25 Old Gloucester Street, London WC1N 3AF

Energy Strategy

June 2017

CUTTING THE COST OF CARBON

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1 Issue Register

Revision	Reason for Issue	Date of Issue	Issued By
1.0	Issued for information	06/06/17	J Simpson CEng MCIBSE

2 Contents

3 Executive Summary

This document responds to planning policy in respect of energy consumption and carbon dioxide emissions. The methodology used herein is consistent with the latest Greater London Authority (GLA) guidance and Part L of the Building Regulations.

There are no installed or proposed district heating schemes in the immediate vicinity of the site, and therefore it is not considered feasible to connect the Proposed Development to a district heating scheme. The Proposed Development is considered to be too small to incorporate a community heating system, with only 6 dwellings and a small commercial kitchen load within the scheme. Combined heat and power (CHP) has been assessed in terms of feasibility. There is no economic or sustainable justification for over-sizing the CHP plant, and therefore the CHP unit size needs to be carefully matched to the demands of the development. The smallest commercially available CHP unit is too large for the scheme due to the limited number of residential dwellings, and therefore CHP is not considered to be viable for the Proposed Development.

The new build elements of the Proposed Development features significantly improved insulation and air tightness standards, when compared against the compliance requirements of Part L 2013 of the Building Regulations. In addition, energy efficient lighting is to be provided throughout the dwellings in excess of the Part L1 2013 requirements. There are limited improvements possible for the existing building due to the listed status of the building, but high efficiency heating and lighting systems are proposed throughout. The proposed energy efficiency measures would reduce the annual carbon dioxide emissions of the site by 5,740 kgCO_2, which equates to a reduction of 17.4% against the baseline TER 2013.

A feasibility study of the currently available low and zero carbon technologies has been undertaken, with photovoltaic panels proposed for the development at roof level to generate electricity for the site. It has been estimated that the proposed photovoltaic systems would reduce the annual carbon dioxide emissions of the site by 4,063 kgCO2, which equates to a reduction of 12.3% against the TER 2013.

The incorporation of the energy efficiency measures, and photovoltaic panels equates to a reduction of 29.8% against the TER 2013 for the schemes. This is considered to be the maximum improvement feasible for the scheme due to the limited opportunities in improving the energy efficiency of the existing building.

A summary of the reduction in emissions is shown in Tables 1 and 2 below, and graphically in Figure 1 below.

Stage	**Regulated carbon dioxide emissions (heating, cooling, hot water, lighting, fans & pumps) (kgCO_2/yr)**	**Unregulated carbon dioxide emissions (cooking, appliances, communal lighting & power) (kgCO_2/yr)**
Building Regulations Compliance (TER 2013)	32,938	15,150
Energy Efficiency Measures ('Be Lean')	27,198	15,150
Proposed Development with PVs ('Be Green')	23,135	15,150

Table 1 – Carbon dioxide emissions after each stage of the Energy Hierarchy for SAP 2012

Stage	Regulated carbon dioxide savings	
	(kgCO2 per annum)	(%)
Savings from energy demand reduction	5,740	17.4
Savings from PVs	4,063	12.3
Total Cumulative Savings	**9,803**	**29.8**

Table 2 – Regulated carbon dioxide savings from each stage of the Energy Hierarchy for SAP 2012

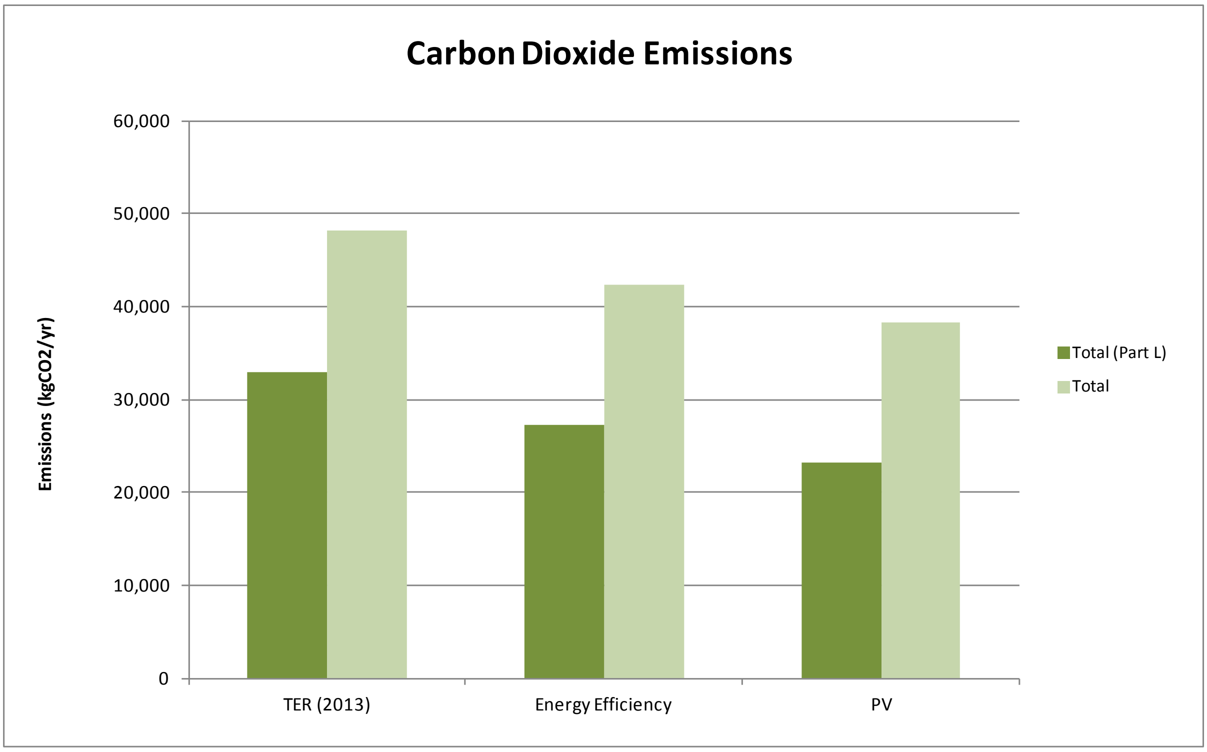


Figure 1 – Summary of carbon dioxide emissions

4 Introduction

4.1 Proposed Development

The Proposed Development comprises the refurbishment and extension of the existing commercial space at basement ground and first floor, with the conversion and extension of the existing building at first, second and third floors to create 3 new residential apartments, and the construction of 3 new build apartments at first, second and third floor.

4.2 Planning Policy Context

4.2.1 National

The following description is taken from the London Renewables Toolkit (LRT):

"Increased development of renewable energy resources is vital to facilitating the delivery of the Government's commitments on both climate change and renewable energy. The Government's Energy Policy, including its policy on renewable energy, is set out in the Energy White Paper. This aims to put the UK on a path to cut its carbon dioxide emissions by some 60% by 2050, with real progress by 2020, and to maintain reliable and competitive energy supplies. As part of the strategy for achieving these reductions the White Paper sets out:

- The Government's target to generate 10% of UK electricity from renewable energy sources by 2010
- The Government's aspiration to double that figure to 20% by 2020 and suggests that still more renewable energy will be needed beyond that date.

"The Energy White Paper indicated that the Government would be looking to work with regional and local bodies to deliver its objectives, including establishing regional targets for renewable energy generation. Regional Planning Guidance should include the target for renewable energy generation for its respective region, derived from assessments of the region's renewable energy resource potential."

The *National Planning Policy Framework* sets out the Government's national policy for renewable energy. It states that "to help increase the use and supply of renewable and low carbon energy, local planning authorities should recognise the responsibility on all communities to contribute to energy generation from renewable or low carbon sources."

4.2.2 Regional

The London Plan is the overall strategic plan for London, and it sets out a fully integrated economic, environmental, transport and social framework for the development of the capital to 2031. It forms part of the development plan for Greater London. The London Plan 2011 was published on 22 July 2011.

Policy 5.2 (Minimising Carbon Dioxide Emissions) states that:

"Development proposals should make the fullest contribution to minimizing carbon dioxide emissions in accordance with the following energy hierarchy:

1 – Be lean: use less energy
2 – Be clean: supply energy efficiently
3 – Be green: use renewable energy

The Mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019.

Year	**Improvement on 2010 Building Regulations**	
	Residential buildings	**Non-domestic buildings**
2010 – 2013	25 per cent	25 per cent
2013 – 2016	40 per cent	40 per cent
2016 – 2019	Zero carbon	As per building regulations requirements
2019 – 2031		Zero carbon

Table 3 – Proposed carbon dioxide reduction targets under the 2011 London Plan

Major development proposals should include a detailed energy assessment to demonstrate how the targets for carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy.

As a minimum, energy assessments should include the following:

a) Calculation of the energy demand and carbon dioxide emissions covered by the Building Regulations and, separately, the energy demand and carbon dioxide emissions from any other part of the development, including plant or equipment, that are not covered by the Building Regulations at each stage of the energy hierarchy
b) Proposals to reduce carbon dioxide emissions through the energy efficient design of the site, buildings and services
c) Proposals to further reduce carbon dioxide emissions through the use of decentralized energy where feasible, such as district heating and cooling and combined heat and power (CHP)
d) Proposals to further reduce carbon dioxide emissions through the use of on-site renewable energy technologies."

Policy 5.7 (Renewable Energy) states that:

"The Mayor seeks to increase the proportion of energy generated from renewable sources, and expects that the projections for installed renewable energy capacity outlined in the Climate Change Mitigation and Energy Strategy and in supplementary planning guidance will be achieved in London.

Within the framework of the energy hierarchy, major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible."

Following the update to Part L of the Building Regulations in April 2014, the carbon dioxide reduction targets have been revised to reflect the changes in software and Building Regulations compliance targets. The GLA have confirmed in their policy update that the current requirement is for a 35% reduction in carbon dioxide emissions against the Part L 2013 TER requirements.

4.2.3 Local

The Core Strategy sets out the key elements of the vision for the Borough of Camden, and is a central part of the Local Development Framework (LDF). Core Policy CS13 on 'tackling climate change through promoting higher environmental standards' states that:

'Reducing the effects of and adapting to climate change
The Council will require all development to take measures to minimise the effects of, and adapt to, climate change and encourage all development to meet the highest feasible environmental standards that are financially viable during construction and occupation by:

a) ensuring patterns of land use that minimise the need to travel by car and help support local energy networks;
b) promoting the efficient use of land and buildings;
c) minimising carbon emissions from the redevelopment, construction and occupation of buildings by implementing, in order, all of the elements of the following energy hierarchy:
   1. *ensuring developments use less energy,*
   2. *making use of energy from efficient sources, such as the King's Cross, Gower Street, Bloomsbury and proposed Euston Road decentralized energy networks;*
   3. *generating renewable energy on-site; and*

d) ensuring buildings and spaces are designed to cope with, and minimise the effects of, climate change.

The Council will have regard to the cost of installing measures to tackle climate change as well as the cumulative future costs of delaying reductions in carbon dioxide emissions

Local energy generation
The Council will promote local energy generation and networks by:

e) working with our partners and developers to implement local energy networks in the parts of Camden most likely to support them, i.e. in the vicinity of:
– housing estates with community heating or the potential for community heating and other uses with large heating loads;
– the growth areas of King's Cross; Euston; Tottenham Court Road; West Hampstead Interchange and Holborn;
– schools to be redeveloped as part of Building Schools for the Future programme;
– existing or approved combined heat and power/local energy networks (see Map 4);
and other locations where land ownership would facilitate their implementation.

f) protecting existing local energy networks where possible (e.g. at Gower Street and Bloomsbury) and safeguarding potential network routes (e.g. Euston Road);

Water and surface water flooding
We will make Camden a water efficient borough and minimise the potential for surface water flooding by:

g) protecting our existing drinking water and foul water infrastructure, including Barrow Hill Reservoir, Hampstead Heath Reservoir, Highgate Reservoir and Kidderpore Reservoir;

h) making sure development incorporates efficient water and foul water infrastructure;
i) requiring development to avoid harm to the water environment, water quality or drainage systems and prevents or mitigates local surface water and downstream flooding, especially in areas up-hill from, and in, areas known to be at risk from surface water flooding such as South and West Hampstead, Gospel Oak and King's Cross (see Map 5).

Camden's carbon reduction measures

The Council will take a lead in tackling climate change by:

j) taking measures to reduce its own carbon emissions;
k) trialling new energy efficient technologies, where feasible; and
l) raising awareness on mitigation and adaptation measures.'

Policy DP22 on 'promoting sustainable design and construction' states that:

"The Council will require development to incorporate sustainable design and construction measures. Schemes must:

a) demonstrate how sustainable development principles, including the relevant measures set out in paragraph 22.5 below, have been incorporated into the design and proposed implementation; and
b) incorporate green or brown roofs and green walls wherever suitable.

The Council will promote and measure sustainable design and construction by:

c) expecting new build housing to meet Code for Sustainable Homes Level 3 by 2010 and Code Level 4 by 2013 and encouraging Code Level 6 (zero carbon) by 2016.;
d) expecting developments (except new build) of 500 sq m of residential floorspace or above or 5 or more dwellings to achieve "very good" in EcoHomes assessments prior to 2013 and encouraging "excellent" from 2013;
e) expecting non-domestic developments of 500sqm of floorspace or above to achieve "very good" in BREEAM assessments and "excellent" from 2016 and encouraging zero carbon from 2019.

The Council will require development to be resilient to climate change by ensuring schemes include appropriate climate change adaptation measures, such as:

f) summer shading and planting;
g) limiting run-off;
h) reducing water consumption;
i) reducing air pollution; and
j) not locating vulnerable uses in basements in flood-prone areas.'

Following the Government's Ministerial Statement released on 25 March 2015 in response to the Housing Standards Review Consultation, a number of changes have been introduced to technical housing standards in England, including the withdrawal of the Code for Sustainable Homes as a national standard.

5 Methodology

This report draws on the information and approach set out in the GLA's latest Energy Planning guidance. The currency used for emissions is carbon dioxide, rather than the carbon equivalent, for consistency with Part L of the Building Regulations.

A Part L analysis is conducted to calculate carbon dioxide emissions for the following end uses: heating; hot water; cooling; fans, pumps and controls; and lighting. Various energy-saving measures are considered in terms of technical and economic feasibility and their effect on carbon dioxide emissions. A package of energy-saving measures is proposed that meets the Part L standard, without reliance on the contribution of CHP or renewables. Unregulated energy end uses, such as appliances, are added using the SBEM or SAP software.

CHP is then considered in terms of technical and economic feasibility and its effect on carbon dioxide emissions. The strategic issues relating to each technology are also considered in the context of the Proposed Development, and two or three preferred options are short-listed. These are then considered in more detail in terms of technical and economic feasibility and its effect on carbon dioxide emissions.

Calculations are presented in summary form in subsequent sections, with detailed calculations in Appendix A.

Figure 2 below provides a summary of the methodology in the form of a flow diagram.

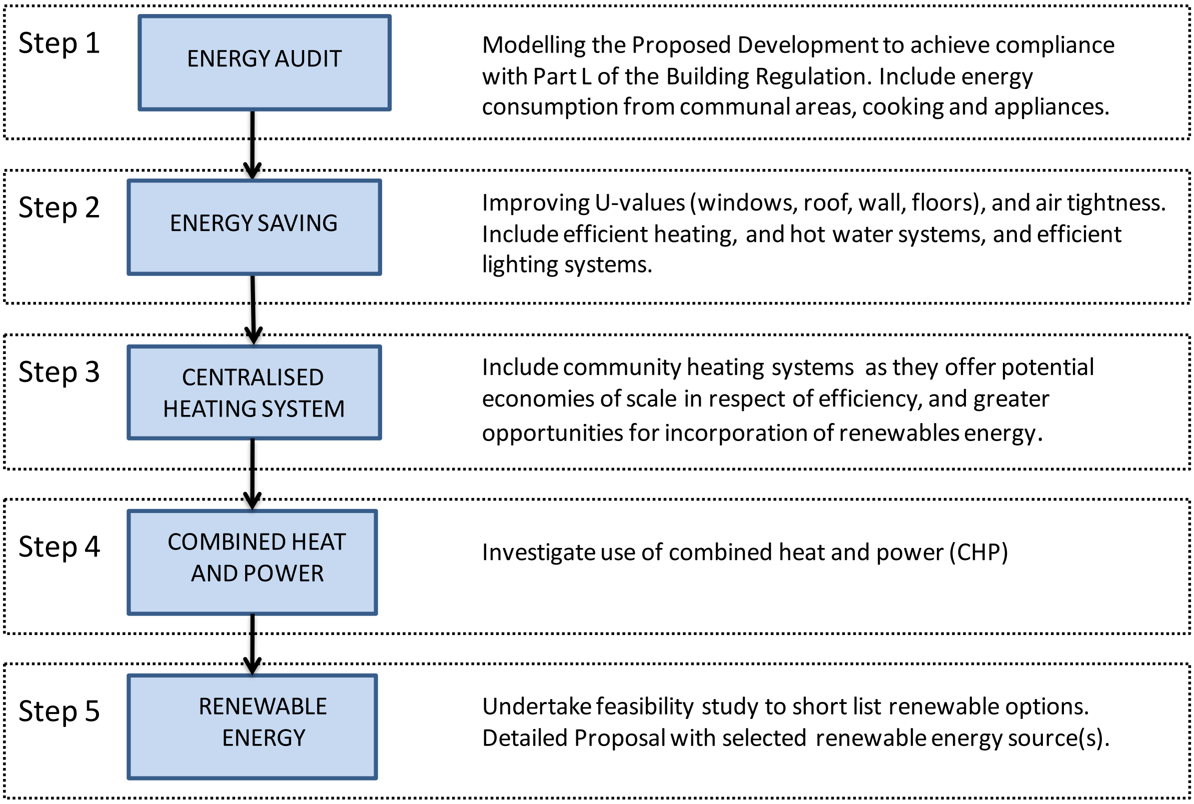


Figure 2 – Flow diagram of methodology

6 Energy Demand

The Development would feature energy saving measures such that compliance with Part L of the Building Regulations (2013) would be achieved without reliance on the contribution of renewable technologies.

6.1 Residential Element

6.1.1 New build apartments

As required under Part L, the new build residential units have been assessed under Part L1A, with calculations undertaken using the Stroma FSAP Assessor software to establish the energy consumption of the scheme.

The minimum requirements for compliance with Part L1A were established using a gas baseline, and feasible improvements were included to further reduce the carbon dioxide emissions. The measures outlined below have been used in the Part L1A calculations, and exceed the requirements of Part L1A. The proposed fabric performance is compared against the Part L1A 2013 requirements in Table 4 below:

Element	Proposed Development	Part L1A 2013 Requirements
External wall U-value	0.18 W/m².K	0.30 W/m².K
Exposed roof U-value	0.15 W/m².K	0.20 W/m².K
Exposed floor U-value	0.15 W/m².K	0.25 W/m².K
Window U-value	1.40 W/m².K	2.00 W/m².K
Door U-value	1.40 W/m².K	2.00 W/m².K
Party wall U-value	0.00 W/m².K (fully filled party wall)	0.20 W/m².K
Air permeability	4 m³/hr/m² @ 50 Pa (with tests undertaken in each dwelling)	10 m³/hr/m² @ 50 Pa
Thermal bridging	Celotex Enhanced Construction Details to be used, with target y-value for lintels to be 0.05 W/m.K	0.15
Low energy lighting	100%	75%

Table 4 – Comparison of proposed residential performance for new build dwellings

High efficiency gas-fired condensing combination boilers have been used. Enhanced heating controls are proposed for the development, with temperature and time zone control, and weather compensators.

6.1.2 Apartments created by material change of use

As required under Part L, the new residential units created by a material change of use have been assessed under Part L1B, with calculations undertaken using the Stroma FSAP Assessor software to establish the energy consumption of the scheme. As these are not assessed as new build units, the TER worksheets have been calculated for each unit using the minimum efficiency standards required under Part L1B.

The minimum requirements for compliance with Part L1B were established using a gas baseline, and feasible improvements were included to further reduce the carbon dioxide emissions. The measures outlined below have been used in the Part L1B calculations, and exceed the requirements of Part L1B. The proposed fabric performance is compared against the Part L1B 2013 requirements in Table 5 below:

Element	Proposed Development	Part L1B 2013 Requirements
Existing external wall U-value	0.28 W/m².K	0.30 W/m².K
New external wall U-value	0.18 W/m².K	0.30 W/m².K
Existing roof U-value	0.13 W/m².K	0.16 W/m².K
New flat roof U-value	0.15 W/m².K	0.18 W/m².K
Window U-value	1.40 W/m².K	1.60 W/m².K
Door U-value	1.40 W/m².K	1.80 W/m².K
Party wall U-value	0.00 W/m².K (fully filled party wall)	0.20 W/m².K
Air permeability	5 m³/hr/m² @ 50 Pa (with tests undertaken in each dwelling)	15 m³/hr/m² @ 50 Pa
Thermal bridging	0.15 (cannot be assessed due to retention of existing external fabric)	0.15
Low energy lighting	100%	75%

Table 5 – Comparison of proposed residential performance for new build dwellings

High efficiency gas-fired condensing combination boilers have been used. Enhanced heating controls are proposed for the development, with temperature and time zone control, and weather compensators.

6.2 Commercial Element

6.2.1 Existing main hall and dining hall

As required under Part L, the existing building has been assessed under Part L2B, with calculations undertaken using the accredited DesignBuilder software to establish the energy consumption of the scheme.

Due to the listed status of the building, it is not proposed to install insulation on the internal or external faces of the existing external walls. While floor and ceiling finishes are to be replaced, it is not considered feasible to excavate the basement floor or install new insulation over the floor. The existing windows and doors are to be retained, and therefore opportunities for improving the fabric efficiency of the existing building are limited.

New heating, hot water, ventilation and lighting services are proposed throughout the existing building, and the following assumptions have been made for the energy model:

- Gas fired heating system, with seasonal efficiency of 96%.
- Local mechanical extract systems for the toilet cores.
- LED lighting throughout, with 100 lamp lumens per circuit-Watt.
- Occupancy sensors for lighting within circulation areas and toilet cores.
- Daylight sensors for lighting within the main hall and office areas.

6.2.2 New build rear extension

As required under Part L, the new build rear extension has been assessed under Part L2A, with calculations undertaken using the accredited DesignBuilder software to establish the energy consumption of the scheme.

The minimum requirements for compliance with Part L2A were established, and feasible improvements were included to further reduce the carbon dioxide emissions. The measures outlined below have been used in the Part L2A calculations, and exceed the requirements of Part L2A. The proposed fabric performance is compared against the Part L2A 2013 requirements in Table 6 below:

Element	Proposed Development	Part L2A 2013 Requirements
External wall U-value	0.18 W/m².K	0.35 W/m².K
Exposed roof U-value	0.15 W/m².K	0.25 W/m².K
Exposed floor U-value	0.15 W/m².K	0.25 W/m².K
Window and roof Glazing U-value	1.00 W/m².K	2.20 W/m².K
External Door	1.40 W/m².K	2.20 W/m².K
Air permeability	5 m³/hr/m² @ 50 Pa	10 m³/hr/m² @ 50 Pa
Lighting	Office and storage areas - 100 luminaire lumens per circuit-Watt All other areas 100 lamp	Office and storage areas - 60 luminaire lumens per circuit-Watt All other areas - 60 lamp

	lumens per circuit-Watt Daylight sensors	lumens per circuit-Watt

Table 6 – Comparison of proposed commercial performance

New heating, hot water, ventilation and lighting services are proposed throughout the extended building, and the following assumptions have been made for the energy model:

- Gas fired heating system, with seasonal efficiency of 96%.
- Local mechanical extract systems for the toilet cores and kitchen.
- LED lighting throughout, with 100 lamp lumens per circuit-Watt.
- Occupancy sensors for lighting within circulation areas and toilet cores.
- Daylight sensors for lighting within the office areas.

7 Passive Design & Preventing Overheating

7.1 Passive Design

The apartments have been designed such that there are no dwellings with only North facing windows – the dwellings will all therefore receive beneficial solar gains and natural daylight at some point during the day.

Apartments 1.01, 1.02, 2.01 and 3.01 have north facing external balconies, which are considered to be beneficial during the summer months, as they provide external shaded areas for occupants, and also enable the opening of larger access doors to provide cooler air for ventilation.

7.2 Avoiding Overheating

In compliance with London Plan policy 5.9, the scheme has been designed to avoid overheating and to minimise cooling demand.

There is solar shading afforded by the 4 storey buildings on the opposite side of Old Gloucester Street, as well as by the 5 storey buildings to the south-east on Southampton Row.

SAP 2012 contains a procedure to check whether solar gains for residential properties are excessive. Detailed SAP calculations have been undertaken for each of the dwellings within the scheme, and these have indicated that the dwellings will have a slight or insignificant risk of high internal temperatures. Energy efficient design and 100% low energy lighting are proposed for the residential properties, and full details of this are provided in this Energy Strategy report. The Overheating Calculations are provided in Appendix E of this report.

SBEM also contains a procedure for checking whether solar gains for non domestic spaces are excessive. This is not appropriate for the existing part of the building as there are no changes proposed to the existing fabric for these areas. The overheating assessment has been undertaken for the new build extension, and the BRUKL report for this space is provided in Appendix D of this reports as confirmation – the roof glazing for the mezzanine admin office has been designed with a g-value of 0.45 to reduce solar overheating in this space, with high efficiency LED lighting proposed throughout.

A green roof is also proposed above the commercial side rear extension to significantly reduce heat build-up at roof level, and also to improve the efficiency and life expectancy of the proposed PV systems.

8 Community Heating & CHP

The Mayor's Energy Strategy favours community heating systems because they offer:

- Potential economies of scale in respect of efficiency and therefore reduced carbon emissions; and
- Greater potential for future replacement with Low or Zero Carbon (LZC) technologies.

There are no existing or proposed district heating systems in the immediate vicinity of the site, and therefore not considered to be feasible to connect to a district heating system. This is confirmed by the London Heat Map for the area around the site, included in Figure 3 below.

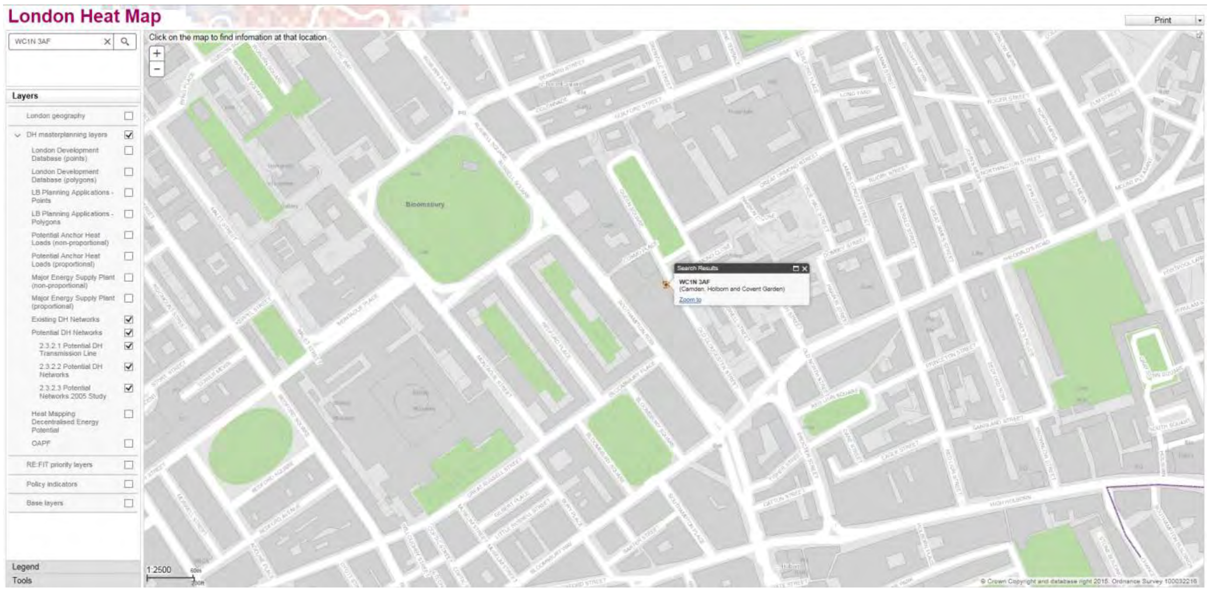


Figure 3 – London Heat Map for the site

The Proposed Development is considered to be too small to successfully incorporate a community heating system, with typically 60 dwellings being the minimum to provide an economically feasible centralized system which also provides a reduction in carbon dioxide emissions. It is also considered that the small increase in heating plant efficiency due to the incorporation of a system of the limited size that this particular scheme would require would be cancelled out by the increase in energy consumption required to pump the heating water circuit. As the Proposed Development comprises 9 apartments and a small commercial unit, there is a low density heat demand, which lowers the feasibility for connection to a district heating system.

Initial studies using the SAP software showed that the provision of a community heating scheme for the 6 dwellings would result in an increased carbon footprint of 17%, with associated increased energy costs, administrative charges and fees. This is due to increased circulation losses and lower summer DHW efficiencies than using high efficiency individual combination boilers. As there are no current plans to install a district heating system in the area, it is not considered to be feasible to provide a communal heating system for the development.

Combined heat and power (CHP) has also been assessed in terms of feasibility. There is no economic or sustainable justification for over-sizing the CHP plant, and therefore the CHP unit size needs to be carefully matched to the demands of the development. The Proposed Development is not large enough to contain a district wide CHP system to serve surrounding buildings and future schemes, and the smallest commercially available CHP unit is too large for the scheme due to the limited number of residential dwellings. CHP systems are usually specified for large schemes with more than 100-150 dwellings due to the need to have a large enough heat demand to supply from the CHP system – the smallest commercially available CHP unit (the Baxi DACHS micro-CHP unit) would supply 60 dwellings, and therefore would not be economically or technically feasible for this scheme. Therefore CHP is not considered to be viable for the Proposed Development.

9 Renewables – Feasibility Study

The LRT provides benchmark sizing and cost data for "renewable energy technologies suitable for London". It therefore provides information to assess the various technologies at an early design stage, with initial measurements of the impact of using each technology on the building's carbon dioxide emissions. Table 7 (below) outlines these technologies and the variations proposed in the LRT used in this assessment.

Technology	End Use Demand Met
Wind	Electricity
PV Cells - rooftop	Electricity
PV Cells - cladding	Electricity
Solar Water Heating	Annual DHW (50 %)
Biomass heating (a)	Annual Space Heating +Domestic Hot Water (33%)
Biomass heating (b)	Annual Space Heating +Domestic Hot Water (50%)
Biomass heating (c)	Annual Space Heating +Domestic Hot Water (100%)
Biomass CHP (a)	Annual Space Heating +Domestic Hot Water (33%)
Biomass CHP (b)	Annual Space Heating +Domestic Hot Water (50%)
Ground sourced heat pumps (a)	Annual Space Heating +Domestic Hot Water (50%)
Ground sourced heat pumps (b)	Annual Space Heating +Domestic Hot Water (100%)
Ground sourced heat pumps (c)	Peak Space Heating (50 %) Annual Space Heating + Domestic Hot Water (85 %)
Ground cooling (a)	Annual Cooling (50%)
Ground cooling (b)	Annual Cooling (100%)

Table 7 – Renewable energy technologies suitable for London

The following other "acceptable renewable energy technologies" are considered to be not typically appropriate in London:

- Fuel cells using hydrogen from renewable sources;
- Gas from anaerobic digestion;
- Geothermal;
- Ground cooling air systems;
- Micro hydro; and
- Solar air collectors.

On the basis of this preliminary analysis, and a review of the general advantages and disadvantages of the different technologies relative to the Proposed Development, the following technologies were not considered to be appropriate to the Proposed Development:

- **Wind turbines:** on the basis of visual appearance, noise issues and concerns over outputs in urban areas. Wind turbines are not considered appropriate for the urban context. There are still concerns over noise with the horizontal axis turbines, and therefore they are not considered appropriate for the development. The average wind speed for the Proposed Development is noted on the Encraft website as 4.7m/s at 10m – this is significantly below the required average wind speed to make wind turbines a practical solution, particularly when the power output of the turbines is reduced by 7/8ths when the wind speed is halved;

- **Biomass:** on the basis of concerns over air quality issues from flue discharge; concerns over transport issues relating to regular deliveries of biomass; security and cost of fuel supply; concerns over disposal of ash; and relatively high maintenance. Biomass is not considered to be a suitable fuel for use within an urban development, and therefore this technology is not considered appropriate for the development. Deliveries of biomass pellets is undertaken by large vehicles the equivalent size of domestic oil delivery tankers and it is not considered appropriate to have vehicles of this size navigating the local streets and making regular deliveries to the site;

- **Biomass CHP:** on the basis of embodied impacts; high maintenance; concerns over air quality issues from flue discharge; concerns over transport issues relating to regular deliveries of biomass; lack of micro-scale units on the market to suit this scale of development; and it being an immature technology. Biomass is not considered to be a suitable fuel for use within an urban development, therefore this technology is not considered appropriate for the development. A large biomass fuelled CHP with heat output of 200 kW is available, but this is approximately 40 times larger than required for this scheme, particularly as the current biomass fuelled CHP units need to operate 24/7 – biomass CHP is therefore not considered to be feasible for this scheme;

- **Solar thermal:** due to the higher carbon dioxide reductions from the photovoltaic systems, it is not proposed to include solar thermal within the scheme. This may be reviewed at detailed design stage, to identify any new technologies and panel types that would make solar thermal more appropriate;

- **Ground source:** due to the limited site area at ground level, there is insufficient area available for horizontal loops. The use of open loop boreholes has been discounted as there is a risk of drilling and not finding a suitable aquifer. The use of closed loop boreholes has been discounted because there is insufficient site area to contain the required number.

10 Renewables - Detailed Proposal

On the basis of this preliminary analysis, and a review of the general advantages and disadvantages of the different technologies relative to the Proposed Development, the following technologies were considered to be appropriate to the Proposed Development:

- Photovoltaic panels.

10.1 Photovoltaic Panels

Photovoltaic panels extract the energy of the sun to generate electricity. It is proposed that photovoltaic panels be installed on the roofs, to generate electricity for the development. These electrical generation systems would be connected to the National Grid so that any surplus electricity can be exported to the Grid, and would be eligible for the feed-in tariffs.

A photovoltaic system of 9.92 kWp is proposed for the development at roof level, with 4.48 kWp facing due south-west on the new rear pitched roof, 3.20 kWp facing due south-west on the front pitched roof, and 2.24 kWp facing due south-west on the new flat roof. All panels would be installed at the same angle as the pitched roofs, and at 15° for the flat roof system, and are currently assumed to be 320 Wp panels with dimensions of 1680mm by 1000mm. This system would provide an annual output of 7,681 kWh for the site.

The rear photovoltaic system of 4.48 kWp would be connected directly to the new build extension at basement/ground floor in order to meet the BREEAM requirements for the unit. The remaining photovoltaic systems would be connected to the Landlord system for the residential units.

The incorporation of the photovoltaic systems within the scheme would reduce the annual carbon dioxide emissions of the Proposed Development by 4,063 kgCO_2, which equates to a reduction of 12.3% against the regulated emissions (2013). A proposed layout is attached in Appendix A, which would be reviewed during the detailed design stage to reflect changes in available products and prices.

Figure 4 - Typical photovoltaic panel installations

11 Conclusion

This document has responded to planning policy in respect of energy consumption and carbon dioxide emissions. The methodology used herein is consistent with the latest GLA guidance and Part L of the Building Regulations.

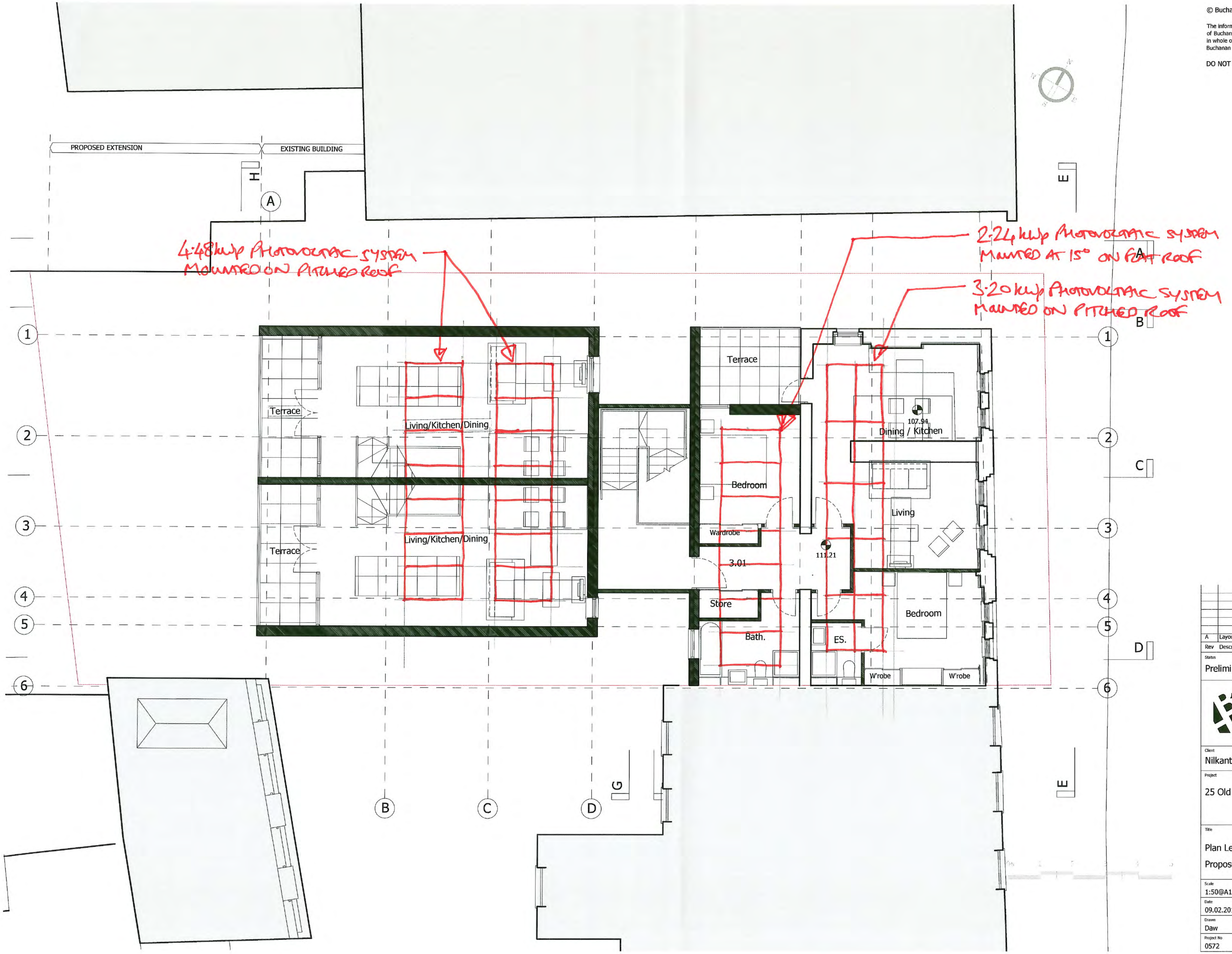
There are no installed or proposed district heating schemes in the immediate vicinity of the site, and therefore it is not considered feasible to connect the Proposed Development to a district heating scheme. The Proposed Development is considered to be too small to incorporate a community heating system, with only 6 dwellings and a small commercial kitchen load within the scheme. CHP has been assessed in terms of feasibility. There is no economic or sustainable justification for over-sizing the CHP plant, and therefore the CHP unit size needs to be carefully matched to the demands of the development. The smallest commercially available CHP unit is too large for the scheme due to the limited number of residential dwellings, and therefore CHP is not considered to be viable for the Proposed Development.

The new build elements of the Proposed Development features significantly improved insulation and air tightness standards, when compared against the compliance requirements of Part L 2013 of the Building Regulations. In addition, energy efficient lighting is to be provided throughout the dwellings in excess of the Part L1 2013 requirements. There are limited improvements possible for the existing building due to the listed status of the building, but high efficiency heating and lighting systems are proposed throughout. The proposed energy efficiency measures would reduce the annual carbon dioxide emissions of the site by 5,740 $kgCO_2$, which equates to a reduction of 17.4% against the baseline TER 2013.

A feasibility study of the currently available low and zero carbon technologies has been undertaken, with photovoltaic panels proposed for the development at roof level to generate electricity for the site. It has been estimated that the proposed photovoltaic systems would reduce the annual carbon dioxide emissions of the site by 4,063 kgCO2, which equates to a reduction of 12.3% against the TER 2013.

The incorporation of the energy efficiency measures, and photovoltaic panels equates to a reduction of 29.8% against the TER 2013 for the schemes. This is considered to be the maximum improvement feasible for the scheme due to the limited opportunities in improving the energy efficiency of the existing building.

12 Appendix A – Proposed PV Layout



DO NOT SCALE FROM THIS DRAWING

Rev	Description	Date	By
A	Layout re-design	06.01.17	JB

Status
Preliminary

Buchanan Hartley Architects Ltd
architecture interiors environment
13 Grosvenor Gardens London SW1W 0BD
T 020 7592 7247
E mail@buchananhartley.co.uk

Client
Nilkanth Estates Ltd.

Project
25 Old Gloucester Street WC1N 3AF

Title
Plan Level 3
Proposed

Scale
1:50@A1

Date
09.02.2015

Drawn
Daw

Checked

Project No
0572

Drawing No
(--) L3

REV
A

13 Appendix B – Baseline TER Worksheets

The following SAP TER worksheets are taken from the SAP 2012 software for the modelled dwellings in accordance with current London Plan policy. The TER worksheets have been created for the 3 dwellings created by a material change of use in accordance with the compliance requirements of Part L1B.

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	John Simpson	**Stroma Number:**	STRO006273
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.7

Property Address: 102

Address : 1.02, 25 Old Gloucester St, LONDON, WC1N 3AF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	88.5	(1a) x	2.5	(2a) =	221.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	88.5	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	221.25	(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	0.56	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	
Doors			2.1	x	1	=	2.1			(26)
Windows Type 1			3.15	x1/[1/(1.4)+ 0.04]		=	4.18			(27)
Windows Type 2			0.78	x1/[1/(1.4)+ 0.04]		=	1.03			(27)
Windows Type 3			1.6	x1/[1/(1.4)+ 0.04]		=	2.12			(27)
Windows Type 4			1.6	x1/[1/(1.4)+ 0.04]		=	2.12			(27)
Windows Type 5			2.25	x1/[1/(1.4)+ 0.04]		=	2.98			(27)
Floor Type 1			85.4	x	0.13	=	11.102			(28)
Floor Type 2			3.1	x	0.13	=	0.403			(28)
Walls Type1	85.1	13.88	71.22	x	0.18	=	12.82			(29)
Walls Type2	13.7	2.1	11.6	x	0.18	=	2.09			(29)
Roof	5	0	5	x	0.13	=	0.65			(30)
Total area of elements, m²			192.3							(31)
Party wall			16.3	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) = 47.56 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (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 14.98 (36)

TER WorkSheet: New dwelling design stage

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

Total fabric heat loss (33) + (36) = 62.55 (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=	42.88	42.63	42.39	41.25	41.04	40.05	40.05	39.86	40.43	41.04	41.47	41.92	(38)

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

(39)m=	105.43	105.18	104.94	103.8	103.59	102.59	102.59	102.41	102.97	103.59	104.02	104.47	

Average = Sum(39)$_{1…12}$ /12= 103.8 (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	1.16	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 2.6 (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 96.06 (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=	105.67	101.82	97.98	94.14	90.3	86.45	86.45	90.3	94.14	97.98	101.82	105.67

Total = Sum(44)$_{1…12}$ = 1152.72 (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=	156.7	137.05	141.42	123.3	118.31	102.09	94.6	108.56	109.85	128.02	139.75	151.76

Total = Sum(45)$_{1…12}$ = 1511.4 (45)

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

(46)m=	23.5	20.56	21.21	18.49	17.75	15.31	14.19	16.28	16.48	19.2	20.96	22.76	(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	49.93	46.42	46.01	42.63	44.06	46.01	46.42	49.93	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=	207.66	183.08	191.35	169.72	164.32	144.72	138.66	154.57	156.28	177.95	189.06	202.71	(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=	207.66	183.08	191.35	169.72	164.32	144.72	138.66	154.57	156.28	177.95	189.06	202.71

Output from water heater (annual)$_{1...12}$ | 2080.08 | (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=	64.84	57.08	59.51	52.6	50.84	44.6	42.47	47.6	48.13	55.05	58.79	63.2	(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=	130.23	130.23	130.23	130.23	130.23	130.23	130.23	130.23	130.23	130.23	130.23	130.23	(66)

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

(67)m=	22.11	19.64	15.97	12.09	9.04	7.63	8.25	10.72	14.39	18.27	21.32	22.73	(67)

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

(68)m=	236.29	238.74	232.56	219.41	202.81	187.2	176.77	174.32	180.5	193.65	210.26	225.87	(68)

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

(69)m=	36.02	36.02	36.02	36.02	36.02	36.02	36.02	36.02	36.02	36.02	36.02	36.02	(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=	-104.19	-104.19	-104.19	-104.19	-104.19	-104.19	-104.19	-104.19	-104.19	-104.19	-104.19	-104.19	(71)

Water heating gains (Table 5)

(72)m=	87.15	84.93	79.98	73.06	68.33	61.95	57.08	63.98	66.85	73.99	81.66	84.94	(72)

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

(73)m=	410.63	408.39	393.59	369.63	345.25	321.85	307.17	314.09	326.81	350.98	378.31	398.61	(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)	
Northeast	0.9x	0.77	x	2.25	x	11.28	x	0.63	x	0.7	=	23.28	(75)
Northeast	0.9x	0.77	x	2.25	x	22.97	x	0.63	x	0.7	=	47.38	(75)
Northeast	0.9x	0.77	x	2.25	x	41.38	x	0.63	x	0.7	=	85.36	(75)
Northeast	0.9x	0.77	x	2.25	x	67.96	x	0.63	x	0.7	=	140.19	(75)
Northeast	0.9x	0.77	x	2.25	x	91.35	x	0.63	x	0.7	=	188.44	(75)
Northeast	0.9x	0.77	x	2.25	x	97.38	x	0.63	x	0.7	=	200.89	(75)
Northeast	0.9x	0.77	x	2.25	x	91.1	x	0.63	x	0.7	=	187.93	(75)
Northeast	0.9x	0.77	x	2.25	x	72.63	x	0.63	x	0.7	=	149.82	(75)
Northeast	0.9x	0.77	x	2.25	x	50.42	x	0.63	x	0.7	=	104.01	(75)
Northeast	0.9x	0.77	x	2.25	x	28.07	x	0.63	x	0.7	=	57.9	(75)
Northeast	0.9x	0.77	x	2.25	x	14.2	x	0.63	x	0.7	=	29.29	(75)
Northeast	0.9x	0.77	x	2.25	x	9.21	x	0.63	x	0.7	=	19.01	(75)
East	0.9x	1	x	3.15	x	19.64	x	0.63	x	0.7	=	18.91	(76)
East	0.9x	1	x	0.78	x	19.64	x	0.63	x	0.7	=	3.28	(76)
East	0.9x	1	x	3.15	x	38.42	x	0.63	x	0.7	=	36.99	(76)
East	0.9x	1	x	0.78	x	38.42	x	0.63	x	0.7	=	6.42	(76)
East	0.9x	1	x	3.15	x	63.27	x	0.63	x	0.7	=	60.91	(76)
East	0.9x	1	x	0.78	x	63.27	x	0.63	x	0.7	=	10.58	(76)
East	0.9x	1	x	3.15	x	92.28	x	0.63	x	0.7	=	88.84	(76)
East	0.9x	1	x	0.78	x	92.28	x	0.63	x	0.7	=	15.43	(76)
East	0.9x	1	x	3.15	x	113.09	x	0.63	x	0.7	=	108.87	(76)
East	0.9x	1	x	0.78	x	113.09	x	0.63	x	0.7	=	18.91	(76)
East	0.9x	1	x	3.15	x	115.77	x	0.63	x	0.7	=	111.45	(76)
East	0.9x	1	x	0.78	x	115.77	x	0.63	x	0.7	=	19.35	(76)
East	0.9x	1	x	3.15	x	110.22	x	0.63	x	0.7	=	106.11	(76)
East	0.9x	1	x	0.78	x	110.22	x	0.63	x	0.7	=	18.43	(76)
East	0.9x	1	x	3.15	x	94.68	x	0.63	x	0.7	=	91.14	(76)
East	0.9x	1	x	0.78	x	94.68	x	0.63	x	0.7	=	15.83	(76)
East	0.9x	1	x	3.15	x	73.59	x	0.63	x	0.7	=	70.84	(76)
East	0.9x	1	x	0.78	x	73.59	x	0.63	x	0.7	=	12.3	(76)
East	0.9x	1	x	3.15	x	45.59	x	0.63	x	0.7	=	43.89	(76)
East	0.9x	1	x	0.78	x	45.59	x	0.63	x	0.7	=	7.62	(76)
East	0.9x	1	x	3.15	x	24.49	x	0.63	x	0.7	=	23.58	(76)
East	0.9x	1	x	0.78	x	24.49	x	0.63	x	0.7	=	4.09	(76)
East	0.9x	1	x	3.15	x	16.15	x	0.63	x	0.7	=	15.55	(76)
East	0.9x	1	x	0.78	x	16.15	x	0.63	x	0.7	=	2.7	(76)
West	0.9x	0.77	x	1.6	x	19.64	x	0.63	x	0.7	=	9.6	(80)
West	0.9x	0.77	x	1.6	x	19.64	x	0.63	x	0.7	=	9.6	(80)
West	0.9x	0.77	x	1.6	x	38.42	x	0.63	x	0.7	=	18.79	(80)

West	0.9x	0.77	x	1.6	x	38.42	x	0.63	x	0.7	=	18.79	(80)
West	0.9x	0.77	x	1.6	x	63.27	x	0.63	x	0.7	=	30.94	(80)
West	0.9x	0.77	x	1.6	x	63.27	x	0.63	x	0.7	=	30.94	(80)
West	0.9x	0.77	x	1.6	x	92.28	x	0.63	x	0.7	=	45.12	(80)
West	0.9x	0.77	x	1.6	x	92.28	x	0.63	x	0.7	=	45.12	(80)
West	0.9x	0.77	x	1.6	x	113.09	x	0.63	x	0.7	=	55.3	(80)
West	0.9x	0.77	x	1.6	x	113.09	x	0.63	x	0.7	=	55.3	(80)
West	0.9x	0.77	x	1.6	x	115.77	x	0.63	x	0.7	=	56.61	(80)
West	0.9x	0.77	x	1.6	x	115.77	x	0.63	x	0.7	=	56.61	(80)
West	0.9x	0.77	x	1.6	x	110.22	x	0.63	x	0.7	=	53.89	(80)
West	0.9x	0.77	x	1.6	x	110.22	x	0.63	x	0.7	=	53.89	(80)
West	0.9x	0.77	x	1.6	x	94.68	x	0.63	x	0.7	=	46.29	(80)
West	0.9x	0.77	x	1.6	x	94.68	x	0.63	x	0.7	=	46.29	(80)
West	0.9x	0.77	x	1.6	x	73.59	x	0.63	x	0.7	=	35.98	(80)
West	0.9x	0.77	x	1.6	x	73.59	x	0.63	x	0.7	=	35.98	(80)
West	0.9x	0.77	x	1.6	x	45.59	x	0.63	x	0.7	=	22.29	(80)
West	0.9x	0.77	x	1.6	x	45.59	x	0.63	x	0.7	=	22.29	(80)
West	0.9x	0.77	x	1.6	x	24.49	x	0.63	x	0.7	=	11.97	(80)
West	0.9x	0.77	x	1.6	x	24.49	x	0.63	x	0.7	=	11.97	(80)
West	0.9x	0.77	x	1.6	x	16.15	x	0.63	x	0.7	=	7.9	(80)
West	0.9x	0.77	x	1.6	x	16.15	x	0.63	x	0.7	=	7.9	(80)

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

(83)m=	64.67	128.36	218.73	334.69	426.82	444.92	420.25	349.38	259.12	153.99	80.91	53.05	(83)

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

(84)m=	475.3	536.75	612.32	704.33	772.06	766.77	727.42	663.47	585.93	504.98	459.21	451.66	(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	0.97	0.91	0.76	0.6	0.67	0.9	0.99	1	1	(86)

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

(87)m=	19.65	19.78	20.04	20.4	20.72	20.92	20.98	20.97	20.81	20.39	19.96	19.62	(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	1	0.99	0.96	0.87	0.67	0.47	0.54	0.84	0.98	1	1	(89)

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

(90)m=	18.12	18.32	18.69	19.22	19.66	19.9	19.95	19.94	19.78	19.21	18.58	18.09	(90)

fLA = Living area ÷ (4) = | 0.4 | (91)

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

(92)m=	18.73	18.9	19.23	19.69	20.09	20.31	20.36	20.36	20.19	19.68	19.13	18.71	(92)

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

(93)m=	18.73	18.9	19.23	19.69	20.09	20.31	20.36	20.36	20.19	19.68	19.13	18.71	(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	0.96	0.88	0.71	0.52	0.59	0.86	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	474.19	534.31	605.02	676.22	677.28	540.92	378.21	390.94	503.89	494	457.15	450.84	(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=	1521.56	1472.97	1336.14	1120.25	869.04	585.99	386.04	405.05	627.58	941.07	1251.81	1515.64	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	779.24	630.78	543.95	319.7	142.67	0	0	0	0	332.62	572.15	792.22	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4113.33 (98)

Space heating requirement in kWh/m²/year 46.48 (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)													
	779.24	630.78	543.95	319.7	142.67	0	0	0	0	332.62	572.15	792.22	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	834.3	675.36	582.39	342.29	152.75	0	0	0	0	356.12	612.58	848.2	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 4404 (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)

	207.66	183.08	191.35	169.72	164.32	144.72	138.66	154.57	156.28	177.95	189.06	202.71	
Efficiency of water heater												80.3	(216)
(217)m=	88.07	87.91	87.53	86.62	84.7	80.3	80.3	80.3	80.3	86.6	87.66	88.14	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	235.79	208.25	218.6	195.93	194.01	180.23	172.67	192.49	194.62	205.48	215.67	229.99

Total = Sum(219a)$_{1...12}$ = 2443.73 (219)

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Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			4404	
Water heating fuel used			2443.73	
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			390.54	(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	=	951.26	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	527.85	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1479.11	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	202.69	(268)
Total CO2, kg/year			sum of (265)…(271) =		1720.72	(272)

TER = 19.44 (273)

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User Details:

Assessor Name:	John Simpson	**Stroma Number:**	STRO006273
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.7

Property Address: 202

Address : 2.02, 25 Old Gloucester St, LONDON, WC1N 3AF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	42.29	(1a)	x	2.4	(2a)	=	101.5	(3a)
First floor	34.9	(1b)	x	2.86	(2b)	=	99.81	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	77.19	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	201.31	(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

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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

0.43	0.42	0.42	0.37	0.36	0.32	0.32	0.31	0.34	0.36	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	
Doors			2.1	x	1	=	2.1			(26)
Windows Type 1			1.52	x1/[1/(1.4)+ 0.04]		=	2.02			(27)
Windows Type 2			2.56	x1/[1/(1.4)+ 0.04]		=	3.39			(27)
Windows Type 3			1.68	x1/[1/(1.4)+ 0.04]		=	2.23			(27)
Windows Type 4			1.11	x1/[1/(1.4)+ 0.04]		=	1.47			(27)
Windows Type 5			6.96	x1/[1/(1.4)+ 0.04]		=	9.23			(27)
Floor			2.4	x	0.13	=	0.312			(28)
Walls Type1	87.6	17.19	70.41	x	0.18	=	12.67			(29)
Walls Type2	16.8	2.1	14.7	x	0.18	=	2.65			(29)
Roof Type1	9.9	0	9.9	x	0.13	=	1.29			(30)
Roof Type2	35.3	0	35.3	x	0.13	=	4.59			(30)
Total area of elements, m²			152							(31)
Party wall			42.9	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) = 46.4 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 89.1 (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 | 13.72 | (36)

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

Total fabric heat loss (33) + (36) = | 60.12 | (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=	39.43	39.19	38.95	37.84	37.63	36.66	36.66	36.49	37.04	37.63	38.05	38.49	(38)

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

(39)m=	99.54	99.3	99.07	97.96	97.75	96.78	96.78	96.6	97.15	97.75	98.17	98.61

Average = Sum(39)1…12 /12= | 97.96 | (39)

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

(40)m=	1.29	1.29	1.28	1.27	1.27	1.25	1.25	1.25	1.26	1.27	1.27	1.28

Average = Sum(40)1…12 /12= | 1.27 | (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 | 91.38 | (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=	100.51	96.86	93.2	89.55	85.89	82.24	82.24	85.89	89.55	93.2	96.86	100.51

Total = Sum(44)1…12 = | 1096.5 | (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=	149.06	130.37	134.53	117.28	112.54	97.11	89.99	103.26	104.49	121.78	132.93	144.35

Total = Sum(45)1…12 = | 1437.69 | (45)

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

(46)m=	22.36	19.56	20.18	17.59	16.88	14.57	13.5	15.49	15.67	18.27	19.94	21.65	(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)

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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	44.58	47.5	44.16	43.77	40.56	41.91	43.77	44.16	47.5	47.77	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=	200.02	174.95	182.02	161.44	156.31	137.67	131.89	147.03	148.66	169.27	180.7	195.31	(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=	200.02	174.95	182.02	161.44	156.31	137.67	131.89	147.03	148.66	169.27	180.7	195.31

Output from water heater (annual)$_{1...12}$ 1985.27 (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=	62.3	54.49	56.6	50.04	48.36	42.43	40.4	45.28	45.78	52.37	56.14	60.74	(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=	120.37	120.37	120.37	120.37	120.37	120.37	120.37	120.37	120.37	120.37	120.37	120.37	(66)

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

(67)m=	19.03	16.9	13.75	10.41	7.78	6.57	7.1	9.22	12.38	15.72	18.35	19.56	(67)

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

(68)m=	213.47	215.68	210.1	198.22	183.22	169.12	159.7	157.48	163.07	174.95	189.95	204.05	(68)

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

(69)m=	35.04	35.04	35.04	35.04	35.04	35.04	35.04	35.04	35.04	35.04	35.04	35.04	(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=	-96.3	-96.3	-96.3	-96.3	-96.3	-96.3	-96.3	-96.3	-96.3	-96.3	-96.3	-96.3	(71)

Water heating gains (Table 5)

(72)m=	83.74	81.09	76.08	69.5	65	58.93	54.3	60.86	63.59	70.38	77.97	81.64	(72)

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

(73)m=	378.35	375.79	362.04	340.23	318.11	296.72	283.2	289.68	301.15	323.16	348.38	367.36	(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)	
Northeast	0.9x	0.77	x	1.68	x	11.28	x	0.63	x	0.7	=	17.38	(75)
Northeast	0.9x	0.77	x	1.68	x	22.97	x	0.63	x	0.7	=	35.38	(75)
Northeast	0.9x	0.77	x	1.68	x	41.38	x	0.63	x	0.7	=	63.74	(75)
Northeast	0.9x	0.77	x	1.68	x	67.96	x	0.63	x	0.7	=	104.67	(75)
Northeast	0.9x	0.77	x	1.68	x	91.35	x	0.63	x	0.7	=	140.7	(75)
Northeast	0.9x	0.77	x	1.68	x	97.38	x	0.63	x	0.7	=	150	(75)
Northeast	0.9x	0.77	x	1.68	x	91.1	x	0.63	x	0.7	=	140.32	(75)
Northeast	0.9x	0.77	x	1.68	x	72.63	x	0.63	x	0.7	=	111.87	(75)
Northeast	0.9x	0.77	x	1.68	x	50.42	x	0.63	x	0.7	=	77.66	(75)
Northeast	0.9x	0.77	x	1.68	x	28.07	x	0.63	x	0.7	=	43.23	(75)
Northeast	0.9x	0.77	x	1.68	x	14.2	x	0.63	x	0.7	=	21.87	(75)
Northeast	0.9x	0.77	x	1.68	x	9.21	x	0.63	x	0.7	=	14.19	(75)
East	0.9x	1	x	1.52	x	19.64	x	0.63	x	0.7	=	9.12	(76)
East	0.9x	1	x	1.11	x	19.64	x	0.63	x	0.7	=	6.66	(76)
East	0.9x	1	x	1.52	x	38.42	x	0.63	x	0.7	=	17.85	(76)
East	0.9x	1	x	1.11	x	38.42	x	0.63	x	0.7	=	13.03	(76)
East	0.9x	1	x	1.52	x	63.27	x	0.63	x	0.7	=	29.39	(76)
East	0.9x	1	x	1.11	x	63.27	x	0.63	x	0.7	=	21.46	(76)
East	0.9x	1	x	1.52	x	92.28	x	0.63	x	0.7	=	42.87	(76)
East	0.9x	1	x	1.11	x	92.28	x	0.63	x	0.7	=	31.3	(76)
East	0.9x	1	x	1.52	x	113.09	x	0.63	x	0.7	=	52.54	(76)
East	0.9x	1	x	1.11	x	113.09	x	0.63	x	0.7	=	38.36	(76)
East	0.9x	1	x	1.52	x	115.77	x	0.63	x	0.7	=	53.78	(76)
East	0.9x	1	x	1.11	x	115.77	x	0.63	x	0.7	=	39.27	(76)
East	0.9x	1	x	1.52	x	110.22	x	0.63	x	0.7	=	51.2	(76)
East	0.9x	1	x	1.11	x	110.22	x	0.63	x	0.7	=	37.39	(76)
East	0.9x	1	x	1.52	x	94.68	x	0.63	x	0.7	=	43.98	(76)
East	0.9x	1	x	1.11	x	94.68	x	0.63	x	0.7	=	32.12	(76)
East	0.9x	1	x	1.52	x	73.59	x	0.63	x	0.7	=	34.18	(76)
East	0.9x	1	x	1.11	x	73.59	x	0.63	x	0.7	=	24.96	(76)
East	0.9x	1	x	1.52	x	45.59	x	0.63	x	0.7	=	21.18	(76)
East	0.9x	1	x	1.11	x	45.59	x	0.63	x	0.7	=	15.47	(76)
East	0.9x	1	x	1.52	x	24.49	x	0.63	x	0.7	=	11.38	(76)
East	0.9x	1	x	1.11	x	24.49	x	0.63	x	0.7	=	8.31	(76)
East	0.9x	1	x	1.52	x	16.15	x	0.63	x	0.7	=	7.5	(76)
East	0.9x	1	x	1.11	x	16.15	x	0.63	x	0.7	=	5.48	(76)
West	0.9x	0.77	x	2.56	x	19.64	x	0.63	x	0.7	=	15.37	(80)
West	0.9x	0.77	x	6.96	x	19.64	x	0.63	x	0.7	=	41.78	(80)
West	0.9x	0.77	x	2.56	x	38.42	x	0.63	x	0.7	=	30.06	(80)

West	0.9x	0.77	x	6.96	x	38.42	x	0.63	x	0.7	=	81.72	(80)
West	0.9x	0.77	x	2.56	x	63.27	x	0.63	x	0.7	=	49.5	(80)
West	0.9x	0.77	x	6.96	x	63.27	x	0.63	x	0.7	=	134.59	(80)
West	0.9x	0.77	x	2.56	x	92.28	x	0.63	x	0.7	=	72.2	(80)
West	0.9x	0.77	x	6.96	x	92.28	x	0.63	x	0.7	=	196.29	(80)
West	0.9x	0.77	x	2.56	x	113.09	x	0.63	x	0.7	=	88.48	(80)
West	0.9x	0.77	x	6.96	x	113.09	x	0.63	x	0.7	=	240.56	(80)
West	0.9x	0.77	x	2.56	x	115.77	x	0.63	x	0.7	=	90.58	(80)
West	0.9x	0.77	x	6.96	x	115.77	x	0.63	x	0.7	=	246.25	(80)
West	0.9x	0.77	x	2.56	x	110.22	x	0.63	x	0.7	=	86.23	(80)
West	0.9x	0.77	x	6.96	x	110.22	x	0.63	x	0.7	=	234.44	(80)
West	0.9x	0.77	x	2.56	x	94.68	x	0.63	x	0.7	=	74.07	(80)
West	0.9x	0.77	x	6.96	x	94.68	x	0.63	x	0.7	=	201.38	(80)
West	0.9x	0.77	x	2.56	x	73.59	x	0.63	x	0.7	=	57.57	(80)
West	0.9x	0.77	x	6.96	x	73.59	x	0.63	x	0.7	=	156.53	(80)
West	0.9x	0.77	x	2.56	x	45.59	x	0.63	x	0.7	=	35.67	(80)
West	0.9x	0.77	x	6.96	x	45.59	x	0.63	x	0.7	=	96.97	(80)
West	0.9x	0.77	x	2.56	x	24.49	x	0.63	x	0.7	=	19.16	(80)
West	0.9x	0.77	x	6.96	x	24.49	x	0.63	x	0.7	=	52.09	(80)
West	0.9x	0.77	x	2.56	x	16.15	x	0.63	x	0.7	=	12.64	(80)
West	0.9x	0.77	x	6.96	x	16.15	x	0.63	x	0.7	=	34.35	(80)

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

(83)m=	90.31	178.04	298.68	447.33	560.63	579.88	549.58	463.42	350.91	212.51	112.8	74.17	(83)

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

(84)m=	468.66	553.82	660.72	787.56	878.74	876.6	832.79	753.09	652.06	535.68	461.18	441.52	(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	0.94	0.84	0.66	0.5	0.57	0.84	0.98	1	1	(86)

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

(87)m=	19.58	19.76	20.07	20.47	20.79	20.95	20.99	20.98	20.85	20.41	19.92	19.55	(87)

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

(88)m=	19.85	19.85	19.85	19.87	19.87	19.88	19.88	19.88	19.87	19.87	19.86	19.86	(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	0.56	0.38	0.44	0.76	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=	17.97	18.23	18.68	19.26	19.67	19.85	19.87	19.87	19.76	19.19	18.48	17.94	(90)

fLA = Living area ÷ (4) = 0.44 (91)

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

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(92)m=	18.68	18.9	19.29	19.8	20.17	20.33	20.37	20.36	20.24	19.73	19.12	18.65	(92)

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

(93)m=	18.68	18.9	19.29	19.8	20.17	20.33	20.37	20.36	20.24	19.73	19.12	18.65	(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	0.43	0.5	0.79	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	466.78	548.96	644.56	726.31	700.97	529.22	360.23	374.71	512.04	514.6	457.57	440.17	(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=	1431.75	1390.46	1267.2	1067.4	827.7	554.96	364.51	382.7	596.43	892.21	1179.59	1425.02	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	717.94	565.49	463.24	245.58	94.28	0	0	0	0	280.94	519.86	732.73	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3620.06 (98)

Space heating requirement in kWh/m²/year 46.9 (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)													
	717.94	565.49	463.24	245.58	94.28	0	0	0	0	280.94	519.86	732.73	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	768.67	605.45	495.97	262.94	100.94	0	0	0	0	300.79	556.59	784.51	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3875.87 (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)

Water heating

Output from water heater (calculated above)

	200.02	174.95	182.02	161.44	156.31	137.67	131.89	147.03	148.66	169.27	180.7	195.31	
Efficiency of water heater												80.3	(216)
(217)m=	87.99	87.79	87.3	86.1	83.82	80.3	80.3	80.3	80.3	86.32	87.56	88.07	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	227.32	199.28	208.5	187.5	186.47	171.44	164.25	183.1	185.13	196.1	206.37	221.77	

Total = Sum(219a)$_{1...12}$ = 2337.23 (219)

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Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			3875.87	
Water heating fuel used			2337.23	
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			336.1	(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	=	837.19	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	504.84	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1342.03	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	174.43	(268)
Total CO2, kg/year			sum of (265)…(271) =		1555.39	(272)

TER = 20.15 (273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	John Simpson	**Stroma Number:**	STRO006273
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.7

Property Address: 203

Address : 2.03, 25 Old Gloucester St, LONDON, WC1N 3AF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	39.4	(1a)	x	2.4	(2a)	=	94.56	(3a)
First floor	34.9	(1b)	x	2.86	(2b)	=	99.81	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.3	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			194.37	(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

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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

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	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=	0.6	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=	0.6	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	
Doors			2.1	x	1	=	2.1			(26)
Windows Type 1			0.63	x1/[1/(1.4)+ 0.04]		=	0.84			(27)
Windows Type 2			3.28	x1/[1/(1.4)+ 0.04]		=	4.35			(27)
Windows Type 3			0.78	x1/[1/(1.4)+ 0.04]		=	1.03			(27)
Windows Type 4			8.93	x1/[1/(1.4)+ 0.04]		=	11.84			(27)
Floor			2.4	x	0.13	=	0.312			(28)
Walls Type1	75.6	13.62	61.98	x	0.18	=	11.16			(29)
Walls Type2	22	2.1	19.9	x	0.18	=	3.58			(29)
Roof Type1	6.8	0	6.8	x	0.13	=	0.88			(30)
Roof Type2	35.3	0	35.3	x	0.13	=	4.59			(30)
Total area of elements, m²			142.1							(31)
Party wall			42.9	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) = 40.68 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 61.2 (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 | 10.78 | (36)

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

Total fabric heat loss (33) + (36) = | 51.46 | (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=	38.23	37.99	37.76	36.66	36.45	35.49	35.49	35.31	35.86	36.45	36.87	37.3	(38)

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

(39)m=	89.69	89.45	89.21	88.11	87.91	86.95	86.95	86.77	87.32	87.91	88.32	88.76	

Average = Sum(39)$_{1…12}$ /12= | 88.11 | (39)

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

(40)m=	1.21	1.2	1.2	1.19	1.18	1.17	1.17	1.17	1.18	1.18	1.19	1.19

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 | 2.35 | (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 | 89.91 | (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=	98.91	95.31	91.71	88.12	84.52	80.92	80.92	84.52	88.12	91.71	95.31	98.91

Total = Sum(44)$_{1…12}$ = | 1078.96 | (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=	146.67	128.28	132.37	115.41	110.74	95.56	88.55	101.61	102.82	119.83	130.8	142.05

Total = Sum(45)$_{1…12}$ = | 1414.69 | (45)

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

(46)m=	22	19.24	19.86	17.31	16.61	14.33	13.28	15.24	15.42	17.97	19.62	21.31	(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)

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

(61)m=	50.4	43.87	46.74	43.45	43.07	39.91	41.24	43.07	43.45	46.74	47	50.4	(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	172.15	179.11	158.86	153.81	135.46	129.78	144.68	146.28	166.57	177.81	192.45	(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	172.15	179.11	158.86	153.81	135.46	129.78	144.68	146.28	166.57	177.81	192.45

Output from water heater (annual)$_{1...12}$ | 1954.03 | (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=	61.37	53.62	55.7	49.24	47.59	41.75	39.75	44.55	45.05	51.53	55.24	59.83	(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=	117.29	117.29	117.29	117.29	117.29	117.29	117.29	117.29	117.29	117.29	117.29	117.29	(66)

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

(67)m=	18.81	16.7	13.58	10.28	7.69	6.49	7.01	9.12	12.23	15.53	18.13	19.33	(67)

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

(68)m=	207.12	209.27	203.85	192.32	177.77	164.09	154.95	152.8	158.22	169.75	184.3	197.98	(68)

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

(69)m=	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	(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=	-93.83	-93.83	-93.83	-93.83	-93.83	-93.83	-93.83	-93.83	-93.83	-93.83	-93.83	-93.83	(71)

Water heating gains (Table 5)

(72)m=	82.49	79.79	74.86	68.38	63.96	57.99	53.43	59.88	62.57	69.26	76.73	80.42	(72)

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

(73)m=	369.6	366.95	353.49	332.18	310.6	289.75	276.58	282.99	294.21	315.73	340.35	358.91	(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	0.63	x	19.64	x	0.63	x	0.7	=	3.78	(76)
East	0.9x 1	x	0.78	x	19.64	x	0.63	x	0.7	=	4.68	(76)
East	0.9x 1	x	0.63	x	38.42	x	0.63	x	0.7	=	7.4	(76)
East	0.9x 1	x	0.78	x	38.42	x	0.63	x	0.7	=	9.16	(76)
East	0.9x 1	x	0.63	x	63.27	x	0.63	x	0.7	=	12.18	(76)
East	0.9x 1	x	0.78	x	63.27	x	0.63	x	0.7	=	15.08	(76)
East	0.9x 1	x	0.63	x	92.28	x	0.63	x	0.7	=	17.77	(76)
East	0.9x 1	x	0.78	x	92.28	x	0.63	x	0.7	=	22	(76)
East	0.9x 1	x	0.63	x	113.09	x	0.63	x	0.7	=	21.77	(76)
East	0.9x 1	x	0.78	x	113.09	x	0.63	x	0.7	=	26.96	(76)
East	0.9x 1	x	0.63	x	115.77	x	0.63	x	0.7	=	22.29	(76)
East	0.9x 1	x	0.78	x	115.77	x	0.63	x	0.7	=	27.6	(76)
East	0.9x 1	x	0.63	x	110.22	x	0.63	x	0.7	=	21.22	(76)
East	0.9x 1	x	0.78	x	110.22	x	0.63	x	0.7	=	26.27	(76)
East	0.9x 1	x	0.63	x	94.68	x	0.63	x	0.7	=	18.23	(76)
East	0.9x 1	x	0.78	x	94.68	x	0.63	x	0.7	=	22.57	(76)
East	0.9x 1	x	0.63	x	73.59	x	0.63	x	0.7	=	14.17	(76)
East	0.9x 1	x	0.78	x	73.59	x	0.63	x	0.7	=	17.54	(76)
East	0.9x 1	x	0.63	x	45.59	x	0.63	x	0.7	=	8.78	(76)
East	0.9x 1	x	0.78	x	45.59	x	0.63	x	0.7	=	10.87	(76)
East	0.9x 1	x	0.63	x	24.49	x	0.63	x	0.7	=	4.72	(76)
East	0.9x 1	x	0.78	x	24.49	x	0.63	x	0.7	=	5.84	(76)
East	0.9x 1	x	0.63	x	16.15	x	0.63	x	0.7	=	3.11	(76)
East	0.9x 1	x	0.78	x	16.15	x	0.63	x	0.7	=	3.85	(76)
West	0.9x 0.77	x	3.28	x	19.64	x	0.63	x	0.7	=	19.69	(80)
West	0.9x 0.77	x	8.93	x	19.64	x	0.63	x	0.7	=	53.6	(80)
West	0.9x 0.77	x	3.28	x	38.42	x	0.63	x	0.7	=	38.51	(80)
West	0.9x 0.77	x	8.93	x	38.42	x	0.63	x	0.7	=	104.85	(80)
West	0.9x 0.77	x	3.28	x	63.27	x	0.63	x	0.7	=	63.43	(80)
West	0.9x 0.77	x	8.93	x	63.27	x	0.63	x	0.7	=	172.68	(80)
West	0.9x 0.77	x	3.28	x	92.28	x	0.63	x	0.7	=	92.5	(80)
West	0.9x 0.77	x	8.93	x	92.28	x	0.63	x	0.7	=	251.84	(80)
West	0.9x 0.77	x	3.28	x	113.09	x	0.63	x	0.7	=	113.37	(80)
West	0.9x 0.77	x	8.93	x	113.09	x	0.63	x	0.7	=	308.64	(80)
West	0.9x 0.77	x	3.28	x	115.77	x	0.63	x	0.7	=	116.05	(80)
West	0.9x 0.77	x	8.93	x	115.77	x	0.63	x	0.7	=	315.95	(80)
West	0.9x 0.77	x	3.28	x	110.22	x	0.63	x	0.7	=	110.48	(80)
West	0.9x 0.77	x	8.93	x	110.22	x	0.63	x	0.7	=	300.8	(80)
West	0.9x 0.77	x	3.28	x	94.68	x	0.63	x	0.7	=	94.9	(80)

West	0.9x	0.77	x	8.93	x	94.68	x	0.63	x	0.7	=	258.38	(80)
West	0.9x	0.77	x	3.28	x	73.59	x	0.63	x	0.7	=	73.77	(80)
West	0.9x	0.77	x	8.93	x	73.59	x	0.63	x	0.7	=	200.83	(80)
West	0.9x	0.77	x	3.28	x	45.59	x	0.63	x	0.7	=	45.7	(80)
West	0.9x	0.77	x	8.93	x	45.59	x	0.63	x	0.7	=	124.42	(80)
West	0.9x	0.77	x	3.28	x	24.49	x	0.63	x	0.7	=	24.55	(80)
West	0.9x	0.77	x	8.93	x	24.49	x	0.63	x	0.7	=	66.83	(80)
West	0.9x	0.77	x	3.28	x	16.15	x	0.63	x	0.7	=	16.19	(80)
West	0.9x	0.77	x	8.93	x	16.15	x	0.63	x	0.7	=	44.08	(80)

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

(83)m=	81.75	159.92	263.37	384.11	470.74	481.89	458.78	394.08	306.31	189.76	101.93	67.23	(83)

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

(84)m=	451.35	526.87	616.86	716.29	781.35	771.64	735.36	677.07	600.52	505.49	442.28	426.14	(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	0.85	0.67	0.51	0.57	0.83	0.97	1	1	(86)

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

(87)m=	19.69	19.85	20.14	20.51	20.81	20.95	20.99	20.98	20.87	20.47	20.01	19.66	(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	19.95	19.94	19.93	19.93	19.92	(88)

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

(89)m=	1	0.99	0.98	0.93	0.8	0.58	0.39	0.45	0.76	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=	18.17	18.41	18.83	19.37	19.75	19.91	19.94	19.94	19.84	19.32	18.65	18.14	(90)

fLA = Living area ÷ (4) = 0.46 (91)

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

(92)m=	18.87	19.07	19.43	19.89	20.23	20.39	20.42	20.42	20.31	19.85	19.28	18.84	(92)

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

(93)m=	18.87	19.07	19.43	19.89	20.23	20.39	20.42	20.42	20.31	19.85	19.28	18.84	(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	0.81	0.62	0.45	0.51	0.79	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	449.61	522.48	602.77	665.23	635.66	480.7	328.77	342.33	472.44	485.78	438.9	424.89	(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=	1306.65	1267.89	1153.8	968.71	750.19	503.61	332.36	348.73	542.44	812.9	1075.52	1299.47	(97)

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=	637.64	500.91	409.96	218.51	85.21	0	0	0	0	243.38	458.37	650.69

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3204.67 (98)

Space heating requirement in kWh/m²/year 43.13 (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)	637.64	500.91	409.96	218.51	85.21	0	0	0	0	243.38	458.37	650.69	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	682.69	536.31	438.93	233.95	91.23	0	0	0	0	260.58	490.76	696.67	(211)

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3431.12 (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
	197.07	172.15	179.11	158.86	153.81	135.46	129.78	144.68	146.28	166.57	177.81	192.45

Efficiency of water heater 80.3 (216)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(217)m=	87.79	87.58	87.07	85.85	83.63	80.3	80.3	80.3	80.3	86	87.33	87.88	(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=	224.48	196.56	205.71	185.04	183.91	168.7	161.62	180.17	182.16	193.67	203.6	218.99

Total = Sum(219a)$_{1...12}$ = 2304.62 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3431.12	
Water heating fuel used			2304.62	
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			332.11	(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	=	741.12	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	497.8	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1238.92	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	172.37	(268)
Total CO2, kg/year		sum of (265)…(271) =		1450.21	(272)

TER = 19.52 (273)

DER WorkSheet: New dwelling created by change of use

User Details:

Assessor Name:	John Simpson	**Stroma Number:**	STRO006273
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.7

Property Address: 101 TER

Address : 1.01, 25 Old Gloucester St, LONDON, WC1N 3AF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	65.6	(1a) x	3	(2a) =	196.8	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	65.6	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		196.8	(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) =	0.15	(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			15	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.9	(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) =		0.77	(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 created by change of use

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

0.98	0.96	0.94	0.84	0.82	0.73	0.73	0.71	0.77	0.82	0.86	0.9

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=	0.98	0.96	0.94	0.86	0.84	0.77	0.77	0.75	0.79	0.84	0.87	0.91	(24d)

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

(25)m=	0.98	0.96	0.94	0.86	0.84	0.77	0.77	0.75	0.79	0.84	0.87	0.91	(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	
Doors			2.1	x	1.8	=	3.78			(26)
Windows Type 1			1.58	x1/[1/(1.6)+ 0.04]		=	2.38			(27)
Windows Type 2			1.5	x1/[1/(1.6)+ 0.04]		=	2.26			(27)
Windows Type 3			2.2	x1/[1/(1.6)+ 0.04]		=	3.31			(27)
Windows Type 4			1.8	x1/[1/(1.6)+ 0.04]		=	2.71			(27)
Windows Type 5			1.8	x1/[1/(1.6)+ 0.04]		=	2.71			(27)
Windows Type 6			1.85	x1/[1/(1.6)+ 0.04]		=	2.78			(27)
Floor			65.6	x	0.25	=	16.4			(28)
Walls Type1	52.3	12.48	39.82	x	0.3	=	11.95			(29)
Walls Type2	10.1	1.85	8.25	x	0.28	=	2.31			(29)
Walls Type3	22.2	2.1	20.1	x	0.3	=	6.03			(29)
Walls Type4	12.6	0	12.6	x	0.28	=	3.53			(29)
Total area of elements, m²			162.8							(31)
Party wall			16.3	x	0.2	=	3.26			(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) = 68.8 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (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 | 24.42 | (36)

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

Total fabric heat loss (33) + (36) = | 93.22 | (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=	63.53	62.33	61.14	55.59	54.55	49.72	49.72	48.82	51.58	54.55	56.65	58.85	(38)

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

(39)m=	156.75	155.55	154.37	148.81	147.77	142.94	142.94	142.04	144.8	147.77	149.88	152.07

Average = Sum(39)$_{1…12}$ /12= | 148.81 | (39)

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

(40)m=	2.39	2.37	2.35	2.27	2.25	2.18	2.18	2.17	2.21	2.25	2.28	2.32

Average = Sum(40)$_{1…12}$ /12= | 2.27 | (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 | 2.13 | (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 | 84.9 | (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=	93.39	89.99	86.6	83.2	79.81	76.41	76.41	79.81	83.2	86.6	89.99	93.39

Total = Sum(44)$_{1…12}$ = | 1018.81 | (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=	138.5	121.13	124.99	108.97	104.56	90.23	83.61	95.94	97.09	113.15	123.51	134.13

Total = Sum(45)$_{1…12}$ = | 1335.82 | (45)

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

(46)m=	20.77	18.17	18.75	16.35	15.68	13.53	12.54	14.39	14.56	16.97	18.53	20.12	(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)

DER WorkSheet: New dwelling created by change of use

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=	47.59	41.42	44.13	41.03	40.67	37.68	38.94	40.67	41.03	44.13	44.38	47.59	(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=	186.09	162.55	169.12	150	145.23	127.91	122.55	136.61	138.12	157.28	167.89	181.72	(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=	186.09	162.55	169.12	150	145.23	127.91	122.55	136.61	138.12	157.28	167.89	181.72	

Output from water heater (annual)$_{1...12}$ | 1845.08 | (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=	57.95	50.63	52.59	46.49	44.93	39.42	37.54	42.07	42.54	48.65	52.16	56.49	(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=	106.74	106.74	106.74	106.74	106.74	106.74	106.74	106.74	106.74	106.74	106.74	106.74	(66)

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

(67)m=	20.85	18.52	15.06	11.4	8.52	7.2	7.78	10.11	13.57	17.22	20.1	21.43	(67)

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

(68)m=	186.82	188.76	183.87	173.47	160.34	148.01	139.76	137.82	142.71	153.11	166.24	178.58	(68)

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

(69)m=	33.67	33.67	33.67	33.67	33.67	33.67	33.67	33.67	33.67	33.67	33.67	33.67	(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=	-85.39	-85.39	-85.39	-85.39	-85.39	-85.39	-85.39	-85.39	-85.39	-85.39	-85.39	-85.39	(71)

Water heating gains (Table 5)

(72)m=	77.89	75.34	70.69	64.57	60.4	54.75	50.45	56.54	59.08	65.4	72.45	75.93	(72)

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

(73)m=	343.58	340.64	327.64	307.47	287.28	267.98	256.01	262.5	273.38	293.75	316.81	333.96	(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 created by change of use

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.5	x	10.63	x	0.72	x	0.7	=	5.57	(74)
North	0.9x	0.77	x	1.85	x	10.63	x	0.72	x	0.7	=	6.87	(74)
North	0.9x	0.77	x	1.5	x	20.32	x	0.72	x	0.7	=	10.65	(74)
North	0.9x	0.77	x	1.85	x	20.32	x	0.72	x	0.7	=	13.13	(74)
North	0.9x	0.77	x	1.5	x	34.53	x	0.72	x	0.7	=	18.09	(74)
North	0.9x	0.77	x	1.85	x	34.53	x	0.72	x	0.7	=	22.31	(74)
North	0.9x	0.77	x	1.5	x	55.46	x	0.72	x	0.7	=	29.06	(74)
North	0.9x	0.77	x	1.85	x	55.46	x	0.72	x	0.7	=	35.84	(74)
North	0.9x	0.77	x	1.5	x	74.72	x	0.72	x	0.7	=	39.14	(74)
North	0.9x	0.77	x	1.85	x	74.72	x	0.72	x	0.7	=	48.28	(74)
North	0.9x	0.77	x	1.5	x	79.99	x	0.72	x	0.7	=	41.9	(74)
North	0.9x	0.77	x	1.85	x	79.99	x	0.72	x	0.7	=	51.68	(74)
North	0.9x	0.77	x	1.5	x	74.68	x	0.72	x	0.7	=	39.12	(74)
North	0.9x	0.77	x	1.85	x	74.68	x	0.72	x	0.7	=	48.25	(74)
North	0.9x	0.77	x	1.5	x	59.25	x	0.72	x	0.7	=	31.04	(74)
North	0.9x	0.77	x	1.85	x	59.25	x	0.72	x	0.7	=	38.28	(74)
North	0.9x	0.77	x	1.5	x	41.52	x	0.72	x	0.7	=	21.75	(74)
North	0.9x	0.77	x	1.85	x	41.52	x	0.72	x	0.7	=	26.83	(74)
North	0.9x	0.77	x	1.5	x	24.19	x	0.72	x	0.7	=	12.67	(74)
North	0.9x	0.77	x	1.85	x	24.19	x	0.72	x	0.7	=	15.63	(74)
North	0.9x	0.77	x	1.5	x	13.12	x	0.72	x	0.7	=	6.87	(74)
North	0.9x	0.77	x	1.85	x	13.12	x	0.72	x	0.7	=	8.48	(74)
North	0.9x	0.77	x	1.5	x	8.86	x	0.72	x	0.7	=	4.64	(74)
North	0.9x	0.77	x	1.85	x	8.86	x	0.72	x	0.7	=	5.73	(74)
East	0.9x	1	x	2.2	x	19.64	x	0.72	x	0.7	=	15.09	(76)
East	0.9x	1	x	1.8	x	19.64	x	0.72	x	0.7	=	12.35	(76)
East	0.9x	3	x	1.8	x	19.64	x	0.72	x	0.7	=	37.04	(76)
East	0.9x	1	x	2.2	x	38.42	x	0.72	x	0.7	=	29.52	(76)
East	0.9x	1	x	1.8	x	38.42	x	0.72	x	0.7	=	24.15	(76)
East	0.9x	3	x	1.8	x	38.42	x	0.72	x	0.7	=	72.46	(76)
East	0.9x	1	x	2.2	x	63.27	x	0.72	x	0.7	=	48.62	(76)
East	0.9x	1	x	1.8	x	63.27	x	0.72	x	0.7	=	39.78	(76)
East	0.9x	3	x	1.8	x	63.27	x	0.72	x	0.7	=	119.34	(76)
East	0.9x	1	x	2.2	x	92.28	x	0.72	x	0.7	=	70.91	(76)
East	0.9x	1	x	1.8	x	92.28	x	0.72	x	0.7	=	58.02	(76)
East	0.9x	3	x	1.8	x	92.28	x	0.72	x	0.7	=	174.05	(76)
East	0.9x	1	x	2.2	x	113.09	x	0.72	x	0.7	=	86.9	(76)
East	0.9x	1	x	1.8	x	113.09	x	0.72	x	0.7	=	71.1	(76)
East	0.9x	3	x	1.8	x	113.09	x	0.72	x	0.7	=	213.3	(76)

East	0.9x	1	x	2.2	x	115.77	x	0.72	x	0.7	=	88.96	(76)
East	0.9x	1	x	1.8	x	115.77	x	0.72	x	0.7	=	72.78	(76)
East	0.9x	3	x	1.8	x	115.77	x	0.72	x	0.7	=	218.35	(76)
East	0.9x	1	x	2.2	x	110.22	x	0.72	x	0.7	=	84.69	(76)
East	0.9x	1	x	1.8	x	110.22	x	0.72	x	0.7	=	69.29	(76)
East	0.9x	3	x	1.8	x	110.22	x	0.72	x	0.7	=	207.88	(76)
East	0.9x	1	x	2.2	x	94.68	x	0.72	x	0.7	=	72.75	(76)
East	0.9x	1	x	1.8	x	94.68	x	0.72	x	0.7	=	59.52	(76)
East	0.9x	3	x	1.8	x	94.68	x	0.72	x	0.7	=	178.57	(76)
East	0.9x	1	x	2.2	x	73.59	x	0.72	x	0.7	=	56.55	(76)
East	0.9x	1	x	1.8	x	73.59	x	0.72	x	0.7	=	46.26	(76)
East	0.9x	3	x	1.8	x	73.59	x	0.72	x	0.7	=	138.79	(76)
East	0.9x	1	x	2.2	x	45.59	x	0.72	x	0.7	=	35.03	(76)
East	0.9x	1	x	1.8	x	45.59	x	0.72	x	0.7	=	28.66	(76)
East	0.9x	3	x	1.8	x	45.59	x	0.72	x	0.7	=	85.98	(76)
East	0.9x	1	x	2.2	x	24.49	x	0.72	x	0.7	=	18.82	(76)
East	0.9x	1	x	1.8	x	24.49	x	0.72	x	0.7	=	15.4	(76)
East	0.9x	3	x	1.8	x	24.49	x	0.72	x	0.7	=	46.19	(76)
East	0.9x	1	x	2.2	x	16.15	x	0.72	x	0.7	=	12.41	(76)
East	0.9x	1	x	1.8	x	16.15	x	0.72	x	0.7	=	10.15	(76)
East	0.9x	3	x	1.8	x	16.15	x	0.72	x	0.7	=	30.46	(76)
West	0.9x	0.54	x	1.58	x	19.64	x	0.72	x	0.7	=	7.6	(80)
West	0.9x	0.54	x	1.58	x	38.42	x	0.72	x	0.7	=	14.87	(80)
West	0.9x	0.54	x	1.58	x	63.27	x	0.72	x	0.7	=	24.49	(80)
West	0.9x	0.54	x	1.58	x	92.28	x	0.72	x	0.7	=	35.71	(80)
West	0.9x	0.54	x	1.58	x	113.09	x	0.72	x	0.7	=	43.77	(80)
West	0.9x	0.54	x	1.58	x	115.77	x	0.72	x	0.7	=	44.8	(80)
West	0.9x	0.54	x	1.58	x	110.22	x	0.72	x	0.7	=	42.66	(80)
West	0.9x	0.54	x	1.58	x	94.68	x	0.72	x	0.7	=	36.64	(80)
West	0.9x	0.54	x	1.58	x	73.59	x	0.72	x	0.7	=	28.48	(80)
West	0.9x	0.54	x	1.58	x	45.59	x	0.72	x	0.7	=	17.64	(80)
West	0.9x	0.54	x	1.58	x	24.49	x	0.72	x	0.7	=	9.48	(80)
West	0.9x	0.54	x	1.58	x	16.15	x	0.72	x	0.7	=	6.25	(80)

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

(83)m=	84.52	164.79	272.63	403.58	502.49	518.49	491.9	416.8	318.66	195.62	105.23	69.65	(83)

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

(84)m=	428.1	505.43	600.27	711.05	789.78	786.46	747.91	679.29	592.04	489.37	422.04	403.61	(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	0.99	0.96	0.91	0.81	0.69	0.74	0.91	0.98	0.99	1	(86)

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

(87)m=	18.44	18.65	19.07	19.67	20.22	20.67	20.86	20.82	20.45	19.74	19.03	18.46	(87)

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

(88)m=	19.09	19.1	19.11	19.16	19.17	19.22	19.22	19.23	19.2	19.17	19.15	19.13	(88)

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

(89)m=	0.99	0.99	0.98	0.95	0.86	0.69	0.47	0.54	0.83	0.97	0.99	1	(89)

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

(90)m=	16.88	17.1	17.51	18.14	18.67	19.07	19.19	19.18	18.9	18.22	17.5	16.92	(90)

fLA = Living area ÷ (4) = 0.37 (91)

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

(92)m=	17.45	17.67	18.08	18.7	19.23	19.65	19.8	19.78	19.47	18.78	18.06	17.48	(92)

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

(93)m=	17.45	17.67	18.08	18.7	19.23	19.65	19.8	19.78	19.47	18.78	18.06	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=	0.99	0.99	0.97	0.94	0.86	0.72	0.55	0.62	0.85	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	424.74	498.77	584.42	667.68	682.79	569.82	413.4	418	501.69	470.49	416.88	401.02	(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=	2060.92	1985.7	1787.53	1458.68	1113.28	722.52	457.43	480.19	777.15	1208.35	1642.54	2020.18	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1217.31	999.22	895.11	569.52	320.29	0	0	0	0	548.97	882.47	1204.66	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 6637.55 (98)

Space heating requirement in kWh/m²/year 101.18 (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		88	(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)													
	1217.31	999.22	895.11	569.52	320.29	0	0	0	0	548.97	882.47	1204.66	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	1383.31	1135.48	1017.18	647.18	363.96	0	0	0	0	623.83	1002.81	1368.93	

Total (kWh/year) =$Sum(211)_{1...5,10....12}$= 7542.67 (211)

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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)

186.09	162.55	169.12	150	145.23	127.91	122.55	136.61	138.12	157.28	167.89	181.72

Efficiency of water heater 88 (216)

(217)m=	88	88	88	88	88	88	88	88	88	88	88	88	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	211.46	184.72	192.19	170.46	165.04	145.35	139.26	155.24	156.96	178.73	190.79	206.5

Total = Sum(219a)$_{1...12}$ = 2096.68 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		7542.67	
Water heating fuel used		2096.68	
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		368.26	(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	=	1629.22	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	452.88	(264)
Space and water heating	(261) + (262) + (263) + (264) =			2082.1	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	191.12	(268)
Total CO2, kg/year		sum of (265)…(271) =		2312.15	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		35.25	(273)
EI rating (section 14)				72	(274)

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User Details:

Assessor Name:	John Simpson	**Stroma Number:**	STRO006273
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.7

Property Address: 201 TER

Address : 2.01, 25 Old Gloucester St, LONDON, WC1N 3AF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	80.37	(1a)	x	3	(2a)	=	241.11	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	80.37	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	241.11	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.87	(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) =	0.74	(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

0.95	0.93	0.91	0.82	0.8	0.71	0.71	0.69	0.74	0.8	0.84	0.87

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=	0.95	0.93	0.91	0.83	0.82	0.75	0.75	0.74	0.78	0.82	0.85	0.88	(24d)

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

(25)m=	0.95	0.93	0.91	0.83	0.82	0.75	0.75	0.74	0.78	0.82	0.85	0.88	(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	
Doors			2.1	x	1.8	=	3.78			(26)
Windows Type 1			1.58	x1/[1/(1.6)+ 0.04]		=	2.38			(27)
Windows Type 2			1.44	x1/[1/(1.6)+ 0.04]		=	2.17			(27)
Windows Type 3			1.44	x1/[1/(1.6)+ 0.04]		=	2.17			(27)
Windows Type 4			1.62	x1/[1/(1.6)+ 0.04]		=	2.44			(27)
Windows Type 5			1.62	x1/[1/(1.6)+ 0.04]		=	2.44			(27)
Windows Type 6			1.85	x1/[1/(1.6)+ 0.04]		=	2.78			(27)
Windows Type 7			0.9	x1/[1/(1.6)+ 0.04]		=	1.35			(27)
Floor			14.1	x	0.22	=	3.102			(28)
Walls Type1	53	12.38	40.62	x	0.3	=	12.19			(29)
Walls Type2	18.9	2.75	16.15	x	0.28	=	4.52			(29)
Walls Type3	15.9	2.1	13.8	x	0.28	=	3.86			(29)
Total area of elements, m²			101.9							(31)
Party wall			25.8	x	0.2	=	5.16			(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) = 55.37 (33)

Heat capacity Cm = S(A x k) — ((28)…(30) + (32) + (32a)…(32e) = 0 (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

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 15.29 | (36)

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

Total fabric heat loss (33) + (36) = | 70.65 | (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=	75.51	74.12	72.76	66.38	65.18	59.62	59.62	58.59	61.76	65.18	67.6	70.13	(38)

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

(39)m=	146.16	144.77	143.41	137.03	135.83	130.27	130.27	129.24	132.41	135.83	138.25	140.78	

Average = Sum(39)$_{1…12}$ /12= | 137.02 | (39)

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

(40)m=	1.82	1.8	1.78	1.7	1.69	1.62	1.62	1.61	1.65	1.69	1.72	1.75

Average = Sum(40)$_{1…12}$ /12= | 1.7 | (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 | 2.47 | (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 | 92.86 | (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=	102.14	98.43	94.72	91	87.29	83.57	83.57	87.29	91	94.72	98.43	102.14	
									Total = Sum(44)$_{1…12}$ =			1114.31	(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=	151.48	132.48	136.71	119.19	114.36	98.69	91.45	104.94	106.19	123.76	135.09	146.7	
									Total = Sum(45)$_{1…12}$ =			1461.03	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	22.72	19.87	20.51	17.88	17.15	14.8	13.72	15.74	15.93	18.56	20.26	22	(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)

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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	45.3	48.27	44.88	44.48	41.21	42.59	44.48	44.88	48.27	48.54	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=	202.44	177.79	184.98	164.07	158.84	139.9	134.04	149.42	151.07	172.02	183.63	197.66	(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=	202.44	177.79	184.98	164.07	158.84	139.9	134.04	149.42	151.07	172.02	183.63	197.66

Output from water heater (annual)$_{1...12}$ — 2015.84 (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=	63.11	55.38	57.52	50.85	49.15	43.12	41.05	46.01	46.53	53.22	57.05	61.52	(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=	123.49	123.49	123.49	123.49	123.49	123.49	123.49	123.49	123.49	123.49	123.49	123.49	(66)

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

(67)m=	24.97	22.18	18.04	13.65	10.21	8.62	9.31	12.1	16.24	20.63	24.07	25.66	(67)

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

(68)m=	220.21	222.5	216.74	204.48	189.01	174.46	164.74	162.46	168.22	180.48	195.95	210.5	(68)

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

(69)m=	35.35	35.35	35.35	35.35	35.35	35.35	35.35	35.35	35.35	35.35	35.35	35.35	(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=	-98.79	-98.79	-98.79	-98.79	-98.79	-98.79	-98.79	-98.79	-98.79	-98.79	-98.79	-98.79	(71)

Water heating gains (Table 5)

(72)m=	84.82	82.41	77.32	70.62	66.06	59.88	55.18	61.84	64.62	71.53	79.24	82.68	(72)

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

(73)m=	393.05	390.13	375.14	351.81	328.32	306.01	292.28	299.45	312.13	335.68	362.31	381.89	(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)	
North	0.9x	0.77	x	1.44	x	10.63	x	0.72	x	0.7	=	10.7	(74)
North	0.9x	0.77	x	1.85	x	10.63	x	0.72	x	0.7	=	6.87	(74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.72	x	0.7	=	20.44	(74)
North	0.9x	0.77	x	1.85	x	20.32	x	0.72	x	0.7	=	13.13	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.72	x	0.7	=	34.73	(74)
North	0.9x	0.77	x	1.85	x	34.53	x	0.72	x	0.7	=	22.31	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.72	x	0.7	=	55.79	(74)
North	0.9x	0.77	x	1.85	x	55.46	x	0.72	x	0.7	=	35.84	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.72	x	0.7	=	75.16	(74)
North	0.9x	0.77	x	1.85	x	74.72	x	0.72	x	0.7	=	48.28	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.72	x	0.7	=	80.46	(74)
North	0.9x	0.77	x	1.85	x	79.99	x	0.72	x	0.7	=	51.68	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.72	x	0.7	=	75.12	(74)
North	0.9x	0.77	x	1.85	x	74.68	x	0.72	x	0.7	=	48.25	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.72	x	0.7	=	59.6	(74)
North	0.9x	0.77	x	1.85	x	59.25	x	0.72	x	0.7	=	38.28	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.72	x	0.7	=	41.76	(74)
North	0.9x	0.77	x	1.85	x	41.52	x	0.72	x	0.7	=	26.83	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.72	x	0.7	=	24.33	(74)
North	0.9x	0.77	x	1.85	x	24.19	x	0.72	x	0.7	=	15.63	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.72	x	0.7	=	13.2	(74)
North	0.9x	0.77	x	1.85	x	13.12	x	0.72	x	0.7	=	8.48	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.72	x	0.7	=	8.92	(74)
North	0.9x	0.77	x	1.85	x	8.86	x	0.72	x	0.7	=	5.73	(74)
East	0.9x	1	x	1.44	x	19.64	x	0.72	x	0.7	=	9.88	(76)
East	0.9x	1	x	1.62	x	19.64	x	0.72	x	0.7	=	11.11	(76)
East	0.9x	3	x	1.62	x	19.64	x	0.72	x	0.7	=	33.34	(76)
East	0.9x	1	x	1.44	x	38.42	x	0.72	x	0.7	=	19.32	(76)
East	0.9x	1	x	1.62	x	38.42	x	0.72	x	0.7	=	21.74	(76)
East	0.9x	3	x	1.62	x	38.42	x	0.72	x	0.7	=	65.22	(76)
East	0.9x	1	x	1.44	x	63.27	x	0.72	x	0.7	=	31.82	(76)
East	0.9x	1	x	1.62	x	63.27	x	0.72	x	0.7	=	35.8	(76)
East	0.9x	3	x	1.62	x	63.27	x	0.72	x	0.7	=	107.4	(76)
East	0.9x	1	x	1.44	x	92.28	x	0.72	x	0.7	=	46.41	(76)
East	0.9x	1	x	1.62	x	92.28	x	0.72	x	0.7	=	52.21	(76)
East	0.9x	3	x	1.62	x	92.28	x	0.72	x	0.7	=	156.64	(76)
East	0.9x	1	x	1.44	x	113.09	x	0.72	x	0.7	=	56.88	(76)
East	0.9x	1	x	1.62	x	113.09	x	0.72	x	0.7	=	63.99	(76)
East	0.9x	3	x	1.62	x	113.09	x	0.72	x	0.7	=	191.97	(76)

DER WorkSheet: New dwelling created by change of use

East	0.9x	1	x	1.44	x	115.77	x	0.72	x	0.7	=	58.23	(76)
East	0.9x	1	x	1.62	x	115.77	x	0.72	x	0.7	=	65.51	(76)
East	0.9x	3	x	1.62	x	115.77	x	0.72	x	0.7	=	196.52	(76)
East	0.9x	1	x	1.44	x	110.22	x	0.72	x	0.7	=	55.43	(76)
East	0.9x	1	x	1.62	x	110.22	x	0.72	x	0.7	=	62.36	(76)
East	0.9x	3	x	1.62	x	110.22	x	0.72	x	0.7	=	187.09	(76)
East	0.9x	1	x	1.44	x	94.68	x	0.72	x	0.7	=	47.62	(76)
East	0.9x	1	x	1.62	x	94.68	x	0.72	x	0.7	=	53.57	(76)
East	0.9x	3	x	1.62	x	94.68	x	0.72	x	0.7	=	160.71	(76)
East	0.9x	1	x	1.44	x	73.59	x	0.72	x	0.7	=	37.01	(76)
East	0.9x	1	x	1.62	x	73.59	x	0.72	x	0.7	=	41.64	(76)
East	0.9x	3	x	1.62	x	73.59	x	0.72	x	0.7	=	124.91	(76)
East	0.9x	1	x	1.44	x	45.59	x	0.72	x	0.7	=	22.93	(76)
East	0.9x	1	x	1.62	x	45.59	x	0.72	x	0.7	=	25.8	(76)
East	0.9x	3	x	1.62	x	45.59	x	0.72	x	0.7	=	77.39	(76)
East	0.9x	1	x	1.44	x	24.49	x	0.72	x	0.7	=	12.32	(76)
East	0.9x	1	x	1.62	x	24.49	x	0.72	x	0.7	=	13.86	(76)
East	0.9x	3	x	1.62	x	24.49	x	0.72	x	0.7	=	41.57	(76)
East	0.9x	1	x	1.44	x	16.15	x	0.72	x	0.7	=	8.12	(76)
East	0.9x	1	x	1.62	x	16.15	x	0.72	x	0.7	=	9.14	(76)
East	0.9x	3	x	1.62	x	16.15	x	0.72	x	0.7	=	27.42	(76)
West	0.9x	0.54	x	1.58	x	19.64	x	0.72	x	0.7	=	7.6	(80)
West	0.9x	0.77	x	0.9	x	19.64	x	0.72	x	0.7	=	6.17	(80)
West	0.9x	0.54	x	1.58	x	38.42	x	0.72	x	0.7	=	14.87	(80)
West	0.9x	0.77	x	0.9	x	38.42	x	0.72	x	0.7	=	12.08	(80)
West	0.9x	0.54	x	1.58	x	63.27	x	0.72	x	0.7	=	24.49	(80)
West	0.9x	0.77	x	0.9	x	63.27	x	0.72	x	0.7	=	19.89	(80)
West	0.9x	0.54	x	1.58	x	92.28	x	0.72	x	0.7	=	35.71	(80)
West	0.9x	0.77	x	0.9	x	92.28	x	0.72	x	0.7	=	29.01	(80)
West	0.9x	0.54	x	1.58	x	113.09	x	0.72	x	0.7	=	43.77	(80)
West	0.9x	0.77	x	0.9	x	113.09	x	0.72	x	0.7	=	35.55	(80)
West	0.9x	0.54	x	1.58	x	115.77	x	0.72	x	0.7	=	44.8	(80)
West	0.9x	0.77	x	0.9	x	115.77	x	0.72	x	0.7	=	36.39	(80)
West	0.9x	0.54	x	1.58	x	110.22	x	0.72	x	0.7	=	42.66	(80)
West	0.9x	0.77	x	0.9	x	110.22	x	0.72	x	0.7	=	34.65	(80)
West	0.9x	0.54	x	1.58	x	94.68	x	0.72	x	0.7	=	36.64	(80)
West	0.9x	0.77	x	0.9	x	94.68	x	0.72	x	0.7	=	29.76	(80)
West	0.9x	0.54	x	1.58	x	73.59	x	0.72	x	0.7	=	28.48	(80)
West	0.9x	0.77	x	0.9	x	73.59	x	0.72	x	0.7	=	23.13	(80)
West	0.9x	0.54	x	1.58	x	45.59	x	0.72	x	0.7	=	17.64	(80)
West	0.9x	0.77	x	0.9	x	45.59	x	0.72	x	0.7	=	14.33	(80)

DER WorkSheet: New dwelling created by change of use

West	0.9x	0.54	x	1.58	x	24.49	x	0.72	x	0.7	=	9.48	(80)
West	0.9x	0.77	x	0.9	x	24.49	x	0.72	x	0.7	=	7.7	(80)
West	0.9x	0.54	x	1.58	x	16.15	x	0.72	x	0.7	=	6.25	(80)
West	0.9x	0.77	x	0.9	x	16.15	x	0.72	x	0.7	=	5.08	(80)

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

(83)m=	85.67	166.8	276.45	411.62	515.59	533.59	505.56	426.18	323.77	198.05	106.59	70.65	(83)

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

(84)m=	478.72	556.93	651.59	763.43	843.91	839.6	797.84	725.63	635.9	533.72	468.9	452.54	(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=	1	1	0.99	0.97	0.91	0.79	0.65	0.71	0.91	0.98	1	1	(86)

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

(87)m=	18.95	19.14	19.5	20.03	20.48	20.82	20.94	20.91	20.64	20.06	19.46	18.98	(87)

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

(88)m=	19.46	19.47	19.48	19.54	19.55	19.6	19.6	19.61	19.58	19.55	19.53	19.5	(88)

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

(89)m=	1	0.99	0.98	0.95	0.87	0.68	0.47	0.54	0.84	0.97	0.99	1	(89)

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

(90)m=	17.65	17.84	18.2	18.76	19.2	19.51	19.58	19.58	19.37	18.81	18.2	17.71	(90)

fLA = Living area ÷ (4) = 0.39 (91)

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

(92)m=	18.15	18.35	18.71	19.25	19.69	20.02	20.11	20.1	19.87	19.29	18.69	18.21	(92)

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

(93)m=	18.15	18.35	18.71	19.25	19.69	20.02	20.11	20.1	19.87	19.29	18.69	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=	1	0.99	0.98	0.95	0.88	0.72	0.54	0.61	0.86	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	476.52	552.35	639.74	726.15	738.78	604.87	432.81	441.01	545.38	518.35	465.34	450.9	(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=	2024.95	1947.02	1750.43	1418.73	1085.64	706.14	457.26	478.23	763.4	1180.67	1602.29	1971.61	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1152.04	937.21	826.35	498.66	258.06	0	0	0	0	492.77	818.61	1131.4	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 6115.1 (98)

Space heating requirement in kWh/m²/year 76.09 (99)

DER WorkSheet: New dwelling created by change of use

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		88	(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)	1152.04	937.21	826.35	498.66	258.06	0	0	0	0	492.77	818.61	1131.4		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1309.13	1065.02	939.04	566.65	293.25	0	0	0	0	559.96	930.24	1285.69		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													6948.98	(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)	202.44	177.79	184.98	164.07	158.84	139.9	134.04	149.42	151.07	172.02	183.63	197.66		
Efficiency of water heater													88	(216)
(217)m=	88	88	88	88	88	88	88	88	88	88	88	88		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	230.04	202.03	210.2	186.44	180.5	158.98	152.31	169.79	171.67	195.48	208.67	224.61		
Total = Sum(219a)$_{1...12}$ =													2290.73	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			6948.98	
Water heating fuel used			2290.73	
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			440.97	(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	=	1500.98	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	494.8	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1995.78	(265)

DER WorkSheet: New dwelling created by change of use

Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	228.86	(268)
Total CO_2, kg/year		sum of (265)…(271) =		2263.57	(272)
Dwelling CO_2 Emission Rate		(272) ÷ (4) =		28.16	(273)
EI rating (section 14)				76	(274)

DER WorkSheet: New dwelling created by change of use

User Details:

Assessor Name:	John Simpson	**Stroma Number:**	STRO006273
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.7

Property Address: 301 TER

Address : 3.01, 25 Old Gloucester St, LONDON, WC1N 3AF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	80.6	(1a)	x	2.83	(2a)	=	228.1	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	80.6	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			228.1	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.88	(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) =	0.75	(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 created by change of use

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

0.96	0.94	0.92	0.82	0.81	0.71	0.71	0.69	0.75	0.81	0.84	0.88

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=	0.96	0.94	0.92	0.84	0.82	0.75	0.75	0.74	0.78	0.82	0.86	0.89	(24d)

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

(25)m=	0.96	0.94	0.92	0.84	0.82	0.75	0.75	0.74	0.78	0.82	0.86	0.89	(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	
Doors			2.1	x	1.8	=	3.78			(26)
Windows Type 1			1.58	x1/[1/(1.6)+ 0.04]		=	2.38			(27)
Windows Type 2			1.3	x1/[1/(1.6)+ 0.04]		=	1.95			(27)
Windows Type 3			1.02	x1/[1/(1.6)+ 0.04]		=	1.53			(27)
Windows Type 4			1.39	x1/[1/(1.6)+ 0.04]		=	2.09			(27)
Windows Type 5			1.02	x1/[1/(1.6)+ 0.04]		=	1.53			(27)
Windows Type 6			1.85	x1/[1/(1.6)+ 0.04]		=	2.78			(27)
Windows Type 7			0.9	x1/[1/(1.6)+ 0.04]		=	1.35			(27)
Walls Type1	58.5	9.74	48.76	x	0.3	=	14.63			(29)
Walls Type2	15.1	2.75	12.35	x	0.28	=	3.46			(29)
Walls Type3	12.7	2.1	10.6	x	0.28	=	2.97			(29)
Roof Type1	52.8	0	52.8	x	0.16	=	8.45			(30)
Roof Type2	27.8	0	27.8	x	0.18	=	5			(30)
Total area of elements, m²			166.9							(31)
Party wall			24.1	x	0.2	=	4.82			(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) = 61.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (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 | 25.04 | (36)

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

Total fabric heat loss | (33) + (36) = | 86.92 | (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=	71.99	70.65	69.35	63.2	62.06	56.71	56.71	55.72	58.77	62.06	64.38	66.81	(38)

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

(39)m=	158.91	157.58	156.27	150.13	148.98	143.63	143.63	142.64	145.69	148.98	151.3	153.73	

Average = Sum(39)$_{1…12}$ /12= | 150.12 | (39)

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

(40)m=	1.97	1.96	1.94	1.86	1.85	1.78	1.78	1.77	1.81	1.85	1.88	1.91	

Average = Sum(40)$_{1…12}$ /12= | 1.86 | (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 | 2.47 | (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 | 92.96 | (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)

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=	102.26	98.54	94.82	91.1	87.38	83.66	83.66	87.38	91.1	94.82	98.54	102.26	

Total = Sum(44)$_{1…12}$ = | 1115.53 | (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=	151.64	132.63	136.86	119.32	114.49	98.8	91.55	105.05	106.31	123.89	135.24	146.86	

Total = Sum(45)$_{1…12}$ = | 1462.64 | (45)

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

(46)m=	22.75	19.89	20.53	17.9	17.17	14.82	13.73	15.76	15.95	18.58	20.29	22.03	(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)

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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	45.35	48.32	44.93	44.53	41.26	42.63	44.53	44.93	48.32	48.59	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=	202.6	177.98	185.18	164.25	159.02	140.06	134.18	149.58	151.24	172.21	183.83	197.82	(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=	202.6	177.98	185.18	164.25	159.02	140.06	134.18	149.58	151.24	172.21	183.83	197.82	

Output from water heater (annual)$_{1...12}$ — 2017.95 (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=	63.16	55.44	57.59	50.91	49.2	43.16	41.1	46.06	46.58	53.27	57.12	61.57	(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=	123.71	123.71	123.71	123.71	123.71	123.71	123.71	123.71	123.71	123.71	123.71	123.71	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	25.95	23.05	18.75	14.19	10.61	8.96	9.68	12.58	16.89	21.44	25.02	26.68	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	220.69	222.98	217.21	204.92	189.42	174.84	165.1	162.81	168.58	180.87	196.38	210.95	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	35.37	35.37	35.37	35.37	35.37	35.37	35.37	35.37	35.37	35.37	35.37	35.37	(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=	-98.97	-98.97	-98.97	-98.97	-98.97	-98.97	-98.97	-98.97	-98.97	-98.97	-98.97	-98.97	(71)
Water heating gains (Table 5)													
(72)m=	84.89	82.5	77.4	70.7	66.13	59.95	55.24	61.91	64.69	71.6	79.33	82.76	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	394.65	391.64	376.47	352.93	329.27	306.86	293.13	300.42	313.27	337.03	363.84	383.5	(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 created by change of use

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.3	x	10.63	x	0.72	x	0.7	=	4.83	(74)
North	0.9x	0.77	x	1.85	x	10.63	x	0.72	x	0.7	=	6.87	(74)
North	0.9x	0.77	x	1.3	x	20.32	x	0.72	x	0.7	=	9.23	(74)
North	0.9x	0.77	x	1.85	x	20.32	x	0.72	x	0.7	=	13.13	(74)
North	0.9x	0.77	x	1.3	x	34.53	x	0.72	x	0.7	=	15.68	(74)
North	0.9x	0.77	x	1.85	x	34.53	x	0.72	x	0.7	=	22.31	(74)
North	0.9x	0.77	x	1.3	x	55.46	x	0.72	x	0.7	=	25.18	(74)
North	0.9x	0.77	x	1.85	x	55.46	x	0.72	x	0.7	=	35.84	(74)
North	0.9x	0.77	x	1.3	x	74.72	x	0.72	x	0.7	=	33.92	(74)
North	0.9x	0.77	x	1.85	x	74.72	x	0.72	x	0.7	=	48.28	(74)
North	0.9x	0.77	x	1.3	x	79.99	x	0.72	x	0.7	=	36.32	(74)
North	0.9x	0.77	x	1.85	x	79.99	x	0.72	x	0.7	=	51.68	(74)
North	0.9x	0.77	x	1.3	x	74.68	x	0.72	x	0.7	=	33.91	(74)
North	0.9x	0.77	x	1.85	x	74.68	x	0.72	x	0.7	=	48.25	(74)
North	0.9x	0.77	x	1.3	x	59.25	x	0.72	x	0.7	=	26.9	(74)
North	0.9x	0.77	x	1.85	x	59.25	x	0.72	x	0.7	=	38.28	(74)
North	0.9x	0.77	x	1.3	x	41.52	x	0.72	x	0.7	=	18.85	(74)
North	0.9x	0.77	x	1.85	x	41.52	x	0.72	x	0.7	=	26.83	(74)
North	0.9x	0.77	x	1.3	x	24.19	x	0.72	x	0.7	=	10.98	(74)
North	0.9x	0.77	x	1.85	x	24.19	x	0.72	x	0.7	=	15.63	(74)
North	0.9x	0.77	x	1.3	x	13.12	x	0.72	x	0.7	=	5.96	(74)
North	0.9x	0.77	x	1.85	x	13.12	x	0.72	x	0.7	=	8.48	(74)
North	0.9x	0.77	x	1.3	x	8.86	x	0.72	x	0.7	=	4.02	(74)
North	0.9x	0.77	x	1.85	x	8.86	x	0.72	x	0.7	=	5.73	(74)
East	0.9x	2	x	1.02	x	19.64	x	0.72	x	0.7	=	13.99	(76)
East	0.9x	2	x	1.39	x	19.64	x	0.72	x	0.7	=	19.07	(76)
East	0.9x	2	x	1.02	x	19.64	x	0.72	x	0.7	=	13.99	(76)
East	0.9x	2	x	1.02	x	38.42	x	0.72	x	0.7	=	27.38	(76)
East	0.9x	2	x	1.39	x	38.42	x	0.72	x	0.7	=	37.31	(76)
East	0.9x	2	x	1.02	x	38.42	x	0.72	x	0.7	=	27.38	(76)
East	0.9x	2	x	1.02	x	63.27	x	0.72	x	0.7	=	45.08	(76)
East	0.9x	2	x	1.39	x	63.27	x	0.72	x	0.7	=	61.44	(76)
East	0.9x	2	x	1.02	x	63.27	x	0.72	x	0.7	=	45.08	(76)
East	0.9x	2	x	1.02	x	92.28	x	0.72	x	0.7	=	65.75	(76)
East	0.9x	2	x	1.39	x	92.28	x	0.72	x	0.7	=	89.6	(76)
East	0.9x	2	x	1.02	x	92.28	x	0.72	x	0.7	=	65.75	(76)
East	0.9x	2	x	1.02	x	113.09	x	0.72	x	0.7	=	80.58	(76)
East	0.9x	2	x	1.39	x	113.09	x	0.72	x	0.7	=	109.81	(76)
East	0.9x	2	x	1.02	x	113.09	x	0.72	x	0.7	=	80.58	(76)

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East	0.9x	2	x	1.02	x	115.77	x	0.72	x	0.7	=	82.49	(76)
East	0.9x	2	x	1.39	x	115.77	x	0.72	x	0.7	=	112.41	(76)
East	0.9x	2	x	1.02	x	115.77	x	0.72	x	0.7	=	82.49	(76)
East	0.9x	2	x	1.02	x	110.22	x	0.72	x	0.7	=	78.53	(76)
East	0.9x	2	x	1.39	x	110.22	x	0.72	x	0.7	=	107.02	(76)
East	0.9x	2	x	1.02	x	110.22	x	0.72	x	0.7	=	78.53	(76)
East	0.9x	2	x	1.02	x	94.68	x	0.72	x	0.7	=	67.46	(76)
East	0.9x	2	x	1.39	x	94.68	x	0.72	x	0.7	=	91.93	(76)
East	0.9x	2	x	1.02	x	94.68	x	0.72	x	0.7	=	67.46	(76)
East	0.9x	2	x	1.02	x	73.59	x	0.72	x	0.7	=	52.43	(76)
East	0.9x	2	x	1.39	x	73.59	x	0.72	x	0.7	=	71.45	(76)
East	0.9x	2	x	1.02	x	73.59	x	0.72	x	0.7	=	52.43	(76)
East	0.9x	2	x	1.02	x	45.59	x	0.72	x	0.7	=	32.48	(76)
East	0.9x	2	x	1.39	x	45.59	x	0.72	x	0.7	=	44.27	(76)
East	0.9x	2	x	1.02	x	45.59	x	0.72	x	0.7	=	32.48	(76)
East	0.9x	2	x	1.02	x	24.49	x	0.72	x	0.7	=	17.45	(76)
East	0.9x	2	x	1.39	x	24.49	x	0.72	x	0.7	=	23.78	(76)
East	0.9x	2	x	1.02	x	24.49	x	0.72	x	0.7	=	17.45	(76)
East	0.9x	2	x	1.02	x	16.15	x	0.72	x	0.7	=	11.51	(76)
East	0.9x	2	x	1.39	x	16.15	x	0.72	x	0.7	=	15.68	(76)
East	0.9x	2	x	1.02	x	16.15	x	0.72	x	0.7	=	11.51	(76)
West	0.9x	0.54	x	1.58	x	19.64	x	0.72	x	0.7	=	7.6	(80)
West	0.9x	0.77	x	0.9	x	19.64	x	0.72	x	0.7	=	6.17	(80)
West	0.9x	0.54	x	1.58	x	38.42	x	0.72	x	0.7	=	14.87	(80)
West	0.9x	0.77	x	0.9	x	38.42	x	0.72	x	0.7	=	12.08	(80)
West	0.9x	0.54	x	1.58	x	63.27	x	0.72	x	0.7	=	24.49	(80)
West	0.9x	0.77	x	0.9	x	63.27	x	0.72	x	0.7	=	19.89	(80)
West	0.9x	0.54	x	1.58	x	92.28	x	0.72	x	0.7	=	35.71	(80)
West	0.9x	0.77	x	0.9	x	92.28	x	0.72	x	0.7	=	29.01	(80)
West	0.9x	0.54	x	1.58	x	113.09	x	0.72	x	0.7	=	43.77	(80)
West	0.9x	0.77	x	0.9	x	113.09	x	0.72	x	0.7	=	35.55	(80)
West	0.9x	0.54	x	1.58	x	115.77	x	0.72	x	0.7	=	44.8	(80)
West	0.9x	0.77	x	0.9	x	115.77	x	0.72	x	0.7	=	36.39	(80)
West	0.9x	0.54	x	1.58	x	110.22	x	0.72	x	0.7	=	42.66	(80)
West	0.9x	0.77	x	0.9	x	110.22	x	0.72	x	0.7	=	34.65	(80)
West	0.9x	0.54	x	1.58	x	94.68	x	0.72	x	0.7	=	36.64	(80)
West	0.9x	0.77	x	0.9	x	94.68	x	0.72	x	0.7	=	29.76	(80)
West	0.9x	0.54	x	1.58	x	73.59	x	0.72	x	0.7	=	28.48	(80)
West	0.9x	0.77	x	0.9	x	73.59	x	0.72	x	0.7	=	23.13	(80)
West	0.9x	0.54	x	1.58	x	45.59	x	0.72	x	0.7	=	17.64	(80)
West	0.9x	0.77	x	0.9	x	45.59	x	0.72	x	0.7	=	14.33	(80)

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West	0.9x	0.54	x	1.58	x	24.49	x	0.72	x	0.7	=	9.48	(80)
West	0.9x	0.77	x	0.9	x	24.49	x	0.72	x	0.7	=	7.7	(80)
West	0.9x	0.54	x	1.58	x	16.15	x	0.72	x	0.7	=	6.25	(80)
West	0.9x	0.77	x	0.9	x	16.15	x	0.72	x	0.7	=	5.08	(80)

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

(83)m=	72.53	141.36	233.97	346.85	432.49	446.58	423.55	358.43	273.61	167.82	90.28	59.78	(83)

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

(84)m=	467.18	533	610.44	699.78	761.76	753.44	716.68	658.85	586.88	504.85	454.12	443.28	(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	0.98	0.94	0.85	0.73	0.78	0.93	0.99	1	1	(86)

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

(87)m=	18.78	18.96	19.31	19.83	20.31	20.71	20.89	20.85	20.52	19.91	19.3	18.81	(87)

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

(88)m=	19.35	19.36	19.37	19.43	19.44	19.48	19.48	19.49	19.46	19.44	19.42	19.4	(88)

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

(89)m=	1	0.99	0.99	0.97	0.91	0.75	0.54	0.61	0.88	0.98	0.99	1	(89)

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

(90)m=	17.4	17.59	17.94	18.49	18.96	19.34	19.46	19.45	19.19	18.59	17.96	17.46	(90)

fLA = Living area ÷ (4) = | 0.39 | (91)

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

(92)m=	17.94	18.12	18.47	19.01	19.48	19.87	20.01	19.99	19.7	19.1	18.48	17.98	(92)

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

(93)m=	17.94	18.12	18.47	19.01	19.48	19.87	20.01	19.99	19.7	19.1	18.48	17.98	(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	0.96	0.91	0.78	0.62	0.68	0.89	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	465.03	528.97	601.11	673.6	691.14	591.08	442.01	445.55	521.45	492.56	450.82	441.63	(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=	2166.75	2082.89	1870.36	1518.1	1159.2	757.3	489.68	512.38	816.5	1266.29	1722.05	2118.4	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1266.08	1044.24	944.32	608.04	348.23	0	0	0	0	575.66	915.29	1247.52	

Total per year (kWh/year) = Sum(98)1…5,9…12 = | 6949.37 | (98)

Space heating requirement in kWh/m²/year | 86.22 | (99)

DER WorkSheet: New dwelling created by change of use

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		88	(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)	1266.08	1044.24	944.32	608.04	348.23	0	0	0	0	575.66	915.29	1247.52		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1438.73	1186.63	1073.09	690.95	395.72	0	0	0	0	654.16	1040.1	1417.63		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													7897.02	(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)	202.6	177.98	185.18	164.25	159.02	140.06	134.18	149.58	151.24	172.21	183.83	197.82		
Efficiency of water heater													88	(216)
(217)m=	88	88	88	88	88	88	88	88	88	88	88	88		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	230.23	202.25	210.43	186.64	180.7	159.15	152.48	169.98	171.86	195.69	208.9	224.79		
Total = Sum(219a)$_{1...12}$ =													2293.13	(219)

Annual totals

		kWh/year	kWh/year	
Space heating fuel used, main system 1			7897.02	
Water heating fuel used			2293.13	
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			458.37	(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	=	1705.76	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	495.32	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2201.07	(265)

DER WorkSheet: New dwelling created by change of use

Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	237.89	(268)
Total CO_2, kg/year		sum of (265)…(271) =		2477.89	(272)
Dwelling CO_2 Emission Rate		(272) ÷ (4) =		30.74	(273)
EI rating (section 14)				74	(274)

14 Appendix C – Energy Efficient Worksheets

The following DER Worksheets are taken from the SAP 2012 software for each dwelling in accordance with current London Plan policy – these are following inclusion of the energy efficiency measures, but before inclusion of the photovoltaic systems proposed.

DER WorkSheet: New dwelling created by change of use

User Details:

Assessor Name:	John Simpson	**Stroma Number:**	STRO006273
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.7

Property Address: 101

Address : 1.01, 25 Old Gloucester St, LONDON, WC1N 3AF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	65.6	(1a)	x	3	(2a)	=	196.8	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	65.6	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	196.8	(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) =	0.15	(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

	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 created by change of use

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=	0.6	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=	0.6	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	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			1.58	x1/[1/(1.4)+ 0.04]		=	2.09			(27)
Windows Type 2			1.5	x1/[1/(1.4)+ 0.04]		=	1.99			(27)
Windows Type 3			2.2	x1/[1/(1.4)+ 0.04]		=	2.92			(27)
Windows Type 4			1.8	x1/[1/(1.4)+ 0.04]		=	2.39			(27)
Windows Type 5			1.8	x1/[1/(1.4)+ 0.04]		=	2.39			(27)
Windows Type 6			1.85	x1/[1/(1.4)+ 0.04]		=	2.45			(27)
Floor			65.6	x	0.2	=	13.12			(28)
Walls Type1	52.3	12.48	39.82	x	0.26	=	10.35			(29)
Walls Type2	10.1	1.85	8.25	x	0.18	=	1.49			(29)
Walls Type3	22.2	2.1	20.1	x	0.26	=	5.23			(29)
Walls Type4	12.6	0	12.6	x	0.18	=	2.27			(29)
Total area of elements, m²			162.8							(31)
Party wall			16.3	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) = 54.39 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (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 | 24.42 | (36)

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

Total fabric heat loss (33) + (36) = | 78.81 | (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=	38.65	38.41	38.17	37.07	36.86	35.9	35.9	35.72	36.27	36.86	37.28	37.72	(38)

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

(39)m=	117.46	117.22	116.98	115.88	115.67	114.71	114.71	114.53	115.08	115.67	116.09	116.53	

Average = Sum(39)$_{1…12}$ /12= | 115.88 | (39)

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

(40)m=	1.79	1.79	1.78	1.77	1.76	1.75	1.75	1.75	1.75	1.76	1.77	1.78	

Average = Sum(40)$_{1…12}$ /12= | 1.77 | (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 | 2.13 | (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 | 84.9 | (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=	93.39	89.99	86.6	83.2	79.81	76.41	76.41	79.81	83.2	86.6	89.99	93.39	
										Total = Sum(44)$_{1…12}$ =		1018.81	(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=	138.5	121.13	124.99	108.97	104.56	90.23	83.61	95.94	97.09	113.15	123.51	134.13	
										Total = Sum(45)$_{1…12}$ =		1335.82	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.77	18.17	18.75	16.35	15.68	13.53	12.54	14.39	14.56	16.97	18.53	20.12	(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)

DER WorkSheet: New dwelling created by change of use

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=	193.77	171.06	180.27	162.47	159.84	143.72	138.89	151.22	150.58	168.43	177.01	189.4	(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=	193.77	171.06	180.27	162.47	159.84	143.72	138.89	151.22	150.58	168.43	177.01	189.4	

Output from water heater (annual)$_{1...12}$ 1986.66 (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=	90.27	80.22	85.78	79.03	78.99	72.8	72.02	76.12	75.08	81.84	83.86	88.82	(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=	106.74	106.74	106.74	106.74	106.74	106.74	106.74	106.74	106.74	106.74	106.74	106.74	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	16.68	14.82	12.05	9.12	6.82	5.76	6.22	8.09	10.85	13.78	16.08	17.15	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	186.82	188.76	183.87	173.47	160.34	148.01	139.76	137.82	142.71	153.11	166.24	178.58	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.67	33.67	33.67	33.67	33.67	33.67	33.67	33.67	33.67	33.67	33.67	33.67	(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=	-85.39	-85.39	-85.39	-85.39	-85.39	-85.39	-85.39	-85.39	-85.39	-85.39	-85.39	-85.39	(71)
Water heating gains (Table 5)													
(72)m=	121.33	119.37	115.3	109.76	106.17	101.11	96.8	102.32	104.27	110	116.48	119.38	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	379.85	377.97	366.24	347.38	328.35	309.89	297.81	303.25	312.86	331.92	353.82	370.12	(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 created by change of use

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.5	x	10.63	x	0.72	x	0.7	=	5.57	(74)
North	0.9x	0.77	x	1.85	x	10.63	x	0.72	x	0.7	=	6.87	(74)
North	0.9x	0.77	x	1.5	x	20.32	x	0.72	x	0.7	=	10.65	(74)
North	0.9x	0.77	x	1.85	x	20.32	x	0.72	x	0.7	=	13.13	(74)
North	0.9x	0.77	x	1.5	x	34.53	x	0.72	x	0.7	=	18.09	(74)
North	0.9x	0.77	x	1.85	x	34.53	x	0.72	x	0.7	=	22.31	(74)
North	0.9x	0.77	x	1.5	x	55.46	x	0.72	x	0.7	=	29.06	(74)
North	0.9x	0.77	x	1.85	x	55.46	x	0.72	x	0.7	=	35.84	(74)
North	0.9x	0.77	x	1.5	x	74.72	x	0.72	x	0.7	=	39.14	(74)
North	0.9x	0.77	x	1.85	x	74.72	x	0.72	x	0.7	=	48.28	(74)
North	0.9x	0.77	x	1.5	x	79.99	x	0.72	x	0.7	=	41.9	(74)
North	0.9x	0.77	x	1.85	x	79.99	x	0.72	x	0.7	=	51.68	(74)
North	0.9x	0.77	x	1.5	x	74.68	x	0.72	x	0.7	=	39.12	(74)
North	0.9x	0.77	x	1.85	x	74.68	x	0.72	x	0.7	=	48.25	(74)
North	0.9x	0.77	x	1.5	x	59.25	x	0.72	x	0.7	=	31.04	(74)
North	0.9x	0.77	x	1.85	x	59.25	x	0.72	x	0.7	=	38.28	(74)
North	0.9x	0.77	x	1.5	x	41.52	x	0.72	x	0.7	=	21.75	(74)
North	0.9x	0.77	x	1.85	x	41.52	x	0.72	x	0.7	=	26.83	(74)
North	0.9x	0.77	x	1.5	x	24.19	x	0.72	x	0.7	=	12.67	(74)
North	0.9x	0.77	x	1.85	x	24.19	x	0.72	x	0.7	=	15.63	(74)
North	0.9x	0.77	x	1.5	x	13.12	x	0.72	x	0.7	=	6.87	(74)
North	0.9x	0.77	x	1.85	x	13.12	x	0.72	x	0.7	=	8.48	(74)
North	0.9x	0.77	x	1.5	x	8.86	x	0.72	x	0.7	=	4.64	(74)
North	0.9x	0.77	x	1.85	x	8.86	x	0.72	x	0.7	=	5.73	(74)
East	0.9x	1	x	2.2	x	19.64	x	0.72	x	0.7	=	15.09	(76)
East	0.9x	1	x	1.8	x	19.64	x	0.72	x	0.7	=	12.35	(76)
East	0.9x	3	x	1.8	x	19.64	x	0.72	x	0.7	=	37.04	(76)
East	0.9x	1	x	2.2	x	38.42	x	0.72	x	0.7	=	29.52	(76)
East	0.9x	1	x	1.8	x	38.42	x	0.72	x	0.7	=	24.15	(76)
East	0.9x	3	x	1.8	x	38.42	x	0.72	x	0.7	=	72.46	(76)
East	0.9x	1	x	2.2	x	63.27	x	0.72	x	0.7	=	48.62	(76)
East	0.9x	1	x	1.8	x	63.27	x	0.72	x	0.7	=	39.78	(76)
East	0.9x	3	x	1.8	x	63.27	x	0.72	x	0.7	=	119.34	(76)
East	0.9x	1	x	2.2	x	92.28	x	0.72	x	0.7	=	70.91	(76)
East	0.9x	1	x	1.8	x	92.28	x	0.72	x	0.7	=	58.02	(76)
East	0.9x	3	x	1.8	x	92.28	x	0.72	x	0.7	=	174.05	(76)
East	0.9x	1	x	2.2	x	113.09	x	0.72	x	0.7	=	86.9	(76)
East	0.9x	1	x	1.8	x	113.09	x	0.72	x	0.7	=	71.1	(76)
East	0.9x	3	x	1.8	x	113.09	x	0.72	x	0.7	=	213.3	(76)

East	0.9x	1	x	2.2	x	115.77	x	0.72	x	0.7	=	88.96	(76)
East	0.9x	1	x	1.8	x	115.77	x	0.72	x	0.7	=	72.78	(76)
East	0.9x	3	x	1.8	x	115.77	x	0.72	x	0.7	=	218.35	(76)
East	0.9x	1	x	2.2	x	110.22	x	0.72	x	0.7	=	84.69	(76)
East	0.9x	1	x	1.8	x	110.22	x	0.72	x	0.7	=	69.29	(76)
East	0.9x	3	x	1.8	x	110.22	x	0.72	x	0.7	=	207.88	(76)
East	0.9x	1	x	2.2	x	94.68	x	0.72	x	0.7	=	72.75	(76)
East	0.9x	1	x	1.8	x	94.68	x	0.72	x	0.7	=	59.52	(76)
East	0.9x	3	x	1.8	x	94.68	x	0.72	x	0.7	=	178.57	(76)
East	0.9x	1	x	2.2	x	73.59	x	0.72	x	0.7	=	56.55	(76)
East	0.9x	1	x	1.8	x	73.59	x	0.72	x	0.7	=	46.26	(76)
East	0.9x	3	x	1.8	x	73.59	x	0.72	x	0.7	=	138.79	(76)
East	0.9x	1	x	2.2	x	45.59	x	0.72	x	0.7	=	35.03	(76)
East	0.9x	1	x	1.8	x	45.59	x	0.72	x	0.7	=	28.66	(76)
East	0.9x	3	x	1.8	x	45.59	x	0.72	x	0.7	=	85.98	(76)
East	0.9x	1	x	2.2	x	24.49	x	0.72	x	0.7	=	18.82	(76)
East	0.9x	1	x	1.8	x	24.49	x	0.72	x	0.7	=	15.4	(76)
East	0.9x	3	x	1.8	x	24.49	x	0.72	x	0.7	=	46.19	(76)
East	0.9x	1	x	2.2	x	16.15	x	0.72	x	0.7	=	12.41	(76)
East	0.9x	1	x	1.8	x	16.15	x	0.72	x	0.7	=	10.15	(76)
East	0.9x	3	x	1.8	x	16.15	x	0.72	x	0.7	=	30.46	(76)
West	0.9x	0.54	x	1.58	x	19.64	x	0.72	x	0.7	=	7.6	(80)
West	0.9x	0.54	x	1.58	x	38.42	x	0.72	x	0.7	=	14.87	(80)
West	0.9x	0.54	x	1.58	x	63.27	x	0.72	x	0.7	=	24.49	(80)
West	0.9x	0.54	x	1.58	x	92.28	x	0.72	x	0.7	=	35.71	(80)
West	0.9x	0.54	x	1.58	x	113.09	x	0.72	x	0.7	=	43.77	(80)
West	0.9x	0.54	x	1.58	x	115.77	x	0.72	x	0.7	=	44.8	(80)
West	0.9x	0.54	x	1.58	x	110.22	x	0.72	x	0.7	=	42.66	(80)
West	0.9x	0.54	x	1.58	x	94.68	x	0.72	x	0.7	=	36.64	(80)
West	0.9x	0.54	x	1.58	x	73.59	x	0.72	x	0.7	=	28.48	(80)
West	0.9x	0.54	x	1.58	x	45.59	x	0.72	x	0.7	=	17.64	(80)
West	0.9x	0.54	x	1.58	x	24.49	x	0.72	x	0.7	=	9.48	(80)
West	0.9x	0.54	x	1.58	x	16.15	x	0.72	x	0.7	=	6.25	(80)

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

(83)m=	84.52	164.79	272.63	403.58	502.49	518.49	491.9	416.8	318.66	195.62	105.23	69.65	(83)

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

(84)m=	464.38	542.75	638.87	750.96	830.84	828.37	789.7	720.04	631.52	527.54	459.04	439.77	(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=	1	0.99	0.98	0.95	0.87	0.74	0.59	0.65	0.86	0.97	0.99	1	(86)

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

(87)m=	19.08	19.27	19.63	20.11	20.55	20.84	20.95	20.92	20.68	20.11	19.51	19.05	(87)

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

(88)m=	19.48	19.48	19.48	19.49	19.5	19.51	19.51	19.51	19.5	19.5	19.49	19.49	(88)

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

(89)m=	0.99	0.99	0.97	0.93	0.81	0.62	0.41	0.47	0.78	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=	17.78	17.98	18.33	18.81	19.21	19.44	19.5	19.49	19.33	18.82	18.22	17.76	(90)

fLA = Living area ÷ (4) = 0.37 (91)

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

(92)m=	18.26	18.45	18.8	19.29	19.7	19.95	20.03	20.01	19.83	19.29	18.69	18.23	(92)

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

(93)m=	18.26	18.45	18.8	19.29	19.7	19.95	20.03	20.01	19.83	19.29	18.69	18.23	(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	0.82	0.66	0.48	0.54	0.8	0.95	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	460.75	535.14	619.26	693.23	684.4	542.83	376.83	388.63	505.7	502.04	452.82	436.94	(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=	1639.23	1588.07	1439.4	1203.43	924.92	613.62	392.94	413.84	658.89	1005.28	1345.97	1634.89	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	876.79	707.57	610.19	367.34	178.95	0	0	0	0	374.41	643.07	891.27	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4649.58 (98)

Space heating requirement in kWh/m²/year 70.88 (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 boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1.05	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating	**kWh/year**
Annual space heating requirement	4649.58

DER WorkSheet: New dwelling created by change of use

Space heat from Community boilers	(98) x (304a) x (305) x (306) =	5126.17	(307a)
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		1986.66	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2190.29	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	73.16	(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		0	(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) =	0	(331)
Energy for lighting (calculated in Appendix L)		294.6	(332)

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				91	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	1736.65	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	37.97	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	1774.63	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				1774.63	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	152.9	(379)
Total CO2, kg/year	sum of (376)…(382) =				1927.53	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				29.38	(384)
EI rating (section 14)					76.65	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	John Simpson	**Stroma Number:**	STRO006273
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.7

Property Address: 102

Address : 1.02, 25 Old Gloucester St, LONDON, WC1N 3AF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	88.5	(1a) x	2.5	(2a) =	221.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	88.5	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	221.25	(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) =	0.09	(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		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.29	(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) =	0.25	(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

0.31	0.31	0.3	0.27	0.27	0.23	0.23	0.23	0.25	0.27	0.28	0.29

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=	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54	(24d)

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

(25)m=	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54	(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	
Doors			2.1	x	1.8	=	3.78			(26)
Windows Type 1			3.15	x1/[1/(1.6)+ 0.04]		=	4.74			(27)
Windows Type 2			0.78	x1/[1/(1.6)+ 0.04]		=	1.17			(27)
Windows Type 3			1.6	x1/[1/(1.6)+ 0.04]		=	2.41			(27)
Windows Type 4			1.6	x1/[1/(1.6)+ 0.04]		=	2.41			(27)
Windows Type 5			2.25	x1/[1/(1.6)+ 0.04]		=	3.38			(27)
Floor Type 1			85.4	x	0.15	=	12.81			(28)
Floor Type 2			3.1	x	0.15	=	0.465			(28)
Walls Type1	85.1	13.88	71.22	x	0.18	=	12.82			(29)
Walls Type2	13.7	2.1	11.6	x	0.18	=	2.09			(29)
Roof	5	0	5	x	0.15	=	0.75			(30)
Total area of elements, m²			192.3							(31)
Party wall			16.3	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) = 53.58 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (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 15.2 (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) = 68.79 (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=	40.12	39.98	39.84	39.2	39.08	38.51	38.51	38.41	38.73	39.08	39.32	39.58	(38)

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

(39)m=	108.91	108.77	108.63	107.99	107.86	107.3	107.3	107.2	107.52	107.86	108.11	108.36	

Average = $Sum(39)_{1...12}$ /12= 107.98 (39)

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

(40)m=	1.23	1.23	1.23	1.22	1.22	1.21	1.21	1.21	1.21	1.22	1.22	1.22	

Average = $Sum(40)_{1...12}$ /12= 1.22 (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 2.6 (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 96.06 (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=	105.67	101.82	97.98	94.14	90.3	86.45	86.45	90.3	94.14	97.98	101.82	105.67

Total = $Sum(44)_{1...12}$ = 1152.72 (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=	156.7	137.05	141.42	123.3	118.31	102.09	94.6	108.56	109.85	128.02	139.75	151.76

Total = $Sum(45)_{1...12}$ = 1511.4 (45)

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

(46)m=	23.5	20.56	21.21	18.49	17.75	15.31	14.19	16.28	16.48	19.2	20.96	22.76	(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=	15.27	13.8	15.27	14.78	15.27	14.78	15.27	15.27	14.78	15.27	14.78	15.27	(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=	171.97	150.85	156.7	138.08	133.58	116.87	109.87	123.83	124.63	143.3	154.53	167.03	(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=	171.97	150.85	156.7	138.08	133.58	116.87	109.87	123.83	124.63	143.3	154.53	167.03

Output from water heater (annual)$_{1...12}$ 1691.24 (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=	55.92	49.02	50.84	44.69	43.16	37.64	35.27	39.91	40.22	46.39	50.16	54.28	(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=	130.23	130.23	130.23	130.23	130.23	130.23	130.23	130.23	130.23	130.23	130.23	130.23	(66)

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

(67)m=	22.11	19.64	15.97	12.09	9.04	7.63	8.25	10.72	14.39	18.27	21.32	22.73	(67)

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

(68)m=	236.29	238.74	232.56	219.41	202.81	187.2	176.77	174.32	180.5	193.65	210.26	225.87	(68)

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

(69)m=	36.02	36.02	36.02	36.02	36.02	36.02	36.02	36.02	36.02	36.02	36.02	36.02	(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=	-104.19	-104.19	-104.19	-104.19	-104.19	-104.19	-104.19	-104.19	-104.19	-104.19	-104.19	-104.19	(71)

Water heating gains (Table 5)

(72)m=	75.16	72.94	68.34	62.07	58	52.28	47.41	53.65	55.86	62.35	69.67	72.95	(72)

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

(73)m=	398.64	396.4	381.94	358.64	334.92	312.18	297.5	303.76	315.82	339.34	366.32	386.62	(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)	
Northeast	0.9x	0.77	x	2.25	x	11.28	x	0.72	x	0.7	=	26.6	(75)
Northeast	0.9x	0.77	x	2.25	x	22.97	x	0.72	x	0.7	=	54.15	(75)
Northeast	0.9x	0.77	x	2.25	x	41.38	x	0.72	x	0.7	=	97.55	(75)
Northeast	0.9x	0.77	x	2.25	x	67.96	x	0.72	x	0.7	=	160.21	(75)
Northeast	0.9x	0.77	x	2.25	x	91.35	x	0.72	x	0.7	=	215.36	(75)
Northeast	0.9x	0.77	x	2.25	x	97.38	x	0.72	x	0.7	=	229.59	(75)
Northeast	0.9x	0.77	x	2.25	x	91.1	x	0.72	x	0.7	=	214.78	(75)
Northeast	0.9x	0.77	x	2.25	x	72.63	x	0.72	x	0.7	=	171.22	(75)
Northeast	0.9x	0.77	x	2.25	x	50.42	x	0.72	x	0.7	=	118.87	(75)
Northeast	0.9x	0.77	x	2.25	x	28.07	x	0.72	x	0.7	=	66.17	(75)
Northeast	0.9x	0.77	x	2.25	x	14.2	x	0.72	x	0.7	=	33.47	(75)
Northeast	0.9x	0.77	x	2.25	x	9.21	x	0.72	x	0.7	=	21.72	(75)
East	0.9x	1	x	3.15	x	19.64	x	0.72	x	0.7	=	21.61	(76)
East	0.9x	1	x	0.78	x	19.64	x	0.72	x	0.7	=	3.75	(76)
East	0.9x	1	x	3.15	x	38.42	x	0.72	x	0.7	=	42.27	(76)
East	0.9x	1	x	0.78	x	38.42	x	0.72	x	0.7	=	7.34	(76)
East	0.9x	1	x	3.15	x	63.27	x	0.72	x	0.7	=	69.61	(76)
East	0.9x	1	x	0.78	x	63.27	x	0.72	x	0.7	=	12.09	(76)
East	0.9x	1	x	3.15	x	92.28	x	0.72	x	0.7	=	101.53	(76)
East	0.9x	1	x	0.78	x	92.28	x	0.72	x	0.7	=	17.63	(76)
East	0.9x	1	x	3.15	x	113.09	x	0.72	x	0.7	=	124.43	(76)
East	0.9x	1	x	0.78	x	113.09	x	0.72	x	0.7	=	21.61	(76)
East	0.9x	1	x	3.15	x	115.77	x	0.72	x	0.7	=	127.37	(76)
East	0.9x	1	x	0.78	x	115.77	x	0.72	x	0.7	=	22.12	(76)
East	0.9x	1	x	3.15	x	110.22	x	0.72	x	0.7	=	121.26	(76)
East	0.9x	1	x	0.78	x	110.22	x	0.72	x	0.7	=	21.06	(76)
East	0.9x	1	x	3.15	x	94.68	x	0.72	x	0.7	=	104.16	(76)
East	0.9x	1	x	0.78	x	94.68	x	0.72	x	0.7	=	18.09	(76)
East	0.9x	1	x	3.15	x	73.59	x	0.72	x	0.7	=	80.96	(76)
East	0.9x	1	x	0.78	x	73.59	x	0.72	x	0.7	=	14.06	(76)
East	0.9x	1	x	3.15	x	45.59	x	0.72	x	0.7	=	50.16	(76)
East	0.9x	1	x	0.78	x	45.59	x	0.72	x	0.7	=	8.71	(76)
East	0.9x	1	x	3.15	x	24.49	x	0.72	x	0.7	=	26.94	(76)
East	0.9x	1	x	0.78	x	24.49	x	0.72	x	0.7	=	4.68	(76)
East	0.9x	1	x	3.15	x	16.15	x	0.72	x	0.7	=	17.77	(76)
East	0.9x	1	x	0.78	x	16.15	x	0.72	x	0.7	=	3.09	(76)
West	0.9x	0.77	x	1.6	x	19.64	x	0.72	x	0.7	=	10.98	(80)
West	0.9x	0.77	x	1.6	x	19.64	x	0.72	x	0.7	=	10.98	(80)
West	0.9x	0.77	x	1.6	x	38.42	x	0.72	x	0.7	=	21.47	(80)

West	0.9x	0.77	x	1.6	x	38.42	x	0.72	x	0.7	=	21.47	(80)
West	0.9x	0.77	x	1.6	x	63.27	x	0.72	x	0.7	=	35.36	(80)
West	0.9x	0.77	x	1.6	x	63.27	x	0.72	x	0.7	=	35.36	(80)
West	0.9x	0.77	x	1.6	x	92.28	x	0.72	x	0.7	=	51.57	(80)
West	0.9x	0.77	x	1.6	x	92.28	x	0.72	x	0.7	=	51.57	(80)
West	0.9x	0.77	x	1.6	x	113.09	x	0.72	x	0.7	=	63.2	(80)
West	0.9x	0.77	x	1.6	x	113.09	x	0.72	x	0.7	=	63.2	(80)
West	0.9x	0.77	x	1.6	x	115.77	x	0.72	x	0.7	=	64.7	(80)
West	0.9x	0.77	x	1.6	x	115.77	x	0.72	x	0.7	=	64.7	(80)
West	0.9x	0.77	x	1.6	x	110.22	x	0.72	x	0.7	=	61.59	(80)
West	0.9x	0.77	x	1.6	x	110.22	x	0.72	x	0.7	=	61.59	(80)
West	0.9x	0.77	x	1.6	x	94.68	x	0.72	x	0.7	=	52.91	(80)
West	0.9x	0.77	x	1.6	x	94.68	x	0.72	x	0.7	=	52.91	(80)
West	0.9x	0.77	x	1.6	x	73.59	x	0.72	x	0.7	=	41.12	(80)
West	0.9x	0.77	x	1.6	x	73.59	x	0.72	x	0.7	=	41.12	(80)
West	0.9x	0.77	x	1.6	x	45.59	x	0.72	x	0.7	=	25.48	(80)
West	0.9x	0.77	x	1.6	x	45.59	x	0.72	x	0.7	=	25.48	(80)
West	0.9x	0.77	x	1.6	x	24.49	x	0.72	x	0.7	=	13.69	(80)
West	0.9x	0.77	x	1.6	x	24.49	x	0.72	x	0.7	=	13.69	(80)
West	0.9x	0.77	x	1.6	x	16.15	x	0.72	x	0.7	=	9.03	(80)
West	0.9x	0.77	x	1.6	x	16.15	x	0.72	x	0.7	=	9.03	(80)

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

(83)m=	73.91	146.7	249.97	382.51	487.79	508.48	480.29	399.29	296.14	175.99	92.46	60.63	(83)

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

(84)m=	472.55	543.1	631.92	741.15	822.71	820.65	777.79	703.05	611.96	515.33	458.78	447.25	(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	0.97	0.9	0.75	0.58	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=	19.59	19.73	20.01	20.38	20.72	20.92	20.98	20.97	20.8	20.36	19.91	19.56	(87)

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

(88)m=	19.9	19.9	19.9	19.9	19.9	19.91	19.91	19.91	19.91	19.9	19.9	19.9	(88)

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

(89)m=	1	1	0.99	0.96	0.86	0.65	0.45	0.52	0.84	0.98	1	1	(89)

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

(90)m=	18.02	18.23	18.63	19.17	19.63	19.86	19.9	19.9	19.73	19.14	18.48	17.98	(90)

fLA = Living area ÷ (4) = 0.4 (91)

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

(92)m=	18.65	18.83	19.18	19.66	20.07	20.29	20.34	20.33	20.16	19.63	19.05	18.61	(92)

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

(93)m=	18.65	18.83	19.18	19.66	20.07	20.29	20.34	20.33	20.16	19.63	19.05	18.61	(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	0.86	0.69	0.51	0.58	0.85	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	471.44	540.47	623.52	707.57	710.45	564.47	392.83	406.06	521.96	503.6	456.7	446.44	(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=	1562.86	1515.52	1377.63	1161.77	902.66	610.13	400.98	421.08	651.82	973.94	1292.31	1561.99	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	812.02	655.23	561.05	327.03	143.01	0	0	0	0	349.93	601.64	829.97	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4279.87 (98)

Space heating requirement in kWh/m²/year 48.36 (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		92.8	(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)													
	812.02	655.23	561.05	327.03	143.01	0	0	0	0	349.93	601.64	829.97	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	875.02	706.07	604.58	352.4	154.1	0	0	0	0	377.08	648.32	894.36	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 4611.93 (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)

171.97	150.85	156.7	138.08	133.58	116.87	109.87	123.83	124.63	143.3	154.53	167.03

Efficiency of water heater 87.3 (216)

(217)m=	89.35	89.32	89.24	89.04	88.57	87.3	87.3	87.3	87.3	89.06	89.28	89.37	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	192.47	168.88	175.59	155.07	150.81	133.87	125.86	141.84	142.76	160.9	173.09	186.89

Total = Sum(219a)$_{1...12}$ = 1908.03 (219)

DER WorkSheet: New dwelling design stage

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			4611.93	
Water heating fuel used			1908.03	
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			390.54	(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	=	996.18	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	412.13	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1408.31	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	202.69	(268)
Total CO2, kg/year			sum of (265)…(271) =		1649.92	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		18.64	(273)
EI rating (section 14)					83	(274)

DER WorkSheet: New dwelling created by change of use

User Details:

Assessor Name:	John Simpson	**Stroma Number:**	STRO006273
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.7

Property Address: 201

Address : 2.01, 25 Old Gloucester St, LONDON, WC1N 3AF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	80.37	(1a)	x	3	(2a)	=	241.11	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	80.37	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	241.11	(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

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	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			1.58	x1/[1/(1.4)+ 0.04]		=	2.09			(27)
Windows Type 2			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 3			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 4			1.62	x1/[1/(1.4)+ 0.04]		=	2.15			(27)
Windows Type 5			1.62	x1/[1/(1.4)+ 0.04]		=	2.15			(27)
Windows Type 6			1.85	x1/[1/(1.4)+ 0.04]		=	2.45			(27)
Windows Type 7			0.9	x1/[1/(1.4)+ 0.04]		=	1.19			(27)
Floor			14.1	x	0.2	=	2.82			(28)
Walls Type1	53	12.38	40.62	x	0.26	=	10.56			(29)
Walls Type2	18.9	2.75	16.15	x	0.18	=	2.91			(29)
Walls Type3	15.9	2.1	13.8	x	0.18	=	2.48			(29)
Total area of elements, m²			101.9							(31)
Party wall			25.8	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) = 41.77 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (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

DER WorkSheet: New dwelling created by change of use

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 15.29 | (36)

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

Total fabric heat loss (33) + (36) = | 57.06 | (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=	46.33	46.08	45.83	44.66	44.44	43.42	43.42	43.23	43.81	44.44	44.88	45.35	(38)

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

(39)m=	103.39	103.14	102.89	101.71	101.5	100.48	100.48	100.29	100.87	101.5	101.94	102.4	

Average = Sum(39)1…12 /12= | 101.71 | (39)

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

(40)m=	1.29	1.28	1.28	1.27	1.26	1.25	1.25	1.25	1.26	1.26	1.27	1.27	

Average = Sum(40)1…12 /12= | 1.27 | (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 | 2.47 | (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 | 92.86 | (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=	102.14	98.43	94.72	91	87.29	83.57	83.57	87.29	91	94.72	98.43	102.14	
										Total = Sum(44)1…12 =		1114.31	(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=	151.48	132.48	136.71	119.19	114.36	98.69	91.45	104.94	106.19	123.76	135.09	146.7	
										Total = Sum(45)1…12 =		1461.03	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	22.72	19.87	20.51	17.88	17.15	14.8	13.72	15.74	15.93	18.56	20.26	22	(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=	15.27	13.8	15.27	14.78	15.27	14.78	15.27	15.27	14.78	15.27	14.78	15.27	(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=	166.75	146.28	151.98	133.97	129.64	113.47	106.72	120.21	120.97	139.03	149.87	161.97	(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=	166.75	146.28	151.98	133.97	129.64	113.47	106.72	120.21	120.97	139.03	149.87	161.97

Output from water heater (annual)$_{1...12}$ 1640.87 (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=	54.18	47.5	49.27	43.33	41.84	36.51	34.22	38.71	39	44.97	48.61	52.6	(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=	123.49	123.49	123.49	123.49	123.49	123.49	123.49	123.49	123.49	123.49	123.49	123.49	(66)

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

(67)m=	19.98	17.74	14.43	10.92	8.17	6.89	7.45	9.68	13	16.5	19.26	20.53	(67)

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

(68)m=	220.21	222.5	216.74	204.48	189.01	174.46	164.74	162.46	168.22	180.48	195.95	210.5	(68)

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

(69)m=	35.35	35.35	35.35	35.35	35.35	35.35	35.35	35.35	35.35	35.35	35.35	35.35	(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=	-98.79	-98.79	-98.79	-98.79	-98.79	-98.79	-98.79	-98.79	-98.79	-98.79	-98.79	-98.79	(71)

Water heating gains (Table 5)

(72)m=	72.83	70.68	66.23	60.17	56.24	50.71	46	52.03	54.17	60.44	67.52	70.69	(72)

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

(73)m=	376.06	373.97	360.45	338.63	316.46	295.11	281.24	287.22	298.43	320.47	345.78	364.77	(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 created by change of use

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.44	x	10.63	x	0.72	x	0.7	=	10.7	(74)
North	0.9x	0.77	x	1.85	x	10.63	x	0.72	x	0.7	=	6.87	(74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.72	x	0.7	=	20.44	(74)
North	0.9x	0.77	x	1.85	x	20.32	x	0.72	x	0.7	=	13.13	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.72	x	0.7	=	34.73	(74)
North	0.9x	0.77	x	1.85	x	34.53	x	0.72	x	0.7	=	22.31	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.72	x	0.7	=	55.79	(74)
North	0.9x	0.77	x	1.85	x	55.46	x	0.72	x	0.7	=	35.84	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.72	x	0.7	=	75.16	(74)
North	0.9x	0.77	x	1.85	x	74.72	x	0.72	x	0.7	=	48.28	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.72	x	0.7	=	80.46	(74)
North	0.9x	0.77	x	1.85	x	79.99	x	0.72	x	0.7	=	51.68	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.72	x	0.7	=	75.12	(74)
North	0.9x	0.77	x	1.85	x	74.68	x	0.72	x	0.7	=	48.25	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.72	x	0.7	=	59.6	(74)
North	0.9x	0.77	x	1.85	x	59.25	x	0.72	x	0.7	=	38.28	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.72	x	0.7	=	41.76	(74)
North	0.9x	0.77	x	1.85	x	41.52	x	0.72	x	0.7	=	26.83	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.72	x	0.7	=	24.33	(74)
North	0.9x	0.77	x	1.85	x	24.19	x	0.72	x	0.7	=	15.63	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.72	x	0.7	=	13.2	(74)
North	0.9x	0.77	x	1.85	x	13.12	x	0.72	x	0.7	=	8.48	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.72	x	0.7	=	8.92	(74)
North	0.9x	0.77	x	1.85	x	8.86	x	0.72	x	0.7	=	5.73	(74)
East	0.9x	1	x	1.44	x	19.64	x	0.72	x	0.7	=	9.88	(76)
East	0.9x	1	x	1.62	x	19.64	x	0.72	x	0.7	=	11.11	(76)
East	0.9x	3	x	1.62	x	19.64	x	0.72	x	0.7	=	33.34	(76)
East	0.9x	1	x	1.44	x	38.42	x	0.72	x	0.7	=	19.32	(76)
East	0.9x	1	x	1.62	x	38.42	x	0.72	x	0.7	=	21.74	(76)
East	0.9x	3	x	1.62	x	38.42	x	0.72	x	0.7	=	65.22	(76)
East	0.9x	1	x	1.44	x	63.27	x	0.72	x	0.7	=	31.82	(76)
East	0.9x	1	x	1.62	x	63.27	x	0.72	x	0.7	=	35.8	(76)
East	0.9x	3	x	1.62	x	63.27	x	0.72	x	0.7	=	107.4	(76)
East	0.9x	1	x	1.44	x	92.28	x	0.72	x	0.7	=	46.41	(76)
East	0.9x	1	x	1.62	x	92.28	x	0.72	x	0.7	=	52.21	(76)
East	0.9x	3	x	1.62	x	92.28	x	0.72	x	0.7	=	156.64	(76)
East	0.9x	1	x	1.44	x	113.09	x	0.72	x	0.7	=	56.88	(76)
East	0.9x	1	x	1.62	x	113.09	x	0.72	x	0.7	=	63.99	(76)
East	0.9x	3	x	1.62	x	113.09	x	0.72	x	0.7	=	191.97	(76)

DER WorkSheet: New dwelling created by change of use

East	0.9x	1	x	1.44	x	115.77	x	0.72	x	0.7	=	58.23	(76)
East	0.9x	1	x	1.62	x	115.77	x	0.72	x	0.7	=	65.51	(76)
East	0.9x	3	x	1.62	x	115.77	x	0.72	x	0.7	=	196.52	(76)
East	0.9x	1	x	1.44	x	110.22	x	0.72	x	0.7	=	55.43	(76)
East	0.9x	1	x	1.62	x	110.22	x	0.72	x	0.7	=	62.36	(76)
East	0.9x	3	x	1.62	x	110.22	x	0.72	x	0.7	=	187.09	(76)
East	0.9x	1	x	1.44	x	94.68	x	0.72	x	0.7	=	47.62	(76)
East	0.9x	1	x	1.62	x	94.68	x	0.72	x	0.7	=	53.57	(76)
East	0.9x	3	x	1.62	x	94.68	x	0.72	x	0.7	=	160.71	(76)
East	0.9x	1	x	1.44	x	73.59	x	0.72	x	0.7	=	37.01	(76)
East	0.9x	1	x	1.62	x	73.59	x	0.72	x	0.7	=	41.64	(76)
East	0.9x	3	x	1.62	x	73.59	x	0.72	x	0.7	=	124.91	(76)
East	0.9x	1	x	1.44	x	45.59	x	0.72	x	0.7	=	22.93	(76)
East	0.9x	1	x	1.62	x	45.59	x	0.72	x	0.7	=	25.8	(76)
East	0.9x	3	x	1.62	x	45.59	x	0.72	x	0.7	=	77.39	(76)
East	0.9x	1	x	1.44	x	24.49	x	0.72	x	0.7	=	12.32	(76)
East	0.9x	1	x	1.62	x	24.49	x	0.72	x	0.7	=	13.86	(76)
East	0.9x	3	x	1.62	x	24.49	x	0.72	x	0.7	=	41.57	(76)
East	0.9x	1	x	1.44	x	16.15	x	0.72	x	0.7	=	8.12	(76)
East	0.9x	1	x	1.62	x	16.15	x	0.72	x	0.7	=	9.14	(76)
East	0.9x	3	x	1.62	x	16.15	x	0.72	x	0.7	=	27.42	(76)
West	0.9x	0.54	x	1.58	x	19.64	x	0.72	x	0.7	=	7.6	(80)
West	0.9x	0.77	x	0.9	x	19.64	x	0.72	x	0.7	=	6.17	(80)
West	0.9x	0.54	x	1.58	x	38.42	x	0.72	x	0.7	=	14.87	(80)
West	0.9x	0.77	x	0.9	x	38.42	x	0.72	x	0.7	=	12.08	(80)
West	0.9x	0.54	x	1.58	x	63.27	x	0.72	x	0.7	=	24.49	(80)
West	0.9x	0.77	x	0.9	x	63.27	x	0.72	x	0.7	=	19.89	(80)
West	0.9x	0.54	x	1.58	x	92.28	x	0.72	x	0.7	=	35.71	(80)
West	0.9x	0.77	x	0.9	x	92.28	x	0.72	x	0.7	=	29.01	(80)
West	0.9x	0.54	x	1.58	x	113.09	x	0.72	x	0.7	=	43.77	(80)
West	0.9x	0.77	x	0.9	x	113.09	x	0.72	x	0.7	=	35.55	(80)
West	0.9x	0.54	x	1.58	x	115.77	x	0.72	x	0.7	=	44.8	(80)
West	0.9x	0.77	x	0.9	x	115.77	x	0.72	x	0.7	=	36.39	(80)
West	0.9x	0.54	x	1.58	x	110.22	x	0.72	x	0.7	=	42.66	(80)
West	0.9x	0.77	x	0.9	x	110.22	x	0.72	x	0.7	=	34.65	(80)
West	0.9x	0.54	x	1.58	x	94.68	x	0.72	x	0.7	=	36.64	(80)
West	0.9x	0.77	x	0.9	x	94.68	x	0.72	x	0.7	=	29.76	(80)
West	0.9x	0.54	x	1.58	x	73.59	x	0.72	x	0.7	=	28.48	(80)
West	0.9x	0.77	x	0.9	x	73.59	x	0.72	x	0.7	=	23.13	(80)
West	0.9x	0.54	x	1.58	x	45.59	x	0.72	x	0.7	=	17.64	(80)
West	0.9x	0.77	x	0.9	x	45.59	x	0.72	x	0.7	=	14.33	(80)

DER WorkSheet: New dwelling created by change of use

West	0.9x	0.54	x	1.58	x	24.49	x	0.72	x	0.7	=	9.48	(80)
West	0.9x	0.77	x	0.9	x	24.49	x	0.72	x	0.7	=	7.7	(80)
West	0.9x	0.54	x	1.58	x	16.15	x	0.72	x	0.7	=	6.25	(80)
West	0.9x	0.77	x	0.9	x	16.15	x	0.72	x	0.7	=	5.08	(80)

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

(83)m=	85.67	166.8	276.45	411.62	515.59	533.59	505.56	426.18	323.77	198.05	106.59	70.65	(83)

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

(84)m=	461.74	540.77	636.9	750.25	832.05	828.69	786.8	713.4	622.2	518.51	452.36	435.42	(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	0.71	0.54	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=	19.56	19.72	20.02	20.41	20.75	20.93	20.98	20.97	20.82	20.37	19.89	19.53	(87)

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

(88)m=	19.85	19.85	19.86	19.87	19.87	19.88	19.88	19.88	19.88	19.87	19.87	19.86	(88)

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

(89)m=	1	0.99	0.98	0.94	0.82	0.61	0.41	0.48	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=	17.94	18.18	18.61	19.18	19.63	19.84	19.87	19.87	19.73	19.14	18.44	17.9	(90)

fLA = Living area ÷ (4) = 0.39 (91)

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

(92)m=	18.57	18.78	19.15	19.66	20.06	20.26	20.31	20.3	20.15	19.62	19	18.54	(92)

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

(93)m=	18.57	18.78	19.15	19.66	20.06	20.26	20.31	20.3	20.15	19.62	19	18.54	(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	0.83	0.65	0.47	0.53	0.82	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	460.21	536.96	624.69	704.18	691.92	534.55	366.43	380.3	507.93	501.99	449.47	434.32	(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=	1474.86	1431.04	1301.92	1094.56	848.75	569.02	372.32	391.06	610.57	915.19	1213.55	1468.04	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	754.9	600.82	503.86	281.07	116.67	0	0	0	0	307.42	550.13	769.08	

Total per year (kWh/year) = Sum(98)$_{1…5,9…12}$ = 3883.96 (98)

Space heating requirement in kWh/m²/year 48.33 (99)

DER WorkSheet: New dwelling created by change of use

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		92.8	(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)	754.9	600.82	503.86	281.07	116.67	0	0	0	0	307.42	550.13	769.08		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	813.46	647.44	542.95	302.88	125.73	0	0	0	0	331.27	592.82	828.76		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													4185.3	(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)	166.75	146.28	151.98	133.97	129.64	113.47	106.72	120.21	120.97	139.03	149.87	161.97		
Efficiency of water heater													87.3	(216)
(217)m=	89.34	89.3	89.21	88.98	88.47	87.3	87.3	87.3	87.3	89.01	89.25	89.35		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	186.65	163.81	170.37	150.57	146.54	129.98	122.25	137.7	138.57	156.2	167.92	181.27		
Total = Sum(219a)$_{1...12}$ =													1851.82	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			4185.3	
Water heating fuel used			1851.82	
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			352.78	(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	=	904.03	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	399.99	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1304.02	(265)

DER WorkSheet: New dwelling created by change of use

Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	183.09	(268)
Total CO2, kg/year		sum of (265)…(271) =			1526.03	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =			18.99	(273)
EI rating (section 14)					84	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	John Simpson	**Stroma Number:**	STRO006273
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.7

Property Address: 202

Address : 2.02, 25 Old Gloucester St, LONDON, WC1N 3AF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	42.29	(1a)	x	2.4	(2a)	=	101.5	(3a)
First floor	34.9	(1b)	x	2.86	(2b)	=	99.81	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	77.19	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	201.31	(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		4	(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

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

0.38	0.37	0.36	0.33	0.32	0.28	0.28	0.27	0.3	0.32	0.33	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	0.54	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	0.54	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	
Doors			2.1	x	1.8	=	3.78			(26)
Windows Type 1			1.95	x1/[1/(1.6)+ 0.04]		=	2.93			(27)
Windows Type 2			3.28	x1/[1/(1.6)+ 0.04]		=	4.93			(27)
Windows Type 3			2.16	x1/[1/(1.6)+ 0.04]		=	3.25			(27)
Windows Type 4			1.43	x1/[1/(1.6)+ 0.04]		=	2.15			(27)
Windows Type 5			8.93	x1/[1/(1.6)+ 0.04]		=	13.43			(27)
Floor			2.4	x	0.15	=	0.36			(28)
Walls Type1	87.6	22.07	65.53	x	0.18	=	11.8			(29)
Walls Type2	16.8	2.1	14.7	x	0.18	=	2.65			(29)
Roof Type1	9.9	0	9.9	x	0.15	=	1.49			(30)
Roof Type2	35.3	0	35.3	x	0.15	=	5.3			(30)
Total area of elements, m²			152							(31)
Party wall			42.9	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) = 58.55 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 89.1 (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		17.9	(36)
if details of thermal bridging are not known (36) = 0.15 x (31)			
Total fabric heat loss	(33) + (36) =	76.45	(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=	37.97	37.78	37.6	36.75	36.59	35.85	35.85	35.72	36.14	36.59	36.92	37.25	(38)

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

(39)m=	114.42	114.23	114.05	113.2	113.04	112.3	112.3	112.17	112.59	113.04	113.36	113.7

Average = Sum(39)$_{1…12}$ /12= 113.2 (39)

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

(40)m=	1.48	1.48	1.48	1.47	1.46	1.45	1.45	1.45	1.46	1.46	1.47	1.47

Average = Sum(40)$_{1…12}$ /12= 1.47 (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 91.38 (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=	100.51	96.86	93.2	89.55	85.89	82.24	82.24	85.89	89.55	93.2	96.86	100.51

Total = Sum(44)$_{1…12}$ = 1096.5 (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=	149.06	130.37	134.53	117.28	112.54	97.11	89.99	103.26	104.49	121.78	132.93	144.35

Total = Sum(45)$_{1…12}$ = 1437.69 (45)

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

(46)m=	22.36	19.56	20.18	17.59	16.88	14.57	13.5	15.49	15.67	18.27	19.94	21.65	(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=	15.27	13.8	15.27	14.78	15.27	14.78	15.27	15.27	14.78	15.27	14.78	15.27	(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=	164.33	144.16	149.8	132.07	127.81	111.89	105.26	118.54	119.28	137.05	147.71	159.63	(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=	164.33	144.16	149.8	132.07	127.81	111.89	105.26	118.54	119.28	137.05	147.71	159.63

Output from water heater (annual)$_{1...12}$ 1617.53 (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=	53.38	46.8	48.55	42.69	41.24	35.98	33.74	38.15	38.44	44.31	47.89	51.82	(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=	120.37	120.37	120.37	120.37	120.37	120.37	120.37	120.37	120.37	120.37	120.37	120.37	(66)

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

(67)m=	19.03	16.9	13.75	10.41	7.78	6.57	7.1	9.22	12.38	15.72	18.35	19.56	(67)

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

(68)m=	213.47	215.68	210.1	198.22	183.22	169.12	159.7	157.48	163.07	174.95	189.95	204.05	(68)

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

(69)m=	35.04	35.04	35.04	35.04	35.04	35.04	35.04	35.04	35.04	35.04	35.04	35.04	(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=	-96.3	-96.3	-96.3	-96.3	-96.3	-96.3	-96.3	-96.3	-96.3	-96.3	-96.3	-96.3	(71)

Water heating gains (Table 5)

(72)m=	71.75	69.64	65.25	59.29	55.43	49.98	45.35	51.28	53.39	59.56	66.52	69.65	(72)

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

(73)m=	366.36	364.33	351.21	330.03	308.53	287.77	274.25	280.1	290.95	312.34	336.93	355.36	(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)	
Northeast	0.9x	0.77	x	2.16	x	11.28	x	0.72	x	0.7	=	25.54	(75)
Northeast	0.9x	0.77	x	2.16	x	22.97	x	0.72	x	0.7	=	51.98	(75)
Northeast	0.9x	0.77	x	2.16	x	41.38	x	0.72	x	0.7	=	93.65	(75)
Northeast	0.9x	0.77	x	2.16	x	67.96	x	0.72	x	0.7	=	153.8	(75)
Northeast	0.9x	0.77	x	2.16	x	91.35	x	0.72	x	0.7	=	206.74	(75)
Northeast	0.9x	0.77	x	2.16	x	97.38	x	0.72	x	0.7	=	220.41	(75)
Northeast	0.9x	0.77	x	2.16	x	91.1	x	0.72	x	0.7	=	206.19	(75)
Northeast	0.9x	0.77	x	2.16	x	72.63	x	0.72	x	0.7	=	164.38	(75)
Northeast	0.9x	0.77	x	2.16	x	50.42	x	0.72	x	0.7	=	114.12	(75)
Northeast	0.9x	0.77	x	2.16	x	28.07	x	0.72	x	0.7	=	63.52	(75)
Northeast	0.9x	0.77	x	2.16	x	14.2	x	0.72	x	0.7	=	32.13	(75)
Northeast	0.9x	0.77	x	2.16	x	9.21	x	0.72	x	0.7	=	20.85	(75)
East	0.9x	1	x	1.95	x	19.64	x	0.72	x	0.7	=	13.38	(76)
East	0.9x	1	x	1.43	x	19.64	x	0.72	x	0.7	=	9.81	(76)
East	0.9x	1	x	1.95	x	38.42	x	0.72	x	0.7	=	26.17	(76)
East	0.9x	1	x	1.43	x	38.42	x	0.72	x	0.7	=	19.19	(76)
East	0.9x	1	x	1.95	x	63.27	x	0.72	x	0.7	=	43.09	(76)
East	0.9x	1	x	1.43	x	63.27	x	0.72	x	0.7	=	31.6	(76)
East	0.9x	1	x	1.95	x	92.28	x	0.72	x	0.7	=	62.85	(76)
East	0.9x	1	x	1.43	x	92.28	x	0.72	x	0.7	=	46.09	(76)
East	0.9x	1	x	1.95	x	113.09	x	0.72	x	0.7	=	77.03	(76)
East	0.9x	1	x	1.43	x	113.09	x	0.72	x	0.7	=	56.49	(76)
East	0.9x	1	x	1.95	x	115.77	x	0.72	x	0.7	=	78.85	(76)
East	0.9x	1	x	1.43	x	115.77	x	0.72	x	0.7	=	57.82	(76)
East	0.9x	1	x	1.95	x	110.22	x	0.72	x	0.7	=	75.07	(76)
East	0.9x	1	x	1.43	x	110.22	x	0.72	x	0.7	=	55.05	(76)
East	0.9x	1	x	1.95	x	94.68	x	0.72	x	0.7	=	64.48	(76)
East	0.9x	1	x	1.43	x	94.68	x	0.72	x	0.7	=	47.29	(76)
East	0.9x	1	x	1.95	x	73.59	x	0.72	x	0.7	=	50.12	(76)
East	0.9x	1	x	1.43	x	73.59	x	0.72	x	0.7	=	36.75	(76)
East	0.9x	1	x	1.95	x	45.59	x	0.72	x	0.7	=	31.05	(76)
East	0.9x	1	x	1.43	x	45.59	x	0.72	x	0.7	=	22.77	(76)
East	0.9x	1	x	1.95	x	24.49	x	0.72	x	0.7	=	16.68	(76)
East	0.9x	1	x	1.43	x	24.49	x	0.72	x	0.7	=	12.23	(76)
East	0.9x	1	x	1.95	x	16.15	x	0.72	x	0.7	=	11	(76)
East	0.9x	1	x	1.43	x	16.15	x	0.72	x	0.7	=	8.07	(76)
West	0.9x	0.77	x	3.28	x	19.64	x	0.72	x	0.7	=	22.5	(80)
West	0.9x	0.77	x	8.93	x	19.64	x	0.72	x	0.7	=	61.26	(80)
West	0.9x	0.77	x	3.28	x	38.42	x	0.72	x	0.7	=	44.02	(80)

West	0.9x	0.77	x	8.93	x	38.42	x	0.72	x	0.7	=	119.83	(80)
West	0.9x	0.77	x	3.28	x	63.27	x	0.72	x	0.7	=	72.49	(80)
West	0.9x	0.77	x	8.93	x	63.27	x	0.72	x	0.7	=	197.35	(80)
West	0.9x	0.77	x	3.28	x	92.28	x	0.72	x	0.7	=	105.72	(80)
West	0.9x	0.77	x	8.93	x	92.28	x	0.72	x	0.7	=	287.82	(80)
West	0.9x	0.77	x	3.28	x	113.09	x	0.72	x	0.7	=	129.56	(80)
West	0.9x	0.77	x	8.93	x	113.09	x	0.72	x	0.7	=	352.74	(80)
West	0.9x	0.77	x	3.28	x	115.77	x	0.72	x	0.7	=	132.63	(80)
West	0.9x	0.77	x	8.93	x	115.77	x	0.72	x	0.7	=	361.09	(80)
West	0.9x	0.77	x	3.28	x	110.22	x	0.72	x	0.7	=	126.27	(80)
West	0.9x	0.77	x	8.93	x	110.22	x	0.72	x	0.7	=	343.77	(80)
West	0.9x	0.77	x	3.28	x	94.68	x	0.72	x	0.7	=	108.46	(80)
West	0.9x	0.77	x	8.93	x	94.68	x	0.72	x	0.7	=	295.29	(80)
West	0.9x	0.77	x	3.28	x	73.59	x	0.72	x	0.7	=	84.3	(80)
West	0.9x	0.77	x	8.93	x	73.59	x	0.72	x	0.7	=	229.52	(80)
West	0.9x	0.77	x	3.28	x	45.59	x	0.72	x	0.7	=	52.23	(80)
West	0.9x	0.77	x	8.93	x	45.59	x	0.72	x	0.7	=	142.19	(80)
West	0.9x	0.77	x	3.28	x	24.49	x	0.72	x	0.7	=	28.06	(80)
West	0.9x	0.77	x	8.93	x	24.49	x	0.72	x	0.7	=	76.38	(80)
West	0.9x	0.77	x	3.28	x	16.15	x	0.72	x	0.7	=	18.5	(80)
West	0.9x	0.77	x	8.93	x	16.15	x	0.72	x	0.7	=	50.38	(80)

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

(83)m=	132.48	261.19	438.18	656.28	822.55	850.8	806.34	679.9	514.82	311.76	165.48	108.8	(83)

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

(84)m=	498.84	625.52	789.4	986.31	1131.08	1138.57	1080.6	960	805.77	624.1	502.41	464.16	(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	0.91	0.78	0.59	0.45	0.52	0.79	0.97	0.99	1	(86)

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

(87)m=	19.38	19.6	19.98	20.46	20.8	20.95	20.99	20.98	20.84	20.34	19.76	19.34	(87)

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

(88)m=	19.7	19.7	19.7	19.71	19.71	19.72	19.72	19.72	19.72	19.71	19.71	19.71	(88)

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

(89)m=	1	0.99	0.97	0.88	0.71	0.49	0.32	0.38	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=	17.57	17.9	18.45	19.12	19.54	19.69	19.72	19.72	19.6	18.97	18.14	17.52	(90)

fLA = Living area ÷ (4) = 0.44 (91)

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

(92)m=	18.37	18.65	19.13	19.71	20.1	20.25	20.28	20.27	20.15	19.58	18.86	18.32	(92)

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

(93)m=	18.37	18.65	19.13	19.71	20.1	20.25	20.28	20.27	20.15	19.58	18.86	18.32	(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	0.88	0.73	0.53	0.38	0.44	0.73	0.94	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	496.08	617.04	758.28	869.99	825.49	608.8	408.56	425.72	591.12	589.51	496.93	462.23	(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=	1610.03	1570.93	1440.5	1223.68	949	634.37	413.16	434.48	681.02	1014.84	1332.93	1605.72	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	828.78	641.02	507.57	254.66	91.89	0	0	0	0	316.45	601.92	850.76	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4093.05 (98)

Space heating requirement in kWh/m²/year 53.03 (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		92.8	(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)														
	828.78	641.02	507.57	254.66	91.89	0	0	0	0	316.45	601.92	850.76		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	893.08	690.75	546.95	274.42	99.02	0	0	0	0	341	648.62	916.76		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													4410.62	(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)														
	164.33	144.16	149.8	132.07	127.81	111.89	105.26	118.54	119.28	137.05	147.71	159.63		
Efficiency of water heater													87.3	(216)
(217)m=	89.38	89.33	89.22	88.93	88.33	87.3	87.3	87.3	87.3	89.03	89.3	89.4		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	183.86	161.38	167.9	148.5	144.7	128.17	120.57	135.78	136.63	153.94	165.42	178.56		
Total = Sum(219a)$_{1...12}$ =													1825.43	(219)

DER WorkSheet: New dwelling design stage

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			4410.62	
Water heating fuel used			1825.43	
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			336.09	(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	=	952.69	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	394.29	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1346.99	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	174.43	(268)
Total CO2, kg/year			sum of (265)…(271) =		1560.34	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		20.21	(273)
EI rating (section 14)					83	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	John Simpson	**Stroma Number:**	STRO006273
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.7

Property Address: 203

Address : 2.03, 25 Old Gloucester St, LONDON, WC1N 3AF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	39.4	(1a)	x	2.4	(2a)	=	94.56	(3a)
First floor	34.9	(1b)	x	2.86	(2b)	=	99.81	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.3	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	194.37	(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		4	(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

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

0.38	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	
Doors			2.1	x	1.8	=	3.78			(26)
Windows Type 1			0.63	x1/[1/(1.6)+ 0.04]		=	0.95			(27)
Windows Type 2			3.28	x1/[1/(1.6)+ 0.04]		=	4.93			(27)
Windows Type 3			0.78	x1/[1/(1.6)+ 0.04]		=	1.17			(27)
Windows Type 4			8.93	x1/[1/(1.6)+ 0.04]		=	13.43			(27)
Floor			2.4	x	0.15	=	0.36			(28)
Walls Type1	75.6	13.62	61.98	x	0.18	=	11.16			(29)
Walls Type2	22	2.1	19.9	x	0.18	=	3.58			(29)
Roof Type1	6.8	0	6.8	x	0.15	=	1.02			(30)
Roof Type2	35.3	0	35.3	x	0.15	=	5.3			(30)
Total area of elements, m²			142.1							(31)
Party wall			42.9	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) =	45.67	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	61.2	(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 | 14.76 | (36)

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

Total fabric heat loss (33) + (36) = | 60.44 | (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=	36.8	36.62	36.44	35.59	35.43	34.7	34.7	34.56	34.98	35.43	35.75	36.09	(38)

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

(39)m=	97.24	97.06	96.88	96.03	95.87	95.13	95.13	95	95.42	95.87	96.19	96.53

Average = Sum(39)$_{1...12}$ /12= | 96.03 | (39)

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

(40)m=	1.31	1.31	1.3	1.29	1.29	1.28	1.28	1.28	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 | 2.35 | (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 | 89.91 | (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=	98.91	95.31	91.71	88.12	84.52	80.92	80.92	84.52	88.12	91.71	95.31	98.91	
									Total = Sum(44)$_{1...12}$ =			1078.96	(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=	146.67	128.28	132.37	115.41	110.74	95.56	88.55	101.61	102.82	119.83	130.8	142.05	
									Total = Sum(45)$_{1...12}$ =			1414.69	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	22	19.24	19.86	17.31	16.61	14.33	13.28	15.24	15.42	17.97	19.62	21.31	(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)

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

(61)m=	15.27	13.8	15.27	14.78	15.27	14.78	15.27	15.27	14.78	15.27	14.78	15.27	(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=	161.95	142.08	147.65	130.19	126.01	110.34	103.82	116.88	117.6	135.1	145.59	157.32	(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=	161.95	142.08	147.65	130.19	126.01	110.34	103.82	116.88	117.6	135.1	145.59	157.32	

Output from water heater (annual)$_{1...12}$ — 1594.53 (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=	52.59	46.1	47.83	42.07	40.64	35.47	33.26	37.6	37.88	43.66	47.19	51.05	(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=	117.29	117.29	117.29	117.29	117.29	117.29	117.29	117.29	117.29	117.29	117.29	117.29	(66)

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

(67)m=	18.81	16.7	13.58	10.28	7.69	6.49	7.01	9.12	12.23	15.53	18.13	19.33	(67)

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

(68)m=	207.12	209.27	203.85	192.32	177.77	164.09	154.95	152.8	158.22	169.75	184.3	197.98	(68)

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

(69)m=	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	34.73	(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=	-93.83	-93.83	-93.83	-93.83	-93.83	-93.83	-93.83	-93.83	-93.83	-93.83	-93.83	-93.83	(71)

Water heating gains (Table 5)

(72)m=	70.68	68.6	64.29	58.43	54.62	49.26	44.71	50.54	52.62	58.69	65.54	68.61	(72)

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

(73)m=	357.79	355.76	342.91	322.22	301.26	281.03	267.85	273.65	284.25	305.15	329.16	347.11	(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	0.63	x	19.64	x	0.72	x	0.7	=	4.32	(76)
East	0.9x	1	x	0.78	x	19.64	x	0.72	x	0.7	=	5.35	(76)
East	0.9x	1	x	0.63	x	38.42	x	0.72	x	0.7	=	8.45	(76)
East	0.9x	1	x	0.78	x	38.42	x	0.72	x	0.7	=	10.47	(76)
East	0.9x	1	x	0.63	x	63.27	x	0.72	x	0.7	=	13.92	(76)
East	0.9x	1	x	0.78	x	63.27	x	0.72	x	0.7	=	17.24	(76)
East	0.9x	1	x	0.63	x	92.28	x	0.72	x	0.7	=	20.31	(76)
East	0.9x	1	x	0.78	x	92.28	x	0.72	x	0.7	=	25.14	(76)
East	0.9x	1	x	0.63	x	113.09	x	0.72	x	0.7	=	24.89	(76)
East	0.9x	1	x	0.78	x	113.09	x	0.72	x	0.7	=	30.81	(76)
East	0.9x	1	x	0.63	x	115.77	x	0.72	x	0.7	=	25.47	(76)
East	0.9x	1	x	0.78	x	115.77	x	0.72	x	0.7	=	31.54	(76)
East	0.9x	1	x	0.63	x	110.22	x	0.72	x	0.7	=	24.25	(76)
East	0.9x	1	x	0.78	x	110.22	x	0.72	x	0.7	=	30.03	(76)
East	0.9x	1	x	0.63	x	94.68	x	0.72	x	0.7	=	20.83	(76)
East	0.9x	1	x	0.78	x	94.68	x	0.72	x	0.7	=	25.79	(76)
East	0.9x	1	x	0.63	x	73.59	x	0.72	x	0.7	=	16.19	(76)
East	0.9x	1	x	0.78	x	73.59	x	0.72	x	0.7	=	20.05	(76)
East	0.9x	1	x	0.63	x	45.59	x	0.72	x	0.7	=	10.03	(76)
East	0.9x	1	x	0.78	x	45.59	x	0.72	x	0.7	=	12.42	(76)
East	0.9x	1	x	0.63	x	24.49	x	0.72	x	0.7	=	5.39	(76)
East	0.9x	1	x	0.78	x	24.49	x	0.72	x	0.7	=	6.67	(76)
East	0.9x	1	x	0.63	x	16.15	x	0.72	x	0.7	=	3.55	(76)
East	0.9x	1	x	0.78	x	16.15	x	0.72	x	0.7	=	4.4	(76)
West	0.9x	0.77	x	3.28	x	19.64	x	0.72	x	0.7	=	22.5	(80)
West	0.9x	0.77	x	8.93	x	19.64	x	0.72	x	0.7	=	61.26	(80)
West	0.9x	0.77	x	3.28	x	38.42	x	0.72	x	0.7	=	44.02	(80)
West	0.9x	0.77	x	8.93	x	38.42	x	0.72	x	0.7	=	119.83	(80)
West	0.9x	0.77	x	3.28	x	63.27	x	0.72	x	0.7	=	72.49	(80)
West	0.9x	0.77	x	8.93	x	63.27	x	0.72	x	0.7	=	197.35	(80)
West	0.9x	0.77	x	3.28	x	92.28	x	0.72	x	0.7	=	105.72	(80)
West	0.9x	0.77	x	8.93	x	92.28	x	0.72	x	0.7	=	287.82	(80)
West	0.9x	0.77	x	3.28	x	113.09	x	0.72	x	0.7	=	129.56	(80)
West	0.9x	0.77	x	8.93	x	113.09	x	0.72	x	0.7	=	352.74	(80)
West	0.9x	0.77	x	3.28	x	115.77	x	0.72	x	0.7	=	132.63	(80)
West	0.9x	0.77	x	8.93	x	115.77	x	0.72	x	0.7	=	361.09	(80)
West	0.9x	0.77	x	3.28	x	110.22	x	0.72	x	0.7	=	126.27	(80)
West	0.9x	0.77	x	8.93	x	110.22	x	0.72	x	0.7	=	343.77	(80)
West	0.9x	0.77	x	3.28	x	94.68	x	0.72	x	0.7	=	108.46	(80)

West	0.9x	0.77	x	8.93	x	94.68	x	0.72	x	0.7	=	295.29	(80)
West	0.9x	0.77	x	3.28	x	73.59	x	0.72	x	0.7	=	84.3	(80)
West	0.9x	0.77	x	8.93	x	73.59	x	0.72	x	0.7	=	229.52	(80)
West	0.9x	0.77	x	3.28	x	45.59	x	0.72	x	0.7	=	52.23	(80)
West	0.9x	0.77	x	8.93	x	45.59	x	0.72	x	0.7	=	142.19	(80)
West	0.9x	0.77	x	3.28	x	24.49	x	0.72	x	0.7	=	28.06	(80)
West	0.9x	0.77	x	8.93	x	24.49	x	0.72	x	0.7	=	76.38	(80)
West	0.9x	0.77	x	3.28	x	16.15	x	0.72	x	0.7	=	18.5	(80)
West	0.9x	0.77	x	8.93	x	16.15	x	0.72	x	0.7	=	50.38	(80)

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

(83)m=	93.43	182.77	301	438.98	537.99	550.73	524.32	450.38	350.07	216.87	116.5	76.83	(83)

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

(84)m=	451.22	538.53	643.91	761.21	839.25	831.76	792.17	724.03	634.32	522.03	445.65	423.94	(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	0.99	0.98	0.95	0.84	0.68	0.51	0.58	0.84	0.97	1	1	(86)

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

(87)m=	19.56	19.74	20.05	20.45	20.78	20.94	20.99	20.98	20.84	20.4	19.9	19.53	(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	19.86	19.85	19.85	19.85	19.84	(88)

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

(89)m=	1	0.99	0.98	0.92	0.79	0.58	0.39	0.45	0.76	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=	17.93	18.19	18.65	19.22	19.64	19.82	19.85	19.85	19.73	19.15	18.43	17.88	(90)

fLA = Living area ÷ (4) = 0.46 (91)

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

(92)m=	18.67	18.9	19.29	19.79	20.16	20.33	20.37	20.37	20.24	19.73	19.11	18.64	(92)

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

(93)m=	18.67	18.9	19.29	19.79	20.16	20.33	20.37	20.37	20.24	19.73	19.11	18.64	(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	0.92	0.81	0.62	0.45	0.51	0.79	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	449.41	533.66	627.76	702.93	677	516.01	353.77	367.8	499.53	501.16	442.13	422.65	(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=	1397.8	1358.77	1239.14	1045.45	810.94	545.59	358.91	376.88	585.9	874.85	1154.86	1393.5	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(98)m=	705.6	554.47	454.87	246.61	99.65	0	0	0	0	278.02	513.17	722.32		
Total per year (kWh/year) = Sum(98)1...5,9...12 =													3574.71	(98)

Space heating requirement in kWh/m²/year	48.11	(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		92.8	(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)	705.6	554.47	454.87	246.61	99.65	0	0	0	0	278.02	513.17	722.32		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	760.34	597.49	490.16	265.75	107.38	0	0	0	0	299.59	552.98	778.36		(211)
Total (kWh/year) =Sum(211)1...5,10....12=													3852.06	(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)	161.95	142.08	147.65	130.19	126.01	110.34	103.82	116.88	117.6	135.1	145.59	157.32		
Efficiency of water heater													87.3	(216)
(217)m=	89.32	89.28	89.17	88.92	88.39	87.3	87.3	87.3	87.3	88.97	89.24	89.34		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	181.31	159.14	165.57	146.41	142.57	126.39	118.93	133.89	134.71	151.86	163.15	176.09		
Total = Sum(219a)1...12 =													1800.01	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3852.06	
Water heating fuel used			1800.01	
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			332.11	(232)

12a. CO_2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

DER WorkSheet: New dwelling design stage

Space heating (main system 1)	(211) x	0.216	=	832.04	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	388.8	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1220.85	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	172.37	(268)
Total CO2, kg/year		sum of (265)…(271) =		1432.14	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		19.28	(273)
EI rating (section 14)				84	(274)

DER WorkSheet: New dwelling created by change of use

User Details:

Assessor Name:	John Simpson	**Stroma Number:**	STRO006273
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.7

Property Address: 301

Address : 3.01, 25 Old Gloucester St, LONDON, WC1N 3AF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	80.6	(1a) x	2.83	(2a) =	228.1	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	80.6	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	228.1	(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

DER WorkSheet: New dwelling created by change of use

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	0.32	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	
Doors			2.1	x	1.4	=	2.94			(26)
Windows Type 1			1.58	x1/[1/(1.4)+ 0.04]		=	2.09			(27)
Windows Type 2			1.3	x1/[1/(1.4)+ 0.04]		=	1.72			(27)
Windows Type 3			1.02	x1/[1/(1.4)+ 0.04]		=	1.35			(27)
Windows Type 4			1.39	x1/[1/(1.4)+ 0.04]		=	1.84			(27)
Windows Type 5			1.02	x1/[1/(1.4)+ 0.04]		=	1.35			(27)
Windows Type 6			1.85	x1/[1/(1.4)+ 0.04]		=	2.45			(27)
Windows Type 7			0.9	x1/[1/(1.4)+ 0.04]		=	1.19			(27)
Walls Type1	58.5	9.74	48.76	x	0.26	=	12.68			(29)
Walls Type2	15.1	2.75	12.35	x	0.18	=	2.22			(29)
Walls Type3	12.7	2.1	10.6	x	0.18	=	1.91			(29)
Roof Type1	52.8	0	52.8	x	0.13	=	6.86			(30)
Roof Type2	27.8	0	27.8	x	0.15	=	4.17			(30)
Total area of elements, m²			166.9							(31)
Party wall			24.1	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) = 47.34 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (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	25.04	(36)
if details of thermal bridging are not known (36) = 0.15 x (31)		
Total fabric heat loss (33) + (36) =	72.38	(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=	44.07	43.82	43.58	42.43	42.21	41.21	41.21	41.02	41.59	42.21	42.65	43.1	(38)

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

(39)m=	116.45	116.2	115.95	114.8	114.59	113.58	113.58	113.4	113.97	114.59	115.02	115.48	

Average = Sum(39)$_{1…12}$ /12= 114.8 (39)

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

(40)m=	1.44	1.44	1.44	1.42	1.42	1.41	1.41	1.41	1.41	1.42	1.43	1.43

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 — 2.47 (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 — 92.96 (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)

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=	102.26	98.54	94.82	91.1	87.38	83.66	83.66	87.38	91.1	94.82	98.54	102.26

Total = Sum(44)$_{1…12}$ = 1115.53 (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=	151.64	132.63	136.86	119.32	114.49	98.8	91.55	105.05	106.31	123.89	135.24	146.86

Total = Sum(45)$_{1…12}$ = 1462.64 (45)

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

(46)m=	22.75	19.89	20.53	17.9	17.17	14.82	13.73	15.76	15.95	18.58	20.29	22.03	(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)

DER WorkSheet: New dwelling created by change of use

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=	15.27	13.8	15.27	14.78	15.27	14.78	15.27	15.27	14.78	15.27	14.78	15.27	(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=	166.92	146.42	152.14	134.1	129.76	113.58	106.82	120.33	121.09	139.17	150.02	162.13	(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=	166.92	146.42	152.14	134.1	129.76	113.58	106.82	120.33	121.09	139.17	150.02	162.13	

Output from water heater (annual)1…12 | 1642.48 | (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=	54.24	47.55	49.32	43.37	41.89	36.54	34.26	38.75	39.04	45.01	48.66	52.65	(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=	123.71	123.71	123.71	123.71	123.71	123.71	123.71	123.71	123.71	123.71	123.71	123.71	(66)

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

(67)m=	20.76	18.44	15	11.35	8.49	7.17	7.74	10.06	13.51	17.15	20.02	21.34	(67)

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

(68)m=	220.69	222.98	217.21	204.92	189.42	174.84	165.1	162.81	168.58	180.87	196.38	210.95	(68)

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

(69)m=	35.37	35.37	35.37	35.37	35.37	35.37	35.37	35.37	35.37	35.37	35.37	35.37	(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=	-98.97	-98.97	-98.97	-98.97	-98.97	-98.97	-98.97	-98.97	-98.97	-98.97	-98.97	-98.97	(71)

Water heating gains (Table 5)

(72)m=	72.9	70.76	66.3	60.23	56.3	50.76	46.05	52.08	54.23	60.5	67.59	70.77	(72)

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

(73)m=	377.47	375.29	361.62	339.63	317.31	295.87	282	288.07	299.43	321.63	347.09	366.17	(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 created by change of use

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.3	x	10.63	x	0.72	x	0.7	=	4.83	(74)
North	0.9x	0.77	x	1.85	x	10.63	x	0.72	x	0.7	=	6.87	(74)
North	0.9x	0.77	x	1.3	x	20.32	x	0.72	x	0.7	=	9.23	(74)
North	0.9x	0.77	x	1.85	x	20.32	x	0.72	x	0.7	=	13.13	(74)
North	0.9x	0.77	x	1.3	x	34.53	x	0.72	x	0.7	=	15.68	(74)
North	0.9x	0.77	x	1.85	x	34.53	x	0.72	x	0.7	=	22.31	(74)
North	0.9x	0.77	x	1.3	x	55.46	x	0.72	x	0.7	=	25.18	(74)
North	0.9x	0.77	x	1.85	x	55.46	x	0.72	x	0.7	=	35.84	(74)
North	0.9x	0.77	x	1.3	x	74.72	x	0.72	x	0.7	=	33.92	(74)
North	0.9x	0.77	x	1.85	x	74.72	x	0.72	x	0.7	=	48.28	(74)
North	0.9x	0.77	x	1.3	x	79.99	x	0.72	x	0.7	=	36.32	(74)
North	0.9x	0.77	x	1.85	x	79.99	x	0.72	x	0.7	=	51.68	(74)
North	0.9x	0.77	x	1.3	x	74.68	x	0.72	x	0.7	=	33.91	(74)
North	0.9x	0.77	x	1.85	x	74.68	x	0.72	x	0.7	=	48.25	(74)
North	0.9x	0.77	x	1.3	x	59.25	x	0.72	x	0.7	=	26.9	(74)
North	0.9x	0.77	x	1.85	x	59.25	x	0.72	x	0.7	=	38.28	(74)
North	0.9x	0.77	x	1.3	x	41.52	x	0.72	x	0.7	=	18.85	(74)
North	0.9x	0.77	x	1.85	x	41.52	x	0.72	x	0.7	=	26.83	(74)
North	0.9x	0.77	x	1.3	x	24.19	x	0.72	x	0.7	=	10.98	(74)
North	0.9x	0.77	x	1.85	x	24.19	x	0.72	x	0.7	=	15.63	(74)
North	0.9x	0.77	x	1.3	x	13.12	x	0.72	x	0.7	=	5.96	(74)
North	0.9x	0.77	x	1.85	x	13.12	x	0.72	x	0.7	=	8.48	(74)
North	0.9x	0.77	x	1.3	x	8.86	x	0.72	x	0.7	=	4.02	(74)
North	0.9x	0.77	x	1.85	x	8.86	x	0.72	x	0.7	=	5.73	(74)
East	0.9x	2	x	1.02	x	19.64	x	0.72	x	0.7	=	13.99	(76)
East	0.9x	2	x	1.39	x	19.64	x	0.72	x	0.7	=	19.07	(76)
East	0.9x	2	x	1.02	x	19.64	x	0.72	x	0.7	=	13.99	(76)
East	0.9x	2	x	1.02	x	38.42	x	0.72	x	0.7	=	27.38	(76)
East	0.9x	2	x	1.39	x	38.42	x	0.72	x	0.7	=	37.31	(76)
East	0.9x	2	x	1.02	x	38.42	x	0.72	x	0.7	=	27.38	(76)
East	0.9x	2	x	1.02	x	63.27	x	0.72	x	0.7	=	45.08	(76)
East	0.9x	2	x	1.39	x	63.27	x	0.72	x	0.7	=	61.44	(76)
East	0.9x	2	x	1.02	x	63.27	x	0.72	x	0.7	=	45.08	(76)
East	0.9x	2	x	1.02	x	92.28	x	0.72	x	0.7	=	65.75	(76)
East	0.9x	2	x	1.39	x	92.28	x	0.72	x	0.7	=	89.6	(76)
East	0.9x	2	x	1.02	x	92.28	x	0.72	x	0.7	=	65.75	(76)
East	0.9x	2	x	1.02	x	113.09	x	0.72	x	0.7	=	80.58	(76)
East	0.9x	2	x	1.39	x	113.09	x	0.72	x	0.7	=	109.81	(76)
East	0.9x	2	x	1.02	x	113.09	x	0.72	x	0.7	=	80.58	(76)

DER WorkSheet: New dwelling created by change of use

East	0.9x	2	x	1.02	x	115.77	x	0.72	x	0.7	=	82.49	(76)
East	0.9x	2	x	1.39	x	115.77	x	0.72	x	0.7	=	112.41	(76)
East	0.9x	2	x	1.02	x	115.77	x	0.72	x	0.7	=	82.49	(76)
East	0.9x	2	x	1.02	x	110.22	x	0.72	x	0.7	=	78.53	(76)
East	0.9x	2	x	1.39	x	110.22	x	0.72	x	0.7	=	107.02	(76)
East	0.9x	2	x	1.02	x	110.22	x	0.72	x	0.7	=	78.53	(76)
East	0.9x	2	x	1.02	x	94.68	x	0.72	x	0.7	=	67.46	(76)
East	0.9x	2	x	1.39	x	94.68	x	0.72	x	0.7	=	91.93	(76)
East	0.9x	2	x	1.02	x	94.68	x	0.72	x	0.7	=	67.46	(76)
East	0.9x	2	x	1.02	x	73.59	x	0.72	x	0.7	=	52.43	(76)
East	0.9x	2	x	1.39	x	73.59	x	0.72	x	0.7	=	71.45	(76)
East	0.9x	2	x	1.02	x	73.59	x	0.72	x	0.7	=	52.43	(76)
East	0.9x	2	x	1.02	x	45.59	x	0.72	x	0.7	=	32.48	(76)
East	0.9x	2	x	1.39	x	45.59	x	0.72	x	0.7	=	44.27	(76)
East	0.9x	2	x	1.02	x	45.59	x	0.72	x	0.7	=	32.48	(76)
East	0.9x	2	x	1.02	x	24.49	x	0.72	x	0.7	=	17.45	(76)
East	0.9x	2	x	1.39	x	24.49	x	0.72	x	0.7	=	23.78	(76)
East	0.9x	2	x	1.02	x	24.49	x	0.72	x	0.7	=	17.45	(76)
East	0.9x	2	x	1.02	x	16.15	x	0.72	x	0.7	=	11.51	(76)
East	0.9x	2	x	1.39	x	16.15	x	0.72	x	0.7	=	15.68	(76)
East	0.9x	2	x	1.02	x	16.15	x	0.72	x	0.7	=	11.51	(76)
West	0.9x	0.54	x	1.58	x	19.64	x	0.72	x	0.7	=	7.6	(80)
West	0.9x	0.77	x	0.9	x	19.64	x	0.72	x	0.7	=	6.17	(80)
West	0.9x	0.54	x	1.58	x	38.42	x	0.72	x	0.7	=	14.87	(80)
West	0.9x	0.77	x	0.9	x	38.42	x	0.72	x	0.7	=	12.08	(80)
West	0.9x	0.54	x	1.58	x	63.27	x	0.72	x	0.7	=	24.49	(80)
West	0.9x	0.77	x	0.9	x	63.27	x	0.72	x	0.7	=	19.89	(80)
West	0.9x	0.54	x	1.58	x	92.28	x	0.72	x	0.7	=	35.71	(80)
West	0.9x	0.77	x	0.9	x	92.28	x	0.72	x	0.7	=	29.01	(80)
West	0.9x	0.54	x	1.58	x	113.09	x	0.72	x	0.7	=	43.77	(80)
West	0.9x	0.77	x	0.9	x	113.09	x	0.72	x	0.7	=	35.55	(80)
West	0.9x	0.54	x	1.58	x	115.77	x	0.72	x	0.7	=	44.8	(80)
West	0.9x	0.77	x	0.9	x	115.77	x	0.72	x	0.7	=	36.39	(80)
West	0.9x	0.54	x	1.58	x	110.22	x	0.72	x	0.7	=	42.66	(80)
West	0.9x	0.77	x	0.9	x	110.22	x	0.72	x	0.7	=	34.65	(80)
West	0.9x	0.54	x	1.58	x	94.68	x	0.72	x	0.7	=	36.64	(80)
West	0.9x	0.77	x	0.9	x	94.68	x	0.72	x	0.7	=	29.76	(80)
West	0.9x	0.54	x	1.58	x	73.59	x	0.72	x	0.7	=	28.48	(80)
West	0.9x	0.77	x	0.9	x	73.59	x	0.72	x	0.7	=	23.13	(80)
West	0.9x	0.54	x	1.58	x	45.59	x	0.72	x	0.7	=	17.64	(80)
West	0.9x	0.77	x	0.9	x	45.59	x	0.72	x	0.7	=	14.33	(80)

DER WorkSheet: New dwelling created by change of use

West	0.9x	0.54	x	1.58	x	24.49	x	0.72	x	0.7	=	9.48	(80)
West	0.9x	0.77	x	0.9	x	24.49	x	0.72	x	0.7	=	7.7	(80)
West	0.9x	0.54	x	1.58	x	16.15	x	0.72	x	0.7	=	6.25	(80)
West	0.9x	0.77	x	0.9	x	16.15	x	0.72	x	0.7	=	5.08	(80)

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

(83)m=	72.53	141.36	233.97	346.85	432.49	446.58	423.55	358.43	273.61	167.82	90.28	59.78	(83)

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

(84)m=	450	516.65	595.59	686.47	749.81	742.46	705.55	646.5	573.04	489.45	437.38	425.95	(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	0.97	0.92	0.8	0.65	0.72	0.91	0.99	1	1	(86)

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

(87)m=	19.35	19.5	19.79	20.2	20.58	20.85	20.96	20.93	20.71	20.21	19.71	19.32	(87)

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

(88)m=	19.73	19.73	19.73	19.74	19.75	19.76	19.76	19.76	19.75	19.75	19.74	19.74	(88)

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

(89)m=	1	1	0.99	0.96	0.88	0.7	0.49	0.56	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=	17.55	17.77	18.2	18.8	19.32	19.65	19.74	19.73	19.5	18.82	18.09	17.52	(90)

fLA = Living area ÷ (4) = | 0.39 | (91)

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

(92)m=	18.24	18.44	18.82	19.34	19.81	20.12	20.21	20.2	19.97	19.36	18.72	18.22	(92)

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

(93)m=	18.24	18.44	18.82	19.34	19.81	20.12	20.21	20.2	19.97	19.36	18.72	18.22	(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	0.99	0.96	0.89	0.74	0.56	0.62	0.87	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	448.52	513.45	586.82	657.46	663.96	546.9	392.31	402.05	496.99	477.38	434.8	424.84	(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=	1623.63	1573.43	1428.17	1198.44	929.49	626.82	410.12	430.48	668.79	1003.79	1336.07	1618.42	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	874.28	712.31	625.96	389.51	197.55	0	0	0	0	391.64	648.91	888.02	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 4728.19 | (98)

Space heating requirement in kWh/m²/year | 58.66 | (99)

DER WorkSheet: New dwelling created by change of use

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		92.8	(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)	874.28	712.31	625.96	389.51	197.55	0	0	0	0	391.64	648.91	888.02		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	942.12	767.57	674.53	419.73	212.88	0	0	0	0	422.03	699.26	956.92		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													5095.03	(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)	166.92	146.42	152.14	134.1	129.76	113.58	106.82	120.33	121.09	139.17	150.02	162.13		
Efficiency of water heater													87.3	(216)
(217)m=	89.39	89.36	89.3	89.15	88.79	87.3	87.3	87.3	87.3	89.13	89.32	89.4		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	186.73	163.85	170.36	150.43	146.14	130.1	122.36	137.83	138.71	156.14	167.96	181.35		
Total = Sum(219a)$_{1...12}$ =													1851.96	(219)

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			5095.03	
Water heating fuel used			1851.96	
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			366.7	(232)
Electricity generated by PVs			-2409.59	(233)

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	=	1100.53	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	400.02	(264)

DER WorkSheet: New dwelling created by change of use

Space and water heating	(261) + (262) + (263) + (264) =			1500.55	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	190.32	(268)
Energy saving/generation technologies Item 1		0.519	=	-1250.58	(269)
Total CO2, kg/year		sum of (265)…(271) =		479.21	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		5.95	(273)
EI rating (section 14)				95	(274)

15 Appendix D – New Extension BRUKL

The following BER BRUKL is taken from the SBEM 5.3 software for the new build extension to the commercial space in accordance with current local policy. This is following inclusion of the energy efficiency measures, but before inclusion of the photovoltaic systems proposed.

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

25 Old Gloucester Street

As designed

Date: Tue Jun 06 13:53:23 2017

Administrative information

Building Details

Address: 25 Old Gloucester Street, LONDON, WC1N 3AF

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.3.a.0

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v5.0.3

BRUKL compliance check version: v5.3.a.0

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Jon West

Telephone number: 01206 266 755

Address: The Colchester Centre Hawkins Road, Colchester, CO2 8JX

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	14.2
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	14.2
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	12.5
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.18	0.18	- 0 Basement - Stairs_W_4
Floor	0.25	0.16	1	0 Ground - Stairs_F_13
Roof	0.25	0.14	0.14	0.1 Mezzanine - Stairs_R_4
Windows***, roof windows, and rooflights	2.2	1	1	0.1 Mezzanine - Admin Office_G_5
Personnel doors	2.2	1.4	1.4	0 Ground - Stairs_D_6
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- Gas boiler

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

1- DHW sup. by gas boiler

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	0.027
Standard value	N/A	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
- 0 Basement - Cold-Dry Store	-	-	-	-	-	-	-	-	-	-	N/A
- 0 Basement - Kitchen	-	-	-	-	-	-	-	-	1	-	N/A
- 0 Basement - Stairs	-	-	-	-	-	-	-	-	-	-	N/A
- 0 Basement - Refuse Store	-	-	-	-	-	-	-	-	-	-	N/A
0.1 Mezzanine - Stairs	-	-	-	-	-	-	-	-	-	-	N/A
0.1 Mezzanine - Admin Office	-	-	-	-	-	-	-	-	-	-	N/A
0 Ground - Meeting Room	-	-	-	-	-	-	-	-	-	-	N/A
0 Ground - Stairs	-	-	-	-	-	-	-	-	-	-	N/A
0 Ground - Acc. WC	0.3	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
- 0 Basement - Cold-Dry Store	100	-	-	12
- 0 Basement - Kitchen	-	100	-	231

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
- 0 Basement - Stairs	-	100	-	52
- 0 Basement - Refuse Store	100	-	-	14
0.1 Mezzanine - Stairs	-	100	-	41
0.1 Mezzanine - Admin Office	100	-	-	215
0 Ground - Meeting Room	100	-	-	228
0 Ground - Stairs	-	100	-	53
0 Ground - Acc. WC	-	100	-	50

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
0.1 Mezzanine - Admin Office	NO (-4%)	NO
0 Ground - Meeting Room	N/A	N/A

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	205.6	205.6
External area [m^2]	198	198
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	5	5
Average conductance [W/K]	45.71	68.89
Average U-value [W/m^{2}K]	0.23	0.35
Alpha value* [%]	21.73	20.65

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
100	**D1 Non-residential Institutions: Community/Day Centre**
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	19.36	21.29
Cooling	0	0
Auxiliary	4.84	2.71
Lighting	8.48	15.15
Hot water	6.43	2.67
Equipment*	22.51	22.51
TOTAL**	**39.1**	**41.82**

* Energy used by equipment does not count towards the total for calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	114.56	126.5
Primary energy* [kWh/m^2]	72.32	82.69
Total emissions [kg/m^2]	12.5	14.2

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	59.7	54.8	19.4	0	4.8	0.86	0	0.96	0
	Notional	62.8	63.7	21.3	0	2.7	0.82	0	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	U_{i-Typ}	U_{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.18	- 0 Basement - Stairs_W_4
Floor	0.2	0.07	- 0 Basement - Stairs_S_3
Roof	0.15	0.14	0.1 Mezzanine - Stairs_R_4
Windows, roof windows, and rooflights	1.5	1	0.1 Mezzanine - Admin Office_G_5
Personnel doors	1.5	1.4	0 Ground - Stairs_D_6
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

U_{i-Typ} = Typical individual element U-values [W/(m²K)] U_{i-Min} = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	5

16 Appendix E – Existing Building BRUKL

The following BRUKLs are taken from the SBEM 5.3 software for the existing commercial building in accordance with current local policy. This is following inclusion of the energy efficiency measures, but before inclusion of the photovoltaic systems proposed.

The TER BRUKL calculation has been created for the existing commercial building in accordance with the compliance requirements of Part L2B.

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

25 Old Gloucester Street

As designed

Date: Tue Jun 06 14:02:12 2017

Administrative information

Building Details

Address: 25 Old Gloucester Street, LONDON, WC1N 3AF

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.3.a.0

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v5.0.3

BRUKL compliance check version: v5.3.a.0

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Jon West

Telephone number: 01206 266 755

Address: The Colchester Centre Hawkins Road, Colchester, CO2 8JX

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

The building does not comply with England Building Regulations Part L 2013

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	24.7
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	24.7
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	38.8
Are emissions from the building less than or equal to the target?	BER > TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	1.57	1.6	- 0 Basement - Utility_W_5
Floor	0.25	0.33	1	- 0 Basement - Utility_F_4
Roof	0.25	2.8	2.8	- 0 Basement - Dining Area_R_11
Windows***, roof windows, and rooflights	2.2	4.7	4.96	- 0 Basement - Toilets_G_10
Personnel doors	2.2	1.4	1.4	- 0 Basement - Utility_D_6
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	25

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- Gas boiler

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.96	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

1- DHW sup. by gas boiler

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	Hot water provided by HVAC system	0.002
Standard value	N/A	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	**System type in Non-domestic Building Services Compliance Guide**
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
- 0 Basement - Utility	-	-	-	-	-	-	-	-	-	-	N/A
- 0 Basement - Dining Store	-	-	-	-	-	-	-	-	-	-	N/A
- 0 Basement - Store	-	-	-	-	-	-	-	-	-	-	N/A
- 0 Basement - Circulation	-	-	-	-	-	-	-	-	-	-	N/A
- 0 Basement - Toilets	0.3	-	-	-	-	-	-	-	-	-	N/A
- 0 Basement - Cleaners Store	0.3	-	-	-	-	-	-	-	-	-	N/A
- 0 Basement - Stairs 1	-	-	-	-	-	-	-	-	-	-	N/A
- 0 Basement - Dining Area	-	-	-	-	-	-	-	-	-	-	N/A
0 Ground - Office	-	-	-	-	-	-	-	-	-	-	N/A
0 Ground - Entrance Lobby	-	-	-	-	-	-	-	-	-	-	N/A
0 Ground - Main Hall	-	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting	**Luminous efficacy [lm/W]**			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
- 0 Basement - Utility	100	-	-	14

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
- 0 Basement - Dining Store	100	-	-	29
- 0 Basement - Store	100	-	-	13
- 0 Basement - Circulation	-	100	-	28
- 0 Basement - Toilets	-	100	-	86
- 0 Basement - Cleaners Store	100	-	-	6
- 0 Basement - Stairs 1	-	100	-	33
- 0 Basement - Dining Area	-	100	-	266
0 Ground - Office	100	-	-	97
0 Ground - Entrance Lobby	-	100	-	57
0 Ground - Main Hall	-	100	-	626

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
- 0 Basement - Dining Area	NO (-87.3%)	NO
0 Ground - Office	YES (+29.6%)	NO
0 Ground - Main Hall	NO (-16.5%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	388.9	388.9
External area [m²]	559.2	559.2
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	25	3
Average conductance [W/K]	854.44	269.87
Average U-value [W/m²K]	1.53	0.48
Alpha value* [%]	5.42	25.74

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
100	**D1 Non-residential Institutions: Community/Day Centre**
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	103.1	32.25
Cooling	0	0
Auxiliary	1.89	1.03
Lighting	4.65	7.37
Hot water	61.01	62.19
Equipment*	17.11	17.11
TOTAL**	**170.64**	**102.84**

* Energy used by equipment does not count towards the total for calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	378.18	155.11
Primary energy* [kWh/m²]	220.27	140.37
Total emissions [kg/m²]	38.8	24.7

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	318.1	60.1	103.1	0	1.9	0.86	0	0.96	0
	Notional	95.1	60	32.3	0	1	0.82	0	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	U_{i-Typ}	U_{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.35	- 0 Basement - Dining Store_W_4
Floor	0.2	0.01	- 0 Basement - Store_S_3
Roof	0.15	2.8	- 0 Basement - Dining Area_R_11
Windows, roof windows, and rooflights	1.5	1	0 Ground - Main Hall_G_4
Personnel doors	1.5	1.4	- 0 Basement - Utility_D_6
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

U_{i-Typ} = Typical individual element U-values [W/(m²K)] U_{i-Min} = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	25

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

25 Old Gloucester Street

As designed

Date: Tue Jun 06 14:30:31 2017

Administrative information

Building Details

Address: 25 Old Gloucester Street, LONDON, WC1N 3AF

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.3.a.0

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v5.0.3

BRUKL compliance check version: v5.3.a.0

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Jon West

Telephone number: 01206 266 755

Address: The Colchester Centre Hawkins Road, Colchester, CO2 8JX

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

The building does not comply with England Building Regulations Part L 2013

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	24.7
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	24.7
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	46.9
Are emissions from the building less than or equal to the target?	BER > TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	1.57	1.6	- 0 Basement - Utility_W_5
Floor	0.25	0.33	1	- 0 Basement - Utility_F_4
Roof	0.25	2.8	2.8	- 0 Basement - Dining Area_R_11
Windows***, roof windows, and rooflights	2.2	4.7	4.96	- 0 Basement - Toilets_G_10
Personnel doors	2.2	1.4	1.4	- 0 Basement - Utility_D_6
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	25

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- Gas boiler

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.84	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

1- DHW sup. by gas boiler

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	0.002
Standard value	N/A	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
- 0 Basement - Utility	-	-	-	-	-	-	-	-	-	-	N/A
- 0 Basement - Dining Store	-	-	-	-	-	-	-	-	-	-	N/A
- 0 Basement - Store	-	-	-	-	-	-	-	-	-	-	N/A
- 0 Basement - Circulation	-	-	-	-	-	-	-	-	-	-	N/A
- 0 Basement - Toilets	0.3	-	-	-	-	-	-	-	-	-	N/A
- 0 Basement - Cleaners Store	0.3	-	-	-	-	-	-	-	-	-	N/A
- 0 Basement - Stairs 1	-	-	-	-	-	-	-	-	-	-	N/A
- 0 Basement - Dining Area	-	-	-	-	-	-	-	-	-	-	N/A
0 Ground - Office	-	-	-	-	-	-	-	-	-	-	N/A
0 Ground - Entrance Lobby	-	-	-	-	-	-	-	-	-	-	N/A
0 Ground - Main Hall	-	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
- 0 Basement - Utility	60	-	-	23

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
- 0 Basement - Dining Store	60	-	-	47
- 0 Basement - Store	60	-	-	21
- 0 Basement - Circulation	-	60	-	47
- 0 Basement - Toilets	-	60	-	143
- 0 Basement - Cleaners Store	60	-	-	10
- 0 Basement - Stairs 1	-	60	-	55
- 0 Basement - Dining Area	-	60	-	443
0 Ground - Office	60	-	-	162
0 Ground - Entrance Lobby	-	60	-	94
0 Ground - Main Hall	-	60	-	1043

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
- 0 Basement - Dining Area	NO (-87.3%)	NO
0 Ground - Office	YES (+29.6%)	NO
0 Ground - Main Hall	NO (-16.5%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	388.9	388.9
External area [m^2]	559.2	559.2
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	25	3
Average conductance [W/K]	854.44	269.87
Average U-value [W/m^{2}K]	1.53	0.48
Alpha value* [%]	5.42	25.74

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
100	**D1 Non-residential Institutions: Community/Day Centre**
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	109.87	32.25
Cooling	0	0
Auxiliary	1.89	1.03
Lighting	13.42	7.37
Hot water	70.43	62.19
Equipment*	17.11	17.11
TOTAL**	**195.61**	**102.84**

* Energy used by equipment does not count towards the total for calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	365.4	155.11
Primary energy* [kWh/m^2]	266.97	140.37
Total emissions [kg/m^2]	46.9	24.7

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	296.6	68.8	109.9	0	1.9	0.75	0	0.84	0
	Notional	95.1	60	32.3	0	1	0.82	0	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	U_{i-Typ}	U_{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.35	- 0 Basement - Dining Store_W_4
Floor	0.2	0.01	- 0 Basement - Store_S_3
Roof	0.15	2.8	- 0 Basement - Dining Area_R_11
Windows, roof windows, and rooflights	1.5	1	0 Ground - Main Hall_G_4
Personnel doors	1.5	1.4	- 0 Basement - Utility_D_6
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

U_{i-Typ} = Typical individual element U-values [W/(m²K)] U_{i-Min} = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	25

17 Appendix F – Overheating Assessments

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 06 June 2017

Property Details: 101

Dwelling type:	Flat
Located in:	England
Region:	Thames valley
Cross ventilation possible:	Yes
Number of storeys:	1
Front of dwelling faces:	Unspecified
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	None
Ventilation rate during hot weather (ach):	6 (Windows fully open)

Overheating Details:

Summer ventilation heat loss coefficient:	389.66	**(P1)**
Transmission heat loss coefficient:	78.8	
Summer heat loss coefficient:	468.47	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
West (Terrace door)	0	1
North (Living)	0	1
East (Living 1)	0	1
East (Kitchen)	0	1
East (Bed 1 & Ensuite)	0	1
North (Bed 2)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
West (Terrace door)	1	0.7	1	0.7	**(P8)**
North (Living)	1	0.9	1	0.9	**(P8)**
East (Living 1)	1	0.9	1	0.9	**(P8)**
East (Kitchen)	1	0.9	1	0.9	**(P8)**
East (Bed 1 & Ensuite)	1	0.9	1	0.9	**(P8)**
North (Bed 2)	1	0.9	1	0.9	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
West (Terrace door)	0.7 x	1.58	117.51	0.72	0.7	0.7	58.95	
North (Living)	0.9 x	1.5	81.19	0.72	0.7	0.9	49.71	
East (Living 1)	0.9 x	2.2	117.51	0.72	0.7	0.9	105.54	
East (Kitchen)	0.9 x	1.8	117.51	0.72	0.7	0.9	86.35	
East (Bed 1 & Ensuite)	0.9 x	5.4	117.51	0.72	0.7	0.9	259.04	
North (Bed 2)	0.9 x	1.85	81.19	0.72	0.7	0.9	61.31	
						Total	620.91	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	429.04	413.59	420.88	
Total summer gains	1090.41	1034.5	959.72	**(P5)**

SAP 2012 Overheating Assessment

Summer gain/loss ratio	2.33	2.21	2.05	**(P6)**
Mean summer external temperature (Thames valley)	16	17.9	17.8	
Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	18.58	20.36	20.1	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Not significant**	**Not significant**	

Assessment of likelihood of high internal temperature: Not significant

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 06 June 2017

Property Details: 102

Dwelling type:	Flat
Located in:	England
Region:	Thames valley
Cross ventilation possible:	Yes
Number of storeys:	1
Front of dwelling faces:	Unspecified
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	None
Ventilation rate during hot weather (ach):	6 (Windows fully open)

Overheating Details:

Summer ventilation heat loss coefficient:	438.08	**(P1)**
Transmission heat loss coefficient:	68.8	
Summer heat loss coefficient:	506.86	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
East (Terrace door)	0	1
East (Terrace 1)	0	1
West (Bed 2)	0	1
West (Living)	0	1
North East (Living 1)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
East (Terrace door)	1	0.9	1	0.9	**(P8)**
East (Terrace 1)	1	0.7	1	0.7	**(P8)**
West (Bed 2)	1	0.9	1	0.9	**(P8)**
West (Living)	1	0.9	1	0.9	**(P8)**
North East (Living 1)	1	0.9	1	0.9	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
East (Terrace door)	0.9 x	3.15	117.51	0.72	0.7	0.9	151.11	
East (Terrace 1)	0.7 x	0.78	117.51	0.72	0.7	0.7	29.1	
West (Bed 2)	0.9 x	1.6	117.51	0.72	0.7	0.9	76.75	
West (Living)	0.9 x	1.6	117.51	0.72	0.7	0.9	76.75	
North East (Living 1)	0.9 x	6.75	98.85	0.72	0.7	0.9	272.38	
						Total	606.1	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	456.08	437.19	445.95	
Total summer gains	1104.38	1043.29	962.38	**(P5)**
Summer gain/loss ratio	2.18	2.06	1.9	**(P6)**
Mean summer external temperature (Thames valley)	16	17.9	17.8	

SAP 2012 Overheating Assessment

Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	18.43	20.21	19.95	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Not significant**	**Not significant**	

Assessment of likelihood of high internal temperature: Not significant

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 06 June 2017

Property Details: 201

Dwelling type:	Flat
Located in:	England
Region:	Thames valley
Cross ventilation possible:	Yes
Number of storeys:	1
Front of dwelling faces:	Unspecified
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	None
Ventilation rate during hot weather (ach):	6 (Windows fully open)

Overheating Details:

Summer ventilation heat loss coefficient:	477.4	**(P1)**
Transmission heat loss coefficient:	57.1	
Summer heat loss coefficient:	534.45	**(P2)**

Overhangs:

Orientation:	Ratio:	Z_overhangs:
West (Terrace door)	0	1
North (Living)	0	1
East (Living 1)	0	1
East (Kitchen)	0	1
East (Bed 1 & Ensuite)	0	1
North (Bed 2)	0	1
West (Bath)	0	1

Solar shading:

Orientation:	Z blinds:	Solar access:	Overhangs:	Z summer:	
West (Terrace door)	1	0.7	1	0.7	**(P8)**
North (Living)	1	0.9	1	0.9	**(P8)**
East (Living 1)	1	0.9	1	0.9	**(P8)**
East (Kitchen)	1	0.9	1	0.9	**(P8)**
East (Bed 1 & Ensuite)	1	0.9	1	0.9	**(P8)**
North (Bed 2)	1	0.9	1	0.9	**(P8)**
West (Bath)	1	0.9	1	0.9	**(P8)**

Solar gains:

Orientation		Area	Flux	g_	FF	Shading	Gains	
West (Terrace door)	0.7 x	1.58	117.51	0.72	0.7	0.7	58.95	
North (Living)	0.9 x	2.88	81.19	0.72	0.7	0.9	95.45	
East (Living 1)	0.9 x	1.44	117.51	0.72	0.7	0.9	69.08	
East (Kitchen)	0.9 x	1.62	117.51	0.72	0.7	0.9	77.71	
East (Bed 1 & Ensuite)	0.9 x	4.86	117.51	0.72	0.7	0.9	233.14	
North (Bed 2)	0.9 x	1.85	81.19	0.72	0.7	0.9	61.31	
West (Bath)	0.9 x	0.9	117.51	0.72	0.7	0.9	43.17	
						Total	638.82	**(P3/P4)**

Internal gains:

	June	July	August	
Internal gains	430.02	412.2	420.4	
Total summer gains	1111.33	1051.02	971.96	**(P5)**

SAP 2012 Overheating Assessment

Summer gain/loss ratio	2.08	1.97	1.82	**(P6)**
Mean summer external temperature (Thames valley)	16	17.9	17.8	
Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	18.33	20.12	19.87	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Not significant**	**Not significant**	

Assessment of likelihood of high internal temperature: Not significant

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 06 June 2017

Property Details: 202

Dwelling type:	Maisonette
Located in:	England
Region:	Thames valley
Cross ventilation possible:	Yes
Number of storeys:	2
Front of dwelling faces:	Unspecified
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	None
Ventilation rate during hot weather (ach):	8 (Windows fully open)

Overheating Details:

Summer ventilation heat loss coefficient:	531.46	**(P1)**
Transmission heat loss coefficient:	76.4	
Summer heat loss coefficient:	607.91	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
East (Bed 2)	0	1
West (Bed 1)	0	1
North East (Bed 1, Bath, Bed 2)	0	1
East (Living)	0	1
West (Living)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
East (Bed 2)	1	0.9	1	0.9	**(P8)**
West (Bed 1)	1	0.9	1	0.9	**(P8)**
North East (Bed 1, Bath, Bed 2)	1	0.9	1	0.9	**(P8)**
East (Living)	1	0.9	1	0.9	**(P8)**
West (Living)	1	0.9	1	0.9	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
East (Bed 2)	0.9 x	1.95	117.51	0.72	0.7	0.9	93.54	
West (Bed 1)	0.9 x	3.28	117.51	0.72	0.7	0.9	157.35	
North East (Bed 1, Bath, Bed 2)	0.9 x	6.48	98.85	0.72	0.7	0.9	261.48	
East (Living)	0.9 x	1.43	117.51	0.72	0.7	0.9	68.6	
West (Living)	0.9 x	8.93	117.51	0.72	0.7	0.9	428.38	
						Total	1009.35	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	418.81	401.45	409.39	
Total summer gains	1494.98	1410.8	1281.27	**(P5)**
Summer gain/loss ratio	2.46	2.32	2.11	**(P6)**
Mean summer external temperature (Thames valley)	16	17.9	17.8	

SAP 2012 Overheating Assessment

Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	18.71	20.47	20.16	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Not significant**	**Not significant**	

Assessment of likelihood of high internal temperature: Not significant

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 06 June 2017

Property Details: 203

Dwelling type:	Maisonette
Located in:	England
Region:	Thames valley
Cross ventilation possible:	No
Number of storeys:	2
Front of dwelling faces:	Unspecified
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	None
Ventilation rate during hot weather (ach):	4 (Windows fully open)

Overheating Details:

Summer ventilation heat loss coefficient:	256.57	**(P1)**
Transmission heat loss coefficient:	60.4	
Summer heat loss coefficient:	317.01	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
East (Bed 2)	0	1
West (Bed 1)	0	1
East (Living)	0	1
West (Living)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
East (Bed 2)	1	0.9	1	0.9	**(P8)**
West (Bed 1)	1	0.9	1	0.9	**(P8)**
East (Living)	1	0.9	1	0.9	**(P8)**
West (Living)	1	0.9	1	0.9	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
East (Bed 2)	0.9 x	0.63	117.51	0.72	0.7	0.9	30.22	
West (Bed 1)	0.9 x	3.28	117.51	0.72	0.7	0.9	157.35	
East (Living)	0.9 x	0.78	117.51	0.72	0.7	0.9	37.42	
West (Living)	0.9 x	8.93	117.51	0.72	0.7	0.9	428.38	
						Total	653.37	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	408.73	391.84	399.73	
Total summer gains	1102.3	1045.21	974.53	**(P5)**
Summer gain/loss ratio	3.48	3.3	3.07	**(P6)**
Mean summer external temperature (Thames valley)	16	17.9	17.8	
Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	19.73	21.45	21.12	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Slight**	**Slight**	

SAP 2012 Overheating Assessment

Assessment of likelihood of high internal temperature: Slight

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 06 June 2017

Property Details: 301

Dwelling type:	Flat
Located in:	England
Region:	Thames valley
Cross ventilation possible:	Yes
Number of storeys:	1
Front of dwelling faces:	Unspecified
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	None
Ventilation rate during hot weather (ach):	6 (Windows fully open)

Overheating Details:

Summer ventilation heat loss coefficient:	451.63	**(P1)**
Transmission heat loss coefficient:	72.4	
Summer heat loss coefficient:	524.01	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
West (Terrace door)	0	1
North (Kitchen)	0	1
East (Kitchen 1)	0	1
East (Living)	0	1
East (Bed 1)	0	1
North (Bed 2)	0	1
West (Bath)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
West (Terrace door)	1	0.7	1	0.7	**(P8)**
North (Kitchen)	1	0.9	1	0.9	**(P8)**
East (Kitchen 1)	1	0.9	1	0.9	**(P8)**
East (Living)	1	0.9	1	0.9	**(P8)**
East (Bed 1)	1	0.9	1	0.9	**(P8)**
North (Bed 2)	1	0.9	1	0.9	**(P8)**
West (Bath)	1	0.9	1	0.9	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
West (Terrace door)	0.7 x	1.58	117.51	0.72	0.7	0.7	58.95	
North (Kitchen)	0.9 x	1.3	81.19	0.72	0.7	0.9	43.09	
East (Kitchen 1)	0.9 x	2.04	117.51	0.72	0.7	0.9	97.86	
East (Living)	0.9 x	2.78	117.51	0.72	0.7	0.9	133.36	
East (Bed 1)	0.9 x	2.04	117.51	0.72	0.7	0.9	97.86	
North (Bed 2)	0.9 x	1.85	81.19	0.72	0.7	0.9	61.31	
West (Bath)	0.9 x	0.9	117.51	0.72	0.7	0.9	43.17	
						Total	535.61	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	431.43	413.63	422.05	
Total summer gains	1002.11	949.23	886.29	**(P5)**

SAP 2012 Overheating Assessment

Summer gain/loss ratio	1.91	1.81	1.69	**(P6)**
Mean summer external temperature (Thames valley)	16	17.9	17.8	
Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	18.16	19.96	19.74	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Not significant**	**Not significant**	

Assessment of likelihood of high internal temperature: Not significant