilation - balanced, extract or positive input from outside | | 232.06 | (330a) |
| warm air heating system fans | | 0 | (330b) |

| | | | | |
|---|---|---|---|---|
| pump for solar water heating | | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | | 232.06 | (331) |
| Energy for lighting (calculated in Appendix L) | | | 314.43 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | -433.91 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | | Energy kWh/year | Emission factor kg CO2/kWh | | Emissions kg CO2/year | |
|---|---|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP) | | | | | | |
| Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 91 | (367b) |
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.52 | = | 311.95 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.22 | = | 606.34 | (368) |
| Electrical energy for heat distribution | [(313) x | | 0.52 | = | 26.52 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | | = | 944.8 | (373) |
| CO2 associated with space heating (secondary) | (309) x | | 0 | = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | | 0.52 | = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | | 944.8 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | | 0.52 | = | 120.44 | (378) |
| CO2 associated with electricity for lighting | (332))) x | | 0.52 | = | 163.19 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable | | | | | | |
| Item 1 | | 0.52 | | x 0.01 = | -225.2 | (380) |
| **Total CO2, kg/year** | sum of (376)…(382) = | | | | 1003.23 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | | | | 14.12 | (384) |
| **EI rating (section 14)** | | | | | 88.41 | (385) |

# DER WorkSheet: New dwelling design stage

User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

Property Address: A9

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 88.79 | (1a) | x | 2.55 | (2a) | = | 226.41 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 88.79 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | | 226.41 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 5.08 | x1/[1/( 1.2 )+ 0.04] | | = | 5.82 | | | (27) |
| Windows Type 2 | | | 5.06 | x1/[1/( 1.2 )+ 0.04] | | = | 5.79 | | | (27) |
| Windows Type 3 | | | 10.85 | x1/[1/( 1.2 )+ 0.04] | | = | 12.42 | | | (27) |
| Walls Type1 | 65.5 | 20.99 | 44.51 | x | 0.18 | = | 8.01 | | | (29) |
| Walls Type2 | 24.84 | 0 | 24.84 | x | 0.18 | = | 4.47 | | | (29) |
| Walls Type3 | 7.37 | 0 | 7.37 | x | 0.23 | = | 1.67 | | | (29) |
| Total area of elements, m² | | | 97.71 | | | | | | | (31) |
| Party wall | | | 33.69 | x | 0 | = | 0 | | | (32) |

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 38.19 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 6119.25 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 10.03 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 48.22 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 23.78 | 23.55 | 23.31 | 22.12 | 21.88 | 20.69 | 20.69 | 20.45 | 21.16 | 21.88 | 22.35 | 22.83 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 72 | 71.77 | 71.53 | 70.34 | 70.1 | 68.91 | 68.91 | 68.67 | 69.38 | 70.1 | 70.58 | 71.05 | |

Average = Sum(39)$_{1…12}$ /12= 70.28 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.81 | 0.81 | 0.81 | 0.79 | 0.79 | 0.78 | 0.78 | 0.77 | 0.78 | 0.79 | 0.79 | 0.8 |

Average = Sum(40)1…12 /12= 0.79 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.61 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 96.16 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | | |
| (44)m= | 105.77 | 101.93 | 98.08 | 94.24 | 90.39 | 86.54 | 86.54 | 90.39 | 94.24 | 98.08 | 101.93 | 105.77 | |
| | | | | | | | | | | | Total = Sum(44)1…12 = | 1153.91 | (44) |
| *Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)* | | | | | | | | | | | | | |
| (45)m= | 156.86 | 137.19 | 141.57 | 123.42 | 118.43 | 102.19 | 94.7 | 108.67 | 109.97 | 128.15 | 139.89 | 151.91 | |
| | | | | | | | | | | | Total = Sum(45)1…12 = | 1512.95 | (45) |
| *If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)* | | | | | | | | | | | | | |
| (46)m= | 23.53 | 20.58 | 21.24 | 18.51 | 17.76 | 15.33 | 14.2 | 16.3 | 16.49 | 19.22 | 20.98 | 22.79 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 212.14 | 187.12 | 196.85 | 176.92 | 173.7 | 155.69 | 149.97 | 163.94 | 163.46 | 183.43 | 193.38 | 207.19 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 212.14 | 187.12 | 196.85 | 176.92 | 173.7 | 155.69 | 149.97 | 163.94 | 163.46 | 183.43 | 193.38 | 207.19 | |

Output from water heater (annual)$_{1...12}$ 2163.79 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 96.38 | 85.56 | 91.29 | 83.83 | 83.6 | 76.77 | 75.71 | 80.35 | 79.36 | 86.83 | 89.31 | 94.73 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 130.44 | 130.44 | 130.44 | 130.44 | 130.44 | 130.44 | 130.44 | 130.44 | 130.44 | 130.44 | 130.44 | 130.44 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| (67)m= | 21.11 | 18.75 | 15.25 | 11.55 | 8.63 | 7.29 | 7.87 | 10.23 | 13.74 | 17.44 | 20.36 | 21.7 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| (68)m= | 236.83 | 239.29 | 233.1 | 219.91 | 203.27 | 187.63 | 177.18 | 174.72 | 180.92 | 194.1 | 210.74 | 226.38 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| (69)m= | 36.04 | 36.04 | 36.04 | 36.04 | 36.04 | 36.04 | 36.04 | 36.04 | 36.04 | 36.04 | 36.04 | 36.04 | (69) |
| Pumps and fans gains (Table 5a) | | | | | | | | | | | | | |
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| (71)m= | -104.35 | -104.35 | -104.35 | -104.35 | -104.35 | -104.35 | -104.35 | -104.35 | -104.35 | -104.35 | -104.35 | -104.35 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| (72)m= | 129.54 | 127.32 | 122.71 | 116.44 | 112.36 | 106.63 | 101.76 | 108 | 110.22 | 116.71 | 124.04 | 127.33 | (72) |
| **Total internal gains =** | | | | | (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m | | | | | | | | |
| (73)m= | 449.62 | 447.5 | 433.19 | 410.03 | 386.4 | 363.68 | 348.94 | 355.09 | 367 | 390.38 | 417.27 | 437.54 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 10.85 | x | 19.64 | x | 0.5 | x | 0.7 | = | 51.69 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 38.42 | x | 0.5 | x | 0.7 | = | 101.11 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 63.27 | x | 0.5 | x | 0.7 | = | 166.51 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 92.28 | x | 0.5 | x | 0.7 | = | 242.85 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 113.09 | x | 0.5 | x | 0.7 | = | 297.62 | (76) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 10.85 | x | 115.77 | x | 0.5 | x | 0.7 | = | 304.67 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 110.22 | x | 0.5 | x | 0.7 | = | 290.06 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 94.68 | x | 0.5 | x | 0.7 | = | 249.16 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 73.59 | x | 0.5 | x | 0.7 | = | 193.66 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 45.59 | x | 0.5 | x | 0.7 | = | 119.98 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 24.49 | x | 0.5 | x | 0.7 | = | 64.45 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 16.15 | x | 0.5 | x | 0.7 | = | 42.5 | (76) |
| West | 0.9x | 0.77 | x | 5.08 | x | 19.64 | x | 0.5 | x | 0.7 | = | 24.2 | (80) |
| West | 0.9x | 0.77 | x | 5.06 | x | 19.64 | x | 0.5 | x | 0.7 | = | 24.1 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 38.42 | x | 0.5 | x | 0.7 | = | 47.34 | (80) |
| West | 0.9x | 0.77 | x | 5.06 | x | 38.42 | x | 0.5 | x | 0.7 | = | 47.15 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 63.27 | x | 0.5 | x | 0.7 | = | 77.96 | (80) |
| West | 0.9x | 0.77 | x | 5.06 | x | 63.27 | x | 0.5 | x | 0.7 | = | 77.66 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 92.28 | x | 0.5 | x | 0.7 | = | 113.7 | (80) |
| West | 0.9x | 0.77 | x | 5.06 | x | 92.28 | x | 0.5 | x | 0.7 | = | 113.26 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 113.09 | x | 0.5 | x | 0.7 | = | 139.35 | (80) |
| West | 0.9x | 0.77 | x | 5.06 | x | 113.09 | x | 0.5 | x | 0.7 | = | 138.8 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 115.77 | x | 0.5 | x | 0.7 | = | 142.65 | (80) |
| West | 0.9x | 0.77 | x | 5.06 | x | 115.77 | x | 0.5 | x | 0.7 | = | 142.09 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 110.22 | x | 0.5 | x | 0.7 | = | 135.81 | (80) |
| West | 0.9x | 0.77 | x | 5.06 | x | 110.22 | x | 0.5 | x | 0.7 | = | 135.27 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 94.68 | x | 0.5 | x | 0.7 | = | 116.66 | (80) |
| West | 0.9x | 0.77 | x | 5.06 | x | 94.68 | x | 0.5 | x | 0.7 | = | 116.2 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 73.59 | x | 0.5 | x | 0.7 | = | 90.67 | (80) |
| West | 0.9x | 0.77 | x | 5.06 | x | 73.59 | x | 0.5 | x | 0.7 | = | 90.32 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 45.59 | x | 0.5 | x | 0.7 | = | 56.17 | (80) |
| West | 0.9x | 0.77 | x | 5.06 | x | 45.59 | x | 0.5 | x | 0.7 | = | 55.95 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 24.49 | x | 0.5 | x | 0.7 | = | 30.17 | (80) |
| West | 0.9x | 0.77 | x | 5.06 | x | 24.49 | x | 0.5 | x | 0.7 | = | 30.06 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 16.15 | x | 0.5 | x | 0.7 | = | 19.9 | (80) |
| West | 0.9x | 0.77 | x | 5.06 | x | 16.15 | x | 0.5 | x | 0.7 | = | 19.82 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 99.99 | 195.6 | 322.13 | 469.81 | 575.77 | 589.4 | 561.13 | 482.01 | 374.65 | 232.1 | 124.68 | 82.23 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 549.61 | 643.1 | 755.32 | 879.84 | 962.17 | 953.08 | 910.08 | 837.1 | 741.66 | 622.48 | 541.95 | 519.77 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.96 | 0.93 | 0.87 | 0.76 | 0.6 | 0.44 | 0.33 | 0.37 | 0.58 | 0.83 | 0.93 | 0.96 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.46 | 19.73 | 20.13 | 20.57 | 20.84 | 20.96 | 20.99 | 20.98 | 20.89 | 20.51 | 19.91 | 19.41 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.24 | 20.25 | 20.25 | 20.26 | 20.26 | 20.27 | 20.27 | 20.28 | 20.27 | 20.26 | 20.26 | 20.25 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.95 | 0.92 | 0.86 | 0.73 | 0.57 | 0.4 | 0.28 | 0.31 | 0.54 | 0.8 | 0.92 | 0.96 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.16 | 18.55 | 19.12 | 19.74 | 20.08 | 20.24 | 20.27 | 20.26 | 20.16 | 19.66 | 18.82 | 18.1 | (90) |

fLA = Living area ÷ (4) = 0.38 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.66 | 19 | 19.51 | 20.06 | 20.37 | 20.51 | 20.54 | 20.54 | 20.44 | 19.99 | 19.24 | 18.6 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.66 | 19 | 19.51 | 20.06 | 20.37 | 20.51 | 20.54 | 20.54 | 20.44 | 19.99 | 19.24 | 18.6 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.94 | 0.9 | 0.84 | 0.72 | 0.57 | 0.41 | 0.3 | 0.33 | 0.55 | 0.79 | 0.91 | 0.94 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 514.95 | 581.57 | 634.67 | 636.74 | 552.2 | 393.99 | 268.54 | 279.45 | 405.85 | 492.22 | 491.67 | 491.15 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1033.71 | 1011.86 | 930.71 | 784.81 | 607.97 | 407.44 | 271.74 | 284.3 | 440.22 | 657.94 | 856.6 | 1023.39 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 385.96 | 289.16 | 220.25 | 106.61 | 41.49 | 0 | 0 | 0 | 0 | 123.3 | 262.75 | 395.99 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1825.5 (98)

Space heating requirement in kWh/m²/year 20.56 (99)

## 9b. Energy requirements – Community heating scheme

| | | | |
|---|---|---|---|
| This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |
| **Space heating** | | **kWh/year** | |
| Annual space heating requirement | | 1825.5 | |

# DER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 958.39 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 958.39 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |

**Water heating**

| | | | |
|---|---|---|---|
| Annual water heating requirement | | 2163.79 | |
| If DHW from community scheme: Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1135.99 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1135.99 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 41.89 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside | | 290.04 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 290.04 | (331) |
| Energy for lighting (calculated in Appendix L) | | 372.88 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -541.76 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | Energy kWh/year | Emission factor kg CO2/kWh | | Emissions kg CO2/year | |
|---|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP) | | | | | |
| Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | 91 | (367b) |
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | 0.52 | = | 255.76 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | 0.22 | = | 497.13 | (368) |
| Electrical energy for heat distribution | [(313) x | 0.52 | = | 21.74 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | = | 774.63 | (373) |
| CO2 associated with space heating (secondary) | (309) x | 0 | = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | 0.52 | = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | 774.63 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | 0.52 | = | 150.53 | (378) |
| CO2 associated with electricity for lighting | (332))) x | 0.52 | = | 193.52 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable Item 1 | | 0.52 | x 0.01 = | -281.18 | (380) |

# DER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| **Total CO2, kg/year** | sum of (376)…(382) = | 837.51 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | 9.43 | (384) |
| **EI rating (section 14)** | | 91.61 | (385) |

# DER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: A10

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 83.09 | (1a) x | 2.55 | (2a) = | 211.88 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 83.09 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 211.88 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |
| *If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)* | | | | |
| Number of storeys in the dwelling (ns) | | | 0 | (9) |
| Additional infiltration | | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | | 0 | (13) |
| Percentage of windows and doors draught stripped | | | 0 | (14) |
| Window infiltration | | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | | 3 | (17) |
| If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | | | 0.15 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | | |
| Number of sides sheltered | | | 2 | (19) |
| Shelter factor | | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.92 | x1/[1/( 1.2 )+ 0.04] = | 5.63 | | | (27) |
| Windows Type 2 | | | 4.92 | x1/[1/( 1.2 )+ 0.04] = | 5.63 | | | (27) |
| Windows Type 3 | | | 2.39 | x1/[1/( 1.2 )+ 0.04] = | 2.74 | | | (27) |
| Floor | | | 93.36 | x 0.13 = | 12.1368 | | | (28) |
| Walls Type1 | 74.77 | 12.23 | 62.54 | x 0.18 = | 11.26 | | | (29) |
| Walls Type2 | 12.35 | 0 | 12.35 | x 0.23 = | 2.79 | | | (29) |
| Total area of elements, m² | | | 180.48 | | | | | (31) |
| Party wall | | | 36.38 | x 0 = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 40.19 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 16400.1 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 13.95 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 54.14 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 22.26 | 22.03 | 21.81 | 20.7 | 20.47 | 19.36 | 19.36 | 19.14 | 19.8 | 20.47 | 20.92 | 21.37 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 76.39 | 76.17 | 75.95 | 74.83 | 74.61 | 73.5 | 73.5 | 73.27 | 73.94 | 74.61 | 75.06 | 75.5 | |

Average = Sum(39)$_{1…12}$ /12= 74.78 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.92 | 0.92 | 0.91 | 0.9 | 0.9 | 0.88 | 0.88 | 0.88 | 0.89 | 0.9 | 0.9 | 0.91 |

Average = Sum(40)$_{1…12}$ /12= 0.9 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.52 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 94.02 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 103.43 | 99.66 | 95.9 | 92.14 | 88.38 | 84.62 | 84.62 | 88.38 | 92.14 | 95.9 | 99.66 | 103.43 |

Total = Sum(44)$_{1…12}$ = 1128.28 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 153.38 | 134.14 | 138.43 | 120.68 | 115.8 | 99.92 | 92.6 | 106.25 | 107.52 | 125.31 | 136.78 | 148.54 |

Total = Sum(45)$_{1…12}$ = 1479.35 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 23.01 | 20.12 | 20.76 | 18.1 | 17.37 | 14.99 | 13.89 | 15.94 | 16.13 | 18.8 | 20.52 | 22.28 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 208.65 | 184.07 | 193.7 | 174.18 | 171.07 | 153.42 | 147.87 | 161.53 | 161.02 | 180.58 | 190.28 | 203.81 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 208.65 | 184.07 | 193.7 | 174.18 | 171.07 | 153.42 | 147.87 | 161.53 | 161.02 | 180.58 | 190.28 | 203.81 | |

Output from water heater (annual)$_{1...12}$ 2130.19 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 95.22 | 84.55 | 90.25 | 82.92 | 82.72 | 76.02 | 75.01 | 79.55 | 78.55 | 85.89 | 88.28 | 93.61 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 21.36 | 18.97 | 15.43 | 11.68 | 8.73 | 7.37 | 7.97 | 10.35 | 13.9 | 17.65 | 20.6 | 21.96 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 225.78 | 228.12 | 222.22 | 209.65 | 193.78 | 178.87 | 168.91 | 166.57 | 172.47 | 185.04 | 200.9 | 215.82 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 127.98 | 125.81 | 121.3 | 115.17 | 111.19 | 105.58 | 100.82 | 106.92 | 109.09 | 115.44 | 122.6 | 125.82 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 435.91 | 433.69 | 419.73 | 397.28 | 374.49 | 352.61 | 338.48 | 344.63 | 356.24 | 378.91 | 404.89 | 424.38 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.92 | x | 19.64 | x | 0.5 | x | 0.7 | = | 23.44 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 38.42 | x | 0.5 | x | 0.7 | = | 45.85 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 63.27 | x | 0.5 | x | 0.7 | = | 75.51 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 92.28 | x | 0.5 | x | 0.7 | = | 110.12 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 113.09 | x | 0.5 | x | 0.7 | = | 134.96 | (76) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.92 | x | 115.77 | x | 0.5 | x | 0.7 | = | 138.15 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 110.22 | x | 0.5 | x | 0.7 | = | 131.53 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 94.68 | x | 0.5 | x | 0.7 | = | 112.98 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 73.59 | x | 0.5 | x | 0.7 | = | 87.82 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 45.59 | x | 0.5 | x | 0.7 | = | 54.4 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 24.49 | x | 0.5 | x | 0.7 | = | 29.22 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 16.15 | x | 0.5 | x | 0.7 | = | 19.27 | (76) |
| West | 0.9x | 0.77 | x | 4.92 | x | 19.64 | x | 0.5 | x | 0.7 | = | 23.44 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 19.64 | x | 0.5 | x | 0.7 | = | 11.39 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 38.42 | x | 0.5 | x | 0.7 | = | 45.85 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 38.42 | x | 0.5 | x | 0.7 | = | 22.27 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 63.27 | x | 0.5 | x | 0.7 | = | 75.51 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 63.27 | x | 0.5 | x | 0.7 | = | 36.68 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 92.28 | x | 0.5 | x | 0.7 | = | 110.12 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 92.28 | x | 0.5 | x | 0.7 | = | 53.49 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 113.09 | x | 0.5 | x | 0.7 | = | 134.96 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 113.09 | x | 0.5 | x | 0.7 | = | 65.56 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 115.77 | x | 0.5 | x | 0.7 | = | 138.15 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 115.77 | x | 0.5 | x | 0.7 | = | 67.11 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 110.22 | x | 0.5 | x | 0.7 | = | 131.53 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 110.22 | x | 0.5 | x | 0.7 | = | 63.89 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 94.68 | x | 0.5 | x | 0.7 | = | 112.98 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 94.68 | x | 0.5 | x | 0.7 | = | 54.88 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 73.59 | x | 0.5 | x | 0.7 | = | 87.82 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 73.59 | x | 0.5 | x | 0.7 | = | 42.66 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 45.59 | x | 0.5 | x | 0.7 | = | 54.4 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 45.59 | x | 0.5 | x | 0.7 | = | 26.43 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 24.49 | x | 0.5 | x | 0.7 | = | 29.22 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 24.49 | x | 0.5 | x | 0.7 | = | 14.2 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 16.15 | x | 0.5 | x | 0.7 | = | 19.27 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 16.15 | x | 0.5 | x | 0.7 | = | 9.36 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 58.26 | 113.97 | 187.69 | 273.74 | 335.48 | 343.42 | 326.95 | 280.85 | 218.29 | 135.24 | 72.64 | 47.91 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 494.17 | 547.66 | 607.42 | 671.02 | 709.96 | 696.03 | 665.43 | 625.47 | 574.54 | 514.14 | 477.53 | 472.29 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.96 | 0.95 | 0.92 | 0.85 | 0.75 | 0.59 | 0.46 | 0.5 | 0.71 | 0.88 | 0.95 | 0.97 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.13 | 19.35 | 19.73 | 20.22 | 20.61 | 20.87 | 20.96 | 20.94 | 20.76 | 20.24 | 19.61 | 19.1 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.15 | 20.15 | 20.16 | 20.17 | 20.17 | 20.18 | 20.18 | 20.18 | 20.18 | 20.17 | 20.16 | 20.16 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.96 | 0.94 | 0.91 | 0.83 | 0.71 | 0.54 | 0.38 | 0.42 | 0.66 | 0.86 | 0.94 | 0.96 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.63 | 17.94 | 18.49 | 19.18 | 19.72 | 20.05 | 20.15 | 20.14 | 19.93 | 19.23 | 18.33 | 17.58 | (90) |

fLA = Living area ÷ (4) = 0.42 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.25 | 18.53 | 19 | 19.61 | 20.09 | 20.39 | 20.48 | 20.47 | 20.27 | 19.65 | 18.86 | 18.21 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.25 | 18.53 | 19 | 19.61 | 20.09 | 20.39 | 20.48 | 20.47 | 20.27 | 19.65 | 18.86 | 18.21 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.94 | 0.93 | 0.89 | 0.82 | 0.7 | 0.55 | 0.41 | 0.45 | 0.66 | 0.85 | 0.92 | 0.95 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 466.79 | 507.03 | 539.57 | 547.5 | 500.29 | 383.89 | 273.17 | 281.83 | 380.52 | 434.65 | 440.85 | 448.82 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1065.93 | 1037.86 | 949.59 | 801.67 | 626.18 | 425.54 | 285.44 | 298.35 | 456.25 | 675.34 | 882.95 | 1057.93 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 445.76 | 356.72 | 305.05 | 183.01 | 93.67 | 0 | 0 | 0 | 0 | 179.07 | 318.31 | 453.17 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2334.76 (98)

Space heating requirement in kWh/m²/year 28.1 (99)

## 9b. Energy requirements – Community heating scheme

| | | |
|---|---|---|
| This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |

| **Space heating** | **kWh/year** |
|---|---|
| Annual space heating requirement | 2334.76 |

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| | | | |
|---|---|---|---|
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 1225.75 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 1225.75 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |

**Water heating**

| | | | |
|---|---|---|---|
| Annual water heating requirement | | 2130.19 | |
| If DHW from community scheme:<br>Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1118.35 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1118.35 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 46.88 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f):<br>mechanical ventilation - balanced, extract or positive input from outside | | 271.42 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 271.42 | (331) |
| Energy for lighting (calculated in Appendix L) | | 377.27 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -507.18 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | | Energy kWh/year | Emission factor kg CO2/kWh | | Emissions kg CO2/year | |
|---|---|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP)<br>Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 91 | (367b) |
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.52 | = | 286.26 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.22 | = | 556.4 | (368) |
| Electrical energy for heat distribution | [(313) x | | 0.52 | = | 24.33 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | | = | 866.99 | (373) |
| CO2 associated with space heating (secondary) | (309) x | | 0 | = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | | 0.52 | = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | | 866.99 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | | 0.52 | = | 140.87 | (378) |
| CO2 associated with electricity for lighting | (332))) x | | 0.52 | = | 195.8 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable<br>Item 1 | | 0.52 | | x 0.01 = | -263.23 | (380) |

# DER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| **Total CO2, kg/year** | sum of (376)…(382) = | 940.43 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | 11.32 | (384) |
| **EI rating (section 14)** | | 90.16 | (385) |

# DER WorkSheet: New dwelling design stage

## User Details:

**Assessor Name:** Joseph Treanor
**Stroma Number:** STRO032062
**Software Name:** Stroma FSAP 2012
**Software Version:** Version: 1.0.4.14

## Property Address: H1

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 88.81 | (1a) | x | 2.55 | (2a) | = | 226.47 | (3a) |
| First floor | 64.98 | (1b) | x | 3 | (2b) | = | 194.94 | (3b) |
| Second floor | 42.74 | (1c) | x | 3 | (2c) | = | 128.22 | (3c) |
| Third floor | 31.59 | (1d) | x | 3 | (2d) | = | 94.77 | (3d) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 228.12 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | | = | 644.4 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|

# DER WorkSheet: New dwelling design stage

Monthly average wind speed from Table 7

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

Wind Factor (22a)m = (22)m ÷ 4

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 2.39 | x1/[1/( 1.2 )+ 0.04] | = | 2.74 | | | (27) |
| Windows Type 2 | | | 4.92 | x1/[1/( 1.2 )+ 0.04] | = | 5.63 | | | (27) |
| Windows Type 3 | | | 5.08 | x1/[1/( 1.2 )+ 0.04] | = | 5.82 | | | (27) |
| Windows Type 4 | | | 2.22 | x1/[1/( 1.2 )+ 0.04] | = | 2.54 | | | (27) |
| Windows Type 5 | | | 2.29 | x1/[1/( 1.2 )+ 0.04] | = | 2.62 | | | (27) |
| Windows Type 6 | | | 4.72 | x1/[1/( 1.2 )+ 0.04] | = | 5.4 | | | (27) |
| Windows Type 7 | | | 5.08 | x1/[1/( 1.2 )+ 0.04] | = | 5.82 | | | (27) |
| Windows Type 8 | | | 2.13 | x1/[1/( 1.2 )+ 0.04] | = | 2.44 | | | (27) |
| Windows Type 9 | | | 3.63 | x1/[1/( 1.2 )+ 0.04] | = | 4.16 | | | (27) |
| Windows Type 10 | | | 4.72 | x1/[1/( 1.2 )+ 0.04] | = | 5.4 | | | (27) |
| Windows Type 11 | | | 4.76 | x1/[1/( 1.2 )+ 0.04] | = | 5.45 | | | (27) |
| Windows Type 12 | | | 5.06 | x1/[1/( 1.2 )+ 0.04] | = | 5.79 | | | (27) |
| Windows Type 13 | | | 4.79 | x1/[1/( 1.2 )+ 0.04] | = | 5.48 | | | (27) |
| Windows Type 14 | | | 8.78 | x1/[1/( 1.2 )+ 0.04] | = | 10.05 | | | (27) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 15 | | | 2.26 | x1/[1/( 1.2 )+ 0.04] = | | 2.59 | | | | (27) |
| Windows Type 16 | | | 3.68 | x1/[1/( 1.2 )+ 0.04] = | | 4.21 | | | | (27) |
| Windows Type 17 | | | 4.93 | x1/[1/( 1.2 )+ 0.04] = | | 5.65 | | | | (27) |
| Floor | | | 88.81 | x | 0.13 | = | 11.5453 | | | (28) |
| Walls | 321.77 | 100.46 | 221.31 | x | 0.18 | = | 39.84 | | | (29) |
| Roof Type1 | 23.96 | 0 | 23.96 | x | 0.13 | = | 3.11 | | | (30) |
| Roof Type2 | 22.13 | 0 | 22.13 | x | 0.13 | = | 2.88 | | | (30) |
| Roof Type3 | 9.98 | 0 | 9.98 | x | 0.13 | = | 1.3 | | | (30) |
| Roof Type4 | 31.59 | 0 | 31.59 | x | 0.13 | = | 4.11 | | | (30) |
| Total area of elements, m² | | | 498.24 | | | | | | | (31) |
| Party wall | | | 65.06 | x | 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 177.81 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 26764.34 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 53.31 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 231.12 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 67.69 | 67.01 | 66.33 | 62.94 | 62.27 | 58.88 | 58.88 | 58.2 | 60.23 | 62.27 | 63.62 | 64.98 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 298.81 | 298.13 | 297.45 | 294.06 | 293.39 | 290 | 290 | 289.32 | 291.35 | 293.39 | 294.74 | 296.1 | |

Average = Sum(39)$_{1…12}$ /12= 293.9 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.31 | 1.31 | 1.3 | 1.29 | 1.29 | 1.27 | 1.27 | 1.27 | 1.28 | 1.29 | 1.29 | 1.3 | |

Average = Sum(40)$_{1…12}$ /12= 1.29 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 3.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 106.36 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 117 | 112.75 | 108.49 | 104.24 | 99.98 | 95.73 | 95.73 | 99.98 | 104.24 | 108.49 | 112.75 | 117 |

Total = Sum(44)$_{1…12}$ = 1276.37 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 173.51 | 151.75 | 156.59 | 136.52 | 131 | 113.04 | 104.75 | 120.2 | 121.64 | 141.75 | 154.74 | 168.03 |

Total = Sum(45)1...12 = 1673.52 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 26.03 | 22.76 | 23.49 | 20.48 | 19.65 | 16.96 | 15.71 | 18.03 | 18.25 | 21.26 | 23.21 | 25.21 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 228.79 | 201.68 | 211.87 | 190.02 | 186.27 | 166.53 | 160.02 | 175.48 | 175.13 | 197.03 | 208.23 | 223.31 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 228.79 | 201.68 | 211.87 | 190.02 | 186.27 | 166.53 | 160.02 | 175.48 | 175.13 | 197.03 | 208.23 | 223.31 |

Output from water heater (annual)1...12 2324.36 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 101.91 | 90.4 | 96.29 | 88.19 | 87.78 | 80.38 | 79.05 | 84.19 | 83.24 | 91.35 | 94.24 | 100.09 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 151.92 | 151.92 | 151.92 | 151.92 | 151.92 | 151.92 | 151.92 | 151.92 | 151.92 | 151.92 | 151.92 | 151.92 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 35.4 | 31.44 | 25.57 | 19.36 | 14.47 | 12.22 | 13.2 | 17.16 | 23.03 | 29.24 | 34.13 | 36.38 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 397.04 | 401.16 | 390.78 | 368.68 | 340.78 | 314.55 | 297.04 | 292.92 | 303.3 | 325.4 | 353.3 | 379.53 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 38.19 | 38.19 | 38.19 | 38.19 | 38.19 | 38.19 | 38.19 | 38.19 | 38.19 | 38.19 | 38.19 | 38.19 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -121.54 | -121.54 | -121.54 | -121.54 | -121.54 | -121.54 | -121.54 | -121.54 | -121.54 | -121.54 | -121.54 | -121.54 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 136.98 | 134.52 | 129.42 | 122.48 | 117.98 | 111.64 | 106.25 | 113.16 | 115.61 | 122.79 | 130.9 | 134.53 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 638 | 635.7 | 614.35 | 579.1 | 541.8 | 506.99 | 485.06 | 491.81 | 510.51 | 546.01 | 586.9 | 619.02 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 8.78 | x | 19.64 | x | 0.5 | x | 0.7 | = | 41.83 | (76) |
| East | 0.9x | 4 | x | 2.26 | x | 19.64 | x | 0.5 | x | 0.7 | = | 43.06 | (76) |
| East | 0.9x | 2 | x | 3.68 | x | 19.64 | x | 0.5 | x | 0.7 | = | 35.06 | (76) |
| East | 0.9x | 1 | x | 4.93 | x | 19.64 | x | 0.5 | x | 0.7 | = | 23.49 | (76) |
| East | 0.9x | 1 | x | 8.78 | x | 38.42 | x | 0.5 | x | 0.7 | = | 81.82 | (76) |
| East | 0.9x | 4 | x | 2.26 | x | 38.42 | x | 0.5 | x | 0.7 | = | 84.24 | (76) |
| East | 0.9x | 2 | x | 3.68 | x | 38.42 | x | 0.5 | x | 0.7 | = | 68.59 | (76) |
| East | 0.9x | 1 | x | 4.93 | x | 38.42 | x | 0.5 | x | 0.7 | = | 45.94 | (76) |
| East | 0.9x | 1 | x | 8.78 | x | 63.27 | x | 0.5 | x | 0.7 | = | 134.75 | (76) |
| East | 0.9x | 4 | x | 2.26 | x | 63.27 | x | 0.5 | x | 0.7 | = | 138.74 | (76) |
| East | 0.9x | 2 | x | 3.68 | x | 63.27 | x | 0.5 | x | 0.7 | = | 112.95 | (76) |
| East | 0.9x | 1 | x | 4.93 | x | 63.27 | x | 0.5 | x | 0.7 | = | 75.66 | (76) |
| East | 0.9x | 1 | x | 8.78 | x | 92.28 | x | 0.5 | x | 0.7 | = | 196.52 | (76) |
| East | 0.9x | 4 | x | 2.26 | x | 92.28 | x | 0.5 | x | 0.7 | = | 202.34 | (76) |
| East | 0.9x | 2 | x | 3.68 | x | 92.28 | x | 0.5 | x | 0.7 | = | 164.74 | (76) |
| East | 0.9x | 1 | x | 4.93 | x | 92.28 | x | 0.5 | x | 0.7 | = | 110.35 | (76) |
| East | 0.9x | 1 | x | 8.78 | x | 113.09 | x | 0.5 | x | 0.7 | = | 240.84 | (76) |
| East | 0.9x | 4 | x | 2.26 | x | 113.09 | x | 0.5 | x | 0.7 | = | 247.97 | (76) |
| East | 0.9x | 2 | x | 3.68 | x | 113.09 | x | 0.5 | x | 0.7 | = | 201.89 | (76) |
| East | 0.9x | 1 | x | 4.93 | x | 113.09 | x | 0.5 | x | 0.7 | = | 135.23 | (76) |
| East | 0.9x | 1 | x | 8.78 | x | 115.77 | x | 0.5 | x | 0.7 | = | 246.54 | (76) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 4 | x | 2.26 | x | 115.77 | x | 0.5 | x | 0.7 | = | 253.84 | (76) |
| East | 0.9x | 2 | x | 3.68 | x | 115.77 | x | 0.5 | x | 0.7 | = | 206.67 | (76) |
| East | 0.9x | 1 | x | 4.93 | x | 115.77 | x | 0.5 | x | 0.7 | = | 138.44 | (76) |
| East | 0.9x | 1 | x | 8.78 | x | 110.22 | x | 0.5 | x | 0.7 | = | 234.72 | (76) |
| East | 0.9x | 4 | x | 2.26 | x | 110.22 | x | 0.5 | x | 0.7 | = | 241.67 | (76) |
| East | 0.9x | 2 | x | 3.68 | x | 110.22 | x | 0.5 | x | 0.7 | = | 196.76 | (76) |
| East | 0.9x | 1 | x | 4.93 | x | 110.22 | x | 0.5 | x | 0.7 | = | 131.8 | (76) |
| East | 0.9x | 1 | x | 8.78 | x | 94.68 | x | 0.5 | x | 0.7 | = | 201.62 | (76) |
| East | 0.9x | 4 | x | 2.26 | x | 94.68 | x | 0.5 | x | 0.7 | = | 207.59 | (76) |
| East | 0.9x | 2 | x | 3.68 | x | 94.68 | x | 0.5 | x | 0.7 | = | 169.01 | (76) |
| East | 0.9x | 1 | x | 4.93 | x | 94.68 | x | 0.5 | x | 0.7 | = | 113.21 | (76) |
| East | 0.9x | 1 | x | 8.78 | x | 73.59 | x | 0.5 | x | 0.7 | = | 156.71 | (76) |
| East | 0.9x | 4 | x | 2.26 | x | 73.59 | x | 0.5 | x | 0.7 | = | 161.36 | (76) |
| East | 0.9x | 2 | x | 3.68 | x | 73.59 | x | 0.5 | x | 0.7 | = | 131.37 | (76) |
| East | 0.9x | 1 | x | 4.93 | x | 73.59 | x | 0.5 | x | 0.7 | = | 88 | (76) |
| East | 0.9x | 1 | x | 8.78 | x | 45.59 | x | 0.5 | x | 0.7 | = | 97.09 | (76) |
| East | 0.9x | 4 | x | 2.26 | x | 45.59 | x | 0.5 | x | 0.7 | = | 99.96 | (76) |
| East | 0.9x | 2 | x | 3.68 | x | 45.59 | x | 0.5 | x | 0.7 | = | 81.38 | (76) |
| East | 0.9x | 1 | x | 4.93 | x | 45.59 | x | 0.5 | x | 0.7 | = | 54.51 | (76) |
| East | 0.9x | 1 | x | 8.78 | x | 24.49 | x | 0.5 | x | 0.7 | = | 52.15 | (76) |
| East | 0.9x | 4 | x | 2.26 | x | 24.49 | x | 0.5 | x | 0.7 | = | 53.7 | (76) |
| East | 0.9x | 2 | x | 3.68 | x | 24.49 | x | 0.5 | x | 0.7 | = | 43.72 | (76) |
| East | 0.9x | 1 | x | 4.93 | x | 24.49 | x | 0.5 | x | 0.7 | = | 29.28 | (76) |
| East | 0.9x | 1 | x | 8.78 | x | 16.15 | x | 0.5 | x | 0.7 | = | 34.4 | (76) |
| East | 0.9x | 4 | x | 2.26 | x | 16.15 | x | 0.5 | x | 0.7 | = | 35.41 | (76) |
| East | 0.9x | 2 | x | 3.68 | x | 16.15 | x | 0.5 | x | 0.7 | = | 28.83 | (76) |
| East | 0.9x | 1 | x | 4.93 | x | 16.15 | x | 0.5 | x | 0.7 | = | 19.31 | (76) |
| Southeast | 0.9x | 0.77 | x | 4.79 | x | 36.79 | x | 0.5 | x | 0.7 | = | 42.75 | (77) |
| Southeast | 0.9x | 0.77 | x | 4.79 | x | 62.67 | x | 0.5 | x | 0.7 | = | 72.81 | (77) |
| Southeast | 0.9x | 0.77 | x | 4.79 | x | 85.75 | x | 0.5 | x | 0.7 | = | 99.63 | (77) |
| Southeast | 0.9x | 0.77 | x | 4.79 | x | 106.25 | x | 0.5 | x | 0.7 | = | 123.44 | (77) |
| Southeast | 0.9x | 0.77 | x | 4.79 | x | 119.01 | x | 0.5 | x | 0.7 | = | 138.27 | (77) |
| Southeast | 0.9x | 0.77 | x | 4.79 | x | 118.15 | x | 0.5 | x | 0.7 | = | 137.27 | (77) |
| Southeast | 0.9x | 0.77 | x | 4.79 | x | 113.91 | x | 0.5 | x | 0.7 | = | 132.34 | (77) |
| Southeast | 0.9x | 0.77 | x | 4.79 | x | 104.39 | x | 0.5 | x | 0.7 | = | 121.28 | (77) |
| Southeast | 0.9x | 0.77 | x | 4.79 | x | 92.85 | x | 0.5 | x | 0.7 | = | 107.88 | (77) |
| Southeast | 0.9x | 0.77 | x | 4.79 | x | 69.27 | x | 0.5 | x | 0.7 | = | 80.48 | (77) |
| Southeast | 0.9x | 0.77 | x | 4.79 | x | 44.07 | x | 0.5 | x | 0.7 | = | 51.2 | (77) |
| Southeast | 0.9x | 0.77 | x | 4.79 | x | 31.49 | x | 0.5 | x | 0.7 | = | 36.58 | (77) |
| South | 0.9x | 0.77 | x | 2.22 | x | 46.75 | x | 0.5 | x | 0.7 | = | 25.17 | (78) |
| South | 0.9x | 0.77 | x | 2.13 | x | 46.75 | x | 0.5 | x | 0.7 | = | 24.15 | (78) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South | 0.9x | 0.77 | x | 4.72 | x | 46.75 | x | 0.5 | x | 0.7 | = | 53.52 | (78) |
| South | 0.9x | 0.77 | x | 4.76 | x | 46.75 | x | 0.5 | x | 0.7 | = | 53.98 | (78) |
| South | 0.9x | 0.77 | x | 5.06 | x | 46.75 | x | 0.5 | x | 0.7 | = | 57.38 | (78) |
| South | 0.9x | 0.77 | x | 2.22 | x | 76.57 | x | 0.5 | x | 0.7 | = | 41.23 | (78) |
| South | 0.9x | 0.77 | x | 2.13 | x | 76.57 | x | 0.5 | x | 0.7 | = | 39.56 | (78) |
| South | 0.9x | 0.77 | x | 4.72 | x | 76.57 | x | 0.5 | x | 0.7 | = | 87.66 | (78) |
| South | 0.9x | 0.77 | x | 4.76 | x | 76.57 | x | 0.5 | x | 0.7 | = | 88.4 | (78) |
| South | 0.9x | 0.77 | x | 5.06 | x | 76.57 | x | 0.5 | x | 0.7 | = | 93.97 | (78) |
| South | 0.9x | 0.77 | x | 2.22 | x | 97.53 | x | 0.5 | x | 0.7 | = | 52.52 | (78) |
| South | 0.9x | 0.77 | x | 2.13 | x | 97.53 | x | 0.5 | x | 0.7 | = | 50.39 | (78) |
| South | 0.9x | 0.77 | x | 4.72 | x | 97.53 | x | 0.5 | x | 0.7 | = | 111.66 | (78) |
| South | 0.9x | 0.77 | x | 4.76 | x | 97.53 | x | 0.5 | x | 0.7 | = | 112.61 | (78) |
| South | 0.9x | 0.77 | x | 5.06 | x | 97.53 | x | 0.5 | x | 0.7 | = | 119.7 | (78) |
| South | 0.9x | 0.77 | x | 2.22 | x | 110.23 | x | 0.5 | x | 0.7 | = | 59.36 | (78) |
| South | 0.9x | 0.77 | x | 2.13 | x | 110.23 | x | 0.5 | x | 0.7 | = | 56.95 | (78) |
| South | 0.9x | 0.77 | x | 4.72 | x | 110.23 | x | 0.5 | x | 0.7 | = | 126.2 | (78) |
| South | 0.9x | 0.77 | x | 4.76 | x | 110.23 | x | 0.5 | x | 0.7 | = | 127.27 | (78) |
| South | 0.9x | 0.77 | x | 5.06 | x | 110.23 | x | 0.5 | x | 0.7 | = | 135.29 | (78) |
| South | 0.9x | 0.77 | x | 2.22 | x | 114.87 | x | 0.5 | x | 0.7 | = | 61.85 | (78) |
| South | 0.9x | 0.77 | x | 2.13 | x | 114.87 | x | 0.5 | x | 0.7 | = | 59.35 | (78) |
| South | 0.9x | 0.77 | x | 4.72 | x | 114.87 | x | 0.5 | x | 0.7 | = | 131.51 | (78) |
| South | 0.9x | 0.77 | x | 4.76 | x | 114.87 | x | 0.5 | x | 0.7 | = | 132.62 | (78) |
| South | 0.9x | 0.77 | x | 5.06 | x | 114.87 | x | 0.5 | x | 0.7 | = | 140.98 | (78) |
| South | 0.9x | 0.77 | x | 2.22 | x | 110.55 | x | 0.5 | x | 0.7 | = | 59.53 | (78) |
| South | 0.9x | 0.77 | x | 2.13 | x | 110.55 | x | 0.5 | x | 0.7 | = | 57.11 | (78) |
| South | 0.9x | 0.77 | x | 4.72 | x | 110.55 | x | 0.5 | x | 0.7 | = | 126.56 | (78) |
| South | 0.9x | 0.77 | x | 4.76 | x | 110.55 | x | 0.5 | x | 0.7 | = | 127.63 | (78) |
| South | 0.9x | 0.77 | x | 5.06 | x | 110.55 | x | 0.5 | x | 0.7 | = | 135.68 | (78) |
| South | 0.9x | 0.77 | x | 2.22 | x | 108.01 | x | 0.5 | x | 0.7 | = | 58.16 | (78) |
| South | 0.9x | 0.77 | x | 2.13 | x | 108.01 | x | 0.5 | x | 0.7 | = | 55.8 | (78) |
| South | 0.9x | 0.77 | x | 4.72 | x | 108.01 | x | 0.5 | x | 0.7 | = | 123.66 | (78) |
| South | 0.9x | 0.77 | x | 4.76 | x | 108.01 | x | 0.5 | x | 0.7 | = | 124.7 | (78) |
| South | 0.9x | 0.77 | x | 5.06 | x | 108.01 | x | 0.5 | x | 0.7 | = | 132.56 | (78) |
| South | 0.9x | 0.77 | x | 2.22 | x | 104.89 | x | 0.5 | x | 0.7 | = | 56.48 | (78) |
| South | 0.9x | 0.77 | x | 2.13 | x | 104.89 | x | 0.5 | x | 0.7 | = | 54.19 | (78) |
| South | 0.9x | 0.77 | x | 4.72 | x | 104.89 | x | 0.5 | x | 0.7 | = | 120.09 | (78) |
| South | 0.9x | 0.77 | x | 4.76 | x | 104.89 | x | 0.5 | x | 0.7 | = | 121.1 | (78) |
| South | 0.9x | 0.77 | x | 5.06 | x | 104.89 | x | 0.5 | x | 0.7 | = | 128.74 | (78) |
| South | 0.9x | 0.77 | x | 2.22 | x | 101.89 | x | 0.5 | x | 0.7 | = | 54.86 | (78) |
| South | 0.9x | 0.77 | x | 2.13 | x | 101.89 | x | 0.5 | x | 0.7 | = | 52.64 | (78) |
| South | 0.9x | 0.77 | x | 4.72 | x | 101.89 | x | 0.5 | x | 0.7 | = | 116.64 | (78) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South | 0.9x | 0.77 | x | 4.76 | x | 101.89 | x | 0.5 | x | 0.7 | = | 117.63 | (78) |
| South | 0.9x | 0.77 | x | 5.06 | x | 101.89 | x | 0.5 | x | 0.7 | = | 125.04 | (78) |
| South | 0.9x | 0.77 | x | 2.22 | x | 82.59 | x | 0.5 | x | 0.7 | = | 44.47 | (78) |
| South | 0.9x | 0.77 | x | 2.13 | x | 82.59 | x | 0.5 | x | 0.7 | = | 42.67 | (78) |
| South | 0.9x | 0.77 | x | 4.72 | x | 82.59 | x | 0.5 | x | 0.7 | = | 94.55 | (78) |
| South | 0.9x | 0.77 | x | 4.76 | x | 82.59 | x | 0.5 | x | 0.7 | = | 95.35 | (78) |
| South | 0.9x | 0.77 | x | 5.06 | x | 82.59 | x | 0.5 | x | 0.7 | = | 101.36 | (78) |
| South | 0.9x | 0.77 | x | 2.22 | x | 55.42 | x | 0.5 | x | 0.7 | = | 29.84 | (78) |
| South | 0.9x | 0.77 | x | 2.13 | x | 55.42 | x | 0.5 | x | 0.7 | = | 28.63 | (78) |
| South | 0.9x | 0.77 | x | 4.72 | x | 55.42 | x | 0.5 | x | 0.7 | = | 63.44 | (78) |
| South | 0.9x | 0.77 | x | 4.76 | x | 55.42 | x | 0.5 | x | 0.7 | = | 63.98 | (78) |
| South | 0.9x | 0.77 | x | 5.06 | x | 55.42 | x | 0.5 | x | 0.7 | = | 68.01 | (78) |
| South | 0.9x | 0.77 | x | 2.22 | x | 40.4 | x | 0.5 | x | 0.7 | = | 21.75 | (78) |
| South | 0.9x | 0.77 | x | 2.13 | x | 40.4 | x | 0.5 | x | 0.7 | = | 20.87 | (78) |
| South | 0.9x | 0.77 | x | 4.72 | x | 40.4 | x | 0.5 | x | 0.7 | = | 46.25 | (78) |
| South | 0.9x | 0.77 | x | 4.76 | x | 40.4 | x | 0.5 | x | 0.7 | = | 46.64 | (78) |
| South | 0.9x | 0.77 | x | 5.06 | x | 40.4 | x | 0.5 | x | 0.7 | = | 49.58 | (78) |
| West | 0.9x | 0.77 | x | 2.39 | x | 19.64 | x | 0.5 | x | 0.7 | = | 22.77 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 19.64 | x | 0.5 | x | 0.7 | = | 23.44 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 19.64 | x | 0.5 | x | 0.7 | = | 24.2 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 19.64 | x | 0.5 | x | 0.7 | = | 65.45 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 19.64 | x | 0.5 | x | 0.7 | = | 44.97 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 19.64 | x | 0.5 | x | 0.7 | = | 24.2 | (80) |
| West | 0.9x | 0.77 | x | 3.63 | x | 19.64 | x | 0.5 | x | 0.7 | = | 17.29 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 38.42 | x | 0.5 | x | 0.7 | = | 44.54 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 38.42 | x | 0.5 | x | 0.7 | = | 45.85 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 38.42 | x | 0.5 | x | 0.7 | = | 47.34 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 38.42 | x | 0.5 | x | 0.7 | = | 128.04 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 38.42 | x | 0.5 | x | 0.7 | = | 87.97 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 38.42 | x | 0.5 | x | 0.7 | = | 47.34 | (80) |
| West | 0.9x | 0.77 | x | 3.63 | x | 38.42 | x | 0.5 | x | 0.7 | = | 33.83 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 63.27 | x | 0.5 | x | 0.7 | = | 73.36 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 63.27 | x | 0.5 | x | 0.7 | = | 75.51 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 63.27 | x | 0.5 | x | 0.7 | = | 77.96 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 63.27 | x | 0.5 | x | 0.7 | = | 210.87 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 63.27 | x | 0.5 | x | 0.7 | = | 144.87 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 63.27 | x | 0.5 | x | 0.7 | = | 77.96 | (80) |
| West | 0.9x | 0.77 | x | 3.63 | x | 63.27 | x | 0.5 | x | 0.7 | = | 55.71 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 92.28 | x | 0.5 | x | 0.7 | = | 106.99 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 92.28 | x | 0.5 | x | 0.7 | = | 110.12 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 92.28 | x | 0.5 | x | 0.7 | = | 113.7 | (80) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 2.29 | x | 92.28 | x | 0.5 | x | 0.7 | = | 307.54 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 92.28 | x | 0.5 | x | 0.7 | = | 211.29 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 92.28 | x | 0.5 | x | 0.7 | = | 113.7 | (80) |
| West | 0.9x | 0.77 | x | 3.63 | x | 92.28 | x | 0.5 | x | 0.7 | = | 81.25 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 113.09 | x | 0.5 | x | 0.7 | = | 131.12 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 113.09 | x | 0.5 | x | 0.7 | = | 134.96 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 113.09 | x | 0.5 | x | 0.7 | = | 139.35 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 113.09 | x | 0.5 | x | 0.7 | = | 376.9 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 113.09 | x | 0.5 | x | 0.7 | = | 258.95 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 113.09 | x | 0.5 | x | 0.7 | = | 139.35 | (80) |
| West | 0.9x | 0.77 | x | 3.63 | x | 113.09 | x | 0.5 | x | 0.7 | = | 99.57 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 115.77 | x | 0.5 | x | 0.7 | = | 134.22 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 115.77 | x | 0.5 | x | 0.7 | = | 138.15 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 115.77 | x | 0.5 | x | 0.7 | = | 142.65 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 115.77 | x | 0.5 | x | 0.7 | = | 385.82 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 115.77 | x | 0.5 | x | 0.7 | = | 265.08 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 115.77 | x | 0.5 | x | 0.7 | = | 142.65 | (80) |
| West | 0.9x | 0.77 | x | 3.63 | x | 115.77 | x | 0.5 | x | 0.7 | = | 101.93 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 110.22 | x | 0.5 | x | 0.7 | = | 127.79 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 110.22 | x | 0.5 | x | 0.7 | = | 131.53 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 110.22 | x | 0.5 | x | 0.7 | = | 135.81 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 110.22 | x | 0.5 | x | 0.7 | = | 367.32 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 110.22 | x | 0.5 | x | 0.7 | = | 252.36 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 110.22 | x | 0.5 | x | 0.7 | = | 135.81 | (80) |
| West | 0.9x | 0.77 | x | 3.63 | x | 110.22 | x | 0.5 | x | 0.7 | = | 97.04 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 94.68 | x | 0.5 | x | 0.7 | = | 109.77 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 94.68 | x | 0.5 | x | 0.7 | = | 112.98 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 94.68 | x | 0.5 | x | 0.7 | = | 116.66 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 94.68 | x | 0.5 | x | 0.7 | = | 315.52 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 94.68 | x | 0.5 | x | 0.7 | = | 216.78 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 94.68 | x | 0.5 | x | 0.7 | = | 116.66 | (80) |
| West | 0.9x | 0.77 | x | 3.63 | x | 94.68 | x | 0.5 | x | 0.7 | = | 83.36 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 73.59 | x | 0.5 | x | 0.7 | = | 85.32 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 73.59 | x | 0.5 | x | 0.7 | = | 87.82 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 73.59 | x | 0.5 | x | 0.7 | = | 90.67 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 73.59 | x | 0.5 | x | 0.7 | = | 245.25 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 73.59 | x | 0.5 | x | 0.7 | = | 168.5 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 73.59 | x | 0.5 | x | 0.7 | = | 90.67 | (80) |
| West | 0.9x | 0.77 | x | 3.63 | x | 73.59 | x | 0.5 | x | 0.7 | = | 64.79 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 45.59 | x | 0.5 | x | 0.7 | = | 52.86 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 45.59 | x | 0.5 | x | 0.7 | = | 54.4 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 5.08 | x | 45.59 | x | 0.5 | x | 0.7 | = | 56.17 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 45.59 | x | 0.5 | x | 0.7 | = | 151.93 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 45.59 | x | 0.5 | x | 0.7 | = | 104.38 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 45.59 | x | 0.5 | x | 0.7 | = | 56.17 | (80) |
| West | 0.9x | 0.77 | x | 3.63 | x | 45.59 | x | 0.5 | x | 0.7 | = | 40.14 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 24.49 | x | 0.5 | x | 0.7 | = | 28.39 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 24.49 | x | 0.5 | x | 0.7 | = | 29.22 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 24.49 | x | 0.5 | x | 0.7 | = | 30.17 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 24.49 | x | 0.5 | x | 0.7 | = | 81.61 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 24.49 | x | 0.5 | x | 0.7 | = | 56.07 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 24.49 | x | 0.5 | x | 0.7 | = | 30.17 | (80) |
| West | 0.9x | 0.77 | x | 3.63 | x | 24.49 | x | 0.5 | x | 0.7 | = | 21.56 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 16.15 | x | 0.5 | x | 0.7 | = | 18.73 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 16.15 | x | 0.5 | x | 0.7 | = | 19.27 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 16.15 | x | 0.5 | x | 0.7 | = | 19.9 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 16.15 | x | 0.5 | x | 0.7 | = | 53.83 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 16.15 | x | 0.5 | x | 0.7 | = | 36.98 | (80) |
| West | 0.9x | 0.77 | x | 5.08 | x | 16.15 | x | 0.5 | x | 0.7 | = | 19.9 | (80) |
| West | 0.9x | 0.77 | x | 3.63 | x | 16.15 | x | 0.5 | x | 0.7 | = | 14.22 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 622.72 | 1139.14 | 1724.84 | 2347.04 | 2770.71 | 2799.77 | 2679.82 | 2365.03 | 1945.15 | 1307.87 | 761.17 | 522.46 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 1260.71 | 1774.84 | 2339.19 | 2926.14 | 3312.51 | 3306.75 | 3164.88 | 2856.84 | 2455.66 | 1853.88 | 1348.07 | 1141.48 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.97 | 0.94 | 0.88 | 0.77 | 0.64 | 0.49 | 0.38 | 0.42 | 0.64 | 0.86 | 0.95 | 0.98 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 18.21 | 18.68 | 19.33 | 20.03 | 20.54 | 20.83 | 20.94 | 20.91 | 20.66 | 19.91 | 18.9 | 18.13 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.83 | 19.84 | 19.84 | 19.85 | 19.85 | 19.86 | 19.86 | 19.87 | 19.86 | 19.85 | 19.85 | 19.84 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.97 | 0.93 | 0.86 | 0.74 | 0.59 | 0.42 | 0.29 | 0.33 | 0.57 | 0.83 | 0.95 | 0.97 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 16.12 | 16.79 | 17.72 | 18.7 | 19.36 | 19.72 | 19.83 | 19.81 | 19.54 | 18.56 | 17.13 | 16 | (90) |

fLA = Living area ÷ (4) = | 0.29 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 16.72 | 17.34 | 18.18 | 19.09 | 19.7 | 20.04 | 20.15 | 20.13 | 19.87 | 18.95 | 17.64 | 16.62 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 16.72 | 17.34 | 18.18 | 19.09 | 19.7 | 20.04 | 20.15 | 20.13 | 19.87 | 18.95 | 17.64 | 16.62 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.95 | 0.9 | 0.83 | 0.72 | 0.58 | 0.43 | 0.31 | 0.36 | 0.57 | 0.8 | 0.92 | 0.96 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 1197.68 | 1605.2 | 1943.63 | 2098.93 | 1922.59 | 1432.24 | 983.64 | 1015.39 | 1393.57 | 1483.45 | 1242.04 | 1094.56 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 3711.24 | 3707.46 | 3474.79 | 2995.78 | 2348.15 | 1577.33 | 1028.43 | 1078.71 | 1680.63 | 2450.02 | 3107.9 | 3676.51 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 1870.09 | 1412.72 | 1139.19 | 645.73 | 316.62 | 0 | 0 | 0 | 0 | 719.13 | 1343.42 | 1920.97 | |

| | | |
|---|---|---|
| Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 9367.87 | (98) |
| Space heating requirement in kWh/m²/year | 41.07 | (99) |

## 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |
| **Space heating** | | **kWh/year** | |
| Annual space heating requirement | | 9367.87 | |
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 4918.13 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 4918.13 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |
| **Water heating** | | | |
| Annual water heating requirement | | 2324.36 | |
| If DHW from community scheme: Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1220.29 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1220.29 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 122.77 | (313) |

# DER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside | | 825.47 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 825.47 | (331) |
| Energy for lighting (calculated in Appendix L) | | 625.12 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -1392.28 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | | Energy kWh/year | Emission factor kg CO2/kWh | | Emissions kg CO2/year | |
|---|---|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP) | | | | | | |
| Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 91 | (367b) |
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.52 | = | 749.61 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.22 | = | 1457.03 | (368) |
| Electrical energy for heat distribution | [(313) x | | 0.52 | = | 63.72 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | | = | 2270.36 | (373) |
| CO2 associated with space heating (secondary) | (309) x | | 0 | = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | | 0.52 | = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | | 2270.36 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | | 0.52 | = | 428.42 | (378) |
| CO2 associated with electricity for lighting | (332))) x | | 0.52 | = | 324.44 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable | | | | | | |
| Item 1 | | 0.52 | | x 0.01 = | -722.6 | (380) |
| **Total CO2, kg/year** | sum of (376)…(382) = | | | | 2300.62 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | | | | 10.09 | (384) |
| **EI rating (section 14)** | | | | | 88.71 | (385) |

# DER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: H2

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 71.45 | (1a) | x | 2.55 | (2a) | = | 182.2 | (3a) |
| First floor | 71.77 | (1b) | x | 3 | (2b) | = | 215.31 | (3b) |
| Second floor | 36.89 | (1c) | x | 3 | (2c) | = | 110.67 | (3c) |
| Third floor | 35.72 | (1d) | x | 3 | (2d) | = | 107.16 | (3d) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 215.83 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | | = | 615.34 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |
| *If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)* | | | | |
| Number of storeys in the dwelling (ns) | | | 0 | (9) |
| Additional infiltration | | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | | 0 | (13) |
| Percentage of windows and doors draught stripped | | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | | 3 | (17) |
| If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | | | 0.15 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | | |
| Number of sides sheltered | | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|

# DER WorkSheet: New dwelling design stage

Monthly average wind speed from Table 7

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

Wind Factor (22a)m = (22)m ÷ 4

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| **ELEMENT** | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 2.52 | x1/[1/( 1.2 )+ 0.04] | | = | 2.89 | | | (27) |
| Windows Type 2 | | | 4.72 | x1/[1/( 1.2 )+ 0.04] | | = | 5.4 | | | (27) |
| Windows Type 3 | | | 2.39 | x1/[1/( 1.2 )+ 0.04] | | = | 2.74 | | | (27) |
| Windows Type 4 | | | 2.29 | x1/[1/( 1.2 )+ 0.04] | | = | 2.62 | | | (27) |
| Windows Type 5 | | | 2.26 | x1/[1/( 1.2 )+ 0.04] | | = | 2.59 | | | (27) |
| Windows Type 6 | | | 1.73 | x1/[1/( 1.2 )+ 0.04] | | = | 1.98 | | | (27) |
| Windows Type 7 | | | 2.53 | x1/[1/( 1.2 )+ 0.04] | | = | 2.9 | | | (27) |
| Windows Type 8 | | | 2.26 | x1/[1/( 1.2 )+ 0.04] | | = | 2.59 | | | (27) |
| Windows Type 9 | | | 4.5 | x1/[1/( 1.2 )+ 0.04] | | = | 5.15 | | | (27) |
| Windows Type 10 | | | 8.82 | x1/[1/( 1.2 )+ 0.04] | | = | 10.1 | | | (27) |
| Floor | | | 71.45 | x | 0.13 | = | 9.288499 | | | (28) |
| Walls | 187.5 | 70.38 | 117.12 | x | 0.18 | = | 21.08 | | | (29) |
| Roof Type1 | 35.25 | 0 | 35.25 | x | 0.13 | = | 4.58 | | | (30) |
| Roof Type2 | 35.72 | 0 | 35.72 | x | 0.13 | = | 4.64 | | | (30) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Total area of elements, m² | 329.92 | | | | | | | (31) |
| Party wall | 190.02 | x | 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

| | | | |
|---|---|---|---|
| Fabric heat loss, W/K = S (A x U) | (26)…(30) + (32) = | 120.18 | (33) |
| Heat capacity Cm = S(A x k ) | ((28)…(30) + (32) + (32a)…(32e) = | 24076.33 | (34) |
| Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K | Indicative Value: Low | 100 | (35) |

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

| | | | |
|---|---|---|---|
| Thermal bridges : S (L x Y) calculated using Appendix K | | 40.41 | (36) |

*if details of thermal bridging are not known (36) = 0.15 x (31)*

| | | | |
|---|---|---|---|
| Total fabric heat loss | (33) + (36) = | 160.59 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 64.64 | 63.99 | 63.34 | 60.11 | 59.46 | 56.22 | 56.22 | 55.58 | 57.52 | 59.46 | 60.75 | 62.05 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 225.23 | 224.58 | 223.94 | 220.7 | 220.05 | 216.82 | 216.82 | 216.17 | 218.11 | 220.05 | 221.35 | 222.64 | |

Average = Sum(39)$_{1…12}$ /12= 220.54 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.04 | 1.04 | 1.04 | 1.02 | 1.02 | 1 | 1 | 1 | 1.01 | 1.02 | 1.03 | 1.03 | |

Average = Sum(40)$_{1…12}$ /12= 1.02 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 3.02 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 105.98 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | | |
| (44)m= | 116.58 | 112.34 | 108.1 | 103.86 | 99.63 | 95.39 | 95.39 | 99.63 | 103.86 | 108.1 | 112.34 | 116.58 | |

Total = Sum(44)$_{1…12}$ = 1271.81 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 172.89 | 151.21 | 156.04 | 136.04 | 130.53 | 112.64 | 104.37 | 119.77 | 121.2 | 141.25 | 154.18 | 167.43 | |

Total = Sum(45)$_{1…12}$ = 1667.55 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 25.93 | 22.68 | 23.41 | 20.41 | 19.58 | 16.9 | 15.66 | 17.97 | 18.18 | 21.19 | 23.13 | 25.12 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

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| | | | |
|---|---|---|---|
| a) If manufacturer's declared loss factor is known (kWh/day): | | 0 | (48) |
| Temperature factor from Table 2b | | 0 | (49) |
| Energy lost from water storage, kWh/year | (48) x (49) = | 110 | (50) |
| b) If manufacturer's declared cylinder loss factor is not known: | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | 0.02 | (51) |
| If community heating see section 4.3 | | | |
| Volume factor from Table 2a | | 1.03 | (52) |
| Temperature factor from Table 2b | | 0.6 | (53) |
| Energy lost from water storage, kWh/year | (47) x (51) x (52) x (53) = | 1.03 | (54) |
| Enter (50) or (54) in (55) | | 1.03 | (55) |

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 228.17 | 201.14 | 211.31 | 189.53 | 185.81 | 166.13 | 159.65 | 175.05 | 174.7 | 196.53 | 207.68 | 222.71 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 228.17 | 201.14 | 211.31 | 189.53 | 185.81 | 166.13 | 159.65 | 175.05 | 174.7 | 196.53 | 207.68 | 222.71 |

Output from water heater (annual)$_{1...12}$ — 2318.39 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 101.71 | 90.22 | 96.1 | 88.03 | 87.62 | 80.25 | 78.93 | 84.05 | 83.09 | 91.19 | 94.06 | 99.89 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 151.13 | 151.13 | 151.13 | 151.13 | 151.13 | 151.13 | 151.13 | 151.13 | 151.13 | 151.13 | 151.13 | 151.13 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 34.4 | 30.55 | 24.85 | 18.81 | 14.06 | 11.87 | 12.83 | 16.67 | 22.38 | 28.42 | 33.16 | 35.36 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 385.85 | 389.86 | 379.77 | 358.29 | 331.17 | 305.69 | 288.66 | 284.66 | 294.75 | 316.23 | 343.34 | 368.83 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 38.11 | 38.11 | 38.11 | 38.11 | 38.11 | 38.11 | 38.11 | 38.11 | 38.11 | 38.11 | 38.11 | 38.11 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -120.9 | -120.9 | -120.9 | -120.9 | -120.9 | -120.9 | -120.9 | -120.9 | -120.9 | -120.9 | -120.9 | -120.9 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 136.7 | 134.25 | 129.17 | 122.26 | 117.77 | 111.45 | 106.08 | 112.96 | 115.41 | 122.56 | 130.64 | 134.27 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 625.29 | 623 | 602.12 | 567.69 | 531.34 | 497.35 | 475.91 | 482.63 | 500.87 | 535.54 | 575.49 | 606.79 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 2.53 | x | 19.64 | x | 0.5 | x | 0.7 | = | 12.05 | (76) |
| East | 0.9x | 3 | x | 2.26 | x | 19.64 | x | 0.5 | x | 0.7 | = | 32.3 | (76) |
| East | 0.9x | 3 | x | 4.5 | x | 19.64 | x | 0.5 | x | 0.7 | = | 64.31 | (76) |
| East | 0.9x | 1 | x | 2.53 | x | 38.42 | x | 0.5 | x | 0.7 | = | 23.58 | (76) |
| East | 0.9x | 3 | x | 2.26 | x | 38.42 | x | 0.5 | x | 0.7 | = | 63.18 | (76) |
| East | 0.9x | 3 | x | 4.5 | x | 38.42 | x | 0.5 | x | 0.7 | = | 125.81 | (76) |
| East | 0.9x | 1 | x | 2.53 | x | 63.27 | x | 0.5 | x | 0.7 | = | 38.83 | (76) |
| East | 0.9x | 3 | x | 2.26 | x | 63.27 | x | 0.5 | x | 0.7 | = | 104.05 | (76) |
| East | 0.9x | 3 | x | 4.5 | x | 63.27 | x | 0.5 | x | 0.7 | = | 207.18 | (76) |
| East | 0.9x | 1 | x | 2.53 | x | 92.28 | x | 0.5 | x | 0.7 | = | 56.63 | (76) |
| East | 0.9x | 3 | x | 2.26 | x | 92.28 | x | 0.5 | x | 0.7 | = | 151.75 | (76) |
| East | 0.9x | 3 | x | 4.5 | x | 92.28 | x | 0.5 | x | 0.7 | = | 302.16 | (76) |
| East | 0.9x | 1 | x | 2.53 | x | 113.09 | x | 0.5 | x | 0.7 | = | 69.4 | (76) |
| East | 0.9x | 3 | x | 2.26 | x | 113.09 | x | 0.5 | x | 0.7 | = | 185.98 | (76) |
| East | 0.9x | 3 | x | 4.5 | x | 113.09 | x | 0.5 | x | 0.7 | = | 370.31 | (76) |
| East | 0.9x | 1 | x | 2.53 | x | 115.77 | x | 0.5 | x | 0.7 | = | 71.04 | (76) |
| East | 0.9x | 3 | x | 2.26 | x | 115.77 | x | 0.5 | x | 0.7 | = | 190.38 | (76) |
| East | 0.9x | 3 | x | 4.5 | x | 115.77 | x | 0.5 | x | 0.7 | = | 379.08 | (76) |
| East | 0.9x | 1 | x | 2.53 | x | 110.22 | x | 0.5 | x | 0.7 | = | 67.64 | (76) |
| East | 0.9x | 3 | x | 2.26 | x | 110.22 | x | 0.5 | x | 0.7 | = | 181.25 | (76) |
| East | 0.9x | 3 | x | 4.5 | x | 110.22 | x | 0.5 | x | 0.7 | = | 360.9 | (76) |
| East | 0.9x | 1 | x | 2.53 | x | 94.68 | x | 0.5 | x | 0.7 | = | 58.1 | (76) |
| East | 0.9x | 3 | x | 2.26 | x | 94.68 | x | 0.5 | x | 0.7 | = | 155.69 | (76) |
| East | 0.9x | 3 | x | 4.5 | x | 94.68 | x | 0.5 | x | 0.7 | = | 310.01 | (76) |
| East | 0.9x | 1 | x | 2.53 | x | 73.59 | x | 0.5 | x | 0.7 | = | 45.16 | (76) |
| East | 0.9x | 3 | x | 2.26 | x | 73.59 | x | 0.5 | x | 0.7 | = | 121.02 | (76) |
| East | 0.9x | 3 | x | 4.5 | x | 73.59 | x | 0.5 | x | 0.7 | = | 240.96 | (76) |
| East | 0.9x | 1 | x | 2.53 | x | 45.59 | x | 0.5 | x | 0.7 | = | 27.98 | (76) |
| East | 0.9x | 3 | x | 2.26 | x | 45.59 | x | 0.5 | x | 0.7 | = | 74.97 | (76) |
| East | 0.9x | 3 | x | 4.5 | x | 45.59 | x | 0.5 | x | 0.7 | = | 149.28 | (76) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 2.53 | x | 24.49 | x | 0.5 | x | 0.7 | = | 15.03 | (76) |
| East | 0.9x | 3 | x | 2.26 | x | 24.49 | x | 0.5 | x | 0.7 | = | 40.27 | (76) |
| East | 0.9x | 3 | x | 4.5 | x | 24.49 | x | 0.5 | x | 0.7 | = | 80.19 | (76) |
| East | 0.9x | 1 | x | 2.53 | x | 16.15 | x | 0.5 | x | 0.7 | = | 9.91 | (76) |
| East | 0.9x | 3 | x | 2.26 | x | 16.15 | x | 0.5 | x | 0.7 | = | 26.56 | (76) |
| East | 0.9x | 3 | x | 4.5 | x | 16.15 | x | 0.5 | x | 0.7 | = | 52.89 | (76) |
| South | 0.9x | 0.77 | x | 2.26 | x | 46.75 | x | 0.5 | x | 0.7 | = | 25.63 | (78) |
| South | 0.9x | 0.77 | x | 1.73 | x | 46.75 | x | 0.5 | x | 0.7 | = | 19.62 | (78) |
| South | 0.9x | 0.77 | x | 8.82 | x | 46.75 | x | 0.5 | x | 0.7 | = | 200.03 | (78) |
| South | 0.9x | 0.77 | x | 2.26 | x | 76.57 | x | 0.5 | x | 0.7 | = | 41.97 | (78) |
| South | 0.9x | 0.77 | x | 1.73 | x | 76.57 | x | 0.5 | x | 0.7 | = | 32.13 | (78) |
| South | 0.9x | 0.77 | x | 8.82 | x | 76.57 | x | 0.5 | x | 0.7 | = | 327.6 | (78) |
| South | 0.9x | 0.77 | x | 2.26 | x | 97.53 | x | 0.5 | x | 0.7 | = | 53.46 | (78) |
| South | 0.9x | 0.77 | x | 1.73 | x | 97.53 | x | 0.5 | x | 0.7 | = | 40.93 | (78) |
| South | 0.9x | 0.77 | x | 8.82 | x | 97.53 | x | 0.5 | x | 0.7 | = | 417.31 | (78) |
| South | 0.9x | 0.77 | x | 2.26 | x | 110.23 | x | 0.5 | x | 0.7 | = | 60.43 | (78) |
| South | 0.9x | 0.77 | x | 1.73 | x | 110.23 | x | 0.5 | x | 0.7 | = | 46.26 | (78) |
| South | 0.9x | 0.77 | x | 8.82 | x | 110.23 | x | 0.5 | x | 0.7 | = | 471.65 | (78) |
| South | 0.9x | 0.77 | x | 2.26 | x | 114.87 | x | 0.5 | x | 0.7 | = | 62.97 | (78) |
| South | 0.9x | 0.77 | x | 1.73 | x | 114.87 | x | 0.5 | x | 0.7 | = | 48.2 | (78) |
| South | 0.9x | 0.77 | x | 8.82 | x | 114.87 | x | 0.5 | x | 0.7 | = | 491.49 | (78) |
| South | 0.9x | 0.77 | x | 2.26 | x | 110.55 | x | 0.5 | x | 0.7 | = | 60.6 | (78) |
| South | 0.9x | 0.77 | x | 1.73 | x | 110.55 | x | 0.5 | x | 0.7 | = | 46.39 | (78) |
| South | 0.9x | 0.77 | x | 8.82 | x | 110.55 | x | 0.5 | x | 0.7 | = | 472.99 | (78) |
| South | 0.9x | 0.77 | x | 2.26 | x | 108.01 | x | 0.5 | x | 0.7 | = | 59.21 | (78) |
| South | 0.9x | 0.77 | x | 1.73 | x | 108.01 | x | 0.5 | x | 0.7 | = | 45.32 | (78) |
| South | 0.9x | 0.77 | x | 8.82 | x | 108.01 | x | 0.5 | x | 0.7 | = | 462.14 | (78) |
| South | 0.9x | 0.77 | x | 2.26 | x | 104.89 | x | 0.5 | x | 0.7 | = | 57.5 | (78) |
| South | 0.9x | 0.77 | x | 1.73 | x | 104.89 | x | 0.5 | x | 0.7 | = | 44.01 | (78) |
| South | 0.9x | 0.77 | x | 8.82 | x | 104.89 | x | 0.5 | x | 0.7 | = | 448.8 | (78) |
| South | 0.9x | 0.77 | x | 2.26 | x | 101.89 | x | 0.5 | x | 0.7 | = | 55.85 | (78) |
| South | 0.9x | 0.77 | x | 1.73 | x | 101.89 | x | 0.5 | x | 0.7 | = | 42.75 | (78) |
| South | 0.9x | 0.77 | x | 8.82 | x | 101.89 | x | 0.5 | x | 0.7 | = | 435.93 | (78) |
| South | 0.9x | 0.77 | x | 2.26 | x | 82.59 | x | 0.5 | x | 0.7 | = | 45.27 | (78) |
| South | 0.9x | 0.77 | x | 1.73 | x | 82.59 | x | 0.5 | x | 0.7 | = | 34.65 | (78) |
| South | 0.9x | 0.77 | x | 8.82 | x | 82.59 | x | 0.5 | x | 0.7 | = | 353.35 | (78) |
| South | 0.9x | 0.77 | x | 2.26 | x | 55.42 | x | 0.5 | x | 0.7 | = | 30.38 | (78) |
| South | 0.9x | 0.77 | x | 1.73 | x | 55.42 | x | 0.5 | x | 0.7 | = | 23.25 | (78) |
| South | 0.9x | 0.77 | x | 8.82 | x | 55.42 | x | 0.5 | x | 0.7 | = | 237.11 | (78) |
| South | 0.9x | 0.77 | x | 2.26 | x | 40.4 | x | 0.5 | x | 0.7 | = | 22.14 | (78) |
| South | 0.9x | 0.77 | x | 1.73 | x | 40.4 | x | 0.5 | x | 0.7 | = | 16.95 | (78) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South | 0.9x | 0.77 | x | 8.82 | x | 40.4 | x | 0.5 | x | 0.7 | = | 172.85 | (78) |
| West | 0.9x | 0.77 | x | 2.52 | x | 19.64 | x | 0.5 | x | 0.7 | = | 12 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 19.64 | x | 0.5 | x | 0.7 | = | 67.45 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 19.64 | x | 0.5 | x | 0.7 | = | 11.39 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 19.64 | x | 0.5 | x | 0.7 | = | 32.73 | (80) |
| West | 0.9x | 0.77 | x | 2.52 | x | 38.42 | x | 0.5 | x | 0.7 | = | 23.48 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 38.42 | x | 0.5 | x | 0.7 | = | 131.96 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 38.42 | x | 0.5 | x | 0.7 | = | 22.27 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 38.42 | x | 0.5 | x | 0.7 | = | 64.02 | (80) |
| West | 0.9x | 0.77 | x | 2.52 | x | 63.27 | x | 0.5 | x | 0.7 | = | 38.67 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 63.27 | x | 0.5 | x | 0.7 | = | 217.31 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 63.27 | x | 0.5 | x | 0.7 | = | 36.68 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 63.27 | x | 0.5 | x | 0.7 | = | 105.43 | (80) |
| West | 0.9x | 0.77 | x | 2.52 | x | 92.28 | x | 0.5 | x | 0.7 | = | 56.4 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 92.28 | x | 0.5 | x | 0.7 | = | 316.94 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 92.28 | x | 0.5 | x | 0.7 | = | 53.49 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 92.28 | x | 0.5 | x | 0.7 | = | 153.77 | (80) |
| West | 0.9x | 0.77 | x | 2.52 | x | 113.09 | x | 0.5 | x | 0.7 | = | 69.13 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 113.09 | x | 0.5 | x | 0.7 | = | 388.42 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 113.09 | x | 0.5 | x | 0.7 | = | 65.56 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 113.09 | x | 0.5 | x | 0.7 | = | 188.45 | (80) |
| West | 0.9x | 0.77 | x | 2.52 | x | 115.77 | x | 0.5 | x | 0.7 | = | 70.76 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 115.77 | x | 0.5 | x | 0.7 | = | 397.61 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 115.77 | x | 0.5 | x | 0.7 | = | 67.11 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 115.77 | x | 0.5 | x | 0.7 | = | 192.91 | (80) |
| West | 0.9x | 0.77 | x | 2.52 | x | 110.22 | x | 0.5 | x | 0.7 | = | 67.37 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 110.22 | x | 0.5 | x | 0.7 | = | 378.55 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 110.22 | x | 0.5 | x | 0.7 | = | 63.89 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 110.22 | x | 0.5 | x | 0.7 | = | 183.66 | (80) |
| West | 0.9x | 0.77 | x | 2.52 | x | 94.68 | x | 0.5 | x | 0.7 | = | 57.87 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 94.68 | x | 0.5 | x | 0.7 | = | 325.16 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 94.68 | x | 0.5 | x | 0.7 | = | 54.88 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 94.68 | x | 0.5 | x | 0.7 | = | 157.76 | (80) |
| West | 0.9x | 0.77 | x | 2.52 | x | 73.59 | x | 0.5 | x | 0.7 | = | 44.98 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 73.59 | x | 0.5 | x | 0.7 | = | 252.74 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 73.59 | x | 0.5 | x | 0.7 | = | 42.66 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 73.59 | x | 0.5 | x | 0.7 | = | 122.62 | (80) |
| West | 0.9x | 0.77 | x | 2.52 | x | 45.59 | x | 0.5 | x | 0.7 | = | 27.87 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 45.59 | x | 0.5 | x | 0.7 | = | 156.58 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 45.59 | x | 0.5 | x | 0.7 | = | 26.43 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 45.59 | x | 0.5 | x | 0.7 | = | 75.97 | (80) |

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| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 2.52 | x | 24.49 | x | 0.5 | x | 0.7 | = | 14.97 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 24.49 | x | 0.5 | x | 0.7 | = | 84.11 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 24.49 | x | 0.5 | x | 0.7 | = | 14.2 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 24.49 | x | 0.5 | x | 0.7 | = | 40.81 | (80) |
| West | 0.9x | 0.77 | x | 2.52 | x | 16.15 | x | 0.5 | x | 0.7 | = | 9.87 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 16.15 | x | 0.5 | x | 0.7 | = | 55.47 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 16.15 | x | 0.5 | x | 0.7 | = | 9.36 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 16.15 | x | 0.5 | x | 0.7 | = | 26.91 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 477.51 | 856 | 1259.86 | 1669.48 | 1939.9 | 1948.88 | 1869.92 | 1669.79 | 1404.67 | 972.33 | 580.3 | 402.92 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 1102.8 | 1479 | 1861.98 | 2237.17 | 2471.24 | 2446.23 | 2345.84 | 2152.43 | 1905.55 | 1507.88 | 1155.79 | 1009.7 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.98 | 0.95 | 0.9 | 0.8 | 0.67 | 0.51 | 0.39 | 0.43 | 0.65 | 0.87 | 0.96 | 0.98 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 18.69 | 19.1 | 19.64 | 20.24 | 20.65 | 20.88 | 20.96 | 20.95 | 20.76 | 20.15 | 19.3 | 18.63 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.05 | 20.05 | 20.05 | 20.06 | 20.07 | 20.08 | 20.08 | 20.08 | 20.07 | 20.07 | 20.06 | 20.06 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.97 | 0.94 | 0.88 | 0.77 | 0.62 | 0.45 | 0.31 | 0.36 | 0.59 | 0.84 | 0.95 | 0.98 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 16.93 | 17.52 | 18.3 | 19.13 | 19.68 | 19.97 | 20.05 | 20.04 | 19.84 | 19.04 | 17.82 | 16.84 | (90) |

fLA = Living area ÷ (4) = 0.14 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 17.19 | 17.74 | 18.49 | 19.29 | 19.82 | 20.1 | 20.18 | 20.17 | 19.97 | 19.2 | 18.03 | 17.1 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 17.19 | 17.74 | 18.49 | 19.29 | 19.82 | 20.1 | 20.18 | 20.17 | 19.97 | 19.2 | 18.03 | 17.1 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.96 | 0.92 | 0.85 | 0.75 | 0.61 | 0.45 | 0.32 | 0.36 | 0.58 | 0.81 | 0.93 | 0.96 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 1054.9 | 1356.66 | 1587.28 | 1670.25 | 1507.21 | 1108.46 | 754.17 | 782.89 | 1106.66 | 1228.92 | 1075 | 973.77 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 2902.15 | 2884.5 | 2684.8 | 2292.78 | 1786.93 | 1193.2 | 776.94 | 815.58 | 1281.08 | 1891.58 | 2419.9 | 2871.7 | (97) |

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 1374.36 | 1026.71 | 816.56 | 448.23 | 208.11 | 0 | 0 | 0 | 0 | 493.02 | 968.33 | 1412.06 |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 6747.38 (98)

| | | | |
|---|---|---|---|
| Space heating requirement in kWh/m²/year | | 31.26 | (99) |

## 9b. Energy requirements – Community heating scheme

| | | | |
|---|---|---|---|
| This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |
| **Space heating** | | **kWh/year** | |
| Annual space heating requirement | | 6747.38 | |
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 3542.37 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 3542.37 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |
| **Water heating** | | | |
| Annual water heating requirement | | 2318.39 | |
| If DHW from community scheme: Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1217.15 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1217.15 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 95.19 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside | | 788.25 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 788.25 | (331) |
| Energy for lighting (calculated in Appendix L) | | 607.5 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -1317.36 | (333) |

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| | | | | |
|---|---|---|---|---|
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP) | | | | | |
| Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | 91 | (367b) |
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.52 | = 581.22 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.22 | = 1129.73 | (368) |
| Electrical energy for heat distribution | [(313) x | | 0.52 | = 49.4 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | | = 1760.36 | (373) |
| CO2 associated with space heating (secondary) | (309) x | | 0 | = 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | | 0.52 | = 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | 1760.36 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | | 0.52 | = 409.1 | (378) |
| CO2 associated with electricity for lighting | (332))) x | | 0.52 | = 315.29 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable | | | | | |
| Item 1 | | 0.52 | x 0.01 = | -683.71 | (380) |
| **Total CO2, kg/year** | sum of (376)…(382) = | | | 1801.04 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | | | 8.34 | (384) |
| **EI rating (section 14)** | | | | 90.75 | (385) |

# DER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: P1

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 119.63 | (1a) x | 2.55 | (2a) = | 305.06 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 119.63 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 305.06 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

Wind Factor (22a)m = (22)m ÷ 4

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.92 | x1/[1/( 1.2 )+ 0.04] = | 5.63 | | | (27) |
| Windows Type 2 | | | 4.92 | x1/[1/( 1.2 )+ 0.04] = | 5.63 | | | (27) |
| Windows Type 3 | | | 2.39 | x1/[1/( 1.2 )+ 0.04] = | 2.74 | | | (27) |
| Floor | | | 119.63 | x 0.13 = | 15.5519 | | | (28) |
| Walls Type1 | 74.77 | 12.23 | 62.54 | x 0.18 = | 11.26 | | | (29) |
| Walls Type2 | 12.35 | 0 | 12.35 | x 0.23 = | 2.79 | | | (29) |
| Total area of elements, m² | | | 206.75 | | | | | (31) |
| Party wall | | | 36.38 | x 0 = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 43.6 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 19289.8 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 13.95 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 57.55 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 32.04 | 31.72 | 31.4 | 29.8 | 29.48 | 27.87 | 27.87 | 27.55 | 28.51 | 29.48 | 30.12 | 30.76 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 89.6 | 89.28 | 88.95 | 87.35 | 87.03 | 85.42 | 85.42 | 85.1 | 86.07 | 87.03 | 87.67 | 88.31 | |

Average = Sum(39)$_{1…12}$ /12= 87.27 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.75 | 0.75 | 0.74 | 0.73 | 0.73 | 0.71 | 0.71 | 0.71 | 0.72 | 0.73 | 0.73 | 0.74 | |

Average = Sum(40)$_{1…12}$ /12= 0.73 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.86 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 102.17 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | | |
| (44)m= | 112.39 | 108.3 | 104.21 | 100.13 | 96.04 | 91.95 | 91.95 | 96.04 | 100.13 | 104.21 | 108.3 | 112.39 | |

Total = Sum(44)$_{1…12}$ = 1226.03 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 166.67 | 145.77 | 150.42 | 131.14 | 125.83 | 108.58 | 100.62 | 115.46 | 116.84 | 136.16 | 148.63 | 161.41 | |

Total = Sum(45)$_{1…12}$ = 1607.52 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 25 | 21.87 | 22.56 | 19.67 | 18.87 | 16.29 | 15.09 | 17.32 | 17.53 | 20.42 | 22.3 | 24.21 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = — 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a — 1.03 (52)

Temperature factor from Table 2b — 0.6 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = — 1.03 (54)

Enter (50) or (54) in (55) — 1.03 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 221.94 | 195.69 | 205.7 | 184.63 | 181.11 | 162.08 | 155.89 | 170.74 | 170.33 | 191.44 | 202.13 | 216.68 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 221.94 | 195.69 | 205.7 | 184.63 | 181.11 | 162.08 | 155.89 | 170.74 | 170.33 | 191.44 | 202.13 | 216.68 | |

Output from water heater (annual)$_{1...12}$ 2258.36 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 99.64 | 88.41 | 94.24 | 86.4 | 86.06 | 78.9 | 77.68 | 82.61 | 81.64 | 89.5 | 92.22 | 97.89 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Metabolic gains (Table 5), Watts** | | | | | | | | | | | | | |
| (66)m= | 143.09 | 143.09 | 143.09 | 143.09 | 143.09 | 143.09 | 143.09 | 143.09 | 143.09 | 143.09 | 143.09 | 143.09 | (66) |
| **Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5** | | | | | | | | | | | | | |
| (67)m= | 29.18 | 25.91 | 21.07 | 15.95 | 11.93 | 10.07 | 10.88 | 14.14 | 18.98 | 24.1 | 28.13 | 29.99 | (67) |
| **Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5** | | | | | | | | | | | | | |
| (68)m= | 284.73 | 287.69 | 280.24 | 264.39 | 244.38 | 225.58 | 213.01 | 210.06 | 217.5 | 233.35 | 253.36 | 272.17 | (68) |
| **Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5** | | | | | | | | | | | | | |
| (69)m= | 37.31 | 37.31 | 37.31 | 37.31 | 37.31 | 37.31 | 37.31 | 37.31 | 37.31 | 37.31 | 37.31 | 37.31 | (69) |
| **Pumps and fans gains (Table 5a)** | | | | | | | | | | | | | |
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |
| **Losses e.g. evaporation (negative values) (Table 5)** | | | | | | | | | | | | | |
| (71)m= | -114.47 | -114.47 | -114.47 | -114.47 | -114.47 | -114.47 | -114.47 | -114.47 | -114.47 | -114.47 | -114.47 | -114.47 | (71) |
| **Water heating gains (Table 5)** | | | | | | | | | | | | | |
| (72)m= | 133.92 | 131.56 | 126.66 | 120 | 115.67 | 109.58 | 104.4 | 111.04 | 113.39 | 120.29 | 128.08 | 131.57 | (72) |
| **Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m | | | | | | | | | | | | | |
| (73)m= | 513.76 | 511.09 | 493.9 | 466.27 | 437.91 | 411.15 | 394.22 | 401.16 | 415.81 | 443.67 | 475.5 | 499.65 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.92 | x | 19.64 | x | 0.5 | x | 0.7 | = | 23.44 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 38.42 | x | 0.5 | x | 0.7 | = | 45.85 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 63.27 | x | 0.5 | x | 0.7 | = | 75.51 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 92.28 | x | 0.5 | x | 0.7 | = | 110.12 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 113.09 | x | 0.5 | x | 0.7 | = | 134.96 | (76) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.92 | x | 115.77 | x | 0.5 | x | 0.7 | = | 138.15 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 110.22 | x | 0.5 | x | 0.7 | = | 131.53 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 94.68 | x | 0.5 | x | 0.7 | = | 112.98 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 73.59 | x | 0.5 | x | 0.7 | = | 87.82 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 45.59 | x | 0.5 | x | 0.7 | = | 54.4 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 24.49 | x | 0.5 | x | 0.7 | = | 29.22 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 16.15 | x | 0.5 | x | 0.7 | = | 19.27 | (76) |
| West | 0.9x | 0.77 | x | 4.92 | x | 19.64 | x | 0.5 | x | 0.7 | = | 23.44 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 19.64 | x | 0.5 | x | 0.7 | = | 11.39 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 38.42 | x | 0.5 | x | 0.7 | = | 45.85 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 38.42 | x | 0.5 | x | 0.7 | = | 22.27 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 63.27 | x | 0.5 | x | 0.7 | = | 75.51 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 63.27 | x | 0.5 | x | 0.7 | = | 36.68 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 92.28 | x | 0.5 | x | 0.7 | = | 110.12 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 92.28 | x | 0.5 | x | 0.7 | = | 53.49 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 113.09 | x | 0.5 | x | 0.7 | = | 134.96 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 113.09 | x | 0.5 | x | 0.7 | = | 65.56 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 115.77 | x | 0.5 | x | 0.7 | = | 138.15 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 115.77 | x | 0.5 | x | 0.7 | = | 67.11 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 110.22 | x | 0.5 | x | 0.7 | = | 131.53 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 110.22 | x | 0.5 | x | 0.7 | = | 63.89 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 94.68 | x | 0.5 | x | 0.7 | = | 112.98 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 94.68 | x | 0.5 | x | 0.7 | = | 54.88 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 73.59 | x | 0.5 | x | 0.7 | = | 87.82 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 73.59 | x | 0.5 | x | 0.7 | = | 42.66 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 45.59 | x | 0.5 | x | 0.7 | = | 54.4 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 45.59 | x | 0.5 | x | 0.7 | = | 26.43 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 24.49 | x | 0.5 | x | 0.7 | = | 29.22 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 24.49 | x | 0.5 | x | 0.7 | = | 14.2 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 16.15 | x | 0.5 | x | 0.7 | = | 19.27 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 16.15 | x | 0.5 | x | 0.7 | = | 9.36 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 58.26 | 113.97 | 187.69 | 273.74 | 335.48 | 343.42 | 326.95 | 280.85 | 218.29 | 135.24 | 72.64 | 47.91 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 572.02 | 625.06 | 681.6 | 740.01 | 773.38 | 754.57 | 721.17 | 682.01 | 634.1 | 578.91 | 548.14 | 547.56 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.98 | 0.97 | 0.95 | 0.89 | 0.8 | 0.64 | 0.5 | 0.54 | 0.76 | 0.91 | 0.97 | 0.98 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.37 | 19.56 | 19.88 | 20.31 | 20.66 | 20.89 | 20.97 | 20.96 | 20.8 | 20.34 | 19.8 | 19.35 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.3 | 20.3 | 20.3 | 20.31 | 20.32 | 20.33 | 20.33 | 20.33 | 20.32 | 20.32 | 20.31 | 20.31 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.97 | 0.96 | 0.94 | 0.88 | 0.77 | 0.59 | 0.43 | 0.47 | 0.71 | 0.9 | 0.96 | 0.98 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.07 | 18.34 | 18.81 | 19.43 | 19.92 | 20.22 | 20.3 | 20.3 | 20.11 | 19.48 | 18.7 | 18.04 | (90) |

fLA = Living area ÷ (4) = 0.26 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.41 | 18.66 | 19.09 | 19.66 | 20.11 | 20.4 | 20.48 | 20.47 | 20.29 | 19.71 | 18.99 | 18.39 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.41 | 18.66 | 19.09 | 19.66 | 20.11 | 20.4 | 20.48 | 20.47 | 20.29 | 19.71 | 18.99 | 18.39 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.96 | 0.95 | 0.92 | 0.86 | 0.76 | 0.6 | 0.44 | 0.49 | 0.71 | 0.88 | 0.95 | 0.97 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 551.5 | 594.33 | 628.75 | 637.9 | 586.34 | 451.37 | 320.01 | 330.79 | 449.43 | 511.55 | 519.63 | 530.26 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1264.62 | 1228.05 | 1119.67 | 939.73 | 732.13 | 495.16 | 331.26 | 346.3 | 532.55 | 792.81 | 1042.03 | 1252.9 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 530.56 | 425.86 | 365.25 | 217.32 | 108.47 | 0 | 0 | 0 | 0 | 209.26 | 376.13 | 537.65 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2770.49 (98)

Space heating requirement in kWh/m²/year 23.16 (99)

## 9b. Energy requirements – Community heating scheme

| | | | |
|---|---|---|---|
| This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |

**Space heating** **kWh/year**

Annual space heating requirement 2770.49

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| | | | |
|---|---|---|---|
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 1454.5 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 1454.5 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |

**Water heating**

| | | | |
|---|---|---|---|
| Annual water heating requirement | | 2258.36 | |
| If DHW from community scheme:<br>Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1185.64 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1185.64 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 52.8 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f):<br>mechanical ventilation - balanced, extract or positive input from outside | | 390.78 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 390.78 | (331) |
| Energy for lighting (calculated in Appendix L) | | 515.24 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -730.31 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | | Energy kWh/year | Emission factor kg CO2/kWh | | Emissions kg CO2/year | |
|---|---|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP)<br>Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 91 | (367b) |
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.52 | = | 322.41 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.22 | = | 626.67 | (368) |
| Electrical energy for heat distribution | [(313) x | | 0.52 | = | 27.4 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | | = | 976.49 | (373) |
| CO2 associated with space heating (secondary) | (309) x | | 0 | = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | | 0.52 | = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | | 976.49 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | | 0.52 | = | 202.81 | (378) |
| CO2 associated with electricity for lighting | (332))) x | | 0.52 | = | 267.41 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable<br>Item 1 | | | 0.52 | x 0.01 = | -379.03 | (380) |

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| | | | |
|---|---|---|---|
| **Total CO2, kg/year** | sum of (376)…(382) = | 1067.68 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | 8.92 | (384) |
| **EI rating (section 14)** | | 91.31 | (385) |

# DER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: P2

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Basement | 107.83 | (1a) x | 2.55 | (2a) = | 274.97 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 107.83 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 274.97 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.92 | x1/[1/( 1.2 )+ 0.04] = | 5.63 | | | (27) |
| Windows Type 2 | | | 4.92 | x1/[1/( 1.2 )+ 0.04] = | 5.63 | | | (27) |
| Windows Type 3 | | | 2.39 | x1/[1/( 1.2 )+ 0.04] = | 2.74 | | | (27) |
| Floor | | | 107.83 | x 0.13 = | 14.0179 | | | (28) |
| Walls Type1 | 74.77 | 12.23 | 62.54 | x 0.18 = | 11.26 | | | (29) |
| Walls Type2 | 12.35 | 0 | 12.35 | x 0.23 = | 2.79 | | | (29) |
| Total area of elements, m² | | | 194.95 | | | | | (31) |
| Party wall | | | 36.38 | x 0 = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 42.07 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 17991.8 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 13.95 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 56.02 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 28.88 | 28.59 | 28.3 | 26.86 | 26.57 | 25.12 | 25.12 | 24.83 | 25.7 | 26.57 | 27.15 | 27.73 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 84.9 | 84.61 | 84.32 | 82.88 | 82.59 | 81.14 | 81.14 | 80.85 | 81.72 | 82.59 | 83.17 | 83.74 | |

Average = Sum(39)$_{1…12}$ /12= 82.8 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.79 | 0.78 | 0.78 | 0.77 | 0.77 | 0.75 | 0.75 | 0.75 | 0.76 | 0.77 | 0.77 | 0.78 | |

Average = Sum(40)1…12 /12= 0.77 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.8 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 100.73 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | | |
| (44)m= | 110.8 | 106.77 | 102.74 | 98.71 | 94.68 | 90.65 | 90.65 | 94.68 | 98.71 | 102.74 | 106.77 | 110.8 | |
| | | | | | | | | | | Total = Sum(44)1…12 = | | | 1208.73 (44) |
| *Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)* | | | | | | | | | | | | | |
| (45)m= | 164.31 | 143.71 | 148.3 | 129.29 | 124.05 | 107.05 | 99.2 | 113.83 | 115.19 | 134.24 | 146.54 | 159.13 | |
| | | | | | | | | | | Total = Sum(45)1…12 = | | | 1584.83 (45) |
| *If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)* | | | | | | | | | | | | | |
| (46)m= | 24.65 | 21.56 | 22.24 | 19.39 | 18.61 | 16.06 | 14.88 | 17.07 | 17.28 | 20.14 | 21.98 | 23.87 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |
| If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H | | | | | | | | | | | | | |
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 219.59 | 193.64 | 203.57 | 182.78 | 179.33 | 160.54 | 154.47 | 169.11 | 168.68 | 189.52 | 200.03 | 214.41 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 219.59 | 193.64 | 203.57 | 182.78 | 179.33 | 160.54 | 154.47 | 169.11 | 168.68 | 189.52 | 200.03 | 214.41 | |

Output from water heater (annual)$_{1...12}$ 2235.67 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 98.86 | 87.73 | 93.53 | 85.78 | 85.47 | 78.39 | 77.2 | 82.07 | 81.1 | 88.86 | 91.52 | 97.13 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 140.06 | 140.06 | 140.06 | 140.06 | 140.06 | 140.06 | 140.06 | 140.06 | 140.06 | 140.06 | 140.06 | 140.06 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 26.89 | 23.88 | 19.42 | 14.71 | 10.99 | 9.28 | 10.03 | 13.03 | 17.49 | 22.21 | 25.93 | 27.64 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 268.4 | 271.19 | 264.17 | 249.23 | 230.36 | 212.64 | 200.8 | 198.01 | 205.03 | 219.97 | 238.83 | 256.56 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 37.01 | 37.01 | 37.01 | 37.01 | 37.01 | 37.01 | 37.01 | 37.01 | 37.01 | 37.01 | 37.01 | 37.01 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -112.05 | -112.05 | -112.05 | -112.05 | -112.05 | -112.05 | -112.05 | -112.05 | -112.05 | -112.05 | -112.05 | -112.05 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 132.87 | 130.54 | 125.71 | 119.14 | 114.88 | 108.87 | 103.77 | 110.31 | 112.63 | 119.43 | 127.11 | 130.55 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 493.18 | 490.63 | 474.32 | 448.09 | 421.25 | 395.81 | 379.61 | 386.37 | 400.17 | 426.63 | 456.88 | 479.77 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.92 | x | 19.64 | x | 0.5 | x | 0.7 | = | 23.44 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 38.42 | x | 0.5 | x | 0.7 | = | 45.85 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 63.27 | x | 0.5 | x | 0.7 | = | 75.51 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 92.28 | x | 0.5 | x | 0.7 | = | 110.12 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 113.09 | x | 0.5 | x | 0.7 | = | 134.96 | (76) |

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| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.92 | x | 115.77 | x | 0.5 | x | 0.7 | = | 138.15 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 110.22 | x | 0.5 | x | 0.7 | = | 131.53 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 94.68 | x | 0.5 | x | 0.7 | = | 112.98 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 73.59 | x | 0.5 | x | 0.7 | = | 87.82 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 45.59 | x | 0.5 | x | 0.7 | = | 54.4 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 24.49 | x | 0.5 | x | 0.7 | = | 29.22 | (76) |
| East | 0.9x | 1 | x | 4.92 | x | 16.15 | x | 0.5 | x | 0.7 | = | 19.27 | (76) |
| West | 0.9x | 0.77 | x | 4.92 | x | 19.64 | x | 0.5 | x | 0.7 | = | 23.44 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 19.64 | x | 0.5 | x | 0.7 | = | 11.39 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 38.42 | x | 0.5 | x | 0.7 | = | 45.85 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 38.42 | x | 0.5 | x | 0.7 | = | 22.27 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 63.27 | x | 0.5 | x | 0.7 | = | 75.51 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 63.27 | x | 0.5 | x | 0.7 | = | 36.68 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 92.28 | x | 0.5 | x | 0.7 | = | 110.12 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 92.28 | x | 0.5 | x | 0.7 | = | 53.49 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 113.09 | x | 0.5 | x | 0.7 | = | 134.96 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 113.09 | x | 0.5 | x | 0.7 | = | 65.56 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 115.77 | x | 0.5 | x | 0.7 | = | 138.15 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 115.77 | x | 0.5 | x | 0.7 | = | 67.11 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 110.22 | x | 0.5 | x | 0.7 | = | 131.53 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 110.22 | x | 0.5 | x | 0.7 | = | 63.89 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 94.68 | x | 0.5 | x | 0.7 | = | 112.98 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 94.68 | x | 0.5 | x | 0.7 | = | 54.88 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 73.59 | x | 0.5 | x | 0.7 | = | 87.82 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 73.59 | x | 0.5 | x | 0.7 | = | 42.66 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 45.59 | x | 0.5 | x | 0.7 | = | 54.4 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 45.59 | x | 0.5 | x | 0.7 | = | 26.43 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 24.49 | x | 0.5 | x | 0.7 | = | 29.22 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 24.49 | x | 0.5 | x | 0.7 | = | 14.2 | (80) |
| West | 0.9x | 0.77 | x | 4.92 | x | 16.15 | x | 0.5 | x | 0.7 | = | 19.27 | (80) |
| West | 0.9x | 0.77 | x | 2.39 | x | 16.15 | x | 0.5 | x | 0.7 | = | 9.36 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 58.26 | 113.97 | 187.69 | 273.74 | 335.48 | 343.42 | 326.95 | 280.85 | 218.29 | 135.24 | 72.64 | 47.91 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 551.44 | 604.6 | 662.01 | 721.83 | 756.73 | 739.23 | 706.56 | 667.22 | 618.47 | 561.87 | 529.53 | 527.68 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.97 | 0.96 | 0.94 | 0.88 | 0.78 | 0.62 | 0.48 | 0.52 | 0.74 | 0.9 | 0.96 | 0.98 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.33 | 19.52 | 19.86 | 20.3 | 20.66 | 20.89 | 20.97 | 20.96 | 20.79 | 20.33 | 19.77 | 19.3 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.26 | 20.27 | 20.27 | 20.28 | 20.28 | 20.29 | 20.29 | 20.3 | 20.29 | 20.28 | 20.28 | 20.27 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.97 | 0.96 | 0.93 | 0.86 | 0.75 | 0.57 | 0.41 | 0.45 | 0.69 | 0.89 | 0.95 | 0.97 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.99 | 18.26 | 18.75 | 19.39 | 19.88 | 20.19 | 20.27 | 20.26 | 20.07 | 19.44 | 18.63 | 17.95 | (90) |

fLA = Living area ÷ (4) = 0.29 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.38 | 18.63 | 19.07 | 19.65 | 20.11 | 20.39 | 20.47 | 20.46 | 20.28 | 19.7 | 18.96 | 18.35 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.38 | 18.63 | 19.07 | 19.65 | 20.11 | 20.39 | 20.47 | 20.46 | 20.28 | 19.7 | 18.96 | 18.35 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.96 | 0.94 | 0.91 | 0.85 | 0.74 | 0.58 | 0.43 | 0.47 | 0.69 | 0.87 | 0.94 | 0.96 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 528.43 | 570.3 | 603.65 | 611.33 | 559.49 | 428.72 | 303.33 | 313.61 | 427.42 | 489.3 | 497.91 | 508.17 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1195.28 | 1161.61 | 1060.15 | 891.12 | 694.45 | 469.84 | 314.19 | 328.51 | 505.13 | 751.45 | 986.32 | 1184.74 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 496.14 | 397.37 | 339.64 | 201.45 | 100.41 | 0 | 0 | 0 | 0 | 195.04 | 351.66 | 503.37 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2585.06 (98)

Space heating requirement in kWh/m²/year 23.97 (99)

## 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |

| | kWh/year |
|---|---|
| **Space heating** | |
| Annual space heating requirement | 2585.06 |

# DER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 1357.16 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 1357.16 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |

**Water heating**

| | | | |
|---|---|---|---|
| Annual water heating requirement | | 2235.67 | |
| If DHW from community scheme: Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1173.73 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1173.73 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 50.62 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside | | 352.23 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 352.23 | (331) |
| Energy for lighting (calculated in Appendix L) | | 474.91 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -658.68 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 12b. $CO_2$ Emissions – Community heating scheme

| | | Energy kWh/year | Emission factor kg $CO_2$/kWh | | Emissions kg $CO_2$/year | |
|---|---|---|---|---|---|---|
| $CO_2$ from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 91 | (367b) |
| $CO_2$ associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.52 | = | 309.07 | (367) |
| $CO_2$ associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.22 | = | 600.74 | (368) |
| Electrical energy for heat distribution | [(313) x | | 0.52 | = | 26.27 | (372) |
| Total $CO_2$ associated with community systems | (363)…(366) + (368)...(372) | | | = | 936.07 | (373) |
| $CO_2$ associated with space heating (secondary) | (309) x | | 0 | = | 0 | (374) |
| $CO_2$ associated with water from immersion heater or instantaneous heater | (312) x | | 0.52 | = | 0 | (375) |
| Total $CO_2$ associated with space and water heating | (373) + (374) + (375) = | | | | 936.07 | (376) |
| $CO_2$ associated with electricity for pumps and fans within dwelling | (331)) x | | 0.52 | = | 182.81 | (378) |
| $CO_2$ associated with electricity for lighting | (332))) x | | 0.52 | = | 246.48 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable Item 1 | | 0.52 | | x 0.01 = | -341.85 | (380) |

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| | | | |
|---|---|---|---|
| **Total CO2, kg/year** | sum of (376)…(382) = | 1023.51 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | 9.49 | (384) |
| **EI rating (section 14)** | | 91.03 | (385) |

# DER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: P3

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 74.01 | (1a) x | 2.55 | (2a) = | 188.73 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 74.01 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 188.73 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 10.85 | x1/[1/( 1.2 )+ 0.04] | | = | 12.42 | | | (27) |
| Windows Type 2 | | | 4.5 | x1/[1/( 1.2 )+ 0.04] | | = | 5.15 | | | (27) |
| Walls Type1 | 34.74 | 19.85 | 14.89 | x | 0.18 | = | 2.68 | | | (29) |
| Walls Type2 | 43.33 | 0 | 43.33 | x | 0.23 | = | 9.85 | | | (29) |
| Total area of elements, m² | | | 78.07 | | | | | | | (31) |
| Party wall | | | 33.58 | x | 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 35.26 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 5004.3 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 13.95 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 49.21 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 19.82 | 19.63 | 19.43 | 18.43 | 18.24 | 17.24 | 17.24 | 17.05 | 17.64 | 18.24 | 18.63 | 19.03 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 69.03 | 68.83 | 68.64 | 67.64 | 67.44 | 66.45 | 66.45 | 66.25 | 66.85 | 67.44 | 67.84 | 68.24 | |

Average = Sum(39)$_{1…12}$ /12= 67.59 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.93 | 0.93 | 0.93 | 0.91 | 0.91 | 0.9 | 0.9 | 0.9 | 0.9 | 0.91 | 0.92 | 0.92 |

Average = Sum(40)$_{1...12}$ /12= 0.91 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.34 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 89.76 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | | |
| (44)m= | 98.74 | 95.15 | 91.56 | 87.97 | 84.38 | 80.79 | 80.79 | 84.38 | 87.97 | 91.56 | 95.15 | 98.74 | |
| | | | | | | | | | | | | Total = Sum(44)$_{1...12}$ = 1077.13 | (44) |
| *Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)* | | | | | | | | | | | | | |
| (45)m= | 146.42 | 128.06 | 132.15 | 115.21 | 110.55 | 95.39 | 88.4 | 101.44 | 102.65 | 119.63 | 130.58 | 141.8 | |
| | | | | | | | | | | | | Total = Sum(45)$_{1...12}$ = 1412.29 | (45) |
| *If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)* | | | | | | | | | | | | | |
| (46)m= | 21.96 | 19.21 | 19.82 | 17.28 | 16.58 | 14.31 | 13.26 | 15.22 | 15.4 | 17.94 | 19.59 | 21.27 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a — 1.03 (52)

Temperature factor from Table 2b — 0.6 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) — 1.03 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 201.7 | 177.99 | 187.43 | 168.71 | 165.83 | 148.89 | 143.67 | 156.71 | 156.14 | 174.9 | 184.08 | 197.08 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 201.7 | 177.99 | 187.43 | 168.71 | 165.83 | 148.89 | 143.67 | 156.71 | 156.14 | 174.9 | 184.08 | 197.08 | |

Output from water heater (annual)$_{1...12}$ 2063.13 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 92.91 | 82.52 | 88.16 | 81.1 | 80.98 | 74.51 | 73.61 | 77.95 | 76.93 | 84 | 86.21 | 91.37 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Metabolic gains (Table 5), Watts** | | | | | | | | | | | | | |
| (66)m= | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | (66) |
| **Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5** | | | | | | | | | | | | | |
| (67)m= | 18.41 | 16.35 | 13.3 | 10.07 | 7.52 | 6.35 | 6.86 | 8.92 | 11.98 | 15.21 | 17.75 | 18.92 | (67) |
| **Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5** | | | | | | | | | | | | | |
| (68)m= | 206.47 | 208.61 | 203.21 | 191.72 | 177.21 | 163.57 | 154.46 | 152.32 | 157.72 | 169.21 | 183.72 | 197.36 | (68) |
| **Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5** | | | | | | | | | | | | | |
| (69)m= | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | (69) |
| **Pumps and fans gains (Table 5a)** | | | | | | | | | | | | | |
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |
| **Losses e.g. evaporation (negative values) (Table 5)** | | | | | | | | | | | | | |
| (71)m= | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | (71) |
| **Water heating gains (Table 5)** | | | | | | | | | | | | | |
| (72)m= | 124.88 | 122.8 | 118.5 | 112.64 | 108.84 | 103.49 | 98.94 | 104.77 | 106.84 | 112.9 | 119.74 | 122.81 | (72) |
| **Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m | | | | | | | | | | | | | |
| (73)m= | 407.84 | 405.85 | 393.1 | 372.52 | 351.67 | 331.51 | 318.36 | 324.11 | 334.63 | 355.41 | 379.3 | 397.18 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 10.85 | x | 19.64 | x | 0.5 | x | 0.7 | = | 51.69 | (76) |
| East | 0.9x | 2 | x | 4.5 | x | 19.64 | x | 0.5 | x | 0.7 | = | 42.87 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 38.42 | x | 0.5 | x | 0.7 | = | 101.11 | (76) |
| East | 0.9x | 2 | x | 4.5 | x | 38.42 | x | 0.5 | x | 0.7 | = | 83.87 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 63.27 | x | 0.5 | x | 0.7 | = | 166.51 | (76) |

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| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 2 | x | 4.5 | x | 63.27 | x | 0.5 | x | 0.7 | = | 138.12 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 92.28 | x | 0.5 | x | 0.7 | = | 242.85 | (76) |
| East | 0.9x | 2 | x | 4.5 | x | 92.28 | x | 0.5 | x | 0.7 | = | 201.44 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 113.09 | x | 0.5 | x | 0.7 | = | 297.62 | (76) |
| East | 0.9x | 2 | x | 4.5 | x | 113.09 | x | 0.5 | x | 0.7 | = | 246.88 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 115.77 | x | 0.5 | x | 0.7 | = | 304.67 | (76) |
| East | 0.9x | 2 | x | 4.5 | x | 115.77 | x | 0.5 | x | 0.7 | = | 252.72 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 110.22 | x | 0.5 | x | 0.7 | = | 290.06 | (76) |
| East | 0.9x | 2 | x | 4.5 | x | 110.22 | x | 0.5 | x | 0.7 | = | 240.6 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 94.68 | x | 0.5 | x | 0.7 | = | 249.16 | (76) |
| East | 0.9x | 2 | x | 4.5 | x | 94.68 | x | 0.5 | x | 0.7 | = | 206.67 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 73.59 | x | 0.5 | x | 0.7 | = | 193.66 | (76) |
| East | 0.9x | 2 | x | 4.5 | x | 73.59 | x | 0.5 | x | 0.7 | = | 160.64 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 45.59 | x | 0.5 | x | 0.7 | = | 119.98 | (76) |
| East | 0.9x | 2 | x | 4.5 | x | 45.59 | x | 0.5 | x | 0.7 | = | 99.52 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 24.49 | x | 0.5 | x | 0.7 | = | 64.45 | (76) |
| East | 0.9x | 2 | x | 4.5 | x | 24.49 | x | 0.5 | x | 0.7 | = | 53.46 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 16.15 | x | 0.5 | x | 0.7 | = | 42.5 | (76) |
| East | 0.9x | 2 | x | 4.5 | x | 16.15 | x | 0.5 | x | 0.7 | = | 35.26 | (76) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 94.56 | 184.98 | 304.64 | 444.29 | 544.5 | 557.39 | 530.66 | 455.83 | 354.3 | 219.49 | 117.91 | 77.76 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 502.4 | 590.83 | 697.73 | 816.81 | 896.17 | 888.9 | 849.02 | 779.93 | 688.93 | 574.9 | 497.21 | 474.94 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.95 | 0.92 | 0.86 | 0.75 | 0.61 | 0.45 | 0.34 | 0.38 | 0.59 | 0.82 | 0.93 | 0.96 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.24 | 19.53 | 19.97 | 20.46 | 20.78 | 20.94 | 20.98 | 20.97 | 20.85 | 20.4 | 19.73 | 19.19 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.14 | 20.14 | 20.14 | 20.16 | 20.16 | 20.17 | 20.17 | 20.17 | 20.16 | 20.16 | 20.15 | 20.15 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.94 | 0.91 | 0.85 | 0.72 | 0.57 | 0.4 | 0.28 | 0.31 | 0.53 | 0.79 | 0.91 | 0.95 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.77 | 18.19 | 18.82 | 19.5 | 19.92 | 20.11 | 20.16 | 20.15 | 20.02 | 19.43 | 18.5 | 17.71 | (90) |

fLA = Living area ÷ (4) = 0.4 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.35 | 18.72 | 19.28 | 19.88 | 20.26 | 20.44 | 20.48 | 20.48 | 20.35 | 19.81 | 18.99 | 18.29 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.35 | 18.72 | 19.28 | 19.88 | 20.26 | 20.44 | 20.48 | 20.48 | 20.35 | 19.81 | 18.99 | 18.29 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.93 | 0.89 | 0.83 | 0.71 | 0.57 | 0.42 | 0.3 | 0.34 | 0.55 | 0.78 | 0.9 | 0.94 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 465.78 | 527.52 | 577.78 | 584.01 | 512.04 | 370.06 | 253.32 | 263.2 | 376.62 | 448.68 | 445.57 | 444.35 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 970.21 | 951.39 | 877.08 | 743.01 | 577.23 | 387.93 | 258.04 | 270.11 | 417.83 | 621.44 | 806.45 | 961.74 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 375.29 | 284.84 | 222.68 | 114.48 | 48.5 | 0 | 0 | 0 | 0 | 128.53 | 259.83 | 384.94 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 1819.1 | (98)

Space heating requirement in kWh/m²/year | 24.58 | (99)

## 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |
| **Space heating** | | **kWh/year** | |
| Annual space heating requirement | | 1819.1 | |
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 955.03 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 955.03 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |
| **Water heating** | | | |
| Annual water heating requirement | | 2063.13 | |
| If DHW from community scheme:<br>Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1083.14 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1083.14 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 40.76 | (313) |

# DER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f):<br>mechanical ventilation - balanced, extract or positive input from outside | | 241.76 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 241.76 | (331) |
| Energy for lighting (calculated in Appendix L) | | 325.07 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -452.02 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | | Energy kWh/year | Emission factor kg CO2/kWh | | Emissions kg CO2/year | |
|---|---|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP)<br>Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 91 | (367b) |
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.52 | = | 248.9 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.22 | = | 483.79 | (368) |
| Electrical energy for heat distribution | [(313) x | | 0.52 | = | 21.16 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | | = | 753.84 | (373) |
| CO2 associated with space heating (secondary) | (309) x | | 0 | = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | | 0.52 | = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | | 753.84 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | | 0.52 | = | 125.47 | (378) |
| CO2 associated with electricity for lighting | (332))) x | | 0.52 | = | 168.71 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable<br>Item 1 | | 0.52 | x 0.01 = | | -234.6 | (380) |
| **Total CO2, kg/year** | sum of (376)…(382) = | | | | 813.43 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | | | | 10.99 | (384) |
| **EI rating (section 14)** | | | | | 90.84 | (385) |

# DER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: P4

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 94.7 | (1a) | x | 2.55 | (2a) | = | 241.48 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 94.7 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | | = | 241.48 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.5 | x1/[1/( 1.2 )+ 0.04] = | 5.15 | | | (27) |
| Windows Type 2 | | | 2.26 | x1/[1/( 1.2 )+ 0.04] = | 2.59 | | | (27) |
| Windows Type 3 | | | 4.72 | x1/[1/( 1.2 )+ 0.04] = | 5.4 | | | (27) |
| Windows Type 4 | | | 2.29 | x1/[1/( 1.2 )+ 0.04] = | 2.62 | | | (27) |
| Floor | | | 33.02 | x 0.13 = | 4.2926 | | | (28) |
| Walls Type1 | 34.82 | 13.77 | 21.05 | x 0.18 = | 3.79 | | | (29) |
| Walls Type2 | 4.02 | 0 | 4.02 | x 0.23 = | 0.91 | | | (29) |
| Total area of elements, m² | | | 71.86 | | | | | (31) |
| Party wall | | | 78.29 | x 0 = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 24.76 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 7503.51 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 13.95 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 38.71 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 25.37 | 25.11 | 24.86 | 23.59 | 23.33 | 22.06 | 22.06 | 21.81 | 22.57 | 23.33 | 23.84 | 24.35 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 64.08 | 63.83 | 63.57 | 62.3 | 62.05 | 60.78 | 60.78 | 60.52 | 61.29 | 62.05 | 62.56 | 63.06 | |

Average = Sum(39)$_{1…12}$ /12= 62.24 (39)

# DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.68 | 0.67 | 0.67 | 0.66 | 0.66 | 0.64 | 0.64 | 0.64 | 0.65 | 0.66 | 0.66 | 0.67 |

Average = Sum(40)$_{1...12}$ /12= 0.66 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.68 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 97.96 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | |
| (44)m= | 107.76 | 103.84 | 99.92 | 96 | 92.09 | 88.17 | 88.17 | 92.09 | 96 | 99.92 | 103.84 | 107.76 |

Total = Sum(44)$_{1...12}$ = 1175.55 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 159.8 | 139.77 | 144.23 | 125.74 | 120.65 | 104.11 | 96.47 | 110.71 | 112.03 | 130.56 | 142.51 | 154.76 |

Total = Sum(45)$_{1...12}$ = 1541.34 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 23.97 | 20.96 | 21.63 | 18.86 | 18.1 | 15.62 | 14.47 | 16.61 | 16.8 | 19.58 | 21.38 | 23.21 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 215.08 | 189.69 | 199.5 | 179.23 | 175.93 | 157.61 | 151.75 | 165.98 | 165.52 | 185.83 | 196.01 | 210.04 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 215.08 | 189.69 | 199.5 | 179.23 | 175.93 | 157.61 | 151.75 | 165.98 | 165.52 | 185.83 | 196.01 | 210.04 | |

Output from water heater (annual)$_{1...12}$ 2192.18 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 97.36 | 86.41 | 92.18 | 84.6 | 84.34 | 77.41 | 76.3 | 81.03 | 80.04 | 87.63 | 90.18 | 95.68 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 134.24 | 134.24 | 134.24 | 134.24 | 134.24 | 134.24 | 134.24 | 134.24 | 134.24 | 134.24 | 134.24 | 134.24 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 23.48 | 20.85 | 16.96 | 12.84 | 9.6 | 8.1 | 8.75 | 11.38 | 15.27 | 19.39 | 22.63 | 24.13 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 247.46 | 250.03 | 243.56 | 229.78 | 212.4 | 196.05 | 185.13 | 182.56 | 189.04 | 202.81 | 220.2 | 236.55 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 36.42 | 36.42 | 36.42 | 36.42 | 36.42 | 36.42 | 36.42 | 36.42 | 36.42 | 36.42 | 36.42 | 36.42 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -107.39 | -107.39 | -107.39 | -107.39 | -107.39 | -107.39 | -107.39 | -107.39 | -107.39 | -107.39 | -107.39 | -107.39 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 130.86 | 128.59 | 123.89 | 117.5 | 113.36 | 107.52 | 102.55 | 108.91 | 111.17 | 117.78 | 125.25 | 128.6 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 465.07 | 462.75 | 447.68 | 423.4 | 398.62 | 374.94 | 359.71 | 366.13 | 378.75 | 403.26 | 431.36 | 452.55 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.5 | x | 19.64 | x | 0.5 | x | 0.7 | = | 21.44 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 19.64 | x | 0.5 | x | 0.7 | = | 10.77 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 38.42 | x | 0.5 | x | 0.7 | = | 41.94 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 38.42 | x | 0.5 | x | 0.7 | = | 21.06 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 63.27 | x | 0.5 | x | 0.7 | = | 69.06 | (76) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 2.26 | x | 63.27 | x | 0.5 | x | 0.7 | = | 34.68 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 92.28 | x | 0.5 | x | 0.7 | = | 100.72 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 92.28 | x | 0.5 | x | 0.7 | = | 50.58 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 113.09 | x | 0.5 | x | 0.7 | = | 123.44 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 113.09 | x | 0.5 | x | 0.7 | = | 61.99 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 115.77 | x | 0.5 | x | 0.7 | = | 126.36 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 115.77 | x | 0.5 | x | 0.7 | = | 63.46 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 110.22 | x | 0.5 | x | 0.7 | = | 120.3 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 110.22 | x | 0.5 | x | 0.7 | = | 60.42 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 94.68 | x | 0.5 | x | 0.7 | = | 103.34 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 94.68 | x | 0.5 | x | 0.7 | = | 51.9 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 73.59 | x | 0.5 | x | 0.7 | = | 80.32 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 73.59 | x | 0.5 | x | 0.7 | = | 40.34 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 45.59 | x | 0.5 | x | 0.7 | = | 49.76 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 45.59 | x | 0.5 | x | 0.7 | = | 24.99 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 24.49 | x | 0.5 | x | 0.7 | = | 26.73 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 24.49 | x | 0.5 | x | 0.7 | = | 13.42 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 16.15 | x | 0.5 | x | 0.7 | = | 17.63 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 16.15 | x | 0.5 | x | 0.7 | = | 8.85 | (76) |
| West | 0.9x | 0.77 | x | 4.72 | x | 19.64 | x | 0.5 | x | 0.7 | = | 22.48 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 19.64 | x | 0.5 | x | 0.7 | = | 10.91 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 38.42 | x | 0.5 | x | 0.7 | = | 43.99 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 38.42 | x | 0.5 | x | 0.7 | = | 21.34 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 63.27 | x | 0.5 | x | 0.7 | = | 72.44 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 63.27 | x | 0.5 | x | 0.7 | = | 35.14 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 92.28 | x | 0.5 | x | 0.7 | = | 105.65 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 92.28 | x | 0.5 | x | 0.7 | = | 51.26 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 113.09 | x | 0.5 | x | 0.7 | = | 129.47 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 113.09 | x | 0.5 | x | 0.7 | = | 62.82 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 115.77 | x | 0.5 | x | 0.7 | = | 132.54 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 115.77 | x | 0.5 | x | 0.7 | = | 64.3 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 110.22 | x | 0.5 | x | 0.7 | = | 126.18 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 110.22 | x | 0.5 | x | 0.7 | = | 61.22 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 94.68 | x | 0.5 | x | 0.7 | = | 108.39 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 94.68 | x | 0.5 | x | 0.7 | = | 52.59 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 73.59 | x | 0.5 | x | 0.7 | = | 84.25 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 73.59 | x | 0.5 | x | 0.7 | = | 40.87 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 45.59 | x | 0.5 | x | 0.7 | = | 52.19 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 45.59 | x | 0.5 | x | 0.7 | = | 25.32 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 24.49 | x | 0.5 | x | 0.7 | = | 28.04 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 24.49 | x | 0.5 | x | 0.7 | = | 13.6 | (80) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 4.72 | x | 16.15 | x | 0.5 | x | 0.7 | = | 18.49 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 16.15 | x | 0.5 | x | 0.7 | = | 8.97 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 65.6 | 128.32 | 211.33 | 308.21 | 377.72 | 386.66 | 368.12 | 316.21 | 245.78 | 152.26 | 81.79 | 53.94 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 530.66 | 591.07 | 659.01 | 731.61 | 776.34 | 761.6 | 727.83 | 682.34 | 624.53 | 555.52 | 513.15 | 506.49 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.96 | 0.94 | 0.9 | 0.8 | 0.66 | 0.49 | 0.36 | 0.4 | 0.62 | 0.85 | 0.94 | 0.97 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.74 | 19.94 | 20.25 | 20.62 | 20.86 | 20.97 | 20.99 | 20.99 | 20.92 | 20.6 | 20.12 | 19.71 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.36 | 20.36 | 20.37 | 20.38 | 20.38 | 20.39 | 20.39 | 20.39 | 20.39 | 20.38 | 20.38 | 20.37 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.96 | 0.94 | 0.89 | 0.78 | 0.63 | 0.45 | 0.31 | 0.35 | 0.58 | 0.83 | 0.93 | 0.96 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.64 | 18.93 | 19.38 | 19.9 | 20.22 | 20.36 | 20.39 | 20.39 | 20.3 | 19.89 | 19.2 | 18.6 | (90) |

fLA = Living area ÷ (4) = | 0.36 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 19.04 | 19.3 | 19.7 | 20.17 | 20.45 | 20.58 | 20.61 | 20.61 | 20.53 | 20.15 | 19.54 | 19.01 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 19.04 | 19.3 | 19.7 | 20.17 | 20.45 | 20.58 | 20.61 | 20.61 | 20.53 | 20.15 | 19.54 | 19.01 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.95 | 0.92 | 0.87 | 0.78 | 0.63 | 0.46 | 0.33 | 0.37 | 0.59 | 0.82 | 0.92 | 0.95 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 501.81 | 545.04 | 575.54 | 567.43 | 492.39 | 352.49 | 241.23 | 251.07 | 366.45 | 454.14 | 471.66 | 482.25 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 944.47 | 918.8 | 839.18 | 701.92 | 542.93 | 363.52 | 243.54 | 254.52 | 393.9 | 592.44 | 778.06 | 933.77 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 329.34 | 251.17 | 196.15 | 96.84 | 37.6 | 0 | 0 | 0 | 0 | 102.89 | 220.61 | 335.93 | |

Total per year (kWh/year) = Sum(98)$_{1…5,9…12}$ = | 1570.53 | (98)

Space heating requirement in kWh/m²/year | 16.58 | (99)

## 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

# DER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |
| **Space heating** | | **kWh/year** | |
| Annual space heating requirement | | 1570.53 | |
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 824.53 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 824.53 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |
| **Water heating** | | | |
| Annual water heating requirement | | 2192.18 | |
| If DHW from community scheme:<br>Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1150.89 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1150.89 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 39.51 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f):<br>mechanical ventilation - balanced, extract or positive input from outside | | 309.34 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 309.34 | (331) |
| Energy for lighting (calculated in Appendix L) | | 414.58 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -577.99 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | **Energy kWh/year** | **Emission factor kg CO2/kWh** | **Emissions kg CO2/year** | |
|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP)<br>Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | 91 | (367b) |

# DER WorkSheet: New dwelling design stage

| | | | | | |
|---|---|---|---|---|---|
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | 0.52 | = | 241.23 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | 0.22 | = | 468.89 | (368) |
| Electrical energy for heat distribution | [(313) x | 0.52 | = | 20.5 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | = | 730.63 | (373) |
| CO2 associated with space heating (secondary) | (309) x | 0 | = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | 0.52 | = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | 730.63 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | 0.52 | = | 160.55 | (378) |
| CO2 associated with electricity for lighting | (332))) x | 0.52 | = | 215.17 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable<br>Item 1 | | 0.52 | x 0.01 = | -299.98 | (380) |
| **Total CO2, kg/year** | sum of (376)…(382) = | | | 806.37 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | | | 8.51 | (384) |
| **EI rating (section 14)** | | | | 92.27 | (385) |

# DER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: P5

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 97.6 | (1a) x | 2.55 | (2a) = | 248.88 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 97.6 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 248.88 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.5 | x1/[1/( 1.2 )+ 0.04] = | 5.15 | | | (27) |
| Windows Type 2 | | | 2.26 | x1/[1/( 1.2 )+ 0.04] = | 2.59 | | | (27) |
| Windows Type 3 | | | 4.72 | x1/[1/( 1.2 )+ 0.04] = | 5.4 | | | (27) |
| Windows Type 4 | | | 2.29 | x1/[1/( 1.2 )+ 0.04] = | 2.62 | | | (27) |
| Floor | | | 33.02 x | 0.13 = | 4.2926 | | | (28) |
| Walls Type1 | 34.82 | 13.77 | 21.05 x | 0.18 = | 3.79 | | | (29) |
| Walls Type2 | 4.02 | 0 | 4.02 x | 0.23 = | 0.91 | | | (29) |
| Total area of elements, m² | | | 71.86 | | | | | (31) |
| Party wall | | | 78.29 x | 0 = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 24.76 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 7503.51 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 13.95 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 38.71 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 26.14 | 25.88 | 25.62 | 24.31 | 24.05 | 22.74 | 22.74 | 22.48 | 23.26 | 24.05 | 24.57 | 25.1 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 64.86 | 64.59 | 64.33 | 63.02 | 62.76 | 61.45 | 61.45 | 61.19 | 61.98 | 62.76 | 63.29 | 63.81 | |

Average = Sum(39)$_{1…12}$ /12= 62.96 (39)

Heat loss parameter (HLP), W/m²K    (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.66 | 0.66 | 0.66 | 0.65 | 0.64 | 0.63 | 0.63 | 0.63 | 0.64 | 0.64 | 0.65 | 0.65 |

Average = Sum(40)$_{1…12}$ /12= 0.65 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.72 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 98.71 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | |
| (44)m= | 108.58 | 104.63 | 100.68 | 96.73 | 92.79 | 88.84 | 88.84 | 92.79 | 96.73 | 100.68 | 104.63 | 108.58 |

Total = Sum(44)$_{1…12}$ = 1184.51 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 161.02 | 140.83 | 145.32 | 126.7 | 121.57 | 104.9 | 97.21 | 111.55 | 112.88 | 131.55 | 143.6 | 155.94 |

Total = Sum(45)$_{1…12}$ = 1553.08 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 24.15 | 21.12 | 21.8 | 19 | 18.24 | 15.74 | 14.58 | 16.73 | 16.93 | 19.73 | 21.54 | 23.39 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

# DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 216.3 | 190.76 | 200.6 | 180.19 | 176.85 | 158.4 | 152.49 | 166.83 | 166.38 | 186.83 | 197.09 | 211.22 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 216.3 | 190.76 | 200.6 | 180.19 | 176.85 | 158.4 | 152.49 | 166.83 | 166.38 | 186.83 | 197.09 | 211.22 | |

Output from water heater (annual)$_{1...12}$ 2203.92 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 97.76 | 86.77 | 92.54 | 84.92 | 84.64 | 77.68 | 76.54 | 81.31 | 80.33 | 87.96 | 90.54 | 96.07 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 135.81 | 135.81 | 135.81 | 135.81 | 135.81 | 135.81 | 135.81 | 135.81 | 135.81 | 135.81 | 135.81 | 135.81 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 24.1 | 21.4 | 17.41 | 13.18 | 9.85 | 8.32 | 8.99 | 11.68 | 15.68 | 19.91 | 23.23 | 24.77 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 252.39 | 255.01 | 248.41 | 234.36 | 216.62 | 199.95 | 188.82 | 186.2 | 192.8 | 206.85 | 224.58 | 241.25 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 36.58 | 36.58 | 36.58 | 36.58 | 36.58 | 36.58 | 36.58 | 36.58 | 36.58 | 36.58 | 36.58 | 36.58 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -108.65 | -108.65 | -108.65 | -108.65 | -108.65 | -108.65 | -108.65 | -108.65 | -108.65 | -108.65 | -108.65 | -108.65 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 131.4 | 129.12 | 124.38 | 117.95 | 113.77 | 107.88 | 102.88 | 109.29 | 111.57 | 118.23 | 125.75 | 129.13 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 471.63 | 469.27 | 453.94 | 429.22 | 403.98 | 379.89 | 364.43 | 370.91 | 383.78 | 408.73 | 437.31 | 458.89 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.5 | x | 19.64 | x | 0.5 | x | 0.7 | = | 21.44 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 19.64 | x | 0.5 | x | 0.7 | = | 10.77 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 38.42 | x | 0.5 | x | 0.7 | = | 41.94 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 38.42 | x | 0.5 | x | 0.7 | = | 21.06 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 63.27 | x | 0.5 | x | 0.7 | = | 69.06 | (76) |

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| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 2.26 | x | 63.27 | x | 0.5 | x | 0.7 | = | 34.68 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 92.28 | x | 0.5 | x | 0.7 | = | 100.72 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 92.28 | x | 0.5 | x | 0.7 | = | 50.58 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 113.09 | x | 0.5 | x | 0.7 | = | 123.44 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 113.09 | x | 0.5 | x | 0.7 | = | 61.99 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 115.77 | x | 0.5 | x | 0.7 | = | 126.36 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 115.77 | x | 0.5 | x | 0.7 | = | 63.46 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 110.22 | x | 0.5 | x | 0.7 | = | 120.3 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 110.22 | x | 0.5 | x | 0.7 | = | 60.42 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 94.68 | x | 0.5 | x | 0.7 | = | 103.34 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 94.68 | x | 0.5 | x | 0.7 | = | 51.9 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 73.59 | x | 0.5 | x | 0.7 | = | 80.32 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 73.59 | x | 0.5 | x | 0.7 | = | 40.34 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 45.59 | x | 0.5 | x | 0.7 | = | 49.76 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 45.59 | x | 0.5 | x | 0.7 | = | 24.99 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 24.49 | x | 0.5 | x | 0.7 | = | 26.73 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 24.49 | x | 0.5 | x | 0.7 | = | 13.42 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 16.15 | x | 0.5 | x | 0.7 | = | 17.63 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 16.15 | x | 0.5 | x | 0.7 | = | 8.85 | (76) |
| West | 0.9x | 0.77 | x | 4.72 | x | 19.64 | x | 0.5 | x | 0.7 | = | 22.48 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 19.64 | x | 0.5 | x | 0.7 | = | 10.91 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 38.42 | x | 0.5 | x | 0.7 | = | 43.99 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 38.42 | x | 0.5 | x | 0.7 | = | 21.34 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 63.27 | x | 0.5 | x | 0.7 | = | 72.44 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 63.27 | x | 0.5 | x | 0.7 | = | 35.14 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 92.28 | x | 0.5 | x | 0.7 | = | 105.65 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 92.28 | x | 0.5 | x | 0.7 | = | 51.26 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 113.09 | x | 0.5 | x | 0.7 | = | 129.47 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 113.09 | x | 0.5 | x | 0.7 | = | 62.82 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 115.77 | x | 0.5 | x | 0.7 | = | 132.54 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 115.77 | x | 0.5 | x | 0.7 | = | 64.3 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 110.22 | x | 0.5 | x | 0.7 | = | 126.18 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 110.22 | x | 0.5 | x | 0.7 | = | 61.22 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 94.68 | x | 0.5 | x | 0.7 | = | 108.39 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 94.68 | x | 0.5 | x | 0.7 | = | 52.59 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 73.59 | x | 0.5 | x | 0.7 | = | 84.25 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 73.59 | x | 0.5 | x | 0.7 | = | 40.87 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 45.59 | x | 0.5 | x | 0.7 | = | 52.19 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 45.59 | x | 0.5 | x | 0.7 | = | 25.32 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 24.49 | x | 0.5 | x | 0.7 | = | 28.04 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 24.49 | x | 0.5 | x | 0.7 | = | 13.6 | (80) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 4.72 | x | 16.15 | x | 0.5 | x | 0.7 | = | 18.49 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 16.15 | x | 0.5 | x | 0.7 | = | 8.97 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 65.6 | 128.32 | 211.33 | 308.21 | 377.72 | 386.66 | 368.12 | 316.21 | 245.78 | 152.26 | 81.79 | 53.94 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 537.23 | 597.59 | 665.27 | 737.43 | 781.7 | 766.56 | 732.55 | 687.12 | 629.57 | 560.99 | 519.1 | 512.84 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.96 | 0.94 | 0.9 | 0.81 | 0.67 | 0.49 | 0.36 | 0.4 | 0.62 | 0.85 | 0.94 | 0.97 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.76 | 19.95 | 20.27 | 20.63 | 20.86 | 20.97 | 20.99 | 20.99 | 20.92 | 20.61 | 20.13 | 19.73 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.37 | 20.37 | 20.38 | 20.39 | 20.39 | 20.4 | 20.4 | 20.41 | 20.4 | 20.39 | 20.39 | 20.38 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.96 | 0.94 | 0.89 | 0.79 | 0.63 | 0.45 | 0.32 | 0.35 | 0.58 | 0.83 | 0.93 | 0.96 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.67 | 18.96 | 19.41 | 19.92 | 20.23 | 20.37 | 20.4 | 20.4 | 20.32 | 19.91 | 19.23 | 18.64 | (90) |

fLA = Living area ÷ (4) = | 0.35 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 19.06 | 19.31 | 19.71 | 20.17 | 20.45 | 20.58 | 20.61 | 20.61 | 20.53 | 20.16 | 19.55 | 19.02 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 19.06 | 19.31 | 19.71 | 20.17 | 20.45 | 20.58 | 20.61 | 20.61 | 20.53 | 20.16 | 19.55 | 19.02 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.95 | 0.92 | 0.88 | 0.78 | 0.64 | 0.47 | 0.33 | 0.37 | 0.59 | 0.82 | 0.92 | 0.95 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 508.98 | 552.45 | 583.11 | 574.83 | 498.78 | 356.8 | 244.06 | 254.04 | 371.24 | 460.41 | 478.29 | 489.13 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 956.99 | 930.74 | 849.83 | 710.44 | 549.4 | 367.66 | 246.3 | 257.39 | 398.51 | 599.7 | 787.95 | 945.94 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 333.32 | 254.21 | 198.44 | 97.64 | 37.66 | 0 | 0 | 0 | 0 | 103.63 | 222.95 | 339.87 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 1587.72 | (98)

Space heating requirement in kWh/m²/year | 16.27 | (99)

## 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

# DER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |
| **Space heating** | | **kWh/year** | |
| Annual space heating requirement | | 1587.72 | |
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 833.56 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 833.56 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |
| **Water heating** | | | |
| Annual water heating requirement | | 2203.92 | |
| If DHW from community scheme:<br>Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1157.06 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1157.06 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 39.81 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f):<br>mechanical ventilation - balanced, extract or positive input from outside | | 318.82 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 318.82 | (331) |
| Energy for lighting (calculated in Appendix L) | | 425.59 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -596.1 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP) | | | | |
| Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | 91 | (367b) |

# DER WorkSheet: New dwelling design stage

| | | | | | |
|---|---|---|---|---|---|
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | 0.52 | = | 243.09 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | 0.22 | = | 472.5 | (368) |
| Electrical energy for heat distribution | [(313) x | 0.52 | = | 20.66 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | = | 736.25 | (373) |
| CO2 associated with space heating (secondary) | (309) x | 0 | = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | 0.52 | = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | 736.25 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | 0.52 | = | 165.47 | (378) |
| CO2 associated with electricity for lighting | (332))) x | 0.52 | = | 220.88 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable<br>Item 1 | | 0.52 | x 0.01 = | -309.38 | (380) |
| **Total CO2, kg/year** | sum of (376)…(382) = | | | 813.21 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | | | 8.33 | (384) |
| **EI rating (section 14)** | | | | 92.36 | (385) |

# DER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

Property Address: P6

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 83.09 | (1a) | x | 2.55 | (2a) | = | 211.88 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 83.09 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | | = | 211.88 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.5 | x1/[1/( 1.2 )+ 0.04] | = | 5.15 | | | (27) |
| Windows Type 2 | | | 2.26 | x1/[1/( 1.2 )+ 0.04] | = | 2.59 | | | (27) |
| Windows Type 3 | | | 4.72 | x1/[1/( 1.2 )+ 0.04] | = | 5.4 | | | (27) |
| Windows Type 4 | | | 2.29 | x1/[1/( 1.2 )+ 0.04] | = | 2.62 | | | (27) |
| Floor | | | 33.02 | x 0.13 | = | 4.2926 | | | (28) |
| Walls Type1 | 34.82 | 13.77 | 21.05 | x 0.18 | = | 3.79 | | | (29) |
| Walls Type2 | 4.02 | 0 | 4.02 | x 0.23 | = | 0.91 | | | (29) |
| Total area of elements, m² | | | 71.86 | | | | | | (31) |
| Party wall | | | 78.29 | x 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 24.76 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 7503.51 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 13.95 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 38.71 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 22.26 | 22.03 | 21.81 | 20.7 | 20.47 | 19.36 | 19.36 | 19.14 | 19.8 | 20.47 | 20.92 | 21.37 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 60.97 | 60.75 | 60.52 | 59.41 | 59.19 | 58.07 | 58.07 | 57.85 | 58.52 | 59.19 | 59.63 | 60.08 | |

Average = Sum(39)1…12 /12= 59.35 (39)

# DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.73 | 0.73 | 0.73 | 0.71 | 0.71 | 0.7 | 0.7 | 0.7 | 0.7 | 0.71 | 0.72 | 0.72 |

Average = Sum(40)1…12 /12= 0.71 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 |

(41)

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.52 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 94.02 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 103.43 | 99.66 | 95.9 | 92.14 | 88.38 | 84.62 | 84.62 | 88.38 | 92.14 | 95.9 | 99.66 | 103.43 |

Total = Sum(44)1…12 = 1128.28 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 153.38 | 134.14 | 138.43 | 120.68 | 115.8 | 99.92 | 92.6 | 106.25 | 107.52 | 125.31 | 136.78 | 148.54 |

Total = Sum(45)1…12 = 1479.35 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 23.01 | 20.12 | 20.76 | 18.1 | 17.37 | 14.99 | 13.89 | 15.94 | 16.13 | 18.8 | 20.52 | 22.28 |

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 |

(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 |

(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 |

(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 208.65 | 184.07 | 193.7 | 174.18 | 171.07 | 153.42 | 147.87 | 161.53 | 161.02 | 180.58 | 190.28 | 203.81 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 208.65 | 184.07 | 193.7 | 174.18 | 171.07 | 153.42 | 147.87 | 161.53 | 161.02 | 180.58 | 190.28 | 203.81 | |

Output from water heater (annual) $_{1...12}$ 2130.19 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 95.22 | 84.55 | 90.25 | 82.92 | 82.72 | 76.02 | 75.01 | 79.55 | 78.55 | 85.89 | 88.28 | 93.61 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | 125.94 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 20.86 | 18.53 | 15.07 | 11.41 | 8.53 | 7.2 | 7.78 | 10.11 | 13.57 | 17.23 | 20.11 | 21.44 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 225.78 | 228.12 | 222.22 | 209.65 | 193.78 | 178.87 | 168.91 | 166.57 | 172.47 | 185.04 | 200.9 | 215.82 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | 35.59 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | -100.76 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 127.98 | 125.81 | 121.3 | 115.17 | 111.19 | 105.58 | 100.82 | 106.92 | 109.09 | 115.44 | 122.6 | 125.82 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 435.4 | 433.24 | 419.37 | 397.01 | 374.28 | 352.43 | 338.29 | 344.38 | 355.91 | 378.49 | 404.4 | 423.86 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.5 | x | 19.64 | x | 0.5 | x | 0.7 | = | 21.44 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 19.64 | x | 0.5 | x | 0.7 | = | 10.77 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 38.42 | x | 0.5 | x | 0.7 | = | 41.94 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 38.42 | x | 0.5 | x | 0.7 | = | 21.06 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 63.27 | x | 0.5 | x | 0.7 | = | 69.06 | (76) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 2.26 | x | 63.27 | x | 0.5 | x | 0.7 | = | 34.68 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 92.28 | x | 0.5 | x | 0.7 | = | 100.72 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 92.28 | x | 0.5 | x | 0.7 | = | 50.58 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 113.09 | x | 0.5 | x | 0.7 | = | 123.44 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 113.09 | x | 0.5 | x | 0.7 | = | 61.99 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 115.77 | x | 0.5 | x | 0.7 | = | 126.36 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 115.77 | x | 0.5 | x | 0.7 | = | 63.46 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 110.22 | x | 0.5 | x | 0.7 | = | 120.3 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 110.22 | x | 0.5 | x | 0.7 | = | 60.42 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 94.68 | x | 0.5 | x | 0.7 | = | 103.34 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 94.68 | x | 0.5 | x | 0.7 | = | 51.9 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 73.59 | x | 0.5 | x | 0.7 | = | 80.32 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 73.59 | x | 0.5 | x | 0.7 | = | 40.34 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 45.59 | x | 0.5 | x | 0.7 | = | 49.76 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 45.59 | x | 0.5 | x | 0.7 | = | 24.99 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 24.49 | x | 0.5 | x | 0.7 | = | 26.73 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 24.49 | x | 0.5 | x | 0.7 | = | 13.42 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 16.15 | x | 0.5 | x | 0.7 | = | 17.63 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 16.15 | x | 0.5 | x | 0.7 | = | 8.85 | (76) |
| West | 0.9x | 0.77 | x | 4.72 | x | 19.64 | x | 0.5 | x | 0.7 | = | 22.48 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 19.64 | x | 0.5 | x | 0.7 | = | 10.91 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 38.42 | x | 0.5 | x | 0.7 | = | 43.99 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 38.42 | x | 0.5 | x | 0.7 | = | 21.34 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 63.27 | x | 0.5 | x | 0.7 | = | 72.44 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 63.27 | x | 0.5 | x | 0.7 | = | 35.14 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 92.28 | x | 0.5 | x | 0.7 | = | 105.65 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 92.28 | x | 0.5 | x | 0.7 | = | 51.26 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 113.09 | x | 0.5 | x | 0.7 | = | 129.47 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 113.09 | x | 0.5 | x | 0.7 | = | 62.82 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 115.77 | x | 0.5 | x | 0.7 | = | 132.54 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 115.77 | x | 0.5 | x | 0.7 | = | 64.3 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 110.22 | x | 0.5 | x | 0.7 | = | 126.18 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 110.22 | x | 0.5 | x | 0.7 | = | 61.22 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 94.68 | x | 0.5 | x | 0.7 | = | 108.39 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 94.68 | x | 0.5 | x | 0.7 | = | 52.59 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 73.59 | x | 0.5 | x | 0.7 | = | 84.25 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 73.59 | x | 0.5 | x | 0.7 | = | 40.87 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 45.59 | x | 0.5 | x | 0.7 | = | 52.19 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 45.59 | x | 0.5 | x | 0.7 | = | 25.32 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 24.49 | x | 0.5 | x | 0.7 | = | 28.04 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 24.49 | x | 0.5 | x | 0.7 | = | 13.6 | (80) |

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| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 4.72 | x | 16.15 | x | 0.5 | x | 0.7 | = | 18.49 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 16.15 | x | 0.5 | x | 0.7 | = | 8.97 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 65.6 | 128.32 | 211.33 | 308.21 | 377.72 | 386.66 | 368.12 | 316.21 | 245.78 | 152.26 | 81.79 | 53.94 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 501 | 561.56 | 630.69 | 705.21 | 752 | 739.1 | 706.41 | 660.59 | 601.7 | 530.75 | 486.19 | 477.8 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.96 | 0.93 | 0.89 | 0.79 | 0.65 | 0.48 | 0.36 | 0.39 | 0.61 | 0.84 | 0.93 | 0.96 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.65 | 19.86 | 20.2 | 20.59 | 20.84 | 20.96 | 20.99 | 20.99 | 20.91 | 20.57 | 20.05 | 19.61 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.31 | 20.31 | 20.32 | 20.33 | 20.33 | 20.34 | 20.34 | 20.34 | 20.34 | 20.33 | 20.33 | 20.32 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.95 | 0.93 | 0.87 | 0.77 | 0.61 | 0.44 | 0.3 | 0.34 | 0.56 | 0.81 | 0.92 | 0.96 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.47 | 18.78 | 19.27 | 19.82 | 20.15 | 20.3 | 20.33 | 20.33 | 20.24 | 19.79 | 19.07 | 18.43 | (90) |

fLA = Living area ÷ (4) = 0.42 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.96 | 19.23 | 19.65 | 20.14 | 20.44 | 20.58 | 20.61 | 20.6 | 20.52 | 20.11 | 19.48 | 18.92 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.96 | 19.23 | 19.65 | 20.14 | 20.44 | 20.58 | 20.61 | 20.6 | 20.52 | 20.11 | 19.48 | 18.92 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.94 | 0.91 | 0.86 | 0.76 | 0.62 | 0.45 | 0.33 | 0.36 | 0.58 | 0.81 | 0.91 | 0.95 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 470.11 | 512.47 | 542.74 | 536.11 | 465.98 | 335.03 | 229.94 | 239.18 | 346.76 | 427.34 | 442.5 | 451.71 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 893.8 | 870.49 | 796.14 | 667.6 | 517.03 | 347.05 | 232.66 | 243.18 | 375.49 | 563.14 | 738.01 | 884.49 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 315.22 | 240.59 | 188.53 | 94.67 | 37.98 | 0 | 0 | 0 | 0 | 101.04 | 212.77 | 321.98 | |

Total per year (kWh/year) = Sum(98)$_{1…5,9…12}$ = 1512.78 (98)

Space heating requirement in kWh/m²/year 18.21 (99)

## 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

# DER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |
| **Space heating** | | **kWh/year** | |
| Annual space heating requirement | | 1512.78 | |
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 794.21 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 794.21 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |
| **Water heating** | | | |
| Annual water heating requirement | | 2130.19 | |
| If DHW from community scheme:<br>Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1118.35 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1118.35 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 38.25 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f):<br>mechanical ventilation - balanced, extract or positive input from outside | | 271.42 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 271.42 | (331) |
| Energy for lighting (calculated in Appendix L) | | 368.35 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -507.18 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP) | | | | |
| Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | 91 | (367b) |

# DER WorkSheet: New dwelling design stage

| | | | | | |
|---|---|---|---|---|---|
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | 0.52 | = | 233.56 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | 0.22 | = | 453.97 | (368) |
| Electrical energy for heat distribution | [(313) x | 0.52 | = | 19.85 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | = | 707.38 | (373) |
| CO2 associated with space heating (secondary) | (309) x | 0 | = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | 0.52 | = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | 707.38 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | 0.52 | = | 140.87 | (378) |
| CO2 associated with electricity for lighting | (332))) x | 0.52 | = | 191.17 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable<br>Item 1 | | 0.52 | x 0.01 = | -263.23 | (380) |
| **Total CO2, kg/year** | sum of (376)…(382) = | | | 776.19 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | | | 9.34 | (384) |
| **EI rating (section 14)** | | | | 91.88 | (385) |

# DER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: P7

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 49.09 | (1a) x | 2.55 | (2a) = | 125.18 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 49.09 | (4) | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 125.18 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |
| *If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)* | | | | |
| Number of storeys in the dwelling (ns) | | | 0 | (9) |
| Additional infiltration | | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | | 0 | (13) |
| Percentage of windows and doors draught stripped | | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | | 3 | (17) |
| If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | | | 0.15 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | | |
| Number of sides sheltered | | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| **ELEMENT** | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.72 | x1/[1/( 1.2 )+ 0.04] | = | 5.4 | | | (27) |
| Windows Type 2 | | | 2.29 | x1/[1/( 1.2 )+ 0.04] | = | 2.62 | | | (27) |
| Walls Type1 | 21.99 | 7.01 | 14.98 | x 0.18 | = | 2.7 | | | (29) |
| Walls Type2 | 32.46 | 0 | 32.46 | x 0.23 | = | 7.38 | | | (29) |
| Total area of elements, m² | | | 54.45 | | | | | | (31) |
| Party wall | | | 23.76 | x 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 18.1 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 3915.6 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 5.66 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 23.76 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 13.15 | 13.02 | 12.89 | 12.23 | 12.1 | 11.44 | 11.44 | 11.31 | 11.7 | 12.1 | 12.36 | 12.62 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 36.91 | 36.78 | 36.65 | 35.99 | 35.86 | 35.2 | 35.2 | 35.07 | 35.46 | 35.86 | 36.12 | 36.39 | |

Average = Sum(39)$_{1…12}$ /12= 35.96 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.75 | 0.75 | 0.75 | 0.73 | 0.73 | 0.72 | 0.72 | 0.71 | 0.72 | 0.73 | 0.74 | 0.74 |

Average = Sum(40)$_{1…12}$ /12= 0.73 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.66 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 73.7 (43)
*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 81.07 | 78.13 | 75.18 | 72.23 | 69.28 | 66.33 | 66.33 | 69.28 | 72.23 | 75.18 | 78.13 | 81.07 |

Total = Sum(44)$_{1…12}$ = 884.45 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 120.23 | 105.16 | 108.51 | 94.6 | 90.77 | 78.33 | 72.58 | 83.29 | 84.29 | 98.23 | 107.22 | 116.44 |

Total = Sum(45)$_{1…12}$ = 1159.66 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 18.03 | 15.77 | 16.28 | 14.19 | 13.62 | 11.75 | 10.89 | 12.49 | 12.64 | 14.73 | 16.08 | 17.47 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 175.51 | 155.08 | 163.79 | 148.1 | 146.05 | 131.82 | 127.86 | 138.57 | 137.78 | 153.5 | 160.72 | 171.71 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 175.51 | 155.08 | 163.79 | 148.1 | 146.05 | 131.82 | 127.86 | 138.57 | 137.78 | 153.5 | 160.72 | 171.71 | |

Output from water heater (annual)$_{1...12}$ 1810.5 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 84.2 | 74.91 | 80.3 | 74.25 | 74.4 | 68.84 | 68.36 | 71.92 | 70.82 | 76.88 | 78.45 | 82.94 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 83.17 | 83.17 | 83.17 | 83.17 | 83.17 | 83.17 | 83.17 | 83.17 | 83.17 | 83.17 | 83.17 | 83.17 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 13.8 | 12.25 | 9.97 | 7.54 | 5.64 | 4.76 | 5.14 | 6.69 | 8.98 | 11.4 | 13.3 | 14.18 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 144.87 | 146.37 | 142.59 | 134.52 | 124.34 | 114.77 | 108.38 | 106.88 | 110.67 | 118.73 | 128.91 | 138.48 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 31.32 | 31.32 | 31.32 | 31.32 | 31.32 | 31.32 | 31.32 | 31.32 | 31.32 | 31.32 | 31.32 | 31.32 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -66.53 | -66.53 | -66.53 | -66.53 | -66.53 | -66.53 | -66.53 | -66.53 | -66.53 | -66.53 | -66.53 | -66.53 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 113.17 | 111.47 | 107.93 | 103.13 | 100 | 95.61 | 91.88 | 96.66 | 98.36 | 103.34 | 108.95 | 111.47 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 319.79 | 318.05 | 308.43 | 293.14 | 277.94 | 263.09 | 253.35 | 258.18 | 265.95 | 281.41 | 299.12 | 312.08 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 4.72 | x | 19.64 | x | 0.5 | x | 0.7 | = | 22.48 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 19.64 | x | 0.5 | x | 0.7 | = | 10.91 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 38.42 | x | 0.5 | x | 0.7 | = | 43.99 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 38.42 | x | 0.5 | x | 0.7 | = | 21.34 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 63.27 | x | 0.5 | x | 0.7 | = | 72.44 | (80) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 2.29 | x | 63.27 | x | 0.5 | x | 0.7 | = | 35.14 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 92.28 | x | 0.5 | x | 0.7 | = | 105.65 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 92.28 | x | 0.5 | x | 0.7 | = | 51.26 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 113.09 | x | 0.5 | x | 0.7 | = | 129.47 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 113.09 | x | 0.5 | x | 0.7 | = | 62.82 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 115.77 | x | 0.5 | x | 0.7 | = | 132.54 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 115.77 | x | 0.5 | x | 0.7 | = | 64.3 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 110.22 | x | 0.5 | x | 0.7 | = | 126.18 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 110.22 | x | 0.5 | x | 0.7 | = | 61.22 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 94.68 | x | 0.5 | x | 0.7 | = | 108.39 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 94.68 | x | 0.5 | x | 0.7 | = | 52.59 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 73.59 | x | 0.5 | x | 0.7 | = | 84.25 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 73.59 | x | 0.5 | x | 0.7 | = | 40.87 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 45.59 | x | 0.5 | x | 0.7 | = | 52.19 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 45.59 | x | 0.5 | x | 0.7 | = | 25.32 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 24.49 | x | 0.5 | x | 0.7 | = | 28.04 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 24.49 | x | 0.5 | x | 0.7 | = | 13.6 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 16.15 | x | 0.5 | x | 0.7 | = | 18.49 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 16.15 | x | 0.5 | x | 0.7 | = | 8.97 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 33.39 | 65.33 | 107.58 | 156.9 | 192.29 | 196.84 | 187.4 | 160.98 | 125.12 | 77.51 | 41.64 | 27.46 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 353.18 | 383.37 | 416.02 | 450.04 | 470.22 | 459.94 | 440.75 | 419.15 | 391.07 | 358.93 | 340.75 | 339.54 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.93 | 0.91 | 0.86 | 0.77 | 0.63 | 0.47 | 0.35 | 0.38 | 0.58 | 0.79 | 0.9 | 0.94 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.79 | 19.97 | 20.27 | 20.61 | 20.84 | 20.96 | 20.99 | 20.99 | 20.92 | 20.63 | 20.17 | 19.76 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.3 | 20.3 | 20.3 | 20.31 | 20.31 | 20.33 | 20.33 | 20.33 | 20.32 | 20.31 | 20.31 | 20.3 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.92 | 0.9 | 0.85 | 0.74 | 0.6 | 0.43 | 0.29 | 0.32 | 0.53 | 0.77 | 0.89 | 0.93 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.66 | 18.93 | 19.35 | 19.83 | 20.14 | 20.29 | 20.32 | 20.32 | 20.24 | 19.86 | 19.22 | 18.63 | (90) |

fLA = Living area ÷ (4) = 0.5 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 19.22 | 19.44 | 19.8 | 20.22 | 20.49 | 20.62 | 20.65 | 20.65 | 20.57 | 20.24 | 19.69 | 19.19 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 19.22 | 19.44 | 19.8 | 20.22 | 20.49 | 20.62 | 20.65 | 20.65 | 20.57 | 20.24 | 19.69 | 19.19 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.91 | 0.88 | 0.83 | 0.74 | 0.61 | 0.44 | 0.32 | 0.35 | 0.55 | 0.76 | 0.88 | 0.92 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 321.64 | 339.26 | 346.96 | 332.51 | 284.99 | 204.64 | 140.92 | 146.67 | 214.02 | 274.45 | 298.28 | 311.85 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 550.8 | 534.95 | 487.57 | 407.46 | 315.17 | 211.98 | 142.63 | 149.03 | 229.61 | 345.69 | 454.91 | 545.47 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 170.49 | 131.5 | 104.61 | 53.97 | 22.45 | 0 | 0 | 0 | 0 | 53.01 | 112.77 | 173.81 | |

| | | |
|---|---|---|
| Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 822.62 | (98) |
| Space heating requirement in kWh/m²/year | 16.76 | (99) |

## 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |
| **Space heating** | | **kWh/year** | |
| Annual space heating requirement | | 822.62 | |
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 431.87 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 431.87 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |
| **Water heating** | | | |
| Annual water heating requirement | | 1810.5 | |
| If DHW from community scheme: Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 950.51 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 950.51 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 27.65 | (313) |

# DER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f):<br>mechanical ventilation - balanced, extract or positive input from outside | | 160.35 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 160.35 | (331) |
| Energy for lighting (calculated in Appendix L) | | 243.65 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -299.7 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | | Energy kWh/year | Emission factor kg CO2/kWh | | Emissions kg CO2/year | |
|---|---|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP)<br>Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 91 | (367b) |
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.52 | = | 168.81 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.22 | = | 328.13 | (368) |
| Electrical energy for heat distribution | [(313) x | | 0.52 | = | 14.35 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | | = | 511.29 | (373) |
| CO2 associated with space heating (secondary) | (309) x | | 0 | = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | | 0.52 | = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | | 511.29 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | | 0.52 | = | 83.22 | (378) |
| CO2 associated with electricity for lighting | (332))) x | | 0.52 | = | 126.45 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable<br>Item 1 | | 0.52 | x 0.01 = | | -155.54 | (380) |
| **Total CO2, kg/year** | sum of (376)…(382) = | | | | 565.42 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | | | | 11.52 | (384) |
| **EI rating (section 14)** | | | | | 91.95 | (385) |

# DER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: P8

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 54.2 | (1a) x | 2.55 | (2a) = | 138.21 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 54.2 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 138.21 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | | |
|---|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = | (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| **ELEMENT** | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.72 | x1/[1/( 1.2 )+ 0.04] | | = | 5.4 | | | (27) |
| Windows Type 2 | | | 2.29 | x1/[1/( 1.2 )+ 0.04] | | = | 2.62 | | | (27) |
| Floor | | | 4.31 | x | 0.13 | = | 0.5603 | | | (28) |
| Walls Type1 | 20.2 | 7.01 | 13.19 | x | 0.18 | = | 2.37 | | | (29) |
| Walls Type2 | 31.46 | 0 | 31.46 | x | 0.23 | = | 7.15 | | | (29) |
| Total area of elements, m² | | | 55.97 | | | | | | | (31) |
| Party wall | | | 26.04 | x | 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 18.11 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 4174.05 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 5.72 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 23.83 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 14.52 | 14.37 | 14.23 | 13.5 | 13.35 | 12.63 | 12.63 | 12.48 | 12.92 | 13.35 | 13.65 | 13.94 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 38.35 | 38.2 | 38.05 | 37.33 | 37.18 | 36.46 | 36.46 | 36.31 | 36.75 | 37.18 | 37.47 | 37.76 | |

Average = Sum(39)$_{1…12}$ /12= 37.29 (39)

# DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.71 | 0.7 | 0.7 | 0.69 | 0.69 | 0.67 | 0.67 | 0.67 | 0.68 | 0.69 | 0.69 | 0.7 |

Average = Sum(40)$_{1…12}$ /12= 0.69 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.81 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 77.28 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | | |
| (44)m= | 85.01 | 81.92 | 78.83 | 75.73 | 72.64 | 69.55 | 69.55 | 72.64 | 75.73 | 78.83 | 81.92 | 85.01 | |
| | | | | | | | | | | Total = Sum(44)$_{1…12}$ = | | 927.36 | (44) |
| *Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)* | | | | | | | | | | | | | |
| (45)m= | 126.06 | 110.26 | 113.77 | 99.19 | 95.18 | 82.13 | 76.11 | 87.33 | 88.38 | 102.99 | 112.42 | 122.09 | |
| | | | | | | | | | | Total = Sum(45)$_{1…12}$ = | | 1215.91 | (45) |
| *If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)* | | | | | | | | | | | | | |
| (46)m= | 18.91 | 16.54 | 17.07 | 14.88 | 14.28 | 12.32 | 11.42 | 13.1 | 13.26 | 15.45 | 16.86 | 18.31 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

# DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 181.34 | 160.18 | 169.05 | 152.69 | 150.45 | 135.62 | 131.38 | 142.61 | 141.87 | 158.27 | 165.92 | 177.36 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 181.34 | 160.18 | 169.05 | 152.69 | 150.45 | 135.62 | 131.38 | 142.61 | 141.87 | 158.27 | 165.92 | 177.36 |

Output from water heater (annual)$_{1...12}$ 1866.75 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 86.14 | 76.6 | 82.05 | 75.78 | 75.87 | 70.1 | 69.53 | 73.26 | 72.18 | 78.47 | 80.18 | 84.82 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 90.69 | 90.69 | 90.69 | 90.69 | 90.69 | 90.69 | 90.69 | 90.69 | 90.69 | 90.69 | 90.69 | 90.69 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 15.39 | 13.67 | 11.12 | 8.42 | 6.29 | 5.31 | 5.74 | 7.46 | 10.01 | 12.71 | 14.84 | 15.82 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 158.12 | 159.76 | 155.63 | 146.83 | 135.71 | 125.27 | 118.29 | 116.65 | 120.79 | 129.59 | 140.7 | 151.14 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 32.07 | 32.07 | 32.07 | 32.07 | 32.07 | 32.07 | 32.07 | 32.07 | 32.07 | 32.07 | 32.07 | 32.07 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -72.56 | -72.56 | -72.56 | -72.56 | -72.56 | -72.56 | -72.56 | -72.56 | -72.56 | -72.56 | -72.56 | -72.56 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 115.78 | 113.99 | 110.28 | 105.24 | 101.97 | 97.37 | 93.45 | 98.47 | 100.25 | 105.47 | 111.36 | 114 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 339.5 | 337.63 | 327.24 | 310.69 | 294.19 | 278.15 | 267.69 | 272.79 | 281.26 | 297.98 | 317.1 | 331.17 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 4.72 | x | 19.64 | x | 0.5 | x | 0.7 | = | 22.48 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 19.64 | x | 0.5 | x | 0.7 | = | 10.91 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 38.42 | x | 0.5 | x | 0.7 | = | 43.99 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 38.42 | x | 0.5 | x | 0.7 | = | 21.34 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 63.27 | x | 0.5 | x | 0.7 | = | 72.44 | (80) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 2.29 | x | 63.27 | x | 0.5 | x | 0.7 | = | 35.14 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 92.28 | x | 0.5 | x | 0.7 | = | 105.65 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 92.28 | x | 0.5 | x | 0.7 | = | 51.26 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 113.09 | x | 0.5 | x | 0.7 | = | 129.47 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 113.09 | x | 0.5 | x | 0.7 | = | 62.82 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 115.77 | x | 0.5 | x | 0.7 | = | 132.54 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 115.77 | x | 0.5 | x | 0.7 | = | 64.3 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 110.22 | x | 0.5 | x | 0.7 | = | 126.18 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 110.22 | x | 0.5 | x | 0.7 | = | 61.22 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 94.68 | x | 0.5 | x | 0.7 | = | 108.39 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 94.68 | x | 0.5 | x | 0.7 | = | 52.59 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 73.59 | x | 0.5 | x | 0.7 | = | 84.25 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 73.59 | x | 0.5 | x | 0.7 | = | 40.87 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 45.59 | x | 0.5 | x | 0.7 | = | 52.19 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 45.59 | x | 0.5 | x | 0.7 | = | 25.32 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 24.49 | x | 0.5 | x | 0.7 | = | 28.04 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 24.49 | x | 0.5 | x | 0.7 | = | 13.6 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 16.15 | x | 0.5 | x | 0.7 | = | 18.49 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 16.15 | x | 0.5 | x | 0.7 | = | 8.97 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 33.39 | 65.33 | 107.58 | 156.9 | 192.29 | 196.84 | 187.4 | 160.98 | 125.12 | 77.51 | 41.64 | 27.46 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 372.89 | 402.96 | 434.82 | 467.59 | 486.47 | 475 | 455.09 | 433.76 | 406.38 | 375.49 | 358.74 | 358.63 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.94 | 0.91 | 0.87 | 0.77 | 0.64 | 0.47 | 0.35 | 0.38 | 0.58 | 0.8 | 0.9 | 0.94 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.87 | 20.04 | 20.32 | 20.65 | 20.86 | 20.97 | 20.99 | 20.99 | 20.93 | 20.66 | 20.23 | 19.84 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.33 | 20.34 | 20.34 | 20.35 | 20.35 | 20.37 | 20.37 | 20.37 | 20.36 | 20.35 | 20.35 | 20.34 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.93 | 0.9 | 0.85 | 0.75 | 0.6 | 0.43 | 0.3 | 0.33 | 0.53 | 0.77 | 0.89 | 0.94 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.8 | 19.05 | 19.45 | 19.91 | 20.19 | 20.33 | 20.36 | 20.36 | 20.29 | 19.94 | 19.34 | 18.77 | (90) |

fLA = Living area ÷ (4) = 0.52 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 19.36 | 19.57 | 19.9 | 20.3 | 20.54 | 20.67 | 20.69 | 20.69 | 20.62 | 20.32 | 19.81 | 19.33 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 19.36 | 19.57 | 19.9 | 20.3 | 20.54 | 20.67 | 20.69 | 20.69 | 20.62 | 20.32 | 19.81 | 19.33 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.92 | 0.89 | 0.84 | 0.75 | 0.61 | 0.45 | 0.32 | 0.35 | 0.55 | 0.77 | 0.88 | 0.92 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 341.59 | 359.22 | 366.19 | 349.78 | 299.09 | 214.22 | 147.6 | 153.61 | 224.75 | 289.78 | 316.2 | 331.2 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 577.48 | 560.31 | 510.08 | 425.39 | 328.85 | 221.1 | 149.13 | 155.74 | 239.69 | 361.26 | 476.11 | 571.48 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 175.5 | 135.14 | 107.06 | 54.43 | 22.14 | 0 | 0 | 0 | 0 | 53.18 | 115.13 | 178.76 | |

| | | |
|---|---|---|
| Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 841.34 | (98) |
| Space heating requirement in kWh/m²/year | 15.52 | (99) |

## 9b. Energy requirements – Community heating scheme

| | | | |
|---|---|---|---|
| This part is used for space heating, space cooling or water heating provided by a community scheme.<br>Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |
| **Space heating** | | **kWh/year** | |
| Annual space heating requirement | | 841.34 | |
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 441.7 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 441.7 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |
| **Water heating** | | | |
| Annual water heating requirement | | 1866.75 | |
| If DHW from community scheme:<br>Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 980.04 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 980.04 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 28.43 | (313) |

# DER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f):<br>mechanical ventilation - balanced, extract or positive input from outside | | 177.05 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 177.05 | (331) |
| Energy for lighting (calculated in Appendix L) | | 271.77 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -330.99 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | | Energy kWh/year | Emission factor kg CO2/kWh | | Emissions kg CO2/year | |
|---|---|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP)<br>Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 91 | (367b) |
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.52 | = | 173.62 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.22 | = | 337.47 | (368) |
| Electrical energy for heat distribution | [(313) x | | 0.52 | = | 14.76 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | | = | 525.85 | (373) |
| CO2 associated with space heating (secondary) | (309) x | | 0 | = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | | 0.52 | = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | | 525.85 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | | 0.52 | = | 91.89 | (378) |
| CO2 associated with electricity for lighting | (332))) x | | 0.52 | = | 141.05 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable<br>Item 1 | | 0.52 | x 0.01 = | | -171.78 | (380) |
| **Total CO2, kg/year** | sum of (376)…(382) = | | | | 587 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | | | | 10.83 | (384) |
| **EI rating (section 14)** | | | | | 92.07 | (385) |

# DER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: P9

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 94.22 | (1a) x | 2.55 | (2a) = | 240.26 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 94.22 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 240.26 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 0 | ÷ (5) = | 0 | (8) |
| *If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)* | | | |
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.86 | x1/[1/( 1.2 )+ 0.04] = | 5.56 | | | (27) |
| Windows Type 2 | | | 2.29 | x1/[1/( 1.2 )+ 0.04] = | 2.62 | | | (27) |
| Windows Type 3 | | | 4.69 | x1/[1/( 1.2 )+ 0.04] = | 5.37 | | | (27) |
| Windows Type 4 | | | 2.26 | x1/[1/( 1.2 )+ 0.04] = | 2.59 | | | (27) |
| Windows Type 5 | | | 4.5 | x1/[1/( 1.2 )+ 0.04] = | 5.15 | | | (27) |
| Windows Type 6 | | | 4.5 | x1/[1/( 1.2 )+ 0.04] = | 5.15 | | | (27) |
| Windows Type 7 | | | 2.26 | x1/[1/( 1.2 )+ 0.04] = | 2.59 | | | (27) |
| Walls Type1 | 72.92 | 27.62 | 45.3 | x 0.18 = | 8.15 | | | (29) |
| Walls Type2 | 4.01 | 0 | 4.01 | x 0.23 = | 0.91 | | | (29) |
| Total area of elements, m² | | | 76.93 | | | | | (31) |
| Party wall | | | 42.45 | x 0 = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 40.69 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 4868.85 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 10.08 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 50.77 (37)

# DER WorkSheet: New dwelling design stage

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 25.24 | 24.99 | 24.73 | 23.47 | 23.22 | 21.95 | 21.95 | 21.7 | 22.46 | 23.22 | 23.72 | 24.23 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 76.01 | 75.76 | 75.51 | 74.24 | 73.99 | 72.73 | 72.73 | 72.47 | 73.23 | 73.99 | 74.49 | 75 | |

Average = Sum(39)$_{1…12}$ /12= 74.18 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.81 | 0.8 | 0.8 | 0.79 | 0.79 | 0.77 | 0.77 | 0.77 | 0.78 | 0.79 | 0.79 | 0.8 | |

Average = Sum(40)$_{1…12}$ /12= 0.79 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 97.83 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | | |
| (44)m= | 107.61 | 103.7 | 99.79 | 95.87 | 91.96 | 88.05 | 88.05 | 91.96 | 95.87 | 99.79 | 103.7 | 107.61 | |

Total = Sum(44)$_{1…12}$ = 1173.97 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 159.59 | 139.58 | 144.03 | 125.57 | 120.49 | 103.97 | 96.34 | 110.56 | 111.88 | 130.38 | 142.32 | 154.55 | |

Total = Sum(45)$_{1…12}$ = 1539.26 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 23.94 | 20.94 | 21.6 | 18.84 | 18.07 | 15.6 | 14.45 | 16.58 | 16.78 | 19.56 | 21.35 | 23.18 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 214.87 | 189.5 | 199.31 | 179.06 | 175.76 | 157.46 | 151.62 | 165.83 | 165.37 | 185.66 | 195.82 | 209.83 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 214.87 | 189.5 | 199.31 | 179.06 | 175.76 | 157.46 | 151.62 | 165.83 | 165.37 | 185.66 | 195.82 | 209.83 |

Output from water heater (annual)$_{1...12}$ — 2190.1 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 97.28 | 86.35 | 92.11 | 84.55 | 84.28 | 77.37 | 76.26 | 80.98 | 79.99 | 87.57 | 90.12 | 95.61 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 133.96 | 133.96 | 133.96 | 133.96 | 133.96 | 133.96 | 133.96 | 133.96 | 133.96 | 133.96 | 133.96 | 133.96 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 21.99 | 19.53 | 15.88 | 12.02 | 8.99 | 7.59 | 8.2 | 10.66 | 14.3 | 18.16 | 21.2 | 22.6 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 246.63 | 249.19 | 242.74 | 229.01 | 211.68 | 195.39 | 184.51 | 181.95 | 188.4 | 202.13 | 219.46 | 235.75 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 36.4 | 36.4 | 36.4 | 36.4 | 36.4 | 36.4 | 36.4 | 36.4 | 36.4 | 36.4 | 36.4 | 36.4 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -107.17 | -107.17 | -107.17 | -107.17 | -107.17 | -107.17 | -107.17 | -107.17 | -107.17 | -107.17 | -107.17 | -107.17 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 130.76 | 128.5 | 123.81 | 117.43 | 113.28 | 107.45 | 102.49 | 108.85 | 111.1 | 117.71 | 125.16 | 128.51 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 462.56 | 460.41 | 445.62 | 421.65 | 397.14 | 373.62 | 358.39 | 364.64 | 376.99 | 401.19 | 429.01 | 450.04 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | Access Factor Table 6d | Area m² | Flux Table 6a | g_ Table 6b | FF Table 6c | Gains (W) |
|---|---|---|---|---|---|---|

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North | 0.9x | 0.77 | x | 4.69 | x | 10.63 | x | 0.5 | x | 0.7 | = | 12.1 | (74) |
| North | 0.9x | 0.77 | x | 2.26 | x | 10.63 | x | 0.5 | x | 0.7 | = | 11.66 | (74) |
| North | 0.9x | 0.77 | x | 4.5 | x | 10.63 | x | 0.5 | x | 0.7 | = | 11.61 | (74) |
| North | 0.9x | 0.77 | x | 4.69 | x | 20.32 | x | 0.5 | x | 0.7 | = | 23.12 | (74) |
| North | 0.9x | 0.77 | x | 2.26 | x | 20.32 | x | 0.5 | x | 0.7 | = | 22.28 | (74) |
| North | 0.9x | 0.77 | x | 4.5 | x | 20.32 | x | 0.5 | x | 0.7 | = | 22.18 | (74) |
| North | 0.9x | 0.77 | x | 4.69 | x | 34.53 | x | 0.5 | x | 0.7 | = | 39.28 | (74) |
| North | 0.9x | 0.77 | x | 2.26 | x | 34.53 | x | 0.5 | x | 0.7 | = | 37.86 | (74) |
| North | 0.9x | 0.77 | x | 4.5 | x | 34.53 | x | 0.5 | x | 0.7 | = | 37.69 | (74) |
| North | 0.9x | 0.77 | x | 4.69 | x | 55.46 | x | 0.5 | x | 0.7 | = | 63.09 | (74) |
| North | 0.9x | 0.77 | x | 2.26 | x | 55.46 | x | 0.5 | x | 0.7 | = | 60.81 | (74) |
| North | 0.9x | 0.77 | x | 4.5 | x | 55.46 | x | 0.5 | x | 0.7 | = | 60.54 | (74) |
| North | 0.9x | 0.77 | x | 4.69 | x | 74.72 | x | 0.5 | x | 0.7 | = | 84.99 | (74) |
| North | 0.9x | 0.77 | x | 2.26 | x | 74.72 | x | 0.5 | x | 0.7 | = | 81.91 | (74) |
| North | 0.9x | 0.77 | x | 4.5 | x | 74.72 | x | 0.5 | x | 0.7 | = | 81.55 | (74) |
| North | 0.9x | 0.77 | x | 4.69 | x | 79.99 | x | 0.5 | x | 0.7 | = | 90.99 | (74) |
| North | 0.9x | 0.77 | x | 2.26 | x | 79.99 | x | 0.5 | x | 0.7 | = | 87.69 | (74) |
| North | 0.9x | 0.77 | x | 4.5 | x | 79.99 | x | 0.5 | x | 0.7 | = | 87.3 | (74) |
| North | 0.9x | 0.77 | x | 4.69 | x | 74.68 | x | 0.5 | x | 0.7 | = | 84.95 | (74) |
| North | 0.9x | 0.77 | x | 2.26 | x | 74.68 | x | 0.5 | x | 0.7 | = | 81.87 | (74) |
| North | 0.9x | 0.77 | x | 4.5 | x | 74.68 | x | 0.5 | x | 0.7 | = | 81.51 | (74) |
| North | 0.9x | 0.77 | x | 4.69 | x | 59.25 | x | 0.5 | x | 0.7 | = | 67.4 | (74) |
| North | 0.9x | 0.77 | x | 2.26 | x | 59.25 | x | 0.5 | x | 0.7 | = | 64.95 | (74) |
| North | 0.9x | 0.77 | x | 4.5 | x | 59.25 | x | 0.5 | x | 0.7 | = | 64.67 | (74) |
| North | 0.9x | 0.77 | x | 4.69 | x | 41.52 | x | 0.5 | x | 0.7 | = | 47.23 | (74) |
| North | 0.9x | 0.77 | x | 2.26 | x | 41.52 | x | 0.5 | x | 0.7 | = | 45.52 | (74) |
| North | 0.9x | 0.77 | x | 4.5 | x | 41.52 | x | 0.5 | x | 0.7 | = | 45.31 | (74) |
| North | 0.9x | 0.77 | x | 4.69 | x | 24.19 | x | 0.5 | x | 0.7 | = | 27.52 | (74) |
| North | 0.9x | 0.77 | x | 2.26 | x | 24.19 | x | 0.5 | x | 0.7 | = | 26.52 | (74) |
| North | 0.9x | 0.77 | x | 4.5 | x | 24.19 | x | 0.5 | x | 0.7 | = | 26.4 | (74) |
| North | 0.9x | 0.77 | x | 4.69 | x | 13.12 | x | 0.5 | x | 0.7 | = | 14.92 | (74) |
| North | 0.9x | 0.77 | x | 2.26 | x | 13.12 | x | 0.5 | x | 0.7 | = | 14.38 | (74) |
| North | 0.9x | 0.77 | x | 4.5 | x | 13.12 | x | 0.5 | x | 0.7 | = | 14.32 | (74) |
| North | 0.9x | 0.77 | x | 4.69 | x | 8.86 | x | 0.5 | x | 0.7 | = | 10.08 | (74) |
| North | 0.9x | 0.77 | x | 2.26 | x | 8.86 | x | 0.5 | x | 0.7 | = | 9.72 | (74) |
| North | 0.9x | 0.77 | x | 4.5 | x | 8.86 | x | 0.5 | x | 0.7 | = | 9.68 | (74) |
| East | 0.9x | 1 | x | 4.5 | x | 19.64 | x | 0.5 | x | 0.7 | = | 21.44 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 19.64 | x | 0.5 | x | 0.7 | = | 10.77 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 38.42 | x | 0.5 | x | 0.7 | = | 41.94 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 38.42 | x | 0.5 | x | 0.7 | = | 21.06 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 63.27 | x | 0.5 | x | 0.7 | = | 69.06 | (76) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 2.26 | x | 63.27 | x | 0.5 | x | 0.7 | = | 34.68 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 92.28 | x | 0.5 | x | 0.7 | = | 100.72 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 92.28 | x | 0.5 | x | 0.7 | = | 50.58 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 113.09 | x | 0.5 | x | 0.7 | = | 123.44 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 113.09 | x | 0.5 | x | 0.7 | = | 61.99 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 115.77 | x | 0.5 | x | 0.7 | = | 126.36 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 115.77 | x | 0.5 | x | 0.7 | = | 63.46 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 110.22 | x | 0.5 | x | 0.7 | = | 120.3 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 110.22 | x | 0.5 | x | 0.7 | = | 60.42 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 94.68 | x | 0.5 | x | 0.7 | = | 103.34 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 94.68 | x | 0.5 | x | 0.7 | = | 51.9 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 73.59 | x | 0.5 | x | 0.7 | = | 80.32 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 73.59 | x | 0.5 | x | 0.7 | = | 40.34 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 45.59 | x | 0.5 | x | 0.7 | = | 49.76 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 45.59 | x | 0.5 | x | 0.7 | = | 24.99 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 24.49 | x | 0.5 | x | 0.7 | = | 26.73 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 24.49 | x | 0.5 | x | 0.7 | = | 13.42 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 16.15 | x | 0.5 | x | 0.7 | = | 17.63 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 16.15 | x | 0.5 | x | 0.7 | = | 8.85 | (76) |
| West | 0.9x | 0.77 | x | 4.86 | x | 19.64 | x | 0.5 | x | 0.7 | = | 23.15 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 19.64 | x | 0.5 | x | 0.7 | = | 10.91 | (80) |
| West | 0.9x | 0.77 | x | 4.86 | x | 38.42 | x | 0.5 | x | 0.7 | = | 45.29 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 38.42 | x | 0.5 | x | 0.7 | = | 21.34 | (80) |
| West | 0.9x | 0.77 | x | 4.86 | x | 63.27 | x | 0.5 | x | 0.7 | = | 74.59 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 63.27 | x | 0.5 | x | 0.7 | = | 35.14 | (80) |
| West | 0.9x | 0.77 | x | 4.86 | x | 92.28 | x | 0.5 | x | 0.7 | = | 108.78 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 92.28 | x | 0.5 | x | 0.7 | = | 51.26 | (80) |
| West | 0.9x | 0.77 | x | 4.86 | x | 113.09 | x | 0.5 | x | 0.7 | = | 133.31 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 113.09 | x | 0.5 | x | 0.7 | = | 62.82 | (80) |
| West | 0.9x | 0.77 | x | 4.86 | x | 115.77 | x | 0.5 | x | 0.7 | = | 136.47 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 115.77 | x | 0.5 | x | 0.7 | = | 64.3 | (80) |
| West | 0.9x | 0.77 | x | 4.86 | x | 110.22 | x | 0.5 | x | 0.7 | = | 129.92 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 110.22 | x | 0.5 | x | 0.7 | = | 61.22 | (80) |
| West | 0.9x | 0.77 | x | 4.86 | x | 94.68 | x | 0.5 | x | 0.7 | = | 111.6 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 94.68 | x | 0.5 | x | 0.7 | = | 52.59 | (80) |
| West | 0.9x | 0.77 | x | 4.86 | x | 73.59 | x | 0.5 | x | 0.7 | = | 86.75 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 73.59 | x | 0.5 | x | 0.7 | = | 40.87 | (80) |
| West | 0.9x | 0.77 | x | 4.86 | x | 45.59 | x | 0.5 | x | 0.7 | = | 53.74 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 45.59 | x | 0.5 | x | 0.7 | = | 25.32 | (80) |
| West | 0.9x | 0.77 | x | 4.86 | x | 24.49 | x | 0.5 | x | 0.7 | = | 28.87 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 24.49 | x | 0.5 | x | 0.7 | = | 13.6 | (80) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 4.86 | x | 16.15 | x | 0.5 | x | 0.7 | = | 19.04 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 16.15 | x | 0.5 | x | 0.7 | = | 8.97 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 101.62 | 197.2 | 328.3 | 495.78 | 630.02 | 656.57 | 620.19 | 516.44 | 386.34 | 234.25 | 126.24 | 83.97 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 564.19 | 657.61 | 773.92 | 917.43 | 1027.16 | 1030.19 | 978.58 | 881.08 | 763.33 | 635.44 | 555.25 | 534.01 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.96 | 0.94 | 0.88 | 0.76 | 0.6 | 0.43 | 0.32 | 0.37 | 0.6 | 0.84 | 0.94 | 0.97 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.43 | 19.7 | 20.11 | 20.57 | 20.84 | 20.96 | 20.99 | 20.98 | 20.89 | 20.49 | 19.89 | 19.39 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.25 | 20.25 | 20.25 | 20.26 | 20.27 | 20.28 | 20.28 | 20.28 | 20.27 | 20.27 | 20.26 | 20.26 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.96 | 0.93 | 0.87 | 0.74 | 0.56 | 0.39 | 0.27 | 0.31 | 0.55 | 0.81 | 0.93 | 0.96 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18.13 | 18.51 | 19.09 | 19.73 | 20.09 | 20.24 | 20.27 | 20.27 | 20.16 | 19.64 | 18.79 | 18.07 | (90) |

fLA = Living area ÷ (4) = 0.34 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.57 | 18.91 | 19.43 | 20.01 | 20.35 | 20.48 | 20.51 | 20.51 | 20.41 | 19.92 | 19.16 | 18.52 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.57 | 18.91 | 19.43 | 20.01 | 20.35 | 20.48 | 20.51 | 20.51 | 20.41 | 19.92 | 19.16 | 18.52 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.94 | 0.91 | 0.85 | 0.73 | 0.57 | 0.4 | 0.29 | 0.33 | 0.56 | 0.8 | 0.91 | 0.95 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 530.74 | 598.6 | 656.44 | 667.61 | 583.34 | 415.03 | 281.49 | 292.83 | 424.39 | 509.03 | 506.77 | 506.37 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1084.39 | 1061.14 | 976.46 | 825.06 | 639.69 | 427.93 | 284.53 | 297.76 | 461.87 | 689.76 | 898.22 | 1073.65 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 411.91 | 310.83 | 238.1 | 113.36 | 41.92 | 0 | 0 | 0 | 0 | 134.46 | 281.85 | 422.05 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1954.48 (98)

Space heating requirement in kWh/m²/year 20.74 (99)

## 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

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| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |
| **Space heating** | | **kWh/year** | |
| Annual space heating requirement | | 1954.48 | |
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 1026.1 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 1026.1 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |
| **Water heating** | | | |
| Annual water heating requirement | | 2190.1 | |
| If DHW from community scheme: Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1149.8 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1149.8 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 43.52 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside | | 307.77 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 307.77 | (331) |
| Energy for lighting (calculated in Appendix L) | | 388.3 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -575.52 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP) | | | | |
| Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | 91 | (367b) |

# DER WorkSheet: New dwelling design stage

| | | | | | |
|---|---|---|---|---|---|
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | 0.52 | = | 265.72 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | 0.22 | = | 516.48 | (368) |
| Electrical energy for heat distribution | [(313) x | 0.52 | = | 22.59 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | = | 804.78 | (373) |
| CO2 associated with space heating (secondary) | (309) x | 0 | = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | 0.52 | = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | 804.78 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | 0.52 | = | 159.73 | (378) |
| CO2 associated with electricity for lighting | (332))) x | 0.52 | = | 201.53 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable<br>Item 1 | | 0.52 | x 0.01 = | -298.7 | (380) |
| **Total CO2, kg/year** | sum of (376)…(382) = | | | 867.35 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | | | 9.21 | (384) |
| **EI rating (section 14)** | | | | 91.65 | (385) |

# DER WorkSheet: New dwelling design stage

**User Details:**

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

**Property Address: P10**

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 74.01 | (1a) x | 2.55 | (2a) = | 188.73 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 74.01 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 188.73 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

Wind Factor (22a)m = (22)m ÷ 4

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| **ELEMENT** | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 10.85 | x1/[1/( 1.2 )+ 0.04] | | = | 12.42 | | | (27) |
| Windows Type 2 | | | 4.5 | x1/[1/( 1.2 )+ 0.04] | | = | 5.15 | | | (27) |
| Walls Type1 | 34.74 | 19.85 | 14.89 | x | 0.18 | = | 2.68 | | | (29) |
| Walls Type2 | 45.63 | 0 | 45.63 | x | 0.23 | = | 10.37 | | | (29) |
| Total area of elements, m² | | | 80.37 | | | | | | | (31) |
| Party wall | | | 31.28 | x | 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 35.78 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 5038.8 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 9.48 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 45.25 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 19.82 | 19.63 | 19.43 | 18.43 | 18.24 | 17.24 | 17.24 | 17.05 | 17.64 | 18.24 | 18.63 | 19.03 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 65.08 | 64.88 | 64.68 | 63.69 | 63.49 | 62.5 | 62.5 | 62.3 | 62.9 | 63.49 | 63.89 | 64.29 | |

Average = Sum(39)$_{1…12}$ /12= 63.64 (39)

# DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.88 | 0.88 | 0.87 | 0.86 | 0.86 | 0.84 | 0.84 | 0.84 | 0.85 | 0.86 | 0.86 | 0.87 |

Average = Sum(40)$_{1...12}$ /12= 0.86 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.34 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 89.76 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 98.74 | 95.15 | 91.56 | 87.97 | 84.38 | 80.79 | 80.79 | 84.38 | 87.97 | 91.56 | 95.15 | 98.74 |

Total = Sum(44)$_{1...12}$ = 1077.13 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 146.42 | 128.06 | 132.15 | 115.21 | 110.55 | 95.39 | 88.4 | 101.44 | 102.65 | 119.63 | 130.58 | 141.8 |

Total = Sum(45)$_{1...12}$ = 1412.29 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 21.96 | 19.21 | 19.82 | 17.28 | 16.58 | 14.31 | 13.26 | 15.22 | 15.4 | 17.94 | 19.59 | 21.27 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 201.7 | 177.99 | 187.43 | 168.71 | 165.83 | 148.89 | 143.67 | 156.71 | 156.14 | 174.9 | 184.08 | 197.08 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 201.7 | 177.99 | 187.43 | 168.71 | 165.83 | 148.89 | 143.67 | 156.71 | 156.14 | 174.9 | 184.08 | 197.08 | |

Output from water heater (annual)$_{1...12}$ 2063.13 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 92.91 | 82.52 | 88.16 | 81.1 | 80.98 | 74.51 | 73.61 | 77.95 | 76.93 | 84 | 86.21 | 91.37 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | 116.97 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 18.41 | 16.35 | 13.3 | 10.07 | 7.52 | 6.35 | 6.86 | 8.92 | 11.98 | 15.21 | 17.75 | 18.92 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 206.47 | 208.61 | 203.21 | 191.72 | 177.21 | 163.57 | 154.46 | 152.32 | 157.72 | 169.21 | 183.72 | 197.36 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | -93.58 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 124.88 | 122.8 | 118.5 | 112.64 | 108.84 | 103.49 | 98.94 | 104.77 | 106.84 | 112.9 | 119.74 | 122.81 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 407.84 | 405.85 | 393.1 | 372.52 | 351.67 | 331.51 | 318.36 | 324.11 | 334.63 | 355.41 | 379.3 | 397.18 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 10.85 | x | 19.64 | x | 0.5 | x | 0.7 | = | 51.69 | (76) |
| East | 0.9x | 2 | x | 4.5 | x | 19.64 | x | 0.5 | x | 0.7 | = | 42.87 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 38.42 | x | 0.5 | x | 0.7 | = | 101.11 | (76) |
| East | 0.9x | 2 | x | 4.5 | x | 38.42 | x | 0.5 | x | 0.7 | = | 83.87 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 63.27 | x | 0.5 | x | 0.7 | = | 166.51 | (76) |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 2 | x | 4.5 | x | 63.27 | x | 0.5 | x | 0.7 | = | 138.12 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 92.28 | x | 0.5 | x | 0.7 | = | 242.85 | (76) |
| East | 0.9x | 2 | x | 4.5 | x | 92.28 | x | 0.5 | x | 0.7 | = | 201.44 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 113.09 | x | 0.5 | x | 0.7 | = | 297.62 | (76) |
| East | 0.9x | 2 | x | 4.5 | x | 113.09 | x | 0.5 | x | 0.7 | = | 246.88 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 115.77 | x | 0.5 | x | 0.7 | = | 304.67 | (76) |
| East | 0.9x | 2 | x | 4.5 | x | 115.77 | x | 0.5 | x | 0.7 | = | 252.72 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 110.22 | x | 0.5 | x | 0.7 | = | 290.06 | (76) |
| East | 0.9x | 2 | x | 4.5 | x | 110.22 | x | 0.5 | x | 0.7 | = | 240.6 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 94.68 | x | 0.5 | x | 0.7 | = | 249.16 | (76) |
| East | 0.9x | 2 | x | 4.5 | x | 94.68 | x | 0.5 | x | 0.7 | = | 206.67 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 73.59 | x | 0.5 | x | 0.7 | = | 193.66 | (76) |
| East | 0.9x | 2 | x | 4.5 | x | 73.59 | x | 0.5 | x | 0.7 | = | 160.64 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 45.59 | x | 0.5 | x | 0.7 | = | 119.98 | (76) |
| East | 0.9x | 2 | x | 4.5 | x | 45.59 | x | 0.5 | x | 0.7 | = | 99.52 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 24.49 | x | 0.5 | x | 0.7 | = | 64.45 | (76) |
| East | 0.9x | 2 | x | 4.5 | x | 24.49 | x | 0.5 | x | 0.7 | = | 53.46 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 16.15 | x | 0.5 | x | 0.7 | = | 42.5 | (76) |
| East | 0.9x | 2 | x | 4.5 | x | 16.15 | x | 0.5 | x | 0.7 | = | 35.26 | (76) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 94.56 | 184.98 | 304.64 | 444.29 | 544.5 | 557.39 | 530.66 | 455.83 | 354.3 | 219.49 | 117.91 | 77.76 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 502.4 | 590.83 | 697.73 | 816.81 | 896.17 | 888.9 | 849.02 | 779.93 | 688.93 | 574.9 | 497.21 | 474.94 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.95 | 0.92 | 0.86 | 0.74 | 0.59 | 0.43 | 0.32 | 0.36 | 0.57 | 0.81 | 0.92 | 0.96 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.37 | 19.66 | 20.09 | 20.55 | 20.82 | 20.95 | 20.99 | 20.98 | 20.88 | 20.48 | 19.85 | 19.33 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.19 | 20.19 | 20.19 | 20.2 | 20.2 | 20.21 | 20.21 | 20.22 | 20.21 | 20.2 | 20.2 | 20.19 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.94 | 0.91 | 0.84 | 0.71 | 0.55 | 0.38 | 0.26 | 0.3 | 0.52 | 0.78 | 0.91 | 0.95 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 18 | 18.41 | 19.02 | 19.65 | 20.01 | 20.17 | 20.21 | 20.2 | 20.1 | 19.57 | 18.69 | 17.93 | (90) |

fLA = Living area ÷ (4) = 0.4 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.54 | 18.91 | 19.44 | 20.01 | 20.33 | 20.48 | 20.52 | 20.51 | 20.41 | 19.93 | 19.15 | 18.49 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.54 | 18.91 | 19.44 | 20.01 | 20.33 | 20.48 | 20.52 | 20.51 | 20.41 | 19.93 | 19.15 | 18.49 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.93 | 0.89 | 0.82 | 0.7 | 0.55 | 0.4 | 0.28 | 0.32 | 0.53 | 0.77 | 0.89 | 0.93 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 465.06 | 525.61 | 572.99 | 573.4 | 496.36 | 354.37 | 241.4 | 251.19 | 364.42 | 443.14 | 444.01 | 443.83 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 927.05 | 908.77 | 837.12 | 707.29 | 548.11 | 367.54 | 244.69 | 256.11 | 396.76 | 592.42 | 769.89 | 918.39 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 343.72 | 257.48 | 196.51 | 96.4 | 38.5 | 0 | 0 | 0 | 0 | 111.06 | 234.63 | 353.07 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 1631.38 | (98)

Space heating requirement in kWh/m²/year | 22.04 | (99)

## 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |
| **Space heating** | | **kWh/year** | |
| Annual space heating requirement | | 1631.38 | |
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 856.48 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 856.48 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |
| **Water heating** | | | |
| Annual water heating requirement | | 2063.13 | |
| If DHW from community scheme: Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1083.14 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1083.14 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 38.79 | (313) |

# DER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f):<br>mechanical ventilation - balanced, extract or positive input from outside | | 241.76 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 241.76 | (331) |
| Energy for lighting (calculated in Appendix L) | | 325.07 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -452.02 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | | Energy kWh/year | Emission factor kg CO2/kWh | | Emissions kg CO2/year | |
|---|---|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP)<br>Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 91 | (367b) |
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.52 | = | 236.86 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.22 | = | 460.39 | (368) |
| Electrical energy for heat distribution | [(313) x | | 0.52 | = | 20.13 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | | = | 717.39 | (373) |
| CO2 associated with space heating (secondary) | (309) x | | 0 | = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | | 0.52 | = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | | 717.39 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | | 0.52 | = | 125.47 | (378) |
| CO2 associated with electricity for lighting | (332))) x | | 0.52 | = | 168.71 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable<br>Item 1 | | 0.52 | | x 0.01 = | -234.6 | (380) |
| **Total CO2, kg/year** | sum of (376)…(382) = | | | | 776.98 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | | | | 10.5 | (384) |
| **EI rating (section 14)** | | | | | 91.25 | (385) |

# DER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: P11

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 56.61 | (1a) | x | 2.55 | (2a) | = | 144.36 | (3a) |
| First floor | 62.48 | (1b) | x | 3 | (2b) | = | 187.44 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 119.09 | (4) | | | | | | |
| Dwelling volume | | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | = | 331.8 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

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Wind Factor (22a)m = (22)m ÷ 4

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.72 | x1/[1/( 1.2 )+ 0.04] | | = | 5.4 | | | (27) |
| Windows Type 2 | | | 2.29 | x1/[1/( 1.2 )+ 0.04] | | = | 2.62 | | | (27) |
| Windows Type 3 | | | 4.51 | x1/[1/( 1.2 )+ 0.04] | | = | 5.16 | | | (27) |
| Windows Type 4 | | | 2.26 | x1/[1/( 1.2 )+ 0.04] | | = | 2.59 | | | (27) |
| Walls Type1 | 70.79 | 20.79 | 50 | x | 0.18 | = | 9 | | | (29) |
| Walls Type2 | 4.01 | 0 | 4.01 | x | 0.23 | = | 0.91 | | | (29) |
| Roof Type1 | 6.58 | 0 | 6.58 | x | 0.13 | = | 0.86 | | | (30) |
| Roof Type2 | 62.48 | 0 | 62.48 | x | 0.13 | = | 8.12 | | | (30) |
| Total area of elements, m² | | | 143.86 | | | | | | | (31) |
| Party wall | | | 109.79 | x | 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 42.69 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 8802.69 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 19.64 (36)

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*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 62.33 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 34.85 | 34.5 | 34.15 | 32.41 | 32.06 | 30.32 | 30.32 | 29.97 | 31.01 | 32.06 | 32.76 | 33.46 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 97.18 | 96.83 | 96.48 | 94.73 | 94.39 | 92.64 | 92.64 | 92.29 | 93.34 | 94.39 | 95.08 | 95.78 | |

Average = Sum(39)$_{1...12}$ /12= 94.65 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.82 | 0.81 | 0.81 | 0.8 | 0.79 | 0.78 | 0.78 | 0.77 | 0.78 | 0.79 | 0.8 | 0.8 | |

Average = Sum(40)$_{1...12}$ /12= 0.79 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.86 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 102.12 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | | |
| (44)m= | 112.33 | 108.25 | 104.16 | 100.08 | 95.99 | 91.91 | 91.91 | 95.99 | 100.08 | 104.16 | 108.25 | 112.33 | |

Total = Sum(44)$_{1...12}$ = 1225.42 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 166.58 | 145.69 | 150.34 | 131.07 | 125.77 | 108.53 | 100.57 | 115.4 | 116.78 | 136.1 | 148.56 | 161.33 | |

Total = Sum(45)$_{1...12}$ = 1606.72 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 24.99 | 21.85 | 22.55 | 19.66 | 18.87 | 16.28 | 15.09 | 17.31 | 17.52 | 20.41 | 22.28 | 24.2 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 221.86 | 195.62 | 205.62 | 184.57 | 181.04 | 162.02 | 155.84 | 170.68 | 170.27 | 191.37 | 202.05 | 216.6 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 221.86 | 195.62 | 205.62 | 184.57 | 181.04 | 162.02 | 155.84 | 170.68 | 170.27 | 191.37 | 202.05 | 216.6 |

Output from water heater (annual)$_{1...12}$ | 2257.56 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 99.61 | 88.39 | 94.21 | 86.38 | 86.04 | 78.88 | 77.66 | 82.59 | 81.62 | 89.47 | 92.19 | 97.86 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 142.99 | 142.99 | 142.99 | 142.99 | 142.99 | 142.99 | 142.99 | 142.99 | 142.99 | 142.99 | 142.99 | 142.99 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| (67)m= | 25.99 | 23.09 | 18.78 | 14.21 | 10.63 | 8.97 | 9.69 | 12.6 | 16.91 | 21.47 | 25.06 | 26.72 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| (68)m= | 284.02 | 286.97 | 279.54 | 263.73 | 243.77 | 225.02 | 212.48 | 209.54 | 216.96 | 232.77 | 252.73 | 271.49 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| (69)m= | 37.3 | 37.3 | 37.3 | 37.3 | 37.3 | 37.3 | 37.3 | 37.3 | 37.3 | 37.3 | 37.3 | 37.3 | (69) |
| Pumps and fans gains (Table 5a) | | | | | | | | | | | | | |
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| (71)m= | -114.39 | -114.39 | -114.39 | -114.39 | -114.39 | -114.39 | -114.39 | -114.39 | -114.39 | -114.39 | -114.39 | -114.39 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| (72)m= | 133.88 | 131.53 | 126.63 | 119.97 | 115.64 | 109.56 | 104.38 | 111.01 | 113.37 | 120.26 | 128.04 | 131.54 | (72) |
| **Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m | | | | | | | | | | | | | |
| (73)m= | 509.8 | 507.48 | 490.84 | 463.81 | 435.94 | 409.44 | 392.45 | 399.04 | 413.14 | 440.4 | 471.73 | 495.64 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

# DER WorkSheet: New dwelling design stage

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.51 | x | 19.64 | x | 0.5 | x | 0.7 | = | 21.48 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 19.64 | x | 0.5 | x | 0.7 | = | 10.77 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 38.42 | x | 0.5 | x | 0.7 | = | 42.03 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 38.42 | x | 0.5 | x | 0.7 | = | 21.06 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 63.27 | x | 0.5 | x | 0.7 | = | 69.21 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 63.27 | x | 0.5 | x | 0.7 | = | 34.68 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 92.28 | x | 0.5 | x | 0.7 | = | 100.95 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 92.28 | x | 0.5 | x | 0.7 | = | 50.58 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 113.09 | x | 0.5 | x | 0.7 | = | 123.71 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 113.09 | x | 0.5 | x | 0.7 | = | 61.99 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 115.77 | x | 0.5 | x | 0.7 | = | 126.64 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 115.77 | x | 0.5 | x | 0.7 | = | 63.46 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 110.22 | x | 0.5 | x | 0.7 | = | 120.57 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 110.22 | x | 0.5 | x | 0.7 | = | 60.42 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 94.68 | x | 0.5 | x | 0.7 | = | 103.57 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 94.68 | x | 0.5 | x | 0.7 | = | 51.9 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 73.59 | x | 0.5 | x | 0.7 | = | 80.5 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 73.59 | x | 0.5 | x | 0.7 | = | 40.34 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 45.59 | x | 0.5 | x | 0.7 | = | 49.87 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 45.59 | x | 0.5 | x | 0.7 | = | 24.99 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 24.49 | x | 0.5 | x | 0.7 | = | 26.79 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 24.49 | x | 0.5 | x | 0.7 | = | 13.42 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 16.15 | x | 0.5 | x | 0.7 | = | 17.67 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 16.15 | x | 0.5 | x | 0.7 | = | 8.85 | (76) |
| West | 0.9x | 0.77 | x | 4.72 | x | 19.64 | x | 0.5 | x | 0.7 | = | 44.97 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 19.64 | x | 0.5 | x | 0.7 | = | 21.82 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 38.42 | x | 0.5 | x | 0.7 | = | 87.97 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 38.42 | x | 0.5 | x | 0.7 | = | 42.68 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 63.27 | x | 0.5 | x | 0.7 | = | 144.87 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 63.27 | x | 0.5 | x | 0.7 | = | 70.29 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 92.28 | x | 0.5 | x | 0.7 | = | 211.29 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 92.28 | x | 0.5 | x | 0.7 | = | 102.51 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 113.09 | x | 0.5 | x | 0.7 | = | 258.95 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 113.09 | x | 0.5 | x | 0.7 | = | 125.63 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 115.77 | x | 0.5 | x | 0.7 | = | 265.08 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 115.77 | x | 0.5 | x | 0.7 | = | 128.61 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 110.22 | x | 0.5 | x | 0.7 | = | 252.36 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 110.22 | x | 0.5 | x | 0.7 | = | 122.44 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 94.68 | x | 0.5 | x | 0.7 | = | 216.78 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 2.29 | x | 94.68 | x | 0.5 | x | 0.7 | = | 105.17 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 73.59 | x | 0.5 | x | 0.7 | = | 168.5 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 73.59 | x | 0.5 | x | 0.7 | = | 81.75 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 45.59 | x | 0.5 | x | 0.7 | = | 104.38 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 45.59 | x | 0.5 | x | 0.7 | = | 50.64 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 24.49 | x | 0.5 | x | 0.7 | = | 56.07 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 24.49 | x | 0.5 | x | 0.7 | = | 27.2 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 16.15 | x | 0.5 | x | 0.7 | = | 36.98 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 16.15 | x | 0.5 | x | 0.7 | = | 17.94 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 99.04 | 193.74 | 319.06 | 465.33 | 570.28 | 583.79 | 555.79 | 477.41 | 371.08 | 229.89 | 123.49 | 81.44 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 608.84 | 701.22 | 809.9 | 929.14 | 1006.22 | 993.22 | 948.24 | 876.46 | 784.22 | 670.29 | 595.22 | 577.08 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.97 | 0.96 | 0.92 | 0.84 | 0.71 | 0.55 | 0.42 | 0.46 | 0.69 | 0.89 | 0.96 | 0.98 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.25 | 19.49 | 19.89 | 20.38 | 20.73 | 20.92 | 20.98 | 20.97 | 20.82 | 20.34 | 19.72 | 19.22 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.24 | 20.24 | 20.24 | 20.26 | 20.26 | 20.27 | 20.27 | 20.28 | 20.27 | 20.26 | 20.25 | 20.25 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.97 | 0.95 | 0.91 | 0.82 | 0.68 | 0.5 | 0.35 | 0.4 | 0.64 | 0.87 | 0.95 | 0.98 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.86 | 18.21 | 18.78 | 19.47 | 19.95 | 20.2 | 20.26 | 20.25 | 20.08 | 19.44 | 18.55 | 17.82 | (90) |

fLA = Living area ÷ (4) = | 0.23 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.18 | 18.51 | 19.04 | 19.68 | 20.13 | 20.36 | 20.42 | 20.42 | 20.25 | 19.65 | 18.82 | 18.14 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.18 | 18.51 | 19.04 | 19.68 | 20.13 | 20.36 | 20.42 | 20.42 | 20.25 | 19.65 | 18.82 | 18.14 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.96 | 0.94 | 0.89 | 0.8 | 0.67 | 0.5 | 0.36 | 0.41 | 0.64 | 0.85 | 0.94 | 0.96 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 583.19 | 656.71 | 722.67 | 747.03 | 676.48 | 501.49 | 346.05 | 358.74 | 501.85 | 571.44 | 558.15 | 555.99 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1349.07 | 1317.53 | 1209.82 | 1021.64 | 795.49 | 533.9 | 354.1 | 370.57 | 574.49 | 853.92 | 1114.12 | 1335.39 | (97) |

# DER WorkSheet: New dwelling design stage

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 569.81 | 444.07 | 362.44 | 197.72 | 88.55 | 0 | 0 | 0 | 0 | 210.17 | 400.3 | 579.87 |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2852.92 (98)

Space heating requirement in kWh/m²/year 23.96 (99)

## 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |
| **Space heating** | | **kWh/year** | |
| Annual space heating requirement | | 2852.92 | |
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 1497.78 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 1497.78 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |
| **Water heating** | | | |
| Annual water heating requirement | | 2257.56 | |
| If DHW from community scheme: Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1185.22 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1185.22 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 53.66 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside | | 425.03 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 425.03 | (331) |
| Energy for lighting (calculated in Appendix L) | | 459.05 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -727.02 | (333) |

# DER WorkSheet: New dwelling design stage

| | | | | | |
|---|---|---|---|---|---|
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | | Energy kWh/year | Emission factor kg CO2/kWh | | Emissions kg CO2/year | |
|---|---|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP) | | | | | | |
| Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | | 91 | (367b) |
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.52 | = | 327.64 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.22 | = | 636.84 | (368) |
| Electrical energy for heat distribution | [(313) x | | 0.52 | = | 27.85 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | | = | 992.34 | (373) |
| CO2 associated with space heating (secondary) | (309) x | | 0 | = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | | 0.52 | = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | | 992.34 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | | 0.52 | = | 220.59 | (378) |
| CO2 associated with electricity for lighting | (332))) x | | 0.52 | = | 238.25 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable | | | | | | |
| Item 1 | | 0.52 | | x 0.01 = | -377.32 | (380) |
| **Total CO2, kg/year** | sum of (376)…(382) = | | | | 1073.85 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | | | | 9.02 | (384) |
| **EI rating (section 14)** | | | | | 91.23 | (385) |

# DER WorkSheet: New dwelling design stage

User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

Property Address: P12

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 45.01 | (1a) | x | 2.55 | (2a) | = | 114.78 | (3a) |
| First floor | 71.14 | (1b) | x | 3 | (2b) | = | 213.42 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 116.15 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | | = | 328.2 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

# DER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.72 | x1/[1/( 1.2 )+ 0.04] | | = | 5.4 | | | (27) |
| Windows Type 2 | | | 2.29 | x1/[1/( 1.2 )+ 0.04] | | = | 2.62 | | | (27) |
| Windows Type 3 | | | 4.51 | x1/[1/( 1.2 )+ 0.04] | | = | 5.16 | | | (27) |
| Windows Type 4 | | | 2.26 | x1/[1/( 1.2 )+ 0.04] | | = | 2.59 | | | (27) |
| Walls Type1 | 67.29 | 20.79 | 46.5 | x | 0.18 | = | 8.37 | | | (29) |
| Walls Type2 | 55.89 | 0 | 55.89 | x | 0.23 | = | 12.62 | | | (29) |
| Roof Type1 | 4.24 | 0 | 4.24 | x | 0.13 | = | 0.55 | | | (30) |
| Roof Type2 | 71.14 | 0 | 71.14 | x | 0.13 | = | 9.25 | | | (30) |
| Total area of elements, m² | | | 198.56 | | | | | | | (31) |
| Party wall | | | 69.63 | x | 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 54.59 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 9955.17 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 20.78 (36)

# DER WorkSheet: New dwelling design stage

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 75.37 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 34.47 | 34.13 | 33.78 | 32.06 | 31.71 | 29.99 | 29.99 | 29.64 | 30.68 | 31.71 | 32.4 | 33.09 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 109.84 | 109.5 | 109.15 | 107.43 | 107.08 | 105.36 | 105.36 | 105.01 | 106.05 | 107.08 | 107.77 | 108.46 | |

Average = Sum(39)$_{1…12}$ /12= 107.34 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.95 | 0.94 | 0.94 | 0.92 | 0.92 | 0.91 | 0.91 | 0.9 | 0.91 | 0.92 | 0.93 | 0.93 | |

Average = Sum(40)$_{1…12}$ /12= 0.92 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.85 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 101.82 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 112 | 107.93 | 103.86 | 99.78 | 95.71 | 91.64 | 91.64 | 95.71 | 99.78 | 103.86 | 107.93 | 112 | |

Total = Sum(44)$_{1…12}$ = 1221.83 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 166.09 | 145.27 | 149.9 | 130.69 | 125.4 | 108.21 | 100.27 | 115.06 | 116.44 | 135.7 | 148.12 | 160.85 | |

Total = Sum(45)$_{1…12}$ = 1602.01 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 24.91 | 21.79 | 22.49 | 19.6 | 18.81 | 16.23 | 15.04 | 17.26 | 17.47 | 20.35 | 22.22 | 24.13 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 221.37 | 195.19 | 205.18 | 184.18 | 180.68 | 161.7 | 155.55 | 170.34 | 169.93 | 190.97 | 201.62 | 216.13 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 221.37 | 195.19 | 205.18 | 184.18 | 180.68 | 161.7 | 155.55 | 170.34 | 169.93 | 190.97 | 201.62 | 216.13 |

Output from water heater (annual)$_{1...12}$ — 2252.85 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 99.45 | 88.24 | 94.06 | 86.25 | 85.92 | 78.77 | 77.56 | 82.48 | 81.51 | 89.34 | 92.05 | 97.71 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 142.36 | 142.36 | 142.36 | 142.36 | 142.36 | 142.36 | 142.36 | 142.36 | 142.36 | 142.36 | 142.36 | 142.36 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 25.53 | 22.67 | 18.44 | 13.96 | 10.44 | 8.81 | 9.52 | 12.37 | 16.61 | 21.09 | 24.61 | 26.24 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 280.11 | 283.02 | 275.69 | 260.1 | 240.42 | 221.92 | 209.56 | 206.65 | 213.98 | 229.57 | 249.25 | 267.75 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -113.89 | -113.89 | -113.89 | -113.89 | -113.89 | -113.89 | -113.89 | -113.89 | -113.89 | -113.89 | -113.89 | -113.89 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 133.67 | 131.31 | 126.43 | 119.79 | 115.48 | 109.41 | 104.25 | 110.86 | 113.21 | 120.08 | 127.84 | 131.32 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 505.01 | 502.72 | 486.27 | 459.56 | 432.04 | 405.84 | 389.03 | 395.59 | 409.5 | 436.45 | 467.41 | 491.02 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

# DER WorkSheet: New dwelling design stage

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.51 | x | 19.64 | x | 0.5 | x | 0.7 | = | 21.48 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 19.64 | x | 0.5 | x | 0.7 | = | 10.77 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 38.42 | x | 0.5 | x | 0.7 | = | 42.03 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 38.42 | x | 0.5 | x | 0.7 | = | 21.06 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 63.27 | x | 0.5 | x | 0.7 | = | 69.21 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 63.27 | x | 0.5 | x | 0.7 | = | 34.68 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 92.28 | x | 0.5 | x | 0.7 | = | 100.95 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 92.28 | x | 0.5 | x | 0.7 | = | 50.58 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 113.09 | x | 0.5 | x | 0.7 | = | 123.71 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 113.09 | x | 0.5 | x | 0.7 | = | 61.99 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 115.77 | x | 0.5 | x | 0.7 | = | 126.64 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 115.77 | x | 0.5 | x | 0.7 | = | 63.46 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 110.22 | x | 0.5 | x | 0.7 | = | 120.57 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 110.22 | x | 0.5 | x | 0.7 | = | 60.42 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 94.68 | x | 0.5 | x | 0.7 | = | 103.57 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 94.68 | x | 0.5 | x | 0.7 | = | 51.9 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 73.59 | x | 0.5 | x | 0.7 | = | 80.5 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 73.59 | x | 0.5 | x | 0.7 | = | 40.34 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 45.59 | x | 0.5 | x | 0.7 | = | 49.87 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 45.59 | x | 0.5 | x | 0.7 | = | 24.99 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 24.49 | x | 0.5 | x | 0.7 | = | 26.79 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 24.49 | x | 0.5 | x | 0.7 | = | 13.42 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 16.15 | x | 0.5 | x | 0.7 | = | 17.67 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 16.15 | x | 0.5 | x | 0.7 | = | 8.85 | (76) |
| West | 0.9x | 0.77 | x | 4.72 | x | 19.64 | x | 0.5 | x | 0.7 | = | 44.97 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 19.64 | x | 0.5 | x | 0.7 | = | 21.82 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 38.42 | x | 0.5 | x | 0.7 | = | 87.97 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 38.42 | x | 0.5 | x | 0.7 | = | 42.68 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 63.27 | x | 0.5 | x | 0.7 | = | 144.87 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 63.27 | x | 0.5 | x | 0.7 | = | 70.29 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 92.28 | x | 0.5 | x | 0.7 | = | 211.29 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 92.28 | x | 0.5 | x | 0.7 | = | 102.51 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 113.09 | x | 0.5 | x | 0.7 | = | 258.95 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 113.09 | x | 0.5 | x | 0.7 | = | 125.63 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 115.77 | x | 0.5 | x | 0.7 | = | 265.08 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 115.77 | x | 0.5 | x | 0.7 | = | 128.61 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 110.22 | x | 0.5 | x | 0.7 | = | 252.36 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 110.22 | x | 0.5 | x | 0.7 | = | 122.44 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 94.68 | x | 0.5 | x | 0.7 | = | 216.78 | (80) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 2.29 | x | 94.68 | x | 0.5 | x | 0.7 | = | 105.17 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 73.59 | x | 0.5 | x | 0.7 | = | 168.5 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 73.59 | x | 0.5 | x | 0.7 | = | 81.75 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 45.59 | x | 0.5 | x | 0.7 | = | 104.38 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 45.59 | x | 0.5 | x | 0.7 | = | 50.64 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 24.49 | x | 0.5 | x | 0.7 | = | 56.07 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 24.49 | x | 0.5 | x | 0.7 | = | 27.2 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 16.15 | x | 0.5 | x | 0.7 | = | 36.98 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 16.15 | x | 0.5 | x | 0.7 | = | 17.94 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 99.04 | 193.74 | 319.06 | 465.33 | 570.28 | 583.79 | 555.79 | 477.41 | 371.08 | 229.89 | 123.49 | 81.44 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 604.05 | 696.45 | 805.33 | 924.89 | 1002.32 | 989.63 | 944.82 | 873.01 | 780.58 | 666.33 | 590.9 | 572.47 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) — 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.97 | 0.96 | 0.93 | 0.86 | 0.75 | 0.6 | 0.46 | 0.51 | 0.73 | 0.9 | 0.96 | 0.98 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 18.94 | 19.19 | 19.62 | 20.16 | 20.59 | 20.86 | 20.95 | 20.93 | 20.72 | 20.14 | 19.45 | 18.9 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.13 | 20.13 | 20.13 | 20.15 | 20.15 | 20.16 | 20.16 | 20.16 | 20.16 | 20.15 | 20.14 | 20.14 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.97 | 0.95 | 0.92 | 0.84 | 0.71 | 0.54 | 0.38 | 0.43 | 0.67 | 0.88 | 0.96 | 0.97 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.34 | 17.7 | 18.32 | 19.09 | 19.68 | 20.03 | 20.13 | 20.11 | 19.87 | 19.09 | 18.09 | 17.29 | (90) |

fLA = Living area ÷ (4) = 0.26 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 17.76 | 18.09 | 18.66 | 19.37 | 19.92 | 20.25 | 20.35 | 20.33 | 20.1 | 19.37 | 18.45 | 17.72 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 17.76 | 18.09 | 18.66 | 19.37 | 19.92 | 20.25 | 20.35 | 20.33 | 20.1 | 19.37 | 18.45 | 17.72 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.96 | 0.94 | 0.9 | 0.82 | 0.7 | 0.54 | 0.4 | 0.45 | 0.67 | 0.86 | 0.94 | 0.96 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 578 | 652.53 | 722.1 | 756.8 | 701.51 | 536.99 | 377.98 | 389.53 | 523.27 | 574.03 | 554.38 | 550.84 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1478.47 | 1444.48 | 1327.31 | 1125.29 | 880.2 | 594.84 | 394.61 | 412.85 | 636.05 | 938.75 | 1223.31 | 1465.9 | (97) |

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 669.94 | 532.19 | 450.28 | 265.31 | 132.94 | 0 | 0 | 0 | 0 | 271.35 | 481.63 | 680.8 |

| | | | |
|---|---|---|---|
| | Total per year (kWh/year) = Sum(98)1...5,9...12 = | 3484.45 | (98) |
| Space heating requirement in kWh/m²/year | | 30 | (99) |

## 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |
| **Space heating** | | **kWh/year** | |
| Annual space heating requirement | | 3484.45 | |
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 1829.34 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 1829.34 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |
| **Water heating** | | | |
| Annual water heating requirement | | 2252.85 | |
| If DHW from community scheme: Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1182.75 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1182.75 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 60.24 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside | | 420.42 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 420.42 | (331) |
| Energy for lighting (calculated in Appendix L) | | 450.84 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -708.9 | (333) |

# DER WorkSheet: New dwelling design stage

| | | | | | |
|---|---|---|---|---|---|
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP) | | | | | |
| Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | 91 | (367b) |
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.52 = | 367.83 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.22 = | 714.96 | (368) |
| Electrical energy for heat distribution | [(313) x | | 0.52 = | 31.27 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | = | 1114.05 | (373) |
| CO2 associated with space heating (secondary) | (309) x | | 0 = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | | 0.52 = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | 1114.05 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | | 0.52 = | 218.2 | (378) |
| CO2 associated with electricity for lighting | (332))) x | | 0.52 = | 233.99 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable | | | | | |
| Item 1 | | 0.52 | x 0.01 = | -367.92 | (380) |
| **Total CO2, kg/year** | sum of (376)…(382) = | | | 1198.31 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | | | 10.32 | (384) |
| **EI rating (section 14)** | | | | 90.04 | (385) |

# DER WorkSheet: New dwelling design stage

User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

Property Address: P13

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 45.86 | (1a) | x | 2.55 | (2a) | = | 116.94 | (3a) |
| First floor | 88.47 | (1b) | x | 3 | (2b) | = | 265.41 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 134.33 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | | = | 382.35 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |

*if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*

| | | | |
|---|---|---|---|
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |

*Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used*

| | | | |
|---|---|---|---|
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

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Wind Factor (22a)m = (22)m ÷ 4

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.72 | x1/[1/( 1.2 )+ 0.04] | | = | 5.4 | | | (27) |
| Windows Type 2 | | | 2.29 | x1/[1/( 1.2 )+ 0.04] | | = | 2.62 | | | (27) |
| Windows Type 3 | | | 4.51 | x1/[1/( 1.2 )+ 0.04] | | = | 5.16 | | | (27) |
| Windows Type 4 | | | 2.26 | x1/[1/( 1.2 )+ 0.04] | | = | 2.59 | | | (27) |
| Floor | | | 16.08 | x | 0.13 | = | 2.0904 | | | (28) |
| Walls Type1 | 66.62 | 25.51 | 41.11 | x | 0.18 | = | 7.4 | | | (29) |
| Walls Type2 | 65.03 | 0 | 65.03 | x | 0.23 | = | 14.68 | | | (29) |
| Roof Type1 | 4 | 0 | 4 | x | 0.13 | = | 0.52 | | | (30) |
| Roof Type2 | 88.47 | 0 | 88.47 | x | 0.13 | = | 11.5 | | | (30) |
| Total area of elements, m² | | | 240.2 | | | | | | | (31) |
| Party wall | | | 51.82 | x | 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 65.4 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 10738.53 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

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| | | | |
|---|---|---|---|
| Thermal bridges : S (L x Y) calculated using Appendix K | | 22.3 | (36) |
| *if details of thermal bridging are not known (36) = 0.15 x (31)* | | | |
| Total fabric heat loss | (33) + (36) = | 87.7 | (37) |
| Ventilation heat loss calculated monthly | (38)m = 0.33 × (25)m x (5) | | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 40.16 | 39.76 | 39.36 | 37.35 | 36.95 | 34.94 | 34.94 | 34.53 | 35.74 | 36.95 | 37.75 | 38.55 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 127.86 | 127.46 | 127.06 | 125.05 | 124.65 | 122.64 | 122.64 | 122.23 | 123.44 | 124.65 | 125.45 | 126.26 | |

Average = Sum(39)$_{1...12}$ /12= 124.95 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.95 | 0.95 | 0.95 | 0.93 | 0.93 | 0.91 | 0.91 | 0.91 | 0.92 | 0.93 | 0.93 | 0.94 | |

Average = Sum(40)$_{1...12}$ /12= 0.93 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.91 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 103.2 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | | |
| (44)m= | 113.52 | 109.4 | 105.27 | 101.14 | 97.01 | 92.88 | 92.88 | 97.01 | 101.14 | 105.27 | 109.4 | 113.52 | |

Total = Sum(44)$_{1...12}$ = 1238.44 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 168.35 | 147.24 | 151.94 | 132.47 | 127.1 | 109.68 | 101.64 | 116.63 | 118.02 | 137.54 | 150.14 | 163.04 | |

Total = Sum(45)$_{1...12}$ = 1623.79 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 25.25 | 22.09 | 22.79 | 19.87 | 19.07 | 16.45 | 15.25 | 17.49 | 17.7 | 20.63 | 22.52 | 24.46 | (46) |

Water storage loss:

| | | | |
|---|---|---|---|
| Storage volume (litres) including any solar or WWHRS storage within same vessel | | 0 | (47) |
| If community heating and no tank in dwelling, enter 110 litres in (47) | | | |
| Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47) | | | |
| Water storage loss: | | | |
| a) If manufacturer's declared loss factor is known (kWh/day): | | 0 | (48) |
| Temperature factor from Table 2b | | 0 | (49) |
| Energy lost from water storage, kWh/year | (48) x (49) = | 110 | (50) |
| b) If manufacturer's declared cylinder loss factor is not known: | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | 0.02 | (51) |
| If community heating see section 4.3 | | | |
| Volume factor from Table 2a | | 1.03 | (52) |
| Temperature factor from Table 2b | | 0.6 | (53) |

# DER WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| Energy lost from water storage, kWh/year | (47) x (51) x (52) x (53) = | 1.03 | (54) |
| Enter (50) or (54) in (55) | | 1.03 | (55) |

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 223.63 | 197.17 | 207.22 | 185.96 | 182.38 | 163.17 | 156.91 | 171.91 | 171.51 | 192.82 | 203.63 | 218.32 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 223.63 | 197.17 | 207.22 | 185.96 | 182.38 | 163.17 | 156.91 | 171.91 | 171.51 | 192.82 | 203.63 | 218.32 | |

Output from water heater (annual)$_{1...12}$ — 2274.63 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 100.2 | 88.9 | 94.74 | 86.84 | 86.48 | 79.26 | 78.02 | 83 | 82.04 | 89.95 | 92.72 | 98.43 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 145.27 | 145.27 | 145.27 | 145.27 | 145.27 | 145.27 | 145.27 | 145.27 | 145.27 | 145.27 | 145.27 | 145.27 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 27.36 | 24.3 | 19.76 | 14.96 | 11.18 | 9.44 | 10.2 | 13.26 | 17.8 | 22.6 | 26.38 | 28.12 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 302.87 | 306.01 | 298.09 | 281.23 | 259.95 | 239.94 | 226.58 | 223.44 | 231.36 | 248.22 | 269.5 | 289.5 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 37.53 | 37.53 | 37.53 | 37.53 | 37.53 | 37.53 | 37.53 | 37.53 | 37.53 | 37.53 | 37.53 | 37.53 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -116.22 | -116.22 | -116.22 | -116.22 | -116.22 | -116.22 | -116.22 | -116.22 | -116.22 | -116.22 | -116.22 | -116.22 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 134.68 | 132.29 | 127.34 | 120.61 | 116.24 | 110.09 | 104.86 | 111.56 | 113.94 | 120.91 | 128.77 | 132.3 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 531.48 | 529.18 | 511.78 | 483.38 | 453.95 | 426.06 | 408.22 | 414.84 | 429.68 | 458.31 | 491.23 | 516.51 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

# DER WorkSheet: New dwelling design stage

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.51 | x | 19.64 | x | 0.5 | x | 0.7 | = | 21.48 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 19.64 | x | 0.5 | x | 0.7 | = | 10.77 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 38.42 | x | 0.5 | x | 0.7 | = | 42.03 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 38.42 | x | 0.5 | x | 0.7 | = | 21.06 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 63.27 | x | 0.5 | x | 0.7 | = | 69.21 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 63.27 | x | 0.5 | x | 0.7 | = | 34.68 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 92.28 | x | 0.5 | x | 0.7 | = | 100.95 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 92.28 | x | 0.5 | x | 0.7 | = | 50.58 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 113.09 | x | 0.5 | x | 0.7 | = | 123.71 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 113.09 | x | 0.5 | x | 0.7 | = | 61.99 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 115.77 | x | 0.5 | x | 0.7 | = | 126.64 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 115.77 | x | 0.5 | x | 0.7 | = | 63.46 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 110.22 | x | 0.5 | x | 0.7 | = | 120.57 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 110.22 | x | 0.5 | x | 0.7 | = | 60.42 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 94.68 | x | 0.5 | x | 0.7 | = | 103.57 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 94.68 | x | 0.5 | x | 0.7 | = | 51.9 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 73.59 | x | 0.5 | x | 0.7 | = | 80.5 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 73.59 | x | 0.5 | x | 0.7 | = | 40.34 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 45.59 | x | 0.5 | x | 0.7 | = | 49.87 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 45.59 | x | 0.5 | x | 0.7 | = | 24.99 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 24.49 | x | 0.5 | x | 0.7 | = | 26.79 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 24.49 | x | 0.5 | x | 0.7 | = | 13.42 | (76) |
| East | 0.9x | 1 | x | 4.51 | x | 16.15 | x | 0.5 | x | 0.7 | = | 17.67 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 16.15 | x | 0.5 | x | 0.7 | = | 8.85 | (76) |
| West | 0.9x | 0.77 | x | 4.72 | x | 19.64 | x | 0.5 | x | 0.7 | = | 67.45 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 19.64 | x | 0.5 | x | 0.7 | = | 21.82 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 38.42 | x | 0.5 | x | 0.7 | = | 131.96 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 38.42 | x | 0.5 | x | 0.7 | = | 42.68 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 63.27 | x | 0.5 | x | 0.7 | = | 217.31 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 63.27 | x | 0.5 | x | 0.7 | = | 70.29 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 92.28 | x | 0.5 | x | 0.7 | = | 316.94 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 92.28 | x | 0.5 | x | 0.7 | = | 102.51 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 113.09 | x | 0.5 | x | 0.7 | = | 388.42 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 113.09 | x | 0.5 | x | 0.7 | = | 125.63 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 115.77 | x | 0.5 | x | 0.7 | = | 397.61 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 115.77 | x | 0.5 | x | 0.7 | = | 128.61 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 110.22 | x | 0.5 | x | 0.7 | = | 378.55 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 110.22 | x | 0.5 | x | 0.7 | = | 122.44 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 94.68 | x | 0.5 | x | 0.7 | = | 325.16 | (80) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 2.29 | x | 94.68 | x | 0.5 | x | 0.7 | = | 105.17 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 73.59 | x | 0.5 | x | 0.7 | = | 252.74 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 73.59 | x | 0.5 | x | 0.7 | = | 81.75 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 45.59 | x | 0.5 | x | 0.7 | = | 156.58 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 45.59 | x | 0.5 | x | 0.7 | = | 50.64 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 24.49 | x | 0.5 | x | 0.7 | = | 84.11 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 24.49 | x | 0.5 | x | 0.7 | = | 27.2 | (80) |
| West | 0.9x | 0.77 | x | 4.72 | x | 16.15 | x | 0.5 | x | 0.7 | = | 55.47 | (80) |
| West | 0.9x | 0.77 | x | 2.29 | x | 16.15 | x | 0.5 | x | 0.7 | = | 17.94 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 121.52 | 237.73 | 391.5 | 570.98 | 699.76 | 716.32 | 681.97 | 585.8 | 455.33 | 282.08 | 151.53 | 99.93 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 653.01 | 766.91 | 903.27 | 1054.36 | 1153.71 | 1142.38 | 1090.19 | 1000.64 | 885.01 | 740.39 | 642.76 | 616.44 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.98 | 0.97 | 0.93 | 0.87 | 0.75 | 0.6 | 0.46 | 0.51 | 0.74 | 0.91 | 0.97 | 0.98 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 18.86 | 19.12 | 19.57 | 20.14 | 20.58 | 20.85 | 20.95 | 20.93 | 20.71 | 20.1 | 19.39 | 18.83 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.12 | 20.13 | 20.13 | 20.14 | 20.14 | 20.16 | 20.16 | 20.16 | 20.15 | 20.14 | 20.14 | 20.13 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.98 | 0.96 | 0.92 | 0.84 | 0.71 | 0.54 | 0.38 | 0.43 | 0.68 | 0.89 | 0.96 | 0.98 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.22 | 17.6 | 18.25 | 19.06 | 19.66 | 20.02 | 20.12 | 20.11 | 19.85 | 19.03 | 18 | 17.18 | (90) |

fLA = Living area ÷ (4) = 0.29 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 17.7 | 18.05 | 18.64 | 19.37 | 19.93 | 20.26 | 20.36 | 20.35 | 20.1 | 19.34 | 18.4 | 17.66 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 17.7 | 18.05 | 18.64 | 19.37 | 19.93 | 20.26 | 20.36 | 20.35 | 20.1 | 19.34 | 18.4 | 17.66 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.96 | 0.94 | 0.9 | 0.82 | 0.7 | 0.55 | 0.4 | 0.45 | 0.68 | 0.87 | 0.95 | 0.97 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 628.91 | 723.54 | 815.81 | 868.64 | 812.37 | 624.66 | 441.18 | 453.74 | 602.57 | 645.59 | 608.1 | 596.76 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1713.81 | 1675.92 | 1541.95 | 1309.46 | 1025.85 | 694.32 | 461.53 | 482.58 | 741 | 1089.72 | 1417.93 | 1699.12 | (97) |

# DER WorkSheet: New dwelling design stage

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (98)m= | 807.17 | 640 | 540.24 | 317.39 | 158.83 | 0 | 0 | 0 | 0 | 330.43 | 583.08 | 820.16 |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4197.31 (98)

Space heating requirement in kWh/m²/year 31.25 (99)

## 9b. Energy requirements – Community heating scheme

| | | | |
|---|---|---|---|
| This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |
| **Space heating** | | **kWh/year** | |
| Annual space heating requirement | | 4197.31 | |
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 2203.59 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 2203.59 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |
| **Water heating** | | | |
| Annual water heating requirement | | 2274.63 | |
| If DHW from community scheme: Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1194.18 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1194.18 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 67.96 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside | | 489.79 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 489.79 | (331) |
| Energy for lighting (calculated in Appendix L) | | 483.19 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -820.06 | (333) |

# DER WorkSheet: New dwelling design stage

| | | | | |
|---|---|---|---|---|
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP) | | | | | |
| Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | 91 | (367b) |
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.52 | = 414.93 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | | 0.22 | = 806.5 | (368) |
| Electrical energy for heat distribution | [(313) x | | 0.52 | = 35.27 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | | = 1256.7 | (373) |
| CO2 associated with space heating (secondary) | (309) x | | 0 | = 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | | 0.52 | = 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | 1256.7 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | | 0.52 | = 254.2 | (378) |
| CO2 associated with electricity for lighting | (332))) x | | 0.52 | = 250.78 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable | | | | | |
| Item 1 | | 0.52 | x 0.01 = | -425.61 | (380) |
| **Total CO2, kg/year** | sum of (376)…(382) = | | | 1336.07 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | | | 9.95 | (384) |
| **EI rating (section 14)** | | | | 90.02 | (385) |

# DER WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

## Property Address: P14

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 57.38 | (1a) | x | 2.55 | (2a) | = | 146.32 | (3a) |
| First floor | 58.34 | (1b) | x | 3 | (2b) | = | 175.02 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 115.72 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | | = | 321.34 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 ÷ (5) = | 0 | (8) |
| *If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)* | | | |
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Monthly average wind speed from Table 7

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

# DER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.85 | x1/[1/( 1.2 )+ 0.04] | | = | 5.55 | | | (27) |
| Windows Type 2 | | | 2.1 | x1/[1/( 1.2 )+ 0.04] | | = | 2.4 | | | (27) |
| Windows Type 3 | | | 4.78 | x1/[1/( 1.2 )+ 0.04] | | = | 5.47 | | | (27) |
| Windows Type 4 | | | 4.99 | x1/[1/( 1.2 )+ 0.04] | | = | 5.71 | | | (27) |
| Windows Type 5 | | | 2.16 | x1/[1/( 1.2 )+ 0.04] | | = | 2.47 | | | (27) |
| Windows Type 6 | | | 5.9 | x1/[1/( 1.2 )+ 0.04] | | = | 6.76 | | | (27) |
| Windows Type 7 | | | 2.26 | x1/[1/( 1.2 )+ 0.04] | | = | 2.59 | | | (27) |
| Walls Type1 | 118.9 | 31.46 | 87.44 | x | 0.18 | = | 15.74 | | | (29) |
| Walls Type2 | 4.02 | 0 | 4.02 | x | 0.23 | = | 0.91 | | | (29) |
| Roof Type1 | 6.82 | 0 | 6.82 | x | 0.13 | = | 0.89 | | | (30) |
| Roof Type2 | 58.34 | 0 | 58.34 | x | 0.13 | = | 7.58 | | | (30) |
| Total area of elements, m² | | | 188.08 | | | | | | | (31) |
| Party wall | | | 72.21 | x | 0 | = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 61.14 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 9323.25 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f* *can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K | 25.71 | (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = | 86.85 | (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 33.75 | 33.42 | 33.08 | 31.39 | 31.05 | 29.36 | 29.36 | 29.02 | 30.04 | 31.05 | 31.73 | 32.4 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 120.6 | 120.26 | 119.93 | 118.24 | 117.9 | 116.21 | 116.21 | 115.87 | 116.88 | 117.9 | 118.57 | 119.25 |

Average = $Sum(39)_{1…12}$ /12= | 118.15 | (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.04 | 1.04 | 1.04 | 1.02 | 1.02 | 1 | 1 | 1 | 1.01 | 1.02 | 1.02 | 1.03 |

Average = $Sum(40)_{1…12}$ /12= | 1.02 | (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 2.85 | (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 | 101.77 | (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 111.95 | 107.88 | 103.81 | 99.74 | 95.67 | 91.59 | 91.59 | 95.67 | 99.74 | 103.81 | 107.88 | 111.95 |

Total = $Sum(44)_{1…12}$ = | 1221.27 | (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 166.02 | 145.2 | 149.83 | 130.63 | 125.34 | 108.16 | 100.23 | 115.01 | 116.38 | 135.63 | 148.06 | 160.78 |

Total = $Sum(45)_{1…12}$ = | 1601.27 | (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 24.9 | 21.78 | 22.48 | 19.59 | 18.8 | 16.22 | 15.03 | 17.25 | 17.46 | 20.35 | 22.21 | 24.12 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 0 | (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): | 0 | (48)

Temperature factor from Table 2b | 0 | (49)

Energy lost from water storage, kWh/year (48) x (49) = | 110 | (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0.02 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 1.03 | (52)

Temperature factor from Table 2b | 0.6 | (53)

| | | | |
|---|---|---|---|
| Energy lost from water storage, kWh/year | (47) x (51) x (52) x (53) = | 1.03 | (54) |
| Enter (50) or (54) in (55) | | 1.03 | (55) |

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 221.29 | 195.13 | 205.11 | 184.12 | 180.62 | 161.65 | 155.5 | 170.29 | 169.88 | 190.91 | 201.55 | 216.06 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 221.29 | 195.13 | 205.11 | 184.12 | 180.62 | 161.65 | 155.5 | 170.29 | 169.88 | 190.91 | 201.55 | 216.06 |

Output from water heater (annual)$_{1...12}$ — 2252.11 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 99.42 | 88.22 | 94.04 | 86.23 | 85.9 | 78.76 | 77.55 | 82.46 | 81.49 | 89.32 | 92.02 | 97.68 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 142.26 | 142.26 | 142.26 | 142.26 | 142.26 | 142.26 | 142.26 | 142.26 | 142.26 | 142.26 | 142.26 | 142.26 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| (67)m= | 24.92 | 22.13 | 18 | 13.63 | 10.19 | 8.6 | 9.29 | 12.08 | 16.21 | 20.59 | 24.03 | 25.61 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| (68)m= | 279.53 | 282.43 | 275.12 | 259.56 | 239.92 | 221.46 | 209.12 | 206.22 | 213.53 | 229.09 | 248.74 | 267.2 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| (69)m= | 37.23 | 37.23 | 37.23 | 37.23 | 37.23 | 37.23 | 37.23 | 37.23 | 37.23 | 37.23 | 37.23 | 37.23 | (69) |
| Pumps and fans gains (Table 5a) | | | | | | | | | | | | | |
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| (71)m= | -113.81 | -113.81 | -113.81 | -113.81 | -113.81 | -113.81 | -113.81 | -113.81 | -113.81 | -113.81 | -113.81 | -113.81 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| (72)m= | 133.63 | 131.28 | 126.4 | 119.76 | 115.45 | 109.39 | 104.23 | 110.84 | 113.18 | 120.05 | 127.81 | 131.29 | (72) |
| **Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m | | | | | | | | | | | | | |
| (73)m= | 503.76 | 501.52 | 485.2 | 458.63 | 431.24 | 405.12 | 388.32 | 394.81 | 408.61 | 435.41 | 466.25 | 489.78 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

# DER WorkSheet: New dwelling design stage

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North | 0.9x | 0.77 | x | 4.78 | x | 10.63 | x | 0.5 | x | 0.7 | = | 12.33 | (74) |
| North | 0.9x | 0.77 | x | 4.99 | x | 10.63 | x | 0.5 | x | 0.7 | = | 12.87 | (74) |
| North | 0.9x | 0.77 | x | 5.9 | x | 10.63 | x | 0.5 | x | 0.7 | = | 15.22 | (74) |
| North | 0.9x | 0.77 | x | 4.78 | x | 20.32 | x | 0.5 | x | 0.7 | = | 23.56 | (74) |
| North | 0.9x | 0.77 | x | 4.99 | x | 20.32 | x | 0.5 | x | 0.7 | = | 24.59 | (74) |
| North | 0.9x | 0.77 | x | 5.9 | x | 20.32 | x | 0.5 | x | 0.7 | = | 29.08 | (74) |
| North | 0.9x | 0.77 | x | 4.78 | x | 34.53 | x | 0.5 | x | 0.7 | = | 40.03 | (74) |
| North | 0.9x | 0.77 | x | 4.99 | x | 34.53 | x | 0.5 | x | 0.7 | = | 41.79 | (74) |
| North | 0.9x | 0.77 | x | 5.9 | x | 34.53 | x | 0.5 | x | 0.7 | = | 49.41 | (74) |
| North | 0.9x | 0.77 | x | 4.78 | x | 55.46 | x | 0.5 | x | 0.7 | = | 64.3 | (74) |
| North | 0.9x | 0.77 | x | 4.99 | x | 55.46 | x | 0.5 | x | 0.7 | = | 67.13 | (74) |
| North | 0.9x | 0.77 | x | 5.9 | x | 55.46 | x | 0.5 | x | 0.7 | = | 79.37 | (74) |
| North | 0.9x | 0.77 | x | 4.78 | x | 74.72 | x | 0.5 | x | 0.7 | = | 86.62 | (74) |
| North | 0.9x | 0.77 | x | 4.99 | x | 74.72 | x | 0.5 | x | 0.7 | = | 90.43 | (74) |
| North | 0.9x | 0.77 | x | 5.9 | x | 74.72 | x | 0.5 | x | 0.7 | = | 106.92 | (74) |
| North | 0.9x | 0.77 | x | 4.78 | x | 79.99 | x | 0.5 | x | 0.7 | = | 92.73 | (74) |
| North | 0.9x | 0.77 | x | 4.99 | x | 79.99 | x | 0.5 | x | 0.7 | = | 96.81 | (74) |
| North | 0.9x | 0.77 | x | 5.9 | x | 79.99 | x | 0.5 | x | 0.7 | = | 114.46 | (74) |
| North | 0.9x | 0.77 | x | 4.78 | x | 74.68 | x | 0.5 | x | 0.7 | = | 86.58 | (74) |
| North | 0.9x | 0.77 | x | 4.99 | x | 74.68 | x | 0.5 | x | 0.7 | = | 90.38 | (74) |
| North | 0.9x | 0.77 | x | 5.9 | x | 74.68 | x | 0.5 | x | 0.7 | = | 106.87 | (74) |
| North | 0.9x | 0.77 | x | 4.78 | x | 59.25 | x | 0.5 | x | 0.7 | = | 68.69 | (74) |
| North | 0.9x | 0.77 | x | 4.99 | x | 59.25 | x | 0.5 | x | 0.7 | = | 71.71 | (74) |
| North | 0.9x | 0.77 | x | 5.9 | x | 59.25 | x | 0.5 | x | 0.7 | = | 84.78 | (74) |
| North | 0.9x | 0.77 | x | 4.78 | x | 41.52 | x | 0.5 | x | 0.7 | = | 48.13 | (74) |
| North | 0.9x | 0.77 | x | 4.99 | x | 41.52 | x | 0.5 | x | 0.7 | = | 50.25 | (74) |
| North | 0.9x | 0.77 | x | 5.9 | x | 41.52 | x | 0.5 | x | 0.7 | = | 59.41 | (74) |
| North | 0.9x | 0.77 | x | 4.78 | x | 24.19 | x | 0.5 | x | 0.7 | = | 28.04 | (74) |
| North | 0.9x | 0.77 | x | 4.99 | x | 24.19 | x | 0.5 | x | 0.7 | = | 29.28 | (74) |
| North | 0.9x | 0.77 | x | 5.9 | x | 24.19 | x | 0.5 | x | 0.7 | = | 34.62 | (74) |
| North | 0.9x | 0.77 | x | 4.78 | x | 13.12 | x | 0.5 | x | 0.7 | = | 15.21 | (74) |
| North | 0.9x | 0.77 | x | 4.99 | x | 13.12 | x | 0.5 | x | 0.7 | = | 15.88 | (74) |
| North | 0.9x | 0.77 | x | 5.9 | x | 13.12 | x | 0.5 | x | 0.7 | = | 18.77 | (74) |
| North | 0.9x | 0.77 | x | 4.78 | x | 8.86 | x | 0.5 | x | 0.7 | = | 10.28 | (74) |
| North | 0.9x | 0.77 | x | 4.99 | x | 8.86 | x | 0.5 | x | 0.7 | = | 10.73 | (74) |
| North | 0.9x | 0.77 | x | 5.9 | x | 8.86 | x | 0.5 | x | 0.7 | = | 12.69 | (74) |
| East | 0.9x | 2 | x | 2.26 | x | 19.64 | x | 0.5 | x | 0.7 | = | 21.53 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 38.42 | x | 0.5 | x | 0.7 | = | 42.12 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 63.27 | x | 0.5 | x | 0.7 | = | 69.37 | (76) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 2 | x | 2.26 | x | 92.28 | x | 0.5 | x | 0.7 | = | 101.17 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 113.09 | x | 0.5 | x | 0.7 | = | 123.99 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 115.77 | x | 0.5 | x | 0.7 | = | 126.92 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 110.22 | x | 0.5 | x | 0.7 | = | 120.84 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 94.68 | x | 0.5 | x | 0.7 | = | 103.8 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 73.59 | x | 0.5 | x | 0.7 | = | 80.68 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 45.59 | x | 0.5 | x | 0.7 | = | 49.98 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 24.49 | x | 0.5 | x | 0.7 | = | 26.85 | (76) |
| East | 0.9x | 2 | x | 2.26 | x | 16.15 | x | 0.5 | x | 0.7 | = | 17.71 | (76) |
| West | 0.9x | 0.77 | x | 4.85 | x | 19.64 | x | 0.5 | x | 0.7 | = | 23.1 | (80) |
| West | 0.9x | 0.77 | x | 2.1 | x | 19.64 | x | 0.5 | x | 0.7 | = | 10 | (80) |
| West | 0.9x | 0.77 | x | 2.16 | x | 19.64 | x | 0.5 | x | 0.7 | = | 20.58 | (80) |
| West | 0.9x | 0.77 | x | 4.85 | x | 38.42 | x | 0.5 | x | 0.7 | = | 45.2 | (80) |
| West | 0.9x | 0.77 | x | 2.1 | x | 38.42 | x | 0.5 | x | 0.7 | = | 19.57 | (80) |
| West | 0.9x | 0.77 | x | 2.16 | x | 38.42 | x | 0.5 | x | 0.7 | = | 40.26 | (80) |
| West | 0.9x | 0.77 | x | 4.85 | x | 63.27 | x | 0.5 | x | 0.7 | = | 74.43 | (80) |
| West | 0.9x | 0.77 | x | 2.1 | x | 63.27 | x | 0.5 | x | 0.7 | = | 32.23 | (80) |
| West | 0.9x | 0.77 | x | 2.16 | x | 63.27 | x | 0.5 | x | 0.7 | = | 66.3 | (80) |
| West | 0.9x | 0.77 | x | 4.85 | x | 92.28 | x | 0.5 | x | 0.7 | = | 108.56 | (80) |
| West | 0.9x | 0.77 | x | 2.1 | x | 92.28 | x | 0.5 | x | 0.7 | = | 47 | (80) |
| West | 0.9x | 0.77 | x | 2.16 | x | 92.28 | x | 0.5 | x | 0.7 | = | 96.69 | (80) |
| West | 0.9x | 0.77 | x | 4.85 | x | 113.09 | x | 0.5 | x | 0.7 | = | 133.04 | (80) |
| West | 0.9x | 0.77 | x | 2.1 | x | 113.09 | x | 0.5 | x | 0.7 | = | 57.6 | (80) |
| West | 0.9x | 0.77 | x | 2.16 | x | 113.09 | x | 0.5 | x | 0.7 | = | 118.5 | (80) |
| West | 0.9x | 0.77 | x | 4.85 | x | 115.77 | x | 0.5 | x | 0.7 | = | 136.19 | (80) |
| West | 0.9x | 0.77 | x | 2.1 | x | 115.77 | x | 0.5 | x | 0.7 | = | 58.97 | (80) |
| West | 0.9x | 0.77 | x | 2.16 | x | 115.77 | x | 0.5 | x | 0.7 | = | 121.31 | (80) |
| West | 0.9x | 0.77 | x | 4.85 | x | 110.22 | x | 0.5 | x | 0.7 | = | 129.66 | (80) |
| West | 0.9x | 0.77 | x | 2.1 | x | 110.22 | x | 0.5 | x | 0.7 | = | 56.14 | (80) |
| West | 0.9x | 0.77 | x | 2.16 | x | 110.22 | x | 0.5 | x | 0.7 | = | 115.49 | (80) |
| West | 0.9x | 0.77 | x | 4.85 | x | 94.68 | x | 0.5 | x | 0.7 | = | 111.37 | (80) |
| West | 0.9x | 0.77 | x | 2.1 | x | 94.68 | x | 0.5 | x | 0.7 | = | 48.22 | (80) |
| West | 0.9x | 0.77 | x | 2.16 | x | 94.68 | x | 0.5 | x | 0.7 | = | 99.2 | (80) |
| West | 0.9x | 0.77 | x | 4.85 | x | 73.59 | x | 0.5 | x | 0.7 | = | 86.57 | (80) |
| West | 0.9x | 0.77 | x | 2.1 | x | 73.59 | x | 0.5 | x | 0.7 | = | 37.48 | (80) |
| West | 0.9x | 0.77 | x | 2.16 | x | 73.59 | x | 0.5 | x | 0.7 | = | 77.11 | (80) |
| West | 0.9x | 0.77 | x | 4.85 | x | 45.59 | x | 0.5 | x | 0.7 | = | 53.63 | (80) |
| West | 0.9x | 0.77 | x | 2.1 | x | 45.59 | x | 0.5 | x | 0.7 | = | 23.22 | (80) |
| West | 0.9x | 0.77 | x | 2.16 | x | 45.59 | x | 0.5 | x | 0.7 | = | 47.77 | (80) |
| West | 0.9x | 0.77 | x | 4.85 | x | 24.49 | x | 0.5 | x | 0.7 | = | 28.81 | (80) |
| West | 0.9x | 0.77 | x | 2.1 | x | 24.49 | x | 0.5 | x | 0.7 | = | 12.47 | (80) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West | 0.9x | 0.77 | x | 2.16 | x | 24.49 | x | 0.5 | x | 0.7 | = | 25.66 | (80) |
| West | 0.9x | 0.77 | x | 4.85 | x | 16.15 | x | 0.5 | x | 0.7 | = | 19 | (80) |
| West | 0.9x | 0.77 | x | 2.1 | x | 16.15 | x | 0.5 | x | 0.7 | = | 8.23 | (80) |
| West | 0.9x | 0.77 | x | 2.16 | x | 16.15 | x | 0.5 | x | 0.7 | = | 16.92 | (80) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 115.63 | 224.38 | 373.57 | 564.23 | 717.11 | 747.39 | 705.95 | 587.78 | 439.63 | 266.54 | 143.65 | 95.55 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 619.4 | 725.91 | 858.77 | 1022.86 | 1148.34 | 1152.51 | 1094.27 | 982.59 | 848.24 | 701.95 | 609.9 | 585.33 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.97 | 0.96 | 0.92 | 0.85 | 0.72 | 0.56 | 0.44 | 0.49 | 0.72 | 0.9 | 0.96 | 0.98 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 18.74 | 19.01 | 19.48 | 20.09 | 20.57 | 20.85 | 20.95 | 20.92 | 20.68 | 20.04 | 19.29 | 18.69 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.05 | 20.05 | 20.05 | 20.07 | 20.07 | 20.08 | 20.08 | 20.08 | 20.07 | 20.07 | 20.06 | 20.06 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.97 | 0.95 | 0.91 | 0.82 | 0.68 | 0.5 | 0.36 | 0.41 | 0.66 | 0.88 | 0.95 | 0.97 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17 | 17.39 | 18.07 | 18.93 | 19.58 | 19.94 | 20.04 | 20.03 | 19.75 | 18.89 | 17.8 | 16.94 | (90) |

fLA = Living area ÷ (4) = 0.23 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 17.4 | 17.77 | 18.4 | 19.2 | 19.81 | 20.15 | 20.25 | 20.24 | 19.97 | 19.15 | 18.15 | 17.35 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 17.4 | 17.77 | 18.4 | 19.2 | 19.81 | 20.15 | 20.25 | 20.24 | 19.97 | 19.15 | 18.15 | 17.35 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.95 | 0.93 | 0.89 | 0.8 | 0.67 | 0.51 | 0.37 | 0.43 | 0.66 | 0.85 | 0.93 | 0.96 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 590.62 | 676.16 | 761.54 | 816.62 | 766.3 | 584.11 | 406.6 | 417.86 | 556.96 | 599.38 | 569.61 | 561.47 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1580.43 | 1547.74 | 1427.27 | 1218.29 | 956.2 | 645.24 | 424.68 | 444.52 | 686.19 | 1008.58 | 1310.33 | 1568.34 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 736.42 | 585.7 | 495.31 | 289.2 | 141.28 | 0 | 0 | 0 | 0 | 304.45 | 533.32 | 749.11 | |

Total per year (kWh/year) = Sum(98)1...5,9...12 = 3834.8 (98)

Space heating requirement in kWh/m²/year 33.14 (99)

# DER WorkSheet: New dwelling design stage

## 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |
| **Space heating** | | **kWh/year** | |
| Annual space heating requirement | | 3834.8 | |
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 2013.27 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 2013.27 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |
| **Water heating** | | | |
| Annual water heating requirement | | 2252.11 | |
| If DHW from community scheme: Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1182.36 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1182.36 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 63.91 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside | | 411.64 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 411.64 | (331) |
| Energy for lighting (calculated in Appendix L) | | 440.1 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -706.43 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 12b. $CO_2$ Emissions – Community heating scheme

| | Energy kWh/year | Emission factor kg $CO_2$/kWh | Emissions kg $CO_2$/year | |
|---|---|---|---|---|
| $CO_2$ from other sources of space and water heating (not CHP) | | | | |
| Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | 425 | (367a) |

# DER WorkSheet: New dwelling design stage

| | | | | | |
|---|---|---|---|---|---|
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | 91 | (367b) |
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | 0.52 | = | 390.24 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | 0.22 | = | 758.52 | (368) |
| Electrical energy for heat distribution | [(313) x | 0.52 | = | 33.17 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | = | 1181.94 | (373) |
| CO2 associated with space heating (secondary) | (309) x | 0 | = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | 0.52 | = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | 1181.94 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | 0.52 | = | 213.64 | (378) |
| CO2 associated with electricity for lighting | (332))) x | 0.52 | = | 228.41 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable<br>Item 1 | | 0.52 | x 0.01 = | -366.64 | (380) |
| **Total CO2, kg/year** | sum of (376)…(382) = | | | 1257.35 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | | | 10.87 | (384) |
| **EI rating (section 14)** | | | | 89.52 | (385) |

# DER WorkSheet: New dwelling design stage

**User Details:**

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

**Property Address: P15**

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 78.35 | (1a) | x | 2.55 | (2a) | = | 199.79 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 78.35 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | | = | 199.79 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | | |
|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 | ÷ (5) = | 0 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

# DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | U-value W/m2K | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 10.85 | x1/[1/( 1.2 )+ 0.04] = | 12.42 | | | (27) |
| Windows Type 2 | | | 4.5 | x1/[1/( 1.2 )+ 0.04] = | 5.15 | | | (27) |
| Windows Type 3 | | | 2.26 | x1/[1/( 1.2 )+ 0.04] = | 2.59 | | | (27) |
| Windows Type 4 | | | 4.5 | x1/[1/( 1.2 )+ 0.04] = | 5.15 | | | (27) |
| Walls Type1 | 52.24 | 22.11 | 30.13 | x 0.18 = | 5.42 | | | (29) |
| Walls Type2 | 24.99 | 0 | 24.99 | x 0.23 = | 5.68 | | | (29) |
| Roof | 35.68 | 0 | 35.68 | x 0.13 = | 4.64 | | | (30) |
| Total area of elements, m² | | | 112.91 | | | | | (31) |
| Party wall | | | 24.69 | x 0 = | 0 | | | (32) |

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 41.06 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 4739.37 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 13.7 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 54.76 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 20.99 | 20.78 | 20.57 | 19.52 | 19.31 | 18.25 | 18.25 | 18.04 | 18.68 | 19.31 | 19.73 | 20.15 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 75.75 | 75.54 | 75.33 | 74.27 | 74.06 | 73.01 | 73.01 | 72.8 | 73.43 | 74.06 | 74.48 | 74.9 |

Average = Sum(39)$_{1…12}$ /12= 74.22 (39)

# DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 0.97 | 0.96 | 0.96 | 0.95 | 0.95 | 0.93 | 0.93 | 0.93 | 0.94 | 0.95 | 0.95 | 0.96 |

Average = Sum(40)$_{1…12}$ /12= 0.95 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.43 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 91.93 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

*Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 101.12 | 97.45 | 93.77 | 90.09 | 86.42 | 82.74 | 82.74 | 86.42 | 90.09 | 93.77 | 97.45 | 101.12 |

Total = Sum(44)$_{1…12}$ = 1103.18 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 149.97 | 131.16 | 135.35 | 118 | 113.22 | 97.7 | 90.54 | 103.89 | 105.13 | 122.52 | 133.74 | 145.23 |

Total = Sum(45)$_{1…12}$ = 1446.44 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 22.49 | 19.67 | 20.3 | 17.7 | 16.98 | 14.66 | 13.58 | 15.58 | 15.77 | 18.38 | 20.06 | 21.78 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 205.24 | 181.09 | 190.62 | 171.49 | 168.5 | 151.2 | 145.81 | 159.17 | 158.62 | 177.8 | 187.23 | 200.51 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 205.24 | 181.09 | 190.62 | 171.49 | 168.5 | 151.2 | 145.81 | 159.17 | 158.62 | 177.8 | 187.23 | 200.51 | |

Output from water heater (annual)$_{1...12}$ 2097.28 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 94.08 | 83.55 | 89.22 | 82.03 | 81.87 | 75.28 | 74.32 | 78.76 | 77.75 | 84.96 | 87.26 | 92.51 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 121.54 | 121.54 | 121.54 | 121.54 | 121.54 | 121.54 | 121.54 | 121.54 | 121.54 | 121.54 | 121.54 | 121.54 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 19.25 | 17.1 | 13.91 | 10.53 | 7.87 | 6.64 | 7.18 | 9.33 | 12.53 | 15.9 | 18.56 | 19.79 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 215.96 | 218.2 | 212.55 | 200.53 | 185.35 | 171.09 | 161.56 | 159.32 | 164.97 | 176.99 | 192.17 | 206.43 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 35.15 | 35.15 | 35.15 | 35.15 | 35.15 | 35.15 | 35.15 | 35.15 | 35.15 | 35.15 | 35.15 | 35.15 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -97.23 | -97.23 | -97.23 | -97.23 | -97.23 | -97.23 | -97.23 | -97.23 | -97.23 | -97.23 | -97.23 | -97.23 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 126.46 | 124.33 | 119.92 | 113.93 | 110.04 | 104.56 | 99.9 | 105.87 | 107.99 | 114.19 | 121.2 | 124.34 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 421.13 | 419.1 | 405.84 | 384.45 | 362.72 | 341.75 | 328.1 | 333.98 | 344.94 | 366.55 | 391.39 | 410.02 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North | 0.9x | 0.54 | x | 4.5 | x | 10.63 | x | 0.5 | x | 0.7 | = | 8.14 | (74) |
| North | 0.9x | 0.54 | x | 4.5 | x | 20.32 | x | 0.5 | x | 0.7 | = | 15.55 | (74) |
| North | 0.9x | 0.54 | x | 4.5 | x | 34.53 | x | 0.5 | x | 0.7 | = | 26.43 | (74) |
| North | 0.9x | 0.54 | x | 4.5 | x | 55.46 | x | 0.5 | x | 0.7 | = | 42.46 | (74) |
| North | 0.9x | 0.54 | x | 4.5 | x | 74.72 | x | 0.5 | x | 0.7 | = | 57.19 | (74) |

# DER WorkSheet: New dwelling design stage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North | 0.9x | 0.54 | x | 4.5 | x | 79.99 | x | 0.5 | x | 0.7 | = | 61.22 | (74) |
| North | 0.9x | 0.54 | x | 4.5 | x | 74.68 | x | 0.5 | x | 0.7 | = | 57.16 | (74) |
| North | 0.9x | 0.54 | x | 4.5 | x | 59.25 | x | 0.5 | x | 0.7 | = | 45.35 | (74) |
| North | 0.9x | 0.54 | x | 4.5 | x | 41.52 | x | 0.5 | x | 0.7 | = | 31.78 | (74) |
| North | 0.9x | 0.54 | x | 4.5 | x | 24.19 | x | 0.5 | x | 0.7 | = | 18.52 | (74) |
| North | 0.9x | 0.54 | x | 4.5 | x | 13.12 | x | 0.5 | x | 0.7 | = | 10.04 | (74) |
| North | 0.9x | 0.54 | x | 4.5 | x | 8.86 | x | 0.5 | x | 0.7 | = | 6.79 | (74) |
| East | 0.9x | 1 | x | 10.85 | x | 19.64 | x | 0.5 | x | 0.7 | = | 51.69 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 19.64 | x | 0.5 | x | 0.7 | = | 21.44 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 19.64 | x | 0.5 | x | 0.7 | = | 10.77 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 38.42 | x | 0.5 | x | 0.7 | = | 101.11 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 38.42 | x | 0.5 | x | 0.7 | = | 41.94 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 38.42 | x | 0.5 | x | 0.7 | = | 21.06 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 63.27 | x | 0.5 | x | 0.7 | = | 166.51 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 63.27 | x | 0.5 | x | 0.7 | = | 69.06 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 63.27 | x | 0.5 | x | 0.7 | = | 34.68 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 92.28 | x | 0.5 | x | 0.7 | = | 242.85 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 92.28 | x | 0.5 | x | 0.7 | = | 100.72 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 92.28 | x | 0.5 | x | 0.7 | = | 50.58 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 113.09 | x | 0.5 | x | 0.7 | = | 297.62 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 113.09 | x | 0.5 | x | 0.7 | = | 123.44 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 113.09 | x | 0.5 | x | 0.7 | = | 61.99 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 115.77 | x | 0.5 | x | 0.7 | = | 304.67 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 115.77 | x | 0.5 | x | 0.7 | = | 126.36 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 115.77 | x | 0.5 | x | 0.7 | = | 63.46 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 110.22 | x | 0.5 | x | 0.7 | = | 290.06 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 110.22 | x | 0.5 | x | 0.7 | = | 120.3 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 110.22 | x | 0.5 | x | 0.7 | = | 60.42 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 94.68 | x | 0.5 | x | 0.7 | = | 249.16 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 94.68 | x | 0.5 | x | 0.7 | = | 103.34 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 94.68 | x | 0.5 | x | 0.7 | = | 51.9 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 73.59 | x | 0.5 | x | 0.7 | = | 193.66 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 73.59 | x | 0.5 | x | 0.7 | = | 80.32 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 73.59 | x | 0.5 | x | 0.7 | = | 40.34 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 45.59 | x | 0.5 | x | 0.7 | = | 119.98 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 45.59 | x | 0.5 | x | 0.7 | = | 49.76 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 45.59 | x | 0.5 | x | 0.7 | = | 24.99 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 24.49 | x | 0.5 | x | 0.7 | = | 64.45 | (76) |
| East | 0.9x | 1 | x | 4.5 | x | 24.49 | x | 0.5 | x | 0.7 | = | 26.73 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 24.49 | x | 0.5 | x | 0.7 | = | 13.42 | (76) |
| East | 0.9x | 1 | x | 10.85 | x | 16.15 | x | 0.5 | x | 0.7 | = | 42.5 | (76) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 4.5 | x | 16.15 | x | 0.5 | x | 0.7 | = | 17.63 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 16.15 | x | 0.5 | x | 0.7 | = | 8.85 | (76) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 92.03 | 179.66 | 296.69 | 436.61 | 540.24 | 555.72 | 527.94 | 449.74 | 346.1 | 213.24 | 114.64 | 75.77 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 513.16 | 598.76 | 702.53 | 821.06 | 902.97 | 897.47 | 856.04 | 783.72 | 691.04 | 579.79 | 506.03 | 485.79 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.96 | 0.93 | 0.88 | 0.78 | 0.64 | 0.48 | 0.36 | 0.41 | 0.62 | 0.84 | 0.93 | 0.96 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.11 | 19.4 | 19.85 | 20.37 | 20.73 | 20.92 | 20.97 | 20.96 | 20.81 | 20.31 | 19.62 | 19.07 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20.11 | 20.11 | 20.12 | 20.13 | 20.13 | 20.14 | 20.14 | 20.14 | 20.14 | 20.13 | 20.12 | 20.12 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.95 | 0.92 | 0.87 | 0.75 | 0.6 | 0.43 | 0.3 | 0.34 | 0.57 | 0.82 | 0.92 | 0.96 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.58 | 17.98 | 18.62 | 19.35 | 19.83 | 20.06 | 20.12 | 20.12 | 19.95 | 19.29 | 18.32 | 17.51 | (90) |

fLA = Living area ÷ (4) = 0.39 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.18 | 18.53 | 19.1 | 19.75 | 20.18 | 20.4 | 20.45 | 20.45 | 20.29 | 19.69 | 18.83 | 18.12 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.18 | 18.53 | 19.1 | 19.75 | 20.18 | 20.4 | 20.45 | 20.45 | 20.29 | 19.69 | 18.83 | 18.12 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.93 | 0.9 | 0.84 | 0.74 | 0.6 | 0.44 | 0.32 | 0.36 | 0.58 | 0.8 | 0.9 | 0.94 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 478.61 | 540.37 | 593.33 | 607.55 | 542.29 | 398.22 | 274.49 | 284.47 | 399.29 | 463.93 | 457.88 | 456.82 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1051.13 | 1029.83 | 949.07 | 805.68 | 627.86 | 423.12 | 281.38 | 294.49 | 454.37 | 673.08 | 873.59 | 1042.59 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 425.96 | 328.92 | 264.67 | 142.66 | 63.67 | 0 | 0 | 0 | 0 | 155.61 | 299.31 | 435.81 | |

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2116.6 (98)

Space heating requirement in kWh/m²/year 27.01 (99)

## 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

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| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |
| **Space heating** | | **kWh/year** | |
| Annual space heating requirement | | 2116.6 | |
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 1111.22 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 1111.22 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |
| **Water heating** | | | |
| Annual water heating requirement | | 2097.28 | |
| If DHW from community scheme:<br>Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 1101.07 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 1101.07 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 44.25 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f):<br>mechanical ventilation - balanced, extract or positive input from outside | | 255.93 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 255.93 | (331) |
| Energy for lighting (calculated in Appendix L) | | 340.01 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -478.37 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP) | | | | |
| Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | 91 | (367b) |

# DER WorkSheet: New dwelling design stage

| | | | | | |
|---|---|---|---|---|---|
| $CO_2$ associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | 0.52 | = | 270.16 | (367) |
| $CO_2$ associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | 0.22 | = | 525.11 | (368) |
| Electrical energy for heat distribution | [(313) x | 0.52 | = | 22.96 | (372) |
| Total $CO_2$ associated with community systems | (363)…(366) + (368)...(372) | | = | 818.24 | (373) |
| $CO_2$ associated with space heating (secondary) | (309) x | 0 | = | 0 | (374) |
| $CO_2$ associated with water from immersion heater or instantaneous heater | (312) x | 0.52 | = | 0 | (375) |
| Total $CO_2$ associated with space and water heating | (373) + (374) + (375) = | | | 818.24 | (376) |
| $CO_2$ associated with electricity for pumps and fans within dwelling | (331)) x | 0.52 | = | 132.83 | (378) |
| $CO_2$ associated with electricity for lighting | (332))) x | 0.52 | = | 176.47 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable<br>Item 1 | | 0.52 | x 0.01 = | -248.27 | (380) |
| **Total $CO_2$, kg/year** | sum of (376)…(382) = | | | 879.26 | (383) |
| **Dwelling $CO_2$ Emission Rate** | (383) ÷ (4) = | | | 11.22 | (384) |
| **EI rating (section 14)** | | | | 90.45 | (385) |

# DER WorkSheet: New dwelling design stage

**User Details:**

| | | | |
|---|---|---|---|
| **Assessor Name:** | Joseph Treanor | **Stroma Number:** | STRO032062 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.4.14 |

**Property Address: P16**

**Address :** , Gondar Gardens, London, NW6 1HG

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 54.62 | (1a) x | 2.55 | (2a) = | 139.28 | (3a) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 54.62 | (4) | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 139.28 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 0 | x 10 = | 0 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

**Air changes per hour**

| | | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 0 ÷ (5) = | 0 | (8) |
| *If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)* | | | |
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.15 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.85 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.13 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | |
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 0.16 | 0.16 | 0.14 | 0.14 | 0.12 | 0.12 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 68.85 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (24a) |

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.32 | 0.32 | 0.31 | 0.3 | 0.29 | 0.28 | 0.28 | 0.27 | 0.28 | 0.29 | 0.3 | 0.31 | (25) |

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Windows Type 1 | | | 4.5 | x1/[1/( 1.2 )+ 0.04] | | = | 5.15 | | | (27) |
| Windows Type 2 | | | 2.26 | x1/[1/( 1.2 )+ 0.04] | | = | 2.59 | | | (27) |
| Windows Type 3 | | | 4.5 | x1/[1/( 1.2 )+ 0.04] | | = | 5.15 | | | (27) |
| Walls Type1 | 50.09 | 20.26 | 29.83 | x | 0.18 | = | 5.37 | | | (29) |
| Walls Type2 | 25.36 | 0 | 25.36 | x | 0.23 | = | 5.76 | | | (29) |
| Roof | 44.8 | 0 | 44.8 | x | 0.13 | = | 5.82 | | | (30) |
| Total area of elements, m² | | | 120.25 | | | | | | | (31) |
| Party wall | | | 24.73 | x | 0 | = | 0 | | | (32) |

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 40.16 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 4827.45 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges : S (L x Y) calculated using Appendix K 13.82 (36)

*if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 53.97 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 14.63 | 14.48 | 14.34 | 13.6 | 13.46 | 12.73 | 12.73 | 12.58 | 13.02 | 13.46 | 13.75 | 14.04 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 68.6 | 68.46 | 68.31 | 67.58 | 67.43 | 66.7 | 66.7 | 66.55 | 66.99 | 67.43 | 67.73 | 68.02 |

Average = Sum(39)$_{1…12}$ /12= 67.54 (39)

# DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.26 | 1.25 | 1.25 | 1.24 | 1.23 | 1.22 | 1.22 | 1.22 | 1.23 | 1.23 | 1.24 | 1.25 |

Average = Sum(40)$_{1…12}$ /12= 1.24 (40)

Number of days in month (Table 1a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.83 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 77.57 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | |
| (44)m= | 85.33 | 82.23 | 79.12 | 76.02 | 72.92 | 69.82 | 69.82 | 72.92 | 76.02 | 79.12 | 82.23 | 85.33 |

Total = Sum(44)$_{1…12}$ = 930.87 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 126.54 | 110.67 | 114.21 | 99.57 | 95.54 | 82.44 | 76.39 | 87.66 | 88.71 | 103.38 | 112.85 | 122.55 |

Total = Sum(45)$_{1…12}$ = 1220.52 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 18.98 | 16.6 | 17.13 | 14.94 | 14.33 | 12.37 | 11.46 | 13.15 | 13.31 | 15.51 | 16.93 | 18.38 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

# DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 181.82 | 160.6 | 169.48 | 153.06 | 150.81 | 135.94 | 131.67 | 142.94 | 142.2 | 158.66 | 166.34 | 177.83 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 181.82 | 160.6 | 169.48 | 153.06 | 150.81 | 135.94 | 131.67 | 142.94 | 142.2 | 158.66 | 166.34 | 177.83 | |

Output from water heater (annual)$_{1...12}$ 1871.36 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 86.3 | 76.74 | 82.19 | 75.9 | 75.99 | 70.21 | 69.62 | 73.37 | 72.29 | 78.6 | 80.32 | 84.97 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 91.31 | 91.31 | 91.31 | 91.31 | 91.31 | 91.31 | 91.31 | 91.31 | 91.31 | 91.31 | 91.31 | 91.31 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 14.19 | 12.61 | 10.25 | 7.76 | 5.8 | 4.9 | 5.29 | 6.88 | 9.23 | 11.72 | 13.68 | 14.59 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 159.21 | 160.86 | 156.69 | 147.83 | 136.64 | 126.13 | 119.1 | 117.45 | 121.62 | 130.48 | 141.67 | 152.18 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 32.13 | 32.13 | 32.13 | 32.13 | 32.13 | 32.13 | 32.13 | 32.13 | 32.13 | 32.13 | 32.13 | 32.13 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -73.05 | -73.05 | -73.05 | -73.05 | -73.05 | -73.05 | -73.05 | -73.05 | -73.05 | -73.05 | -73.05 | -73.05 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 115.99 | 114.2 | 110.48 | 105.42 | 102.13 | 97.51 | 93.58 | 98.61 | 100.4 | 105.64 | 111.55 | 114.21 | (72) |

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 339.78 | 338.06 | 327.82 | 311.4 | 294.97 | 278.93 | 268.37 | 273.34 | 281.65 | 298.24 | 317.3 | 331.37 | (73) |

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 3 | x | 4.5 | x | 19.64 | x | 0.5 | x | 0.7 | = | 64.31 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 19.64 | x | 0.5 | x | 0.7 | = | 10.77 | (76) |
| East | 0.9x | 3 | x | 4.5 | x | 38.42 | x | 0.5 | x | 0.7 | = | 125.81 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 38.42 | x | 0.5 | x | 0.7 | = | 21.06 | (76) |
| East | 0.9x | 3 | x | 4.5 | x | 63.27 | x | 0.5 | x | 0.7 | = | 207.18 | (76) |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East | 0.9x | 1 | x | 2.26 | x | 63.27 | x | 0.5 | x | 0.7 | = | 34.68 | (76) |
| East | 0.9x | 3 | x | 4.5 | x | 92.28 | x | 0.5 | x | 0.7 | = | 302.16 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 92.28 | x | 0.5 | x | 0.7 | = | 50.58 | (76) |
| East | 0.9x | 3 | x | 4.5 | x | 113.09 | x | 0.5 | x | 0.7 | = | 370.31 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 113.09 | x | 0.5 | x | 0.7 | = | 61.99 | (76) |
| East | 0.9x | 3 | x | 4.5 | x | 115.77 | x | 0.5 | x | 0.7 | = | 379.08 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 115.77 | x | 0.5 | x | 0.7 | = | 63.46 | (76) |
| East | 0.9x | 3 | x | 4.5 | x | 110.22 | x | 0.5 | x | 0.7 | = | 360.9 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 110.22 | x | 0.5 | x | 0.7 | = | 60.42 | (76) |
| East | 0.9x | 3 | x | 4.5 | x | 94.68 | x | 0.5 | x | 0.7 | = | 310.01 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 94.68 | x | 0.5 | x | 0.7 | = | 51.9 | (76) |
| East | 0.9x | 3 | x | 4.5 | x | 73.59 | x | 0.5 | x | 0.7 | = | 240.96 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 73.59 | x | 0.5 | x | 0.7 | = | 40.34 | (76) |
| East | 0.9x | 3 | x | 4.5 | x | 45.59 | x | 0.5 | x | 0.7 | = | 149.28 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 45.59 | x | 0.5 | x | 0.7 | = | 24.99 | (76) |
| East | 0.9x | 3 | x | 4.5 | x | 24.49 | x | 0.5 | x | 0.7 | = | 80.19 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 24.49 | x | 0.5 | x | 0.7 | = | 13.42 | (76) |
| East | 0.9x | 3 | x | 4.5 | x | 16.15 | x | 0.5 | x | 0.7 | = | 52.89 | (76) |
| East | 0.9x | 1 | x | 2.26 | x | 16.15 | x | 0.5 | x | 0.7 | = | 8.85 | (76) |
| South | 0.9x | 0.77 | x | 4.5 | x | 46.75 | x | 0.5 | x | 0.7 | = | 51.03 | (78) |
| South | 0.9x | 0.77 | x | 4.5 | x | 76.57 | x | 0.5 | x | 0.7 | = | 83.57 | (78) |
| South | 0.9x | 0.77 | x | 4.5 | x | 97.53 | x | 0.5 | x | 0.7 | = | 106.46 | (78) |
| South | 0.9x | 0.77 | x | 4.5 | x | 110.23 | x | 0.5 | x | 0.7 | = | 120.32 | (78) |
| South | 0.9x | 0.77 | x | 4.5 | x | 114.87 | x | 0.5 | x | 0.7 | = | 125.38 | (78) |
| South | 0.9x | 0.77 | x | 4.5 | x | 110.55 | x | 0.5 | x | 0.7 | = | 120.66 | (78) |
| South | 0.9x | 0.77 | x | 4.5 | x | 108.01 | x | 0.5 | x | 0.7 | = | 117.89 | (78) |
| South | 0.9x | 0.77 | x | 4.5 | x | 104.89 | x | 0.5 | x | 0.7 | = | 114.49 | (78) |
| South | 0.9x | 0.77 | x | 4.5 | x | 101.89 | x | 0.5 | x | 0.7 | = | 111.21 | (78) |
| South | 0.9x | 0.77 | x | 4.5 | x | 82.59 | x | 0.5 | x | 0.7 | = | 90.14 | (78) |
| South | 0.9x | 0.77 | x | 4.5 | x | 55.42 | x | 0.5 | x | 0.7 | = | 60.49 | (78) |
| South | 0.9x | 0.77 | x | 4.5 | x | 40.4 | x | 0.5 | x | 0.7 | = | 44.09 | (78) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 126.11 | 230.44 | 348.32 | 473.07 | 557.69 | 563.2 | 539.21 | 476.4 | 392.51 | 264.41 | 154.1 | 105.83 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 465.89 | 568.49 | 676.14 | 784.47 | 852.66 | 842.13 | 807.58 | 749.74 | 674.15 | 562.65 | 471.39 | 437.2 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.93 | 0.9 | 0.83 | 0.73 | 0.6 | 0.46 | 0.34 | 0.38 | 0.57 | 0.79 | 0.9 | 0.94 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 18.76 | 19.13 | 19.65 | 20.22 | 20.63 | 20.87 | 20.95 | 20.94 | 20.76 | 20.18 | 19.36 | 18.68 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.88 | 19.88 | 19.88 | 19.89 | 19.89 | 19.9 | 19.9 | 19.91 | 19.9 | 19.89 | 19.89 | 19.88 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.92 | 0.88 | 0.81 | 0.69 | 0.55 | 0.39 | 0.27 | 0.3 | 0.5 | 0.75 | 0.89 | 0.93 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 16.93 | 17.45 | 18.19 | 18.97 | 19.5 | 19.79 | 19.87 | 19.86 | 19.67 | 18.94 | 17.81 | 16.83 | (90) |

fLA = Living area ÷ (4) = 0.58 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 17.99 | 18.42 | 19.03 | 19.69 | 20.15 | 20.41 | 20.5 | 20.49 | 20.3 | 19.66 | 18.71 | 17.9 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 17.99 | 18.42 | 19.03 | 19.69 | 20.15 | 20.41 | 20.5 | 20.49 | 20.3 | 19.66 | 18.71 | 17.9 | (93) |

## 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.9 | 0.86 | 0.79 | 0.69 | 0.56 | 0.42 | 0.31 | 0.34 | 0.53 | 0.74 | 0.87 | 0.91 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 420.46 | 488.21 | 534.85 | 539.37 | 478.68 | 355.93 | 249.64 | 258.05 | 357.5 | 418.07 | 408.06 | 399.16 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 938.9 | 925.71 | 856.1 | 729.35 | 570.06 | 387.72 | 260.01 | 271.9 | 415.35 | 610.92 | 786.11 | 932.05 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 385.72 | 294 | 239.01 | 136.78 | 67.99 | 0 | 0 | 0 | 0 | 143.48 | 272.2 | 396.47 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1935.65 (98)

Space heating requirement in kWh/m²/year 35.44 (99)

## 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | | 0 | (301) |
| Fraction of space heat from community system 1 – (301) = | | 1 | (302) |

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

| | | | |
|---|---|---|---|
| Fraction of heat from Community heat pump | | 0.5 | (303a) |
| Fraction of community heat from heat source 2 | | 0.5 | (303b) |
| Fraction of total space heat from Community heat pump | (302) x (303a) = | 0.5 | (304a) |
| Fraction of total space heat from community heat source 2 | (302) x (303b) = | 0.5 | (304b) |
| Factor for control and charging method (Table 4c(3)) for community heating system | | 1 | (305) |
| Distribution loss factor (Table 12c) for community heating system | | 1.05 | (306) |

| **Space heating** | **kWh/year** |
|---|---|
| Annual space heating requirement | 1935.65 |

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| | | | |
|---|---|---|---|
| Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 1016.22 | (307a) |
| Space heat from heat source 2 | (98) x (304b) x (305) x (306) = | 1016.22 | (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | 0 | (308 |
| Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309) |

**Water heating**

| | | | |
|---|---|---|---|
| Annual water heating requirement | | 1871.36 | |
| If DHW from community scheme:<br>Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 982.46 | (310a) |
| Water heat from heat source 2 | (64) x (303b) x (305) x (306) = | 982.46 | (310b) |
| Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 39.97 | (313) |
| Cooling System Energy Efficiency Ratio | | 0 | (314) |
| Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315) |
| Electricity for pumps and fans within dwelling (Table 4f):<br>mechanical ventilation - balanced, extract or positive input from outside | | 178.42 | (330a) |
| warm air heating system fans | | 0 | (330b) |
| pump for solar water heating | | 0 | (330g) |
| Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 178.42 | (331) |
| Energy for lighting (calculated in Appendix L) | | 250.66 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -333.46 | (333) |
| Electricity generated by wind turbine (Appendix M) (negative quantity) | | 0 | (334) |

## 12b. CO2 Emissions – Community heating scheme

| | Energy kWh/year | Emission factor kg CO2/kWh | | Emissions kg CO2/year | |
|---|---|---|---|---|---|
| CO2 from other sources of space and water heating (not CHP)<br>Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | 425 | (367a) |
| Efficiency of heat source 2 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | | | 91 | (367b) |
| CO2 associated with heat source 1 | [(307b)+(310b)] x 100 ÷ (367b) x | 0.52 | = | 244.07 | (367) |
| CO2 associated with heat source 2 | [(307b)+(310b)] x 100 ÷ (367b) x | 0.22 | = | 474.41 | (368) |
| Electrical energy for heat distribution | [(313) x | 0.52 | = | 20.75 | (372) |
| Total CO2 associated with community systems | (363)…(366) + (368)...(372) | | = | 739.23 | (373) |
| CO2 associated with space heating (secondary) | (309) x | 0 | = | 0 | (374) |
| CO2 associated with water from immersion heater or instantaneous heater | (312) x | 0.52 | = | 0 | (375) |
| Total CO2 associated with space and water heating | (373) + (374) + (375) = | | | 739.23 | (376) |
| CO2 associated with electricity for pumps and fans within dwelling | (331)) x | 0.52 | = | 92.6 | (378) |
| CO2 associated with electricity for lighting | (332))) x | 0.52 | = | 130.09 | (379) |
| Energy saving/generation technologies (333) to (334) as applicable<br>Item 1 | | 0.52 | x 0.01 = | -173.06 | (380) |

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| | | | |
|---|---|---|---|
| **Total CO2, kg/year** | sum of (376)…(382) = | 788.86 | (383) |
| **Dwelling CO2 Emission Rate** | (383) ÷ (4) = | 14.44 | (384) |
| **EI rating (section 14)** | | 89.39 | (385) |