

Energy & Sustainability Statement

13 - 15 John's Mews London WC1N 2PA

11th July 2017

Prepared for:

JM13 LTD

eb7 Ltd, Studio 1B, 63 Webber Street, London, SE1 0QW | 020 7148 6290 | info@eb7.co.uk | www.eb7.co.uk

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1.0 The Site & Proposal

The proposed development is located at 13 - 15 John's Mews, London, WC1N 2PA.

The development site relates to two attached buildings (Nos.13 and 15 St John's Mews), 2 x two storey traditional mews buildings located on the western side of the mews and forming part of a terrace.

The proposals comprises of the part demolition, change of use and conversion from B1 garage/workshop/offices (B1) to create 4 x 2 bed flats (C3) with basement and mansard extensions.

1.1 Planning Context

The project sits within the London Borough of Camden (Camden) and specific planning guidance has been taken into account via a per-application consultation.

Specific advice was offered in response to the pre-application submission:-

Sustainability

Water and energy

London Plan policy 5.3 'Sustainable design and construction' removes requirements for the Code for Sustainable Homes but continues to require development to demonstrate that sustainable design standards are integral to the proposal, including its construction and operation.

The Council will continue to require the submission of a Sustainability Statement with applications for new residential development demonstrating how the development mitigates against the causes of climate change and adapts to the effects of climate change in line with existing policies contained in Camden's Core Strategy CS13 Tackling climate change through promoting higher environmental standards and Development Policies document DP22 Sustainable design and construction. Proposals should demonstrate how sustainable design and construction principles, including the relevant measures as set out in DP22 page 104, have been incorporated into the design and proposed implementation.

New residential development will be required to demonstrate that the development is capable of achieving a maximum internal water use of 105 litres per person/day, with an additional 5 litres person/day for external water use.

The Council will continue to apply policies which require compliance with energy performance standards until the Planning and Energy Act 2008 has been amended (likely late 2016). The Code Level 4 equivalent in carbon dioxide emissions reduction below part L Building Regulations 2013 is 20%. New residential dwellings will be required to demonstrate how this has been met by following the energy hierarchy in an energy statement.

Please note that policy CS13 also requires that all developments (existing and new build) achieve a 20% reduction in on-site carbon dioxide emissions through renewable technologies, unless demonstrated that such provision is not feasible.

Based on this, a sustainability statement and water efficiency should be submitted with any future applications.





1.2 Current Planning Policy

Since the date of the pre-application advice the new Local Plan was adopted by Camden on 3rdJuly 2017 and has replaced the Core Strategy and Camden Development Policies documents as the basis for planning decisions and future development in the borough.

Therefore the key policies taken into account when compiling this report are:-

- London Plan Policy
- Camden Local Plan 2017 Chapter 8 (key policies reproduced below)
- Camden's CPG 3 Sustainability

Camden's Local Plan, Chapter 8 - Sustainability and Climate Change

Policy CC1 Climate change mitigation

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

We will:

a. promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;

b. require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met;

c. ensure that the location of development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks;

d. support and encourage sensitive energy efficiency improvements to existing buildings;

e. require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and

f. expect all developments to optimise resource efficiency.

For decentralised energy networks, we will promote decentralised energy by:

g. working with local organisations and developers to implement decentralised energy networks in the parts of Camden most likely to support them;

h. protecting existing decentralised energy networks (e.g. at Gower Street, Bloomsbury, King's Cross, Gospel Oak and Somers Town) and safeguarding potential network routes; and

i. requiring all major developments to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible establishing a new network.

To ensure that the Council can monitor the effectiveness of renewable and low carbon technologies, major developments will be required to install appropriate monitoring equipment.





Policy CC2 Adapting to climate change

The Council will require development to be resilient to climate change.

All development should adopt appropriate climate change adaptation measures such as:

a. the protection of existing green spaces and promoting new appropriate green infrastructure;

b. not increasing, and wherever possible reducing, surface water runoff through increasing permeable surfaces and use of Sustainable Drainage Systems;

c. incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and

d. measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.

Any development involving 5 or more residential units or 500 sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement.

Sustainable design and construction measures

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

e. ensuring development schemes demonstrate how adaptation measures and sustainable development principles have been incorporated into the design and proposed implementation;

f. encourage new build residential development to use the Home Quality Mark and Passivhaus design standards;

g. encouraging conversions and extensions of 500 sqm of residential floorspace or above or five or more dwellings to achieve "excellent" in BREEAM domestic refurbishment; and

h. expecting non-domestic developments of 500 sqm of floorspace or above to achieve "excellent" in BREEAM assessments and encouraging zero carbon in new development from 2019.

1.3 The London Plan

On 10 March 2015, the Mayor published (i.e. adopted) the Further Alterations to the London Plan (FALP). From this date, the FALP are operative as formal alterations to the London Plan (the Mayor's spatial development strategy) and form part of the development plan for Greater London; further updates to The London Plan – not relevant to this report – were adopted in 2016

Chapter 5 deals with London's Response to Climate Change and covers areas such as climate change - minimising energy; (see Policy 5.2 below), sustainable use of water, aggregates and other resources, reducing air and water pollution, managing flood risk and sustainable urban drainage systems, conserving and enhancing the natural environment and promoting sustainable waste behaviour.

Of particular significance is Policy 5.2 Minimising Carbon Dioxide Emissions, which requires:-



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Development proposals should make the fullest contribution to minimising carbon dioxide emission 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

As part of this assessment, it must consider unregulated energy use not covered under the Building Regulations at each stage of the Energy Hierarchy i.e. cooking and appliances and use of equipment.

In March 2016, the Mayor's office published "Energy Planning - Greater London Authority guidance on preparing energy assessments"

This document formally introduces the principle of zero carbon hoes from 1st October 2016 and confirmed that "the London Plan policy seeking 'zero carbon' homes remains in place and was not changed by the recent Minor Alterations to the London Plan."

'Zero carbon homes are defined as homes forming part of major development applications where the residential element of the application achieves at least a 35 per cent reduction in regulated carbon dioxide emissions (beyond Part L 2013) on-site. The remaining regulated carbon dioxide emissions, to 100 per cent, are to be off-set through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

Accordingly, this report is guided by and reports against the above noted required standards, however, it should be noted that the project at 13-15 Johns Mews would not be considered major development.





2.0 Baseline Energy Results

In order to consider the project against the London Plan Energy Hierarchy, this report will first establish the "Baseline" energy consumption.

2.1 Dwelling created via change of use/conversion

The new dwellings created as part of the conversion/extension of the existing office building will be considered against the Building Regulations AD L1B; Accordingly, the energy requirements for space heating, water heating and ventilation for the dwellings within the existing structure have been calculated using the Standard Assessment Procedure 2012 (SAP) in line with Part L1B of the Building Regulations 2013 and the Domestic Heating Compliance Guide 2nd Edition.

The baseline building results have been calculated and are presented in Table 4 below. They have been compiled assuming basic compliance with the building regulations as set out below:-

| Element | AD L1B U -Value Standard |
|---------------------------------|-------------------------------------|
| Retained Walls (where upgraded) | 0.30 |
| New Walls | 0.28 |
| Retained/New Roof - pitched | 0.16 |
| Retained/New Roof - flat | 0.18 |
| Floors | 0.22 |
| Windows | 1.6 |
| Doors | 1.8 |
| Air permeability | 15m ³ /Hr/m ² |

Table 1 - AD L1B Elemental Standards

The replacement of/new controlled services are governed by the Compliance Guides:-

Table 2 – AD L1B - Controlled services and fittings

| Controlled Service | AD L1B Compliance |
|--------------------|---------------------|
| | Requirement |
| Mains Gas Boiler | 86% Efficient |
| DHW | 150I tank with 35mm |
| | Foam insulation |
| Controls | Programmer, Stat, |
| | TRVs & Interlock |
| Lighting | N/A |

The baseline un-regulated energy uses for cooking & appliances in the residential units have been calculated using the SAP Section 16 methodology; the same calculation used for Code for Sustainable Homes (CfSH) Ene 7.

Appliances = $E_A = 207.8 \text{ X} (TFA \text{ X N})^{0.4714}$ Cooking = (119 + 24N)/TFA

N= no of occupant SAP table 1B

TFA – Total Floor Areas

The unregulated energy use per sqm is summarised in Table 3 below

| Unit | Unregulated Energy Use |
|--------|---------------------------|
| | Kg/sqm |
| Flat 1 | 15.08 |
| Flat 2 | 15.13 |
| Flat 3 | 15.29 |
| Flat 4 | 15.23 |

Table 3 – Unregulated Energy Use

The un-regulated emission rates are added to the baseline regulated emission rates (as calculated above) in order to set the total baseline emission rates before then applying the energy hierarchy in line with The London Plan and Camden Local Plans policies: -

Table 4 – Baseline energy consumption and CO2 emissions

| Unit | Baseline Emission | Unregulated Energy | Total baseline | Total baseline |
|--------|-------------------|--------------------|----------------|----------------|
| | (regulated energy | Use | emissions | emissions |
| | use) | | | |
| | Kg/sqm | Kg/sqm | Kg/sqm | Kg |
| Flat 1 | 32.38 | 15.08 | 47.46 | 4617.80 |
| Flat 2 | 34.29 | 15.13 | 49.42 | 4543.81 |
| Flat 3 | 31.49 | 15.29 | 46.78 | 3567.81 |
| Flat 4 | 27.49 | 15.23 | 42.72 | 3488.19 |
| | | | | |
| Total | | | | 16217.61 |

The baseline SAP DER outputs are attached at **Appendix A** confirming the above tabulated data.





3.0 Design for energy efficiency

The first step in the Mayor's 'Energy Hierarchy' as laid out in Section 5 of The London Plan requests that buildings be designed to use improved energy efficiency measures – Be Lean. This will reduce demand for heating, cooling, and lighting, and therefore reduce operational costs while also minimising associated carbon dioxide emissions.

This section sets out the measures included within the design of the proposed dwellings, to reduce the demand for energy, both gas and electricity (not including energy from renewable sources). The table at the end of this section details the amount of energy used and CO_2 produced by the proposed development after the energy efficiency measures have been included.

To achieve reductions in energy, demand the following measures have been included within the design and specification of the building:

3.1 Orientation & Passive Design

Local Plan policy requires "measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.."

The project is based upon a site with fixed southwest – northeast orientation due to its mid-terrace location.

The fenestration design is specific to meeting the design requirements of the building's contribution to the conservation area, so options for external shading are limited.

Accordingly, passive solar gain control is achieved via the use of a solar control glazing with a g-value at less than 0.45.

Advantage is taken of the north easterly aspect – not seen from the road, with larger areas of glazing incorporated to enhance internal daylight levels and reduce reliance on artificial lighting

All flats have a design which enables cross ventilation, enabling a purge ventilation rate at circa 3 air changes per hour - maximising passive cooling, with upper floor flats able to purge ventilate overnight.

3.2 Heating system

The primary heating system for the dwellings will consist of a high efficiency condensing gas boilers - this will in turn provide domestic heating and hot water via highly insulated low loss cylinders for DHW storage

- High efficiency gas boiler (89.3% SEDBUK efficiency)
- Built-in flue gas heat recovery, improving combustion efficiency by up to 3%

To increase the efficiency in the use of the heating system, the following controls will be used in a 'boiler interlock' system to eliminate needless firing of the boiler.

- Time and temperature zone control
- Boiler fitted with delayed start thermostat



3.3 Fabric heat loss

Insulation measures will be utilised to ensure the calculated u values exceed the Building Regulations minima, with specific guidance taken from the design team, with the applicant seeking to go beyond the recommendation contained within Camden's CPG 3:

New basement wall constructions will aim to be achieving a u value of 0.18.

Existing walls will be internally lined to go beyond the requirements of AD L1B, achieving a u value of 0.25.

The mansard roof structures will meet a u-value of 0.12 for the roof and 0.15 for the walls.

The basement floors will be an insulated ground slab floor structure achieving u = 0.14. Glazing

New glazing for windows, roof lights and doors have area weighted average U-Values of 1.4w/m^2 K or better

3.4 Lighting and appliances

A 100% of internal light fittings will be dedicated low-energy/compact fluorescent fittings, with extensive use of LED lighting.

It is anticipated that under the principles of BREEAM and best practice sustainability, all of the electrical appliances will be provided as part of the finished dwelling; fridge/freezers A+ rated, Dishwasher and washing machines A rated and tumble dryer with a B rating.

In addition, again in line with BREEAM principles, any external lighting will be of the low energy type with consideration given to the design and location to reduce light pollution.

3.5 Energy efficiency results

The following table shows a comparison between the baseline scheme assessed under the SAP methodology based upon AD Part L1B minima and the scheme following the introduction of energy efficiency measures (not including energy from renewable sources).

| Unit | "Be lean" Emission | Unregulated Energy | Total "Be lean" | Total emissions |
|--------|--------------------|--------------------|-----------------|-----------------|
| | Rate | Use | emissions | |
| | (regulated energy | | | |
| | use) | | | |
| | Kg/sqm | Kg/sqm | Kg/sqm | Kg |
| Flat 1 | 26.28 | 15.08 | 41.36 | 4024.33 |
| Flat 2 | 26.97 | 15.13 | 42.10 | 3870.81 |
| Flat 3 | 22.26 | 15.29 | 37.55 | 2863.84 |
| Flat 4 | 21.53 | 15.23 | 36.76 | 3001.55 |
| | | | | |
| Total | | | | 13760.54 |

Table 5 – Energy consumption and CO2 reductions



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The results show that, the new dwellings with the energy efficiency measures have achieved emissions reductions of 15.15% over the baseline model and clearly, the applicant has confirmed their commitment to go beyond the requirements of the minimum standards of the Building Regulations through the fabric first approach.

The SAP 2013 Dwelling Emission Rate outputs are attached at Appendix B.





4.0 Supplying Energy Efficiently

The second stage in the Mayor's 'Energy Hierarchy' is to ensure efficient and low carbon energy supply – Be Clean. In particular, this concerns provision of decentralised energy where practical and appropriate.

4.1 Community Heating/Combined Heat and Power (CHP)

Combined heat and power systems are essentially biomass or fossil fuel fired electricity generators that use the heat by-product to provide space and water heating. The electricity generated can be used directly within the host buildings or sold to electricity suppliers on the national grid. These systems can be employed on a large scale for community schemes or at the micro scale for individual dwellings.

Alternatively, larger scale systems operated as a standalone entity can be used to provide heat and power to the local neighbourhood – a District Energy Network (DEN).

The London Heat map has been consulted to look at the potential for the project to connect to a DEN now, or in the future. However, as can be seen from the extract below, the development site at Johns Mew's is some 150m distant from any opportunity areas of decentralised energy potential.



With this in mind, the distance that the heat network flow and return would need to be brought to site, as well as the small scale of the proposed development, the design team has agreed that a district heating system would not be appropriately employed in this scheme.



So, in line with best practice - we consider on-site provision:-

4.2 On-site CHP/District Heating

The heat production facility for a district heating scheme is generally considered to include heat only boilers (HOB) and/or the production of both electricity and heat i.e. CHP.

CHP is, as a rule of thumb, is only operated as a base load as, depending on the technology, it may be difficult and/or inefficient to operate according to daily variations in demand.

In a well-designed district heating network heat from CHP will provide between 60% and 80% of the annual heat (heating and hot water) requirement with heat-only boiler plants providing the peak load and back-up. To maximise efficiency of the engine it needs to run for at least 17 hours a day; therefore, the heat load needs to be present for this period.

Clearly, as a limited scale domestic development, with only the limited combined DHW demand to support a CHP installation, the economy of scale, in terms of year-round demand simply isn't present and as such the potential use of on-site CHP can be dismissed.

We should however, consider the use of a heat only DEN;

In more recent times, the difference between the actual and assumed efficiency of DH networks has come under the spotlight from a number of different sources.

Indeed, in recent studies collated by Innovate UK in the Building Data Exchange, inappropriately installed community heating systems were suffering heat losses of 50% or more.

However, when it comes to small scale networks as least, it is becoming very apparent that there is a difference between theoretical and real-world system efficiencies. In the CIBSE Technical symposium "CHP and District Heating - how efficient are these technologies?" (2011), further commentary is made on this issue.

This report identifies and acknowledges that the heat losses within a well-designed DH network will be at minimum of 15%, so immediately it can be seen that, a large scale modular boiler system offering gross efficiencies at circa 96%, will be less efficient than a local condensing boiler with a gross efficiency of 92%-93% at point of delivery.

It should be noted, that the efficiency of the latest condensing boilers with built-in heat recovery systems and modern controls, such as the Vaillant Home boilers noted under 3.2 above, that they can achieve gross efficiencies close to 96%. A further significant benefit of the use of local gas boilers, is the lower NOx emission associated, commonly less than 40mg/KWh of heat delivered.

Clearly, a DH network driven by HOB would not be viable at the John's Mews development.





5.0 Renewable Energy Options

The final element of the Mayor's 'Energy Hierarchy' requires development proposals should provide a reduction in expected carbon dioxide emissions through the use of onsite renewable energy generation, where feasible – Be Green.

Renewable energy can be defined as energy taken from naturally occurring or renewable sources, such as sunlight, wind, waves/tides, geothermal etc. Harnessing these energy sources can involve a direct use of natural energy, such as solar water heating panels, or it can be a more indirect process, such as the use of Biofuels produced from plants, which have harnessed and embodied the suns energy through photosynthesis.

The Energy Efficiency measures outlined under 3.0 above have the most significant impact on the heating and hot water energy requirements for the dwelling, and the associated reduction in gas consumption.

It should be noted that each Kwh of gas energy saved reduces emissions by 0.216kgCO₂/kwh, whereas, grid based electrical energy has a emissions factor of 0.519kgCO₂/kwh and accordingly, emphasis will be placed upon "off-setting" grid based electricity in order to achieve the optimum use of renewable technologies.

This section then sets out the feasibility of implementing different energy technologies in consideration of: -

- Potential for Carbon savings
- Capital costs
- Running costs
- Payback period as a result of energy saved/Government incentives
- Maturity/availability of technology
- Reliability of the technology and need for back up or alternative systems.

5.1 Government incentives

5.1.1 Feed in Tariff

Feed in Tariffs (FiTs) replaced ROCs for renewable energy generators rated at less than 5MW in April 2010. FiTs are payments made for every kilowatt-hour kWh of renewable electricity generated and the level of the payment is laid down by the government, and varies for different renewable energy sources and at different scales. Unlike the flat rates paid for ROCs, FiTs are designed to compensate for less efficient/more expensive sources of renewable energy – and for the first time – make the investment in low and zero carbon technologies viable for both domestic generators and larger companies alike.

Recent reviews of Feed in Tariff rates will lead to lower returns on such technologies in 2016, but the expectation is that system capital costs and enhanced efficiencies will compensate for this over the medium term.





5.1.2 Renewable Heat Incentive

The Renewable Heat Incentive (RHI) was formally launched by the UK Government on 10th March 2011. The RHI will pay a tariff payment to renewable technologies that provide heat energy from a renewable source, with the payment relating to the KWh of heat energy provided e.g. if a property has a heat load of 20,000 KWh per annum, and it is 100% provided from a renewable source, then the tariff is paid against the 20,000KWh.

The Government decided on a two stage delivery - the first stage being for non-domestic schemes, which commenced in July 2011, with domestic scheme having come on stream in April 2014.

5.2 Wind turbines

Wind turbines come in two main types'- horizontal axis and vertical axis. The more traditional horizontally axis systems rotate around the central pivot to face into the wind, whilst vertical axis systems work with wind from all directions.

The potential application of wind energy technologies at a particular site is dependent upon a variety of factors. But mainly these are: -

- Wind speed
- Wind turbulence
- Visual impact
- Noise impact
- Impact upon ecology

The availability and consistency of wind in urban environments is largely dependent upon the proximity, scale and orientation of surrounding obstructions. The site is surrounded with other properties of 3-4 storeys in height adjacent and in all directions.

To overcome these obstructions and to receive practical amounts of non-turbulent wind, the blades of a wind turbine would need to be placed significantly above the roof level of the surrounding buildings.

It is clear that a wind turbine of this size would be considered unacceptable in this location and is therefore dismissed as an option.

5.3 Solar Energy

5.3.1 Solar water heating

Solar water heating panels come in two main types; flat plate collectors and evacuated tubes. Flat plate collectors feed water, or other types of fluid used specifically to carry heat, through a roof mounted collector and into a hot water storage tank. Evacuated tube collectors are slightly more advanced as they employ sealed vacuum tubes, which capture and harness the heat more effectively.

Solar energy can be delivered in 2 formats as noted above, each system requiring an appropriate area in which to install panels.

The new development at John's Mews has some available roof space with a clear southerly aspect, so solar panels could be an option.





However, given the limited roof space available, and the strategy to off-set the electrical use, solar PV may be a stronger candidate (see below) and would offer a greater return in terms of carbon savings

Solar thermal systems also require a constant demand on hot water, and a large solar tank in which to store the pre-heated water as well as a management strategy to ensure energy savings and environmental benefits are maximised – the space required not being a commodity available for the development at John's Mews

Additionally, the development is located within the Bloomsbury conservation area, therefore the feasibility of installing solar thermal collectors is not considered viable due to the aesthetic constraints.

Accordingly, this technology is dismissed as being inappropriate for the development.

5.3.2 Photovoltaics (PV)

Solar panel electricity systems, also known as solar photovoltaics (PV), capture the sun's energy using photovoltaic cells. These cells will be accumulated on a PV panel, usually about 2.0m x 1.0m. These panels are then wall, roof or floor mounted and are connected directly to the electricity grid via the properties meter. In this way, the electrical generation can be fully exported and is not related to the consumption of the houses within this development.

PV panels also offer a much more attractive return from the Feed in Tariff often achieving 6-8% returns or better.

As noted above, the available roof spaces located on the main roof areas would be appropriate for solar PV panels. However, also as noted above, the development is located within the Bloomsbury conservation area where rooftop development is not acceptable. Therefore Photovoltaics are not proposed for inclusion.

5.4 Biomass heating

Biomass is a term given to fuel derived directly from biological sources for example rapeseed oil, wood chip/pellets or gas from anaerobic digestion. It can only be considered as a renewable energy source if the carbon dioxide emitted from burning the fuel is later recaptured in reproducing the fuel source (i.e. trees that are grown to become wood fuel, capture carbon as they grow).

Biomass heating systems require space to site a boiler and fuel hopper along with a supply of fuel. There also needs to be a local source of biomass fuel that can be delivered on a regular basis.

It is not considered appropriate to specify biomass boilers within these dwellings, as they do not have space to accommodate a relatively large biomass boiler and a supply of fuel.

A boiler of this type would replace the need for a conventional gas boiler and therefore offset all the gas energy typically used for space and water heating, however, biomass releases high levels of NO_x emissions and would therefore have to be considered carefully against the high standard of air quality requirements set out in the London Plan.





5.5 Ground source heat pump

All heat pump technologies utilise electricity as the primary fuel source – in this case displacing gas, as such, the overall reduction in emissions when using this technology can be less effective when opposed to a technology that is actually displacing electricity.

Ground source heating or cooling requires a source of consistent ground temperature, which could be a vertical borehole or a spread of pipework loops and a 'heat pump'. The system uses a loop of fluid to collect the more constant temperature in the ground and transport it to a heat pump. In a cooling system this principle works in reverse and the heat is distributed into the ground.

The heat pump then generates increased temperatures by 'condensing' the heat taken from the ground, producing hot water temperatures in the region of 45°C. This water can then be used as pre-heated water for a conventional boiler or to provide space heating with an under floor heating system.

The use of a ground source heating/cooling system will therefore require:

- Vertical borehole or ground loop
- Use of under floor heating
- Space for heat pump unit

Clearly, there is insufficient land area to install low level collector loops, leaving deep bore GSHP as the only potential option.

Normally the boreholes would need to be 6 to 8 metres apart and a 100 metre deep borehole will only provide about 5kW of heat. The borehole should also be formed around 3m away from the perimeter of the building and most specialists don't recommend using the structural boreholes.

Clearly, in the case of the proposed development at John's Mews, there is no scope for the locating of the ground collector devices and as such, ground source heating cannot be considered.

5.6 Air source heat pump

Air source heating or cooling also employs the principle of a heat pump. This time either, upgrading the ambient external air temperature to provide higher temperatures for water and space heating, or taking warmth from within the building and dissipating it to the outdoor air.

It must be remembered that heat pumps utilise grid based electricity and the associated emissions, so that the actual reduction in emissions can be limited. Assuming a seasonal system efficiency of 320% (Coefficient of Performance of 3.2) and that the air source heat pump will replace 90% of the space heating/hot water demand, then the system would reduce the overall CO_2 emissions by approximately 10-20%. The table below demonstrates, on the assumption of a demand of 10000Kwh/year for heating and hot water:-





Table 6 – Comparative Heat Pump performance

| | | - | |
|---------------------------------------|---------------------------------|---|---|
| Type of Array | Energy Consumption (Kwh/yr.) | Emission factor (kgCO ₂ /Kwh) | Total CO ₂ emissions (kg/annum) |
| 90% efficient gas boiler | 11111 | 0.216 | 2400 |
| 320% efficient ASHP | 2813 | 0.519 | 1460 |
| 100% efficient immersion (back-up) | 1000 | 0.519 | 519 |

A theoretical carbon saving of 17.5%

With the above data in mind, clearly an ASHP could be an option, however, heat pump would require external installation, giving rise to: -

- A potential visual impact to neighbouring properties overlooking the installation location.
- The requirement for a noise impact assessment, and the potential for a noise nuisance to be present in this dense suburban location.
- Associated loss of amenity space.
- Negative impact on the Bloomsbury conservation area.

Given such impacts, it is considered that air source heat pumps would not be appropriate at this location.

5.7 Final Emissions Calculation

The results of the assessment of suitable technologies relative to the nature, locations and type of development suggest that, principally due to the development's location in the Bloomsbury conservation area – there are no suitable renewable technologies that would be acceptable in this location.

Accordingly, the data set out in Table 5 above and reproduced below demonstrate the final design SAP DER outputs, which are attached at **Appendix B**: -

| Unit | "Be lean" Emission | Unregulated Energy | Total "Be lean" | Total emissions |
|--------|--------------------|--------------------|-----------------|-----------------|
| | Rate | Use | emissions | |
| | (regulated energy | | | |
| | use) | | | |
| | Kg/sqm | Kg/sqm | Kg/sqm | Kg |
| Flat 1 | 26.28 | 15.08 | 41.36 | 4024.33 |
| Flat 2 | 26.97 | 15.13 | 42.10 | 3870.81 |
| Flat 3 | 22.26 | 15.29 | 37.55 | 2863.84 |
| Flat 4 | 21.53 | 15.23 | 36.76 | 3001.55 |
| | | | | |
| Total | | | | 13760.54 |

Table 5 – Energy consumption and CO2 reductions

The data at Table 5 confirms that overall emissions – including unregulated energy use - have been reduced by **15.15%** over and above the baseline model.





Excluding the un-regulated use, i.e. considering emissions controlled under the Building Regulations AD Part L, then the reduction equates to **22.44%** and given the proposals put in place above, it is clear that the applicant has sought to meet the requirements of London Borough of Camden's Policies through a careful design strategy involving best practice passive design and efficient services.



6.0 Sustainable Development

Due to the small scale nature of the development, LDF Policy DP22's requirement for a formal Eco Homes assessment does not apply - indeed, in March 2015, HM Government withdrew the Code for sustainable Homes and any other technical housing standard.

However, the applicant is committed to adopting many of the principles of Eco Homes and the Code for Sustainable Homes:-

Materials

- Newly construction elements will be considered against the BRE Green Guide to ensure that, where practical, the most environmentally friendly construction techniques are deployed.
- Construction materials will be sourced from suppliers capable of demonstrating a culture of responsible sourcing via environmental management certification, such as BES6001
- Insulation materials will be selected that demonstrate the use of blowing agents with a low global warming potential, specifically, a rating of 5 or less. Additionally, all insulants used will demonstrate responsible sourcing of material and key processes.
- The principle contractor with be required to produce a site waste management plan and sustainable procure plan, in line with BREEAM requirements – this will include a pre-demolition audit to identify demolition materials to reuse on-site or salvage appropriate materials to enable their reuse or recycling off-site. The procurement plan will follow the waste hierarchy Reduce; Reuse & Recycle.
- A Site Waste Management Plan (SWMP) will be developed prior to commencement of development stage to inform the adoption of good practice waste minimisation in design. This will set targets to minimise the generation of non-hazardous construction waste using the sustainable procurement plan to avoid over-ordering and to use just-in-time delivery policies.
- The developer will also maximise the use of recycled and secondary aggregates.
- Waste and recycling appropriate internal and external storage space will be provided to ensure that residents can sort, store and dispose of waste and recyclable materials in line with Camden's collection policies.

Pollution

- The contractor will also monitor the use of energy and water use during the construction phase and incorporate best site practices to reduce the potential for air (dust) and ground water pollution.
- The completed dwellings will use low NOx emission gas boilers, with a minimum NOx rating of 5 and emissions at less than 40mg/Kwh
- The main contractor will be required to register the site with the Considerate Constructors Scheme and achieve a best practice score of 25 or more.
- To void the issue of noise pollution, the development will comply with Building Regulations Part E, providing a good level of sound insulation between the proposed development and surrounding buildings. All new windows will be double glazed to minimise the transmission of noise between the building and adjacent properties.





Energy

- All the new dwellings will incorporate the energy efficient measures as set out within the main body of this report.
- Each home will also be supplied with a Home User Guide offering practical advice on how to use the home economically and efficiently.
- This will be further enhanced by the installation of smart energy metering, enabling occupants to accurately assess their energy usage and thereby, manage it.

Water

- The development minimise water use as far as practicable by incorporating appropriate water efficiency and water recycling measures. In new homes, the applicants will ensure that all dwellings meet the required level of 105 litres maximum daily allowable usage per person in accordance with Level 4 of the Code for Sustainable Homes. A sample Part G internal water use calculation is attached at **Appendix D**
- The individual dwelling at basement level will have rainwater harvesting water butts connected to rainwater pipes to enable the recycling of rainwater for the upkeep of terrace planting
- SuDs The site is located in Flood Zone 1 at low risk of flooding. The Site is
 also currently completely impermeable with hard landscaping and building areas,
 the main aim of development will be to improve the water retention of the site.
 The design will ensure the peak rate of surface runoff into watercourse is no
 worse than existing rate.
- Elements of green roof are to be incorporated into the design proposals to further aid in the attenuation of surface water run-off, as well as enhances site ecology.





7.0 Conclusions

This report has detailed the baseline energy requirements for the proposed development, the reduction in energy demand as a result of energy efficiency measures and the potential to achieve further CO₂ reductions using renewable energy technologies.

The baseline results have shown that if the development was built to a standard to meet only the minimum requirements of current building regulations, the total amount of CO_2 emissions would be **16,218Kg/year**.

Following the introduction of passive energy efficiency measures into the development, as detailed in section 3, the total amount of CO_2 emissions would be reduced to **13,761Kg/year**, a reduction of **15.15%**.

There is also a requirement to reduce CO_2 emissions across the development using renewable or low-carbon energy sources, where practical and feasible. Therefore, the report has considered the feasibility of the following technologies:

- Wind turbines
- Solar hot water
- Photovoltaic systems
- Biomass heating
- CHP (Combined heat and power)
- Ground & Air source heating

The results of the assessment of suitable technologies relative to the nature, location and type of development suggest that given the limitations imposed by the sensitive location within the Bloomsbury conservation area, there are no appropriate renewable technologies that can be recommended for the Johns Mews development.

The SAP models (reproduced at **Appendix B**) for the development which have also been detailed above in Table 5, which show a final gross emission level of **13,760/year** representing a total reduction in emission over the baseline model, considering unregulated energy, of **15.15%**.





Tables 8 & 9 Demonstrate how the project at John's Mews aligns with the London Plan requirements and current GLA guidance on the preparation of energy statements.

Table 8 – Carbon Emission Reductions – Domestic Buildings

| | Carbon Dioxide Emissions (Tonnes CO2 per annum) | | | | | | |
|--|--|-------------|--|--|--|--|--|
| | Regulated | Unregulated | | | | | |
| Building Regulations 2013 Part L1A Compliant Development | 10.95 | 5.27 | | | | | |
| After Energy Demand Reduction | 8.49 | 5.27 | | | | | |
| After renewable energy | 8.49 | 5.27 | | | | | |

Table 9 - Regulated Emissions Savings - Domestic Buildings

| | Regulated Carbo | n Dioxide Savings |
|---|------------------------|-------------------|
| | (Tonnes CO2 per annum) | % |
| Savings from energy demand reduction | 2.46 | 22.47 |
| Savings from renewable energy | 0.00 | 0.00 |
| Total Cumulative Savings | 2.46 | 22.47 |
| Annual Savings from off- set payment | 8.49 | |
| Cumulative savings for off-set payment | 254.7 | |



ej7°

Appendix A

Baseline Energy Use:-

SAP 2012 Dwelling Emission Rate Outputs



| | | | | | | | User D | Details: | | | | | | |
|----------------------------|---------------------------------|--------------------|----------------------------|-------------------------|-----------------------|-------------------|------------|---------------------|--------------|--------------|----------|-----------|-------------------------|--------------|
| Assessor Name: George Farr | | | | | | | | Stroma Number: STRC | | | | | 028460 | |
| Softw | Software Name: Stroma FSAP 2012 | | | | | | | Softwa | are Vei | on: 1.0.4.6 | | | | |
| | | | | | | Р | roperty | Address | : Flat 1 - | Base | | | | |
| Addre | SS : | | | | | | | | | | | | | |
| 1. Ove | erall dwe | elling di | mension | s: | | | | | | | | | | |
| | | | | | | | Are | a(m²) | | Av. He | ight(m) | - | Volume(m ³) | - |
| Ground | l floor | | | | | | Ę | 52.41 | (1a) x | 2 | .95 | (2a) = | 154.61 | (3a) |
| First flo | or | | | | | | 4 | 14.88 | (1b) x | 3 | .25 | (2b) = | 145.86 | (3b) |
| Total flo | oor area | a TFA = | (1a)+(1 | o)+(1c)+ | (1d)+(1e | e)+(1n |) | 97.29 | (4) | | | - | | _ |
| Dwellin | g volum | ne | | | | | L | | (3a)+(3b |)+(3c)+(3d | l)+(3e)+ | .(3n) = | 300.47 | (5) |
| 2. Ver | ntilation | rate: | | | | | | | | | | | | _ |
| | | | | main heating | Se h | econdar eating | у | other | | total | | | m ³ per hour | |
| Numbe | r of chir | nneys | Г | 0 |] + [| 0 |] + [| 0 |] = [| 0 | x 4 | 40 = | 0 | (6a) |
| Numbe | r of ope | n flues | Γ | 0 | + | 0 |] + [| 0 |] = [| 0 | x | 20 = | 0 | (6b) |
| Numbe | r of inte | rmittent | fans | | | | | | | 3 | x ′ | 10 = | 30 | (7a) |
| Numbe | r of pas | sive ver | nts | | | | | | L L | 0 | x ^ | 10 = | 0 |] (7b) |
| Numbe | r of flue | less gas | s fires | | | | | | L L | 0 | x 4 | 40 = | 0 |] (7c) |
| | | Ū | | | | | | | L | - | | | |]`` |
| | | | | | | | | | | | | Air ch | hanges per ho | ur |
| Infiltrati | on due | to chim | neys, flu | es and f | ans = <mark>(6</mark> | a)+(6b)+(7 | a)+(7b)+(| (7c) = | Г | 30 | · · | ÷ (5) = | 0.1 | (8) |
| lf a pr | essurisati | on test ha | is been ca | rried out o | r is intende | ed, proceed | d to (17), | otherwise | continue fr | rom (9) to (| (16) | | | - |
| Num | ber of st | toreys ir | n the dw | elling (n | S) | | | | | | | | 0 | (9) |
| Addit | tional inf | filtration | 0.05 (| | | | | | | | [(9)- | -1]x0.1 = | 0 | (10) |
| Struc | ctural inf | of wall an | : 0.25 to | r steel o | r timber i | frame or | 0.35 to | r masoni | ry constr | uction | | | 0 | (11) |
| dec | ducting are | eas of ope | enings); if | equal user | 0.35 | ponung to | ine grea | | a (anoi | | | | | |
| lf sus | spendec | d woode | n floor, | enter 0.2 | (unseal | ed) or 0. | 1 (seale | ed), else | enter 0 | | | | 0 | (12) |
| lf no | draught | lobby, | enter 0.0 | 05, else | enter 0 | | | | | | | | 0 | (13) |
| Perce | entage o | of windo | ows and | doors di | aught st | ripped | | | | | | | 0 | (14) |
| Wind | low infilt | tration | | | | | | 0.25 - [0.2 | 2 x (14) ÷ 1 | = [00 | | | 0 | (15) |
| Infiltr | ation ra | te | | | | | | (8) + (10) | + (11) + (1 | 12) + (13) - | + (15) = | | 0 | (16) |
| Airpo | ermeabi | ility valu | ie, q50, | expresse | ed in cub | rac metre | s per ho | our per s | quare m | etre of e | nvelope | area | 15 | (17) |
| II Dased | u on air rmeability | permea value an | IDIIITY VA nlies if a n | iue, men ressurisati | (10) = ((1)) | 7) - 20j+(0 | e or a de | ree air ne | rmeability | is heina u | bad | | 0.85 | (18) |
| Numbe | r of side | es shelte | ered | 1000011000 | 01110011140 | 5 00011 0011 | | gree an pe | incability | is being ut | 500 | | 0 | (19) |
| Shelter | factor | | | | | | | (20) = 1 - | [0.075 x (1 | 9)] = | | | 1 | (20) |
| Infiltrati | on rate | incorpo | rating sł | nelter fac | tor | | | (21) = (18 |) x (20) = | | | | 0.85 | (21) |
| Infiltrati | on rate | modifie | d for mo | nthly wir | nd speed | k | | | | | | | | _ |
| [| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Monthly | y averaç | ge wind | speed f | rom Tab | e 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 F | actor (2 | 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 | | |
| Adjuste | ed infiltra | ation rat | e (allowi | ing for sl | nelter an | d wind s | speed) = | = (21a) x | (22a)m | | | | | |
| • | 1.08 | 1.06 | 1.04 | 0.93 | 0.91 | 0.81 | 0.81 | 0.79 | 0.85 | 0.91 | 0.96 | 1 | | |
| Calcul | ate effec | ctive air | change | rate for t | he appli | cable ca | ise | _ ! | | | | г | | |
| IT ME | ecnanica | | | ondix N (2 | (25) = (22) | | oquation | (NE)) othe | nuico (22k | (220) | | Ļ | 0 | (23a) |
| If hale | aust all the | heat reco | overv: effic | iency in % | allowing f | or in-use f | factor (fro | m Table 4h | n) = |) – (23a) | | Ļ | 0 | (230) |
| a) If | halance | nd mech | anical ve | ntilation | with he | at recov | | | n = (2) | 2h)m ± (| (23h) v [| _ 1 _ (23c) | 0 · 1001 | (230) |
| (24a)m= | | | | | | | | | | | | $\frac{1}{0}$ | - 100] | (24a) |
| () b) If | halance | d mech | l anical ve | I | without | heat rec | | M\/) (24 | $1 - \frac{1}{2}$ | 1 | (23h) | | | , |
| (24b)m= | 0 | | | 0 | 0 | 0 | | | | | 0 | 0 | | (24b) |
| c) If | whole h | L OUSE EX | I tract ver | L ntilation (| L or positiv | L /e input : | I ventilati | on from | L outside | I | Į | <u> </u> | | |
| i i | if (22b)n | n < 0.5 > | < (23b), 1 | then (24 | c) = (23k | o); other | wise (24 | 4c) = (22 | b) m + 0 | .5 × (23 | c) | | | |
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (24c) |
| d) If | natural | ventilatio | on or wh | ole hous | se positiv | ve input | ventilat | ion from | loft | | - | | | |
| i | if (22b)n | n = 1, th | en (24d) | m = (22 | b)m othe | erwise (2 | 24d)m = | 0.5 + [(2 | 22b)m² x | 0.5] | | | | |
| (24d)m= | 1.08 | 1.06 | 1.04 | 0.94 | 0.92 | 0.83 | 0.83 | 0.81 | 0.86 | 0.92 | 0.96 | 1 | | (24d) |
| Effe | ctive air | change | rate - er | nter (24a | i) or (24k | o) or (24 | c) or (24 | 4d) in bo | x (25) | <u> </u> | | <u> </u> | | (05) |
| (25)m= | 1.08 | 1.06 | 1.04 | 0.94 | 0.92 | 0.83 | 0.83 | 0.81 | 0.86 | 0.92 | 0.96 | 1 | | (25) |
| 3. He | at losse | s and he | eat loss | paramet | er: | | | | | | | | | |
| ELEN | IENT | Gros area | ss (m²) | Openin rr | igs 1² | Net Ar A ,r | rea m² | U-val W/m2 | ue 2K | A X U (W/ | K) | k-value kJ/m²⋅K | A k | ∖Xk J/K |
| Doors | | | | | | 1.89 | x | 1.6 | = | 3.024 | | | | (26) |
| Windo | ws Type | e 1 | | | | 9.96 | x x | 1/[1/(1.6)+ | - 0.04] = | 14.98 | | | | (27) |
| Windo | ws Type | 2 | | | | 21.89 | э х | 1/[1/(1.6)+ | - 0.04] = | 32.92 | | | | (27) |
| Rooflig | phts | | | | | 3.12 | x x | 1/[1/(1.6) + | 0.04] = | 4.992 | | | | (27b) |
| Floor | | | | | | 52.4 | 1 × | 0.22 | = | 11.530 | 2 | | 7 [| (28) |
| Walls - | Гуре1 | 45.3 | 39 | 0 | | 45.39 | э х | 0.28 | = | 12.71 | | | i — | (29) |
| Walls - | Гуре2 | 45.5 | 55 | 31.8 | 5 | 13.7 | · x | 0.28 | | 3.84 | | | i — | (29) |
| Walls - | ГуреЗ | 21.8 | 39 | 1.89 |) | 20 | x | 0.25 | | 5 | | | i — | (29) |
| Roof | | 12.5 | 53 | 3.12 | 2 | 9.41 | × | 0.18 | = | 1.69 | | | i — | (30) |
| Total a | rea of e | lements | s, m² | L | | 177.7 | 7 | L | | | I | | J L | (31) |
| Party v | vall | | | | | 42.43 | 3 X | 0 | | 0 | | | <u>ا</u> ا | (32) |
| Party o | eiling | | | | | 39.88 | 3 | | | | I | | i | (32b) |
| * for win | dows and | roof wind | ows, use e | effective wi | indow U-va | alue calcul | lated usin | g formula : | 1/[(1/U-vali | ue)+0.04] a | L as given in | paragraph | ы Ц 3.2 | ` |
| Fabric | heat los | as on doth ss W/K | = S (A v | iternar war | is and par | แแบกร | | (26)(30 |) + (32) = | | | Г | 00.30 | (22) |
| Heat c | apacity | Cm = S(| (A x k) | -, | | | | | ((28). | (30) + (3 | 2) + (32a). | (32e) = | 12446.8 | (34) |

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

Indicative Value: Medium

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K

250

(35)

| can be ι | ised inste | ad of a de | tailed calc | ulation. | | | | | | | | | | |
|-----------------|-------------------|--------------------------|--------------|-------------------------|------------------|-------------|------------|--------------------|------------|------------------------|------------------------|-------------------|---------|-------|
| Therm | al bridg | es : S (L | x Y) cal | culated u | using Ap | pendix ł | < | | | | | | 26.67 | (36) |
| if details | of therma | al bridging | are not kn | own (36) = | = 0.15 x (3 | 1) | | | | | | | | |
| Total fa | abric he | at loss | | | | | | | (33) + | (36) = | | | 117.04 | (37) |
| Ventila | tion hea | at loss ca | alculated | monthl | y | | | | (38)m | = 0.33 × (| 25)m x (5) | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (38)m= | 107.44 | 105.33 | 103.23 | 92.9 | 90.96 | 81.89 | 81.89 | 80.21 | 85.38 | 90.96 | 94.9 | 99.01 | | (38) |
| Heat tr | ansfer o | coefficier | nt, W/K | | | | | | (39)m | = (37) + (| 38)m | | | |
| (39)m= | 224.48 | 222.38 | 220.27 | 209.95 | 208 | 198.94 | 198.94 | 197.26 | 202.43 | 208 | 211.94 | 216.06 | | |
| Heatle | se nara | meter (F | | /m²k | I | I | | | (40)m | Average = - (39)m - | Sum(39)1. | 12 /12= | 209.89 | (39) |
| (40)m- | 2 21 | | 2.26 | 2.16 | 2.14 | 2.04 | 2.04 | 2.02 | 2.08 | 2 14 | (-) | 2.22 | 1 | |
| (40)11= | 2.31 | 2.29 | 2.20 | 2.10 | 2.14 | 2.04 | 2.04 | 2.03 | 2.00 | 2.14 | 2.10 | 2.22 | 0.46 | (40) |
| Numbe | er of day | /s in moi | nth (Tab | le 1a) | | | | | | Average = | Sum(40)1. | 12 / 1 Z = | 2.10 | (40) |
| | 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 Wa | iter hea | tina ener | rav reau | irement [.] | | | | | | | | kWh/v | ear: | |
| | | | gyroqu | | | | | | | | | | | |
| Assum | ed occu | upancy, I | N | | | | | | | | 2. | 71 | | (42) |
| IT I F if TF | A > 13. A £ 13 | 9, $N = 1$ 9, $N = 1$ | + 1.76 X | [1 - exp | (-0.0003 | 349 X (1F | -A -13.9 |)2)] + 0.0 | JU13 X (| IFA -13 | .9) | | | |
| Annua | l averad | e hot wa | ater usad | ae in litre | es per da | av Vd.av | erage = | (25 x N) | + 36 | | 98 | .63 | 1 | (43) |
| Reduce | the annua | , al average | hot water | usage by a | 5% if the a | lwelling is | designed t | to achieve | a water us | se target o | f | | I | (- / |
| not more | e that 125 | litres per p | person per | r day (all w | ater use, l | hot and co | ld) | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Hot wate | er usage i | n litres per | day for ea | ach month | Vd,m = fa | ctor from T | Table 1c x | (43) | | | | | | |
| (44)m= | 108.5 | 104.55 | 100.61 | 96.66 | 92.72 | 88.77 | 88.77 | 92.72 | 96.66 | 100.61 | 104.55 | 108.5 | | |
| | | | | | | | | | | Total = Su | m(44) ₁₁₂ = | = | 1183.6 | (44) |
| Energy of | content of | hot water | used - cal | culated mo | onthly $= 4$. | 190 x Vd,n | n x nm x D | 0Tm / 3600 |) kWh/mor | nth (see Ta | ables 1b, 1 | c, 1d) | | |
| (45)m= | 160.9 | 140.72 | 145.21 | 126.6 | 121.48 | 104.82 | 97.13 | 111.46 | 112.79 | 131.45 | 143.49 | 155.82 | | |
| | | | | | | | | | | Total = Su | m(45) ₁₁₂ = | = | 1551.89 | (45) |
| If instant | taneous v | vater heatii | ng at point | of use (no | hot water | r storage), | enter 0 in | boxes (46) |) to (61) | | ī | | | |
| (46)m= | 24.13 | 21.11 | 21.78 | 18.99 | 18.22 | 15.72 | 14.57 | 16.72 | 16.92 | 19.72 | 21.52 | 23.37 | | (46) |
| vvater | storage | IOSS: | in also alte | | - \ A | | - 4 | | | 1 | | | 1 | |
| Storag | | ie (iitres) | incluair | ig any so | Jar or W | | storage | within Sa | ame ves | sei | | 150 | | (47) |
| If com | nunity f | neating a | ind no ta | INK IN OW | /elling, e | nter 110 | litres in | (47) mahi hail | ara) ant | or (0) in (| 47) | | | |
| Water | storado | | not wate | | iciudes i | nstantai | leous co | | ers) ente | | 47) | | | |
| a) If m | anufact | turer's de | eclared l | oss facto | or is kno | wn (kWł | n/dav): | | | | | 0 | 1 | (48) |
| Tempe | arature f | actor fro | m Table | 2h | | | "aay): | | | | | 0 | | (40) |
| Enorm | | | | | | | | $(40) \times (40)$ | | | | 0 | | (49) |
| b) If m | anufact | urer's de | slorage | , Kvvn/ye svlinder l | ear loss fact | or is not | known. | (46) X (49) | = | | 1: | 50 | | (50) |
| Hot wa | iter stor | age loss | factor fr | om Tabl | e 2 (kW | h/litre/da | iy) | | | | 0 | 01 |] | (51) |
| If com | munity h | neating s | ee secti | on 4.3 | `` | | - / | | | | | | I | |
| Volum | e factor | from Ta | ble 2a | | | | | | | | 0. | 93 | | (52) |
| Tempe | erature f | actor fro | m Table | 2b | | | | | | | 0. | 54 | | (53) |

| Enera | lost fro | m wata | r storade | k\Mb/u | oor | | | (47) x (51 |) x (52) x (| 53) - | | 07 | (54 | n |
|---------------|------------------------|------------------------|---------------|------------------------|-----------------------|---------------|-------------------------|--------------|--------------------|--------------|-------------|-------------|--------------------|------------|
| Enter | (50) or | (54) in (5 | 501290 55) | , it v v i i/ y v | cai | | | (47) X (01 |) | 50) – | 0 | .67 | (55 | 9 5) |
| Water | storage | loss cal | , culated | for each | month | | | ((56)m = (| (55) × (41) | m | | | | ĺ |
| (56)m- | 20.88 | 18.86 | 20.88 | 20.2 | 20.88 | 20.2 | 20.88 | 20.88 | 20.2 | 20.88 | 20.2 | 20.88 | (56 | 5) |
| If cylinde | er contain | s dedicate | d solar sto | rage, (57) | m = (56)m | x [(50) – (| [H11)] ÷ (5 | 0), else (5 | 7)m = (56) | m where (| H11) is fro | m Append | lix H | 1 |
| (57)m- | 20.88 | 18.86 | 20.88 | 20.2 | 20.88 | 20.2 | 20.88 | 20.88 | 20.2 | 20.88 | 20.2 | 20.88 | (57 | n |
| (57)11- | 20.00 | 10.00 | 20.00 | 20.2 | 20.00 | 20.2 | 20.00 | 20.00 | 20.2 | 20.00 | 20.2 | 20.00 | (0) | , |
| Primar | y circuit | loss (ar | nnual) fro | om Table | e 3 month (| E0)m | (EQ) . 20 | E (11) | | | | 0 | (58 | <i>i</i>) |
| (mo | y circuit dified by | ioss cai i factor f | rom Tab | lor each le H5 if t | montn (there is s | solar wat | (58) ÷ 30 ter heatii | oo x (41) |)m a cylinde | r thermo | stat) | | | |
| (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 |)) |
| O a sea la la | | | (| | (04) | (00) - 0 | | | | | | | | Ì |
| Combi | loss ca | | for each | | (61)m = | (60) ÷ 30 | 65 × (41) |)m | | 0 | 0 | | (61 | 1 |
| (61)m= | 0 | | | | | | | 0 | 0 | 0 | 0 | | |) |
| I otal r | leat req | uired for | water h | eating ca | alculated | for eac | h month | (62)m = | = 0.85 × (| 45)m + | (46)m + | (57)m + | (59)m + (61)m I | |
| (62)m= | 205.04 | 180.59 | 189.35 | 169.32 | 165.62 | 147.54 | 141.28 | 155.6 | 155.51 | 175.59 | 186.21 | 199.96 | (62 | .) |
| Solar Di | dditiona | calculated | | endix G of | r Appendix | H (negati | ve quantity | /) (enter '0 | י if no sola ר) | r contributi | on to wate | er heating) | | |
| (auu a | | | | | | | , see Ap | | 3) | 0 | 0 | | (63 | 2 |
| (03)III= | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (00 | 7 |
| | 1005.04 | ater nea | | 160.22 | 105.00 | 447.54 | 141.00 | 155.0 | 155 54 | 175 50 | 196.01 | 100.00 | I | |
| (64)11= | 205.04 | 180.59 | 169.35 | 169.32 | 105.02 | 147.34 | 141.20 | 155.6 | 155.51 | 175.59 | 100.21 | 199.90 | 2071.61 (64 | 0 |
| | | | h | | | | | | | | | 12 | 2071.01 | , |
| Heat g | ains fro | m water | heating, | , KVVh/m | onth 0.2 | 5 [0.85 | × (45)m | + (61)n | n] + 0.8 > | ((46)m | + (57)m | + (59)m | | - |
| (65)m= | 88.81 | /8.69 | 83.6 | 76.27 | /5./ | 69.03 | 67.61 | /2.3/ | /1.68 | 79.02 | 81.88 | 87.12 | (05 | ワ |
| inclu | ide (57) | m in calo | culation | of (65)m | only if c | ylinder i | s in the o | dwelling | or hot w | ater is fr | om com | munity h | eating | |
| 5. Int | ternal ga | ains (see | e Table 5 | 5 and 5a |): | | | | | | | | | |
| Metab | olic gair | is (Table | e 5), Wat | ts | i | | I | | I . | - | | | l | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | (| |
| (66)m= | 135.65 | 135.65 | 135.65 | 135.65 | 135.65 | 135.65 | 135.65 | 135.65 | 135.65 | 135.65 | 135.65 | 135.65 | (66 | i) |
| Lightin | g gains | (calcula | ted in Ap | opendix I | L, equat | ion L9 o I | r L9a), a 1 | lso see | Table 5 | | | 1 | l (a- | |
| (67)m= | 28.07 | 24.93 | 20.27 | 15.35 | 11.47 | 9.69 | 10.47 | 13.6 | 18.26 | 23.19 | 27.06 | 28.85 | (67 |) |
| Applia | nces ga | ins (calc | ulated ir | n Appeno | dix L, eq | uation L | 13 or L1 | 3a), also | see Ta | ble 5 | | 1 | I. | |
| (68)m= | 251.87 | 254.48 | 247.9 | 233.88 | 216.18 | 199.54 | 188.43 | 185.82 | 192.4 | 206.42 | 224.12 | 240.76 | (68 | 6) |
| Cookir | ng gains | (calcula | ated in A | ppendix | L, equat | tion L15 | or L15a) |), also se | ee Table | 5 | | - | | |
| (69)m= | 36.56 | 36.56 | 36.56 | 36.56 | 36.56 | 36.56 | 36.56 | 36.56 | 36.56 | 36.56 | 36.56 | 36.56 | (69 | י) |
| Pumps | and fa | ns gains | (Table & | 5a) | | | - | | - | | | | | |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70 |)) |
| Losses | s e.g. ev | vaporatio | on (nega | tive valu | es) (Tab | ole 5) | | - | | | | | | |
| (71)m= | -108.52 | -108.52 | -108.52 | -108.52 | -108.52 | -108.52 | -108.52 | -108.52 | -108.52 | -108.52 | -108.52 | -108.52 | (71 |) |
| Water | heating | gains (1 | Table 5) | | | | | | | | | | | |
| (72)m= | 119.37 | 117.09 | 112.36 | 105.93 | 101.75 | 95.87 | 90.87 | 97.28 | 99.55 | 106.21 | 113.73 | 117.1 | (72 | 2) |
| Total i | nternal | gains = | | | | (66) |)m + (67)m | n + (68)m · | + (69)m + (| (70)m + (7 | 1)m + (72) |)m | - | |
| (73)m= | 466 | 463.2 | 447.23 | 421.85 | 396.1 | 371.8 | 356.46 | 363.39 | 376.91 | 402.51 | 431.61 | 453.4 | (73 | ;) |
| 6. So | lar gains | S: | - | • | - | • | - | • | - | | | | | |

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

| Orientation: | Access Factor Table 6d | r | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|-----------------|---------------------------|---|------------|---|------------------|-----|----------------|---|----------------|---|--------------|------------------|
| Northeast 0.9x | 0.3 | x | 21.89 | × | 11.28 |) × | 0.63 | x | 0.7 | = | 29.41 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 22.97 | x | 0.63 | x | 0.7 | = | 59.86 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 41.38 | x | 0.63 | x | 0.7 | = | 107.85 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 67.96 | x | 0.63 | x | 0.7 | = | 177.12 | – (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 91.35 | x | 0.63 | x | 0.7 | = | 238.09 | – (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | × | 97.38 | x | 0.63 | x | 0.7 | = | 253.83 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | × | 91.1 | x | 0.63 | x | 0.7 | = | 237.45 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 72.63 | x | 0.63 | x | 0.7 | = | 189.3 | – (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 50.42 | x | 0.63 | x | 0.7 | = | 131.42 | – (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 28.07 | x | 0.63 | x | 0.7 | = | 73.16 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | × | 14.2 | x | 0.63 | x | 0.7 | = | 37 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 9.21 | x | 0.63 | x | 0.7 | = | 24.02 | (75) |
| Southwest0.9x | 0.77 | x | 9.96 | × | 36.79 | i | 0.63 | x | 0.7 | = | 112 | – (79) |
| Southwest0.9x | 0.77 | x | 9.96 | × | 62.67 | ĺ | 0.63 | x | 0.7 | = | 190.77 | (79) |
| Southwest0.9x | 0.77 | x | 9.96 | × | 85.75 | i | 0.63 | x | 0.7 | = | 261.02 | - (79) |
| Southwest0.9x | 0.77 | x | 9.96 | x | 106.25 | i | 0.63 | x | 0.7 | = | 323.42 | – (79) |
| Southwest0.9x | 0.77 | x | 9.96 | × | 119.01 | ĺ | 0.63 | x | 0.7 | = | 362.26 | (79) |
| Southwest0.9x | 0.77 | x | 9.96 | × | 118.15 | i | 0.63 | x | 0.7 | = | 359.64 | – (79) |
| Southwest0.9x | 0.77 | x | 9.96 | x | 113.91 | i | 0.63 | x | 0.7 | = | 346.73 | (79) |
| Southwest0.9x | 0.77 | x | 9.96 | × | 104.39 | 1 | 0.63 | x | 0.7 | = | 317.75 | – (79) |
| Southwest0.9x | 0.77 | x | 9.96 | × | 92.85 | 1 | 0.63 | x | 0.7 | = | 282.63 | – (79) |
| Southwest0.9x | 0.77 | x | 9.96 | x | 69.27 | i | 0.63 | x | 0.7 | = | 210.84 | (79) |
| Southwest0.9x | 0.77 | x | 9.96 | × | 44.07 | ĺ | 0.63 | x | 0.7 | = | 134.15 | (79) |
| Southwest0.9x | 0.77 | x | 9.96 | x | 31.49 | i | 0.63 | x | 0.7 | = | 95.85 | – (79) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 26 | x | 0.63 | x | 0.8 | = | 36.8 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 54 | x | 0.63 | x | 0.8 | = | 76.42 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 96 | x | 0.63 | x | 0.8 | = | 135.86 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 150 | x | 0.63 | x | 0.8 | = | 212.28 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 192 | x | 0.63 | x | 0.8 | = | 271.72 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 200 | x | 0.63 | x | 0.8 | = | 283.05 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | x | 189 | x | 0.63 | x | 0.8 | = | 267.48 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 157 | x | 0.63 | x | 0.8 | = | 222.19 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 115 | × | 0.63 | x | 0.8 | = | 162.75 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 66 | × | 0.63 | x | 0.8 | = | 93.41 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 33 | × | 0.63 | × | 0.8 | = | 46.7 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | x | 21 | İ x | 0.63 | x | 0.8 | = | 29.72 | – (82) |

| Solar g | ains in | watts, ca | alculated | for eac | h month | | | (83)m = S | um(74)m . | (82)m | | | |
|--|---------|-----------|-----------|---------|---------|---------|---------|-----------|-----------|--------|--------|--------|------|
| (83)m= | 178.2 | 327.06 | 504.74 | 712.83 | 872.07 | 896.51 | 851.66 | 729.24 | 576.8 | 377.4 | 217.85 | 149.58 | (83) |
| Total gains – internal and solar (84)m = (73)m + (83)m , watts | | | | | | | | | | | | | |
| (84)m= | 644.2 | 790.26 | 951.96 | 1134.68 | 1268.17 | 1268.31 | 1208.12 | 1092.64 | 953.71 | 779.92 | 649.46 | 602.98 | (84) |

| 7. Me | an inter | nal temp | perature | (heating | season |) | | | | | | | | |
|---------|-----------|------------|---------------|--------------------|-------------|---|-----------|--------------------|------------|------------|-------------|------------|---------|-------|
| Temp | erature | during h | neating p | eriods ir | n the livir | ng area t | from Tab | ole 9, Th | 1 (°C) | | | | 21 | (85) |
| Utilisa | ation fac | tor for g | ains for | iving are | ea, h1,m | (see Ta | ble 9a) | | | | | | | _ |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (86)m= | 1 | 0.99 | 0.98 | 0.95 | 0.89 | 0.77 | 0.63 | 0.69 | 0.88 | 0.97 | 0.99 | 1 | | (86) |
| Mean | internal | l temper | ature in | living are | ea T1 (fo | ollow ste | ps 3 to 7 | in Table | e 9c) | | | | | |
| (87)m= | 18.52 | 18.76 | 19.19 | 19.81 | 20.34 | 20.75 | 20.91 | 20.87 | 20.54 | 19.85 | 19.13 | 18.55 | | (87) |
| Temp | erature | during h | neating p | eriods ir | n rest of | dwelling | from Ta | ble 9, Tl | n2 (°C) | | | | | |
| (88)m= | 19.14 | 19.15 | 19.16 | 19.23 | 19.24 | 19.3 | 19.3 | 19.32 | 19.28 | 19.24 | 19.22 | 19.19 | | (88) |
| Utilisa | tion fac | tor for a | ains for | rest of d | vellina | h2 m (se | e Table | 9a) | | | | | | |
| (89)m= | 0.99 | 0.99 | 0.97 | 0.93 | 0.83 | 0.64 | 0.43 | 0.49 | 0.8 | 0.96 | 0.99 | 1 | | (89) |
| Moon | intorna | tompor | l oturo in | the rest | of dwolli | na T2 (f | | \sim 2 to $^{-}$ | 7 in Tabl | | | | | |
| (90)m= | 16.99 | 17.24 | 17.67 | 18.32 | 18.82 | 19.2 | 19.29 | 19.29 | 19.04 | 18.38 | 17.65 | 17.06 | | (90) |
| (| | | | | | | | | f | LA = Livin | g area ÷ (4 | 4) = | 0.43 | (91) |
| | | | | | | () () () () () () () () () () () () () (| | . (4 (1 | A) TO | | - | | 0.10 | |
| Mean | Interna | temper | ature (fo | | | ling) = fl | | + (1 – fL 10.06 | A) × 12 | 10.01 | 19.29 | 177 | | (92) |
| | adiustr | nont to t | 10.32 | internal | temper | ature fro | m Table | 19.90 | | | 10.20 | 17.7 | | (52) |
| (93)m= | 17.64 | 17.89 | 18.32 | 18.96 | 19.47 | 19.86 | 19.98 | 19.96 | 19.68 | 19.01 | 18.28 | 17.7 | | (93) |
| 8. Spa | ace hea | tina real | uirement | | | | | | | | | | | |
| Set Ti | to the r | nean int | ernal ter | nperatur | e obtain | ed at ste | ep 11 of | Table 9t | o, so tha | t Ti,m=(| 76)m an | d re-calc | ulate | |
| the ut | ilisation | factor fo | or gains | using Ta | ble 9a | | | | | | , | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Utilisa | ation fac | tor for g | ains, hm I | : | | | | | | | | | | |
| (94)m= | 0.99 | 0.99 | 0.97 | 0.93 | 0.84 | 0.69 | 0.52 | 0.58 | 0.82 | 0.96 | 0.99 | 0.99 | | (94) |
| Usetu | l gains, | hmGm | W = (94) | 4)m x (84 | 4)m | 074.04 | 602.0 | 622.2 | 705 4 | 745.0 | 644.47 | 500.00 | | (05) |
| (95)m= | 039.21 | 770.02 | 923.23 | 1054.13 | from T | o/1.01 | 023.0 | 033.3 | 765.4 | 740.2 | 041.17 | 599.28 | | (93) |
| (96)m= | 4.3 | 4 9 | 65 | 89 | 11 7 | 14.6 | 16.6 | 16.4 | 14 1 | 10.6 | 71 | 42 | | (96) |
| Heat | oss rate | for me | an intern | al tempe | erature | | =[(39)m : | x [(93)m | – (96)m | 1 | | | | () |
| (97)m= | 2995.45 | 2888.41 | 2602.69 | 2111.68 | 1616.29 | 1046.47 | 671.58 | 702.6 | 1129.94 | 1749.1 | 2369.7 | 2915.78 | | (97) |
| Space | e heatin | g require | ement fo | r each m | nonth, k\ | Nh/moni | th = 0.02 | 24 x [(97) |)m – (95 |)m] x (4′ | 1)m | | | |
| (98)m= | 1753.04 | 1417.64 | 1249.52 | 761.44 | 407.29 | 0 | 0 | 0 | 0 | 746.9 | 1244.55 | 1723.48 | | |
| • | | | | | | | | Tota | l per year | (kWh/year |) = Sum(9 | 8)15,912 = | 9303.85 | (98) |
| Space | e heating | g require | ement in | kWh/m ² | /year | | | | | | | ĺ | 95.63 | (99) |
| 9a. Ene | erav rea | uiremer | nts – Indi | vidual h | eating sv | vstems i | ncludina | micro-C | HP) | | | I | | |
| Space | e heatir | ng: | | | eening e. | | | |) | | | | | |
| Fracti | on of sp | ace hea | at from s | econdar | y/supple | mentary | system | | | | | | 0 | (201) |
| Fracti | on of sp | ace hea | nt from m | nain syst | em(s) | | | (202) = 1 - | - (201) = | | | İ | 1 | (202) |
| Fracti | on of to | tal heatii | ng from | main sys | stem 1 | | | (204) = (20 | 02) × [1 – | (203)] = | | | 1 | (204) |
| Efficie | ency of r | nain spa | ace heat | ing syste | em 1 | | | | | | | | 86.9 | (206) |
| Efficie | ency of s | seconda | ry/suppl | ementar | y heating | g system | ז, % | | | | | | 0 | (208) |
| | | | 2 - F F F | | | | | | | | | l | - | ` ´ |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/yea | ar |
|----------------------|-----------------|-------------------------|---------------------|-------------|-----------|-----------|------------------------|-------------|--------------------|------------------------|--------------------------------|---------|-------------------------|--------|
| Space | e heatin | g require | ement (c | alculate | d above) |) | 1 | | 1 | 1 | 1 | | 1 | |
| | 1753.04 | 1417.64 | 1249.52 | 761.44 | 407.29 | 0 | 0 | 0 | 0 | 746.9 | 1244.55 | 1723.48 | | |
| (211)m | n = {[(98 |)m x (20 | 04)] } x 1 | 100 ÷ (20 |)6) | i | i | r | i | i | i | | 1 | (211) |
| | 2017.31 | 1631.35 | 1437.88 | 876.22 | 468.69 | 0 | 0 | 0 | 0 | 859.5 | 1432.16 | 1983.29 | | ٦ |
| | | | | | | | | lota | il (kWh/yea | ar) =Sum(2 | 211) _{15,1012} | - | 10706.39 | (211) |
| Space | e heatin | g fuel (s | econdar | y), kWh/ | month | | | | | | | | | |
| $= \{[(98) (215)m =$ | $m \times (20)$ |)]}x1 0 | $00 \div (20)$ | 08) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |] | |
| (2.0) | Ŭ | Ĵ | | | Ů | Ů | Ĵ | Tota | l v il (kWh/yea | ar) =Sum(2 | 215), 510 12 | = | 0 | (215) |
| Water | heating | r | | | | | | | | , , | * 13, 1012 | | | |
| Output | from w | ater hea | ter (calc | ulated a | bove) | | | | | | | | | |
| | 205.04 | 180.59 | 189.35 | 169.32 | 165.62 | 147.54 | 141.28 | 155.6 | 155.51 | 175.59 | 186.21 | 199.96 | | |
| Efficier | ncy of w | ater hea | ater | - | - | - | - | | - | - | - | | 76.8 | (216) |
| (217)m= | 85.72 | 85.63 | 85.42 | 84.87 | 83.72 | 76.8 | 76.8 | 76.8 | 76.8 | 84.78 | 85.44 | 85.73 | | (217) |
| Fuel fo | r water | heating, | kWh/m | onth | | | | | | | | | | |
| (219)m = | 1 = (64) | <u>m x 100</u> 210.9 |) ÷ (217) 221.67 |)m 199.5 | 197.83 | 192.11 | 183.95 | 202.61 | 202.49 | 207.12 | 217.94 | 233.25 | | |
| () | | | | | | | | Tota | l = Sum(2 | 19a) _{1 12} = | | | 2508.58 | (219) |
| Annua | I totals | | | | | | | | | k | Wh/year | | kWh/year | |
| Space | heating | fuel use | ed, main | system | 1 | | | | | | | | 10706.39 | 1 |
| Water | heating | fuel use | ed | | | | | | | | | | 2508.58 | ī |
| Electric | city for p | oumps, f | ans and | electric | keep-ho | t | | | | | | | | 4 |
| centra | al heatir | ng pump | : | | | | | | | | | 30 | | (230c) |
| boiler | with a f | an-assis | sted flue | | | | | | | | | 45 | | (230e) |
| Total e | lectricit | y for the | above, l | kWh/yea | ır | | | sum | of (230a). | (230g) = | : | | 75 | (231) |
| Electric | city for l | ighting | | | | | | | | | | | 495.69 | (232) |
| 12a. (| CO2 em | issions · | – Individ | lual heat | ing syste | ems inclu | uding mi | cro-CHF |) | | | | | 1 |
| | | | | | | _ | | | | | | | | |
| | | | | | | En kW | ergy /h/year | | | Emiss kg CO | i on fac 2/kWh | tor | Emissions kg CO2/yea | ır |
| Space | heating | (main s | ystem 1 |) | | (21 | 1) x | | | 0.2 | 16 | = | 2312.58 | (261) |
| Space | heating | (second | dary) | | | (21 | 5) x | | | 0.5 | 19 | = | 0 | (263) |
| Water | heating | | | | | (21 | 9) x | | | 0.2 | 16 | = | 541.85 | (264) |
| Space | and wa | ter heati | ng | | | (26 | 1) + (262) | + (263) + (| (264) = | | | | 2854.43 | (265) |
| Electric | city for p | oumps, f | ans and | electric | keep-ho | t (23 | 1) x | | | 0.5 | 19 | = | 38.93 | (267) |
| Electric | city for I | ighting | | | | (23 | 2) x | | | 0.5 | 19 | = | 257.26 | (268) |
| Total C | CO2, kg/ | /year | | | | | | | sum o | of (265)(2 | 271) = | | 3150.62 | (272) |
| Dwelli | ng CO2 | Emissi | on Rate | • | | | | | (272) | ÷ (4) = | | | 32.38 | (273) |
| EI ratir | ng (secti | on 14) | | | | | | | | | | | 70 | (274) |

| | | | | | | | User D | Details: | | | | | | |
|------------|--------------------------|------------|---------------------------|-----------------|-----------------------|-------------------|------------|-----------------------|--------------|-------------|----------|----------|-------------------------|---------------|
| Asses | ssor N | ame: | Ge | orge Fa | arr | | | Strom | a Num | ber: | | STRO | 028460 | |
| Softw | are Na | ame: | Str | oma FS | SAP 201 | 2 | | Softwa | are Ver | rsion: | | Versic | on: 1.0.4.6 | |
| | | | | | | Р | roperty | Address | : Flat 2 - | Base | | | | |
| Addre | ss : | | | | | | | | | | | | | |
| 1. Ove | erall dwe | elling di | mension | IS: | | | | | | | | | | |
| | | | | | | | Are | a(m²) | L | Av. He | ight(m) | | Volume(m ³) | - |
| Ground | l floor | | | | | | Ę | 52.41 | (1a) x | 2 | .95 | (2a) = | 154.61 | (3a) |
| First flo | or | | | | | | | 39.53 | (1b) x | 3 | .25 | (2b) = | 128.47 | (3b) |
| Total flo | oor area | a TFA = | (1a)+(1 | b)+(1c)+ | (1d)+(1e | e)+(1r | I) | 91.94 | (4) | | | - | | _ |
| Dwellin | g volum | ne | | | | | | | (3a)+(3b) |)+(3c)+(3d | l)+(3e)+ | .(3n) = | 283.08 | (5) |
| 2. Ver | ntilation | rate: | | | | | | | | | | | | _ |
| | | | | main heating | S(| econdar | у | other | | total | | | m ³ per hour | |
| Numbe | r of chir | nneys | Γ | 0 | _ + [| 0 |] + [| 0 |] = [| 0 | x 4 | 40 = | 0 | (6a) |
| Numbe | r of ope | n flues | Г | 0 | | 0 | i + F | 0 | - - [| 0 | x2 | 20 = | 0 | (6b) |
| Numbe | r of inte | rmittent | fans L | | L_ | | | | | 3 | x ′ | 0 = | 30 | _](7a) |
| Numbe | r of pas | sive ver | nts | | | | | | | 0 | x ^ | 0 = | 0 |](7b) |
| Numbe | r of flue | less das | s fires | | | | | | | 0 | x 4 | 40 = | 0 |]](7c) |
| | | | | | | | | | | 0 | | | 0 | |
| | | | | | | | | | | | | Air ch | anges per ho | ur |
| Infiltrati | on due | to chim | neys, flu | ies and f | ans = <mark>(6</mark> | a)+(6b)+(7 | a)+(7b)+(| (7c) = | Г | 30 | <u> </u> | ÷ (5) = | 0.11 | (8) |
| lf a pr | essurisati | on test ha | is been ca | rried out o | r is intende | ed, procee | d to (17), | otherwise o | continue fr | om (9) to (| (16) | | | _ |
| Num | ber of st | toreys ir | n the dw | elling (n | s) | | | | | | | | 0 | (9) |
| Addit | ional in | filtration | 1 | | | | | | | | [(9)- | 1]x0.1 = | 0 | (10) |
| Struc | tural inf | iltration | : 0.25 fo | r steel o | r timber i | frame or | 0.35 fo | r masoni | ry constr | uction | | | 0 | (11) |
| dec | oun types ducting are | eas of ope | e present, enings); if | equal user | 0.35 | ponaing to | ine grea | ler wall are | a (aller | | | | | |
| lf sus | spendec | l woode | n floor, | enter 0.2 | ? (unseal | ed) or 0. | 1 (seale | ed), else | enter 0 | | | | 0 | (12) |
| lf no | draught | lobby, | enter 0.0 | 05, else | enter 0 | | | | | | | | 0 | (13) |
| Perce | entage o | of windo | ows and | doors di | raught st | ripped | | | | | | | 0 | (14) |
| Wind | ow infilt | ration | | | | | | 0.25 - [0.2 | 2 x (14) ÷ 1 | = [00 | | | 0 | (15) |
| Infiltr | ation ra | te | | | | | | (8) + (10) | + (11) + (1 | 2) + (13) - | + (15) = | | 0 | (16) |
| Air p | ermeabi | ility valu | ie, q50, | expresse | ed in cub | oic metre | s per ho | our per s | quare m | etre of e | nvelope | area | 15 | (17) |
| If base | d on air rmoobility | permea | idility va | lue, then | (10) = [(1) | $() \div 20]+(0)$ | o or o do | records = (10) = (10) | rmoobility | is boing u | and | | 0.86 | (18) |
| Numbe | r of side | es shelte | ered | เธรรณกรสแ | Uniesinas | s been don | e or a de | yiee all pe | ппеаршку | is being us | seu | | 0 |] (19) |
| Shelter | factor | | | | | | | (20) = 1 - | [0.075 x (1 | 9)] = | | | 1 | (20) |
| Infiltrati | on rate | incorpo | rating sl | nelter fac | ctor | | | (21) = (18 |) x (20) = | | | | 0.86 | (21) |
| Infiltrati | on rate | modifie | d for mo | onthly wir | nd speed | ł | | | | | | | | _ |
| [| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |] | |
| Monthly | / averaç | ge wind | speed f | rom Tab | le 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 F | actor (2 | 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 | I | |
| Adjust | ed infiltra | ation rat | e (allowi | ing for sł | nelter an | d wind s | speed) = | = (21a) x | (22a)m | | | | | |
| • | 1.09 | 1.07 | 1.05 | 0.94 | 0.92 | 0.81 | 0.81 | 0.79 | 0.86 | 0.92 | 0.96 | 1.01 | | |
| Calcul | ate effec | ctive air | change | rate for t | he appli | cable ca | ise | | | | | | | |
| IT Me | echanica | | | ondix N (2 | (25) = (22) | | | (NE)) othe | nuico (22k | (220) | | l | 0 | (23a) |
| If bal | aust all the | heat reco | overv: effic | viency in % | allowing f | or in-use f | factor (fro | m Table 4h |) = |) – (23a) | | | 0 | (230) |
| a) If | halance | d mach | anical ve | antilation | with he | at recov | | | -) -) -) -) -) - - - - - - - - - - - - | 2h)m ± (| (23h) v [| 1 _ (23c) | 0 · 1001 | (230) |
| (24a)m= | | | | | | | | | $\frac{1}{0}$ | | | 1 - (230) | ÷ 100] | (24a) |
| b) If | halance | d mech | l anical ve | I | without | heat rec | noverv (| M\/) (24ł | $1 - \frac{1}{2}$ | 1 | 23h) | - | | , |
| (24b)m= | 0 | | | 0 | 0 | 0 | | | | | 0 | 0 | | (24b) |
| c) If | whole h | ouse ex | I tract ver | L ntilation of | I or positiv | I ve input v | I ventilati | on from | L outside | I | I | <u> </u> | | |
| •) | if (22b)n | n < 0.5 > | < (23b), 1 | then (24 | c) = (23k | o); other | wise (24 | 4c) = (22 | b) m + 0 | .5 × (23 | c) | | | |
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (24c) |
| d) If | natural | ventilatio | on or wh | ole hous | se positiv | ve input | ventilati | ion from | loft | | | - | | |
| İ | if (22b)n | n = 1, th | en (24d) | m = (22 | b)m othe | erwise (2 | 24d)m = | 0.5 + [(2 | 2b)m² x | 0.5] | | | | (|
| (24d)m= | 1.09 | 1.07 | 1.05 | 0.94 | 0.92 | 0.83 | 0.83 | 0.81 | 0.87 | 0.92 | 0.96 | 1.01 | | (24d) |
| Effe | ctive air | change | rate - er | nter (24a | i) or (24k | o) or (24 | c) or (24 | 4d) in bo | x (25) | <u> </u> | <u> </u> | | | (05) |
| (25)m= | 1.09 | 1.07 | 1.05 | 0.94 | 0.92 | 0.83 | 0.83 | 0.81 | 0.87 | 0.92 | 0.96 | 1.01 | | (25) |
| 3. He | at losse | s and he | eat loss | paramet | er: | | | | | | | | | |
| ELEN | IENT | Gros area | ss (m²) | Openin rr | igs 1 ² | Net Ar A ,r | rea m² | U-val W/m2 | ue 2K | A X U (W/ | K) | k-value kJ/m²·ł | · A K k | ∖Xk J/K |
| Doors | | | | | | 1.89 | x | 1.6 | = | 3.024 | | | | (26) |
| Windo | ws Type | e 1 | | | | 7.24 | . x | 1/[1/(1.6)+ | - 0.04] = | 10.89 | | | | (27) |
| Windo | ws Type | 2 | | | | 21.89 | э х | 1/[1/(1.6)+ | - 0.04] = | 32.92 | | | | (27) |
| Rooflig | ghts | | | | | 3.12 | × | 1/[1/(1.6) + | 0.04] = | 4.992 | | | | (27b) |
| Floor | | | | | | 52.4 | 1 × | 0.22 | | 11.530 | 2 | | 7 | (28) |
| Walls | Type1 | 45.3 | 39 | 0 | | 45.39 | э х | 0.28 | = | 12.71 | i T | | i — | (29) |
| Walls | Type2 | 42. | 3 | 29.1 | 3 | 13.17 | 7 X | 0.28 | = | 3.69 | i T | | i — | (29) |
| Walls | ТуреЗ | 23.5 | 58 | 1.89 | • | 21.69 | э х | 0.6 | = | 12.91 | i T | | i — | (29) |
| Roof | | 12.8 | 39 | 3.12 | 2 | 9.77 | · x | 0.18 | = | 1.76 | | | i — | (30) |
| Total a | rea of e | lements | s, m² | | | 176.5 | 57 | | | | | | | (31) |
| Party v | vall | | | | | 42.43 | 3 X | 0 | = | 0 | | | - | (32) |
| Party of | ceiling | | | | | 35.55 | 5 | L | | | L | | ╡ ├── | (32b) |
| * for win | dows and le the area | roof wind | ows, use e sides of in | effective wi | indow U-va | alue calcul | lated usin | g formula d | 1/[(1/U-val | ue)+0.04] a | L as given in | paragraph | 3.2 | ` ′ |
| Fabric | heat los | s, W/K | = S (A x | U) | .s and par | | | (26)(30 |) + (32) = | | | | 94.12 | (33) |
| Heat c | apacity | Cm = S | (Axk) | - | | | | | ((28). | (30) + (3 | 2) + (32a). | (32e) = | 12389.74 | (34) |

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K

250

(35)

Indicative Value: Medium

| can be ι | ised inste | ad of a de | tailed calcu | ulation. | | | | | | | | | | |
|---|------------|--------------------|--------------|----------------------|----------------|------------|----------------|-------------|------------|-------------|------------------------|-----------|---------|------|
| Thermal bridges : S (L x Y) calculated using Appendix K if details of thermal bridging are not known (36) = $0.15 \times (31)$ | | | | | | | | | | | | | | (36) |
| if details | of therma | al bridging | are not kn | own (36) = | = 0.15 x (3 | 1) | | | | | | | | |
| Total fa | abric he | at loss | | | | | | | (33) + | (36) = | | | 120.6 | (37) |
| Ventila | tion hea | at loss ca | alculated | monthl | y | | | | (38)m | = 0.33 × (| (25)m x (5) | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (38)m= | 101.95 | 99.95 | 97.95 | 88.12 | 86.26 | 77.59 | 77.59 | 75.99 | 80.93 | 86.26 | 90.02 | 93.96 | | (38) |
| Heat tr | ansfer o | coefficie | nt, W/K | | | | | | (39)m | = (37) + (| 38)m | | | |
| (39)m= | 222.55 | 220.56 | 218.56 | 208.72 | 206.86 | 198.2 | 198.2 | 196.59 | 201.53 | 206.86 | 210.62 | 214.56 | | |
| Heatle | | motor (F | | /m2k | | | | | (40)m | Average = | Sum(39)1. | 12 /12= | 208.65 | (39) |
| (40)- | 2 42 | | 1LF), VV/ | 2.27 | 2.25 | 2.16 | 2.16 | 2.14 | 2.10 | - (59)m - | 2 20 | 2.22 | | |
| (40)m= | 2.42 | 2.4 | 2.30 | 2.27 | 2.25 | 2.10 | 2.10 | 2.14 | 2.19 | 2.20 | 2.29 | 2.33 | 0.07 | |
| Numbe | er of day | s in mo | nth (Tab | le 1a) | | | | | | Average = | Sum(40)₁. | 12 /12= | 2.27 | (40) |
| Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (41)m= 31 28 31 30 31 | | | | | | | | | | | | | | |
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | | (41) |
| | | | | | | | | | | | | | | |
| 4 \M/a | iter hea | ting ener | rav reaui | irement [.] | | | | | | | | k\/\/h/\/ | ear: | |
| 4. Water heating energy requirement. | | | | | | | | | | | | | | |
| Assumed occupancy, N 2.65 (42) | | | | | | | | | | | | | | |
| it TF | A > 13. | 9, N = 1 | + 1.76 x | [1 - exp | (-0.0003 | 49 x (TF | -A -13.9 |)2)] + 0.0 | 0013 x (| FFA -13. | .9) | | | |
| Annua | Laverad | e hot wa | ater usad | ne in litre | es ner da | w Vd av | erade = | (25 x N) | + 36 | | 07 | 17 | | (43) |
| Reduce | the annua | al average | hot water | usage by a | 5% if the a | welling is | designed t | to achieve | a water us | se target o | of ST | .17 | | (40) |
| not more | e that 125 | litres per | person per | r day (all w | ater use, l | not and co | ld) | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Hot wate | er usage i | n litres per | day for ea | ach month | Vd,m = fa | ctor from | Table 1c x | (43) | | | | | | |
| (44)m= | 106.89 | 103 | 99.11 | 95.23 | 91.34 | 87.45 | 87.45 | 91.34 | 95.23 | 99.11 | 103 | 106.89 | | |
| | | | | | | | 1 | 1 | | rotal = Su | m(44) ₁₁₂ = | = | 1166.04 | (44) |
| Energy of | content of | hot water | used - cal | culated mo | onthly $= 4$. | 190 x Vd,r | m x nm x D | 0Tm / 3600 |) kWh/mor | nth (see Ta | ables 1b, 1 | c, 1d) | | |
| (45)m= | 158.51 | 138.63 | 143.06 | 124.72 | 119.67 | 103.27 | 95.69 | 109.81 | 111.12 | 129.5 | 141.36 | 153.51 | | |
| | | | | | | | | | | Total = Su | m(45) ₁₁₂ = | = | 1528.86 | (45) |
| lf instan | taneous w | ater heati | ng at point | of use (no | hot water | storage), | enter 0 in | boxes (46 |) to (61) | | ī | | | |
| (46)m= | 23.78 | 20.8 | 21.46 | 18.71 | 17.95 | 15.49 | 14.35 | 16.47 | 16.67 | 19.43 | 21.2 | 23.03 | | (46) |
| Water | storage | loss: | | | | | | | | | | | I | |
| Storag | e volum | e (litres) | incluain | ig any so | Diar or V | WHRS | storage | within sa | ame ves | sei | | 150 | | (47) |
| If com | nunity h | leating a | ind no ta | ink in dw | elling, e | nter 110 |) litres in | (47) | | (0) : (| (47) | | | |
| Otherv | lise if no | o stored | not wate | er (this in | iciudes i | nstantar | neous co | nod idmo | ers) ente | er 'O' in (| (47) | | | |
| a) If m | storage | IUSS: urer's de | aclared l | oss facto | or is kno | wn (k)/k | v(dav). | | | | | 0 | l | (40) |
| | | | | | | | i/uay). | | | | | 0 | | (40) |
| Tempe | erature i | actor Iro | miable | 20 | | | | | | | | 0 | | (49) |
| Energy | / lost fro | m water | storage | , kWh/ye | ear | or io not | known | (48) x (49) |) = | | 1: | 50 | | (50) |
| Hot wa | ianuiaci | ane loss | factor fr | om Tahl | e 2 (kW | h/litre/ds | NIUWII: av) | | | | | 01 | | (51) |
| If com | nunitv h | leating s | ee secti | on 4.3 | (1000 | | .,, | | | | <u>0</u> . | 01 | | (01) |
| | a factor | | | - | | | | | | | | | | |
| volum | | from ra | ble 2a | | | | | | | | 0. | 93 | | (52) |

| Energ | y lost fro | m water | r storage | e, kWh/y | ear | | | (47) x (51 |) x (52) x (| 53) = | 0. | .67 | (54) |
|-----------|------------|------------|-------------|-------------|------------|-------------|------------------------|-------------------------|------------------|--------------|-------------|---------------------------------------|---------------|
| Enter | (50) or | (54) in (8 | 55) | | | | | | | | 0. | .67 | (55) |
| Water | storage | loss cal | culated | for each | month | | | ((56)m = (| (55) × (41) | m | | | |
| (56)m= | 20.88 | 18.86 | 20.88 | 20.2 | 20.88 | 20.2 | 20.88 | 20.88 | 20.2 | 20.88 | 20.2 | 20.88 | (56) |
| If cylind | er contain | s dedicate | d solar sto | orage, (57) | m = (56)m | x [(50) – (| (H11)] ÷ (5 - | 0), else (5 | 7)m = (56) | m where (| H11) is fro | m Append | lix H |
| (57)m= | 20.88 | 18.86 | 20.88 | 20.2 | 20.88 | 20.2 | 20.88 | 20.88 | 20.2 | 20.88 | 20.2 | 20.88 | (57) |
| Prima | ry circuit | loss (ar | nnual) fro | om Table | e 3 | | | | | | | 0 | (58) |
| Prima | ry circuit | loss cal | culated | for each | month (| 59)m = | (58) ÷ 36 | 65 × (41) | m | | | | |
| (mo | dified by | factor f | rom Tab | le H5 if t | here is s | solar wa | ter heatii | ng and a | a cylinde | r thermo | stat) | 1 | l . |
| (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) |
| Comb | i loss ca | lculated | for each | month | (61)m = | (60) ÷ 3 | 65 × (41) |)m | | | | | |
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |
| Total h | neat req | uired for | water h | eating ca | alculated | l for eac | h month | (62)m = | : 0.85 × (| (45)m + | (46)m + | (57)m + | (59)m + (61)m |
| (62)m= | 202.65 | 178.5 | 187.2 | 167.44 | 163.81 | 145.99 | 139.83 | 153.95 | 153.84 | 173.64 | 184.08 | 197.65 | (62) |
| Solar D | HW input | calculated | using App | endix G o | r Appendix | H (negati | ve quantity | /) (enter 'C | ' if no sola | r contributi | ion to wate | er heating) | |
| (add a | dditiona | l lines if | FGHRS | and/or \ | NWHRS | applies | , see Ap | pendix (| G) | | - | | |
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |
| Outpu | t from w | ater hea | iter | | | | | - | | | - | | |
| (64)m= | 202.65 | 178.5 | 187.2 | 167.44 | 163.81 | 145.99 | 139.83 | 153.95 | 153.84 | 173.64 | 184.08 | 197.65 | |
| | | | | | | | | Out | out from wa | ater heatei | r (annual) | 12 | 2048.58 (64) |
| Heat g | ains fro | m water | heating | , kWh/m | onth 0.2 | 5 ´ [0.85 | × (45)m | + (61)n | n] + 0.8 x | (46)m | + (57)m | + (59)m |] |
| (65)m= | 88.02 | 77.99 | 82.88 | 75.64 | 75.1 | 68.51 | 67.13 | 71.82 | 71.12 | 78.37 | 81.18 | 86.35 | (65) |
| inclu | ude (57) | m in cale | culation | of (65)m | only if c | ylinder i | s in the o | dwelling | or hot w | ater is fr | om com | munity h | eating |
| 5. In | ternal ga | ains (see | e Table 5 | 5 and 5a |): | | | | | | | | |
| Metab | olic gair | ıs (Table | e 5), Wat | ts | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| (66)m= | 132.57 | 132.57 | 132.57 | 132.57 | 132.57 | 132.57 | 132.57 | 132.57 | 132.57 | 132.57 | 132.57 | 132.57 | (66) |
| Lightir | ng gains | (calcula | ted in Ap | opendix | L, equat | ion L9 o | r L9a), a | lso see | Table 5 | | | | |
| (67)m= | 27.04 | 24.01 | 19.53 | 14.78 | 11.05 | 9.33 | 10.08 | 13.1 | 17.59 | 22.33 | 26.07 | 27.79 | (67) |
| Applia | nces ga | ins (calc | ulated ir | n Appeno | dix L, eq | uation L | 13 or L1 | 3a), also | see Ta | ble 5 | • | | |
| (68)m= | 242.6 | 245.12 | 238.78 | 225.27 | 208.22 | 192.2 | 181.49 | 178.98 | 185.32 | 198.83 | 215.87 | 231.9 | (68) |
| Cookii | ng gains | (calcula | ted in A | ppendix | L, equat | tion L15 | or L15a) |), also se | ee Table | 5 | | | |
| (69)m= | 36.26 | 36.26 | 36.26 | 36.26 | 36.26 | 36.26 | 36.26 | 36.26 | 36.26 | 36.26 | 36.26 | 36.26 | (69) |
| Pump | s and fa | ns gains | (Table (| 5a) | | | | | | | | | |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |
| Losse | s e.q. ev | aporatic | n (nega | tive valu | es) (Tab | le 5) | 1 | | | | | | |
| (71)m= | -106.05 | -106.05 | -106.05 | -106.05 | -106.05 | -106.05 | -106.05 | -106.05 | -106.05 | -106.05 | -106.05 | -106.05 | (71) |
| Water | heating | gains (1 | rable 5) | ! | ! | ļ | I | | ļ | | | ļ | I |
| (72)m= | 118.3 | 116.06 | 111.4 | 105.06 | 100.95 | 95.15 | 90.23 | 96.54 | 98.78 | 105.34 | 112.74 | 116.07 | (72) |
| Total | internal | aains = | ! : | I | I | I(66) | I)m + (67)m | l 1 + (68)m · | L + (69)m + (| (70)m + (7 | 1)m + (72) | ۱ــــــــــــــــــــــــــــــــــــ | |
| (73)m= | 453.71 | 450.96 | 435.47 | 410.88 | 385.99 | 362.45 | 347.58 | 354.39 | 367.46 | 392.27 | 420.45 | 441.52 | (73) |
| 6. So | lar gains | S: | L | | | 1 | L | | I | | | I *- | , |

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

| Orientation: | Access Factor Table 6d | r | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|-----------------|---------------------------|---|------------|---|------------------|-----|----------------|---|----------------|-----|--------------|------|
| Northeast 0.9x | 0.3 | x | 21.89 | × | 11.28 |) × | 0.63 | × | 0.7 |] = | 29.41 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | × | 22.97 | x | 0.63 | × | 0.7 | = | 59.86 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | × | 41.38 | x | 0.63 | × | 0.7 | = | 107.85 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 67.96 | x | 0.63 | x | 0.7 | i = | 177.12 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 91.35 | x | 0.63 | x | 0.7 | = | 238.09 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | × | 97.38 | x | 0.63 | × | 0.7 | = | 253.83 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 91.1 | x | 0.63 | x | 0.7 | i = | 237.45 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 72.63 | x | 0.63 | x | 0.7 | = | 189.3 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | × | 50.42 | x | 0.63 | × | 0.7 | i = | 131.42 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | × | 28.07 | x | 0.63 | × | 0.7 | i = | 73.16 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | × | 14.2 | x | 0.63 | × | 0.7 | = | 37 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | × | 9.21 | x | 0.63 | × | 0.7 | i = | 24.02 | (75) |
| Southwest0.9x | 0.77 | x | 7.24 | × | 36.79 | i | 0.63 | × | 0.7 | i = | 81.41 | (79) |
| Southwest0.9x | 0.77 | x | 7.24 | x | 62.67 | 1 | 0.63 | x | 0.7 | i = | 138.67 | (79) |
| Southwest0.9x | 0.77 | x | 7.24 | x | 85.75 | ĺ | 0.63 | × | 0.7 | i = | 189.74 | (79) |
| Southwest0.9x | 0.77 | x | 7.24 | x | 106.25 | i | 0.63 | x | 0.7 | i = | 235.1 | (79) |
| Southwest0.9x | 0.77 | x | 7.24 | x | 119.01 | 1 | 0.63 | x | 0.7 | i = | 263.33 | (79) |
| Southwest0.9x | 0.77 | x | 7.24 | x | 118.15 | i | 0.63 | × | 0.7 | i = | 261.42 | (79) |
| Southwest0.9x | 0.77 | x | 7.24 | × | 113.91 | ĺ | 0.63 | x | 0.7 | = | 252.04 | (79) |
| Southwest0.9x | 0.77 | x | 7.24 | × | 104.39 | 1 | 0.63 | x | 0.7 | = | 230.98 | (79) |
| Southwest0.9x | 0.77 | x | 7.24 | × | 92.85 | ĺ | 0.63 | × | 0.7 | = | 205.45 | |
| Southwest0.9x | 0.77 | x | 7.24 | × | 69.27 | ĺ | 0.63 | x | 0.7 | = | 153.26 | (79) |
| Southwest0.9x | 0.77 | x | 7.24 | × | 44.07 | Ī | 0.63 | x | 0.7 | = | 97.51 | (79) |
| Southwest0.9x | 0.77 | x | 7.24 | × | 31.49 | ĺ | 0.63 | × | 0.7 | = | 69.67 | (79) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 26 | x | 0.63 | × | 0.8 |] = | 36.8 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 54 | × | 0.63 | × | 0.8 | = | 76.42 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 96 | x | 0.63 | × | 0.8 |] = | 135.86 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | x | 150 | x | 0.63 | x | 0.8 |] = | 212.28 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 192 | x | 0.63 | × | 0.8 | = | 271.72 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 200 | x | 0.63 | × | 0.8 | = | 283.05 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 189 | x | 0.63 | × | 0.8 | = | 267.48 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 157 | x | 0.63 | × | 0.8 | = | 222.19 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | x | 115 | x | 0.63 | x | 0.8 | = | 162.75 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | x | 66 | x | 0.63 | × | 0.8 |] = | 93.41 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 33 | × | 0.63 | × | 0.8 |] = | 46.7 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | x | 21 | x | 0.63 | x | 0.8 | = | 29.72 | (82) |

| Solar g | ains in | watts, ca | alculated | for eac | h month | | | (83)m = S | um(74)m . | (82)m | | | |
|--|---------|-----------|-----------|---------|---------|---------|---------|-----------|-----------|--------|--------|--------|------|
| (83)m= | 147.62 | 274.96 | 433.45 | 624.5 | 773.14 | 798.3 | 756.97 | 642.47 | 499.62 | 319.82 | 181.22 | 123.41 | (83) |
| Total gains – internal and solar (84)m = (73)m + (83)m , watts | | | | | | | | | | | | | |
| (84)m= | 601.33 | 725.92 | 868.92 | 1035.39 | 1159.13 | 1160.75 | 1104.54 | 996.86 | 867.08 | 712.09 | 601.67 | 564.93 | (84) |
| 7. Me | an inter | nal temp | erature | (heating | season |) | | | | | | | | |
|-------------------|-----------|------------------------|------------|--------------------|-------------|-------------|--------------|--------------------|--------------------|-----------------|-------------|------------|---------|-------|
| Temp | erature | during h | leating p | eriods ir | n the livir | ng area t | from Tab | ole 9, Th | 1 (°C) | | | | 21 | (85) |
| Utilisa | tion fac | tor for g | ains for l | iving are | ea, h1,m | (see Ta | ble 9a) | | | | | | | _ |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (86)m= | 1 | 0.99 | 0.98 | 0.96 | 0.9 | 0.79 | 0.66 | 0.72 | 0.9 | 0.98 | 0.99 | 1 | | (86) |
| Mean | internal | l temper | ature in | living are | ea T1 (fo | ollow ste | ps 3 to 7 | in Table | e 9c) | | | | | |
| (87)m= | 18.41 | 18.64 | 19.07 | 19.7 | 20.25 | 20.7 | 20.88 | 20.84 | 20.48 | 19.76 | 19.03 | 18.44 | | (87) |
| Temp | erature | during h | eating p | eriods ir | n rest of | dwelling | from Ta | ble 9, Tl | n2 (°C) | | | | | |
| (88)m= | 19.07 | 19.08 | 19.09 | 19.16 | 19.17 | 19.23 | 19.23 | 19.24 | 19.21 | 19.17 | 19.15 | 19.12 | | (88) |
| Utilisa | tion fac | tor for a | ains for | rest of d | welling. | h2.m (se | e Table | 9a) | | | | | | |
| (89)m= | 0.99 | 0.99 | 0.98 | 0.94 | 0.85 | 0.66 | 0.45 | 0.52 | 0.82 | 0.96 | 0.99 | 1 | | (89) |
| Mean | interna | temper | ature in | the rest | of dwelli | na T2 (f | n Now ste | ons 3 to 7 | 7 in Tahl | e 9c) | | | | |
| (90)m= | 16.84 | 17.08 | 17.5 | 18.17 | 18.69 | 19.1 | 19.21 | 19.21 | 18.93 | 18.25 | 17.5 | 16.9 | | (90) |
| ` <i>`</i> | | | | | | | | | f | L LA = Livin | g area ÷ (4 | 1) = | 0.41 | (91) |
| Moon | internal | tompor | atura (fo | r tho wh | olo dwol | lling) – fl | I A ⊷ T1 | ⊥ (1 _ fl | ۸) v T2 | | | I | | |
| (92)m= | 17.49 | 17.72 | 18.15 | 18.8 | 19.34 | 19.76 | 19.9 | + (1 − 1∟ 19.88 | 19.57 | 18.87 | 18.13 | 17.54 | | (92) |
| vlagA | adiustr | nent to t | he mear | internal | tempera | ature fro | m Table | 4e. whe | ere appro | opriate | | | | |
| (93)m= | 17.49 | 17.72 | 18.15 | 18.8 | 19.34 | 19.76 | 19.9 | 19.88 | 19.57 | 18.87 | 18.13 | 17.54 | | (93) |
| 8. Spa | ace hea | ting requ | uirement | | | | | | | | | | | |
| Set Ti | to the r | nean int | ernal ter | nperatur | e obtain | ed at ste | ep 11 of | Table 9t | o, so tha | t Ti,m=(| 76)m an | d re-calc | ulate | |
| the ut | ilisation | factor fo | or gains | using Ta | ble 9a | | | | | | | | | |
| | Jan | Feb | Mar | Apr | Мау | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (94)m- | | | | | 0.86 | 0.71 | 0 54 | 0.6 | 0.84 | 0.96 | 0.99 | 0 99 | | (94) |
| Usefu | l gains | hmGm | W = (94 | 4)m x (84 | 4)m | 0.11 | 0.01 | 0.0 | 0.01 | 0.00 | 0.00 | 0.00 | | |
| (95)m= | 596.59 | 715.83 | 844.5 | 968 | 991.69 | 822.91 | 595.71 | 601.61 | 727.27 | 682.75 | 594.11 | 561.34 | | (95) |
| Month | ly avera | age exte | rnal tem | perature | e from Ta | able 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 I | oss rate | e for mea | an intern | al tempe | erature, | Lm , W = | =[(39)m : | x [(93)m | – (96)m |] | | | | |
| (97)m= | 2934.74 | 2827.91 | 2545.85 | 2066.21 | 1579.73 | 1022.84 | 653.36 | 683.87 | 1102.05 | 1710.77 | 2323.72 | 2861.68 | | (97) |
| Space | e heating | g require | ement fo | r each m | nonth, k | Nh/mont | th = 0.02 | 24 x [(97) |)m – (95 |)m] x (4′ | 1)m | | | |
| (98)m= | 1739.58 | 1419.32 | 1265.8 | 790.71 | 437.5 | 0 | 0 | 0 | 0 | 764.84 | 1245.32 | 1/11.45 | 0074 50 | |
| | | | | | | | | lota | l per year | (kwh/year |) = Sum(9) | 8)15,912 = | 9374.53 | (96) |
| Space | e heating | g require | ement in | kWh/m ² | /year | | | | | | | | 101.96 | (99) |
| 9a. Ene | ergy req | luiremer | nts – Indi | vidual h | eating sy | ystems i | ncluding | micro-C | HP) | | | | | |
| Space Fraction | e heatir | ig: Jace hea | t from s | econdar | /sunnle | mentary | svstem | | | | | 1 | 0 | (201) |
| Fracti | on of sn | ace hea | it from m | nain svst | em(s) | montary | System | (202) = 1 - | - (201) = | | | l | 1 | (202) |
| Fracti | on of to | tal heati | ng from | main sys | stem 1 | | | (204) = (20 | 02) × [1 – | (203)] = | | | 1 | (204) |
| Efficie | ency of r | nain spa | ace heat | ing syste | em 1 | | | | | | | | 86.9 | (206) |
| Efficie | ency of s | seconda | ry/supple | ementar | y heating | g system | ז, % | | | | | | 0 | (208) |
| | | | | | | | | | | | | | | |

| | | | _ | _ | | _ | _ | _ | | _ | | | _ | |
|-----------------|-------------|-------------------------|----------------|------------------|-----------|-----------|------------|-------------|------------|-----------------------|--------------------------|---------|------------|------------|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/yea | ır |
| Space | e heatin | g require | ement (o | calculate | d above) |) | | | | | | | 1 | |
| | 1739.58 | 1419.32 | 1265.8 | 790.71 | 437.5 | 0 | 0 | 0 | 0 | 764.84 | 1245.32 | 1711.45 | | |
| (211)m | 1 = {[(98 |)m x (20 | (4)] } x 1 | 100 ÷ (20 |)6) | | | | | | | | 1 | (211) |
| | 2001.82 | 1633.28 | 1456.62 | 909.91 | 503.45 | 0 | 0 | | | 880.14 | 1433.04 | 1969.45 | | |
| 0 | | - f] / . | | | | | | TULA | | | 211) _{15,10} 12 | - | 10787.72 | (211) |
| = {[(98] |) m x (20 | g iuei (s)1)] } x 1 | $00 \div (20)$ | у), күүн/)8) | monun | | | | | | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| I | | | | | | | | Tota | l (kWh/yea | ar) =Sum(2 | 215) _{15,1012} | = | 0 | (215) |
| Water | heating | J | | | | | | | | | | | | - |
| Output | from w | ater hea | ter (calc | ulated a | bove) | | | | | | | | 1 | |
| Efficien | 202.65 | 178.5 | 187.2 | 167.44 | 163.81 | 145.99 | 139.83 | 153.95 | 153.84 | 173.64 | 184.08 | 197.65 | | |
| (217)m- | 85 72 | 85 64 | 85.45 | 8/ 05 | 83.80 | 76.8 | 76.8 | 76.8 | 76.8 | 8/ 8/ | 85.45 | 85 73 | 76.8 | (217) |
| Euel fo | r water | heating | kWh/m | onth | 05.09 | 70.0 | 70.0 | 70.0 | 70.0 | 04.04 | 00.40 | 05.75 | | (217) |
| (219)m | 1 = (64) | <u>m x 100</u> |) ÷ (217) | <u>)m</u> | | | | | | | | | | |
| (219)m= | 236.4 | 208.43 | 219.07 | 197.11 | 195.26 | 190.09 | 182.08 | 200.46 | 200.31 | 204.68 | 215.41 | 230.54 | | - |
| | | | | | | | | Tota | I = Sum(2 | 19a) ₁₁₂ = | | | 2479.83 | (219) |
| Annua | l totals | fueluse | nd main | evetam | 1 | | | | | k | Wh/year | | kWh/year | 1 |
| Water | heating | fueluse | d, main | System | 1 | | | | | | | | 10707.72 | J |
| water | neating | iuei use | a . | | | | | | | | | | 2479.83 | |
| Electric | city for p | oumps, f | ans and | electric | keep-ho | t | | | | | | | | |
| centra | al heatin | ig pump | : | | | | | | | | | 30 | | (230c) |
| boiler | with a f | an-assis | sted flue | | | | | | | | | 45 | | (230e) |
| Total e | lectricity | / for the | above, | kWh/yea | r | | | sum | of (230a). | (230g) = | | | 75 | (231) |
| Electric | city for li | ghting | | | | | | | | | | | 477.45 | (232) |
| 12a. (| CO2 em | issions · | – Individ | lual heat | ing syste | ems inclu | uding mi | cro-CHF |) | | | | | |
| | | | | | | Fn | erav | | | Fmiss | ion fact | tor | Fmissions | |
| | | | | | | k٧ | /h/year | | | kg CO | 2/kWh | | kg CO2/yea | r |
| Space | heating | (main s | ystem 1 |) | | (21 | 1) x | | | 0.2 | 16 | = | 2330.15 | (261) |
| Space | heating | (second | dary) | | | (21 | 5) x | | | 0.5 | 19 | = | 0 | (263) |
| Water | heating | | | | | (21 | 9) x | | | 0.2 | 16 | = | 535.64 | (264) |
| Space | and wa | ter heati | ng | | | (26 | 1) + (262) | + (263) + (| 264) = | · | | | 2865.79 | (265) |
| Electric | city for p | oumps, f | ans and | electric | keep-ho | t (23 | 1) x | | | 0.5 | 19 | = | 38.93 |](267) |
| Electric | city for li | ghting | | | | (23) | 2) x | | | 0.5 | 19 | = | 247.8 | _ (268) |
| Total C | :02, kg/ | 'year | | | | | | | sum o | f (265)(2 | 271) = | | 3152.51 | (272) |
| Dwelli | ng CO2 | Emissi | on Rate | • | | | | | (272) | ÷ (4) = | | | 34.29 | (273) |
| EI ratir | ıg (secti | on 14) | | | | | | | | | | | 69 | (274) |

| | | | User D | etails: | | | | | | |
|---|--|---------------------|------------------|----------------------|--------------|-------------------|------------------------|-----------|-----------------------------------|---------|
| Assessor Name: | George Farr | | | Strom | a Num | ber: | | STRO | 028460 | |
| Software Name: | Stroma FSAP 20 | 012 | | Softwa | are Ver | sion: | | Versic | on: 1.0.4.6 | |
| | | P | roperty <i>i</i> | Address: | Flat 3 - | Base | | | | |
| Address : | | | | | | | | | | |
| 1. Overall dwelling dime | nsions: | | | | | | | | | |
| Ground floor | | | Area | a(m²) 6.27 | (1a) x | Av. He i | i ght(m) .35 | (2a) = | Volume(m ³) 179.23 | (3a) |
| Total floor area TFA = (1a | a)+(1b)+(1c)+(1d)+(| 1e)+(1r | ı)7 | 6.27 | (4) | | | - | | |
| Dwelling volume | | | L | | (3a)+(3b) | +(3c)+(3d |)+(3e)+ | .(3n) = | 179.23 | (5) |
| 2. Ventilation rate: | | | | | | | | | | |
| Number of chimneys | main heating 0 + | secondar heating | у] + [| other 0 |] = [| total | x 4 | 40 = | m ³ per hour | (6a) |
| Number of open flues | 0 + | 0 | + | 0 |] = [| 0 | x 2 | 20 = | 0 | (6b) |
| Number of intermittent fai | าร | | | | | 3 | x ′ | 10 = | 30 | (7a) |
| Number of passive vents | | | | | Ē | 0 | x ′ | 10 = | 0 | (7b) |
| Number of flueless gas fi | es | | | | | 0 | x 4 | 40 = | 0 | (7c) |
| | | | | | | | | Air ch | anges per ho | _ ur |
| Infiltration due to chimne | s flues and fans - | (6a)+(6b)+(7) | 'a)+(7b)+(' | 7c) = | Г | 20 | | . (5) - | 0.47 | |
| If a pressurisation test has be | een carried out or is inter | ided, procee | d to (17), c | otherwise c | continue fro | 30 om (9) to (| 16) | ÷ (0) – | 0.17 | |
| Number of storeys in th | e dwelling (ns) | | | | | | | | 0 | (9) |
| Additional infiltration | | | | | | | [(9)- | -1]x0.1 = | 0 | (10) |
| Structural infiltration: 0. | 25 for steel or timbe | er frame or | 0.35 for | masonr | y constr | uction | | | 0 | (11) |
| if both types of wall are pr deducting areas of openin | esent, use the value corr as): if equal user 0.35 | esponding to | the great | er wall are | a (after | | | | | |
| If suspended wooden f | oor, enter 0.2 (unse | aled) or 0. | 1 (seale | d), else | enter 0 | | | | 0 | (12) |
| If no draught lobby, ent | er 0.05, else enter (|) | | | | | | | 0 | (13) |
| Percentage of windows | and doors draught | stripped | | | | | | | 0 | (14) |
| Window infiltration | | | | 0.25 - [0.2 | x (14) ÷ 1 | = [00 | | | 0 | (15) |
| Infiltration rate | | | | (8) + (10) | + (11) + (1 | 2) + (13) + | + (15) = | | 0 | (16) |
| Air permeability value, | q50, expressed in c | ubic metre | s per ho | our per so | quare m | etre of e | nvelope | area | 15 | (17) |
| If based on air permeabili | ty value, then (18) = | [(17) ÷ 20]+(8 | 3), otherwi | se (18) = (| 16) | | | | 0.92 | (18) |
| Air permeability value applies | s if a pressurisation test l d | as been dor | e or a deg | gree air pei | rmeability i | is being us | sed | | | |
| Shelter factor | u | | | (20) = 1 - | [0.075 x (1 | 9)] = | | | 1 | (19) |
| Infiltration rate incorporati | ng shelter factor | | | (21) = (18) |) x (20) = | | | | 0.92 |](21) |
| Infiltration rate modified for | or monthly wind spe | ed | | | | | | | 0.02 | |
| Jan Feb | Mar Apr Ma | y Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Monthly average wind sp | eed 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 | 2)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 |] | |
| | | | | | | | | | | |

| Adjuste | ed infiltr | ation rat | e (allow | ing for sh | elter an | d wind s | speed) = | (21a) x | (22a)m | | | - | _ | |
|-------------------------|-------------------------|--------------------------------|---------------------------|-------------------------------|--------------------------|------------------------|-----------------|----------------|---------------|-------------|------------------------------|-----------|-----------------|---------|
| | 1.17 | 1.15 | 1.12 | 1.01 | 0.99 | 0.87 | 0.87 | 0.85 | 0.92 | 0.99 | 1.03 | 1.08 | | |
| Calcula If me | ate ette | <i>ctive air</i> al ventila | change | rate for t | he appli | cable ca | se | | | | | | | (232) |
| If exh | aust air h | eat pump | usina App | endix N. (2 | 3b) = (23a | i) × Fmv (e | equation (1 | N5)) . othe | rwise (23b |) = (23a) | | | 0 | (23b) |
| If bala | anced wit | h heat reco | overy: effic | ciency in % | allowing f | or in-use f | actor (fron | n Table 4h |) = | , (, | | | 0 | (23c) |
| a) If | halance | d mech | anical ve | entilation | with he | at recove | ≏rv (M\/I | HR) (24a | ′ a)m – (2 | 2h)m + (| 23h) x [[,] | 1 – (23c) |) <u>-</u> 1001 | (200) |
| (24a)m= | | | | | 0 | 0 | | | | | | |] | (24a) |
| ().if | halance | d mech | l anical ve | | without | heat rec | noverv (N | 1 MV/) (24H | 1 - (2) | 2h)m + (' | 23h) | |] | |
| (24b)m= | 0 | | | 0 | 0 | 0 | | | | | 0 | 0 | 1 | (24b) |
|) c) If | whole h | | I tract ver | LI | or positiv | l ve input v | l ventilatio | I on from (| L | <u> </u> | 1 | | 1 | |
| i i | f (22b)r | n < 0.5 × | (23b), t | then (24c | c) = (23b |); otherv | vise (24 | c) = (22 | o) m + 0 | .5 × (23b |)) | | | |
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |] | (24c) |
| d) If | natural | ventilatio | on or wh | ole hous | e positiv | /e input | ventilatio | on from I | loft | <u>.</u> | | | 3 | |
| i | f (22b)r | n = 1, th | en (24d) |)m = (22t | o)m othe | rwise (2 | 4d)m = | 0.5 + [(2 | 2b)m² x | 0.5] | | | - | |
| (24d)m= | 1.17 | 1.15 | 1.12 | 1.01 | 0.99 | 0.88 | 0.88 | 0.86 | 0.92 | 0.99 | 1.03 | 1.08 | | (24d) |
| Effec | ctive air | change | rate - er | nter (24a |) or (24b | o) or (24 | c) or (24 | d) in bo | x (25) | | | | - | |
| (25)m= | 1.17 | 1.15 | 1.12 | 1.01 | 0.99 | 0.88 | 0.88 | 0.86 | 0.92 | 0.99 | 1.03 | 1.08 | | (25) |
| 3. He | at losse | s and he | eat loss | paramete | er: | | | | | | | | | |
| ELEN | IENT | Gros | SS (m ²) | Openin | gs 2 | Net Ar | ea n² | U-val | ue | A X U | K) | k-valu | к e | A X k |
| Doors | | arca | (11) | | | 1.80 | | 16 | | 3 024 | | N0/111 - | IX . | (26) |
| Window | ws Type | 1 | | | | 1.09 | | /[1/(31)+ | - 0.041 - | 00.45 | | | | (20) |
| Window | | | | | | 0.14 | | /[1/(31)+ | 0.04] | 22.40 | | | | (27) |
| Floor | wsiype | 52 | | | | 12.82 | <u>2</u> X1 | /[//(3.1)+ | 0.04] = | 35.36 | ╡╷ | | | (27) |
| | | | | | | 5.62 | | 0.22 | = | 1.2364 | | | \dashv | (28) |
| | гурет | 49.9 | 96 | 20.96 | 5 | 29 | × | 0.3 | = | 8.7 | ╡╎ | | \dashv | (29) |
| vvalis | i ype∠ | 24.4 | 17 | 1.89 | | 22.58 | 3 × | 0.25 | = | 5.64 | | | \dashv | (29) |
| Roof | | 13.3 | 31 | 0 | | 13.31 | x | 0.18 | = | 2.4 | | | | (30) |
| l otal a | rea of e | elements | , m² | | | 93.36 | 3 | | | | | | | (31) |
| Party v | vall | | | | | 51.46 | 3 X | 0 | = | 0 | | | | (32) |
| Party fl | loor | | | | | 70.66 | 3 | | | | | | | (32a) |
| Party c | eiling | | | | | 62.97 | 7 | | | | | | | (32b) |
| * for wind ** includ | dows and le the area | l roof wind as on both | ows, use e sides of ii | effective wil nternal wall | ndow U-va 's and part | alue calcul titions | ated using | g formula 1 | /[(1/U-valı | ue)+0.04] a | as given in | paragrapl | h 3.2 | |
| Fabric | heat los | ss, W/K : | = S (A x | U) | | | | (26)(30) |) + (32) = | | | | 78.81 | (33) |
| Heat ca | apacity | Cm = S(| (Axk) | | | | | | ((28). | (30) + (32 | 2) + (32a). | (32e) = | 10474.7 | '9 (34) |
| Therma | al mass | parame | ter (TMI | P = Cm ÷ | - TFA) in | n kJ/m²K | | | Indica | ative Value | : Medium | | 250 | (35) |
| For desig | gn asses Ised inste | sments wh ad of a de | ere the de tailed calc | etails of the ulation. | constructi | ion are not | t known pr | recisely the | e indicative | e values of | TMP in Ta | able 1f | | |
| Therma | al bridg | es : S (L | x Y) cal | culated u | using Ap | pendix ł | < | | | | | | 14 | (36) |
| if details | of therma | al bridging | are not kr | 10wn (36) = | = 0.15 x (3 | 1) | | | | | | | L | ` ´ |
| Total fa | abric he | at loss | | | | | | | (33) + | - (36) = | | | 92.81 | (37) |

| Ventila | ation hea | at loss ca | alculated | d monthl | у | - | - | | (38)m | = 0.33 × (| 25)m x (5) | | | |
|----------------|------------------------|-------------------------|------------------------|--------------------------|-------------------------|----------------------|-----------------------|--------------------|-----------------------|--------------------|------------------------|-------------|----------|--------------|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (38)m= | 69.18 | 67.83 | 66.47 | 59.69 | 58.34 | 52.04 | 52.04 | 50.87 | 54.46 | 58.34 | 61.04 | 63.76 | | (38) |
| Heat t | ransfer c | coefficie | nt, W/K | | | | | | (39)m | = (37) + (3 | 38)m | | | |
| (39)m= | 161.99 | 160.64 | 159.28 | 152.5 | 151.15 | 144.85 | 144.85 | 143.68 | 147.27 | 151.15 | 153.85 | 156.57 | | |
| Heatle | | motor (l | ער ים ור | /~21/ | | | | - | (40)~ | Average = | Sum(39)1. | 12 /12= | 152.31 | (39) |
| | 2 12 | | $1 \square P$, W | /m²ĸ | 1.09 | 1.0 | 1.0 | 1 99 | (40)m | = (39)m - | 2.02 | 2.05 | | |
| (40)11= | 2.12 | 2.11 | 2.09 | 2 | 1.90 | 1.9 | 1.9 | 1.00 | 1.95 | Average - | Sum(40), | 2.05 | 2 | (40) |
| Numb | er of day | s in mo | nth (Tab | le 1a) | | | | | | Wordgo - | Cum(40) | | <u> </u> | |
| | 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. Wa | ater heat | ing ene | rgy requ | irement: | | | | | | | | kWh/ye | ear: | |
| A | | | NI | | | | | | | | | | | (10) |
| Assum if TF | A > 13.9 | ipancy, i 9. N = 1 | N + 1.76 x | (1 - exp | (-0.0003 | 849 x (TF | - A -13.9 |)2)] + 0.(|)013 x (⁻ | ΓFA -13. | 2. .9) | 39 | | (42) |
| if TF | A £ 13.9 | 9, N = 1 | - | | (| - (| | , ,] | | - | | | | |
| Annua | l averag | e hot wa | ater usa | ge in litre | es per da | ay Vd,av | erage = | (25 x N) | + 36 | o torgot o | 90 | .92 | | (43) |
| not mor | e that 125 | litres per | not water person pe | r day (all w | ater use, l | hot and co | ld) | to acriieve | a water us | se largel o | 1 | | | |
| | lan | Fob | Mor | Apr | May | lun | , Iul | Δυσ | Son | Oct | Nov | Dec | | |
| Hot wat | er usage ii | n litres per | r day for e | Api ach month | Vd,m = fa | ctor from T | Table 1c x | (43) | Sep | 001 | NOV | Dec | | |
| (44)m- | 100.01 | 96.38 | 92 74 | 89.1 | 85.47 | 81.83 | 81.83 | 85.47 | 80.1 | 92 74 | 96 38 | 100.01 | | |
| (44)11- | 100.01 | 30.30 | 52.74 | 03.1 | 00.47 | 01.00 | 01.05 | 00.47 | 03.1 | JZ.14 | m(44) | 100.01 | 1091.06 | (44) |
| Energy | content of | hot water | used - ca | lculated m | onthly $= 4$. | 190 x Vd,r | n x nm x D | OTm / 3600 |) kWh/mor | oth (see Ta | ables 1b, 1 | - c, 1d) | 1031.00 | |
| (45)m= | 148.32 | 129.72 | 133.86 | 116.7 | 111.98 | 96.63 | 89.54 | 102.75 | 103.98 | 121.17 | 132.27 | 143.64 | | |
| | | | | | | | | | | Fotal = Su | m(45) ₁₁₂ = | = | 1430.55 | (45) |
| lf instan | taneous w | ater heati | ng at poin | t of use (no | o hot water | r storage), | enter 0 in | boxes (46 |) to (61) | | | | | _ |
| (46)m= | 22.25 | 19.46 | 20.08 | 17.51 | 16.8 | 14.49 | 13.43 | 15.41 | 15.6 | 18.18 | 19.84 | 21.55 | | (46) |
| vvater | storage | IOSS: | includir | | alar ar M | | storago | within or | | | | 450 | | (47) |
| Siorag | | e (illes) | | ig any so | | ///IK3 | slorage | WILLIN Se | ame ves | sei | | 150 | | (47) |
| Otherv | munity n vise if no | eating a | no no ta hot wate | ank in av er (this ir | /elling, e ncludes i | nter 110 nstantar | nitres in Neous co | (47) mbi boil | ers) ente | er '0' in <i>(</i> | 47) | | | |
| Water | storage | loss: | not wat | | | notantai | | | | | | | | |
| a) If m | nanufact | urer's de | eclared | loss fact | or is kno | wn (kWł | n/day): | | | | | 0 | | (48) |
| Tempe | erature fa | actor fro | m Table | e 2b | | | | | | | | 0 | | (49) |
| Energ | y lost fro | m water | · storage | e, kWh/y | ear | | | (48) x (49) |) = | | 1 | 50 | | (50) |
| b) If m | nanufact | urer's de | eclared | cylinder | loss fact | or is not | known: | | | | | | | |
| Hot wa | ater stora | age loss | factor f | rom Tab | le 2 (kW | h/litre/da | ıy) | | | | 0. | .01 | | (51) |
| If com | munity h | eating s | ee secti | on 4.3 | | | | | | | | | | (50) |
| Tempe | e lactor | actor fro | bie za m Table | 2h | | | | | | | 0. | .93 54 | | (52) |
| Enorm | / loot fro | m watar | | | oor | | | $(47) \times (51)$ | (F2) y (| E2) _ | 0. | .54 | | (53) |
| Energ | (50) or (| 111 water (54) in (F | 501age | ; KVV[1/Y | zdi | | | (47) X (51) | x (22) X (| us) = | 0. | 67 | | (54) (55) |
| Water | storade | | culated | for each | month | | | ((56)m - (| 55) x (41) | m | L0. | 01 | | (00) |
| (50)=- | | 10.00 001 | | | | 00.0 | 20.00 | | | | 00.0 | 00.00 | | (56) |
| =m(ac) | ∠0.88 | 18.86 | 20.88 | 20.2 | 20.88 | 20.2 | 20.88 | 20.88 | 20.2 | 20.88 | 20.2 | 20.88 | | (00) |

| If cylinde | er contair | s dedicate | d solar sto | rage, (57) | m = (56)m | x [(50) – (| H11)] ÷ (5 | 0), else (5 | 7)m = (56) | m where (| H11) is fro | m Append | ix H | |
|------------|------------|-------------|-------------|-------------|------------|-------------|-------------|--------------|--------------|-------------|-------------|-------------|---------------|------|
| (57)m= | 20.88 | 18.86 | 20.88 | 20.2 | 20.88 | 20.2 | 20.88 | 20.88 | 20.2 | 20.88 | 20.2 | 20.88 | | (57) |
| Primar | y circui | t loss (ar | nual) fro | om Table | 93 | - | - | | - | - | | 0 | | (58) |
| Primar | y circui | t loss cal | culated | for each | month (| 59)m = (| (58) ÷ 36 | 65 × (41) | m | | | | | |
| (mod | dified by | y factor fi | rom Tab | le H5 if t | here is s | solar wat | er heati | ng and a | cylinde | r thermo | stat) | | | |
| (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 ca | lculated | for each | month (| (61)m = | (60) ÷ 36 | 65 × (41) |)m | | | | | | |
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (61) |
| Total h | eat req | uired for | water h | eating ca | alculated | for eacl | h month | (62)m = | 0.85 × (| (45)m + | (46)m + | (57)m + | (59)m + (61)m | |
| (62)m= | 192.46 | 169.59 | 178 | 159.42 | 156.12 | 139.35 | 133.68 | 146.89 | 146.69 | 165.31 | 174.99 | 187.78 | | (62) |
| Solar DH | IW input | calculated | using App | endix G oı | · Appendix | H (negati | ve quantity | /) (enter '0 | ' if no sola | r contribut | ion to wate | er heating) | | |
| (add a | dditiona | al lines if | FGHRS | and/or \ | WWHRS | applies | , see Ap | pendix C | G) | | | | | |
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (63) |
| Output | from w | ater hea | ter | | | | | | | | | | | |
| (64)m= | 192.46 | 169.59 | 178 | 159.42 | 156.12 | 139.35 | 133.68 | 146.89 | 146.69 | 165.31 | 174.99 | 187.78 | | _ |
| | | | | | | | | Outp | out from wa | ater heate | r (annual)₁ | 12 | 1950.27 | (64) |
| Heat g | ains fro | m water | heating, | kWh/m | onth 0.2 | 5 ´ [0.85 | × (45)m | ı + (61)m | n] + 0.8 x | (46)m | + (57)m | + (59)m |] | |
| (65)m= | 84.63 | 75.03 | 79.82 | 72.98 | 72.55 | 66.3 | 65.08 | 69.48 | 68.75 | 75.6 | 78.15 | 83.07 | | (65) |
| inclu | ide (57) | m in calo | culation | of (65)m | only if c | ylinder i | s in the o | dwelling | or hot w | ater is fr | om com | munity h | eating | |
| 5. Int | ernal g | ains (see | e Table 5 | 5 and 5a |): | | | | | | | | | |
| Metabo | olic gaiı | ns (Table | e 5), Wat | ts | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (66)m= | 119.41 | 119.41 | 119.41 | 119.41 | 119.41 | 119.41 | 119.41 | 119.41 | 119.41 | 119.41 | 119.41 | 119.41 | | (66) |
| Lightin | g gains | (calcula | ted in Ap | opendix | L, equat | ion L9 oi | r L9a), a | lso see | Table 5 | | | | | |
| (67)m= | 23.57 | 20.93 | 17.02 | 12.89 | 9.63 | 8.13 | 8.79 | 11.42 | 15.33 | 19.47 | 22.72 | 24.22 | | (67) |
| Applia | nces ga | ins (calc | ulated ir | Append | dix L, eq | uation L | 13 or L1 | 3a), alsc | see Ta | ble 5 | | | | |
| (68)m= | 211.47 | 213.66 | 208.13 | 196.36 | 181.5 | 167.53 | 158.2 | 156.01 | 161.54 | 173.31 | 188.17 | 202.14 | | (68) |
| Cookin | ng gains | s (calcula | ted in A | ppendix | L, equat | ion L15 | or L15a) |), also se | e Table | 5 | - | | | |
| (69)m= | 34.94 | 34.94 | 34.94 | 34.94 | 34.94 | 34.94 | 34.94 | 34.94 | 34.94 | 34.94 | 34.94 | 34.94 | | (69) |
| Pumps | and fa | ns gains | (Table § | 5a) | | | | | | | | | | |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | | (70) |
| Losses | s e.g. e | vaporatio | n (nega | tive valu | es) (Tab | le 5) | | | | | | | | |
| (71)m= | -95.53 | -95.53 | -95.53 | -95.53 | -95.53 | -95.53 | -95.53 | -95.53 | -95.53 | -95.53 | -95.53 | -95.53 | | (71) |
| Water | heating | gains (T | able 5) | | | | | | | | | | | |
| (72)m= | 113.75 | 111.65 | 107.29 | 101.36 | 97.51 | 92.09 | 87.48 | 93.38 | 95.48 | 101.62 | 108.55 | 111.66 | | (72) |
| Total i | nterna | l gains = | | | | (66) | m + (67)m | n + (68)m + | ⊦ (69)m + (| (70)m + (7 | 1)m + (72) | m | | |
| (73)m= | 410.61 | 408.07 | 394.27 | 372.43 | 350.47 | 329.58 | 316.3 | 322.64 | 334.17 | 356.22 | 381.26 | 399.84 | | (73) |
| 6. Sol | lar gain | s: | | • | | | | • | | | | | | |
| Solar g | ains are | calculated | using sola | r flux from | Table 6a | and associ | iated equa | itions to co | onvert to th | e applicat | le orientat | ion. | | |
| Orienta | ation: | Access F | actor | Area | | Flu | х | | g_ | | FF | | Gains | |

Table 6b

Table 6c

Table 6a

Table 6d

m²

(W)

| Northea | ast <mark>0.9x</mark> | 0.77 |) | • | 12.8 | 32 | x | 1 | 1.28 | x | | 0.63 | x | 0.7 | | = | 44.21 | (75) |
|----------|-----------------------|-----------|----------|------------|-----------------------|---------|--------|----------|-----------|-------------------|--------|---------|--------|----------|----------|-------------|--------|------|
| Northea | ast <mark>0.9x</mark> | 0.77 | , | (| 12.8 | 32 | x | 2 | 2.97 | X | | 0.63 | × | 0.7 | | = | 89.98 | (75) |
| Northea | ast <mark>0.9x</mark> | 0.77 |) | • | 12.8 | 32 | x | 4 | 1.38 | × | | 0.63 | x | 0.7 | | = | 162.12 | (75) |
| Northea | ast <mark>0.9x</mark> | 0.77 |) | (| 12.8 | 32 | x | 6 | 7.96 | × | | 0.63 | × | 0.7 | | = | 266.25 | (75) |
| Northea | ast <mark>0.9x</mark> | 0.77 |) | (| 12.8 | 32 | x | 9 | 1.35 | × | | 0.63 | x | 0.7 | | = | 357.89 | (75) |
| Northea | ast <mark>0.9x</mark> | 0.77 |) | (| 12.8 | 32 | x | 9 | 7.38 | × | | 0.63 | x | 0.7 | | = | 381.55 | (75) |
| Northea | ast <mark>0.9x</mark> | 0.77 |) | • | 12.8 | 32 | x | | 91.1 | × | | 0.63 | x | 0.7 | | = | 356.93 | (75) |
| Northea | ast <mark>0.9x</mark> | 0.77 |) | • | 12.8 | 32 | x | 7 | 2.63 | × | | 0.63 | x | 0.7 | | = | 284.55 | (75) |
| Northea | ast <mark>0.9x</mark> | 0.77 |) | • | 12.8 | 32 | x | 5 | 0.42 | x | | 0.63 | × | 0.7 | | = | 197.55 | (75) |
| Northea | ast <mark>0.9x</mark> | 0.77 |) | • | 12.8 | 32 | x | 2 | 8.07 | × | | 0.63 | x | 0.7 | | = | 109.97 | (75) |
| Northea | ast <mark>0.9x</mark> | 0.77 |) | • | 12.8 | 32 | x | | 14.2 | x | | 0.63 | × | 0.7 | | = | 55.62 | (75) |
| Northea | ast <mark>0.9x</mark> | 0.77 |) | • | 12.8 | 32 | x | 9 | 9.21 | x | | 0.63 | × | 0.7 | | = | 36.1 | (75) |
| Southw | est <mark>0.9x</mark> | 0.77 |) | • | 8.1 | 4 | x | 3 | 6.79 |] | | 0.63 | x | 0.7 | | = | 91.53 | (79) |
| Southw | est <mark>0.9x</mark> | 0.77 |) | • | 8.1 | 4 | x | 6 | 2.67 |] | | 0.63 | x | 0.7 | | = | 155.91 | (79) |
| Southw | est <mark>0.9x</mark> | 0.77 |) | • | 8.1 | 4 | x | 8 | 5.75 |] | | 0.63 | x | 0.7 | | = | 213.33 | (79) |
| Southw | est <mark>0.9x</mark> | 0.77 |) | • | 8.1 | 4 | x | 1 | 06.25 |] | | 0.63 | x | 0.7 | | = | 264.32 | (79) |
| Southw | est <mark>0.9x</mark> | 0.77 |) | (| 8.1 | 4 | x | 1 | 19.01 |] | | 0.63 | x | 0.7 | | = | 296.06 | (79) |
| Southw | est <mark>0.9x</mark> | 0.77 |) | • | 8.1 | 4 | x | 1 | 18.15 |] | | 0.63 | × | 0.7 | | = | 293.92 | (79) |
| Southw | est <mark>0.9x</mark> | 0.77 |) | • | 8.1 | 4 | x | 1 | 13.91 |] | | 0.63 | × | 0.7 | | = | 283.37 | (79) |
| Southw | est <mark>0.9x</mark> | 0.77 |) | • | 8.1 | 4 | x | 1(| 04.39 |] | | 0.63 | × | 0.7 | | = | 259.69 | (79) |
| Southw | est <mark>0.9x</mark> | 0.77 |) | • | 8.1 | 4 | x | 9 | 2.85 |] | | 0.63 | x | 0.7 | | = | 230.99 | (79) |
| Southw | est <mark>0.9x</mark> | 0.77 |) | • | 8.1 | 4 | x | 6 | 9.27 |] | | 0.63 | x | 0.7 | | = | 172.32 | (79) |
| Southw | est <mark>0.9x</mark> | 0.77 |) | • | 8.1 | 4 | x | 4 | 4.07 |] | | 0.63 | × | 0.7 | | = | 109.63 | (79) |
| Southw | est <mark>0.9x</mark> | 0.77 |) | • | 8.1 | 4 | x | 3 | 1.49 |] | | 0.63 | × | 0.7 | | = | 78.33 | (79) |
| | | | | | | | | | | | | | | | | | | |
| Solar g | ains in | watts, ca | alculate | d | for each | n mont | h | | | (83)r | n = Sı | um(74)m | .(82)m | | <u> </u> | | | (00) |
| (83)m= | 135.74 | 245.89 | 375.45 | Ţ | 530.57 | 653.95 | | 675.47 | 640.3 | 544 | 1.24 | 428.53 | 282.28 | 3 165.26 | 114 | 1.43 | | (83) |
| 10tal g | | | | л Т | $\frac{(04)(0)}{002}$ | 1004.4 | 1+ | (03)III | | 0.00 | | 760 74 | 620 5 | 546 52 | 51/ | 1.07 | | (84) |
| (04)111= | 546.34 | 053.90 | 769.71 | | 903 | 1004.4 | -2 | 1005.05 | 956.6 | 800 | 0.00 | 762.71 | 030.3 | 540.52 | 514 | . ∠/ | | (04) |
| 7. Me | an inter | nal temp | perature | e (| heating | seaso | on) | | | | | | | | | - | | _ |
| Temp | erature | during h | eating | pe | eriods in | the liv | ving | g area f | rom Tal | ble 9 | , Th | 1 (°C) | | | | | 21 | (85) |
| Utilisa | ation fac | tor for g | ains for | · lir T | ving are | a, h1, | m (| see Ta | ble 9a) | <u> </u> | | | | | | | | |
| (00) | Jan | Feb | Mar | ╉ | Apr | May | 4 | Jun | Jul | | ug | Sep | Oct | Nov | |)ec | | (96) |
| (86)m= | 1 | 0.99 | 0.98 | | 0.95 | 0.88 | | 0.74 | 0.6 | 0. | 66 | 0.87 | 0.97 | 0.99 | | 1 | | (00) |
| Mean | interna | l temper | ature ir | n li | iving are | ea T1 (| (foll | ow ste | ps 3 to 7 | 7 in ⁻ | Fable | e 9c) | | 1 | | | | |
| (87)m= | 18.74 | 18.97 | 19.36 | | 19.95 | 20.44 | | 20.8 | 20.93 | 20 |).9 | 20.62 | 19.98 | 19.3 | 18 | .76 | | (87) |
| Temp | erature | during h | eating | pe | eriods in | rest c | of d | welling | from Ta | able | 9, Tł | n2 (°C) | | - | | | | |
| (88)m= | 19.25 | 19.26 | 19.28 | | 19.33 | 19.35 | | 19.4 | 19.4 | 19 | .41 | 19.38 | 19.35 | 19.32 | 19 | 9.3 | | (88) |
| Utilisa | ation fac | tor for g | ains for | re | est of d | velling | i, hź | 2,m (se | e Table | 9a) | | | | | | | | |
| (89)m= | 0.99 | 0.99 | 0.97 | | 0.93 | 0.82 | | 0.62 | 0.41 | 0. | 48 | 0.78 | 0.95 | 0.99 | 0. | 99 | | (89) |
| | | | | | | | | | | | | | | | | | | |

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

| (90)m= | 17.29 | 17.52 | 17.92 | 18.53 | 18.99 | 19.32 | 19.39 | 19.39 | 19.18 | 18.58 | 17.9 | 17.34 | | (90) |
|------------------|------------|-------------------------|-----------------|-------------------|-----------|----------------|--------------|------------|-------------------|-----------------|--------------------|------------|---------|---------|
| | | | | | | | | | 1 | fLA = Livin | ig area ÷ (4 | 4) = | 0.48 | (91) |
| Mean | interna | l temper | ature (fo | or the wh | ole dwe | llina) = f | LA x T1 | + (1 – fL | A) x T2 | | | | | |
| (92)m= | 17.99 | 18.22 | 18.62 | 19.22 | 19.69 | 20.04 | 20.13 | 20.12 | 19.88 | 19.26 | 18.58 | 18.03 | | (92) |
| Apply | v adjustn | nent to t | he mear | n interna | temper | i ature fro | n m Table | 4e, whe | ere appro | opriate | | | | |
| (93)m= | 17.99 | 18.22 | 18.62 | 19.22 | 19.69 | 20.04 | 20.13 | 20.12 | 19.88 | 19.26 | 18.58 | 18.03 | | (93) |
| 8. Sp | ace hea | ting requ | uirement | t | | | <u> </u> | • | | • | • | | | |
| Set T | i to the r | mean int | ernal te | mperatu | re obtain | ed at st | ep 11 of | Table 9 | o, so tha | t Ti,m=(| 76)m an | d re-calc | ulate | |
| the ut | tilisation | factor fo | or gains | using Ta | ble 9a | - | | _ | | | , | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Utilisa | ation fac | tor for g | ains, hm | 1: | | | - | - | | - | - | | | |
| (94)m= | 0.99 | 0.98 | 0.97 | 0.93 | 0.83 | 0.67 | 0.5 | 0.57 | 0.81 | 0.95 | 0.99 | 0.99 | | (94) |
| Usefu | ul gains, | hmGm | , W = (9 | 4)m x (84 | 4)m | | _ | _ | - | _ | _ | | | |
| (95)m= | 541.54 | 643.64 | 745.17 | 835.81 | 838.38 | 676.15 | 482.4 | 491.22 | 619.99 | 607.28 | 538.55 | 510.62 | | (95) |
| Mont | hly aver | age exte | rnal terr | perature | e from Ta | able 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 | e for mea | an interr | al tempe | erature, | Lm,W: | =[(39)m | x [(93)m | – (96)m |] | - | | | |
| (97)m= | 2217.57 | 2139.78 | 1930.5 | 1573.12 | 1207.99 | 787.68 | 512 | 534.87 | 850.88 | 1308.8 | 1765.71 | 2164.82 | | (97) |
| Spac | e heatin | g require | ement fo | r each n | nonth, k\ | Nh/mon | th = 0.02 | 24 x [(97 |)m – (95 | 5)m] x (4 | 1)m | | | |
| (98)m= | 1246.96 | 1005.41 | 881.88 | 530.86 | 274.99 | 0 | 0 | 0 | 0 | 521.93 | 883.55 | 1230.73 | | |
| | | | | | | | - | Tota | l per year | (kWh/year | r) = Sum(9 | 8)15,912 = | 6576.31 | (98) |
| Spac | e heatin | a reauire | ement in | kWh/m² | /vear | | | | | | | | 86.22 | (99) |
| | orauroa | | sto Ind | ividual b | ooting o | votomo i | noludino | , mioro (| חחי | | | l | | |
| Sa. LI | o hostir | a | ns – mu | iviuuai ri | eating s | ystems i | nciuumg | f micro-c | 21 IF) | | | | | |
| Fract | ion of sc | ig. bace hea | at from s | econdar | v/supple | mentarv | v svstem | | | | | | 0 | (201) |
| Fract | ion of sr | ace hes | at from n | nain evet | om(s) | , | -) | (202) = 1 | - (201) = | | | | 1 | |
| Final | | | | iairi syst | | | | (204) (2 | (201) = | (202)] | | | | |
| Fract | ion of to | tal neati | ng from | main sys | stem 1 | | | (204) = (2 | 02) x [1 – | (203)] = | | - | 1 | (204) |
| Efficie | ency of r | main spa | ace heat | ing syste | em 1 | | | | | | | | 86.9 | (206) |
| Efficie | ency of s | seconda | ry/suppl | ementar | y heating | g systen | า, % | | | | | | 0 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/ye | ar |
| Spac | e heatin | g require | ement (c | alculate | d above) |) | | L Č | | | | | | |
| - | 1246.96 | 1005.41 | 881.88 | 530.86 | 274.99 | 0 | 0 | 0 | 0 | 521.93 | 883.55 | 1230.73 | | |
| (211)n | n = {[(98 |)m x (20 | 1 14)1 } x 1 | $100 \div (20)$ |)6) | | 1 | 1 | | 1 | 1 | | | (211) |
| () | 1434.94 | 1156.97 | 1014.82 | 610.89 | 316.45 | 0 | 0 | 0 | 0 | 600.61 | 1016.75 | 1416.25 | | () |
| | | | | | | | | Tota | l I (kWh/yea | ar) =Sum(2 | 211) | = | 7567 68 | (211) |
| Snoo | a haatin | a fuel (e | aaandar | | month | | | | | , | / 15, 1012 | | 1001.00 | (= , |
| | m x (20) | y iuei (S)1)] \ v 1 | $00 \pm (20)$ | y), KVVII/ 181 | monun | | | | | | | | | |
| (215)m= | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| ()///- | Ŭ | | l | l | | | l | Tota | l (kWh/ve: | I ar) =Sum() | 1 215). | | 0 | (215) |
| \\/ <u>-</u> +-~ | ha-1! | | | | | | | | | ,(| - <i>1</i> 15,1012 | | U | |
| Output | from w |) ator boo | tor (colo | ulated el | hove | | | | | | | | | |
| Julpu | 192.46 | 169.59 | 178 | 159.42 | 156.12 | 139.35 | 133.68 | 146.89 | 146.69 | 165.31 | 174.99 | 187.78 | | |
| Efficie | ncy of w | ater hea | ıter | I | L | I | I | I | I | I | I | I | 76.8 | (216) |
| | , | | | | | | | | | | | | | · · · · |

| _ | | | | | | - | | - | _ | _ | - | _ | _ | |
|--|---|---|--|----------------|----------|---|--|------------------------|---------------------------|---|--|-------------------------|--|---|
| (217)m= | 85.4 | 85.28 | 85.02 | 84.34 | 82.95 | 76.8 | 76.8 | 76.8 | 76.8 | 84.24 | 85.05 | 85.41 | | (217) |
| Fuel for | r water | heating, | kWh/mo | onth | | | | | | | | | | |
| (219)m (219)m= | <u>= (64)</u> 225.37 | m x 100 |) ÷ (217) 209.36 | m 189.02 | 188.21 | 181.44 | 174.06 | 191.26 | 191.01 | 196.25 | 205.74 | 219.85 | 1 | |
| | | | | | | | | Tota | l = Sum(2 | 19a) ₁₁₂ = | | | 2370.43 | (219) |
| Annua | l totals | ; | | | | | | | | k | Wh/year | - | kWh/year | |
| Space | heating | j fuel use | ed, main | system | 1 | | | | | | • | | 7567.68 |] |
| Water h | neating | fuel use | d | | | | | | | | | | 2370.43 | Ī |
| Electric | ity for p | oumps, fa | ans and | electric l | keep-ho | t | | | | | | | | - |
| centra | I heatir | ng pump: | : | | | | | | | | | 30 |] | (230c) |
| boiler | with a f | fan-assis | ted flue | | | | | | | | | 45 | j | (230e) |
| Total el | lectricit | y for the | above, k | (Wh/yea | r | | | sum | of (230a). | (230g) = | | | 75 | (231) |
| Electric | ity for I | ighting | | | | | | | | | | | 416.18 | (232) |
| | | | | | | | | | | | | | | _ |
| 12a. C | CO2 em | nissions - | – Individ | ual heati | ng syste | ems inclu | uding mi | cro-CHF | , | | | | | |
| 12a. C | CO2 em | nissions - | – Individ | ual heati | ng syste | ems inclu En kW | uding mi ergy /h/year | cro-CHF | , | Emiss kg CO | ion fac 2/kWh | tor | Emissions kg CO2/yea | ar |
| 12a. C Space | CO2 em | nissions - g (main s | - Individ ystem 1) | ual heati) | ng syste | ems inclu En kW (21 [,] | uding mi ergy /h/year I) x | cro-CHF | | Emiss kg CO | ion fac 2/kWh 16 | tor = | Emissions kg CO2/yea 1634.62 | ar](261) |
| 12a. C Space Space | CO2 em heating heating | iissions -) (main s) (seconc | - Individ ystem 1) dary) | ual heati | ng syste | ems inclu En kW (21 (21 | uding mi ergy /h/year I) x 5) x | cro-CHF | | Emiss kg CO 0.2 | ion fac 2/kWh 16 | tor = = | Emissions kg CO2/yea 1634.62 | ar](261)](263) |
| 12a. C Space Space Water H | CO2 em heating heating neating | iissions -) (main s) (second | - Individ ystem 1) dary) | ual heati | ng syste | ems inclu En kW (21 (21) (21) | uding mil ergy /h/year I) x 5) x 9) x | cro-CHF | | Emiss kg CO 0.2 0.5 | ion fac 2/kWh 16 19 16 | tor = = = | Emissions kg CO2/yea 1634.62 0 512.01 | ar](261)](263)](264) |
| 12a. C Space Space Water H Space | CO2 em heating heating neating and wa | issions -) (main s) (second iter heati | - Individ ystem 1) dary) ng | ual heati | ng syste | ems inclu En kW (21 ² (21) (21) (26) | uding mil ergy /h/year 1) x 5) x 9) x 1) + (262) · | cro-CHF + (263) + (| (264) = | Emiss kg CO 0.2 0.5 | ion fac 2/kWh 16 19 16 | tor = = = | Emissions kg CO2/yea 1634.62 0 512.01 2146.63 | ar](261)](263)](264)](265) |
| 12a. C Space Space Water H Space | heating heating heating and wa | issions -) (main s) (second ter heati pumps, fa | - Individ ystem 1) dary) ng ans and | electric l | ng syste | ems inclu En kW (21 ² (21) (21) (21) (26 ² t (23) | uding mil ergy /h/year 1) x 5) x 9) x 1) + (262) · 1) x | cro-CHF + (263) + (| (264) = | Emiss kg CO 0.2 0.5 0.2 | ion fac 2/kWh 16 19 16 | tor = = = | Emissions kg CO2/yea 1634.62 0 512.01 2146.63 38.93 | ar](261)](263)](264)](265)](267) |
| 12a. C Space Space Water h Space Electric | heating heating heating and wa ity for p | issions - (main s (second ter heati bumps, fa ighting | - Individ ystem 1) dary) ng ans and | electric l | ng syste | ems inclu En kW (21 ² (21) (21) (21) (23) t (23) | uding mil ergy /h/year 1) x 5) x 9) x 1) + (262) · 1) x 2) x | cro-CHF + (263) + (| (264) = | Emiss kg CO 0.2 0.5 0.2 | ion fac 2/kWh 16 19 16 | tor = = = = | Emissions kg CO2/yea 1634.62 0 512.01 2146.63 38.93 216 | ar](261)](263)](264)](265)](267)](268) |
| 12a. C Space I Space I Space I Electric Electric Total C | heating heating heating and wa sity for p sity for I | issions - (main s (second ter heati bumps, fa ighting /year | - Individ ystem 1) dary) ng ans and | electric l | ng syste | ems inclu En kW (21 ² (21) (21) (21) (23) t (23) | uding mil ergy /h/year 1) x 5) x 9) x 1) + (262) · 1) x 2) x | cro-CHF + (263) + (| (264) = sum o | Emiss kg CO 0.2 0.5 0.5 0.5 f (265)(2 | ion fac 2/kWh 16 19 16 19 19 19 271) = | tor = = = = | Emissions kg CO2/yea 1634.62 0 512.01 2146.63 38.93 216 2401.55 | ar (261) (263) (264) (265) (267) (268) (272) |
| 12a. C Space I Space I Space I Electric Electric Total C Dwellir | heating heating heating and wa sity for p sity for l :O2, kg, ng CO2 | issions - (main s) (second ter heati bumps, fa ighting /year 2 Emissi | - Individ ystem 1) dary) ng ans and on Rate | electric l | ng syste | ems inclu En kW (21 ² (21) (21) (21) (23) t (23) | uding mil ergy /h/year 1) x 5) x 9) x 1) + (262) 1) x 2) x | cro-CHF + (263) + (| (264) = sum o (272) | Emiss kg CO. 0.2 0.5 0.5 (0.5 f (265)(2 \div (4) = | ion fac 2/kWh 16 19 16 19 19 19 271) = | tor = = = | Emissions kg CO2/yes 1634.62 0 512.01 2146.63 38.93 216 2401.55 31.49 | ar (261) (263) (264) (265) (265) (267) (268) (272) (273) |
| 12a. C Space I Space I Space I Electric Electric Total C Dwellir El ratin | heating heating heating and wa sity for p sity for I :O2, kg, ng CO2 g (secti | issions - (main s (second ter heati bumps, fa ighting /year 2 Emissi ion 14) | - Individ ystem 1) dary) ng ans and on Rate | electric l | ng syste | ems inclu En kW (211 (211 (211 (211) (212) | uding mil ergy /h/year I) x 5) x 9) x 1) + (262) · 1) x 2) x | cro-CHF + (263) + (| (264) = sum o (272) | Emiss kg CO. 0.2 0.5 0.5 f (265)(2) \div (4) = | ion fac 2/kWh 16 19 16 19 19 271) = | tor = = = | Emissions kg CO2/yes 1634.62 0 512.01 2146.63 38.93 216 2401.55 31.49 73 | ar] (261)] (263)] (264)] (265)] (267)] (268)] (272)] (273)] (274) |

| | | | | | | | User D | Details: | | | | | | | |
|---------------|--|------------|-------------------------|-----------------|------------------------|--------------------|------------|--------------------------|----------------------|-------------|----------|-----------|-------------------------|----------|--|
| Asses | sor N | ame: | Ge | orge Fa | rr | | | Strom | a Num | ber: | | STRC | 028460 | | |
| Softw | are Na | ame: | Str | oma FS | AP 201 | 2 | | Softwa | are Ver | rsion: | | Versio | on: 1.0.4.6 | | |
| | | | | | | Р | roperty | Address | : Flat 4 - | Base | | | | | |
| Addre | ss : | | | | | | | | | | | | | | |
| 1. Ove | Area(m²)Av. Height(m)ound floor 5.28 $(1a) \times$ 2.55 $(2a) =$ at floor 76.37 $(1b) \times$ 2.1 $(2b) =$ | | | | | | | | | | | | | | |
| | | | | | | | Are | a(m²) | | Av. He | ight(m) | - | Volume(m ³) | - | |
| Ground | l floor | | | | | | | 5.28 | (1a) x | 2 | .55 | (2a) = | 13.46 | (3a) | |
| First flo | or | | | | | | 7 | 76.37 | (1b) x | 2 | 2.1 | (2b) = | 160.38 | (3b) | |
| Total flo | oor area | TFA = | (1a)+(1l | o)+(1c)+ | (1d)+(1e | e)+(1n | i) [| 31.65 | (4) | | | - | | _ | |
| Dwellin | g volum | e | | | | | | | (3a)+(3b) |)+(3c)+(3d | l)+(3e)+ | .(3n) = | 173.84 | (5) | |
| 2. Ver | tilation | rate: | | | | | | | | | | | | | |
| | | | | main heating | se h | econdar neating | у | other | | total | | | m ³ per hour | | |
| Numbe | r of chir | nneys | Г | 0 | + | 0 |] + [| 0 | = | 0 | X 4 | 40 = | 0 | (6a) | |
| Numbe | r of ope | n flues | Ē | 0 | _ + [| 0 | ī + Ē | 0 | - - | 0 | x 2 | 20 = | 0 | (6b) | |
| Numbe | r of inte | rmittent | fans | | | | | | | 3 | × ′ | 10 = | 30 | (7a) | |
| Numbe | r of pas | sive ver | nts | | | | | | Г | 0 | x ^ | 10 = | 0 | (7b) | |
| Numbe | r of flue | less ga | s fires | | | | | | Ē | 0 | x 4 | 40 = | 0 | (7c) | |
| | | - | | | | | | | L | | | | | | |
| | | | | | | | | | | | | Air ch | hanges per hou | ur | |
| Infiltrati | on due | to chim | neys, flu | es and f | ans = <mark>(6</mark> | a)+(6b)+(7 | a)+(7b)+(| (7c) = | Г | 30 | · [| ÷ (5) = | 0.17 | (8) | |
| lf a pr | essurisati | on test ha | s been ca | rried out o | r is intende | ed, proceed | d to (17), | otherwise o | continue fr | om (9) to (| (16) | | | - | |
| Num | ber of si | toreys ir | n the dw | elling (n | S) | | | | | | (0) | | 0 | (9) | |
| Addi | ional ini | iltration | 0.05 fo | r otool o | r timbor | frama ar | 0.25 fo | r 20000 | n conotr | uction | [(9)- | -1]x0.1 = | 0 | | |
| Struc if b | oth types | of wall ar | : 0.25 10 e present. | r steel o | r timber due corres | ponding to | the great | r masoni ter wall are | y constr a (after | uction | | | 0 | (11) | |
| dec | lucting are | eas of ope | enings); if | equal user | 0.35 | portainig to | une grea | | a faiter | | | | | | |
| lf sus | spendec | woode | n floor, o | enter 0.2 | (unseal | ed) or 0. | 1 (seale | ed), else | enter 0 | | | | 0 | (12) | |
| lf no | draught | lobby, | enter 0.0 | 05, else | enter 0 | | | | | | | | 0 | (13) | |
| Perce | entage o | of windo | ws and | doors di | aught st | ripped | | | | | | | 0 | (14) | |
| Wind | low infilt | ration | | | | | | 0.25 - [0.2 | 2 x (14) ÷ 1 | = [00] | (| | 0 | (15) | |
| Infiltr | ation ra | te | | | | _ | | (8) + (10) | + (11) + (1 | 2) + (13) - | + (15) = | | 0 | (16) | |
| Air p | ermeabi | ility valu | e, q50, | expresse | ed in cub | oic metre | s per ho | our per s | quare m | etre of e | nvelope | area | 15 | (17) | |
| If base | d on air | permea | bility val | lue, then | (18) = [(1 | 7) ÷ 20]+(8 | s), otnerw | 1Se(18) = (| (10) | ia haina w | and | | 0.92 | (18) | |
| Numbe | r of side | es shelte | ered | เธรรณกรสแ | Un lest nas | s been don | e or a de | giee all pe | тпеаршку | is being us | seu | | 0 | 7(19) | |
| Shelter | factor | | | | | | | (20) = 1 - | [0.075 x (1 | 9)] = | | | 1 | (10) | |
| Infiltrati | on rate | incorpo | rating sł | nelter fac | ctor | | | (21) = (18 |) x (20) = | | | | 0.92 | (21) | |
| Infiltrati | on rate | modifie | d for mo | nthly wir | nd speed | ł | | | | | | | | <u> </u> | |
| [| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |] | | |
| Monthly | / averag | ge wind | speed f | rom Tab | le 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 \div 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 an | d wind speed) | = (21a) x (22a)m | า | | | | |
| 1.18 1.15 1.13 1.01 0.99 | 0.88 0.88 | 0.85 0.92 | 0.99 | 1.04 | 1.08 | | |
| Calculate effective air change rate for the applic | cable case | • • | • | | | | 1 2-1 |
| If exhaust air heat pump using Appendix N. (23b) = (23a |) × Fmv (equation | (N5)) . otherwise (23 | 3b) = (23a) | | | 0 (2 | .5a) 235) |
| If balanced with heat recovery: efficiency in % allowing for | or in-use factor (fr | om Table 4h) = | | | | 0 (2 | .30) 23c) |
| a) If balanced mechanical ventilation with hea | at recoverv (M) | VHR) (24a)m = (| 22b)m + () | 23b) × [⁻ | ∟ ÷ (23c) – 1 | (| .00) |
| (24a)m= 0 0 0 0 0 | 0 0 | 0 0 | 0 | 0 | | (2 | 24a) |
| b) If balanced mechanical ventilation without | heat recovery | (MV) (24b)m = (| 22b)m + (2 | 23b) | | | |
| (24b)m= 0 0 0 0 0 | 0 0 | 0 0 | 0 | 0 | 0 | (2 | :4b) |
| c) If whole house extract ventilation or positiv | e input ventila | tion from outside | | | | | |
| if (22b)m < 0.5 × (23b), then (24c) = (23b |); otherwise (2 | 24c) = (22b) m + | 0.5 × (23b |) | | | |
| (24c)m= 0 0 0 0 0 | 0 0 | 0 0 | 0 | 0 | 0 | (2 | :4c) |
| d) If natural ventilation or whole house positivity if (22b)m = 1, then (24d)m = (22b)m other | ve input ventila rwise (24d)m : | tion from loft = $0.5 + [(22b)m^2]$ | x 0.5] | | | | |
| (24d)m= 1.18 1.15 1.13 1.01 0.99 | 0.88 0.88 | 0.86 0.93 | 0.99 | 1.04 | 1.08 | (2 | :4d) |
| Effective air change rate - enter (24a) or (24b |) or (24c) or (2 | 24d) in box (25) | • | | | | |
| (25)m= 1.18 1.15 1.13 1.01 0.99 | 0.88 0.88 | 0.86 0.93 | 0.99 | 1.04 | 1.08 | (2 | 25) |
| 3. Heat losses and heat loss parameter: | | | | | | | |
| ELEMENT Gross Openings area (m ²) m ² | Net Area A ,m² | U-value W/m2K | A X U (W/I | () | k-value kJ/m²·K | A X k kJ/K | |
| Doors | 1.89 | × 1.6 = | 3.024 | <i>,</i> | | (2 | 26) |
| Windows Type 1 | 5.92 | x1/[1/(1.6)+ 0.04] = | 8.9 | | | (2 | 27) |
| Windows Type 2 | 5.92 | x1/[1/(1.6)+ 0.04] = | 8.9 | | | (2 | 27) |
| Rooflights | 4.3 | x1/[1/(1.6) + 0.04] = | 6.88000 | 1 | | (2 | 27b) |
| Floor | 9.73 | x 0.22 = | 2.1406 | | |] [(2 | 28) |
| Walls Type1 36.78 0 | 36.78 | × 0.28 = | 10.3 | F i | |) [2 | 29) |
| Walls Type2 8.55 1.89 | 6.66 | × 0.25 = | 1.66 | F i | |) [2 | 29) |
| Walls Type3 56.27 11.84 | 44.43 | × 0.28 = | 12.44 | F i | |) [2 | 29) |
| Roof 46.19 4.3 | 41.89 | x 0.18 = | 7.54 | i F | | (3 | 30) |
| Total area of elements, m ² | 157.52 | | | | | , (3 | 31) |
| Party wall | 38.99 | x 0 = | = 0 | | |] [](3 | 32) |
| Party floor | 71.82 | | L | | |] [](3 | 32a) |
| * for windows and roof windows, use effective window U-va | lue calculated usi itions | ing formula 1/[(1/U-va | alue)+0.04] a | L Is given in | paragraph 3 | .2 | |
| Fabric heat loss, $W/K = S (A \times U)$ | | (26)(30) + (32) = | = | | Г | 61.38 (3 | 33) |

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K

Heat capacity $Cm = S(A \times k)$

(34)

(35)

7839.35

250

((28)...(30) + (32) + (32a)...(32e) =

Indicative Value: Medium

| can be u | used inste | ad of a de | tailed calc | ulation. | | | | | | | | | | |
|---|-------------------|--------------------------|--------------|--------------|---------------------|-------------|------------|-------------------|------------|---------------------------------------|------------------------|---------|---------|------|
| Therm | al bridg | es : S (L | x Y) cal | culated u | using Ap | pendix ł | < | | | | | | 23.63 | (36) |
| if details | of therma | al bridging | are not kn | own (36) = | = 0.15 x (3 | 1) | | | | | | | | |
| Total f | abric he | at loss | | | | | | | (33) + | (36) = | | | 85.01 | (37) |
| Ventila | ation hea | at loss ca | alculated | monthl | y | | _ | | (38)m | = 0.33 × (| (25)m x (5) | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (38)m= | 67.48 | 66.16 | 64.83 | 58.22 | 56.9 | 50.72 | 50.72 | 49.57 | 53.1 | 56.9 | 59.54 | 62.19 | | (38) |
| Heat ti | ransfer o | coefficie | nt, W/K | | | | | | (39)m | = (37) + (| 38)m | | | |
| (39)m= | 152.49 | 151.16 | 149.84 | 143.22 | 141.9 | 135.72 | 135.72 | 134.58 | 138.1 | 141.9 | 144.55 | 147.19 | | |
| Heat lo | oss para | ameter (H | HLP). W/ | /m²K | | | | | / (40)m | Average = = (39)m ÷ | Sum(39)1. - (4) | 12 /12= | 143.03 | (39) |
| (40)m= | 1.87 | 1.85 | 1.84 | 1.75 | 1.74 | 1.66 | 1.66 | 1.65 | 1.69 | 1.74 | 1.77 | 1.8 | | |
| (-) | | | | _ | | | | | | Average = | Sum(40)₁ | 12 /12= | 1.75 | (40) |
| Numbe | er of day | /s in mo | nth (Tab | le 1a) | | | | | | , , , , , , , , , , , , , , , , , , , | | | | |
| Average = Sum(40)112 /12=Number of days in month (Table 1a)JanFebMarAprMayJunJulAugSepOctNovDec(41)m=312831303130313130313031 | | | | | | | | | | | | | | |
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | | (41) |
| | | | | | | | | | | • | - | | | |
| 4. Wa | ater hea | tina ene | rav reau | irement: | | | | | | | | kWh/ve | ear: | |
| | | | 37 10 10 | | | | | | | | | | | |
| Assum | | upancy, I | N 1 7 0 M | 14 | (0.000 | 10 v /Tr | - 42.0 | | 040 x /- | | 2. | 49 | | (42) |
| if TF | A > 13. A £ 13 | 9, $N = 1$ 9, $N = 1$ | + 1.76 X | [1 - exp | (-0.0003 | 649 X (1F | -A -13.9 |)2)] + 0.0 | JU13 X (| IFA -13 | .9) | | | |
| Annua | l averag | je hot wa | ater usag | ge in litre | es per da | ay Vd,av | erage = | (25 x N) | + 36 | | 93 | .42 | | (43) |
| Reduce | the annua | al average | hot water | usage by a | 5% if the a | lwelling is | designed t | o achieve | a water us | se target o | of | | | |
| not mor | e that 125 | litres per | berson per | r day (all w | ater use, l | hot and co | ld) | | | | | i | | |
| $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | | | | | | | | | | | | | | |
| Hot wat | er usage i | n litres per | day for ea | ach month | Vd,m = fa | ctor from T | Table 1c x | (43) | | | | - | | |
| (44)m= | 102.76 | 99.02 | 95.29 | 91.55 | 87.81 | 84.08 | 84.08 | 87.81 | 91.55 | 95.29 | 99.02 | 102.76 | | |
| _ | | | | | | | | - (| - | Total = Su | m(44) ₁₁₂ = | = | 1121.03 | (44) |
| Energy | content of | hot water | used - cal | culated mo | onthly $= 4$. | 190 x Vd,n | n x nm x L | 01m / 3600 | kWh/mor | nth (see Ta | ables 1b, 1 | c, 1d) | | |
| (45)m= | 152.39 | 133.28 | 137.54 | 119.91 | 115.05 | 99.28 | 92 | 105.57 | 106.83 | 124.5 | 135.9 | 147.58 | | _ |
| 15 : | (· · - · · | | | | . h . t t | (| antan O in | haven (40 | - | Total = Su | m(45) ₁₁₂ = | = | 1469.84 | (45) |
| it instan | taneous v | vater neatli | ng at point | or use (no | not water | storage), | enter 0 in | boxes (46) | 1 to (61) | r | | | I | |
| (46)m= | 22.86 | 19.99 | 20.63 | 17.99 | 17.26 | 14.89 | 13.8 | 15.84 | 16.02 | 18.68 | 20.39 | 22.14 | | (46) |
| Storage | | 1055. Da (litras) | includir | | alar or M | | storada | within sa | mavas | ما | | 450 | | (47) |
| If com | munity k | | nd no to | ng any so | | ntor 110 | litroc in | (47) | | 501 | | 150 | | (47) |
| Otherv | vise if n | nealing a | hot wate | r (this in | venny, e Indes i | nstantar | | (47) mbi boili | ers) ente | r 'O' in <i>(</i> | (47) | | | |
| Water | storage | loss: | not wate | | | notantai | | | | 51 0 111 | , | | | |
| a) If m | nanufact | turer's de | eclared I | oss facto | or is kno | wn (kWł | n/day): | | | | | 0 | | (48) |
| Tempe | erature f | actor fro | m Table | 2b | | | • / | | | | | 0 | | (49) |
| Energy | / lost fro | om water | storage | . kWh/ve | ear | | | (48) x (49) | = | | 1 | 50 | | (50) |
| b) If m | nanufact | turer's de | eclared of | cylinder l | oss fact | or is not | known: | | | | | | | () |
| Hot wa | ater stor | age loss | factor fr | om Tabl | e 2 (kW | h/litre/da | ıy) | | | | 0. | 01 | | (51) |
| If com | munity ł | neating s | ee secti | on 4.3 | | | | | | | | | | |
| Volum | e factor | from Ta | ble 2a | | | | | | | | 0. | 93 | | (52) |
| Tempe | erature f | actor fro | m Table | 2b | | | | | | | 0. | 54 | | (53) |

| Energy | / lost fro | om water | r storage | , kWh/ye | ear | | | (47) x (51 |) x (52) x (| 53) = | 0. | .67 | (5 | 54) 55) |
|------------|-------------|------------|------------------------|---------------|------------|-------------|-------------|--------------|---------------|-------------|-------------|---------------|---------------|-------------|
| Wator | ctorago | | | for oach | month | | | ((56)m - 1) | (55) v (11) | m | 0. | .07 | (6 | 13) |
| vvalei | Sillaye | | | | | | | ((50))) = (| (41) | | | | l /- | - 0) |
| (56)m= | 20.88 | 18.86 | 20.88 | 20.2 | 20.88 | 20.2 | 20.88 | 20.88 | 20.2 | 20.88 | 20.2 | 20.88 | (t | <i>i</i> 6) |
| II Cylinde | er contains | | | rage, (57) | m = (00)m | x [(50) – (| c) - [(117 | 0), eise (5 | 7)m = (56) | m where (| | | | |
| (57)m= | 20.88 | 18.86 | 20.88 | 20.2 | 20.88 | 20.2 | 20.88 | 20.88 | 20.2 | 20.88 | 20.2 | 20.88 | (5 | 57) |
| Primar | y circuit | loss (ar | nnual) fro | om Table | e 3 | | | | | | | 0 | (5 | ;8) |
| Primar | y circuit | loss cal | lculated t | for each | month (| 59)m = (| (58) ÷ 36 | 65 × (41) | m | | | | | |
| (mo | dified by | factor f | rom Tab | le H5 if t | there is s | solar wat | ter heati | ng and a | a cylinde | r thermo | stat) | i | | |
| (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 | (5 | ; 9) |
| Combi | loss ca | lculated | for each | month | (61)m = | (60) ÷ 30 | 65 × (41 |)m | | | | | | |
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (6 | 51) |
| Total h | eat req | uired for | water he | eating ca | alculated | for eac | h month | (62)m = | : 0.85 × (| (45)m + | (46)m + | (57)m + | (59)m + (61)m | |
| (62)m= | 196.53 | 173.15 | 181.68 | 162.62 | 159.19 | 142 | 136.14 | 149.71 | 149.55 | 168.64 | 178.62 | 191.72 | (6 | 52) |
| Solar Di | -IW input | calculated | using App | endix G o | r Appendix | H (negati | ve quantity | /) (enter '0 | ' if no sola | r contribut | ion to wate | er heating) | | |
| (add a | dditiona | l lines if | FGHRS | and/or \ | WWHRS | applies | , see Ap | pendix (| G) | | | | | |
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (6 | 3 3) |
| Output | t from w | ater hea | ter | | | | ! | | | | | | | |
| (64)m= | 196.53 | 173.15 | 181.68 | 162.62 | 159.19 | 142 | 136.14 | 149.71 | 149.55 | 168.64 | 178.62 | 191.72 | | |
| | | | 1 | | | | | Out | out from wa | ater heate | r (annual)₁ | 12 | 1989.56 (6 | <u>54)</u> |
| Heat g | ains fro | m water | heating. | kWh/m | onth 0.2 | 5 ´ [0.85 | × (45)m | + (61)n | ר 1] + 0.8 א | (46)m | + (57)m | + (59)m | 1 | |
| (65)m= | 85.98 | 76.21 | 81.04 | 74.04 | 73.57 | 67.18 | 65.9 | 70.41 | 69.7 | 76.71 | 79.36 | 84.38 | . (6 | 35) |
| inclu | ude (57) | n in cal | ulation of | u of (65)m | only if c | vlinder i | s in the o | dwellina | or hot w | ater is fr | om com | n munity h | i Jeating | |
| 5 Int | ternal or | ains (see | Table 5 | and 5a |). | , | | | | | | | g | |
| Matak | | | | | | | | | | | | | | |
| wetab | olic gain | IS (TADIE | <u>5), vvat</u> Mar | | May | lun | | Διια | Sen | Oct | Nov | Dec | l | |
| (66)m = | 124 67 | 124 67 | 124 67 | 124 67 | 124.67 | 124 67 | 124 67 | 124.67 | 124 67 | 124 67 | 124 67 | 124 67 | (6 | 6) |
| Lightin | | | | | | | r 00) 0 | | | 121.01 | 121.07 | 12 | | , |
| Lignun | | | | | L, equal | | 1 L9a), a | 12.05 | | 20.52 | 22.06 | 25.54 | (e | 57) |
| (07)11= | 24.05 | 22.07 | | 13.59 | | 0.00 | 9.27 | 12.05 | | 20.00 | 23.90 | 23.34 | | , |
| Applia | nces ga | ins (caid | ulated in | | dix L, eq | uation L | 13 or L1 | 3a), aisc | | | 400.0 | | | 20) |
| (68)m= | 222.85 | 225.17 | 219.34 | 206.93 | 191.27 | 176.55 | 166.72 | 164.41 | 170.24 | 182.64 | 198.3 | 213.02 | (6 |)0) |
| Cookir | ng gains | (calcula | ated in A | ppendix I | L, equat | tion L15 | or L15a) |), also se | ee Table | 5 | | | I | |
| (69)m= | 35.47 | 35.47 | 35.47 | 35.47 | 35.47 | 35.47 | 35.47 | 35.47 | 35.47 | 35.47 | 35.47 | 35.47 | (6 | ;9) |
| Pumps | s and fai | ns gains | (Table § | 5a) | | | | | | | | | L | |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (7 | '0) |
| Losses | s e.g. ev | aporatic | on (nega | tive valu | es) (Tab | le 5) | | | | | | | | |
| (71)m= | -99.74 | -99.74 | -99.74 | -99.74 | -99.74 | -99.74 | -99.74 | -99.74 | -99.74 | -99.74 | -99.74 | -99.74 | (7 | '1) |
| Water | heating | gains (1 | Table 5) | | | | | | | | | | | |
| (72)m= | 115.57 | 113.41 | 108.93 | 102.84 | 98.88 | 93.31 | 88.58 | 94.64 | 96.8 | 103.1 | 110.22 | 113.42 | (7 | '2) |
| Total i | nternal | gains = | | | | (66) |)m + (67)m | n + (68)m · | + (69)m + (| (70)m + (7 | 1)m + (72) |)m | - | |
| (73)m= | 426.68 | 424.05 | 409.62 | 386.76 | 363.72 | 341.85 | 327.97 | 334.5 | 346.61 | 369.68 | 395.89 | 415.39 | (7 | '3) |
| 6 So | lar gains | 3. | | • | | | | • | • | | | | • | |

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 | 5.92 | × | 11.28 | × | 0.63 | x | 0.7 |] = | 20.41 | (75) |
| Northeast 0.9x | 0.77 | x | 5.92 | x | 22.97 | x | 0.63 | x | 0.7 | j = | 41.55 | (75) |
| Northeast 0.9x | 0.77 | x | 5.92 | × | 41.38 | × | 0.63 | x | 0.7 | j = | 74.86 | (75) |
| Northeast 0.9x | 0.77 | x | 5.92 | x | 67.96 | × | 0.63 | x | 0.7 | i = | 122.95 | (75) |
| Northeast 0.9x | 0.77 | x | 5.92 | x | 91.35 | x | 0.63 | x | 0.7 | i = | 165.27 | (75) |
| Northeast 0.9x | 0.77 | x | 5.92 | × | 97.38 | × | 0.63 | x | 0.7 | j = | 176.19 |](75) |
| Northeast 0.9x | 0.77 | x | 5.92 | × | 91.1 | × | 0.63 | x | 0.7 | i - | 164.82 | (75) |
| Northeast 0.9x | 0.77 | x | 5.92 | x | 72.63 | × | 0.63 | x | 0.7 | j = | 131.4 | (75) |
| Northeast 0.9x | 0.77 | x | 5.92 | x | 50.42 | × | 0.63 | x | 0.7 | j = | 91.22 | (75) |
| Northeast 0.9x | 0.77 | x | 5.92 | × | 28.07 | × | 0.63 | x | 0.7 | i = | 50.78 | (75) |
| Northeast 0.9x | 0.77 | x | 5.92 | x | 14.2 | x | 0.63 | x | 0.7 | = | 25.69 | (75) |
| Northeast 0.9x | 0.77 | x | 5.92 | × | 9.21 | × | 0.63 | x | 0.7 | j = | 16.67 | (75) |
| Southwest0.9x | 0.77 | x | 5.92 | × | 36.79 | İ | 0.63 | x | 0.7 | i = | 66.57 | (79) |
| Southwest0.9x | 0.77 | x | 5.92 | x | 62.67 | İ | 0.63 | x | 0.7 | j = | 113.39 | (79) |
| Southwest0.9x | 0.77 | x | 5.92 | × | 85.75 | İ | 0.63 | x | 0.7 | j = | 155.15 | – (79) |
| Southwest0.9x | 0.77 | x | 5.92 | × | 106.25 | İ | 0.63 | x | 0.7 | i = | 192.23 | (79) |
| Southwest0.9x | 0.77 | x | 5.92 | × | 119.01 | İ | 0.63 | x | 0.7 | i = | 215.32 | _ (79) |
| Southwest0.9x | 0.77 | x | 5.92 | x | 118.15 | İ | 0.63 | x | 0.7 | i = | 213.76 | _ (79) |
| Southwest0.9x | 0.77 | x | 5.92 | × | 113.91 | İ | 0.63 | x | 0.7 | j = | 206.09 | (79) |
| Southwest0.9x | 0.77 | x | 5.92 | × | 104.39 | İ | 0.63 | x | 0.7 | j = | 188.87 | (79) |
| Southwest0.9x | 0.77 | x | 5.92 | × | 92.85 | İ | 0.63 | x | 0.7 |] = | 167.99 | (79) |
| Southwest0.9x | 0.77 | x | 5.92 | × | 69.27 | Ì | 0.63 | x | 0.7 |] = | 125.32 | (79) |
| Southwest0.9x | 0.77 | x | 5.92 | × | 44.07 | | 0.63 | x | 0.7 |] = | 79.73 | (79) |
| Southwest0.9x | 0.77 | x | 5.92 | × | 31.49 | 1 | 0.63 | x | 0.7 |] = | 56.97 | (79) |
| Rooflights 0.9x | 1 | x | 4.3 | x | 26 | x | 0.63 | x | 0.8 |] = | 50.71 | (82) |
| Rooflights 0.9x | 1 | x | 4.3 | x | 54 | × | 0.63 | x | 0.8 | = | 105.33 | (82) |
| Rooflights 0.9x | 1 | x | 4.3 | x | 96 | x | 0.63 | x | 0.8 |] = | 187.25 | (82) |
| Rooflights 0.9x | 1 | x | 4.3 | x | 150 | x | 0.63 | x | 0.8 |] = | 292.57 | (82) |
| Rooflights 0.9x | 1 | x | 4.3 | x | 192 | × | 0.63 | x | 0.8 |] = | 374.49 | (82) |
| Rooflights 0.9x | 1 | x | 4.3 | x | 200 | x | 0.63 | x | 0.8 |] = | 390.1 | (82) |
| Rooflights 0.9x | 1 | x | 4.3 | x | 189 | x | 0.63 | x | 0.8 |] = | 368.64 | (82) |
| Rooflights 0.9x | 1 | x | 4.3 | × | 157 | × | 0.63 | x | 0.8 |] = | 306.23 | (82) |
| Rooflights 0.9x | 1 | x | 4.3 | x | 115 | x | 0.63 | x | 0.8 |] = | 224.31 | (82) |
| Rooflights 0.9x | 1 | x | 4.3 | × | 66 | × | 0.63 | x | 0.8 |] = | 128.73 | (82) |
| Rooflights 0.9x | 1 | x | 4.3 | x | 33 | × | 0.63 | x | 0.8 | = | 64.37 | (82) |
| Rooflights 0.9x | 1 | x | 4.3 | x | 21 | × | 0.63 | x | 0.8 |] = | 40.96 | – (82) |

| Solar g | ains in | watts, ca | alculated | for eac | h month | | | (83)m = S | um(74)m . | (82)m | | | |
|---------|---|-----------|-----------|---------|---------|---------|---------|-----------|-----------|--------|--------|--------|------|
| (83)m= | 137.69 | 260.27 | 417.26 | 607.75 | 755.08 | 780.05 | 739.55 | 626.49 | 483.52 | 304.83 | 169.78 | 114.6 | (83) |
| Total g | otal gains – internal and solar (84)m = (73)m + (83)m , watts | | | | | | | | | | | | |
| (84)m= | 564.37 | 684.32 | 826.88 | 994.52 | 1118.79 | 1121.89 | 1067.52 | 960.99 | 830.12 | 674.51 | 565.68 | 529.99 | (84) |

| Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (65) Utilisation factor for gains for living area, h1,m (see Table 9a) 30 $Apr Apr May Jun Jul Aug Sep Oct Nov Dec (66) (86)m= 1 0.99 0.98 0.94 0.85 0.68 0.53 0.6 0.84 0.97 0.99 1 (66) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (67) Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88) (89) (89) (89) 19.21 19.45 19.5 19.5 19.47 (88) Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) (89) (89) 0.99 0.99 0.99 0.99 1 (89) (80)m= 17.65 17.88 18.27 19.57 19.56 19.57 19.41 18.87 18.22 17.7 (90) (80)m= 17.65 17.88 18.27 19.27 19.52 19.57 19.41 18.87 18.22 17.7 (90) (Pa) (Pa) $ |
|---|
| 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)me 1 0.99 0.98 0.94 0.85 0.68 0.53 0.6 0.84 0.97 0.99 1 (66) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)me 18.98 19.21 19.61 20.17 20.61 20.89 20.97 20.95 20.73 20.15 19.5 19 (67) Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (80)me 19.42 19.43 19.5 19.51 19.57 19.58 19.55 19.51 19.47 (68) Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) (80)me 0.99 0.99 0.97 0.91 0.78 0.56 0.37 0.43 0.75 0.95 0.99 1 (69) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90) 11.4 18.38 18.77 19.35 < |
| $ \begin{array}{ c c c c c c c c c c c c c c c c c c c$ |
| (86)m= 1 0.99 0.98 0.94 0.85 0.68 0.53 0.6 0.84 0.97 0.99 1 (86) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 18.98 19.21 19.61 20.17 20.61 20.89 20.97 20.95 20.73 20.15 19.5 19.5 19.5 19.5 19.5 19.5 19.5 19.5 19.5 19.5 19.5 19.5 19.5 19.51 19.42 19.43 19.45 19.5 19.57 19.58 19.55 19.51 19.49 19.47 (88) Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) (89)m= 0.99 0.97 0.91 0.78 0.56 0.37 0.43 0.75 0.95 0.99 1 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 17.65 17.88 18.28 18.77 19.35 19.77 19.41 18.87 18.22 17.7 (90) (9 |
| Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 18.98 19.21 19.61 20.17 20.61 20.89 20.97 20.95 20.73 20.15 19.5 19 (87) Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 19.42 19.43 19.45 19.5 19.57 19.57 19.55 19.51 19.49 19.47 (88) Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) (89)m= 0.99 0.97 0.91 0.78 0.56 0.37 0.43 0.75 0.95 0.99 1 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 17.65 17.88 18.28 18.87 19.27 19.56 19.57 19.41 18.87 18.22 17.7 (90) Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 - fLA) × T2 (92) 18.14 18.38 18.77 19.35 19.77 20.03 20.08 19.9 19.34 18.69 18.18 (92) Apply adjustment to the mean internal temp |
| |
| Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 19.42 19.43 19.45 19.5 19.51 19.57 19.58 19.55 19.51 19.47 (88) Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) (89)m= 0.99 0.97 0.91 0.78 0.56 0.37 0.43 0.75 0.95 0.99 1 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 17.65 17.88 18.28 18.87 19.27 19.56 19.57 19.41 18.87 18.22 17.7 (90) (IA = Living area \div (4) = 0.37 0.31 20.08 19.9 19.34 18.69 18.18 (92) Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 - fLA) × T2 (92)m= 18.14 18.38 18.77 19.35 19.77 20.03 20.08 19.9 19.34 18.69 18.18 (92) Apply adjustment to the mean internal temperature from Table 4e, where appropriate (93)me 18.14 18.30 |
| $\begin{array}{c} \text{(88)} \text{m} = & 19.42 & 19.43 & 19.45 & 19.5 & 19.51 & 19.57 & 19.57 & 19.58 & 19.55 & 19.51 & 19.49 & 19.47 \\ \text{(88)} \text{m} = & 0.92 & 0.99 & 0.97 & 0.91 & 0.78 & 0.56 & 0.37 & 0.43 & 0.75 & 0.95 & 0.99 & 1 \\ \text{(89)} \text{m} = & 0.99 & 0.99 & 0.97 & 0.91 & 0.78 & 0.56 & 0.37 & 0.43 & 0.75 & 0.95 & 0.99 & 1 \\ \text{(89)} \text{m} = & 0.99 & 0.99 & 0.97 & 0.91 & 0.78 & 0.56 & 0.37 & 0.43 & 0.75 & 0.95 & 0.99 & 1 \\ \text{(80)} \text{m} = & 17.65 & 17.88 & 18.28 & 18.87 & 19.27 & 19.52 & 19.56 & 19.57 & 19.41 & 18.87 & 18.22 & 17.7 & (90) \\ \text{(90)} \text{m} = & 17.65 & 17.88 & 18.28 & 18.7 & 19.27 & 19.52 & 19.56 & 19.57 & 19.41 & 18.87 & 18.22 & 17.7 & (91) \\ \text{Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 - fLA) × T2 \\ \text{(92)} \text{m} = & 18.14 & 18.38 & 18.77 & 19.35 & 19.77 & 20.03 & 20.08 & 20.08 & 19.9 & 19.34 & 18.69 & 18.18 & (92) \\ \text{Apply adjustment to the mean internal temperature from Table 4e, where appropriate \\ \text{(93)} \text{m} = & 18.14 & 18.38 & 18.77 & 19.35 & 19.77 & 20.03 & 20.08 & 20.08 & 19.9 & 19.34 & 18.69 & 18.18 & (93) \\ \textbf{8. Space heating requirement} \\ \text{Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a \\ \hline \text{Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec} \\ \text{Utilisation factor for gains, hm:} \\ \text{(94)} \text{m} = & 0.99 & 0.99 & 0.97 & 0.91 & 0.79 & 0.6 & 0.43 & 0.49 & 0.77 & 0.95 & 0.99 & 0.99 & (94) \\ \text{Useful gains, hmGm, W = (94)m x (84)m} \\ \text{(95)} \text{m} = & 560.16 & 674.27 & 798.89 & 905.88 & 88.93 & 677.43 & 400.38 & 475.18 & 643.02 & 639.43 & 558.24 & 526.87 & (95) \\ \end{array}$ |
| Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) (89)m= 0.99 0.97 0.91 0.78 0.56 0.37 0.43 0.75 0.95 0.99 1 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 17.65 17.88 18.28 18.87 19.27 19.52 19.56 19.57 19.41 18.87 18.22 17.7 (90) (90)m= 17.65 17.88 18.28 18.87 19.27 19.52 19.56 19.57 19.41 18.87 18.22 17.7 (90) Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 - fLA) × T2 (92)m= 18.14 18.38 18.77 19.35 19.77 20.03 20.08 19.9 19.34 18.69 18.18 (92) Apply adjustment to the mean internal temperature from Table 4e, where appropriate (93) 8 . Space heating requirement (93) 8. Space heating requirement Utilisation factor for gains, hm: (94) Aug Sep Oct Nov Dec |
| (B9)m= 0.99 0.97 0.91 0.78 0.56 0.37 0.43 0.75 0.99 1 (B9) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 17.65 17.88 18.28 18.87 19.27 19.52 19.56 19.57 19.41 18.87 18.22 17.7 (90) (90)m= 17.65 17.88 18.28 18.87 19.27 19.52 19.56 19.57 19.41 18.87 18.22 17.7 (90) (92)m= 18.14 18.38 18.77 19.35 19.77 20.03 20.08 19.9 19.34 18.69 18.18 (92) (93)m= 18.14 18.38 18.77 19.35 19.77 20.03 20.08 19.9 19.34 18.69 18.18 (93) Apply adjustment to the mean internal temperature from Table 4e, where appropriate (93)m= 18.14 18.38 18.77 19.35 19.77 20.03 20.08 19.9 1 |
| (a) (a) (b) (c) (c) (c) (c) (c) (c) (c) (c) (c) (c |
| Mean internal temperature in the rest of dwelling 12 (follow steps 3 to 7 in Table 9c)(90)m=17.6517.8818.2818.8719.2719.5219.5619.5719.4118.8718.2217.7(90)fLA = Living area \div (4) =0.37(91)Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 - fLA) x T2(92)m=18.1418.3818.7719.3519.7720.0320.0819.919.3418.6918.18(92)Apply adjustment to the mean internal temperature from Table 4e, where appropriate(93)m=18.1418.3818.7719.3519.7720.0320.0819.919.3418.6918.18(93)8. Space heating requirementSet 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 9aJanFebMarAprMayJunJulAugSepOctNovDecUtilisation factor for gains, hm:(94)m=0.990.990.970.910.790.60.430.490.770.950.990.99(94)Useful gains, hmGm, W = (94)m x (84)m(95)m=560.16674.27798.89905.88888.93677.43460.38475.18643.02639.43558.24526.87(95) |
| $\begin{array}{c c c c c c c c c c c c c c c c c c c $ |
| Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 - fLA) x T2 (92)m= 18.14 18.38 18.77 19.35 19.77 20.03 20.08 19.9 19.34 18.69 18.18 (92) Apply adjustment to the mean internal temperature from Table 4e, where appropriate (93)m= 18.14 18.38 18.77 19.35 19.77 20.03 20.08 19.9 19.34 18.69 18.18 (93) September 18.14 18.38 18.77 19.35 19.77 20.03 20.08 19.9 19.34 18.69 18.18 (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 0.97 0.91 0.79 0.6 0.43 0.49 0.77 0.95 0.99 0.99 (94) Useful gains, hmGm, W = (94)m x (84)m (95)m= |
| Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$ (92)m=18.1418.3818.7719.3519.7720.0320.0820.0819.919.3418.6918.18(92)Apply adjustment to the mean internal temperature from Table 4e, where appropriate(93)m=18.1418.3818.7719.3519.7720.0320.0820.0819.919.3418.6918.18(93)8. Space heating requirementSet Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculatethe utilisation factor for gains using Table 9aUtilisation factor for gains, hm:(94)m =0.990.990.970.910.790.60.430.490.770.950.990.99(94)Useful gains, hmGm, W = (94)m x (84)m(95)m=560.16674.27798.89905.88888.93677.43460.38475.18643.02639.43558.24526.87(95) |
| (92)m= 18.14 18.38 18.77 19.35 19.77 20.03 20.08 20.08 19.9 19.34 18.69 18.18 (92) Apply adjustment to the mean internal temperature from Table 4e, where appropriate (93)m= 18.14 18.38 18.77 19.35 19.77 20.03 20.08 20.08 19.9 19.34 18.69 18.18 (92) (93)m= 18.14 18.38 18.77 19.35 19.77 20.03 20.08 20.08 19.9 19.34 18.69 18.18 (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 0.97 0.91 0.79 0.6 0.43 0.49 0.77 0.95 0.99 0.99 (94) Useful gains, hmGm, W = (94)m x (84)m (95)m= 560.16 674.27 798.89 905.88 888.93 677. |
| Apply adjustment to the mean internal temperature from Table 4e, where appropriate $(93)m=$ 18.1418.3818.7719.3519.7720.0320.0820.0819.919.3418.6918.18(93)8. Space heating requirementSet 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 9aJan Feb Mar Apr May Jun Jul Aug Sep Oct Nov DecUtilisation factor for gains, hm:(94)m=0.990.970.910.790.60.430.490.770.950.990.99(94)Useful gains, hmGm, W = (94)m x (84)m(95)m= 560.16674.27798.89905.88888.93677.43460.38475.18643.02639.43558.24526.87(95) |
| (93)m= 18.14 18.38 18.77 19.35 19.77 20.03 20.08 20.08 19.9 19.34 18.69 18.18 (93) 8. Space heating requirement Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, hm: (94)m= 0.99 0.99 0.97 0.91 0.79 0.6 0.43 0.49 0.77 0.95 0.99 0.99 (94) Useful gains, hmGm , W = (94)m x (84)m (95)m= 560.16 674.27 798.89 905.88 888.93 677.43 460.38 475.18 643.02 639.43 558.24 526.87 (95) |
| 8. Space nearing requirementSet 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 9aJanFebMarAprMayJunJulAugSepOctNovDecUtilisation factor for gains, hm:(94)m= 0.99 0.99 0.97 0.91 0.79 0.6 0.43 0.49 0.77 0.95 0.99 0.99 (94)Useful gains, hmGm, W = (94)m x (84)m(95)m= 560.16 674.27 798.89 905.88 888.93 677.43 460.38 475.18 643.02 639.43 558.24 526.87 (95) |
| Set 11 to the mean internal temperature obtained at step 11 of Table 9b, so that $\Pi, m=(76)m$ 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 0.91 0.79 0.6 0.43 0.49 0.77 0.95 0.99 0.99 (94) Useful gains, hmGm, W = (94)m x (84)m (95)m= 560.16 674.27 798.89 905.88 888.93 677.43 460.38 475.18 643.02 639.43 558.24 526.87 (95) |
| $\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$ |
| Utilisation factor for gains, hm: $(94)m =$ 0.99 0.97 0.91 0.79 0.6 0.43 0.49 0.77 0.95 0.99 0.99 (94) Useful gains, hmGm , W = (94)m x (84)m (95)m= 560.16 674.27 798.89 905.88 888.93 677.43 460.38 475.18 643.02 639.43 558.24 526.87 (95) |
| (94)m= 0.99 0.99 0.97 0.91 0.79 0.6 0.43 0.49 0.77 0.95 0.99 0.99 (94) Useful gains, hmGm , W = (94)m x (84)m (95)m= 560.16 674.27 798.89 905.88 888.93 677.43 460.38 475.18 643.02 639.43 558.24 526.87 (95) |
| Useful gains, hmGm , W = $(94)m \times (84)m$ (95)m= 560.16 674.27 798.89 905.88 888.93 677.43 460.38 475.18 643.02 639.43 558.24 526.87 (95) |
| (95)m= 560.16 674.27 798.89 905.88 888.93 677.43 460.38 475.18 643.02 639.43 558.24 526.87 (95) |
| |
| Monthly average external temperature from Table 8 |
| (96)m= 4.3 4.9 6.5 8.9 11.7 14.6 16.6 16.4 14.1 10.6 7.1 4.2 (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m] |
| $ \begin{array}{c} (97) \\ \hline \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$ |
| Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$ |
| (30)III 1153.07 915.75 775.9 425.72 190.42 0 0 0 0 0 4447.04 604.61 1159.26 |
| $1 \text{ otal per year } (kvvn/year) = \text{Sum}(98)_{15,912} = 5850.57 \tag{90}$ |
| Space heating requirement in kWh/m²/year 71.65 (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 $(204) = (202) \times [1 - (203)] =$ 1(204) |
| Efficiency of main analysis heating system 1 |
| Enciency of main space heating system 1 86.9 (200) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/yea | ar |
|-------------------|--------------------|--------------------|---------------------------|--------------|-----------------|----------|--------------|-------------|-----------------|-----------------------|-------------------------|---------|------------|------------|
| Space | e heatin | g require | ement (o | calculate | d above) |) | 1 | | 1 | 1 | 1 | | I | |
| | 1153.67 | 915.73 | 773.9 | 425.72 | 190.42 | 0 | 0 | 0 | 0 | 447.04 | 804.81 | 1139.28 | | |
| (211)m | $1 = \{[(98)]$ |)m x (20 | 94)] } x ´ | 100 ÷ (20 |)6) | 0 | | 0 | | E14 40 | 026.14 | 1211.02 | | (211) |
| | 1327.59 | 1053.77 | 890.57 | 469.69 | 219.13 | 0 | 0 | U Tota | l (kWh/vea | r) = Sum(2) | 211) | = | 6722.52 | 7(211) |
| Space | e heatin | a fuel (s | econdar | ·v) kWh/ | month | | | | | | /15,1012 | | 0732.33 |](=) |
| = {[(98] |)m x (20 |)1)]}x1 | 00 ÷ (20 |)8) | | | | | | | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | | | | | | | | Tota | ıl (kWh/yea | ar) =Sum(2 | 215) _{15,1012} | F | 0 | (215) |
| Water | heating | J | | | | | | | | | | | | |
| Output | 196.53 | ater hea 173.15 | ter (calc 181.68 | ulated a | bove) 159.19 | 142 | 136.14 | 149.71 | 149.55 | 168.64 | 178.62 | 191.72 | | |
| Efficier | L ncy of w | L ater hea | I iter | | | | | | I | I | I | | 76.8 | (216) |
| (217)m= | 85.27 | 85.12 | 84.78 | 83.85 | 81.99 | 76.8 | 76.8 | 76.8 | 76.8 | 83.88 | 84.87 | 85.28 | | 」 (217) |
| Fuel fo | r water | heating, | kWh/m | onth | | | | | | | • | | | |
| (219)m (219)m= | 1 = (64) 230.49 | m x 100 203.42 |) <u>÷ (217</u> 214.29 |)m 193.94 | 194.16 | 184.89 | 177.27 | 194.94 | 194.72 | 201.06 | 210.46 | 224.8 | | |
| | | | I | | | | | Tota | l II = Sum(2 | 19a) ₁₁₂ = | | | 2424.44 | (219) |
| Annua | I totals | | | | | | | | | k | Wh/year | | kWh/year | _ |
| Space | heating | fuel use | ed, main | system | 1 | | | | | | | | 6732.53 | |
| Water | heating | fuel use | d | | | | | | | | | | 2424.44 |] |
| Electric | city for p | oumps, fa | ans and | electric | keep-ho | t | | | | | | | | |
| centra | al heatin | g pump | : | | | | | | | | | 30 | | (230c) |
| boiler | with a f | an-assis | sted flue | | | | | | | | | 45 | | (230e) |
| Total e | lectricity | / for the | above, | kWh/yea | r | | | sum | of (230a). | (230g) = | | | 75 | (231) |
| Electric | city for li | ghting | | | | | | | | | | | 438.92 | (232) |
| 12a. (| CO2 em | issions - | – Individ | lual heat | ing syste | ems incl | uding mi | cro-CHF |) | | | | | |
| | | | | | | Fn | erav | | | Fmiss | ion fac | tor | Fmissions | |
| | | | | | | k٧ | /h/year | | | kg CO | 2/kWh | | kg CO2/yea | r |
| Space | heating | (main s | ystem 1 |) | | (21 | 1) x | | | 0.2 | 16 | = | 1454.23 | (261) |
| Space | heating | (second | dary) | | | (21 | 5) x | | | 0.5 | 19 | = | 0 | (263) |
| Water | heating | | | | | (21 | 9) x | | | 0.2 | 16 | = | 523.68 | (264) |
| Space | and wa | ter heati | ng | | | (26 | 1) + (262) · | + (263) + (| (264) = | | | | 1977.91 | (265) |
| Electric | city for p | oumps, fa | ans and | electric | keep-ho | t (23 | 1) x | | | 0.5 | 19 | = | 38.93 | (267) |
| Electric | city for li | ghting | | | | (23 | 2) x | | | 0.5 | 19 | = | 227.8 | (268) |
| Total C | CO2, kg/ | 'year | | | | | | | sum o | of (265)(2 | 271) = | | 2244.63 | (272) |
| Dwelli | ng CO2 | Emissi | on Rate | ; | | | | | (272) | ÷ (4) = | | | 27.49 | (273) |
| El ratir | ng (secti | on 14) | | | | | | | | | | | 76 | (274) |

eJ7°

Appendix B

SAP 2012 Dwelling Emission Rate Outputs

"Be Lean"



| | | | | | | | User [| Details: | | | | | | |
|----------------|-------------------------|---------------------------|---------------------------|--------------------------|----------------------|--------------------|------------|-----------------|---------------------|----------------|----------|----------------|-------------------------|------|
| Asses Softw | ssor N vare Na | ame: ame: | Ge Str | orge Fa oma FS | irr SAP 201 | 2 | roportu | Strom Softwa | a Num are Vei | ber: rsion: | | STRO Versic | 028460 on: 1.0.4.6 | |
| Addro | ee : | | | | | Γ. | openy | Address | . Flat I | | | | | |
| 1. Ove | erall dw | ellina diı | mension | S: | | | | | | | | | | |
| | | | | | | | Are | a(m²) | | Av. Hei | ight(m) | | Volume(m ³) |) |
| Ground | d floor | | | | | | | 52.41 | (1a) x | 2 | .95 | (2a) = | 154.61 | (3a) |
| First flo | or | | | | | | | 44.88 | (1b) x | 3 | .25 | (2b) = | 145.86 | (3b) |
| Total fl | oor area | a TFA = | (1a)+(1l | o)+(1c)+ | (1d)+(1e | e)+(1n |) | 97.29 | (4) | | | • | | |
| Dwellin | ıg volum | ne | | | | | | | (3a)+(3b |)+(3c)+(3d | l)+(3e)+ | .(3n) = | 300.47 | (5) |
| 2. Ver | ntilation | rate: | | | | | | | | | | | | |
| | | | | main heating | se h | econdar neating | у | other | | total | | | m ³ per hou | • |
| Numbe | er of chir | nneys | | 0 | + | 0 |] + [| 0 |] = [| 0 | X 4 | 40 = | 0 | (6a) |
| Numbe | er of ope | en flues | Γ | 0 | + | 0 |] + [| 0 |] = [| 0 | x 2 | 20 = | 0 | (6b) |
| Numbe | er of inte | rmittent | fans | | | | | | | 3 | x ^ | 10 = | 30 | (7a) |
| Numbe | er of pas | sive ver | nts | | | | | | Ē | 0 | x ^ | 10 = | 0 | (7b) |
| Numbe | er of flue | less ga | s fires | | | | | | Ē | 0 | x 4 | 40 = | 0 | (7c) |
| | | | | | | | | | | | | Air ch | nanges per ho | ur |
| Infiltrati | ion due | to chim | neys, flu | es and f | ans = (6 | a)+(6b)+(7 | a)+(7b)+ | (7c) = | Г | 30 | <u> </u> | ÷ (5) = | 0.1 | (8) |
| lf a pr | essurisati | on test ha | s been ca | rried out o | r is intende | ed, proceed | d to (17), | otherwise | continue fr | rom (9) to (| (16) | | | |
| Num | ber of s | toreys ir | n the dw | elling (n | s) | | | | | | | | 0 | (9) |
| Addi | tional in | filtration | | | | | | | | | [(9)- | -1]x0.1 = | 0 | (10) |
| Struc | ctural inf | filtration | : 0.25 fo | r steel o | r timber i | frame or | 0.35 fo | r mason | ry constr | uction | | | 0 | (11) |
| if b dec | oth types ducting ar | of wall are eas of ope | e present, enings); if | use the va equal user | lue corres • 0.35 | ponding to | the grea | ter wall are | a (after | | | | | |
| If sus | spendeo | d woode | n floor, e | enter 0.2 | (unseal | ed) or 0. | 1 (seal | ed), else | enter 0 | | | | 0 | (12) |
| lf no | draught | t lobby, | enter 0.0 | 05, else | enter 0 | | | | | | | | 0 | (13) |
| Perc | entage | of windo | ows and | doors di | aught st | ripped | | | | | | | 0 | (14) |
| Winc | low infil | tration | | | | | | 0.25 - [0.2 | 2 x (14) ÷ 1 | = [00 | | | 0 | (15) |
| Infiltr | ation ra | te | | | | | | (8) + (10) | + (11) + (1 | 12) + (13) - | + (15) = | | 0 | (16) |
| Air p | ermeab | ility valu | ie, q50, i | expresse | ed in cub | bic metre | s per h | our per s | quare m | etre of e | envelope | area | 15 | (17) |
| If base | d on air | permea | bility val | lue, then | (18) = [(1 | 7) ÷ 20]+(8 | s), otherw | /ISE (18) = (| (16) vrmoobilitu | ia haina u | and | | 0.85 | (18) |
| Numbe | er of side | es shelte | ered | เธรรณกรสแ | Un lest nas | s been don | e or a ue | gree all pe | THEADINY | is being us | seu | | 0 | (19) |
| Shelter | factor | | | | | | | (20) = 1 - | [0.075 x (1 | 9)] = | | | 1 | (20) |
| Infiltrati | ion rate | incorpo | rating sh | nelter fac | ctor | | | (21) = (18 |) x (20) = | | | | 0.85 | (21) |
| Infiltrati | ion rate | modifie | d for mo | nthly wir | nd speed | ł | | | | | | | L | |
| [| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |] | |
| Monthl | y avera | ge wind | speed f | rom Tab | le 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 F | actor (2 | 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 | | |
| Adjuste | ed infiltra | ation rat | e (allowi | ing for sł | nelter an | d wind s | speed) = | = (21a) x | (22a)m | | | | | |
| • | 1.08 | 1.06 | 1.04 | 0.93 | 0.91 | 0.81 | 0.81 | 0.79 | 0.85 | 0.91 | 0.96 | 1 | | |
| Calcul | ate effec | ctive air | change | rate for t | he appli | cable ca | ise | _ ! | | ! | | г | | |
| IT ME | ecnanica | | ition: | ondix N (2 | (25) = (22) | | oquation | (NE)) othe | nuico (22h | (220) | | Ļ | 0 | (23a) |
| If hale | aust all the | heat reco | overv: effic | viency in % | allowing f | or in-use f | factor (fro | m Table 4h |) = |) – (23a) | | | 0 | (230) |
| a) If | halance | d mach | anical ve | antilation | with he | at recov | | | -) — -) m — (2) | 2h)m + (| (23h) v [| _ 1 _ (23c) | 0 · 1001 | (230) |
| (24a)m= | | | | | | | | | $\frac{1}{0}$ | | | 1 - (230) | - 100] | (24a) |
| () b) If | halance | d mech | l anical ve | I | without | heat rec | | M\/) (24ł | 1 - (2) | 1 2h)m + (| (23h) | | | , |
| (24b)m= | 0 | | | 0 | 0 | 0 | | | | | 0 | 0 | | (24b) |
| c) If | whole h | ouse ex | I tract ver | L ntilation o | L or positiv | L /e input : | I ventilati | on from (| L outside | I | Į | <u> </u> | | |
| i i | if (22b)n | n < 0.5 > | (23b), 1 | then (24 | c) = (23k | o); other | wise (24 | 4c) = (22 | b) m + 0 | .5 × (23 | c) | | | |
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (24c) |
| d) If | natural | ventilatio | on or wh | ole hous | se positiv | ve input | ventilat | ion from | loft | - | - | | | |
| i | if (22b)n | n = 1, th | en (24d) | m = (22l | b)m othe | erwise (2 | 24d)m = | 0.5 + [(2 | 2b)m² x | 0.5] | | · · · · · · | | (- · · · |
| (24d)m= | 1.08 | 1.06 | 1.04 | 0.94 | 0.92 | 0.83 | 0.83 | 0.81 | 0.86 | 0.92 | 0.96 | 1 | | (24d) |
| Effe | ctive air | change | rate - er | nter (24a | i) or (24k | o) or (24 | c) or (24 | 4d) in bo | x (25) | | | <u> </u> | | (05) |
| (25)m= | 1.08 | 1.06 | 1.04 | 0.94 | 0.92 | 0.83 | 0.83 | 0.81 | 0.86 | 0.92 | 0.96 | 1 | | (25) |
| 3. He | at losse | s and he | eat loss | paramet | er: | | | | | | | | | |
| ELEN | IENT | Gros area | ss (m²) | Openin rr | igs 1 ² | Net Ar A ,r | rea m² | U-val W/m2 | ue 2K | A X U (W/ | K) | k-value kJ/m²⋅K | A k | AXk J/K |
| Doors | | | | | | 1.89 | x | 1.4 | = | 2.646 | | | | (26) |
| Windo | ws Type | e 1 | | | | 9.96 | x | 1/[1/(1.4)+ | 0.04] = | 13.2 | | | | (27) |
| Windo | ws Type | 2 | | | | 21.89 | э х | 1/[1/(1.4)+ | - 0.04] = | 29.02 | | | | (27) |
| Rooflig | phts | | | | | 3.12 | x | 1/[1/(1.4) + | 0.04] = | 4.368 | | | | (27b) |
| Floor | | | | | | 52.4 | 1 × | 0.14 | = | 7.3374 | ↓ _ [| | 7 | (28) |
| Walls - | Type1 | 45.3 | 39 | 0 | | 45.39 | э х | 0.18 | = | 8.17 | = i | | i — | (29) |
| Walls - | Гуре2 | 45.5 | 55 | 31.8 | 5 | 13.7 | · x | 0.22 | = | 3.01 | = i | | i — | (29) |
| Walls - | ГуреЗ | 21.8 | 39 | 1.89 | | 20 | × | 0.2 | = | 4.02 | | | i — | (29) |
| Roof | | 12.5 | 53 | 3.12 | 2 | 9.41 | x | 0.14 | = | 1.32 | | | i — | (30) |
| Total a | rea of e | lements | , m² | | | 177.7 | 7 | L | | | เ | | J | (31) |
| Party v | vall | | | | | 42.43 | 3 × | 0 | | 0 | | | | (32) |
| Party of | eiling | | | | | 39.88 | 3 | L | | | L | | ╡ ├── | (32b) |
| * for win | dows and | roof wind | ows, use e | effective wi | indow U-va | alue calcul | lated usin | g formula 1 | 1/[(1/U-valu | ue)+0.04] a | L as given in | paragraph | ы Царана 3.2 | |
| Fabric | heat los | as on doth ss W/K | sides of if = S (A v | uernai wal | is and par | แแบกร | | (26)(30 |) + (32) = | | | Г | 70 07 | (22) |
| Heat c | apacity | Cm = S(| (A x k) | -, | | | | | ((28). | (30) + (3 | 2) + (32a). | (32e) = | 12446.8 | (34) |

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K

250

(35)

Indicative Value: Medium

| can be l | used inste | ad of a de | tailed calc | ulation. | | | | | | | | | | |
|--|--|------------------------|------------------|-------------------------|------------------------|----------------------|------------|------------------|--------------|---------------------------|---------------------------------------|-------------|---------|--------------|
| Therm | used instead of a detailed oxiduation. Ial bridges : S (L x Y) calculated using Appendix K $(28, 1)$ abric heat loss calculated using Appendix K $(33) + (39) = (28, 57)$ (36) is diama bridging are not known (39) = 0.15 x (31) abric heat loss calculated monthly $(38)n = 0.33 \times (25)n \times (5)$ 107.44 + 106.33 + 103.23 + 29.9 + 90.96 + 81.88 + 81.89 + 90.21 + 85.38 + 90.96 + 94.9 + 99.01 (38) ransfer coefficient, W/K $(39)n = (37) + (38)m200.97 + 204.86 + 202.76 + 192.44 + 190.49 + 181.42 + 181.42 + 179.75 + 184.92 + 190.49 + 194.43 + 190.49 + 192.37 (39) or sparameter (HLP), W/m2K (40)n - (30)n + (4)2.13 - 2.11 - 2.08 + 1.98 + 1.96 + 1.86 + 1.86 + 1.85 + 1.9 + 1.96 + 2 - 2.04 + 0.000 + $ | | | | | | | | | | | | | |
| if details | of therma | al bridging | are not kn | own (36) = | = 0.15 x (3 | 1) | | | | | | | | |
| can be used instead of a detailed calculation. 26.67 Thermal bridges : S (L x Y) calculated using Appendix K 26.67 if details of thermal bridging are not known (36) = 0.15 x (31) (3) + (36) = 99.53 Vontilation heat loss calculated monthly (38) m = 0.33 x (25) m x (5) 99.53 Ventilation heat loss calculated monthly (39) m = 0.33 x (25) m x (5) 99.53 (38)m= 107.44 105.33 103.23 92.9 90.96 81.89 81.89 80.21 85.38 90.96 94.9 99.01 Heat transfer coefficient, W/K (39)m = (37) + (38)m (39)m = (37) + (38)m 90.96 181.42 181.42 179.75 184.92 190.49 194.43 198.54 Heat toss parameter (HLP), W/m?K (40)m = (37) + (38)m 196 1.86 1.86 1.85 1.9 1.96 2 2.04 (40)m = (2.13 2.11 2.08 1.98 1.96 1.86 1.85 1.9 1.96 2 2.04 (41)m = 1 1.91 2.03 1.92 1.91 1.92 1.92 1.92 1.92 1.92 1.92 1.92 1.92 1 | | | | | | | | | | | | | (37) | |
| Ventila | ation hea | at loss ca | alculated | I monthly | y | | | | (38)m | = 0.33 × (| 25)m x (5) | | | |
| | $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | | | | | | | | | | | | | |
| (38)m= | 107.44 | 105.33 | 103.23 | 92.9 | 90.96 | 81.89 | 81.89 | 80.21 | 85.38 | 90.96 | 94.9 | 99.01 | | (38) |
| Heat t | ransfer o | coefficier | nt, W/K | | | | | | (39)m | = (37) + (3 | 38)m | | | |
| (39)m= | 206.97 | 204.86 | 202.76 | 192.44 | 190.49 | 181.42 | 181.42 | 179.75 | 184.92 | 190.49 | 194.43 | 198.54 | | |
| Heat lo | oss para | meter (F | HP)W | ′m²K | | | 1 | | (40)m | Average = = (39)m ÷ | Sum(39) ₁ . | 12 /12= | 192.37 | (39) |
| (40)m= | 2.13 | 2.11 | 2.08 | 1.98 | 1.96 | 1.86 | 1.86 | 1.85 | 1.9 | 1.96 | 2 | 2.04 | | |
| (10) | 2.10 | | 2.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.0 | Average = | - Sum(40) | 10/12= | 1 98 | (40) |
| Numb | er of day | /s in moi | nth (Tab | le 1a) | | | - | | | worugo – | | | 1.00 | |
| | 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. Wa | ater hea | tina enei | rav reau | rement: | | | | | | | | kWh/ve | ear: | |
| | | 9 | 3, 10 1 | | | | | | | | | | | |
| Assumed occupancy, N 2.71 (42) if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9) if TFA £ 13.9, N = 1 Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 98.63 (43) | | | | | | | | | | | | | | |
| Annua | if TFA £ 13.9, N = 1 Annual average hot water usage in litres per day Vd,average = $(25 \times N) + 36$ Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of (43) | | | | | | | | | | | | | |
| Reduce | if TFA £ 13.9, N = 1 Annual average hot water usage in litres per day Vd, average = $(25 \times N) + 36$ 98.63 (43) Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of that more that 125 litres per perpendent day (all water use, hot and cold) | | | | | | | | | | | | | |
| normon | Water heating energy requirement:kWh/year:essumed occupancy, N 2.71 (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) 98.63 (43)if TFA £ 13.9, N = 1 $1000000000000000000000000000000000000$ | | | | | | | | | | | | | |
| 11-4 | 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 = $(25 \times N) + 36$ Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of ot 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 Not water usage in litres per day for each month Vd,m = factor from Table 1c x (43) | | | | | | | | | | | | | |
| HOT WAT | er usage i | n litres per | r day for ea | acn month | va,m = ta | ctor from 1 | able 1c x | (43) | | | | | 1 | |
| (44)m= | 108.5 | 104.55 | 100.61 | 96.66 | 92.72 | 88.77 | 88.77 | 92.72 | 96.66 | 100.61 | 104.55 | 108.5 | | |
| Energy | content of | ^t hot water | used - cal | culated mo | onthly $= 4$. | 190 x Vd,r | n x nm x D |)Tm / 3600 | • kWh/mor | Total = Su oth (see Ta | m(44) ₁₁₂ = ables 1b, 1 | = c, 1d) | 1183.6 | (44) |
| (45)m= | 160.9 | 140.72 | 145.21 | 126.6 | 121.48 | 104.82 | 97.13 | 111.46 | 112.79 | 131.45 | 143.49 | 155.82 | | |
| 16 : | | | | - [| | | | | | Total = Su | m(45) ₁₁₂ = | - | 1551.89 | (45) |
| it instan | taneous v | vater neatli | ng at point I | or use (no | o not water | storage), | enter 0 in | boxes (46) | 10 (61) | r | | | 1 | |
| (46)m= | 24.13 | 21.11 | 21.78 | 18.99 | 18.22 | 15.72 | 14.57 | 16.72 | 16.92 | 19.72 | 21.52 | 23.37 | | (46) |
| Storage | | IUSS. | includir | | alar or M | | etorado | within ea | mayas | sol | | 0 | l | (47) |
| Sillay | | | | iy any su | | | | (47) | | 501 | | 0 | | (47) |
| Otherw | munity r viso if n | neating a | hot wate | nk in aw ar (this in | vening, e veludes i | nter 110 nstantar | | (47) mbi boil | ore) onte | ar 'O' in (| 47) | | | |
| Water | storage | loss. | not wate | | iciuues i | instantai | | | | | | | | |
| a) If m | nanufact | turer's de | eclared I | oss facto | or is kno | wn (kWł | n/dav): | | | | | 0 | | (48) |
| Tempe | erature f | actor fro | m Table | 2b | | , | , | | | | | 0 | | (49) |
| Energy | / lost fro | m water | storage | k\//h/\/ | ar | | | (48) x (49) | - | | | 0 | | (50) |
| b) If m | nanufac | turer's de | eclared of | ylinder l | oss fact | or is not | known: | (40) X (40) | _ | | | 0 | | (50) |
| Hot wa | ater stor | age loss | factor fr | om Tabl | e 2 (kW | h/litre/da | ıy) | | | | | 0 | | (51) |
| | nunity f | from To | ble 22 | UN 4.3 | | | | | | | | 0 | l | (50) |
| Tempe | erature f | actor fro | m Table | 2b | | | | | | | | 0 | | (52) (53) |
| p | | | | | | | | | | | | 0 | | (00) |

| Energy | y lost fro | m water | r storage | , kWh/ye | ear | | | (47) x (51 |) x (52) x (| 53) = | | 0 | | (54) |
|------------|------------------|------------------------|-------------|------------|------------|-------------|-------------|--------------|--------------|-------------|-------------|-------------|---------------|------|
| Enter | (50) or | (54) in (5 | 55) | - | | | | | | | | 0 | | (55) |
| Water | storage | loss cal | culated | for each | month | | | ((56)m = (| (55) × (41) | m | | | | |
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (56) |
| If cylinde | er contain | s dedicate | d solar sto | rage, (57) | m = (56)m | x [(50) – (| (H11)] ÷ (5 | 0), else (5 | 7)m = (56) | m where (| H11) is fro | m Append | lix H | |
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (57) |
| Primar | v circuit | loss (ar | nnual) fro | om Table | e 3 | | | | | | | 0 | | (58) |
| Primar | y circuit | loss cal | culated | for each | month (| 59)m = | (58) ÷ 36 | 65 × (41) | m | | | | | |
| (mo | dified by | factor f | rom Tab | le H5 if t | here is s | solar wa | ter heatii | ng and a | a cylinde | r thermo | stat) | | | |
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (59) |
| Combi | loss ca | lculated | for each | month | (61)m = | (60) ÷ 3 | 65 × (41) |)m | | | | | | |
| (61)m= | 12.79 | 11.53 | 12.72 | 12.23 | 12.58 | 12.1 | 12.46 | 12.54 | 12.17 | 12.66 | 12.32 | 12.77 | | (61) |
| Total h | neat req | uired for | water h | eating ca | alculated | for eac | h month | (62)m = | 0.85 × (| (45)m + | (46)m + | (57)m + | (59)m + (61)m | |
| (62)m= | 173.69 | 152.25 | 157.93 | 138.83 | 134.05 | 116.93 | 109.6 | 124 | 124.97 | 144.11 | 155.81 | 168.59 | | (62) |
| Solar DI | HW input | calculated | using App | endix G o | r Appendix | H (negati | ve quantity | /) (enter '0 | ' if no sola | r contribut | on to wate | er heating) | | |
| (add a | dditiona | l lines if | FGHRS | and/or \ | NWHRS | applies | , see Ap | pendix (| G) | | | - | | |
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (63) |
| Output | t from w | ater hea | ter | | | | | | | | | | | |
| (64)m= | 173.69 | 152.25 | 157.93 | 138.83 | 134.05 | 116.93 | 109.6 | 124 | 124.97 | 144.11 | 155.81 | 168.59 | | |
| | | | | | | | | Out | out from wa | ater heate | r (annual) | 12 | 1700.76 | (64) |
| Heat g | ains fro | m water | heating, | kWh/m | onth 0.2 | 5 ´ [0.85 | × (45)m | + (61)n | n] + 0.8 > | (46)m | + (57)m | + (59)m |] | |
| (65)m= | 56.7 | 49.67 | 51.46 | 45.15 | 43.53 | 37.88 | 35.41 | 40.2 | 40.55 | 46.87 | 50.79 | 55 | | (65) |
| inclu | ude (57) | m in cale | culation | of (65)m | only if c | ylinder i | s in the o | dwelling | or hot w | ater is fr | om com | munity h | eating | |
| 5. In | ternal ga | ains (see | e Table 5 | 5 and 5a |): | | | | | | | | | |
| Metab | <u>olic gair</u> | <u>is (Table</u> | e 5), Wat | ts | | | - | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (66)m= | 135.65 | 135.65 | 135.65 | 135.65 | 135.65 | 135.65 | 135.65 | 135.65 | 135.65 | 135.65 | 135.65 | 135.65 | | (66) |
| Lightin | g gains | (calcula | ted in Ap | opendix | L, equat | ion L9 o | r L9a), a | lso see | Table 5 | | | | | |
| (67)m= | 22.45 | 19.94 | 16.22 | 12.28 | 9.18 | 7.75 | 8.37 | 10.88 | 14.61 | 18.55 | 21.65 | 23.08 | | (67) |
| Applia | nces ga | ins (calc | ulated in | Append | dix L, eq | uation L | 13 or L1 | 3a), also | see Ta | ble 5 | | | | |
| (68)m= | 251.87 | 254.48 | 247.9 | 233.88 | 216.18 | 199.54 | 188.43 | 185.82 | 192.4 | 206.42 | 224.12 | 240.76 | | (68) |
| Cookir | ng gains | (calcula | ated in A | ppendix | L, equat | tion L15 | or L15a) |), also se | ee Table | 5 | | | | |
| (69)m= | 36.56 | 36.56 | 36.56 | 36.56 | 36.56 | 36.56 | 36.56 | 36.56 | 36.56 | 36.56 | 36.56 | 36.56 | | (69) |
| Pumps | s and fa | ns gains | (Table s | 5a) | | | _ | - | - | | | - | | |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | | (70) |
| Losses | s e.g. ev | vaporatio | on (nega | tive valu | es) (Tab | ole 5) | | | | | | | | |
| (71)m= | -108.52 | -108.52 | -108.52 | -108.52 | -108.52 | -108.52 | -108.52 | -108.52 | -108.52 | -108.52 | -108.52 | -108.52 | | (71) |
| Water | heating | gains (T | Table 5) | | | | | | | | | | | |
| (72)m= | 76.2 | 73.92 | 69.17 | 62.71 | 58.51 | 52.61 | 47.6 | 54.03 | 56.32 | 63 | 70.54 | 73.93 | | (72) |
| Total i | internal | gains = | | | | (66) |)m + (67)m | n + (68)m · | + (69)m + (| (70)m + (7 | 1)m + (72) |)m | | |
| (73)m= | 417.22 | 415.04 | 399.98 | 375.56 | 350.57 | 326.6 | 311.09 | 317.42 | 330.02 | 354.67 | 383.01 | 404.46 | | (73) |
| 6. So | lar gains | S: | | | | | | | | | | | | |

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

| Orientation: | Access Factor Table 6d | r | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|-----------------|---------------------------|---|------------|---|------------------|-----|----------------|---|----------------|---|--------------|------------------|
| Northeast 0.9x | 0.3 | x | 21.89 | × | 11.28 |) × | 0.63 | x | 0.7 | = | 29.41 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 22.97 | x | 0.63 | x | 0.7 | = | 59.86 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 41.38 | x | 0.63 | x | 0.7 | = | 107.85 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 67.96 | x | 0.63 | x | 0.7 | = | 177.12 | – (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 91.35 | x | 0.63 | x | 0.7 | = | 238.09 | – (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | × | 97.38 | x | 0.63 | x | 0.7 | = | 253.83 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | × | 91.1 | x | 0.63 | x | 0.7 | = | 237.45 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 72.63 | x | 0.63 | x | 0.7 | = | 189.3 | – (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 50.42 | x | 0.63 | x | 0.7 | = | 131.42 | – (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 28.07 | x | 0.63 | x | 0.7 | = | 73.16 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | × | 14.2 | x | 0.63 | x | 0.7 | = | 37 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 9.21 | x | 0.63 | x | 0.7 | = | 24.02 | (75) |
| Southwest0.9x | 0.77 | x | 9.96 | × | 36.79 | i | 0.63 | x | 0.7 | = | 112 | (79) |
| Southwest0.9x | 0.77 | x | 9.96 | × | 62.67 | ĺ | 0.63 | x | 0.7 | = | 190.77 | (79) |
| Southwest0.9x | 0.77 | x | 9.96 | × | 85.75 | i | 0.63 | x | 0.7 | = | 261.02 | - (79) |
| Southwest0.9x | 0.77 | x | 9.96 | x | 106.25 | i | 0.63 | x | 0.7 | = | 323.42 | – (79) |
| Southwest0.9x | 0.77 | x | 9.96 | × | 119.01 | ĺ | 0.63 | x | 0.7 | = | 362.26 | (79) |
| Southwest0.9x | 0.77 | x | 9.96 | × | 118.15 | i | 0.63 | x | 0.7 | = | 359.64 | – (79) |
| Southwest0.9x | 0.77 | x | 9.96 | x | 113.91 | i | 0.63 | x | 0.7 | = | 346.73 | (79) |
| Southwest0.9x | 0.77 | x | 9.96 | × | 104.39 | 1 | 0.63 | x | 0.7 | = | 317.75 | – (79) |
| Southwest0.9x | 0.77 | x | 9.96 | × | 92.85 | 1 | 0.63 | x | 0.7 | = | 282.63 | – (79) |
| Southwest0.9x | 0.77 | x | 9.96 | x | 69.27 | i | 0.63 | x | 0.7 | = | 210.84 | (79) |
| Southwest0.9x | 0.77 | x | 9.96 | × | 44.07 | ĺ | 0.63 | x | 0.7 | = | 134.15 | – (79) |
| Southwest0.9x | 0.77 | x | 9.96 | x | 31.49 | i | 0.63 | x | 0.7 | = | 95.85 | – (79) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 26 | x | 0.63 | x | 0.8 | = | 36.8 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 54 | x | 0.63 | x | 0.8 | = | 76.42 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 96 | x | 0.63 | x | 0.8 | = | 135.86 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 150 | x | 0.63 | x | 0.8 | = | 212.28 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 192 | x | 0.63 | x | 0.8 | = | 271.72 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 200 | x | 0.63 | x | 0.8 | = | 283.05 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | x | 189 | x | 0.63 | x | 0.8 | = | 267.48 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 157 | x | 0.63 | x | 0.8 | = | 222.19 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 115 | × | 0.63 | x | 0.8 | = | 162.75 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 66 | × | 0.63 | x | 0.8 | = | 93.41 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 33 | × | 0.63 | × | 0.8 | = | 46.7 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | x | 21 | İ x | 0.63 | x | 0.8 | = | 29.72 | – (82) |

| Solar g | ains in | watts, ca | alculated | for eac | h month | | | (83)m = S | um(74)m . | (82)m | | | |
|---------|---|-----------|-----------|---------|---------|---------|---------|-----------|-----------|--------|--------|--------|------|
| (83)m= | 178.2 | 327.06 | 504.74 | 712.83 | 872.07 | 896.51 | 851.66 | 729.24 | 576.8 | 377.4 | 217.85 | 149.58 | (83) |
| Total g | otal gains – internal and solar (84)m = (73)m + (83)m , watts | | | | | | | | | | | | |
| (84)m= | 595.43 | 742.1 | 904.72 | 1088.39 | 1222.64 | 1223.11 | 1162.75 | 1046.66 | 906.82 | 732.07 | 600.86 | 554.04 | (84) |

| 7. Me | an interi | nal temp | perature | (heating | season |) | | | | | | | | |
|---------------|-----------------------|------------|-----------------------|----------------------|---------------------|-------------|-----------|----------------------|------------|-----------------|-------------|------------|---------|----------|
| Temp | erature | during h | neating p | eriods ir | n the livir | ng area t | from Tab | ole 9, Th | 1 (°C) | | | | 21 | (85) |
| Utilisa | tion fac | tor for g | ains for | iving are | ea, h1,m | (see Ta | ble 9a) | | | | | | | _ |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (86)m= | 1 | 0.99 | 0.98 | 0.96 | 0.89 | 0.76 | 0.62 | 0.68 | 0.89 | 0.98 | 0.99 | 1 | | (86) |
| Mean | internal | l temper | ature in | living are | ea T1 (fo | ollow ste | ps 3 to 7 | in Table | e 9c) | | | | | |
| (87)m= | 18.65 | 18.89 | 19.31 | 19.92 | 20.42 | 20.8 | 20.93 | 20.9 | 20.6 | 19.94 | 19.24 | 18.69 | | (87) |
| Temp | erature | durina h | eating p | eriods ir | n rest of | dwellina | from Ta | ble 9. Tl | n2 (°C) | | | | | |
| (88)m= | 19.25 | 19.26 | 19.28 | 19.35 | 19.36 | 19.43 | 19.43 | 19.44 | 19.4 | 19.36 | 19.33 | 19.31 | | (88) |
| ا د siliti | tion fac | tor for a | ains for | rest of du | velling | h2 m (sc | a Tabla | (a) | | | | | | |
| (89)m= | 1 | 0.99 | 0.98 | 0.94 | 0.83 | 0.63 | 0.43 | 9 a) 0.49 | 0.8 | 0.96 | 0.99 | 1 | | (89) |
| | | | - 4 | 44 | | | | | 7 in Tabl | . 0) | | | | |
| | Internal | temper | ature in | | | ng 12 (f | | ps 3 to 1 | 10.00 | e 9C) | 17.15 | 16.22 | | (90) |
| (90)11= | 10.25 | 10.01 | 17.22 | 10.13 | 10.02 | 19.5 | 19.4 | 19.4 | 19.09 | 10.17 | 17.10 | 10.33 | 0.42 | |
| | | | | | | | | | | | g arca ÷ (- | - | 0.43 | (91) |
| Mean | internal | temper | ature (fo | r the wh | ole dwe | lling) = fl | LA x T1 | + (1 – fL | A) × T2 | i | | | | () |
| (92)m= | 17.27 | 17.58 | 18.11 | 18.89 | 19.5 | 19.94 | 20.05 | 20.04 | 19.73 | 18.92 | 18.04 | 17.33 | | (92) |
| Apply | adjustn | nent to t | he mear | internal | temper | ature fro | m Table | 4e, whe | ere appro | opriate | | | | (00) |
| (93)m= | 17.27 | 17.58 | 18.11 | 18.89 | 19.5 | 19.94 | 20.05 | 20.04 | 19.73 | 18.92 | 18.04 | 17.33 | | (93) |
| 8. Spa | ace hear | ting requ | urement | | | ! -! -! | | | | 4 T : /* | 70) | | | |
| the ut | to the r ilisation | factor fo | ernal ter or dains | nperatur using Ta | e obtain Ible 9a | ied at ste | epitor | i able 90 | o, so tha | t 11,m=(| 76)m an | d re-caic | ulate | |
| [| Jan | Feb | Mar | Apr | Mav | Jun | Jul | Aua | Sep | Oct | Nov | Dec | | |
| Utilisa | ition fac | tor for g | u ains, hm | : | | | I | | | I | | | | |
| (94)m= | 0.99 | 0.99 | 0.97 | 0.93 | 0.84 | 0.68 | 0.51 | 0.57 | 0.82 | 0.96 | 0.99 | 1 | | (94) |
| Usefu | l gains, | hmGm | , W = (94 | 4)m x (84 | 4)m | | | | | | | | | |
| (95)m= | 591.54 | 732.41 | 878.66 | 1011.32 | 1026.62 | 830.64 | 590.77 | 600.58 | 747.98 | 701.78 | 594.32 | 551.28 | | (95) |
| Month | nly avera | age exte | rnal tem | perature | e from Ta | able 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 I | oss rate | e for mea | an intern | al tempe | erature, | Lm , W = | =[(39)m : | x [(93)m· | – (96)m |] | | | | () |
| (97)m= | 2684.97 | 2597.78 | 2353.57 | 1922.93 | 1486.34 | 968.48 | 626.56 | 654.29 | 1041.29 | 1585.68 | 2127.25 | 2607.76 | | (97) |
| Space | e heating | g require | ement fo | r each m | nonth, k | Nh/mont | th = 0.02 | 24 x [(97) |)m – (95 |)m] x (4′ | 1)m | 4500.00 | | |
| (98)m= | 1557.51 | 1253.53 | 1097.34 | 656.36 | 342.03 | 0 | 0 | 0 | 0 | 657.63 | 1103.71 | 1530.03 | | |
| | | | | | | | | Tota | l per year | (kWh/year |) = Sum(9 | 8)15,912 = | 8198.12 | (98) |
| Space | e heating | g require | ement in | kWh/m ² | /year | | | | | | | | 84.26 | (99) |
| 9a. Ene | ergy req | uiremer | nts – Indi | ividual h | eating sy | ystems i | ncluding | micro-C | HP) | | | | | |
| Space | e heatin | ng: | | | , . | | | | | | | , | | - |
| Fracti | on ot sp | ace hea | at from s | econdary | y/supple | mentary | system | | | | | | 0 | (201) |
| Fraction | on of sp | ace hea | at from m | nain syst | em(s) | | | (202) = 1 - | - (201) = | | | | 1 | (202) |
| Fraction | on of to | tal heatii | ng from | main sys | stem 1 | | | (204) = (20 | 02) × [1 – | (203)] = | | | 1 | (204) |
| Efficie | ency of r | nain spa | ace heat | ing syste | em 1 | | | | | | | | 93.2 | (206) |
| Efficie | ency of s | seconda | ry/suppl | ementar | y heating | g system | n, % | | | | | ĺ | 0 | (208) |
| | | | | | | | | | | | | - | | |

| Spage | Jan | Feb | Mar Mar | | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/yea | ır |
|----------|---------------------|----------------------|-----------------------|---------------|-----------|----------|------------|-------------|----------------|-----------------------|-------------------------|---------|------------|-------------------|
| Space | 1557.51 | 1253.53 | 1097.34 | 656.36 | 342.03 |) 0 | 0 | 0 | 0 | 657.63 | 1103.71 | 1530.03 | | |
| (211)m | $h = \{[(98)]$ |)m x (20 | I)4)] } x 1 | 1 00 ÷ (20 |)6) | | | | | | | | | (211) |
| () | 1671.15 | 1344.99 | 1177.4 | 704.25 | 366.98 | 0 | 0 | 0 | 0 | 705.61 | 1184.23 | 1641.66 | | ` |
| | | | | | | | | Tota | l (kWh/yea | ar) =Sum(2 | 211) _{15,1012} | - | 8796.27 | (211) |
| Space | e heatin | g fuel (s | econdar | y), kWh/ | month | | | | | | | | | - |
| = {[(98 |)m x (20 |)1)]}x1 | 00 ÷ (20 | (8) | | | | | | | | | l | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | U Tota | U 0 (kWh/ve | or) =Sum(2 | 0 (15) | 0 | 0 | 1 (215) |
| Wator | heating | | | | | | | 1010 | | ai) – C uiri(1 | | | 0 | |
| Output | from wa | , ater hea | ter (calc | ulated a | bove) | | | | | | | | | |
| · | 173.69 | 152.25 | 157.93 | 138.83 | 134.05 | 116.93 | 109.6 | 124 | 124.97 | 144.11 | 155.81 | 168.59 | | _ |
| Efficier | ncy of w | ater hea | ater | | | | | | | | | | 87.3 | (216) |
| (217)m= | 89.9 | 89.88 | 89.82 | 89.68 | 89.36 | 87.3 | 87.3 | 87.3 | 87.3 | 89.66 | 89.83 | 89.9 | | (217) |
| Fuel fo | r water a = (64) | heating, m x 100 | , kWh/mo) ∸ (217) | onth | | | | | | | | | | |
| (219)m= | 193.2 | 169.4 | 175.82 | 154.81 | 150.01 | 133.94 | 125.54 | 142.04 | 143.15 | 160.72 | 173.45 | 187.52 | | |
| | | | | | | | - | Tota | al = Sum(2 | 19a) ₁₁₂ = | | | 1909.6 | (219) |
| Annua | I totals | () | | | | | | | | k | Wh/year | , | kWh/year | - - |
| Space | heating | fuel use | ed, main | system | 1 | | | | | | | | 8796.27 | ļ |
| Water | heating | fuel use | ed | | | | | | | | | | 1909.6 | |
| Electric | city for p | oumps, f | ans and | electric | keep-ho | t | | | | | | | | |
| centra | al heatin | ig pump | : | | | | | | | | | 30 | | (230c) |
| boiler | with a f | an-assis | sted flue | | | | | | | | | 45 | | (230e) |
| Total e | lectricity | / for the | above, I | kWh/yea | r | | | sum | of (230a). | (230g) = | | | 75 | (231) |
| Electric | city for li | ghting | | | | | | | | | | | 396.55 | (232) |
| 12a. (| CO2 em | issions · | – Individ | ual heat | ing syste | ems incl | uding mi | cro-CHF | þ | | | | | - |
| | | | | | | En | | | | Emico | ion foo | 101 | Emissions | |
| | | | | | | kW | Vh/year | | | kg CO | 2/kWh | | kg CO2/yea | r |
| Space | heating | (main s | ystem 1 |) | | (21 | 1) x | | | 0.2 | 16 | = | 1899.99 | (261) |
| Space | heating | (second | darv) | , , | | (21 | 5) x | | | 0.5 | 19 | = | 0 |] (263) |
| Water | heating | (| , | | | (21 | 9) x | | | 0.0 | 16 | = | 412.47 | $\frac{1}{(264)}$ |
| Snace | and wa | ter heati | na | | | (26 | 1) + (262) | + (263) + (| (264) = | 0.2 | | | 2212.47 | (265) |
| Electric | and wa | | anc and | oloctric | kaan ha | + (23 | 1) x | (/) | (-) | | 10 | _ | 2312.47 | |
| | | abtina | ans anu | electric | кеер-по | (22) | 2) v | | | 0.5 | 19 | | 38.93 | |
| | | gnung | | | | (23) | <i>~</i> / | | | 0.5 | 19 | = | 205.81 |](268)] |
| I otal C | .02, kg/ | year | _ | | | | | | sum o | א (∠05)(ג) גע | 271) = | | 2557.2 | (272) |
| Dwelli | ng CO2 | Emissi | on Rate | 9 | | | | | (272) | ÷ (4) = | | | 26.28 | (273) |
| EI ratir | ig (secti | on 14) | | | | | | | | | | | 76 | (274) |

| | | | | | | | User D | Details: | | | | | | | |
|---|--|-------------|-------------------------|-----------------|-----------------------|---------------------|--------------|-------------------|--------------|-------------|----------|-----------|-------------------------|--------------|--|
| Asses | ssor N | ame: | Ge | orge Fa | arr | | | Strom | a Num | ber: | | STRO | 028460 | | |
| Softw | are Na | ame: | Str | oma FS | SAP 201 | 2 | | Softwa | are Vei | rsion: | | Versic | on: 1.0.4.6 | | |
| | | | | | | Р | roperty | Address | : Flat 2 | | | | | | |
| Addre | SS : | | | | | | | | | | | | | | |
| 1. Ove | oftware Name: Stroma FSAP 2012Software Version: Version: 1.0.4.6Property Address: Flat 2cddress :ddress :1. Overall dwelling dimensions:Area(m²)Av. Height(m)Volume(m³)iround floor $52.41 (1a) \times 2.95 (2a) = 154.61 (3a)$ iround floor $52.41 (1a) \times 2.95 (2a) = 154.61 (3a)$ iround floor $52.41 (1a) \times 2.95 (2b) = 128.47 (3b)$ iround floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+(1n) 91.94 (4)welling volume $(3a)+(3b)+(3c)+(3d)+(3e)+(3n) = 283.08 (5)$ C. Ventilation rate:naming heating heating $+ 0 + 0 = 0 \times 40 = 0 (6a)$ lumber of chimneys0 $+ 0 + 0 = 0 \times 40 = 0 (6a)$ 1umber of open flues $0 + 0 + 0 = 0 \times 20 = 0 (6b)$ 1umber of intermittent fans $x 10 = 30 (7a)$ | | | | | | | | | | | | | | |
| User Details:Assessor Name:George FarrStroma Number:STR002846Software Name:Stroma FSAP 2012Software Version:Version: 1.0Property Address: Flat 2Address :Image: Colspan="2">Av. Height(m)VoltGround floorSize (2a) =1First floorSize (2a) =1Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+(1n)91.94(4)Dwelling volumeSecondaryothertotalNumber of chimneys0+0=0Number of passive vents0+0=0x40 =Number of flueless gas fires0x 10 =3x 10 =Air changesInfiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =30 \pm (5) =1 | | | | | | | | | | | | | | | |
| Ground | l floor | | | | | | Ę | 52.41 | (1a) x | 2 | .95 | (2a) = | 154.61 | (3a) | |
| First flo | or | | | | | | ; | 39.53 | (1b) x | 3 | .25 | (2b) = | 128.47 | (3b) | |
| Total flo | oor area | a TFA = | (1a)+(1 | b)+(1c)+ | (1d)+(1e | e)+(1n | i) | 91.94 | (4) | | | - | | _ | |
| Dwellin | g volum | ne | | | | | | | (3a)+(3b |)+(3c)+(3d | l)+(3e)+ | .(3n) = | 283.08 | (5) | |
| 2. Ventilation rate:Main heatingsecondary heatingothertotalm³Number of chimneys 0 $+$ 0 $+$ 0 $=$ 0 $x 40 =$ Number of open flues 0 $+$ 0 $+$ 0 $=$ 0 $x 20 =$ | | | | | | | | | | | | | | | |
| | | | | main heating | se h | econdar leating | у | other | | total | | | m ³ per hour | | |
| Numbe | umber of chimneys 0 + 0 + 0 = 0 x 40 =umber of open flues 0 + 0 + 0 = 0 x 20 =umber of intermittent fans 10 10 10 10 10 10 | | | | | | | | | | | | | | |
| Numbe | r of ope | n flues | Ē | 0 | - + - | 0 | <u> </u> + [| 0 | _ _ = _ | 0 | x 2 | 20 = | 0 | (6b) | |
| Numbe | r of inte | rmittent | fans | | | | | | - Ē | 3 | x ′ | 10 = | 30 | (7a) | |
| Numbe | r of pas | sive ver | nts | | | | | | Ē | 0 | x ′ | 10 = | 0 | (7b) | |
| Numbe | r of flue | less gas | s fires | | | | | | Г | 0 | x 4 | 40 = | 0 | (7c) | |
| | | | | | | | | | L | | | | | | |
| | | | | | | | | | | | | Air ch | anges per ho | ur | |
| Infiltrati | on due | to chim | neys, flu | ies and f | ans = <mark>(6</mark> | a)+(6b)+(7 | a)+(7b)+(| (7c) = | Γ | 30 | · [| ÷ (5) = | 0.11 | (8) | |
| lf a pr | essurisati | on test ha | is been ca | rried out o | r is intende | ed, proceed | d to (17), | otherwise | continue fr | om (9) to (| (16) | | | ٦ | |
| Num | ber of si | toreys Ir | n the dw | elling (n | S) | | | | | | (0) | 41-0-4 | 0 | (9) | |
| Addi | uonai ini | iltration | · 0 25 fo | r ctool o | r timbor | frama ar | 0 25 fo | r macani | av constr | uction | [(9)- | -1]x0.1 = | 0 | | |
| if b | oth types | of wall are | . 0.25 10 e present. | use the va | alue corres | pondina to | the area | ter wall are | a (after | uction | | | 0 | (11) | |
| dec | ducting are | eas of ope | enings); if | equal user | 0.35 | | 5 | | | | | | | _ | |
| If sus | spendec | l woode | n floor, | enter 0.2 | ? (unseal | ed) or 0. | 1 (seale | ed), else | enter 0 | | | | 0 | (12) | |
| lf no | draught | lobby, | enter 0.0 | 05, else | enter 0 | | | | | | | | 0 | (13) | |
| Perc | entage (| of windo | ows and | doors di | raught st | ripped | | | | | | | 0 | (14) | |
| Wind | low infilt | ration | | | | | | 0.25 - [0.2 | 2 x (14) ÷ 1 | = [00] | (4.5) | | 0 | (15) | |
| Infiltr | ation ra | te | | | | | | (8) + (10) | + (11) + (1 | 2) + (13) - | + (15) = | | 0 | (16) | |
| Airp | ermeab | ility valu | ie, q50, | expresse | | oic metre | s per ho | our per s | quare m | etre of e | nvelope | area | 15 | (17) | |
| If base | d on air rmoobility | permea | idility va | lue, then | (10) = [(1) | $() \div 20] + (c)$ | o or o do | $rac{10}{10} = 0$ | rmoobility | is boing u | ood | | 0.86 | (18) | |
| Numbe | r of side | es shelte | ered | 1033011380 | 01110311143 | s been don | eoraue | giee all pe | ineability | is being us | 360 | | 0 | (19) | |
| Shelter | factor | | | | | | | (20) = 1 - | [0.075 x (1 | 9)] = | | | 1 | (20) | |
| Infiltrati | on rate | incorpo | rating sł | nelter fac | ctor | | | (21) = (18 |) x (20) = | | | | 0.86 | (21) | |
| Infiltrati | on rate | modifie | d for mo | onthly wir | nd speed | ł | | | | | | | | | |
| [| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | | |
| Monthly | y averaç | ge wind | speed f | rom Tab | le 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 F | actor (2 | 2a)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 | | |
| Adjuste | ed infiltra | ation rat | e (allow | ing for sł | nelter an | d wind s | speed) = | = (21a) x | (22a)m | | | | | |
| • | 1.09 | 1.07 | 1.05 | 0.94 | 0.92 | 0.81 | 0.81 | 0.79 | 0.86 | 0.92 | 0.96 | 1.01 | | |
| Calcul | ate effec | ctive air | change | rate for t | he appli | cable ca | ise | _ ! | | Į | | | | |
| IT ME | echanica | | | ondix N (2 | (25) = (22) | | oquation | (NE)) otho | nuico (22h | (220) | | l | 0 | (23a) |
| If hale | aust all the | heat reco | overv: effic | viency in % | allowing f | or in-use f | factor (fro | m Table 4h |) = |) – (23a) | | | 0 | (230) |
| a) If | halance | d mach | anical ve | antilation | with he | at recov | | | -) — -) m — (2) | 2h)m + (| (23h) v [| 1 _ (23c) | 0 · 1001 | (230) |
| (24a)m= | | | | | | | | | $\frac{1}{0}$ | | | 1 - (230) | ÷ 100] | (24a) |
| () b) If | halance | d mech | l anical ve | I | without | heat rec | | M\/) (24ł | 1 - (2) | 1 2h)m + (| (23h) | | I | , |
| (24b)m= | 0 | | | 0 | 0 | 0 | | | | | 0 | 0 | | (24b) |
| c) If | whole h | ouse ex | I tract ver | L ntilation (| L or positiv | L /e input : | I ventilati | on from (| L outside | I | Į | | 1 | |
| i i | if (22b)n | ו < 0.5 א | < (23b), 1 | then (24 | c) = (23k | o); other | wise (24 | 4c) = (22l | b) m + 0 | .5 × (23 | c) | | | |
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (24c) |
| d) If | natural | ventilatio | on or wh | ole hous | se positiv | ve input | ventilat | ion from | loft | - | - | | | |
| i | if (22b)n | n = 1, th | en (24d) | m = (22 | b)m othe | erwise (2 | 24d)m = | 0.5 + [(2 | 2b)m² x | 0.5] | | | I | (- · · · |
| (24d)m= | 1.09 | 1.07 | 1.05 | 0.94 | 0.92 | 0.83 | 0.83 | 0.81 | 0.87 | 0.92 | 0.96 | 1.01 | l | (24d) |
| Effe | ctive air | change | rate - er | nter (24a | i) or (24k | o) or (24 | c) or (24 | 4d) in bo | x (25) | | | | l | (05) |
| (25)m= | 1.09 | 1.07 | 1.05 | 0.94 | 0.92 | 0.83 | 0.83 | 0.81 | 0.87 | 0.92 | 0.96 | 1.01 | l | (25) |
| 3. He | at losse | s and he | eat loss | paramet | er: | | | | | | | | | |
| ELEN | IENT | Gros area | ss (m²) | Openin rr | igs 1 ² | Net Ar A ,r | rea m² | U-val W/m2 | ue 2K | A X U (W/ | K) | k-value kJ/m²·ł | у А К k | ∖Xk J/K |
| Doors | | | | | | 1.89 | x | 1.4 | = | 2.646 | | | | (26) |
| Windo | ws Type | e 1 | | | | 7.24 | . x | 1/[1/(1.4)+ | - 0.04] = | 9.6 | | | | (27) |
| Windo | ws Type | 2 | | | | 21.89 | э х | 1/[1/(1.4)+ | - 0.04] = | 29.02 | | | | (27) |
| Rooflig | phts | | | | | 3.12 | x x | 1/[1/(1.4) + | 0.04] = | 4.368 | | | | (27b) |
| Floor | | | | | | 52.4 | 1 × | 0.14 | = | 7.3374 | ↓ [| | 一 「一 | (28) |
| Walls - | Гуре1 | 45.3 | 39 | 0 | | 45.39 | э х | 0.18 | = | 8.17 | | | i — | (29) |
| Walls - | Гуре2 | 42. | 3 | 29.1 | 3 | 13.17 | 7 X | 0.22 | = | 2.9 | | | i – | (29) |
| Walls - | Гуре3 | 23.5 | 58 | 1.89 |) | 21.69 | х | 0.2 | = | 4.36 | | | i – | (29) |
| Roof | | 12.8 | 39 | 3.12 | 2 | 9.77 | · × | 0.14 | | 1.37 | | | \dashv | (30) |
| Total a | rea of e | lements | s, m² | L | | 176.5 | 57 | L | | | I | | | (31) |
| Party v | vall | | | | | 42.43 | 3 X | 0 | = | 0 | | | _ | (32) |
| Party c | eiling | | | | | 35.5 | 5 | | | - | I | | ╡ | ` ´ ´ (32b) |
| * for win | dows and | roof wind | ows, use e | effective wi | indow U-va | alue calcul | lated usin | g formula 1 | 1/[(1/U-valu | ue)+0.04] a | L as given in | paragraph | 3.2 | (```' |
| Fabric | heat los | s, W/K | = S (A x | U) | is and par | | | (26)(30 |) + (32) = | | | [| 69 53 | (33) |
| Heat c | apacity | Cm = S(| (Axk) | , | | | | | ((28). | (30) + (3 | 2) + (32a). | (32e) = | 12389.74 | (34) |

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K

(35)

250

Indicative Value: Medium

| can be i | used inste | ad of a de | tailed calc | ulation. | | | | | | | | | | | |
|------------|---|--------------------------|------------------|----------------------|----------------|-------------|---------------------------------------|--------------------|------------|------------------------|------------------------|----------------|---------|------|--|
| Therm | al bridg | es : S (L | x Y) cal | culated | using Ap | pendix ł | < | | | | | | 26.49 | (36) | |
| if details | of therma | al bridging | are not kn | own (36) = | = 0.15 x (3 | 1) | | | | | | | | | |
| Total f | be used instead of a detailed calculation. simal bridges : S (L x Y) calculated using Appendix K (3) = (36) tails of thematibinging are not known (36) = 0.15 x (31) al fabric heat loss (31) = (35) (33) + (36) = (37) (33) tail fabric heat loss calculated monthly (38) = 0.33 x (25)m x (5) mage 101.95 99.95 97.95 88.12 86.26 77.59 77.59 77.59 80.93 88.26 90.02 93.96 (38) at transfer coefficient, W/K (39)m = (37) + (38)m mage 197.97 195.97 193.97 184.14 182.28 173.61 173.61 172.01 176.55 182.28 186.04 189.98 Average = Sum(39) /12= (184.07 (39)m = (4)) mage 2.15 2.13 2.11 2 1.98 1.89 1.87 1.92 1.98 2.02 2.07 Average = Sum(40) r/12= (40) mber of days in month (Table 1a) mage 1 2.15 2.13 3.01 3.0 3.1 3.0 3.1 3.0 3.1 3.0 3.1 3.0 3.1 (41) Water heating energy requirement: kWh/year: transfer coccupancy, N TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)2] + 0.0013 x (TFA - 13.9) TFA 5 13.9, N = 1 (1.76 x [1 - exp(-0.000349 x (TFA - 13.9)2]) + 0.0013 x (TFA - 13.9) TFA 5 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)2] + 0.0013 x (TFA - 13.9) TFA 5 13.9, N = 1 (1.76 x [1 - exp(-0.000349 x (TFA - 13.9)2]) + 0.0013 x (TFA - 13.9) TFA 5 13.9, N = 1 (1.76 x [1 - exp(-0.000349 x (TFA - 13.9)2]) + 0.0013 x (TFA - 13.9) TFA 5 13.9, N = 1 (1.76 x [1 - exp(-0.000349 x (TFA - 13.9)2]) + 0.0013 x (TFA - 13.9) TFA 5 13.9, N = 1 (1.76 x [1 - exp(-0.000349 x (TFA - 13.9)2]) + 0.0013 x (TFA - 13.9) TFA 5 13.9, N = 1 (1.76 x [1 - exp(-0.000349 x (TFA - 13.9)2]) + 0.0013 x (TFA - 13.9) TFA 5 13.9, N = 1 (1.76 x [1 - exp(-0.000349 x (TFA - 13.9)2]) + 0.0013 x (TFA - 13.9) TFA 5 13.9, N = 1 (1.76 x [1 - exp(-0.000349 x (TFA - 13.9)2]) + 0.0013 x (TFA - 13.9) TFA 5 13.9, N = 1 (1.76 x [1 - exp(-0.000349 x (TFA - 13.9)2]) + 0.0013 x (TFA - 13.9) TFA 5 13.9, N = 1 (1.76 x [1 - exp(-0.000349 x (TFA - 13.9)2]) + 0.0013 x (TFA - 13.9) TFA 5 13.9, N = 1 (1.76 x [1 - exp(-0.000349 x (TFA - 13.9)2]) + 0.0013 x (TFA - 1.3.9) TFA 5 13.9, N = 1 (1.76 x [1 - exp(-0.000349 x (TFA - 13.9)2]) + 0.001 | | | | | | | | | | | | | | |
| Ventila | ation hea | at loss ca | alculated | monthl | y | - | - | - | (38)m | = 0.33 × (| 25)m x (5) | | _ | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | | |
| (38)m= | 101.95 | 99.95 | 97.95 | 88.12 | 86.26 | 77.59 | 77.59 | 75.99 | 80.93 | 86.26 | 90.02 | 93.96 |] | (38) | |
| Heat t | ransfer o | coefficie | nt, W/K | | | | | | (39)m | = (37) + (3 | 38)m | | | | |
| (39)m= | 197.97 | 195.97 | 193.97 | 184.14 | 182.28 | 173.61 | 173.61 | 172.01 | 176.95 | 182.28 | 186.04 | 189.98 | | | |
| Heat lo | uss nara | meter (l | HP) W | /m²K | | | | | (40)m | Average = = (39)m ÷ | Sum(39)1 | 12 /12= | 184.07 | (39) | |
| (40)m= | 2 15 | 2 13 | 2 11 | 2 | 1.98 | 1 89 | 1 89 | 1.87 | 1.92 | 1.98 | 2.02 | 2.07 | 1 | | |
| (40)11- | 2.10 | 2.10 | 2.11 | 2 | 1.50 | 1.00 | 1.00 | 1.07 | 1.52 | | Sum(40). | 2.07 m /12- | 2 | (40) | |
| Numb | er of day | ys in mo | nth (Tab | le 1a) | - | - | - | | | -verage – | Oum(+0)1 | | 2 | | |
| | 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 Wa | ater hea | tina ene | rav reau | irement [.] | | | | | | | | kWh/ve | ear: | | |
| | Water heating energy requirement: kWh/year: ssumed occupancy, N if TEA > 13.9, N = 1 + 1.76 x [1 = oxp(.0.000240 x (TEA = 13.0)2)] + 0.0013 x (TEA = 13.0) (42) | | | | | | | | | | | | | | |
| Assum | . Water heating energy requirement: kWh/year: sumed occupancy, N 2.65 (42) | | | | | | | | | | | | | | |
| | A > 13. A £ 13 | 9, $N = 1$ 9, $N = 1$ | + 1.76 x | [1 - exp | (-0.0003 | 349 X (1F | -A -13.9 |)2)] + 0.0 | JU13 X (| IFA -13. | .9) | | | | |
| Annua | l averaç | ae hot wa | ater usag | ge in litre | es per da | ay Vd,av | erage = | (25 x N) | + 36 | | 97 | .17 |] | (43) | |
| Reduce | the annu | al average | hot water | usage by | 5% if the a | lwelling is | designed t | to achieve | a water us | se target o | f | | 1 | | |
| not mor | (40)m = (39)m ÷ (4) (40)m = (39)m ÷ (4) Mar Apr May 1.89 1.89 1.87 1.92 1.98 2.02 2.07 Average = Sum(40) ₁₋₁₉ /12= 2 (40) Mar Apr May Jun Jul Aug Sep Oct Nov Dec (40) (40) Mar Apr May Jun Jul Aug Sep Oct Nov Dec (40) (40) Mar Apr May Jun Jul Aug Sep Oct Nov Dec (40) (40) (40) (40) Mar Apr May Jun Jul Aug Sep Oct Nov Dec (41) Water heating energy requirement: KWh/year: sumed occupancy, N (1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9) (42) The base in litres per day Vd, average = (25 x N) + 36 mual average hot water usage by 5% if the dwelling is designed to achieve a water use target of more that 125 litres per person per day (all water use, hot and cold) Total = Sum(44) ₁₋₁₀ = Total = Sum(44) ₁₋₁₀ = <th col<="" td=""></th> | | | | | | | | | | | | | | |
| | $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | | | | | | | | | | | | | | |
| Hot wat | er usage i | in litres per | r day for ea | ach month | Vd,m = fa | ctor from T | Table 1c x | (43) | | | | | _ | | |
| (44)m= | 106.89 | 103 | 99.11 | 95.23 | 91.34 | 87.45 | 87.45 | 91.34 | 95.23 | 99.11 | 103 | 106.89 | | | |
| _ | | | | | | | | | | Total = Su | m(44) ₁₁₂ = | = | 1166.04 | (44) | |
| Energy | content of | f hot water | used - cal | culated mo | onthly $= 4$. | 190 x Vd,r | n x nm x C | 0Tm / 3600 |) kWh/mor | nth (see Ta | ables 1b, 1 | c, 1d) | | | |
| (45)m= | 158.51 | 138.63 | 143.06 | 124.72 | 119.67 | 103.27 | 95.69 | 109.81 | 111.12 | 129.5 | 141.36 | 153.51 | | | |
| | | | | | | <i>.</i> | | | | Total = Su | m(45) ₁₁₂ = | = | 1528.86 | (45) | |
| it instan | taneous v | vater neati | ng at point I | t of use (no | o not water | r storage), | enter 0 in | boxes (46) |) to (61) | · · · · · · | | | 1 | | |
| (46)m= | 23.78 | 20.8 | 21.46 | 18.71 | 17.95 | 15.49 | 14.35 | 16.47 | 16.67 | 19.43 | 21.2 | 23.03 | | (46) | |
| Stores | storage | IOSS: | includir | | olor or M | | otorogo | within or | mayoa | | | | 1 | (47) | |
| Siorag | | | | ig any so | | | | | ame ves | Sei | | 0 | J | (47) | |
| Othory | munity r | neating a | and no ta | INK IN AW | /eiling, e | nter 110 | iltres in | (47) mbi boil | ore) onto | or 'O' in (| (17) | | | | |
| Water | storane | | not wate | 51 (1115 11 | iciuues i | nstantai | | | | | 47) | | | | |
| a) If m | nanufact | turer's de | eclared I | oss facto | or is kno | wn (kWł | n/dav): | | | | | 0 | 1 | (48) | |
| Tempe | erature f | actor fro | m Table | 2b | | , | , , , , , , , , , , , , , , , , , , , | | | | | 0 |] | (49) | |
| Energy | / lost fro | m water | storage | _~ k\//b/\/ | ar | | | $(48) \times (49)$ | _ | | | 0 |] | (50) | |
| b) If m | nanufac | turer's de | eclared of | cylinder l | loss fact | or is not | known: | (40) X (40) | _ | | | 0 | J | (50) | |
| Hot wa | ater stor | age loss | factor fr | om Tabl | e 2 (kW | h/litre/da | ıy) | | | | | 0 |] | (51) | |
| If com | munity ł | neating s | ee secti | on 4.3 | | | | | | | | | | | |
| Volum | e factor | from Ta | ble 2a | | | | | | | | | 0 | ļ | (52) | |
| Tempe | erature f | actor fro | m Table | 2b | | | | | | | | 0 | J | (53) | |

| | 1 | | | 1.1.4/1./ | | | | (| (50) (| | | | 1 | |
|------------|---------------|-----------------|------------------|---------------|----------------|----------------|------------------|------------------|-----------------|--------------|-------------|---------------|---------------|------|
| Energy | y lost fro | om watei | r storage | , KVVN/y | ear | | | (47) X (51 |) x (52) x (| 53) = | | 0 | | (54) |
| | (50) 01 | (34) 11 (3 | | (| | | | ((50) | | | | 0 | l | (55) |
| vvater | storage | | | ior each | month | 1 | | ((00))) = (| 55) × (41) | n | | 1 | I | |
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (56) |
| If cylinde | er contain | s dedicate | d solar sto | rage, (57) | m = (56)m - | x [(50) – (| (H11)] ÷ (5 - | 0), else (5 | 7)m = (56) - | m where (| H11) is fro | m Append | ix H | |
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (57) |
| Primar | y circuit | loss (ar | nnual) fro | om Table | e 3 | | | | | | | 0 | | (58) |
| Primar | y circuit | loss cal | lculated | for each | month (| 59)m = | (58) ÷ 36 | 65 × (41) | m | | | | ' | |
| (mo | dified by | / factor f | rom Tab | le H5 if t | there is s | solar wa | ter heati | ng and a | a cylinde | r thermo | stat) | - | | |
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (59) |
| Combi | loss ca | lculated | for each | month | (61)m = | (60) ÷ 30 | 65 × (41 |)m | | | | | | |
| (61)m= | 12.78 | 11.52 | 12.71 | 12.21 | 12.56 | 12.09 | 12.45 | 12.52 | 12.16 | 12.65 | 12.31 | 12.76 | | (61) |
| Total h | heat req | uired for | water h | eating ca | alculated | l for eac | h month | (62)m = | : 0.85 × (| 45)m + | (46)m + | (57)m + | (59)m + (61)m | |
| (62)m= | 171.29 | 150.16 | 155.76 | 136.94 | 132.24 | 115.36 | 108.14 | 122.33 | 123.28 | 142.15 | 153.67 | 166.27 | | (62) |
| Solar DI | HW input | L calculated | using App | endix G o | r Appendix | H (negati | ve quantity | /) (enter '0 | if no sola | r contributi | on to wate | r heating) | 1 | |
| (add a | dditiona | I lines if | FGHRS | and/or \ | WWHRS | applies | , see Ap | pendix (| G) | | | | | |
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (63) |
| Output | t from w | ater hea | ter | | | | | | | | | | 1 | |
| (64)m= | 171.29 | 150.16 | 155.76 | 136.94 | 132.24 | 115.36 | 108.14 | 122.33 | 123.28 | 142.15 | 153.67 | 166.27 | | |
| | | 1 | 1 | | 1 | 1 | 1 | Out | Dut from wa | ater heatei | ∙ (annual)₁ | 12 | 1677.58 | (64) |
| Heat o | ains fro | m water | heating. | kWh/m | onth 0.2 | 5 ´ [0.85 | × (45)m | ı + (61)n | nl + 0.8 x | (46)m | + (57)m | + (59)m | 1 | |
| (65)m= | 55.9 | 48.98 | 50.74 | 44.52 | 42.93 | 37.36 | 34.93 | 39.64 | 39.99 | 46.22 | 50.08 | 54.23 | 1 | (65) |
| inclu | L | l m in calı | L | L of (65)m | I only if c | l vlinder i | l s in the (| l | I or bot w | ater is fr | | I munity h | l | |
| 5 10 | | | | |). | ymraer r | | awening | or not w | | | indiney i | cating | |
| 5. 11 | iemai ya | | |) and 5a |). | | | | | | | | | |
| Metab | olic gair | is (Table | <u>e 5), Wat</u> | ts Anr | Max | lun | L 1. 1 | A.1.9 | San | Oct | Nov | | 1 | |
| (66)m- | Jan 122.57 | 122.57 | 122.57 | Api 122.57 | 122.57 | 122.57 | Jui 122.57 | Aug | 3ep | 122.57 | 122.57 | 122.57 | | (66) |
| (00)11= | 132.37 | (| 132.57 | 132.37 | 132.37 | 132.57 | 132.37 | 132.37 | Table 5 | 132.37 | 132.37 | 132.37 | İ | (00) |
| Lightin | ig gains | | ted in Ap | | L, equat | | r L9a), a I | Iso see | Table 5 | 47.07 | 00.05 | 00.00 | I | (67) |
| (67)m= | 21.63 | 19.21 | 15.62 | 11.83 | 8.84 | 7.46 | 8.07 | 10.48 | 14.07 | 17.87 | 20.85 | 22.23 | | (07) |
| Applia | nces ga | ins (calc | ulated in | n Appeno | dix L, eq | uation L | 13 or L1 | 3a), also I | o see Ta | ble 5 | | | I | (00) |
| (68)m= | 242.6 | 245.12 | 238.78 | 225.27 | 208.22 | 192.2 | 181.49 | 178.98 | 185.32 | 198.83 | 215.87 | 231.9 | | (68) |
| Cookir | ng gains | calcula | ated in A | ppendix | L, equa | tion L15 | or L15a) |), also se | ee Table | 5 | | | 1 | |
| (69)m= | 36.26 | 36.26 | 36.26 | 36.26 | 36.26 | 36.26 | 36.26 | 36.26 | 36.26 | 36.26 | 36.26 | 36.26 | | (69) |
| Pumps | s and fa | ns gains | (Table & | 5a) | | | | | - | | | - | | |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | | (70) |
| Losses | s e.g. ev | vaporatio | on (nega | tive valu | es) (Tab | ole 5) | | | | | | | | |
| (71)m= | -106.05 | -106.05 | -106.05 | -106.05 | -106.05 | -106.05 | -106.05 | -106.05 | -106.05 | -106.05 | -106.05 | -106.05 | | (71) |
| Water | heating | gains (1 | Table 5) | | | | | | | | | | | |
| (72)m= | 75.13 | 72.88 | 68.2 | 61.84 | 57.7 | 51.89 | 46.95 | 53.28 | 55.54 | 62.12 | 69.56 | 72.89 | | (72) |
| Total i | internal | gains = | : | • | | . (66) |)m + (67)m | • n + (68)m · | • + (69)m + | (70)m + (7 | 1)m + (72) |)m | 1 | |
| (73)m= | 405.13 | 402.98 | 388.37 | 364.71 | 340.54 | 317.32 | 302.28 | 308.51 | 320.7 | 344.59 | 372.05 | 392.79 | | (73) |
| 6. So | lar gains | s: | | 1 | <u> </u> | | <u> </u> | 1 | 1 | | | | | |

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 | 0.3 | x | 21.89 | × | 11.28 | × | 0.63 | x | 0.7 |] = | 29.41 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 22.97 | × | 0.63 | x | 0.7 | = | 59.86 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | × | 41.38 | × | 0.63 | × | 0.7 | = | 107.85 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 67.96 | × | 0.63 | x | 0.7 | i = | 177.12 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 91.35 | x | 0.63 | x | 0.7 | i = | 238.09 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | × | 97.38 | × | 0.63 | × | 0.7 | i = | 253.83 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 91.1 | × | 0.63 | x | 0.7 | i = | 237.45 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | × | 72.63 | x | 0.63 | × | 0.7 | = | 189.3 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 50.42 | × | 0.63 | x | 0.7 | i = | 131.42 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | x | 28.07 | × | 0.63 | x | 0.7 | = | 73.16 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | × | 14.2 | x | 0.63 | × | 0.7 | = | 37 | (75) |
| Northeast 0.9x | 0.3 | x | 21.89 | × | 9.21 | × | 0.63 | × | 0.7 | = | 24.02 | (75) |
| Southwest0.9x | 0.77 | x | 7.24 | × | 36.79 | İ | 0.63 | × | 0.7 | = | 81.41 | (79) |
| Southwest0.9x | 0.77 | x | 7.24 | × | 62.67 | İ | 0.63 | × | 0.7 | = | 138.67 | (79) |
| Southwest0.9x | 0.77 | x | 7.24 | x | 85.75 | İ | 0.63 | x | 0.7 | i = | 189.74 | (79) |
| Southwest0.9x | 0.77 | x | 7.24 | × | 106.25 | İ | 0.63 | × | 0.7 | = | 235.1 | (79) |
| Southwest0.9x | 0.77 | x | 7.24 | × | 119.01 | İ | 0.63 | × | 0.7 | = | 263.33 | (79) |
| Southwest0.9x | 0.77 | x | 7.24 | x | 118.15 | İ | 0.63 | × | 0.7 | i = | 261.42 | (79) |
| Southwest0.9x | 0.77 | x | 7.24 | × | 113.91 | İ | 0.63 | x | 0.7 | = | 252.04 | (79) |
| Southwest0.9x | 0.77 | x | 7.24 | × | 104.39 | İ | 0.63 | x | 0.7 | = | 230.98 | (79) |
| Southwest0.9x | 0.77 | x | 7.24 | × | 92.85 | İ | 0.63 | × | 0.7 | = | 205.45 | (79) |
| Southwest0.9x | 0.77 | x | 7.24 | × | 69.27 | Ì | 0.63 | × | 0.7 | = | 153.26 | (79) |
| Southwest0.9x | 0.77 | x | 7.24 | × | 44.07 | Ì | 0.63 | x | 0.7 | = | 97.51 | (79) |
| Southwest0.9x | 0.77 | x | 7.24 | × | 31.49 | İ | 0.63 | × | 0.7 | = | 69.67 | – (79) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 26 | x | 0.63 | × | 0.8 | = | 36.8 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 54 | × | 0.63 | × | 0.8 |] = | 76.42 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 96 | × | 0.63 | × | 0.8 | = | 135.86 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 150 | x | 0.63 | × | 0.8 | = | 212.28 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 192 | x | 0.63 | × | 0.8 | = | 271.72 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 200 | × | 0.63 | × | 0.8 | = | 283.05 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | x | 189 | x | 0.63 | x | 0.8 | = | 267.48 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | x | 157 | × | 0.63 | x | 0.8 | = | 222.19 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 115 | × | 0.63 | × | 0.8 | = | 162.75 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 66 | × | 0.63 | × | 0.8 | = | 93.41 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | × | 33 | × | 0.63 | × | 0.8 | = | 46.7 | (82) |
| Rooflights 0.9x | 1 | x | 3.12 | x | 21 | × | 0.63 | x | 0.8 | i = | 29.72 | – (82) |

| Solar g | ains in | watts, ca | alculated | for eac | h month | | | (83)m = S | um(74)m . | (82)m | | | |
|---------|-----------|-----------|-----------|----------------------|-----------|---------|---------|-----------|-----------|--------|--------|--------|------|
| (83)m= | 147.62 | 274.96 | 433.45 | 624.5 | 773.14 | 798.3 | 756.97 | 642.47 | 499.62 | 319.82 | 181.22 | 123.41 | (83) |
| Total g | ains – ir | nternal a | ind solar | ⁻ (84)m = | = (73)m - | + (83)m | , watts | | | | | | |
| (84)m= | 552.75 | 677.94 | 821.82 | 989.21 | 1113.68 | 1115.62 | 1059.25 | 950.98 | 820.32 | 664.41 | 553.27 | 516.2 | (84) |

| 7. Me | an inter | nal temp | oerature | (heating | season |) | | | | | | | | |
|-------------------|----------------------|------------------------|------------|------------|-------------|-------------|-----------|----------------------|------------|-------------------|----------------------|--------------------|---------|-------------------|
| Temp | erature | during h | neating p | eriods ir | n the livir | ng area t | from Tab | ole 9, Th | 1 (°C) | | | | 21 | (85) |
| Utilisa | tion fac | tor for g | ains for | living are | ea, h1,m | (see Ta | ble 9a) | | | | | | | _ |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (86)m= | 1 | 0.99 | 0.99 | 0.96 | 0.9 | 0.77 | 0.64 | 0.7 | 0.9 | 0.98 | 1 | 1 | | (86) |
| Mean | internal | l temper | ature in | living are | ea T1 (fo | ollow ste | ps 3 to 7 | in Table | e 9c) | | | | | |
| (87)m= | 18.62 | 18.85 | 19.26 | 19.87 | 20.38 | 20.78 | 20.92 | 20.89 | 20.57 | 19.9 | 19.21 | 18.66 | | (87) |
| Temp | erature | durina h | eating p | eriods ir | n rest of | dwellina | from Ta | ble 9. Tl | n2 (°C) | | | | | |
| (88)m= | 19.23 | 19.25 | 19.26 | 19.33 | 19.34 | 19.41 | 19.41 | 19.42 | 19.38 | 19.34 | 19.32 | 19.29 | | (88) |
| ا د siliti | ution fac | tor for a | ains for | rest of du | velling | h2 m (sc | n Tahla | (a) | | | | | | |
| (89)m= | 1 | 0.99 | 0.98 | 0.94 | 0.85 | 0.65 | 0.44 | 9 a) 0.51 | 0.82 | 0.97 | 0.99 | 1 | | (89) |
| ` l | intornol | | | | | L | | | 7 in Tabl | | | | | |
| | 16 10 | 16.53 | ature in | | OF OWEIII | ng 12 (f | | 10 38 | | e 9C) | 17.00 | 16.27 | | (90) |
| (30)11- | 10.13 | 10.55 | 17.15 | 10.00 | 10.70 | 19.27 | 19.00 | 19.50 | 13.04 | LA = Livin | $q area \div (4$ | 10.27 | 0.41 | (00) – (91) |
| | | | | | | | | | | | 9 4.04 . (| ., | 0.41 | |
| Mean | interna | temper | ature (fo | or the wh | ole dwe | lling) = fl | LA × T1 | + (1 – fL | .A) × T2 | 10.05 | | | | (00) |
| (92)m= | 17.19 | 17.49 | 18.01 | 18.8 | 19.43 | 19.89 | 20.02 | 20 | 19.67 | 18.85 | 17.96 | 17.26 | | (92) |
| Apply | adjustn | | he mear | | tempera | ature fro | m Table | 4e, whe | ere appro | | 17.00 | 17.00 | | (03) |
| (93)m= | 17.19 | ting rogu | uiromont | 10.0 | 19.43 | 19.69 | 20.02 | 20 | 19.07 | 10.00 | 17.90 | 17.20 | | (33) |
| Sot Ti | to the r | mean int | arnal to | moratu | e obtain | od at st | on 11 of | Tahla Ok | n so tha | t Ti m-(' | 76)m an | d ro-calc | ulata | |
| the ut | ilisation | factor fo | or gains | using Ta | ible 9a | | 50 11 01 | | , so ina | u 11,111–(| r ojin an | | ulate | |
| [| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Utilisa | tion fac | tor for g | ains, hm | 1: | | | | | | | | | | |
| (94)m= | 0.99 | 0.99 | 0.97 | 0.93 | 0.85 | 0.69 | 0.52 | 0.59 | 0.84 | 0.96 | 0.99 | 1 | | (94) |
| Usefu | l gains, | hmGm | , W = (94 | 4)m x (84 | 4)m | | | | | | | | | |
| (95)m= | 549.25 | 669.73 | 800.17 | 924.86 | 947.02 | 775.19 | 554.98 | 562.3 | 687.51 | 639.32 | 547.57 | 513.67 | | (95) |
| Month | nly avera | age exte | rnal tem | perature | e from Ta | able 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 I | oss rate | e for mea | an intern | al tempe | erature, | Lm , W = | =[(39)m : | x [(93)m | – (96)m | 4500.05 | 0004.00 | 0.400.04 | | (07) |
| (97)m= [| 2552.06 | 2466.62 | 2232.57 | 1823.15 | 1408.87 | 918.30 | 593.13 | 619.35 | 985.46 | 1502.95 | 2021.02 | 2480.21 | | (97) |
| (98)m= | 1490 09 | 1207 51 | 1065.7 | 646 77 | 343.62 | | 11 = 0.02 | 4 X [(97) | 0 |)111] X (4 | 1060.88 | 1463 11 | | |
| (00) | 1100.00 | 1201.01 | 1000.1 | 010.11 | 010.02 | Ů | Ŭ | Tota | l per vear | (kWb/year | r = Sum(9) | 8), | 7920 23 | (98) |
| Snoor | haatin | a roquir | | 14\1/b/m2 | hicor | | | , ota | i poi you | (norm your |) – Cu iii(0) | G)15,912 — | 00.45 | |
| Space | e neaung | grequire | ementin | KVVII/III- | year | | | | | | | | 86.15 | (99) |
| 9a. Ene | ergy req | luiremer | nts – Indi | ividual h | eating sy | ystems i | ncluding | micro-C | (HP) | | | | | |
| Space Fraction | e heatir on of sp | ig: bace hea | at from s | econdar | y/supple | mentary | system | | | | | | 0 | (201) |
| Fraction | on of sp | ace hea | at from m | nain syst | em(s) | | | (202) = 1 - | - (201) = | | | | 1 | (202) |
| Fracti | on of to | tal heatii | ng from | main sys | stem 1 | | | (204) = (20 | 02) × [1 – | (203)] = | | | 1 | (204) |
| Efficie | ency of r | nain spa | ace heat | ing syste | em 1 | | | | | | | | 93.2 | (206) |
| Efficie | ency of s | seconda | ry/suppl | ementar | y heating | g system | n, % | | | | | | 0 | (208) |
| | | | | | | | | | | | | | | |

| | lan | F ab | Max | A | Mari | L. us | | A | 0.00 | Ort | New | Dee | | |
|----------------|------------------------------|---------------|--------------------------|------------|-----------|------------|------------------------|-------------|-------------|-----------------------|-------------------------|---------|--------------------------------|-------------------------|
| Space | Jan e heatin | require | ement (c | alculate | d above | Jun | Jui | Aug | Sep | Oct | INOV | Dec | Kvvn/yea | ar |
| Opuol | 1490.09 | 1207.51 | 1065.7 | 646.77 | 343.62 | 0 | 0 | 0 | 0 | 642.54 | 1060.88 | 1463.11 | | |
| (211)m | n = {[(98 |)m x (20 |)4)]}x 1 | 100 ÷ (20 | | | | | | | | | 1 | (211) |
| . , | 1598.81 | 1295.62 | 1143.46 | 693.95 | 368.69 | 0 | 0 | 0 | 0 | 689.42 | 1138.29 | 1569.86 | | |
| | | | | - | | | | Tota | al (kWh/yea | ar) =Sum(2 | 211) _{15,1012} | | 8498.1 | (211) |
| Space | e heatin | g fuel (s | econdar | y), kWh/ | month | | | | | | | | | |
| $= \{[(98)]$ |)m x (20 | 01)]}x1 | $\frac{00 \div (20)}{0}$ |)8) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |] | |
| (210)11- | Ū | 0 | Ů | Ů | Ů | Ů | Ů | Tota | l (kWh/yea | ar) =Sum(2 | 215) _{15 1012} | = | 0 | (215) |
| Water | heating | 1 | | | | | | | | | | | |], , |
| Output | from w | , ater hea | ter (calc | ulated a | bove) | | | | | | | | 1 | |
| | 171.29 | 150.16 | 155.76 | 136.94 | 132.24 | 115.36 | 108.14 | 122.33 | 123.28 | 142.15 | 153.67 | 166.27 | | - |
| Efficier | ncy of w | ater hea | ater | 00.00 | 00.07 | 07.0 | 07.0 | 07.0 | 07.0 | 00.00 | 00.00 | 00.0 | 87.3 | (216) |
| (217)m= | 89.89 | 89.87 | 89.82 | 89.68 | 89.37 | 87.3 | 87.3 | 87.3 | 87.3 | 89.66 | 89.82 | 89.9 | | (217) |
| (219)m | 1 = (64) | m x 100 | $2 \div (217)$ | <u>)</u> m | - | - | | - | - | - | - | | | |
| (219)m= | 190.55 | 167.08 | 173.42 | 152.69 | 147.96 | 132.14 | 123.88 | 140.13 | 141.21 | 158.54 | 171.09 | 184.95 | | - |
| _ | | | | | | | | Tota | al = Sum(2) | 19a) ₁₁₂ = | | | 1883.64 | (219) |
| Annua Space | l i totals beating | fueluse | ed main | system | 1 | | | | | k | Wh/year | , | kWh/year | T |
| Water | heating | fueluse | d | oyotom | | | | | | | | | 1002.04 |] T |
| | | | u ana and | alaatria | liaan ha | | | | | | | | 1003.04 | |
| Electric | ity for p | umps, i | ans and | electric | кеер-по | ι | | | | | | | 1 | |
| centra | al heatin | g pump | : | | | | | | | | | 30 | | (230c) |
| boiler | with a f | an-assis | sted flue | | | | | | | | | 45 | | (230e) _ |
| Total e | lectricity | / for the | above, l | kWh/yea | ır | | | sum | of (230a). | (230g) = | | | 75 | (231) |
| Electric | city for li | ghting | | | | | | | | | | | 381.96 | (232) |
| 12a. (| CO2 em | issions · | – Individ | lual heat | ing syste | ems incl | uding mi | cro-CHF |) | | | | | |
| | | | | | | En kV | ergy /h/year | | | Emiss kg CO | ion fac 2/kWh | tor | Emissions kg CO2/yea | ır |
| Space | heating | (main s | system 1 |) | | (21 | 1) x | | | 0.2 | 16 | = | 1835.59 | (261) |
| Space | heating | (second | dary) | | | (21 | 5) x | | | 0.5 | 19 | = | 0 | (263) |
| Water | heating | | | | | (21 | 9) x | | | 0.2 | 16 | = | 406.87 | _](264) |
| Space | and wa | ter heati | ing | | | (26 | 1) + (262) | + (263) + (| (264) = | L | | | 2242.46 | (265) |
| Electric | city for p | oumps, f | ans and | electric | keep-ho | t (23 | 1) x | | | 0.5 | 19 | = | 38.93 |] (267) |
| Electric | city for li | ahtina | | | | (23) | 2) x | | | 0.5 | 10 | = | 108.24 | $\frac{1}{268}$ |
| Total C | CO2 ka/ | vear | | | | x - | | | sum a | of (265)(2 | 271) = | | 2470.62 |](272) |
| Dwelli | | Fmicei | on Rate | ` | | | | | (272) | ÷ (4) = | , | | 2413.02 | $\int_{(272)}^{(-1/2)}$ |
| El rotia | | on 14) | | • | | | | | () | - 17 | | | 20.97 | $\int_{1}^{(273)}$ |
| | iy (secti | 011 14) | | | | | | | | | | | 76 | (274) |

| | | | User D | etails: | | | | | | |
|--|--|---------------------|------------------|--------------|--------------|-------------------|----------|-----------|-------------------------|-------|
| Assessor Name: | George Farr | | | Strom | a Num | ber: | | STRO | 028460 | |
| Software Name: | Stroma FSAP 20 | 12 | | Softwa | are Ver | sion: | | Versio | on: 1.0.4.6 | |
| | | P | roperty <i>i</i> | Address: | Flat 3 | | | | | |
| Address : | | | | | | | | | | |
| 1. Overall dwelling dimen | isions: | | | | | | | | | |
| 0 | | | Area | a(m²) | | Av. Hei | ight(m) | - | Volume(m ³) | - |
| Ground floor | | | 7 | 6.27 | (1a) x | 2. | .35 | (2a) = | 179.23 | (3a) |
| Total floor area TFA = (1a |)+(1b)+(1c)+(1d)+(1 | e)+(1r | I) 7 | 6.27 | (4) | | | | | |
| Dwelling volume | | | | | (3a)+(3b) | +(3c)+(3d |)+(3e)+ | .(3n) = | 179.23 | (5) |
| 2. Ventilation rate: | | | | | | | | | | |
| | main heating | secondar heating | у | other | | total | | | m ³ per hour | |
| Number of chimneys | 0 + | 0 | + [| 0 |] = [| 0 | x 4 | 40 = | 0 | (6a) |
| Number of open flues | 0 + | 0 | <u> </u> + [| 0 |] = [| 0 | x2 | 20 = | 0 | (6b) |
| Number of intermittent fan | s | | | | - | 3 | × | 10 = | 30 | (7a) |
| Number of passive vents | | | | | | 0 | x | 10 = | 0 | (7b) |
| Number of flueless gas fire | es | | | | Г | 0 | x 4 | 40 = | 0 | (7c) |
| | | | | | | | | Air ch | anges per hou | |
| Infiltration due to obimpour | | (6a) (6b) (7 | 'a) (7b) ((| 70) - | – | | | | | |
| In Intration due to chimney | s, nues and rans = en carried out or is inten | ded, procee | d to (17), c | otherwise c | continue fro | 30 om (9) to (| · 16) | ÷ (5) = | 0.17 | (8) |
| Number of storeys in the | e dwelling (ns) | | ()/ | | | | , | | 0 | (9) |
| Additional infiltration | | | | | | | [(9) | -1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.2 | 25 for steel or timbe | r frame or | 0.35 for | masonr | y constr | uction | | | 0 | (11) |
| if both types of wall are pre | sent, use the value corre | esponding to | the great | er wall area | a (after | | | | | |
| If suspended wooden flo | or. enter 0.2 (unse | aled) or 0. | 1 (seale | d). else | enter 0 | | | | 0 | 7(12) |
| If no draught lobby, ente | er 0.05, else enter 0 | , | (| .,, | | | | | 0 | (13) |
| Percentage of windows | and doors draught | stripped | | | | | | | 0 | (14) |
| Window infiltration | - | | | 0.25 - [0.2 | x (14) ÷ 1 | = [00 | | | 0 | (15) |
| Infiltration rate | | | | (8) + (10) - | + (11) + (1 | 2) + (13) + | + (15) = | | 0 | (16) |
| Air permeability value, c | 50, expressed in cu | ubic metre | s per ho | our per so | quare m | etre of e | nvelope | area | 15 | (17) |
| If based on air permeabilit | y value, then (18) = [| (17) ÷ 20]+(8 | 3), otherwi | se (18) = (| 16) | | | | 0.92 | (18) |
| Air permeability value applies | if a pressurisation test h | as been dor | e or a deg | gree air pei | rmeability i | is being us | sed | | | - |
| Number of sides sheltered | | | | (20) = 1 - 1 | 0.075 x (1 | 9)] = | | | 0 | (19) |
| Infiltration rate incorporation | ng shelter factor | | | (21) = (18) | x(20) = | -/] | | | 0.02 | (20) |
| Infiltration rate modified fo | r monthly wind spec | he | | () () | , (=0) | | | | 0.92 | (21) |
| Jan Feb N | Mar Apr Ma | / Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Monthly average wind spe | ed from Table 7 | I | | | · | | | | | |
| (22)m= 5.1 5 4 | .9 4.4 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 | | |
| | | 1 | | | | | | | I | |
| VVIND Factor (22a)m = (22) (22a)m 1.27 1.25 1 |)m÷4 | 0.05 | 0.05 | 0.02 | 1 | 1.02 | 1 1 2 | 1 1 2 | l | |
| | .23 1.1 1.08 | 0.95 | 0.90 | 0.92 | I | 1.00 | 1.12 | 1.10 | | |

| Adjuste | ed infiltr | ation rat | e (allowi | ing for sh | elter an | d wind s | speed) = | : (21a) x | (22a)m | | | | _ | |
|-------------------------------|------------------------------|------------------------|-------------------|---------------|------------------|----------------|-----------------|----------------|---------------|---------------|------------------|-------------------|-------------------------------------|---------------|
| | 1.17 | 1.15 | 1.12 | 1.01 | 0.99 | 0.87 | 0.87 | 0.85 | 0.92 | 0.99 | 1.03 | 1.08 | | |
| Calcula If me | ate ette | ctive air | change | rate for t | he appli | cable ca | Se | | | | | | | (232) |
| lf exha | aust air h | eat pump | usina App | endix N. (2 | 3b) = (23a |) × Fmv (e | equation (| N5)) . othe | rwise (23b | (23a) = (23a) | | | 0 | (23b) |
| lf bala | nced wit | n heat reco | overy: effic | iency in % | allowing f | or in-use f | actor (fron | n Table 4h | i) = | / (/ | | | 0 | (23c) |
| a) If I | halance | n mech | anical ve | entilation | with he | at recove | erv (MV | HR) (24: | ′ a)m – (2 | 2h)m + (| (23h) x [| 1 – (23c) | $\downarrow 0$ $\downarrow 1001$ | (200) |
| (24a)m= | 0 | | | | 0 | 0 | | | | | | |] | (24a) |
| b) If I | halance | d mech | anical ve | entilation | without | heat rec | covery (I | 1 MV/) (24h | 1 = (2) | 1 2h)m + (| (23b) | |] | |
| (24b)m= | 0 | 0 | | 0 | 0 | 0 | | | | 0 | 0 | 0 |] | (24b) |
| c) If y | whole h | I IOUSE EX | I tract ver | ntilation c | or positiv | re input v | I ventilatio | I on from (| L outside | | | |] | |
| il | f (22b)r | n < 0.5 > | < (23b), 1 | then (24c | c) = (23b |); other | wise (24 | c) = (22 | b) m + 0 | .5 × (23ł | c) | | | |
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |] | (24c) |
| d) If i | natural | ventilati | on or wh | ole hous | e positiv | e input | ventilati | on from | loft | | | | | |
| it r | f (22b)r | n = 1, th | en (24d) | m = (22t |)m othe | rwise (2 | 24d)m = | 0.5 + [(2 | 2b)m² x | 0.5] | - | | 1 | |
| (24d)m= | 1.17 | 1.15 | 1.12 | 1.01 | 0.99 | 0.88 | 0.88 | 0.86 | 0.92 | 0.99 | 1.03 | 1.08 |] | (24d) |
| Effec | tive air | change | rate - er | nter (24a |) or (24b | o) or (24 | c) or (24 | ld) in bo | x (25) | | | i | 1 | |
| (25)m= | 1.17 | 1.15 | 1.12 | 1.01 | 0.99 | 0.88 | 0.88 | 0.86 | 0.92 | 0.99 | 1.03 | 1.08 |] | (25) |
| 3. Hea | at losse | s and he | eat loss | paramete | er: | | | | | | | | | |
| ELEM | IENT | Gros area | ss (m²) | Openin m | gs ² | Net Ar A ,r | rea m² | U-val W/m2 | ue 2K | A X U (W/ | K) | k-value kJ/m²⊷ | э К | A X k kJ/K |
| Doors | | | | | | 1.89 | x | 1.4 | = | 2.646 | | | | (26) |
| Window | vs Type | e 1 | | | | 8.14 | | /[1/(1.4)+ | 0.04] = | 10.79 | | | | (27) |
| Window | vs Type | e 2 | | | | 12.82 | <u></u> | /[1/(1.4)+ | 0.04] = | 17 | | | | (27) |
| Floor | | | | | | 5.62 | x | 0.14 | = | 0.7868 | 3] [| | | (28) |
| Walls T | ype1 | 49.9 | 96 | 20.96 | 3 | 29 | × | 0.25 | | 7.25 | = i | | \dashv | (29) |
| Walls T | ype2 | 24.4 | 17 | 1.89 | = | 22.58 | 3 × | 0.2 | | 4.54 | = 1 | | \dashv | (29) |
| Roof | 51 | 13.3 | 31 | | | 13.31 | | 0.14 | | 1.86 | | | \dashv | (30) |
| Total a | rea of e | elements | 5. m ² | | | 93.36 | | | | | L | | | (31) |
| Party w | all | | , | | | 51.46 | | 0 | | 0 | | | | (32) |
| Party fl | oor | | | | | 70.66 | | | | 0 | L | | \dashv | (32a) |
| Party c | eilina | | | | | 62.07 | 7 | | | | L | | \dashv | (32b) |
| * for wind | dows and | l roof wind | ows, use e | effective wi | ndow U-va | alue calcul | lated using | g formula 1 | 1/[(1/U-valu | ue)+0.04] a | L as given in | paragraph | L h 3.2 | (320) |
| ** include | e the area | as on both | sides of ir | nternal wall | s and part | itions | | (00) (00) |) . (00) | | | | | |
| Fabric | heat los | ss, W/K | = S (A x | U) | | | | (26)(30 |) + (32) = | (0.0) (0 | | (22.) | 44.87 | , (33) |
| Heat ca | apacity | Cm = Si | (AXK) | | TC A \ '. | 1.1/ | | | ((28). | (30) + (3 | 2) + (32a). | (32e) = | 10474. | 79 (34) |
| Inerma | al mass | parame | eter (1M | $- = Cm \div$ | • IFA) In | i кJ/m²K | 4 l/no | rooioch - 4- | Indica | ative Value | | abla df | 250 | (35) |
| ror desig | yn asses sed inste | ad of a de | tailed calc | ulation. | constructi | un are noi | ı known pi | ecisely the | ə indicative | e values oi | пирів Га | adie 11 | | |
| Therma | al bridg | es : S (L | x Y) cal | culated u | using Ap | pendix I | K | | | | | | 14 | (36) |
| <i>if details</i> Total fa | <i>of therma</i> abric he | al bridging at loss | are not kr | nown (36) = | : 0.15 x (3 | 1) | | | (33) + | - (36) = | | | 58.86 | 3 (37) |
| | | | | | | | | | | | | | L | ` ′ |

| Ventila | ation hea | at loss ca | alculated | d monthl | у | | | | (38)m | = 0.33 × (| (25)m x (5) | | | |
|---|--|--|--|---|--|--|--|--------------------------------------|---|---------------------------|---------------------------------------|-------------|---------|--------------|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (38)m= | 69.18 | 67.83 | 66.47 | 59.69 | 58.34 | 52.04 | 52.04 | 50.87 | 54.46 | 58.34 | 61.04 | 63.76 | | (38) |
| Heat t | ransfer o | coefficie | nt, W/K | | | | | | (39)m | = (37) + (| 38)m | | | |
| (39)m= | 128.06 | 126.7 | 125.35 | 118.56 | 117.21 | 110.91 | 110.91 | 109.75 | 113.34 | 117.21 | 119.92 | 122.63 | | |
| Heat lo | oss para | meter (H | HLP). W | /m²K | | | | | (40)m | Average = = (39)m ÷ | - Sum(39)₁. - (4) | 12 /12= | 118.38 | (39) |
| (40)m= | 1.68 | 1.66 | 1.64 | 1.55 | 1.54 | 1.45 | 1.45 | 1.44 | 1.49 | 1.54 | 1.57 | 1.61 | | |
| Numb | er of day | vs in mo | nth (Tab | le 1a) | 1 | 1 | 1 | 1 | | Average = | Sum(40)1. | 12 /12= | 1.55 | (40) |
| | 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) |
| | | | 1 | | | | 1 | | | | | | | |
| 4. Wa | ater heat | ting ene | rgy requ | irement: | | | | | | | | kWh/ye | ear: | |
| Assum if TF if TF Annua Reduce not mor | The docculor $A > 13.9$ The factor $A \ge 13.9$ The factor $A \ge 13.9$ The annual state of the annual state of the annual state of the st | ipancy, I 9, N = 1 9, N = 1 ie hot wa al average litres per j | N + 1.76 > ater usay hot water person pe | c [1 - exp ge in litre usage by r day (all w | (-0.0003 es per da 5% if the c vater use, l | 349 x (TF ay Vd,av Iwelling is hot and co | FA -13.9 erage = designed i ld) |)2)] + 0.((25 x N) to achieve | 0013 x (⁻ + 36 a water us | TFA -13. se target o | 2. .9) | 39 0.92 | | (42) (43) |
| | Jan | Feb | Mar | Apr | Mav | Jun | Jul | Aua | Sep | Oct | Nov | Dec | | |
| Hot wat | er usage ii | n litres per | r day for e | ach month | Vd,m = fa | ctor from | Table 1c x | (43) | | | | - • • | | |
| (44)m= | 100.01 | 96.38 | 92.74 | 89.1 | 85.47 | 81.83 | 81.83 | 85.47 | 89.1 | 92.74 | 96.38 | 100.01 | | |
| Energy | content of | hot water | used - ca | lculated m | onthly = 4. | 190 x Vd,r | m x nm x D |) DTm / 3600 |) kWh/mor | Total = Su hth (see Ta | m(44) ₁₁₂ = ables 1b, 1 | - c, 1d) | 1091.06 | (44) |
| (45)m= | 148.32 | 129.72 | 133.86 | 116.7 | 111.98 | 96.63 | 89.54 | 102.75 | 103.98 | 121.17 | 132.27 | 143.64 | | |
| lf instan | taneous w | ater heati | ng at poin | t of use (no | hot wate | r storage), | enter 0 in | boxes (46 |) to (61) | Total = Su | m(45) ₁₁₂ = | - | 1430.55 | (45) |
| (46)m= | 22.25 | 19.46 | 20.08 | 17.51 | 16.8 | 14.49 | 13.43 | 15.41 | 15.6 | 18.18 | 19.84 | 21.55 | | (46) |
| Water | storage | loss: | I | I | I | I | I | I | | | | | | |
| Storag | je volum | e (litres) |) includir | ng any s | olar or W | /WHRS | storage | within sa | ame ves | sel | | 0 | | (47) |
| If com Otherv Water | munity h vise if no storage | eating a stored | and no ta hot wate | ank in dw er (this ir | velling, e ncludes i | nter 110 nstantar |) litres in neous co | i (47) ombi boil | ers) ente | er '0' in (| (47) | | | |
| a) If n | nanufact | urer's de | eclared | loss fact | or is kno | wn (kWł | n/day): | | | | | 0 | | (48) |
| Tempe | erature f | actor fro | m Table | e 2b | | , | • / | | | | | 0 | | (49) |
| Energy | y lost fro | m water | storage | e, kWh/ye | ear loss fact | or is not | known: | (48) x (49) |) = | | | 0 | | (50) |
| Hot wa | ater stora | age loss | factor f | rom Tab | le 2 (kW | h/litre/da | ay) | | | | | 0 | | (51) |
| If com | munity h | eating s | ee secti | on 4.3 | | | | | | | | | | |
| Volum | e factor | from Ta | ble 2a | 0 | | | | | | | | 0 | | (52) |
| Tempe | erature f | actor fro | m Table | e 2b | | | | | | | | 0 | | (53) |
| Energy | y lost fro | m water | storage | e, kWh/y | ear | | | (47) x (51) | x (52) x (| 53) = | | 0 | | (54) |
| | (SU) OF (| (04) III (0 | oulotod | for oash | month | | | ((56)~ (| 55) - (AA) | m | | 0 | | (55) |
| vvater | siorage | | | | | | | ((oo))) = (| 55) × (41) | | | | | |
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (56) |

| If cylinde | er contair | ns dedicated | d solar sto | rage, (57)r | m = (56)m | x [(50) – (| H11)] ÷ (5 | 0), else (57 | 7)m = (56) | m where (| H11) is fro | m Append | ix 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) | |
| Primar | Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$ | | | | | | | | | | | | | | |
| (mod | dified b | y factor fr | om Tab | le H5 if t | here is s | olar wat | er heatir | ng and a | cylinde | r thermo | stat) | | | | |
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (59) | |
| Combi | loss ca | alculated | for each | month (| (61)m = | (60) ÷ 36 | 65 × (41) |)m | | | | | | | |
| (61)m= | 12.73 | 11.46 | 12.63 | 12.15 | 12.5 | 12.04 | 12.4 | 12.47 | 12.1 | 12.58 | 12.25 | 12.71 | | (61) | |
| Total h | eat rec | uired for | water h | eating ca | alculated | for eacl | n month | (62)m = | 0.85 × | (45)m + | (46)m + | (57)m + | (59)m + (61)m | | |
| (62)m= | 161.05 | 141.18 | 146.49 | 128.85 | 124.48 | 108.67 | 101.94 | 115.22 | 116.08 | 133.75 | 144.52 | 156.35 | | (62) | |
| Solar DH | - IW input | calculated | using App | endix G or | Appendix | H (negativ | ve quantity | /) (enter '0' | ' if no sola | r contribut | ion to wate | er 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= | 161.05 | 141.18 | 146.49 | 128.85 | 124.48 | 108.67 | 101.94 | 115.22 | 116.08 | 133.75 | 144.52 | 156.35 | | _ | |
| | | | | | | | | Outp | out from w | ater heate | r (annual)₁ | 12 | 1578.59 | (64) | |
| Heat g | ains fro | om water | heating, | kWh/mo | onth 0.2 | 5 ´ [0.85 | × (45)m | + (61)m | n] + 0.8 x | x [(46)m | + (57)m | + (59)m |] | | |
| (65)m= | 52.5 | 46 | 47.67 | 41.84 | 40.36 | 35.14 | 32.87 | 37.28 | 37.6 | 43.43 | 47.04 | 50.94 | | (65) | |
| inclu | de (57 |)m in calc | culation | of (65)m | only if c | ylinder is | s in the c | dwelling | or hot w | ater is fr | om com | munity h | eating | | |
| 5. Int | ernal g | ains (see | Table 5 | 5 and 5a) |): | | | | | | | | | | |
| Metabo | olic gai | ns (Table | 5), Wat | ts | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | Мау | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | | |
| (66)m= | 119.41 | 119.41 | 119.41 | 119.41 | 119.41 | 119.41 | 119.41 | 119.41 | 119.41 | 119.41 | 119.41 | 119.41 | | (66) | |
| Lightin | g gains | (calculat | ted in Ap | opendix l | L, equati | ion L9 oı | [.] L9a), a | lso see - | Table 5 | | | | | | |
| (67)m= | 18.85 | 16.74 | 13.62 | 10.31 | 7.71 | 6.51 | 7.03 | 9.14 | 12.26 | 15.57 | 18.18 | 19.38 | | (67) | |
| Appliar | nces ga | ains (calc | ulated ir | Append | dix L, eq | uation L | 13 or L1 | 3a), also | see Ta | ble 5 | | _ | | | |
| (68)m= | 211.47 | 213.66 | 208.13 | 196.36 | 181.5 | 167.53 | 158.2 | 156.01 | 161.54 | 173.31 | 188.17 | 202.14 | | (68) | |
| Cookin | ig gain: | s (calcula | ted in A | ppendix | L, equat | ion L15 | or L15a) |), also se | e Table | 5 | - | | | | |
| (69)m= | 34.94 | 34.94 | 34.94 | 34.94 | 34.94 | 34.94 | 34.94 | 34.94 | 34.94 | 34.94 | 34.94 | 34.94 | | (69) | |
| Pumps | and fa | ins gains | (Table s | 5a) | | | | | | | | | | | |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | | (70) | |
| Losses | Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | | |
| (71)m= | -95.53 | -95.53 | -95.53 | -95.53 | -95.53 | -95.53 | -95.53 | -95.53 | -95.53 | -95.53 | -95.53 | -95.53 | | (71) | |
| Water | heating | gains (T | able 5) | | | | | | | | | | | | |
| (72)m= | 70.56 | 68.45 | 64.07 | 58.11 | 54.25 | 48.8 | 44.18 | 50.11 | 52.22 | 58.38 | 65.34 | 68.47 | | (72) | |
| Total i | nterna | l gains = | | | | (66) | m + (67)m | n + (68)m + | + (69)m + | (70)m + (7 | 1)m + (72) | m | | | |
| (73)m= | 362.71 | 360.68 | 347.64 | 326.61 | 305.28 | 284.67 | 271.24 | 277.08 | 287.85 | 309.09 | 333.51 | 351.8 | | (73) | |
| 6. Sol | lar gain | IS: | | | | | | | | | • | | | | |
| Solar g | ains are | calculated | using sola | r flux from | Table 6a a | and associ | ated equa | tions to co | nvert to th | ne applicat | le orientat | ion. | | | |
| Orienta | ation: | Access F Table 6d | actor | Area m² | | Flu Tat | x ble 6a | Т | g_ able 6b | Та | FF able 6c | | Gains (W) | | |

| Northea | ast <mark>0.9x</mark> | 0.77 | × | | 12.82 | | × | 11.28 | x | (| 0.63 | × | 0.7 | | = | 44.21 | (75) |
|---------------------------|--------------------------------|---|-----------------|----------------------|-------------|----------|--------------|-------------|-------------------|---------|--------|--------|--------|-----------|--------|--------|-------|
| Northea | ast 0.9x | 0.77 | × | Ē | 12.82 | | x | 22.97 | x | (| 0.63 | × | 0.7 | | = | 89.98 | (75) |
| Northea | ast <mark>0.9x</mark> | 0.77 | × | Ē | 12.82 | | × | 41.38 | x | (| 0.63 | × | 0.7 | | = | 162.12 | (75) |
| Northea | ast <mark>0.9x</mark> | 0.77 | x | | 12.82 | | × | 67.96 | x | (| 0.63 | × | 0.7 | | = | 266.25 | (75) |
| Northea | ast <mark>0.9x</mark> | 0.77 | × | Ē | 12.82 | | × | 91.35 | | (| 0.63 | × | 0.7 | | = | 357.89 | (75) |
| Northea | ast <mark>0.9x</mark> | 0.77 | | | 12.82 | | × | 97.38 | x | (| 0.63 | × | 0.7 | | = | 381.55 | (75) |
| Northea | theast 0.9x 0.77 | | x | Ē | 12.82 | | × | 91.1 | x | (| 0.63 | × | 0.7 | | = | 356.93 | (75) |
| Northea | ast 0.9x 0.77 | | x | | 12.82 | | × | 72.63 | x | (| 0.63 | × | 0.7 | | = | 284.55 | (75) |
| Northea | heast 0.9x 0.77 | | x | | 12.82 | | x | 50.42 | x | (| 0.63 | x | 0.7 | | = | 197.55 | (75) |
| Northea | neast 0.9x 0.77 | | × | | 12.82 | | x | 28.07 | x | (| 0.63 | × | 0.7 | | = | 109.97 | (75) |
| Northea | Northeast 0.9x 0.77 | | x | - | 12.82 | .82 × | | 14.2 | x | (| 0.63 | x | 0.7 | | = | 55.62 | (75) |
| Northea | ortheast 0.9x 0.77 | | x | | 12.82 | × | | 9.21 | x | (| 0.63 | × | 0.7 | | = | 36.1 | (75) |
| Southw | ithwest0.9x 0.77 | | x | | 8.14 | | × | 36.79 | | (| 0.63 | × | 0.7 | | = | 91.53 | (79) |
| Southw | outhwest0.9x 0.77 | | x | | 8.14 | x | | 62.67 | | (| 0.63 | × | 0.7 | | = | 155.91 | (79) |
| Southw | hwest _{0.9x} 0.77 | | x | | 8.14 | | × | 85.75 |] | (| 0.63 | × | 0.7 | | = | 213.33 | (79) |
| Southw | uthwest _{0.9x} 0.77 | | × | Ē | 8.14 | | × | 106.25 |] | 0.63 | | × | 0.7 | | = | 264.32 | (79) |
| Southw | uthwest _{0.9x} 0.77 | | x | Ē | 8.14 | | × | 119.01 | | (| 0.63 | × | 0.7 | | = | 296.06 | (79) |
| Southw | outhwest _{0.9x} 0.77 | | x | E | 8.14 | | x | 118.15 | | (| 0.63 | x | 0.7 | | = | 293.92 | (79) |
| Southw | Southwest _{0.9x} 0.77 | | x | | 8.14 | | × | 113.91 | | (| 0.63 | × | 0.7 | | = | 283.37 | (79) |
| Southw | outhwest _{0.9x} 0.77 | | x | | 8.14 | | × | 104.39 | | 0.63 | | × | 0.7 | | = | 259.69 | (79) |
| Southwest0.9x 0.77 | | x | Ē | 8.14 | | × | 92.85 |] | (| 0.63 | × | 0.7 | | = | 230.99 | (79) | |
| Southwest _{0.9x} | | 0.77 | × | Ē | 8.14 | | × | 69.27 | | (| 0.63 | × | 0.7 | | = | 172.32 | (79) |
| Southwest _{0.9x} | | 0.77 | × | Ē | 8.14 | | x | 44.07 |] | (| 0.63 | × | 0.7 | | = | 109.63 | (79) |
| Southwest0.9x | | 0.77 | x | | 8.14 | н х З | | 31.49 |] | (| 0.63 | × | 0.7 | | = | 78.33 | (79) |
| | | | | | | | | | | | | | | | | | |
| Solar g | ains in | watts, ca | alculate | d fo | or each m | nonth | | | (83)r | n = Sun | m(74)m | .(82)m | | 1 | | | |
| (83)m= | 135.74 | 245.89 | 375.45 | 375.45 530.57 653.95 | | 675. | 675.47 640.3 | | 544.24 428 | | 282.28 | 165.26 | 114.43 | | | (83) | |
| Total g | ains – i | is – internal and solar (84)m = (73)m + (| | | | | - (83) | m , watts | | | | | 1 | 77 466 04 | | | (0.4) |
| (84)m= | 498.45 | 606.58 | 723.09 | 1 | 357.18 95 | 59.23 | 960. | 14 911.54 | 821 | 1.32 | 716.38 | 591.37 | 498.77 | 466.2 | 24 | | (84) |
| 7. Me | an inter | nal temp | perature | (h | eating se | eason) |) | | | | | | | | | | _ |
| Temp | erature | during h | eating | per | riods in th | ne livir | ng are | ea from Ta | ble 9 |), Th1 | (°C) | | | | | 21 | (85) |
| Utilisa | ation fac | tor for g | ains for | livi | ing area, | h1,m | (see | Table 9a) | | | | | | | | | |
| | Jan | Feb | Mar | | Apr | May | Ju | n Jul | A | ug | Sep | Oct | Nov | De | с | | |
| (86)m= | 1 | 0.99 | 0.98 | | 0.94 0 | 0.85 | 0.6 | .67 0.52 | | 58 | 0.84 | 0.97 | 0.99 | 1 | | | (86) |
| Mean | interna | l temper | ature in | liv | ring area | T1 (fo | llow | steps 3 to | 7 in ⁻ | Table | 9c) | | - | | | | |
| (87)m= | 19.16 | 19.38 | 19.75 | | 20.28 2 | 0.68 | 20.9 | 2 20.98 | 20 | .97 | 20.79 | 20.26 | 19.66 | 19.19 | | | (87) |
| Temp | erature | during h | eating | per | riods in re | est of | dwell | ing from Ta | able | 9, Th2 | 2 (°C) | | | _ | | | |
| (88)m= | 19.56 | 19.57 | 19.58 | | 19.65 1 | 9.66 | 19.7 | 2 19.72 | 19 | .73 | 19.7 | 19.66 | 19.63 | 19.6 | 1 | | (88) |
| Utilisa | ation fac | tor for g | ains for | re | st of dwel | lling, ł | ח2,m | (see Table | 9a) | | | | | | | | |
| (89)m= | 1 | 0.99 | 9 0.97 0.92 0.1 | | 0.79 | 0.5 | 6 0.38 | 0. | 44 | 0.75 | 0.96 | 0.99 | 1 | | | (89) | |
| | | | - | • | | | | | • | | | | | - | | | |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)
| (90)m= | 17.16 | 17.49 | 18.03 | 18.83 | 19.36 | 19.67 | 19.72 | 19.72 | 19.54 | 18.82 | 17.94 | 17.24 | | (90) |
|------------------|----------------------|-------------------------|----------------|-------------------|-----------|-------------|--------------|-------------|-----------------|-----------------|-------------------|------------|---------|--------------|
| | | | | | | | | | 1 | fLA = Livin | g area ÷ (4 | 4) = | 0.48 | (91) |
| Mear | interna | l temper | ature (fo | or the wh | ole dwe | llina) = fl | LA × T1 | + (1 – fL | A) × T2 | | | | | |
| (92)m= | 18.12 | 18.41 | 18.86 | 19.53 | 20 | 20.28 | 20.33 | 20.32 | , 20.14 | 19.52 | 18.77 | 18.18 | | (92) |
| Apply | v adjustn | nent to t | he mear | n interna | temper | ature fro | m Table | 4e, whe | ere appro | opriate | | | | |
| (93)m= | 18.12 | 18.41 | 18.86 | 19.53 | 20 | 20.28 | 20.33 | 20.32 | 20.14 | 19.52 | 18.77 | 18.18 | | (93) |
| 8. Sp | ace hea | ting requ | uirement | t | | | • | • | | • | | | | |
| Set T | i to the i | mean int | ernal te | mperatu | re obtain | ed at ste | ep 11 of | Table 9 | o, so tha | t Ti,m=(| 76)m an | d re-calc | ulate | |
| the ut | tilisation | factor fo | or gains | using Ta | ble 9a | - | • | - | | , (| , | - | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Utilisa | ation fac | tor for g | ains, hm | n: | | | - | - | | - | | | | |
| (94)m= | 0.99 | 0.99 | 0.97 | 0.92 | 0.81 | 0.61 | 0.44 | 0.51 | 0.79 | 0.95 | 0.99 | 1 | | (94) |
| Usefu | ul gains, | hmGm | , W = (9 | 4)m x (8- | 4)m | | | | | | | | | |
| (95)m= | 495.38 | 598.81 | 701.52 | 787.91 | 773.3 | 587.99 | 404.99 | 416.8 | 563.07 | 563.65 | 493.26 | 464.06 | | (95) |
| Mont | hly aver | age exte | ernal tem | perature | e from Ta | able 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 | e for mea | an interr | al tempe | erature, | Lm , W = | - =[(39)m | x [(93)m | – (96)m |] | | | | |
| (97)m= | 1770.4 | 1711.29 | 1549.78 | 1260.85 | 973.03 | 629.83 | 413.4 | 430.75 | 684.85 | 1045.21 | 1400.06 | 1714.38 | | (97) |
| Spac | e heatin | g require | ement fo | r each n | honth, k | Nh/moni | th = 0.02 | 24 x [(97 |)m – (95 | 5)m] x (4 | 1)m | | | |
| (98)m= | 948.62 | 747.58 | 631.1 | 340.51 | 148.59 | 0 | 0 | 0 | 0 | 358.28 | 652.9 | 930.24 | | |
| | | | | | | | | Tota | l per year | (kWh/year | .) = Sum(9 | 8)15,912 = | 4757.82 | (98) |
| Spac | e heatin | g require | ement in | kWh/m² | /year | | | | | | | | 62.38 | (99) |
| 9a Fn | erav rea | uiremer | nts – Ind | ividual h | eating s | vstems i | ncluding | umicro-C | HP) | | | | | |
| Snac | e heatir | na. | | i viadai ii | outing o | yotorno i | rioraanig | | , , | | | | | |
| Fract | ion of sp | ace hea | at from s | econdar | y/supple | mentary | v system | | | | | | 0 | (201) |
| Fract | ion of sr | ace hea | at from n | nain svst | em(s) | - | - | (202) = 1 · | - (201) = | | | | 1 | (202) |
| Erect | ion of to | | na from | moin ov | otom 1 | | | (204) - (2) | 02) ~ [1 _ | (203)] - | | · | | |
| | | | | inain sys | | | | (204) - (2 | 02) ~ [1 | (200)] = | | - | | (204) |
| Efficie | ency of i | main spa | ace heat | ing syste | em 1 | | | | | | | | 93.2 | (206) |
| Efficie | ency of s | seconda | ry/suppl | ementar | y heating | g system | า, % | | | | | | 0 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/ye | ar |
| Spac | e heatin | g require | ement (c | alculate | d above) |) | | | | | | | | |
| | 948.62 | 747.58 | 631.1 | 340.51 | 148.59 | 0 | 0 | 0 | 0 | 358.28 | 652.9 | 930.24 | | |
| (211)n | n = {[(98 |)m x (20 |)4)] } x 1 | 00 ÷ (20 |)6) | | • | • | | • | | | | (211) |
| (, | 1017.83 | 802.13 | 677.15 | 365.36 | 159.43 | 0 | 0 | 0 | 0 | 384.42 | 700.53 | 998.11 | | |
| | | | | I | | | I | I Tota | l I (kWh/yea | I ar) =Sum(2 | L 211), 540 42 | = | 5104 96 | (211) |
| Snac | o hootin | a fuol (c | ocondor | w) k\//b/ | month | | | | | | 1 | | 0.0.000 | |
| | m x (20) | y iuei (S)1)] \ x 1 | $00 \div (20)$ | y), KVVII/ 181 | monun | | | | | | | | | |
| (215)m= | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| () | <u> </u> | | | | <u> </u> | Ŭ | | Tota | l (kWh/vea | ar) =Sum(2 | 215) | = | 0 | (215) |
| \ N/ _4 = | h = = 1 ¹ | _ | | | | | | | | ., | · · · / 15,1012 | | U | (213) |
| outout | neating |) ator has | tor (colo | ulated a | | | | | | | | | | |
| Juipu | 161.05 | ater nea | 146.49 | 128.85 | 124.48 | 108.67 | 101.94 | 115.22 | 116.08 | 133.75 | 144.52 | 156.35 | | |
| Efficie | | ater hea | L | L | | | | | | | | | 87.3 | (216) |
| | | | | | | | | | | | | | 07.5 | (=·•) |

| (217)m= | 89.77 | 89.73 | 89.64 | 89.38 | 88.85 | 87.3 | 87.3 | 87.3 | 87.3 | 89.39 | 89.66 | 89.77 | | (217) |
|--|--|--|--|--|----------|---|---|-------------|---------------------------|---|--|-------------------------|---|---|
| Fuel for | r water | heating, | kWh/mo | onth | | | | | | | | | | |
| (219)m (219)m= | <u>= (64)</u> 179.41 | m x 100 157.35 |) ÷ (217) 163.42 | m 144.15 | 140.1 | 124.48 | 116.78 | 131.98 | 132.96 | 149.62 | 161.19 | 174.17 |] | |
| | | | | I | | | | Tota | l = Sum(2 | 19a) ₁₁₂ = | | | 1775.6 | (219) |
| Annual | l totals | | | | | | | | | k | Wh/year | • | kWh/year | |
| Space I | heating | fuel use | ed, main | system | 1 | | | | | | | | 5104.96 | |
| Water h | neating | fuel use | d | | | | | | | | | | 1775.6 | |
| Electric | ity for p | oumps, fa | ans and | electric l | keep-ho | t | | | | | | | | _ |
| centra | l heatin | ig pump: | | | | | | | | | | 30 | | (230c) |
| boiler | with a f | an-assis | ted flue | | | | | | | | | 45 | j | (230e) |
| Total el | ectricity | y for the | above, ł | <wh td="" yea<=""><td>r</td><td></td><td></td><td>sum</td><td>of (230a).</td><td>(230g) =</td><td></td><td></td><td>75</td><td>(231)</td></wh> | r | | | sum | of (230a). | (230g) = | | | 75 | (231) |
| Electric | ity for li | ighting | | | | | | | | | | | 332.94 | (232) |
| 120 0 | `O2 em | issions - | - Individ | ual heati | na svste | ems inclu | ıdina mi | cro-CHF |) | | | | | |
| 12a. C | | | | | | | | | | | | | | |
| 12a. C | | | | | | En kW | ergy /h/year | | | Emiss kg CO | ion fac 2/kWh | tor | Emissions kg CO2/yea | ar |
| Space I | heating | (main s | ystem 1) |) | | En kW (211 | ergy /h/year I) x | | | Emiss kg CO | ion fac 2/kWh 16 | tor = | Emissions kg CO2/yea | ar](261) |
| Space I Space I | heating | (main s | ystem 1) lary) |) | | En kW (211 (215 | ergy /h/year I) x 5) x | | | Emiss kg CO 0.2 | ion fac 2/kWh 16 | tor = = | Emissions kg CO2/yea 1102.67 | ar](261)](263) |
| Space I Space I Water h | heating heating | (main sı (secono | ystem 1) lary) |) | | En kW (211 (215 | ergy /h/year I) x 5) x 9) x | | | Emiss kg CO 0.2 0.5 | ion fac 2/kWh 16 19 | tor = = = | Emissions kg CO2/yes 1102.67 0 383.53 | ar](261)](263)](264) |
| Space I Space I Water h Space a | heating heating neating and wa | (main s (seconc ter heati | ystem 1) lary) ng |) | | En kW (211 (211 (211) (211) | ergy /h/year 1) x 5) x 9) x 1) + (262) | + (263) + (| (264) = | Emiss kg CO. 0.2 0.5 | ion fac 2/kWh 16 19 16 | tor = = = | Emissions kg CO2/yea 1102.67 0 383.53 1486.2 | ar](261)](263)](264)](265) |
| Space I Space I Water I Space a Electric | heating heating neating and wa | (main s (second ter heatin pumps, fa | ystem 1) lary) ng ans and |) electric l | keep-ho | En kW (211 (211 (211 (211) (261) (261) | ergy /h/year 1) x 5) x 2) x 1) + (262) (1) x | + (263) + (| (264) = | Emiss kg CO. 0.2 0.5 0.2 | ion fac 2/kWh 16 19 16 | tor = = = | Emissions kg CO2/yea 1102.67 0 383.53 1486.2 38.93 | ar](261)](263)](264)](265)](267) |
| Space I Space I Water h Space a Electric Electric | heating heating neating and wa ity for p | (main s (second ter heatin pumps, fa | ystem 1) lary) ng ans and |) electric l | keep-ho | En kW (211 (215 (215 (264) t (234) (234) | ergy /h/year 1) x 5) x 2) x 1) + (262) (1) x 2) x | + (263) + (| (264) = | Emiss kg CO. 0.2 0.5 0.2 | ion fac 2/kWh 16 19 16 19 19 | tor = = = = | Emissions kg CO2/yea 1102.67 0 383.53 1486.2 38.93 172.8 | ar](261)](263)](264)](265)](267)](268) |
| Space I Space I Water H Space a Electric Electric Total C | heating heating and wa ity for p ity for li O2, kg/ | (main s (second ter heatin pumps, fa ighting /year | ystem 1) lary) ng ans and |) electric I | keep-ho | En kW (211 (215 (215 (264 t (234) (232 | ergy /h/year 1) x 5) x 2) x 1) + (262) (1) x 2) x | + (263) + (| (264) = sum o | Emiss kg CO. 0.2 0.5 0.2 0.5 f (265)(2 | ion fac 2/kWh 16 19 16 19 19 19 19 271) = | tor = = = = | Emissions kg CO2/yea 1102.67 0 383.53 1486.2 38.93 172.8 1697.92 | ar] (261)] (263)] (264)] (265)] (267)] (268)] (272) |
| Space I Space I Water I Space a Electric Electric Total C | heating heating neating and wa ity for p ity for li O2, kg/ | (main s (second ter heatin pumps, fa ighting /year | ystem 1) lary) ng ans and on Rate |) electric I | keep-ho | En kW (211 (215 (215 (264) t (234) (234) | ergy /h/year 1) x 5) x 2) x 1) + (262) (1) x 2) x | + (263) + (| (264) = sum o (272) | Emiss kg CO. 0.2 0.5 0.5 (265)(2 \div (4) = | ion fac 2/kWh 16 19 16 19 19 19 271) = | tor = = = | Emissions kg CO2/yea 1102.67 0 383.53 1486.2 38.93 172.8 1697.92 22.26 | ar] (261)] (263)] (264)] (265)] (267)] (268)] (272)] (273) |
| Space I Space I Water I Space a Electric Electric Total C Dwellin El rating | heating heating neating and wa ity for p ity for li O2, kg/ ng CO2 g (secti | (main sy (second ter heatin oumps, fa ghting /year 2 Emissi a on 14) | ystem 1) dary) ng ans and on Rate |) electric I | keep-ho | En kW (211 (215 (215 (264 t (234) (234) | ergy /h/year 1) x 5) x 2) x 1) + (262) (1) x 2) x | + (263) + (| (264) = sum o (272) | Emiss kg CO. 0.2 0.5 0.5 (265)(2) | ion fac 2/kWh 16 19 16 19 19 19 271) = | tor = = = | Emissions kg CO2/yea 1102.67 0 383.53 1486.2 38.93 172.8 1697.92 22.26 81 | ar] (261)] (263)] (264)] (265)] (267)] (268)] (272)] (273)] (274) |

| | | | | | | | User [| Details: | | | | | | |
|----------------|-------------------------|--------------------|--------------------------|-------------------------|-------------------------|--------------------|------------|-----------------|-----------------------|----------------|----------|----------------|-------------------------|------|
| Asses Softw | ssor N vare Na | ame: ame: | Ge Str | orge Fa oma FS | irr SAP 201 | 2 | roportu | Strom Softwa | a Num are Vei | ber: rsion: | | STRO Versio | 028460 on: 1.0.4.6 | |
| Addro | | | | | | Γ. | openy | Address | . Flat 4 | | | | | |
| 1. Ove | erall dw | ellina diı | mension | S: | | | | | | | | | | |
| | | | | | | | Are | a(m²) | | Av. Hei | ight(m) | | Volume(m ³) |) |
| Ground | d floor | | | | | | | 5.28 | (1a) x | 2 | .55 | (2a) = | 13.46 | (3a) |
| First flo | or | | | | | | | 76.37 | (1b) x | 2 | 2.1 | (2b) = | 160.38 | (3b) |
| Total flo | oor area | a TFA = | (1a)+(1l | o)+(1c)+ | (1d)+(1e | e)+(1n |) | 81.65 | (4) | | | - | | |
| Dwellin | ıg volum | ne | | | | | | | (3a)+(3b) |)+(3c)+(3d | l)+(3e)+ | .(3n) = | 173.84 | (5) |
| 2. Ver | ntilation | rate: | | | | | | | | | | | | |
| | | | | main heating | se h | econdar leating | у | other | | total | | | m ³ per hou | • |
| Numbe | er of chir | nneys | | 0 | + | 0 |] + [| 0 | = | 0 | X 4 | 40 = | 0 | (6a) |
| Numbe | er of ope | en flues | | 0 | + | 0 |] + [| 0 |] = [| 0 | × 2 | 20 = | 0 | (6b) |
| Numbe | er of inte | rmittent | fans | | | | | | | 3 | x ^ | 10 = | 30 | (7a) |
| Numbe | er of pas | sive ver | nts | | | | | | Γ | 0 | x ^ | 10 = | 0 | (7b) |
| Numbe | er of flue | less ga | s fires | | | | | | Ē | 0 | x 4 | 40 = | 0 | (7c) |
| | | | | | | | | | | | | Air ch | nanges per ho | ur |
| Infiltrati | ion due | to chim | neys, flu | es and f | ans = (6 | a)+(6b)+(7 | a)+(7b)+ | (7c) = | Г | 30 | <u> </u> | ÷ (5) = | 0.17 | (8) |
| lf a pr | essurisati | on test ha | s been ca | rried out o | r is intende | ed, proceed | d to (17), | otherwise | continue fr | om (9) to (| (16) | | | |
| Num | ber of s | toreys ir | n the dw | elling (n | s) | | | | | | | | 0 | (9) |
| Addit | tional in | filtration | | | | | | | | | [(9)- | -1]x0.1 = | 0 | (10) |
| Struc | ctural ini | filtration | : 0.25 fo | r steel o | r timber i | frame or | 0.35 fo | r masoni | ry constr a (after | ruction | | | 0 | (11) |
| dec | ducting ar | eas of ope | enings); if | equal user | 0.35 | ponung to | ino grou | | u (unor | | | | | _ |
| lf sus | spendeo | d woode | n floor, o | enter 0.2 | (unseal | ed) or 0. | 1 (seal | ed), else | enter 0 | | | | 0 | (12) |
| lf no | draught | t lobby, | enter 0.0 | 05, else | enter 0 | | | | | | | | 0 | (13) |
| Perc | entage | of windo | ows and | doors di | aught st | ripped | | 0.05 10.0 | | 0.01 | | | 0 | (14) |
| Wind | | tration | | | | | | 0.25 - [0.2 | X (14) ÷ 1 | [00] = | | | 0 | (15) |
| Infiltr | ation ra | te | | | | •••••• | | (8) + (10) | + (11) + (1 | 2) + (13) - | + (15) = | | 0 | (16) |
| Air p | ermeab | nity valu | le, q50, i | expresse | ed in cub (18) - [(1 | 7) : 201 (S | s per n | our per s | quare m | etre of e | nvelope | area | 15 | (17) |
| II Dase | u on air Irmeability | permea value an | DIIIty Va Nies if a n | iue, men ressurisati | (10) = [(1) | 7) - 20j+(C | e or a de | aree air ne | rmeahility | is heina u | bod | | 0.92 | (18) |
| Numbe | er of side | es shelte | ered | 1000011000 | 01110311140 | | | gree an pe | incability | is being ut | 500 | | 0 | (19) |
| Shelter | factor | | | | | | | (20) = 1 - | [0.075 x (1 | 9)] = | | | 1 | (20) |
| Infiltrati | ion rate | incorpo | rating sh | nelter fac | ctor | | | (21) = (18 |) x (20) = | | | | 0.92 | (21) |
| Infiltrati | ion rate | modifie | d for mo | nthly wir | nd speed | ł | | | | | | | | _ |
| [| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |] | |
| Monthl | y avera | ge wind | speed f | rom Tab | e 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 $(22a)m = (22)r$ | n ÷ 4 | | | | | | | | |
|---|----------------------------|-------------------|---------------------|---------------------|---------------|-----------------|--------------------|------------|---------------|
| (22a)m= 1.27 1.25 1.2 | 23 1.1 1.08 | 0.95 | 0.95 0.92 | 1 | 1.08 | 1.12 | 1.18 | | |
| Adjusted infiltration rate (all | owing for shelter ar | nd wind spe | ed) = (21a) x | (22a)m | | | | | |
| 1.18 1.15 1.1 | 3 1.01 0.99 | 0.88 | 0.88 0.85 | 0.92 | 0.99 | 1.04 | 1.08 | | |
| Calculate effective air chan | ge rate for the appl | icable case |) | | | | ——— Г | | |
| If exhaust air heat pump using | Appendix N. (23b) = (23 | a) x Fmv (equ | ation (N5)) . othei | wise (23b |) = (23a) | | | 0 | (23a) |
| If balanced with heat recovery: | efficiency in % allowing | for in-use fact | or (from Table 4h) |) = | , (, | | L | 0 | (23c) |
| a) If balanced mechanica | al ventilation with he | at recovery | / (MVHR) (24a | ı)m = (22 | 2b)m + (2 | 23b) × [′ | L - (23c) – | ÷ 100] | (200) |
| (24a)m= 0 0 0 | 0 0 | 0 | 0 0 | 0 | 0 | 0 | 0 | - | (24a) |
| b) If balanced mechanica | al ventilation without | heat recov | /ery (MV) (24b |)m = (22 | 2b)m + (2 | 23b) | | | |
| (24b)m= 0 0 0 | 0 0 | 0 | 0 0 | 0 | 0 | 0 | 0 | | (24b) |
| c) If whole house extract | ventilation or positi | ve input ver | ntilation from c | outside | F (00) | 、 | | | |
| (24c)m = 0 + 0 + 0 | b), then $(24c) = (23)$ | $\frac{1}{1}$ | se(24C) = (22C) |) m + 0. | 5 × (230 |) | | | (24c) |
| d) If natural ventilation or | | | ntilation from I | oft | 0 | 0 | Ů | | (210) |
| if $(22b)m = 1$, then $(2b)m = 1$ | (22b)m = (22b)m oth | erwise (24d | f(1) = 0.5 + [(2)] | 2b)m ² x | 0.5] | | | | |
| (24d)m= 1.18 1.15 1.1 | 3 1.01 0.99 | 0.88 | 0.88 0.86 | 0.93 | 0.99 | 1.04 | 1.08 | | (24d) |
| Effective air change rate | - enter (24a) or (24 | b) or (24c) | or (24d) in box | (25) | | | | | |
| (25)m= 1.18 1.15 1.1 | 3 1.01 0.99 | 0.88 | 0.88 0.86 | 0.93 | 0.99 | 1.04 | 1.08 | | (25) |
| 3. Heat losses and heat lo | ss parameter: | | | | | | | | |
| ELEMENT Gross area (m ²) | Openings m ² | Net Area A ,m² | u U-valu W/m2 | le K | A X U (W/ł | <) | k-value kJ/m²⋅K | | A X k kJ/K |
| Doors | | 1.89 | x 1.4 | = | 2.646 | , | | | (26) |
| Windows Type 1 | | 5.92 | x1/[1/(1.4)+ | 0.04] = | 7.85 | | | | (27) |
| Windows Type 2 | | 5.92 | | 0.04] = | 7.85 | | | | (27) |
| Rooflights | | 4.3 | x1/[1/(1.4) + | 0.04] = | 6.02 | | | | (27b) |
| Floor | | 9.73 | x 0.14 | = [| 1.3622 | | | 7 | (28) |
| Walls Type1 36.78 | 0 | 36.78 | × 0.15 | | 5.52 | ה ה | | i 📛 | (29) |
| Walls Type2 8.55 | 1.89 | 6.66 | x 0.2 | = [| 1.34 | ן ר | | i 📛 | (29) |
| Walls Type3 56.27 | 11.84 | 44.43 | × 0.15 | = [| 6.66 | ן ר | | i 📛 | (29) |
| Roof 46.19 | 4.3 | 41.89 | x 0.14 | = [| 5.86 | | | i 📛 | (30) |
| Total area of elements, m ² | | 157.52 | | | | | | J | (31) |
| Party wall | | 38.99 | x 0 | | 0 | | | 7 | (32) |
| Party floor | | 71.82 | - <u> </u> | L | | L | | i 🚞 | (32a) |
| * for windows and roof windows, L | ise effective window U-v | alue calculate | d using formula 1. | /[(1/U-valu | ıe)+0.04] a | ∟ s given in | paragraph 3 | 3.2 | |
| Fabric heat loss, $W/K = S$ (| A x U) | | (26)(30) | + (32) = | | | | 44.79 | (33) |

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K

Heat capacity $Cm = S(A \times k)$

(34)

(35)

7839.35

250

((28)...(30) + (32) + (32a)...(32e) =

Indicative Value: Medium

| can be l | used inste | ad of a de | tailed calc | ulation. | | | | | | | | | | |
|----------------|-------------------------|--------------------------|-------------------------|--------------------------|-----------------------------|------------|-------------------|-------------|-----------------------|---------------------------|---------------------------------------|--------------------|---------|------------|
| Therm | al bridg | es : S (L | x Y) cal | culated u | using Ap | pendix ł | < | | | | | | 23.63 | (36) |
| if details | of therma | al bridging | are not kn | own (36) = | = 0.15 x (3 | 1) | | | | | | | | |
| Total f | abric he | at loss | | | | | | | (33) + | (36) = | | | 68.42 | (37) |
| Ventila | ation hea | at loss ca | alculated | I monthly | y | | | | (38)m | = 0.33 × (| 25)m x (5) | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (38)m= | 67.48 | 66.16 | 64.83 | 58.22 | 56.9 | 50.72 | 50.72 | 49.57 | 53.1 | 56.9 | 59.54 | 62.19 | | (38) |
| Heat t | ransfer (| coefficie | nt, W/K | | | | | | (39)m | = (37) + (| 38)m | | | |
| (39)m= | 135.9 | 134.58 | 133.25 | 126.64 | 125.32 | 119.14 | 119.14 | 117.99 | 121.52 | 125.32 | 127.96 | 130.61 | | |
| Heat lo | oss para | ameter (H | · HLP), W/ | ′m²K | | | | | (40)m | Average = = (39)m ÷ | Sum(39)₁. · (4) | 12 /12= | 126.45 | (39) |
| (40)m= | 1.66 | 1.65 | 1.63 | 1.55 | 1.53 | 1.46 | 1.46 | 1.45 | 1.49 | 1.53 | 1.57 | 1.6 | | |
| | | | I | | | | | | | Average = | Sum(40)1. | ₁₂ /12= | 1.55 | (40) |
| Numb | er of day | ys in mo | nth (Tab | le 1a) | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | Мау | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | | (41) |
| | | | | | | | | | | | • | | | |
| 4 Wa | ater hea | tina ene | rav reau | rement. | | | | | | | | kWh/ve | ear: | |
| | | ang ono | gy roqu | | | | | | | | | | | |
| Assum if TF | A > 13. | upancy, 9, N = 1 | N + 1.76 x | [1 - exp | (-0.0003 | 849 x (TF | -A -13.9 |)2)] + 0.(|)013 x (⁻ | TFA -13 | 2. .9) | 49 | | (42) |
| Annua | l averaç | 9, N = 1 | ater usag | ge in litre | es per da | y Vd,av | erage = | (25 x N) | + 36 | | 93 | .42 | | (43) |
| Reduce | the annua e that 125 | al average litres per | hot water person per | usage by : day (all w | 5% if the a rater use. I | welling is | designed (Id) | to achieve | a water us | se target o | f | | - | |
| notmor | | | | | | | | | | | | | l | |
| Hot wat | Jan | | Mar day for ea | Apr | May Vd m – fa | Jun | Jul Table 1c x | Aug | Sep | Oct | Nov | Dec | | |
| not wat | er usage i | T T | | | vu,iii – ia | | | (+3) I | | | 1 | | 1 | |
| (44)m= | 102.76 | 99.02 | 95.29 | 91.55 | 87.81 | 84.08 | 84.08 | 87.81 | 91.55 | 95.29 | 99.02 | 102.76 | | - 1 |
| Energy | content of | ^f hot water | used - cal | culated mo | onthly $= 4$. | 190 x Vd,r | n x nm x D |)Tm / 3600 |) kWh/mor | Total = Su hth (see Ta | m(44) ₁₁₂ = ables 1b, 1 | c, 1d) | 1121.03 | (44) |
| (45)m= | 152.39 | 133.28 | 137.54 | 119.91 | 115.05 | 99.28 | 92 | 105.57 | 106.83 | 124.5 | 135.9 | 147.58 | | |
| lf instan | taneous v | vater heati | na at point | of use (no | hot water | storage) | enter () in | boxes (46 | -) to (61) | Total = Su | m(45) ₁₁₂ = | | 1469.84 | (45) |
| (46)- | 22.96 | 10.00 | 20.62 | 17.00 | 17.06 | 14.90 | 12.0 | 15.94 | 16.02 | 10.60 | 20.20 | 22.14 | | (46) |
| Water | storage | loss: | 20.03 | 17.99 | 17.20 | 14.09 | 13.0 | 15.64 | 10.02 | 10.00 | 20.39 | 22.14 | | (40) |
| Storac | e volum | ne (litres) | includir | iq any so | olar or W | /WHRS | storage | within sa | ame ves | sel | | 0 | | (47) |
| If com | munity k | neating a | ind no ta | nk in dw | ellina e | nter 110 | litres in | (47) | | | | 0 | | () |
| Otherv | vise if n | o stored | hot wate | er (this in | icludes i | nstantar | neous co | mbi boil | ers) ente | er '0' in (| 47) | | | |
| Water | storage | loss: | | , | | | | | , | · | | | | |
| a) If m | nanufac | turer's de | eclared I | oss facto | or is kno | wn (kWł | n/day): | | | | | 0 | | (48) |
| Tempe | erature f | actor fro | m Table | 2b | | | | | | | | 0 | | (49) |
| Energ | y lost fro | om water | · storage | , kWh/ye | ear | | | (48) x (49) | = | | | 0 | | (50) |
| b) If n | nanufac | turer's de | eclared o | ylinder l | oss fact | or is not | known: | | | | | | | |
| Hot wa | ater stor | age loss | factor fr | om Tabl | e 2 (kW | h/litre/da | ıy) | | | | | 0 | | (51) |
| | munity h | from To | ee secti blo 20 | on 4.3 | | | | | | | | | | |
| Tempe | e lacior | actor fro | ule za m Tahlo | 2h | | | | | | | | 0 | | (52) |
| , on po | | 20101 110 | | | | | | | | | | 0 | | (00) |

| Energy Enter | y lost fro (50) or | om watei (54) in (5 | ⁻ storage 55) | e, kWh/y₀ | ear | | | (47) x (51 |) x (52) x (| 53) = | | 0 | | (54) (55) |
|-----------------|-----------------------|------------------------|-----------------------------|------------|------------|-------------|------------------|--------------|-----------------|-------------|-------------|------------|---------------|--------------|
| Water | storage | loss cal | culated | for each | month | | | ((56)m = (| (55) × (41) | m | | | I | |
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (56) |
| If cylinde | er contain | s dedicate | l d solar sto | rage, (57) | n = (56)m | x [(50) – (| I [H11)] ÷ (5 | 0), else (5 | 1 7)m = (56) | m where (| H11) is fro | m Append | ix H | |
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (57) |
| Primar | y circuit | loss (ar | nnual) fro | om Table | e 3 | | | | | | | 0 | | (58) |
| Primar | y circuit | loss cal | culated | for each | month (| 59)m = (| (58) ÷ 36 | 65 × (41) |)m Novlindo | r thormo | ctat) | | ' | |
| (110) (59)m= | | | | | | | | | | | 0 | 0 | | (59) |
| Combi | loss ca | lculated | for each | month | (61)m = | (60) ÷ 30 | 65 x (41) |)m | 1 | I | 1 | 1 | | |
| (61)m= | 12.75 | 11.49 | 12.66 | 12.18 | 12.53 | 12.06 | 12.42 | 12.49 | 12.12 | 12.6 | 12.28 | 12.73 | | (61) |
| Total h | eat req | uired for | water h | eating ca | alculated | for eac | h month | (62)m = | : 0.85 × (| (45)m + | (46)m + | (57)m + | (59)m + (61)m | |
| (62)m= | 165.14 | 144.78 | 150.19 | 132.08 | 127.58 | 111.34 | 104.42 | 118.06 | 118.95 | 137.11 | 148.19 | 160.31 | | (62) |
| Solar DI | -IW input | calculated | using App | endix G o | r Appendix | H (negati | ve quantity | /) (enter '0 | i if no sola | r contribut | ion to wate | r heating) | 1 | |
| (add a | dditiona | l lines if | FGHRS | and/or \ | NWHRS | applies | , see Ap | pendix (| G) | | | | | |
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (63) |
| Output | from w | ater hea | ter | | • | • | • | | • | | | | I | |
| (64)m= | 165.14 | 144.78 | 150.19 | 132.08 | 127.58 | 111.34 | 104.42 | 118.06 | 118.95 | 137.11 | 148.19 | 160.31 | | |
| | | | | | | | | Out | out from w | ater heate | r (annual)₁ | 12 | 1618.16 | (64) |
| Heat g | ains fro | m water | heating, | , kWh/m | onth 0.2 | 5 ´ [0.85 | × (45)m | ı + (61)n | n] + 0.8 x | (46)m | + (57)m | + (59)m |] | |
| (65)m= | 53.86 | 47.19 | 48.9 | 42.91 | 41.39 | 36.03 | 33.7 | 38.22 | 38.55 | 44.55 | 48.26 | 52.25 | | (65) |
| inclu | ıde (57) | m in cale | culation | of (65)m | only if c | ylinder i | s in the o | dwelling | or hot w | ater is fr | om com | munity h | eating | |
| 5. Int | ternal ga | ains (see | e Table 5 | 5 and 5a |): | | | | | | | | | |
| Metab | olic gair | is (Table | e 5), Wat | ts | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (66)m= | 124.67 | 124.67 | 124.67 | 124.67 | 124.67 | 124.67 | 124.67 | 124.67 | 124.67 | 124.67 | 124.67 | 124.67 | | (66) |
| Lightin | g gains | (calcula | ted in Ap | opendix | L, equat | ion L9 o | r L9a), a | lso see | Table 5 | | | | | |
| (67)m= | 19.88 | 17.66 | 14.36 | 10.87 | 8.13 | 6.86 | 7.41 | 9.64 | 12.94 | 16.42 | 19.17 | 20.44 | | (67) |
| Applia | nces ga | ins (calc | ulated ir | n Appeno | dix L, eq | uation L | 13 or L1 | 3a), also | see Ta | ble 5 | | | ' | |
| (68)m= | 222.85 | 225.17 | 219.34 | 206.93 | 191.27 | 176.55 | 166.72 | 164.41 | 170.24 | 182.64 | 198.3 | 213.02 | | (68) |
| Cookir | ng gains | (calcula | ted in A | ppendix | L, equat | tion L15 | or L15a) |), also se | ee Table | 5 | | | I | |
| (69)m= | 35.47 | 35.47 | 35.47 | 35.47 | 35.47 | 35.47 | 35.47 | 35.47 | 35.47 | 35.47 | 35.47 | 35.47 | | (69) |
| Pumps | s and fa | ns gains | (Table | 5a) | | | | | | | | | I | |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | | (70) |
| Losses | s e.g. ev | vaporatio | n (nega | tive valu | es) (Tab | le 5) | • | | • | | | | I | |
| (71)m= | -99.74 | -99.74 | -99.74 | -99.74 | -99.74 | -99.74 | -99.74 | -99.74 | -99.74 | -99.74 | -99.74 | -99.74 | | (71) |
| Water | heating | gains (1 | able 5) | | | | | | | | | | 1 | |
| (72)m= | 72.39 | 70.22 | 65.72 | 59.6 | 55.63 | 50.04 | 45.29 | 51.38 | 53.54 | 59.88 | 67.03 | 70.23 | | (72) |
| Total i | internal | gains = | : | - | - | (66) |)m + (67)m | n + (68)m · | + (69)m + | (70)m + (7 | 1)m + (72) | m | 1 | |
| (73)m= | 378.53 | 376.45 | 362.82 | 340.81 | 318.43 | 296.85 | 282.83 | 288.82 | 300.12 | 322.34 | 347.9 | 367.09 | | (73) |
| 6. So | lar gains | S: | | | | | | • | | | | • | | |

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 | 5.92 | × | 11.28 | x | 0.63 | x | 0.7 | = | 20.41 | (75) |
| Northeast 0.9x | 0.77 | x | 5.92 | x | 22.97 | × | 0.63 | x | 0.7 | i = | 41.55 | (75) |
| Northeast 0.9x | 0.77 | x | 5.92 | × | 41.38 | × | 0.63 | x | 0.7 | i = | 74.86 | (75) |
| Northeast 0.9x | 0.77 | x | 5.92 | x | 67.96 | x | 0.63 | x | 0.7 | i = | 122.95 | – (75) |
| Northeast 0.9x | 0.77 | x | 5.92 | x | 91.35 | x | 0.63 | x | 0.7 | i = | 165.27 | (75) |
| Northeast 0.9x | 0.77 | x | 5.92 | × | 97.38 | × | 0.63 | × | 0.7 | i = | 176.19 | – (75) |
| Northeast 0.9x | 0.77 | x | 5.92 | x | 91.1 | x | 0.63 | x | 0.7 | i = | 164.82 | – (75) |
| Northeast 0.9x | 0.77 | x | 5.92 | x | 72.63 | x | 0.63 | x | 0.7 | i = | 131.4 | (75) |
| Northeast 0.9x | 0.77 | x | 5.92 | × | 50.42 | × | 0.63 | × | 0.7 | i = | 91.22 | (75) |
| Northeast 0.9x | 0.77 | x | 5.92 | x | 28.07 | × | 0.63 | x | 0.7 | i = | 50.78 | (75) |
| Northeast 0.9x | 0.77 | x | 5.92 | × | 14.2 | x | 0.63 | × | 0.7 | = | 25.69 | (75) |
| Northeast 0.9x | 0.77 | x | 5.92 | × | 9.21 | × | 0.63 | × | 0.7 | = | 16.67 | (75) |
| Southwest0.9x | 0.77 | x | 5.92 | × | 36.79 | İ | 0.63 | × | 0.7 | = | 66.57 | (79) |
| Southwest0.9x | 0.77 | x | 5.92 | x | 62.67 | İ | 0.63 | x | 0.7 | = | 113.39 | (79) |
| Southwest0.9x | 0.77 | x | 5.92 | x | 85.75 | İ | 0.63 | x | 0.7 | i = | 155.15 | (79) |
| Southwest0.9x | 0.77 | x | 5.92 | x | 106.25 | İ | 0.63 | x | 0.7 | i = | 192.23 | (79) |
| Southwest0.9x | 0.77 | x | 5.92 | x | 119.01 | İ | 0.63 | x | 0.7 | i = | 215.32 | (79) |
| Southwest0.9x | 0.77 | x | 5.92 | x | 118.15 | İ | 0.63 | × | 0.7 | i = | 213.76 | (79) |
| Southwest0.9x | 0.77 | x | 5.92 | × | 113.91 | İ | 0.63 | × | 0.7 | = | 206.09 | (79) |
| Southwest0.9x | 0.77 | x | 5.92 | × | 104.39 | İ | 0.63 | × | 0.7 | = | 188.87 | (79) |
| Southwest0.9x | 0.77 | x | 5.92 | × | 92.85 | İ | 0.63 | × | 0.7 | = | 167.99 | (79) |
| Southwest0.9x | 0.77 | x | 5.92 | x | 69.27 | İ | 0.63 | x | 0.7 | = | 125.32 | (79) |
| Southwest0.9x | 0.77 | x | 5.92 | × | 44.07 | Ì | 0.63 | × | 0.7 |] = | 79.73 | (79) |
| Southwest0.9x | 0.77 | x | 5.92 | × | 31.49 | İ | 0.63 | × | 0.7 | = | 56.97 | (79) |
| Rooflights 0.9x | 1 | x | 4.3 | x | 26 | x | 0.63 | x | 0.8 |] = | 50.71 | (82) |
| Rooflights 0.9x | 1 | x | 4.3 | x | 54 | x | 0.63 | x | 0.8 | = | 105.33 | (82) |
| Rooflights 0.9x | 1 | x | 4.3 | x | 96 | × | 0.63 | x | 0.8 | = | 187.25 | (82) |
| Rooflights 0.9x | 1 | x | 4.3 | x | 150 | × | 0.63 | x | 0.8 | = | 292.57 | (82) |
| Rooflights 0.9x | 1 | x | 4.3 | × | 192 | × | 0.63 | × | 0.8 |] = | 374.49 | (82) |
| Rooflights 0.9x | 1 | x | 4.3 | × | 200 | × | 0.63 | × | 0.8 |] = | 390.1 | (82) |
| Rooflights 0.9x | 1 | x | 4.3 | x | 189 | × | x 0.63 x 0.8 = | | = | 368.64 | (82) | |
| Rooflights 0.9x | 1 | x | 4.3 | × | 157 | × | x 0.63 x 0.8 = 306.23 | | | 306.23 | (82) | |
| Rooflights 0.9x | 1 | x | 4.3 | × | 115 | × | 0.63 | × | 0.8 |] = | 224.31 | (82) |
| Rooflights 0.9x | 1 | x | 4.3 | × | 66 | × | 0.63 | × | 0.8 | = | 128.73 | (82) |
| Rooflights 0.9x | 1 | x | 4.3 | × | 33 | × | 0.63 | x | 0.8 |] = | 64.37 | (82) |
| Rooflights 0.9x | 1 | x | 4.3 | x | 21 | x | 0.63 | x | 0.8 | = | 40.96 | _ (82) |

| Solar g | ains in | watts, ca | alculated | for eacl | h month | | | (83)m = S | um(74)m . | (82)m | | | |
|---------|-----------|-----------|-----------|----------|-----------|---------|---------|-----------|-----------|--------|--------|--------|------|
| (83)m= | 137.69 | 260.27 | 417.26 | 607.75 | 755.08 | 780.05 | 739.55 | 626.49 | 483.52 | 304.83 | 169.78 | 114.6 | (83) |
| Total g | ains – ir | nternal a | nd solar | (84)m = | = (73)m - | + (83)m | , watts | | | | | | |
| (84)m= | 516.22 | 636.72 | 780.08 | 948.56 | 1073.5 | 1076.9 | 1022.38 | 915.32 | 783.64 | 627.18 | 517.69 | 481.69 | (84) |

| 7. Me | an inter | nal temp | erature | (heating | season |) | | | | | | | | |
|----------|-------------------------|-----------------------|-----------------------|----------------------|---------------------|-------------|----------------|-------------|------------|-------------------------|-------------|------------|--------|-------|
| Temp | erature | during h | leating p | eriods ir | n the livir | ng area i | from Tab | ole 9, Th | 1 (°C) | | | | 21 | (85) |
| Utilisa | ation fac | tor for g | ains for | living are | ea, h1,m | (see Ta | ble 9a) | - | | | | | | _ |
| | Jan | Feb | Mar | Apr | Мау | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (86)m= | 1 | 0.99 | 0.98 | 0.94 | 0.83 | 0.65 | 0.5 | 0.56 | 0.83 | 0.97 | 0.99 | 1 | | (86) |
| Mean | interna | l temper | ature in | living are | ea T1 (fo | ollow ste | ps 3 to 7 | in Table | e 9c) | | | | | |
| (87)m= | 19.15 | 19.38 | 19.77 | 20.31 | 20.71 | 20.93 | 20.98 | 20.97 | 20.8 | 20.25 | 19.65 | 19.18 | | (87) |
| Temp | erature | durina h | eating n | eriods ir | rest of | dwelling | from Ta | ble 9 Tl | n2 (°C) | | | | | |
| (88)m= | 19.57 | 19.58 | 19.59 | 19.65 | 19.66 | 19.72 | 19.72 | 19.73 | 19.7 | 19.66 | 19.64 | 19.61 | | (88) |
| Litilion | tion foo | tor for a | oine for | root of d | volling | L | | () | | | | | | |
| (89)m= | | 0.99 | 0.97 | 0.91 | 0 77 | 0.54 | | 9a) 0.42 | 0 74 | 0.96 | 0.99 | 1 | | (89) |
| (00) | | 0.00 | | | | | | 0.12 | | 0.00 | 0.00 | | | () |
| Mean | interna | temper | ature in | the rest | of dwelli | ng T2 (f | ollow ste | ps 3 to 7 | 7 in Tabl | e 9c) | 47.00 | 47.00 | | (00) |
| (90)m= | 17.16 | 17.5 | 18.07 | 18.87 | 19.39 | 19.68 | 19.71 | 19.72 | 19.54 | 18.82 | 17.93 | 17.23 | 0.07 | |
| | | | | | | | | | 1 | | y alea ÷ (* | +) = | 0.37 | (91) |
| Mean | interna | l temper | ature (fo | or the wh | ole dwe | lling) = fl | LA × T1 | + (1 – fL | A) × T2 | | | | | |
| (92)m= | 17.9 | 18.2 | 18.7 | 19.41 | 19.88 | 20.14 | 20.18 | 20.18 | 20.01 | 19.35 | 18.57 | 17.95 | | (92) |
| Apply | adjustn | nent to t | he mear | internal | temper | ature fro | m Table | 4e, whe | ere appro | opriate | | | | (00) |
| (93)m= | 17.9 | 18.2 | 18.7 | 19.41 | 19.88 | 20.14 | 20.18 | 20.18 | 20.01 | 19.35 | 18.57 | 17.95 | | (93) |
| 8. Spa | ace hea | ting requ | urement | | | | | | | · T ' · · · · /· | 70) | | 1-1- | |
| the ut | i to the r ilisation | nean int factor fo | ernal ter or gains | nperatur using Ta | e obtain Ible 9a | ied at ste | ep 11 of | I able 90 | o, so tha | t II,m=(| 76)m an | d re-caic | ulate | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Utilisa | ation fac | tor for g | ains, hm | <u> </u> | | I | | | | | | | | |
| (94)m= | 0.99 | 0.99 | 0.97 | 0.91 | 0.78 | 0.58 | 0.41 | 0.48 | 0.77 | 0.95 | 0.99 | 1 | | (94) |
| Usefu | I gains, | hmGm | W = (94 | 4)m x (84 | 4)m | | | | | | | | | |
| (95)m= | 513.23 | 628.66 | 755.09 | 861.8 | 839.24 | 624.21 | 420.36 | 434.93 | 601.48 | 596.88 | 512.21 | 479.59 | | (95) |
| Month | nly avera | age exte | rnal tem | perature | e from Ta | able 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 I | loss rate | e for mea | an intern | al tempe | erature, | Lm , W = | =[(39)m : I | x [(93)m· | – (96)m |] | | | | |
| (97)m= | 1848.41 | 1789.73 | 1625.2 | 1330.52 | 1025.12 | 660.25 | 426.93 | 446.38 | 717.82 | 1096.61 | 1467.37 | 1795.9 | | (97) |
| Space | e heatin | g require | ement fo | r each m | nonth, k | /Vh/mont | h = 0.02 | 24 x [(97) |)m – (95 |)m] x (4′ | 1)m | 070.00 | | |
| (96)11= | 993.30 | 760.24 | 047.30 | 337.40 | 130.29 | 0 | 0 | U | 0 | 371.0 | 007.72 | 979.33 | 1005.0 | |
| | | | | | | | | lota | i per year | (kvvn/year |) = Sum(9 | 8)15,912 = | 4935.6 | (90) |
| Space | e heatin | g require | ement in | kWh/m ² | /year | | | | | | | | 60.45 | (99) |
| 9a. Ene | ergy rec | luiremer | nts – Ind | ividual h | eating sy | ystems i | ncluding | micro-C | HP) | | | | | |
| Space | e heatir | ng: | | | 1 | | | | | | | ı | | |
| ⊢racti | on of sp | ace hea | it from s | econdar <u>.</u> | y/supple | mentary | system | (0.05) | | | | | 0 | (201) |
| Fracti | on of sp | ace hea | it from m | nain syst | em(s) | | | (202) = 1 - | - (201) = | | | | 1 | (202) |
| Fracti | on of to | tal heatii | ng from | main sys | stem 1 | | | (204) = (20 | 02) × [1 – | (203)] = | | | 1 | (204) |
| Efficie | ency of r | main spa | ace heat | ing syste | em 1 | | | | | | | | 93.2 | (206) |
| Efficie | ency of s | seconda | ry/suppl | ementar | y heating | g system | n, % | | | | | | 0 | (208) |
| | | | | | | | | | | | | | | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/yea | ar |
|----------|-----------------|-----------|------------|--|-----------|-----------|------------|----------------|-------------|---------------|---------------------------------|---------|------------|----------------|
| Space | e heatin | g require | ement (o | alculate | d above) |) | | r | 1 | | 1 | | I | |
| | 993.38 | 780.24 | 647.36 | 337.48 | 138.29 | 0 | 0 | 0 | 0 | 371.8 | 687.72 | 979.33 | | |
| (211)m | 1 = {[(98 |)m x (20 | (4)] } x 1 | $100 \div (20)$ |)6) | | | | | 000.00 | 707.00 | 4050 70 | l | (211) |
| | 1065.86 | 837.17 | 694.59 | 362.1 | 148.38 | 0 | 0 | 0 Tota | | 398.93 | 737.89 211) | 1050.79 | 5005 74 | 1 (211) |
| Snace | a hoatin | a fuol (e | econdar | ייי) אין אין אין אין אין אין אין אין אין אין | month | | | Tota | | | | | 5295.71 | |
| = {[(98] |)m x (20 |)1)]}x1 | 00 ÷ (20 |)8) | monun | | | | | | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | | | | - | | | | Tota | ll (kWh/yea | ar) =Sum(2 | 2 15) _{15,1012} | | 0 | (215) |
| Water | heating | J | | | | | | | | | | | | |
| Output | from w | ater hea | ter (calc | ulated a | bove) | 111 34 | 104.42 | 118.06 | 118.95 | 137 11 | 148 19 | 160 31 | | |
| Efficier | ncv of w | ater hea | ter | 102.00 | 127.00 | 111.04 | 104.42 | 110.00 | 110.00 | 107.11 | 140.15 | 100.01 | 87.3 | 1 (216) |
| (217)m= | 89.77 | 89.73 | 89.64 | 89.36 | 88.78 | 87.3 | 87.3 | 87.3 | 87.3 | 89.4 | 89.67 | 89.78 | | (217) |
| Fuel fo | r water | heating, | kWh/m | onth | | | | | | | | | | |
| (219)m | <u>1 = (64)</u> | m x 100 |) ÷ (217) |)m | | 407.54 | | 405.04 | 400.00 | 450.00 | 405.00 | 470.50 | l | |
| (219)m= | 183.95 | 161.34 | 167.55 | 147.8 | 143.7 | 127.54 | 119.61 | 135.24 Tota | 136.26 | 153.36 | 165.26 | 178.56 | 1920.17 | |
| Annua | l totals | | | | | | | | | k | Wh/vear | , | kWh/vear |](219) |
| Space | heating | fuel use | ed, main | system | 1 | | | | | K | , year | | 5295.71 |] |
| Water | heating | fuel use | ed | | | | | | | | | | 1820.17 | ī |
| Electric | city for p | oumps, f | ans and | electric | keep-ho | t | | | | | | | | J |
| centra | al heatir | ig pump | : | | - | | | | | | | 30 | | (230c) |
| boiler | with a f | an-assis | sted flue | | | | | | | | | 45 | | (230e) |
| Total e | lectricity | / for the | above, | kWh/yea | ır | | | sum | of (230a). | (230g) = | | | 75 | (231) |
| Electric | city for li | ghting | · | | | | | | | | | | 351.14 | _ (232) |
| 12a. (| CO2 em | issions · | – Individ | lual heat | ing syste | ems inclu | uding mi | cro-CHF |) | | | | | 7 |
| | | | | | | Г., | | | | F mion | lon foo | 1 | Freissiana | |
| | | | | | | ⊏n kW | h/year | | | kg CO | 2/kWh | tor | kg CO2/yea | r |
| Space | heating | (main s | system 1 |) | | (21 | 1) x | | | 0.2 | 16 | = | 1143.87 | (261) |
| Space | heating | (second | dary) | | | (21 | 5) x | | | 0.5 | 19 | = | 0 | (263) |
| Water | heating | | | | | (21 | 9) x | | | 0.2 | 16 | = | 393.16 | (264) |
| Space | and wa | ter heati | ng | | | (26 | 1) + (262) | + (263) + (| (264) = | | | | 1537.03 | (265) |
| Electric | city for p | oumps, f | ans and | electric | keep-ho | t (23 | 1) x | | | 0.5 | 19 | = | 38.93 | (267) |
| Electric | city for li | ghting | | | | (23 | 2) x | | | 0.5 | 19 | = | 182.24 | (268) |
| Total C | CO2, kg/ | year | | | | | | | sum o | of (265)(2 | 271) = | | 1758.19 | (272) |
| Dwelli | ng CO2 | Emissi | on Rate |) | | | | | (272) | ÷ (4) = | | | 21.53 | (273) |
| El ratir | ng (secti | on 14) | | | | | | | | | | | 81 | (274) |

ej7°

Appendix C

Part G Water Use calculations



| hrealohal | |
|-------------------|------------------|
| Job no: | 17282 |
| Date: | 19th May 2017 |
| Assessor name: | Neil Ingham |
| Registration no: | STRO010493 |
| Development name: | 13-15 Johns Mews |
| Issue Date: | 19th May 2017 |
| Rainwater Gr | reywater Results |

WATER EFFICIENCY CALCULATOR FOR NEW DWELLINGS

(for use with the Code for Sustainable Homes issues Wat 1 for the May 2009 and subsequent versions)

Dwelling Description Typical 2 bed 2 bath Flat

1st step - Select from options below:

| No | Is a Rain and/or Greywater system specified? |
|-----|---|
| Yes | Is a shower AND bath present? |
| No | Has a washing machine been specified? |
| No | Has a dishwasher been specified? |

2nd step - Build spreadsheet (click button below)

BUILD SPREADSHEET

As soon as this button is pressed the spreadsheet will change according to the options selected previously in the 1st step. Scroll down to see the changes.

3rd step - Enter consumption details for the specified fittings

| TAPS (excluding kitchen taps) | | Fitting type | Flow rate (litres/min) | Number of fittings |
|----------------------------------|---|--------------------------------------|------------------------|-----------------------|
| | 1 | Basin Taps | 4.50 | 2 |
| | 2 | | | |
| | 3 | | | |
| | 4 | | | |
| | | Proportionate flow rate (litres/min) | | 3.15 |
| | | Consumption / person / day (Litres) | | 8.69 |

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| BATHS | | Fitting type | Capacity to overflow (litres) | Number of fittings |
|--|-----|-------------------------------------|----------------------------------|-----------------------|
| | 1 | Main Bath | 155.00 | 1 |
| | 2 | | | |
| | 3 | | | |
| | 4 | | | |
| | | Proportionate of | apacity to overflow (litres) | 108.50 |
| | | Consump | otion / person / day (Litres) | 17.05 |
| SHOWERS | | Fitting type | Flow rate (litres/min) | Number of fittings |
| | 1 | Shower | 9.00 | 2 |
| | 2 | | | |
| | 3 | | | |
| | 4 | | | |
| | | Proporti | onate flow rate (litres/min) | 6.30 |
| | | Consumption / person / day (Litres) | | 39.33 |
| DISHWASHER | | | | |
| Where no dishwasher is specified, a default consumption figure of 1.25 litres per place setting is used. | | | | |
| | | Consump | otion / person / day (Litres) | 4.50 |
| | | | | Number of |
| WASHING MACHI | NES | | | <i>fittin m</i> = |



fittings

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| us | sed. | | | | |
|---------------------|---|--------------|--|-------------------------------|-----------------------|
| Whe | Where no washing machines have been specified but plumbing for future | | | | |
| | 34 | spiy or give | | | |
| | | | Consump | 17.16 | |
| | | | | | |
| WC's | Fitting Ty | /pe | Flush Type | Volume** | Number of fittings |
| | Duel Flu | | Full Flush | 4.50 | 0 |
| | Dual Flu | sn | Part Flush | 3.00 | 2 |
| | | | Full Flush | | |
| | | | Part Flush | | |
| 3 | | | Full Flush | | |
| | | | Part Flush | | |
| 4 | | | Full Flush | | |
| | | | Part Flush | | |
| | | | Average effective flushing volume (litres) | | 3.50 |
| | | | Consump | otion / person / day (Litres) | 15.47 |
| KITCHE | N SINK T | APS | Fitting Type | Flow rate (litres/minute) | Number of fittings |
| | | 1 | Kitchen Tap | 5.50 | 1 |
| | | 2 | | | |
| | | 3 | | | |
| | | 4 | | | |
| | Proportionate flow rate (litres/min) | | | 3.85 | |
| | Consumption / person / day (Litres) | | | 12.78 | |
| WASTE DISPOSAL UNIT | | | | | |

| Is a waste disposal unit specified for the dwelling? | | No | |
|--|--|----|------|
| | Consumption / person / day (Litres) 0.00 | | 0.00 |
| WATER SOFTENER | | | |
| | Water Softener in use? No | | |
| Total capacity used per regeneration (%) | | | |

| Water consumed per regeneration (litres) | |
|---|------|
| Average number of regeneration cycles per day (No.) | |
| Number of occupants served by the system (No.) | |
| Water consumed beyond 4% person / day (Litres) | 0.00 |

4th step - Analyse Results

Go to Start

| INTERNAL WATER CONSUMPTION | | | | |
|--|---------------------|--------|--|--|
| NET INTERNAL WATER CONSUMPTION | (litres/person/day) | 114.98 | | |
| RAINWATER ONLY COLLECTION SAVING | (litres/person/day) | 0.00 | | |
| GREYWATER ONLY RECYCLING SAVING | (litres/person/day) | 0.00 | | |
| RAIN/GREYWATER COLLECTION SAVING (combined system) | (litres/person/day) | 0.00 | | |
| NORMALISATION FACTOR | (litres/person/day) | 0.91 | | |
| TOTAL WATER CONSUMPTION | (litres/person/day) | 104.6 | | |
| | 3 | | | |
| (| Level 3/4 | | | |

| 17. K COMPLIANCE | | | |
|-------------------------|-------------------------|-------|--|
| EXTERNAL WATER USE | (litres / person / day) | 5.00 | |
| TOTAL WATER CONSUMPTION | (litres / person / day) | 109.6 | |
| | 17. K COMPLIANCE? | Yes | |

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