

Sustainability & Energy Statement

Arlington Works, 23 Arlington Road, Twickenham (With Amendments Highlighted in Yellow)

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1st November 2018





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Executive Summary

This revision to the Sustainability and Energy Statement has been amended in response to queries raised by Climate Integrated Solutions acting for LBRuT. The Statement has been prepared in support of a planning application to provide five commercial units totalling 610 m² and 24, 1, 2 and 3-bedroom apartments at the Arlington Works, 23 Arlington Road, Twickenham. It includes an energy demand assessment showing how selected energy efficiency, low carbon and renewable energy measures have been incorporated into the development design.

Working drawings have yet to been produced but SAP calculations have been prepared for a sample of the apartments based upon an agreed construction specification and the detailed planning drawings and a SBEM calculation for a similar unit built to a similar specification has been used for the commercial accommodation. When aggregated across all development these calculations provide an estimate of the total baseline emissions. The calculations used are attached as Appendices 4 & 5.

It is proposed to enhance the fabric insulation standards of the buildings and the energy modelling has assumed the installation of an air source heat pump into each of the five commercial units. The specific unit will be selected at the construction stage but details of an appropriate unit have been attached as Appendix 6. These systems will provide space heating and cooling if required. The apartments will be provided with individual gas condensing boilers. In addition it is proposed to install a photovoltaic array totalling 19.8 kW. This will be comprised of 66 x 300W panels and a Roof Layout is attached as Appendix 3 showing the possible location of the panels. The layout is indicative but demonstrates the quantity of panels can be accommodated. A sketch is also attached in Appendix 3 showing the spacing required between rows to avoid overshadowing.

There is currently no district heating network serving the site and we understand none is planned in the foreseeable future. The site does not have sufficient baseload to efficiency sustain a communal heating system either with or without a combined heat and power unit and therefore neither is proposed.

The combined reduction as a result of the energy efficiency measures (Be Clean) and the use renewable technologies (Be Green) can be summarised as follows;

| | Total Emissions | % Reduction |
|---|-----------------------------|---------------------------------|
| | kg CO ₂ per year | |
| Baseline (Building Regulations TER) - Commercial | <mark>12,139</mark> | • |
| Baseline (Building Regulations TER) - Residential | <mark>27,182</mark> | |
| Baseline (Building Regulations TER) - Total | <mark>39,321</mark> | |
| Be Lean - after energy efficiency (BER) - Commercial | <mark>9,882</mark> | <mark>18.59%</mark> |
| Be Lean - after energy efficiency (DER) - Residential | <mark>25,182</mark> | <mark>7.36%</mark> |
| Be Lean - after energy efficiency (BER/DER) - Total | <mark>35,064</mark> | <u>10.83%</u> |
| Be Green - after efficiency and renewable energy | <mark>25,494</mark> | <mark>35.16%</mark> (of TER) |



The residual carbon dioxide emissions are **25.494 tonnes** and therefore the carbon offset payment required by the London Plan is **£44,089**. The Council's Consultant has asked for confirmation of the residual emissions from just the residential element. The photovoltaic array is proposed to be installed on the roof of both residential buildings and therefore the residual emissions are calculated as **15.612 tonnes**. The carbon offset for the residential element is therefore calculated as **£28,102**.

The commercial accommodation will achieve BREEAM, 'Excellent' and a Pre-Assessment Estimator is included as Appendix 1.

The London Borough of Richmond Sustainable Construction Checklist is attached as Appendix 2.

The summer overheating risk to the most vulnerable apartments is assessed as 'Medium'. This meets the requirements of the Building Regulations for overheating criteria.



1.0 Introduction

This report has been commissioned by Sharpe Refinery Service (Hydro-Carbons) Ltd and provides a Sustainability and Energy Statement for the construction of five commercial units totalling 610 m² in floor space and 24, 1, 2 & 3-bedroom apartments on land at Arlington Works, 23 Arlington Road, Twickenham.

The report describes the methodology used in assessing the development and the initiatives proposed.

The buildings have been designed and will be constructed to reduce energy demand and carbon dioxide emissions. The objective is to reduce the energy demand to an economic minimum by making investment in the parts of the buildings that have the greatest impact on energy demand and are the most difficult and costly to change in the future, namely the building fabric. Once cost effective structures have been designed, low-carbon and renewable technologies will be considered for installation to provide heat and/or electricity.

The following hierarchy will be followed:

- Lean reduce demand and consumption
- Clean increase energy efficiency
- Green provide low carbon renewable energy sources

The report has been prepared by Ivan Ball of Bluesky Unlimited who are sustainability consultants.



2.0 Planning Policy Context

National Policy

The UK Government published its sustainable development strategy in 1999 entitled "A better quality of life: A strategy for sustainable development in the UK". This sets out four main objectives for sustainable development in the UK:

- Social progress that recognises the needs of everyone.
- Effective protection of the environment.
- Prudent use of natural resources.
- Maintenance of high stable levels of economic growth and employment.

Sustainable Communities: Building for the Future, known colloquially as the Communities Plan was published in 2003. The Plan sets out a long-term programme of action for delivering sustainable communities in both urban and rural areas. It aims to tackle housing supply issues in parts of the country, low demand in other parts and the quality of our public spaces. The Communities Plan describes sustainable communities as: Active, inclusive and safe, well run, environmentally sensitive, well designed and built, well connected, thriving, well served and fair for everyone.

The most relevant national planning policy guidance on sustainability is set out in:

• National Planning Policy Framework - 2018

Paragraph 148 states;

"The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure."



Regional and Local Policies

The Development Plan comprises the London Plan (2016) and the London Borough of Richmond Local Plan (2018).

London Plan, published March 2016 – the following policies are relevant to the application:

Policy 5.2 – Minimising carbon dioxide emissions

- A Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:
 - 1 Be lean: use less energy
 - 2 Be clean: supply energy efficiently
 - 3 Be green: use renewable energy

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

Residential and Non-residential buildings:

YearImprovement on 2013 Building Regulations2013 - 201635 per cent

- C Major development proposals should include a detailed energy assessment to demonstrate how the targets for carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy.
- D As a minimum, energy assessments should include the following details:
 - a calculation of the energy demand and carbon dioxide emissions covered by the Building Regulations and, separately, the energy demand and carbon dioxide emissions from any other part of the development, including plant or equipment, that are not covered by the Building Regulations (see paragraph 5.22) at each stage of the energy hierarchy
 - *b* proposals to reduce carbon dioxide emissions through the energy efficient design of the site, buildings and services
 - c proposals to further reduce carbon dioxide emissions through the use of decentralised energy where feasible, such as district heating and cooling and combined heat and power (CHP)
 - d proposals to further reduce carbon dioxide emissions through the use of on-site renewable energy technologies.



E The carbon dioxide reduction targets should be met on-site. Where it is clearly demonstrated that the specific targets cannot be fully achieved on-site, any shortfall may be provided off-site or through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

Policy 5.3 – Sustainable design and construction

- A The highest standards of sustainable design and construction should be achieved in London to improve the environmental performance of new developments and to adapt to the effects of climate change over their lifetime.
- B Development proposals should demonstrate that sustainable design standards are integral to the proposal, including its construction and operation, and ensure that they are considered at the beginning of the design process.
- C Major development proposals should meet the minimum standards outlined in the Mayor's supplementary planning guidance and this should be clearly demonstrated within a design and access statement. The standards include measures to achieve other policies in this Plan and the following sustainable design principles:
 - a. minimising carbon dioxide emissions across the site, including the building and services (such as heating and cooling systems)
 - b. avoiding internal overheating and contributing to the urban heat island effect
 - c. efficient use of natural resources (including water), including making the most of natural systems both within and around buildings
 - d. minimising pollution (including noise, air and urban runoff)
 - e. minimising the generation of waste and maximising reuse or recycling
 - f. avoiding impacts from natural hazards (including flooding)
 - g. ensuring developments are comfortable and secure for users, including avoiding the creation of adverse local climatic conditions
 - h. securing sustainable procurement of materials, using local supplies where feasible, and
 - *i.* promoting and protecting biodiversity and green infrastructure.

Policy 5.6 – Decentralised energy in development proposals

- A Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems.
- *B* Major development proposals should select energy systems in accordance with the following hierarchy:
 - 1 Connection to existing heating or cooling networks
 - 2 Site wide CHP network
 - 3 Communal heating and cooling.
- C Potential opportunities to meet the first priority in this hierarchy are outlined in the London Heat Map tool. Where future network opportunities are identified, proposals should be designed to connect to these networks.



Policy 5.7 – Renewable Energy

B Within the framework of the energy hierarchy (Policy 5.2), major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible.

Policy 5.15 – Water Use and Supplies

- *B* Development should minimise the use of mains water by:
 - a incorporating water saving measures and equipment
 - *b designing residential development so that mains water consumption would meet a target* of 105 litres or less per head per day

Sustainable Design and Construction SPG – April 2014

The SPG provides Guidance on how schemes should comply with the London Plan and this Sustainability Statement has been prepared in accordance with the Guidance provided.

London Borough of Richmond

The London Borough of Richmond adopted its new Local Plan on the 3rd July 2018 and this supersedes the Core Strategy (2009) and the Development Management Plan (2011).

The following policy is of particular relevance to the topic area of this Statement and has been edited for clarity and relevance to the application in question.

Local Plan (2018)

Policy LP 22 - Sustainable Design and Construction

A. Developments will be required to achieve the highest standards of sustainable design and construction to mitigate the likely effects of climate change. Applicants will be required to complete the following:

- Development of 1 dwelling unit or more, or 100sqm or more of non-residential floor space (including extensions) will be required to complete the Sustainable Construction Checklist SPD. A completed Checklist has to be submitted as part of the planning application.
- 2. Development that results in a new residential dwelling, including conversions, change of use, and extensions that result in a new dwelling unit, will be required to incorporate water conservation measures to achieve maximum water consumption of 110 litres per person per day for homes (including an allowance of 5 litres or less per person per day for external water consumption).
- 3. New non-residential buildings over 100sqm will be required to meet BREEAM 'Excellent' standard.



Reducing Carbon Dioxide Emissions

B. Developers are required to incorporate measures to improve energy conservation and efficiency as well as contributions to renewable and low carbon energy generation. Proposed developments are required to meet the following minimum reductions in carbon dioxide emissions:

- 1. All new major residential developments (10 units or more) should achieve zero carbon standards in line with London Plan policy.
- 2. All other new residential buildings should achieve a 35% reduction.
- 3. All non-residential buildings over 100sqm should achieve a 35% reduction. From 2019 all major non-residential buildings should achieve zero carbon standards in line with London Plan policy.

Targets are expressed as a percentage improvement over the target emission rate (TER) based on Part L of the 2013 Building Regulations.

- C. This should be achieved by following the Energy Hierarchy:
- 1. Be lean: use less energy
- 2. Be clean: supply energy efficiently
- 3. Be green: use renewable energy

Decentralised Energy Networks

D. The Council requires developments to contribute towards the Mayor of London target of 25% of heat and power to be generated through localised decentralised energy (DE) systems by 2025. The following will be required:

1. All new development will be required to connect to existing DE networks where feasible. This also applies where a DE network is planned and expected to be operational within 5 years of the development being completed.

Applicants are required to consider the installation of low, or preferably ultra-low, NOx boilers to reduce the amount of NOx emitted in the borough.

Local opportunities to contribute towards decentralised energy supply from renewable and low-carbon technologies will be encouraged where appropriate.



3.0 Assessment Methodology

The baseline energy demand and carbon dioxide emissions for the development have been established using agreed building specifications and the detailed planning drawings.

A number of calculations have been prepared for a representative number of units.

A SBEM calculation prepared for one of the commercial units and the results have been aggregated across all commercial accommodation to provide a total emissions figure.

A range of SAP calculations have been prepared for the representative range of the residential units including a 1-Bedroom apartment of 50.6 m^2 , which has been modelled as a ground-floor and mid-floor unit (there are no top-floor 1-Bedroom apartments) and for a 3-Bedroom apartment of 76.1 m^2 modelled as a ground, mid and top-floor unit. It is assumed the two duplex apartments will have the same emissions as a top-floor 3-Bedroom unit.

The results from the SAP calculations have been aggregated across units of a similar floor area to deduce the total site emissions.

Emission Factors

The CO_2 emission factors, where applicable, used throughout this report have been taken from the Building Regulation Approved Document L - 2013.

| | kg CO₂/kWh |
|---------------------------|------------|
| Natural Gas | 0.216 |
| Grid supplied electricity | 0.519 |
| Displaced electricity | 0.519 |

In assessing this proposal we have also been informed by the following guidance:

London Sustainability Checklist

BRE Green Guide to Specification

The Building Research Establishment Green Guide to Specification lists building materials and components, and ranks their potential life cycle environmental impact.



4.0 Proposal

The proposal is for the erection of five, commercial units and 24, 1, 2 & 3-bedroom apartments.

The accommodation schedule is;

| Unit Type | No. | Area | Totals |
|----------------------------|-----|-------|---------|
| | | m² | m² |
| Commercial | | | |
| Unit 5 | 1 | 75.2 | 75.2 |
| Unit 3 | 1 | 133.0 | 133.0 |
| Unit 1 | 1 | 133.2 | 133.2 |
| Unit 2 | 1 | 133.8 | 133.8 |
| Unit 4 | 1 | 134.8 | 134.8 |
| Sub-Total | 5 | | 610.0 |
| Residential | | | |
| 1-Bedroom apartment | 5 | 50.6 | 253.0 |
| 2-Bedroom apartment | 2 | 62.0 | 124.0 |
| 2-Bedroom apartment | 2 | 62.4 | 124.8 |
| 2-Bedroom apartment | 1 | 71.5 | 71.5 |
| 2-Bedroom apartment | 1 | 72.1 | 72.1 |
| 2-Bedroom apartment | 1 | 74.1 | 74.1 |
| 3-Bedroom apartment | 4 | 75.7 | 302.8 |
| 3-Bedroom apartment | 3 | 76.1 | 228.3 |
| 3-Bedroom apartment | 2 | 76.4 | 152.8 |
| 2-Bedroom apartment | 1 | 78.0 | 78.0 |
| 3-Bedroom duplex apartment | 1 | 101.0 | 101.0 |
| 3-Bedroom duplex apartment | 1 | 101.1 | 101.1 |
| Sub-Total | 24 | | 1,683.5 |
| Total | | | 2,293.5 |



5.0 Energy Efficiency

5.1 Demand Reduction (Be Lean)

Design

The energy performance of a building is affected by its design, construction and use and whilst occupant behaviour is beyond the remit of this statement, better design and construction methods can significantly reduce the life cycle emissions of a building and assist the occupant to reduce consumption.

Sustainable design is not just about incorporating renewable technologies; buildings should be designed at the outset to provide suitable environmental conditions for the occupants whilst also consuming as little energy as practical. It is possible to exceed Building Regulations requirements (Part L - 2013) through demand reduction measures alone, which typically include a combination of passive design measures (e.g. building design and efficient building fabric) and active design measures (e.g. variable speed motors).

Passive Design Measures

The passive design measures proposed include;

Passive Solar Gain

Passive measures include allowing for natural ventilation and exposed thermal mass coupled with high levels of insulation, air tightness and the control of solar gain.

The layout of the buildings are in the context of the shape of the site and surrounding development but broadly the commercial units and homes are arranged to provide all units with either a north-west and south-east or south-west and north-east orientation. There are six single aspect units (1-Bedroom apartments) which benefit from a south-east orientation.

There are no units with a solely northerly aspect and therefore all have access to sunshine at some point throughout the day.

Natural Daylighting

The orientation and the size of the windows have been optimised to maximise the amount of natural daylight and therefore reduce the demand for artificial lighting.



Efficient Building Fabric

Building Envelope

U-values of the building envelope must meet Building Regulations Part L standards and further improvements to U-values will reduce the building's heating requirements.

There is a commitment to exceed the minimum U-values required by the Building Regulations

Whilst the construction type has not been fixed both the residential and commercial units would suit the use of load bearing walls with either timber I beam or concrete intermediate floors.

The following U-values have been based upon the use of a 300mm load bearing cavity wall with 100mm cavity fully filled with XtraTherm CavityTherm or similar. Ground floors will be insulated with 150mm PIR insulation and flat roofs will be insulated with PIR insulation on top of the roof decking.

Windows are proposed as double glazed with Low 'e' soft coat and argon filled.

It is proposed to set maximum limits for the elemental U-values as follows:

| Element | Part L Limiting U-values | Proposed U-values | Proposed Improvement |
|----------------|--------------------------------|----------------------|-------------------------|
| | W/m ² K | W/m ² K | |
| External Walls | 0.30 | 0.17 | 43% |
| Flat Roofs | 0.20 | 0.16 | 20% |
| Ground Floors | 0.20 | 0.11 | 40% |
| Windows | 2.00 | 1.40 | 30% |

Air Leakage

Large amounts of heat are lost in winter through air leakage from a building (also referred to as infiltration or air permeability) often through poor sealing of joints and openings in the building

The Building Regulations set a minimum standard for air permeability of 10 m³ of air per hour per m² of envelope area, at 50Pa. The air tightness standards at this site will target a 60% improvement over the Regulations and will seek to achieve a permeability of less than $4m^3/hr/m^2$.

Thermal Bridging

The significance of Thermal Bridging, as a potentially major source of fabric heat losses, is increasingly understood. Improving the U-values for the main building fabric without accurately addressing the Thermal Bridging is no longer an option and will not achieve the fabric energy efficiency and energy and CO₂ reduction targets set out in this strategy.



Accredited Construction Details (ACD's) have been developed to provide the performance standards required to achieve the higher energy efficiency requirements of the Building Regulations. The bridging losses have been calculated using SAP Appendix K Table 1.

Ventilation

As a result of increasing thermal efficiency and air tightness, Building Regulations Approved Document F18 was also revised in 2006 to address the possibility of overheating and poor air quality. It has been assumed that individual mechanical extract ventilation units will be provided to all WCs, bathrooms and shower rooms and that the apartments on the south-eastern side of the main building will benefit from natural ventilation and for those rooms on the north-western side of the main building acoustically damped ventilation units will be installed and ventilation systems will be used to allow windows adjacent to the railway to remain closed when required.

Active Design Measures will include;

Efficient Lighting and Controls

Throughout the scheme natural lighting will be optimised.

Approved Document L1A requires three in four light fittings (75%) to be dedicated low energy fittings. The development will exceed this and all light fittings will be of a dedicated energy efficient type.

External lighting will be fitted with time controls and light sensors to ensure illumination is restricted to required times. External lighting will be limited to a maximum fitting output of 150w.

Heating

Space heating and hot water demand will be provided to the apartments by natural gas fired combination boilers.

The SAP calculations have been modelled on the use of an Alpha Intec combination boiler, which has NOx emissions of 27 mg/kWh and therefore complies with the policy requirements governing boiler emissions.

The space heating to the commercial units is proposed to be provided by air source heat pumps, which could also provide cooling if required. The requirement for cooling will depend on the end use of the unit in question but the BRUKL used to calculate the carbon emissions has assumed cooling is provided to all units and therefore assumes the worse case scenario. The specific unit to be used will be determined at the detailed working drawing stage but an appropriate unit is attached as Appendix 6 showing an example of the type of installation proposed.



5.2 Establishing Carbon Dioxide Emissions

Commercial Accommodation

The baseline emissions for the non-residential space has been established by using a SBEM calculation from similar accommodation built to a similar specification. The calculation used is attached as Appendix 4. Also attached is an alternative BRUKL calculation for another similar unit.

The specification has been assumed as follows and includes an installation of an air source heat pump to provide space heating and cooling:

| Element | Specification |
|--------------|---------------------------------|
| Ventilation | VRF with mechanical ventilation |
| SFP (W/I/s) | 1.6 |
| HR % | 70 |
| Heating | Electric Heat Pump |
| Efficiency % | 450 |
| Cooling | Electric |
| Efficiency % | 4.5 |
| Hot Water | Electric |
| Efficiency % | 100% |

The emissions are calculated as follows:

| B1 Accommodation | TER CO₂ Emissions | BER CO ₂ Emissions |
|----------------------|-------------------------|-------------------------------------|
| | kg CO₂ /yr | kg CO ₂ /yr |
| B1 accommodation | 19.9 | 16.2 |
| Emissions (per year) | 19.9 | 16.2 |

Residential

SAP calculations have been prepared for a 1-Bedroom Ground-floor and Mid-floor apartment at 50.6 m^2 , which are presented as representative of the five 1-Bedroom apartments. A SAP calculation has been prepared for a 3-Bedroom Ground, Mid and Top-floor apartment at 76.1 m^2 , which are presented as representative of all 2 and 3-Bedroom apartments.

It is assumed the two, 3-Bedroom Duplex apartments will have similar emissions to the Top-floor 3-Bedroom apartments.



The modelling has been based on the use of a gas combination boiler to provide space and hot water heating. The Building Regulation Compliance Report, TER and DER Worksheets are attached as Appendix 5 but the results can be summarised as follows:

| 1-Bed Ground-floor apartment 50.6 m ² | CO₂ TER | CO₂ DER |
|---|------------|------------|
| | kg/m²/yr | kg/m²/yr |
| Space heating | 5.92 | 5.79 |
| Water heating | 8.30 | 7.06 |
| Electricity for pumps and fans | 0.77 | 0.77 |
| Electricity for lighting | 2.43 | 2.43 |
| Total | 17.42 | 16.05 |

| 1-Bed Mid-floor apartment 50.6 m ² | CO₂ TER | CO₂ DER |
|--|------------|------------|
| | kg/m²/yr | kg/m²/yr |
| Space heating | 3.70 | 4.17 |
| Water heating | 8.39 | 7.07 |
| Electricity for pumps and fans | 0.77 | 0.77 |
| Electricity for lighting | 2.43 | 2.43 |
| Total | 15.29 | 14.44 |

| 3-Bed Ground-floor apartment 76.1 m ² | CO₂ TER | CO₂ DER |
|---|------------|------------|
| | kg/m²/yr | kg/m²/yr |
| Space heating | 7.82 | 7.27 |
| Water heating | 6.64 | 5.50 |
| Electricity for pumps and fans | 0.51 | 0.51 |
| Electricity for lighting | 2.28 | 2.28 |
| Total | 17.25 | 15.56 |

| 3-Bed Mid-floor apartment 76.1 m ² | CO₂ TER | CO₂ DER |
|--|------------|------------|
| | kg/m²/yr | kg/m²/yr |
| Space heating | 5.55 | 5.49 |
| Water heating | 6.69 | 5.51 |
| Electricity for pumps and fans | 0.51 | 0.51 |
| Electricity for lighting | 2.28 | 2.28 |
| Total | 15.03 | 13.79 |



| 3-Bed Top-floor apartment 76.1 m ² | CO₂ TER | CO ₂ DER |
|--|------------|------------------------|
| | kg/m²/yr | kg/m²/yr |
| Space heating | 7.23 | 7.53 |
| Water heating | 6.65 | 5.50 |
| Electricity for pumps and fans | 0.51 | 0.51 |
| Electricity for lighting | 2.28 | 2.28 |
| Total | 16.67 | 15.82 |

Total Emissions

Using the above information the total carbon emissions from the site following the energy efficiency measures detailed can be calculated as follows:

| | Area | TER CO2 | DER/BER CO ₂ |
|--|--------|------------|----------------------------|
| | m² | kg/year | kg/year |
| Commercial | | | |
| B1 Office Accommodation | 610.0 | 12,139 | 9,882 |
| Sub-total | 610.0 | 12,139 | 9,882 |
| Residential | | | |
| 1-Bed ground-floor apartments | 50.6 | 881 | 812 |
| 1-Bed mid-floor apartments | 202.4 | 3,095 | 2,923 |
| 2 & 3-Bed ground-floor apartments | 399.0 | 6,883 | 6,208 |
| 2 & 3-Bed mid-floor apartments | 531.7 | 7,991 | 7,332 |
| 2 & 3-Bed top-floor apartments (inc. duplexes) | 499.8 | 8,332 | 7,907 |
| Sub-total | 1683.5 | 27,182 | 25,182 |
| Totals | | 39,321 | 35,064 |

The total emissions based upon the TER for the units is assessed as:

• 39,321 kg CO₂ per year

The total emissions based upon the DER and BER for the units is assessed as:

• 35,064 kg CO₂ per year

The reduction in site CO₂ emissions as a result of the energy efficiency measures incorporated in the building is assessed as;

4,257 kg CO₂ per year, which equates to a reduction of 10.83%



5.3 Overheating Assessment

Commercial

Commercial units 3 and 4 only have openings on the north-west elevation and therefore do not have any risk of overheating.

Commercial units 1, 2 and 5 do have existing openings orientated towards the south-east.

| | Floor Area (FA) | Window Area (WA) | % (FA/WA) |
|---------------------|-------------------|-------------------|---------------------|
| | m² | m² | |
| Unit 1 Ground-floor | <mark>66.6</mark> | <mark>1.94</mark> | <mark>2.91%</mark> |
| Unit 1 First-floor | <mark>66.6</mark> | <mark>3.38</mark> | <mark>5.08%</mark> |
| Unit 2 Ground-floor | <mark>66.9</mark> | <mark>1.94</mark> | <mark>2.90%</mark> |
| Unit 2 First-floor | <mark>66.9</mark> | <mark>6.69</mark> | <mark>10.00%</mark> |
| Unit 5 Ground-floor | <mark>37.6</mark> | <mark>0.88</mark> | <mark>2.34%</mark> |
| Unit 5 First-floor | <mark>37.6</mark> | <mark>5.06</mark> | <mark>13.46%</mark> |

As can be seen the percentages of window opening to floor area is low for each unit. Therefore, it is suggested a full TM59 overheating assessment is not required and the risk of overheating to the commercial units is low.

Residential

As a consequence of the proximity of railway line to the north-west of the site a number of apartments will require noise attenuation measures. The apartments, which have a façade facing the railway line are all at least dual aspect and therefore the rooms to the south-west, south-east or north-east elevation can benefit from opening windows. In addition the rooms, which are orientated towards the railway line are north-west facing and therefore are not likely to suffer from excessive solar gain. The SAP modelling has assumed windows on the south-west (or north-east) and south-east elevations will be opening and that windows on the north-west elevation will be designed to be closed with ventilation to specific room provided by acoustically damped ventilation units.

The increased thermal mass provided by traditional construction will assist in stabilising summer nighttime temperatures.

In addition, the 'g' value of the glazing has been reduced to 0.63 to reduce solar gain. This glazing has been selected as providing the best balance between winter solar gain to provide passive heating within the apartments and limiting summer solar gain to reduce passive overheating.



The Overheating Assessment for each of the modelled apartments can be summarised as follows;

| | Likelihood | Assessment | | |
|--------------------|------------|------------|--------|--------|
| | June | July | August | |
| 1-Bed Ground-floor | Slight | Medium | Medium | Medium |
| 1-Bed Mid-floor | Slight | Medium | Medium | Medium |
| 3-Bed Ground-floor | Slight | Medium | Medium | Medium |
| 3-Bed Mid-floor | Slight | Medium | Medium | Medium |
| 3-Bed Top-floor | Slight | Medium | Medium | Medium |

These results demonstrate the apartments all pass Building Regulations with regards to the overheating criteria.



5.4 Low-Carbon and Renewable Technologies (Be Clean and Be Green)

The energy demand established above has been used to test the viability of various low-carbon and renewable technologies as follows.

This section determines the appropriateness of each renewable technology and considers the ability of each technology to comply with the planning requirements as set out above in Section 2.0.

The Government's Renewable Obligation defines renewable energy in the UK. The identified technologies are;

- Small hydro-electric
- Landfill and sewage gas
- Onshore and offshore wind
- Biomass
- Tidal and wave power
- Geothermal power
- Solar

The use of landfill or sewage gas, offshore wind or any form of hydroelectric power is not suitable for the site due to its location. The remaining technologies are considered below;

Wind

Wind turbines are available in various sizes from large rotors able to supply whole communities to small roof or wall-mounted units for individual dwellings.

The Government wind speed database predicts local wind speeds at Arlington Road to be 4.6 m/s at 10m above ground level and 5.4 m/s at 25m above ground level. This is below the level generally required for commercial investment in large wind turbines and in addition the land take, potential for noise and signal interference make a large wind turbine unsuitable for this development.

Roof mounted turbines could be used at the development to generate small but valuable amounts of renewable electricity but the small output and contribution to total emissions means any investment would be small and purely tokenism. In addition the use of wind turbines will have a detrimental aesthetic impact on the development.

Combined Heat and Power and Community Heating

Combined heat and power (CHP) also called co-generation is a de-centralised method of producing electricity from a fuel and 'capturing' the heat generated for use in buildings. The plant is essentially a small-scale electrical power station.



The production and transportation of electricity via the National Grid is very inefficient with over 65% of the energy produced at the power station being lost to the atmosphere and through transportation. Consequently CHP can demonstrate significant CO_2 savings and although not necessary classed as renewable energy (depending on the fuel used) the technology is low carbon.

For a CHP plant to be economic it needs to operate for as much of the time as possible (usually deemed to be in excess of 14 hours per day) and therefore the size of the unit are usually based upon the hot water load of the buildings with additional boilers meeting the peak space heating demand.

In order to optimise a combined heat and power or communal heating system, whether fuelled by biomass or a fossil fuel the site needs to be relatively dense with buildings close together and preferable multi storey in order to minimise infrastructure pipe work.

The total hot water load from the residential units is 44,726 kWh per year. Mirco CHP units are available with outputs from around 12.5 kW_{th} and 5.5. kW_e, and with the anticipated baseload the unit would run for 9.80 hours per day, which is not economic. CHP is not proposed.

Ground Source Heat Pumps

Sub soil temperatures are reasonably constant and predictable in the UK, providing a store of the sun's energy throughout the year. Below London the groundwater in the lower London aquifer is at a fairly constant temperature of 12° C. Ground source heat pumps (GSHP) extract this low-grade heat and convert it to usable heat for space heating.

GSHP operates on a similar principle to refrigerators, transferring heat from a cool place to a warmer place. They operate most efficiently when providing space heating at a low temperature, typically via under floor heating or with low temperature radiators.

Theoretically, ground source heat pumps could be used subject to satisfactory ground investigation to establish whether the sub strata is appropriate.

However, there is insufficient ground area to accommodate a horizontal 'slinky' collector system for the homes and bore-hole systems would be necessary and the installation of ground source heat pumps into apartment buildings is very complex.

GSHP systems are not proposed.

Solar

(i) Solar Water Heating

Solar hot water panels use the suns energy to directly heat water circulating through panels or pipes and the technology is simple and easily understood by purchasers.



Solar hot water heating panels are based generally around two types, which are available being 'flat plate collectors' and 'evacuated tubes'. Flat plate collectors can achieve an output of up to 1,124 kWh/annum (Schuco) and evacuated tubes can achieve outputs up to 1,365 kWh/annum (Riomay).

Panels are traditionally roof mounted and for highest efficiencies should be mounted plus or minus 30 degrees of due south. Evacuated tubes can be laid horizontally on flat roofs but flat plate collectors are recommended for installation at an incline of 30 degrees

Solar hot water panels are considered appropriate and evacuated tube panels could be installed horizontally on the flat roof of the apartment building.

However, servicing units on lower floors can be problematic and therefore it is only really practical to service Plots 17-20 and Plots 23 & 24. These units have currently been modelled with a combination gas boiler and the use of solar hot water panels would require a switch to a conventional boiler with accompanying hot water cylinder. This could detrimentally impact on internal space planning. The total hot water load from these six units is 12,725 kWh per year. Assuming panels could reduce energy demand by 50%, this equates to a reduction in demand of 6,363 kWh per year with an associated reduction in CO_2 emissions of 1,374 kg CO_2 per year.

When combined with the energy efficiency measures this equates to a total reduction in emissions of **5,631 kg CO₂ per year** or **14.32%** of total (TER) emissions.

Solar hot water panels are not proposed.

(ii) Photovoltaics

Photovoltaic panels (PV) provide clean silent electricity. They generate electricity during most daylight conditions although they are most efficient when exposed to direct sunlight or are orientated to face plus or minus 30 degrees of due south.

PV panels can be integrated into many different aspects of a development including roofs, walls, shading devices or architectural panels. The panels typically have an electrical warranty of 20-25 years and an expected system lifespan of 25-40 years.

Photovoltaic panels could be used and could be installed on the flat roof of all buildings.

In order to achieve the requirements of the planning policy (and accounting for the reduction from energy efficiency measures of 4,257 kg CO₂ per year) a total of 66 x 300W photovoltaic panels would be required.

These could be accommodated on the roofs of the buildings and an indicative Roof Layout is attached as Appendix 3. This quantity of panels would reduce emissions by **9,570 kg CO₂ per year**, which when combined with the reductions from energy efficiency measures equates to a reduction of **35.16%** of TER emissions.



In addition the reduction in emissions from renewable technologies would equate to 27.29% of the DER emissions.

Photovoltaic panels are a viable method of achieving the policy requirement and there is sufficient roof area to accommodate the required quantity. The panels will be installed on frames, inclined at circa 15 degrees and orientated towards south-west. The electricity generated by each array will be connected to the landlords meter within each building with any surplus generated sold back to the Grid. A sketch is included within Appendix 3 showing how the panels could be arranged.

Air Source Heat Pumps (ASHP)

Air sourced heat pumps operate using the same reverse refrigeration cycle as ground source heat pumps, however the initial heat energy is extracted from the external air rather than the ground. These heat pumps can be reversed to provide cooling to an area although this reduces the coefficient of performance of the pumps.

ASHPs are an appropriate technology for the commercial units where there is a low hot water demand but care will need to be taken to ensure the location of the outside unit does not create a noise nuisance either to the residential neighbours or to other occupants of the commercial accommodation.

The Statement assumes the use of air source heat pumps to each commercial unit and the BRUKL modelling assumes cooling may be required. However, this will be determined by the end use of the unit in question but by assuming cooling is provided to all assumes the worse case scenario.

The specific unit to be used will be determined at the detailed working drawing stage but an appropriate unit is attached as Appendix 6 showing an example of the type of installation proposed.



5.5 Summary of Calculations and Proposals for Low-carbon and Renewable Technologies

The total site CO₂ emissions are calculated as **39,321 kg CO₂ per year** (TER) and **35,064 kg CO₂ per year** (DER/BER).

To meet the requirements of the planning policy, a reduction of 35% of the total (TER) emissions need to be achieved and the DER emissions need to be reduced by 20% through the use of renewable technologies.

Various technologies are considered above and whilst wind turbines, combined heat and power, ground or air source heat pumps (for the residential units) and solar hot water heating panels are not considered appropriate the use of photovoltaic panels and air source heat pumps for the commercial units are considered feasible and appropriate.

Be Lean

The construction standards proposed include U-values, which demonstrate good practice and improve upon those required by the Building Regulations. Air tightness standards are targeted at a 60% improvement upon the minimum required by the Building Regulations.

The DER/BER is reduced from the TER by **4,257 kg CO₂ per year** or **10.83%** as a result of the energy efficiency measures incorporated into the design.

Be Green

It is proposed to install a total of 66 x 300W photovoltaic panels. The reduction in emissions as a result of the PV panels is $9,570 \text{ kg CO}_2$ per year.

The total reduction in emissions following the energy efficiency measures (Be Lean) and the photovoltaic panels (Be Green) is 13,827 kg CO_2 per year, which equates to a reduction of <u>35.16%</u> of the TER emissions.

The reduction in (DER) emissions from renewable technologies is 27.29%



6.0 Climate change adaption and Water resources

Sustainable Drainage Systems (SUDS)

The site lies within Flood Zone 1 and is classified as being of low risk.

Surface Water Management

Rainwater harvesting butts will be provided for landscaping maintenance.

Consideration has been given to the use of grey water recycling. However, customer's resistance to the appearance of the recycled water and the cost of the systems does not currently make them a viable option. They have therefore not been included in the proposals.

Water efficiency measures

In excess of 20% of the UK's water is used domestically with over 50% of this used for flushing WCs and washing (source: Environment Agency). The majority of this comes from drinking quality standard or potable water.

The water efficiency measures included will ensure that the apartments achieve a water use target of 105 litres per person per day.

Water efficient devices will be fully evaluated, and installed, wherever possible. The specification of such devices will be considered at detailed design stage and each will be subject to an evaluation based on technical performance, cost and market appeal, together with compliance with the water use regulations.

The following devices will be incorporated within the apartments:

- Water efficient taps.
- Water efficient toilets.
- Low output showers.
- Flow restrictors to manage water pressures to achieve optimum levels.
- Water meters with guidance on water consumption and savings.

Water consumption calculations have been carried out using the Water Efficiency Calculator provided by the BRE. Although not perfect this calculator gives a good indication of the probable water use in a dwelling.



Below is a typical specification, which would achieve the 105 Litres per person per day target.

| Schedule of Appliance Water Consumption | | |
|---|-------------------------|--------------|
| Appliance | Flow rate or capacity | Total Litres |
| WC | 4/2.6 litres dual flush | 14.72 |
| Basin | 1.7 litres/min. | 5.98 |
| Shower | 8 litres/min | 24.00 |
| Bath | 160 litres | 25.60 |
| Sink | 4 litres/min | 14.13 |
| Washing Machine | Default used | 16.66 |
| Dishwasher | Default used | 3.90 |
| | | 104.99 |



7.0 Materials

The BRE Green Guide to Specification is a simple guide for design professionals. The guide provides environmental impact, cost and replacement interval information for a wide range of commonly used building specifications over a notional 60-year building life. The construction specification will prioritise materials within ratings A+, A or B.

Preference will be given to the use of local materials & suppliers where viable to reduce the transport distances and to support the local economy. A full evaluation of these suppliers will be undertaken at the next stage of design.

In addition, timber would be sourced, where practical, certified by PEFC or an equivalent approved certification body and all site timber used within the construction process would be recycled.

All insulation materials to will have a zero ozone depleting potential

Construction waste

Targets will be set to promote resource efficiency in accordance with guidance from WRAP, Envirowise, BRE and DEFRA.

The overarching principle of waste management is that waste should be treated or disposed of within the region where it is produced.

Construction operations generate waste materials as a result of general handling losses and surpluses. These wastes can be reduced through appropriate selection of the construction method, good site management practices and spotting opportunities to avoid creating unnecessary waste.

The Construction Strategy will explore these issues, some of which are set out below:

- Proper handling and storage of all materials to avoid damage.
- Efficient purchasing arrangements to minimise over ordering.
- Segregation of construction waste to maximise potential for reuse/recycling.
- Suppliers who collect and reuse/recycle packaging materials



Appendix 1 – BREEAM Pre-Assessment Estimator



BREEAM[®] UK

BREEAM UK New Construction 2014 Pre-Assessment Estimator: Assessment Issue Scoring

| Building name Arlington Works | | | | |
|--|------------|-------------------|-------------------------|-------|
| Building score (%) 71.85% | | | | |
| Building rating Excellent | | | | |
| Minimum standards level achieved Excellent level | | | | |
| | | | | |
| MANAGEMENT | | | | |
| Man 01 Project brief and design | | | | |
| No. of BREEAM credits available 4 | | Available contri | bution to overall score | 3.33% |
| No. of BREEAM innovation credits available | | Minimur | n standards applicable | Νο |
| | | | | |
| | | | | |
| Assessment Criteria | Compliant? | Credits available | Credits achieved | |
| Will stakeholder consultation (project delivery) take place | ? Yes | 1 | 1 | |
| Will stakeholder consultation (third party) take place | ? No | 1 | 0 | |
| Will a sustainability champion (design) be assigned | ? Yes | 1 | 1 | |
| Will a sustainability champion (monitoring progress) be assigned | ? Yes | 1 | 1 | |
| | | | | |
| Total BREEAM credits achieved 3 | | | | |
| Total contribution to overall building score2.50% | | | | |
| Total BREEAM innovation credits achieved 0 | | | | |
| Minimum standard(s) level N/A | | | | |
| | | | | |
| Comments/notes: | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

Man 02 Life cycle cost and service life planning

| No. of BREEAM credits available | 4 | Available contribution to overall score | 3.33% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | No |

| Assessment Criteria | | Compliant? | Credits available | Credits achieved |
|---|-------------------|------------|-------------------|------------------|
| Will an elemental life cycle cost (LCC)analyses b | e carried out? | No | 2 | 0 |
| Will a component level LCC plan b | be developed? | No | 1 | 0 |
| Will the predicted capital cost | t be reported? | No | 1 | 0 |
| Expected capital cost of the project | ct (if available) | | £/m² | |
| | | | | |
| Total BREEAM credits achieved | 0 | | | |
| Total contribution to overall building score | 0.00% | | | |
| Total BREEAM innovation credits achieved | N/A | | | |
| Minimum standard(s) level N/A | | | | |



Man 03 Responsible construction practices

| No. of BREEAM credits available | 6 | Available contribution to overall score | 5.00% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 1 | Minimum standards applicable | Yes |

| Assessment Criteria | Compliant? | Credits available | Credits achieved |
|--|------------|-------------------|------------------|
| Is all site timber used in the project 'legally harvested and traded timber'? | Yes | | |
| Will/does the principal contractor operate a compliant Environmental Management System? | Yes | 1 | 1 |
| Will a construction stage sustainability champion be assigned? | Yes | 1 | 1 |
| Will a considerate construction scheme be used by the principal contractor? (One credit where 'compliance' has been achieved. Two credits where 'compliance' is significantly exceeded.) | 1 | 2 | 1 |
| Will construction site impacts be metered/monitored? | Yes | | |
| Will site utility consumption be metered/monitored? | Yes | 1 | 1 |
| Will transport of construction materials and waste be metered/monitored? | No | 1 | 0 |
| Will exemplary level criteria be met? | | | |
| | | | |
| Total BREEAM credits achieved 4 | | | |
| Total contribution to overall building score 3.33% | | | |
| Total BREEAM innovation credits achieved 0 | | | |
| Minimum standard(s) level Excellent level | | | |
| | | | |



Man 04 Commisioning and handover

| No. of BREEAM credits available | 1 | Available contribution to overall score | 0.83% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | Yes |

| Assessment Criteria | Compliant? | Credits available | Credits achieved |
|--|------------|-------------------|------------------|
| Will commissioning schedule and responsibilities be developed & accounted for? | | | |
| Will a commissioning manager be appointed? | | | |
| Will the building fabric be commissioned? | Yes | 1 | 1 |
| Will a training schedule for building occupiers/managers at Handover? | | | |
| Will a building user guide be developed prior to handover? | | | |
| | | | |
| Total BREEAM credits achieved 1 | | | |
| Total contribution to overall building score 0.83% | | | |
| Total BREEAM innovation credits achieved N/A | | | |
| Minimum standard(s) level N/A | | | |

Comments/notes:

Man 05 Aftercare

Assessment issue not applicable

| N/A | Available contribution to overall score | N/A | No. of BREEAM credits available |
|-----|---|-----|--|
| N/A | Minimum standards applicable | N/A | No. of BREEAM innovation credits available |

| Assessment Criteria | Compliant? | Credits available | Credits achieved |
|--|------------|-------------------|------------------|
| Will aftercare support be provided to building occupiers? | | | |
| Will seasonal commissioning occur over 12months once substantially occupied? | | | |
| Will a post occupancy evaluation be carried out 1 year after occupation? | | | |
| Will exemplary level criteria be met? | | | |
| | | | |
| Total BREEAM credits achieved N/A | | | |

| Total contribution to overall building score | N/A |
|--|-----|
| Total BREEAM innovation credits achieved | N/A |
| Minimum standard(s) level | N/A |



HEALTH & WELLBEING

Hea 01 Visual Comfort

| No. of BREEAM credits available | 4 | Available contribution to overall score | 4.44% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 1 | Minimum standards applicable | No |

| Assessment Criteria | Compliant? | Credits available | Credits achieved |
|--|------------|-------------------|------------------|
| Will the design provide adequate glare control for building users? | Yes | 1 | 1 |
| Will relevant building areas be designed to achieve appropriate daylight factor(s)? | 1 | 1 | 1 |
| Will the design provide adequate view out for building users? | Yes | 1 | 1 |
| Will internal/external lighting levels, zoning and controls be specified in accordance with the relevant CIBSE Guides/British Standards? | Yes | 1 | 1 |
| Will exemplary level criteria be met? | Yes | 1 | 1 |

| Total BREEAM credits achieved | 4 |
|--|-------|
| Total contribution to overall building score | 4.44% |
| Total BREEAM innovation credits achieved | 1 |
| Minimum standard(s) level | N/A |

Comments/notes:

Hea 02 Indoor Air Quality

| No. of BREEAM credits available | 1 | Available contribution to overall score | 1.11% |
|--|-----|---|-------|
| No. of BREEAM innovation credits available | N/A | Minimum standards applicable | No |

| Assessment Criteria | Compliant? | Credits available | Credits achieved |
|--|------------|-------------------|------------------|
| Will an air quality plan be produced and building designed to minimise air pollution? | | | |
| Will building be designed to minimise the concentration and recirculation of pollutants in the building? | | | |
| Will the relevant products be specified to meet the VOC testing and emission levels required? | | | |
| Will formaldehyde and total VOC levels be measured post construction? | | | |
| Will the building be designed to, or have the potential to provide, natural ventilation? | Yes | 1 | 1 |
| Will exemplary level VOCs (products)criteria be met? | | | |

| Total BREEAM credits achieved | 1 |
|--|-------|
| Total contribution to overall building score | 1.11% |
| Total BREEAM innovation credits achieved | N/A |
| Minimum standard(s) level | N/A |



Assessment issue not applicable

Hea 03 Safe containment in laboratories

| No. of BREEAM credits available | N/A | Available contribution to overall score | N/A |
|--|-----|---|-----|
| No. of BREEAM innovation credits available | N/A | Minimum standards applicable | N/A |

| Assessment Criteria | Compliant? | Credits available | Credits achieved |
|---|------------|-------------------|------------------|
| Will an objective risk assessment of proposed laboratory facilities' design be completed? | | | |
| Will the manufacture & installation of fume cupboards and containment devices meet best practice standards? | | | |
| Will containment level 2 & 3 labs meet best practice safety & performance criteria? | | | |

| N/A | Total BREEAM credits achieved |
|-----|--|
| N/A | Total contribution to overall building score |
| N/A | Total BREEAM innovation credits achieved |
| N/A | Minimum standard(s) level |

Comments/notes:

Hea 04 Thermal comfort

| No. of BREEAM credits available | 1 | Available contribution to overall score | 1.11% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | No |

| Assessment Criteria | Compliant? | Credits available | Credits achieved |
|--|------------|-------------------|------------------|
| Will thermal modelling of the design be carried out? | Yes | 1 | 1 |

| Total BREEAM credits achieved | 1 |
|--|-------|
| Total contribution to overall building score | 1.11% |
| Total BREEAM innovation credits achieved | N/A |
| Minimum standard(s) level | N/A |



Hea 05 Acoustic Performance

| No. of BREEAM credits available | 1 | Available contribution to overall score | 1.11% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | No |

| Assessment Criteria | | Credits | Credits available | Credits achieved |
|---|--|---------|-------------------|------------------|
| Will the building meet the appropriate acoustic performance standards and ter a b. Indoor a c. Rev | sting requirements for: a. Sound insulation Imbient noise level verberation times? | 1 | 1 | 1 |
| | | | | |
| Total BREEAM credits achieved | 1 | | | |
| Total contribution to overall building score | 1.11% | | | |
| Total BREEAM innovation credits achieved | N/A | | | |
| Minimum standard(s) level | N/A | | | |

Comments/notes:

Hea 06 Safety and Security

| No. of BREEAM credits available | 2 | Available contribution to overall score | 2.22% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | No |

| Assessment Criteria | | Compliant? | Credits available | Credits achieved |
|---|-------|------------|-------------------|------------------|
| Where external site areas are present, will safe access be designed for pedestrians and cyclists? | | Yes | 1 | 1 |
| Will a suitably qualified security consultant be appointed and security considerations accounted for? | | Yes | 1 | 1 |
| Total BREEAM credits achieved | 2 | | | |
| Total contribution to overall building score | 2.22% | | | |
| Total BREEAM innovation credits achieved | N/A | | | |
| Minimum standard(s) level | N/A | | | |



ENERGY

Ene 01 Reduction of energy use and carbon emissions

| No. of BREEAM credits available | 12 | Available contribution to overall score | 10.88% |
|--|----------------------|---|--------|
| No. of BREEAM innovation credits available | 5 | Minimum standards applicable | Yes |
| | | | |
| How do you wish to assess the number of BREEAM credits achie | eved for this issue? | Define a target number of BREEAM credits achieved | |
| Select the target number of BREEAM credits for | or the Ene01 issue: | 8 | |

Ene 01 Calculator

| Country of the UK where the building is located | | Confirm building regulation and version to be used: | |
|---|--|---|--|
|---|--|---|--|

| New Construction (shell only) | |
|--|------------|
| Building floor area | m2 |
| Notional building heating and cooling energy demand | MJ/m2yr |
| Actual building heating and cooling energy demand | MJ/m2yr |
| Notional building primary energy consumption | kWh/m2yr |
| Actual building primary energy consumption | kWh/m2yr |
| Target emission rate (TER) | kgCO2/m2yr |
| Building emission rate (BER) | kgCO2/m2yr |
| Building emission rate improvement over TER | |
| Heating & cooling demand energy performance ratio (EPR _{ED}) | |
| Primary consumption energy performance ratio (EPR _{PC}) | |
| CO ₂ Energy performance ratio (EPR _{co2}) | |
| Overall building energy performance ratio (EPR _{NC}) | |

| Where specified, please confirm the energy production from onsite or near site energy generation technologies | |
|--|--|
| Equivalent % of the building's 'regulated' energy consumption generated by carbon neutral sources and used to meet energy demand from 'unregulated' building | |
| systems or processes? | |
| Is the building designed to be 'carbon negative' ? | |
| If the building is defined as 'carbon negative' what is the total (modelled) renewable/carbon neutral energy generated and exported? | |

| Total BREEAM credits achieved | 8 |
|--|-------------------|
| Total contribution to overall building score | 7.25% |
| Total BREEAM innovation credits achieved | N/A |
| Minimum standard(s) level | Outstanding level |


Ene 02 Energy monitoring

| No. of BREEAM credits available | N/A | Available contribution to overall score | N/A |
|--|-----|---|-----|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | Yes |

| Assessment criteria | | Compliant? | Credits available | Credits achieved |
|--|------------------|------------|-------------------|------------------|
| Will a BMS or sub-meters be specified to monitor energy use from major building se | ervices systems? | | | |
| Will a BMS or sub-meters be specified to monitor energy use by tenant/building | function areas? | | | |
| Total BREEAM credits achieved | N/A | | | |
| Total contribution to overall building score | N/A | | | |
| Total BREEAM innovation credits achieved | N/A | | | |
| Minimum standard(s) level N/ | Ά | | | |

Comments/notes:

Ene 03 External lighting

| No. of BREEAM credits available | 1 | Available contribution to overall score | 0.91% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | No |

| Assessment criteria | Compliant? | Credits available | Credits achieved |
|--|------------|-------------------|------------------|
| Will external light fittings and controls be specified in accordance with the BREEAM criteria? | | 1 | 1 |
| | 1 | | |
| Total BREEAM credits achieved 1 | | | |
| Total contribution to overall building score 0.91% | | | |
| Total BREEAM innovation credits achieved N/A | | | |
| Minimum standard(s) level N/A | | | |



Ene 04 Low carbon design

| No. of BREEAM credits available | 3 | Available contribution to overall score | 2.72% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | No |

| Assessment criteria | Compliant? | Credits available | Credits achieved |
|--|------------|-------------------|------------------|
| Will passive design measures be used in line with an analysis be carried out during concept design stage (RIBA stage 2 or equivalent)? | Yes | 1 | 1 |
| Will free cooling measures be implemented in the whole building in line with the passive design analysis? | No | 1 | 0 |
| Will a LZC technology be specified in line with a feasibility study carried out by the completion of the Concept Design stage (RIBA Stage 2 or equivalent)? | Yes | 1 | 1 |

| Total BREEAM credits achieved | 2 |
|--|-------|
| Total contribution to overall building score | 1.81% |
| Total BREEAM innovation credits achieved | N/A |
| Minimum standard(s) level | N/A |

Comments/notes:

Assessment issue not applicable

Ene 05 Energy efficient cold storage

| N/A | Available contribution to overall score | N/A | No. of BREEAM credits available |
|-----|---|-----|--|
| N/A | Minimum standards applicable | N/A | No. of BREEAM innovation credits available |

| Assessment criteria | | Compliant? | Credits available | Credits achieved |
|--|--------------------|------------|-------------------|------------------|
| Will the refrigeration system be designed, installed & commissioned in accroda | ance with BREEAM | | | |
| | criteria? | | | |
| Will the refrigeration system demonstrate a saving in indirect greenhou | use gas emissions? | | | |
| | | | | |
| Total BREEAM credits achieved | N/A | | | |
| Total contribution to overall building score | N/A | | | |
| Total BREEAM innovation credits achieved | N/A | | | |
| Minimum standard(s) level | N/A | | | |
| | | | | |



Ene 06 Energy efficient transportation systems

| No. of BREEAM credits available | N/A | Available contribution to overall score | N/A |
|--|-----|---|-----|
| No. of BREEAM innovation credits available | N/A | Minimum standards applicable | N/A |

| Assessment criteria | | Compliant? | Credits available | Credits achieved |
|---|--|------------|-------------------|------------------|
| Will a transportation system analysis be carried out to determine and specify the size and type of lifts that is most | optimum number, t energy efficient? | | | |
| Will the relevant energy-efficient feature | es criteria be met? | | | |
| | | | | |
| Total BREEAM credits achieved | N/A | | | |
| Total contribution to overall building score | N/A | | | |
| Total BREEAM innovation credits achieved | N/A | | | |
| Minimum standard(s) level | N/A | | | |

Comments/notes:

Ene 07 Energy efficient laboratory systems

Assessment issue not applicable

| No. of BREEAM credits available | N/A | Available contribution to overall score | N/A |
|--|-----|---|-----|
| No. of BREEAM innovation credits available | N/A | Minimum standards applicable | N/A |

| Assessment criteria | Compliant? | Credits available | Credits achieved |
|---|------------|-------------------|------------------|
| Pre-requisite: Criterion 1 of Hea 03 - risk assessment of laboratory faciliti | es |] | |
| Have the occupants' laboratory requirements & performance criteria been confirmed during t preparation of the initial project brief to minimise energy deman | he d? | | |
| | | | |
| Best Practice Energy Practices in Laboratories (table 2 | .7) | | |
| Will the laboratory meet criteria item b) Fan powe | er? | | |
| Will the laboratory criteria item c) Fume cupboard volume flow rate | es? | | |
| Will the lab meet item d) Grouping / isolation of high filtration/ventilation activitie | s? | | |
| Will the laboratory meet criteria item e) Energy recovery - hea | it? | | |
| Will the laboratory meet criteria item f) Energy recovery - coolin | g? | | |
| Will the laboratory meet criteria item g) Grouping of cooling load | -2 | | |
| Will the laboratory meet criteria item n) Free coolin | g? | | |
| Will the laboratory meet criteria item i) Load responsivenes | .S? | - | |
| Will the laboratory meet criteria item () Creditorin Will the laboratory meet criteria item () Diversit | v2 | | |
| Will the laboratory meet criteria item I) Room air-change rate | y: | | |
| | | 1 | |
| Total BREEAM credits achieved N/A | | | |
| Total contribution to overall building score N/A | | | |
| Total BREEAM innovation credits achieved N/A | | | |
| Minimum standard(s) level N/A | | | |



Ene 08 Energy efficient equipment

| No. of BREEAM credits available | N/A | Available contribution to overall score | N/A |
|--|-----|---|-----|
| No. of BREEAM innovation credits available | N/A | Minimum standards applicable | N/A |

Assessment criteria

| Which of the following will be present and likely to be a/the major contributor to 'unregulated' energy use? | Present | Major impact |
|---|---------|--------------|
| Ref A Small power and plug in equipment? | | |
| Ref B Swimming pool? | | |
| Ref C Communal laundry? | | |
| Ref D Data centre? | | |
| Ref E IT-intensive operation areas? | | |
| Ref F Residential areas? | | |
| Ref G Healthcare? | | |
| Ref H Kitchen and catering facilities? | | |

 Compliant
 Credits available
 Credits achieved

 Will the significant majority contributor(s) to 'unregulated' energy use above meet the BREEAM criteria?
 Image: Credits achieved
 Image: Credits achieved

| N/A | Total BREEAM credits achieved |
|-----|--|
| N/A | Total contribution to overall building score |
| N/A | Total BREEAM innovation credits achieved |
| N/A | Minimum standard(s) level |

Comments/notes:

Ene 09 Drying space

Assessment issue not applicable

| No. of BREEAM credits available | N/A | Available contribution to overall score | N/A |
|--|-----|---|-----|
| No. of BREEAM innovation credits available | N/A | Minimum standards applicable | N/A |

| Assessment criteria | | Compliant? | Credits available | Credits achieved |
|--|-------------------|------------|-------------------|------------------|
| Will internal/external drying space and fix | ings be provided? | | | |
| | | | | |
| Total BREEAM credits achieved | N/A | | | |
| Total contribution to overall building score | N/A | | | |
| Total BREEAM innovation credits achieved | N/A | | | |
| Minimum standard(s) level | N/A | | | |



TRANSPORT

Tra 01 Public Transport Accessibility

| No. of BREEAM credits available | 3 | Available contribution to overall score | 3.83% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | No |

Building type category (for purpose of Tra01 issue assessment) Business (office/industrial)

| Assessment Criter | ia | Compliant | Credits available | Credits achieved |
|-------------------|---|-----------|-------------------|------------------|
| | Indicative public transport accessibility index (AI): | 10.00 | 3 | 3 |
| | Will the building have a dedicated bus service? | | 5 | N/A |
| | | | | |
| AI | Indicative Accessibility Index for pre-assessment | | | |
| | | | | |
| 0 | Poor or no public transport provision | | | |
| 1 | A single BREEAM compliant public transport node available | | | |

| = | |
|----|--|
| 2 | Some BREEAM compliant public transport nodes/services available |
| 4 | A selection of BREEAM compliant public transport nodes/services available |
| 8 | Good provision of public transport i.e. small urban centre / suburban area |
| 10 | Very Good provision of public transport i.e. small/medium urban centre |
| 12 | Excellent provision of public transport, i.e. medium urban centre |
| 18 | Excellent provision of public transport, i.e. large urban/metropolitan city centre |

| Total BREEAM credits achieved | 3 |
|--|-------|
| Total contribution to overall building score | 3.83% |
| Total BREEAM innovation credits achieved | N/A |
| Minimum standard(s) level | N/A |

| Comments/notes: | | |
|-----------------|--|--|
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Tra 02 Proximity to Amenities

| No. of BREEAM credits available | 1 | Available contribution to overall score | 1.28% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | No |

| Will the building be in close proximity of and accessible to applicable amenities? Yes 1 1 Total BREEAM credits achieved 1 1 1 1 Total contribution to overall building score 1.28% 1 1 1 Total BREEAM innovation credits achieved N/A N/A 1 1 | Assessment Criteria | | Compliant? | Credits available | Credits achieved |
|--|--|--------------------|------------|-------------------|------------------|
| Total BREEAM credits achieved1Total contribution to overall building score1.28%Total BREEAM innovation credits achievedN/A | Will the building be in close proximity of and accessible to app | licable amenities? | Yes | 1 | 1 |
| Total contribution to overall building score 1.28% Total BREEAM innovation credits achieved N/A | Total RREEAM credits achieved | 1 | | | |
| Total BREEAM innovation credits achieved N/A | Total contribution to overall building score | 1 28% | | | |
| | Total BREEAM innovation credits achieved | N/A | | | |
| Minimum standard(s) level N/A | Minimum standard(s) level | N/A | | | |



Tra 03 Cyclist facilities

| No. of BREEAM credits available | 2 | Available contribution to overall score | 2.56% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | No |

| Building type category (for purpose of Tra03 issue assessment) | Business - (office/I | ndustrial) |
|--|----------------------|------------|
| How many compliant cycle storage spaces will be provided? | 14 | |
| What cyclist facilities will be provided? | No compliant facili | ties |

| Assessment Criteria | | Compliant? | Credits available | Credits achieved |
|--|--------------------|------------|-------------------|------------------|
| Cy | cle storage spaces | Yes | 2 | 1 |
| | Cyclist facilities | | | T |
| | | | | |
| Total BREEAM credits achieved | 1 | | | |
| Total contribution to overall building score | 1.28% | | | |
| Total BREEAM innovation credits achieved | N/A | | | |
| Minimum standard(s) level | N/A | | | |

Comments/notes:

Tra 04 Maximum Car Parking Capacity

| No. of BREEAM credits available | 2 | Available contribution to overall score | 2.56% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | No |

| Building type category (for purpose of Tra04 issue) | Business - (office/Ir | ndustrial) |
|--|-----------------------|------------|
| Building's indicative Accessibility Index (sourced from issue Tra01) | 10 | |

| | Compliant? | Credits available | Credits achieved |
|---|---|--|--|
| Will BREEAM's maximum parking capacity criteria for the building type/Accessibility Index be met? | | 2 | 2 |
| 2 | | | |
| 2.56% | | | |
| N/A | | | |
| N/A | | | |
| | y Index be met? 2 2.56% N/A N/A | Compliant? y Index be met? Yes 2.56% N/A N/A | Compliant? Credits available y Index be met? Yes 2 2 2.56% N/A N/A N/A |



Tra 05 Travel Plan

| 1.28% | Available contribution to overall score | 1 | No. of BREEAM credits available |
|-------|---|---|--|
| No | Minimum standards applicable | 0 | No. of BREEAM innovation credits available |

| Assessment Criteria | | Compliant? | Credits available | Credits achieved |
|---|-------------------|------------|-------------------|------------------|
| Will a transport plan based on site specific travel survey/assessme | ent be developed? | Yes | 1 | 1 |
| | | | | |
| Total BREEAM credits achieved | 1 | | | |
| Total contribution to overall building score | 1.28% | | | |
| Total BREEAM innovation credits achieved | N/A | | | |
| Minimum standard(s) level | N/A | | | |
| | | | | |

Comments/notes:

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WATER

| Wat 01 Water Consumption | | | Assessment iss | ue not applicable |
|--------------------------|--|-----|---|-------------------|
| | No. of BREEAM credits available | N/A | Available contribution to overall score | N/A |
| | No. of BREEAM innovation credits available | N/A | Minimum standards applicable | N/A |
| | | | | |

How do you wish to assess the number of BREEAM credits to be achieved for this issue?

Please select the calculation procedure used

Standard approach data

| Water Consumption from building micro-components | |
|--|--|
| Water demand met via greywater/rainwater sources | |
| Total net water consumption | |
| Improvement on baseline performance | |

Key Performance Indicator - use of freshwater resource

| Total net Water Consumption | |
|-----------------------------|--|
| Default building occupancy | |
| | |

Alternative approach data

| | Overall microcomponent performance level achieved | | | | |
|----------------|---|-----|--|--|--|
| Please select: | | | | | |
| | | | | | |
| | Total BREEAM credits achieved | N/A | | | |
| | Total contribution to overall building score | N/A | | | |
| | Total BREEAM innovation credits achieved | N/A | | | |
| | Minimum standard(s) level | N/A | | | |



I

Wat 02 Water Monitoring

| No. of BREEAM credits available | 1 | Available contribution to overall score | 2.00% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | Yes |

| Assessment Criteria | | Compliant? | Credits available | Credits achieved |
|--|-----------------|------------|-------------------|------------------|
| Will there be a water meter on the mains water supply to t | he building(s)? | Yes | 1 | 1 |
| Will metering/monitoring equipment be specified on the water supply to | to any relevant | | | |
| Will all specified water meters have a p | pulsed output? | Yes | | |
| If the site/building has an existing BMS connection, will all pulsed meters be connected | ed to the BMS? | N/A | | |
| | | | | |
| Total BREEAM credits achieved | 1 | | | |
| Total contribution to overall building score | 2.00% | | | |
| Total BREEAM innovation credits achieved | N/A | | | |
| Minimum standard(s) level Out | standing level | | | |

Comments/notes:

Wat 03 Water Leak Detection and Prevention

| No. of BREEAM credits available | 1 | Available contribution to overall score | 2.00% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | No |

| Assessment Criteria | _ | Compliant? | Credits available | Credits achieved |
|---|---------------------|------------|-------------------|------------------|
| Will a mains water leak detection system be installed on the building's mains water supply? | | Yes | 1 | 1 |
| Will flow control devices be installed in each sani | tary area/facility? | | | |
| | | | | |
| Total BREEAM credits achieved | 1 | | | |
| Total contribution to overall building score | 2.00% | | | |
| Total BREEAM innovation credits achieved | N/A | | | |
| Minimum standard(s) level | N/A | | | |
| | | | | |



Wat 04 Water Efficient Equipment

| No. of BREEAM credits available | N/A | Available contribution to overall score | N/A |
|--|-----|---|-----|
| No. of BREEAM innovation credits available | N/A | Minimum standards applicable | N/A |

| Assessment Criteria | | | Compliant? | Credits available | Credits achieved |
|---|--|-----|------------|-------------------|------------------|
| Has a meaningful reduction in unregulated water demand been achieved? | | | | | |
| | Total BREEAM credits achieved | N/A | | | |
| | Total contribution to overall building score | N/A | | | |
| | Total BREEAM innovation credits achieved | N/A | | | |
| | Minimum standard(s) level | N/A | | | |

Comments/notes:

| - | | |
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MATERIALS

Mat 01 Life Cycle Impacts

| No. of BREEAM credits available | 5 | | Available contribution to overall score | 6.73% |
|---|---------------------|-------------------|---|-------|
| No. of BREEAM innovation credits available | 3 | | Minimum standards applicable | No |
| | | | | |
| How do you wish to assess the number of BREEAM credits to be achieved for | or this issue? | Define the number | r of Mat 01 credits achieved | |
| Assessment Criteria | | | | |
| Predicted total Mat | 01 credits achieved | 3 |] | |
| | | | | |
| Number of building | elements assessed | | _ | |
| Green Guide exempla | ry level compliant? | No | | |
| Has IMPACT compliant sc | oftware been used? | No | | |
| | | | 1 | |
| Total BREEAM credits achieved | 3 | | | |
| Total contribution to overall building score | 4.04% | | | |
| Total BREEAM innovation credits achieved | 0 | | | |
| Minimum standard(s) level | N/A | | | |
| | | | | |
| Comments/notes: | | | | |
| | | | | |



Mat 02 Hard Landscaping and Boundary Protection

| No. of BREEAM credits available | 1 | Available contribution to overall score | 1.35% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | No |

| | Compliant? | Credits available | Credits achieved |
|---|--|---|--|
| Will ≥80% of all external hard landscaping and boundary protection achieve a Green Guide A or A+ rating? | | 1 | 0 |
| 0 | | | |
| 0.00% | | | |
| N/A | | | |
| N/A | | | |
| | n Guide A or A+ rating? 0 0.00% N/A N/A | Compliant? n Guide A or A+ rating? No 0 0.00% N/A N/A | Compliant? Credits available n Guide A or A+ rating? No 1 0 0 0.00% N/A N/A N/A |

Comments/notes:

Mat 03 Responsible Sourcing

| No. of BREEAM credits available | 4 | Available contribution to overall score | 5.38% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 1 | Minimum standards applicable | Yes |

| Assessment Criteria | | Compliant | Credits available | Credits achieved |
|---|--------------------|---------------------|------------------------|------------------|
| All timber and timber based products are 'Legally harvested | and trader timber' | Yes | | |
| Is there a documented sustainable p | procurement plan? | Yes | 1 | 1 |
| Percentage of available responsible sourcing of materials points achieved | | 36.00% | 3 | 2 |
| | | | | |
| Please confirm the route use | ed to assess Mat03 | Route 2: Proportion | n of materials respons | sibly sourced |
| | | | | |
| Total BREEAM credits achieved | 3 | | | |
| Total contribution to overall building score | 4.04% | | | |
| Total BREEAM innovation credits achieved | 0 | | | |
| Minimum standard(s) level | Outstanding level | | | |



Mat 04 Insulation

| No. of BREEAM credits available | 1 | Available contribution to overall score | 1.35% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | No |

| What is the building's targeted insulating index?2.5011Note: An | |
|---|------------|
| | insulation |
| | |
| Total BREEAM credits achieved 1 | |
| Total contribution to overall building score 1.35% | |
| Total BREEAM innovation credits achieved N/A | |
| Minimum standard(s) level N/A | |

Comments/notes:

Mat 05 Designing for durability and resilience

| No. of BREEAM credits available | 1 | Available contribution to overall score | 1.35% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | N/A |

N/A

| Assessment Criteria | | Compliant? | Credits available | Credits achieved |
|--|----------------------------------|------------|-------------------|------------------|
| Will suitable durability/protection measures be specified and installed to vulne | erable areas of the building? | N/A | 1 | 1 |
| Will suitable durability/protection measures be specified and installed to expecified and installed to expect the second se | posed parts of the building? | Yes | 1 | 1 |
| | | | | |
| Total BREEAM credits achieved | 1 | | | |
| Total contribution to overall building score | 1.35% | | | |
| Total BREEAM innovation credits achieved | N/A | | | |

Minimum standard(s) level

Comments/notes:

Mat 06 Material efficiency

| No. of BREEAM credits available | 1 | Available contribution to overall score | 1.35% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | No |

| Assessment Criteria | Compliant? | Credits available | Credits achieved |
|---|------------|-------------------|------------------|
| Will material efficiency measures be identified & implemented during all RIBA stages? | | 1 | 0 |
| | | | |
| Total BREEAM credits achieved 0 | | | |
| Total contribution to overall building score 0.00% | | | |

Total BREEAM innovation credits achieved

Minimum standard(s) level

N/A

N/A



WASTE

Wst 01 Construction Waste Management

| No. of BREEAM credits available | 1 | Available contribution to overall score | 5.50% |
|---|----------|--|-------|
| No. of BREEAM innovation credits available | L | Minimum standards applicable | Yes |
| How do you wish to assess the number of BREEAM credits to be achieved for this issu | ıe? | Define a target number of BREEAM credits | |
| Select the number of BREEAM credits being targeted for issu | e Wst 01 | BREEAM Wst01 Innovation credits: | 0 |

| Assessment Criteria | Compliant? |
|--|------------|
| Construction resource management plan | |
| Compliant Pre-demolition audit | |
| Does the excavation waste meet the exemplary level requirements? | |
| Key Performance Indicators - Construction Waste | |

| Non-hazardous construction waste (excluding demolition/excavation |) |
|--|-----|
| Total non-hazardous construction waste generate | bl |
| Non-hazardous non-demolition const. waste diverted from landfi | 1 |
| Total non-hazardous non-demolition const. waste diverted from landfi | 1 |
| Total non-hazardous demolition waste generate | b l |
| Non-hazardous demolition waste diverted from landfi | 1 |
| Total non-hazardous demolition waste to dispose | 1 |
| Material for reus | 2 |
| Material for recyclin | B |
| Material for energy recover | / |
| Hazardous waste to disposa | 1 |

Note: At the pre-assessment stage this fig Note: At this stage this will be a target ber Note: At the pre-assessment stage this fig Note: At this stage this will be a target ber Note: At this stage this will be a target ber Note: At the pre-assessment stage this fig Note: At the stage this will be a target ber Note: At this stage this will be a target ber Note: At this stage this will be a target ber Note: At this stage this will be a target ber Note: At this stage this will be a target ber Note: At this stage this will be a target ber Note: At this stage this will be a target ber

| Total BREEAM credits achieved | 2 |
|--|-------------------|
| Total contribution to overall building score | 2.75% |
| Total BREEAM innovation credits achieved | 0 |
| Minimum standard(s) level | Outstanding level |



Wst 02 Recycled Aggregates

| No. of BREEAM credits available | 1 | Available contribution to overall score | 1.38% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 1 | Minimum standards applicable | No |

| Assessment Criteria | Total |
|---|-------|
| What is the target total % of high-grade aggregate that will be recycled/secondary aggregate? | 0% |

% of high-grade aggregate that is recycled/secondary aggregate - by application

| ne | Structural frame |
|----|--|
| es | Bitumen/hydraulically bound base, binder and surface courses |
| hs | Building foundations |
| es | Concrete road surfaces |
| ng | Pipe bedding |
| ng | Granular fill and capping |
| | |

| Total BREEAM credits achieved | 0 |
|--|-------|
| Total contribution to overall building score | 0.00% |
| Total BREEAM innovation credits achieved | 0 |
| Minimum standard(s) level | N/A |

Comments/notes:

| Wst 03 | Operational | Waste |
|--------|-------------|-------|
|--------|-------------|-------|

| No. of BREEAM credits available | 1 | Available contribution to overall score | 1.38% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | Yes |

| Assessment Criteria | Compliant? | Credits available | Credits achieved |
|---|------------|-------------------|------------------|
| Will operational recyclable waste volumes be segregated and stored | Yes | 1 | 1 |
| Will static waste compactor(s) or baler(s) be specified where appropriate | N/A | | |
| Will vessel(s) for composting suitable organic waste where appropriate | N/A | | |

| Total BREEAM credits achieved | 1 |
|--|-------------------|
| Total contribution to overall building score | 1.38% |
| Total BREEAM innovation credits achieved | N/A |
| Minimum standard(s) level | Outstanding level |



Wst 04 Speculative Floor and Ceiling Finishes

| | No. of BREEAM credits available | N/A | Available contribution to overall score | | | N/A |
|---------------------|--|-----|---|-------------------|------------------|-----|
| | No. of BREEAM innovation credits available | N/A | Minimum standards applicable | | | N/A |
| | | | | | | |
| Assessment Criteria | | | Compliant? | Credits available | Credits achieved | |
| | | | | | | |
| | | | | | | |
| | Total BREEAM credits achieved | N/A | | | | |
| | Total contribution to overall building score | N/A | | | | |
| | Total BREEAM innovation credits achieved | N/A | | | | |
| | Minimum standard(s) level | N/A | | | | |
| | | | | | | |

Comments/notes:

Wst 05 Adaption to climate change

| No. of BREEAM credits available | 1 | Available contribution to overall score | 1.38% |
|--|-----|---|-------|
| No. of BREEAM innovation credits available | N/A | Minimum standards applicable | N/A |

| Assessment Criteria | | Compliant? | Credits available | Credits achieved |
|---|----------------|------------|-------------------|------------------|
| Will a climate change adaptation strategy appraisal for structural and fabric resilience be conducted by the end of Concept Design (RIBA Stage 2 or equivalent)? | | No | 1 | 0 |
| Will emexplary level criteria – Responding to adaptation to climate | change be met? | | | |
| Total BREEAM credits achieved | 0 | | | |
| Total contribution to overall building score | 0.00% | | | |
| Total BREEAM innovation credits achieved | N/A | | | |
| Minimum standard(s) level | N/A | | | |

Comments/notes:

Wst 06 Functional adaptability

| No. of BREEAM credits available | 1 | Available contribution to overall score | 1.38% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | N/A |

| Assessment Criteria | Compliant? | Credits available | Credits achieved |
|--|------------|-------------------|------------------|
| Will a building specific functional adaptation strategy appraisal be conducted by Concept Design (RIBA Stage 2 or equivalent) and will functional adaptation measures be implemented? | No | 1 | 0 |

| Total BREEAM credits achieved | 0 |
|--|-------|
| Total contribution to overall building score | 0.00% |
| Total BREEAM innovation credits achieved | N/A |
| Minimum standard(s) level | N/A |

BREEAM®

LAND USE & ECOLOGY

LE 01 Site Selection

| No. of BREEAM credits available | 2 | Available contribution to overall score | 2.60% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | No |
| | | | |

| Assessment Criteria | Compliant? | Credits available | Credits achieved | |
|---|------------|-------------------|------------------|--|
| Will at least 75% of the proposed development's footprint be located on previously occupied land? | Yes | 1 | 1 | |
| Is the site deemed to be significantly contaminated? | Yes | 1 | 1 | |
| | | | | |

| Total BREEAM credits achieved | 2 |
|--|-------|
| Total contribution to overall building score | 2.60% |
| Total BREEAM innovation credits achieved | N/A |
| Minimum standard(s) level | N/A |



LE 02 Ecological Value of Site and Protection of Ecological Features

| No. of BREEAM credits available | 2 | Available contribution to overall score | 2.60% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | No |

| Assessment Criteria | Compliant? | Credits available | Credits achieved |
|---|------------|-------------------|------------------|
| Can the land within the construction zone be defined as 'land of low ecological value'? | Yes | 1 | 1 |
| Will all features of ecological value surrounding the construction zone/site boundary be protected? | Yes | 1 | 1 |
| Total BREEAM credits achieved 2 | | | |

| 2 | Total Breezeward a chieved |
|-------|--|
| 2.60% | Total contribution to overall building score |
| N/A | Total BREEAM innovation credits achieved |
| N/A | Minimum standard(s) level |

Comments/notes:

LE 03 Mitigating Ecological Impact

| No. of BREEAM credits available | 2 | Available contribution to overall score | 2.60% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | Yes |

Assessment Criteria

| What is the likely change in ecological value as a result of the | sites development? | ≥0 species (i.e. no negative change) | Plant species richne |
|--|--------------------|--------------------------------------|----------------------|
| | | | |
| Total BREEAM credits achieved | 2 | | |
| Total contribution to overall building score | 2.60% | | |
| Total BREEAM innovation credits achieved | N/A | | |
| Minimum standard(s) level | Outstanding level | | |

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LE 04 Enhancing Site Ecology

| No. of BREEAM credits available | 2 | Available contribution to overall score | 2.60% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | No |

| Assessment Criteria | Compliant? | Credits available | Credits achieved | |
|--|---------------------|-------------------|------------------|----------------------|
| Will a suitably qualified ecologist be appointed to report on enhancing and protecting site ecology? | Yes | 2 | 1 | |
| Will the suitably qualified ecologist's general recommendations be implemented? | Yes | | | 1 |
| What is the targeted/intended improvement in ecological value as a result of enhancement actions? | <6 species (small p | ositive change) | | Plant species richne |
| | | | | - |
| Total BREEAM credits achieved 1 | | | | |
| Total contribution to overall building score 1.30% | | | | |
| Total BREEAM innovation credits achieved N/A | | | | |
| Minimum standard(s) level N/A | | | | |
| Comments/notes: | | | | |

LE 05 Long Term Impact on Biodiversity

| No. of BREEAM credits available | 2 | Available contribution to overall score | 2.60% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | No |

| Assessment Criteria | | Compliant? | Credits available | Credits achieved |
|---|----------------------------------|------------|-------------------|------------------|
| Will a Suitably Qualified Ecologist be appointed to monitor/minimise impacts of s | site activities on biodiversity? | Yes | 2 | 0 |
| Will a landscape and habitat management plan be produced covering at least the first five years after project completion in accordance with British Standards? | | No | | |
| Number of applicable measures to improve biodiversity cor | nfirmed by SQE: | 0 | | |
| Number of applicable measure | s implemented: | 0 | | |
| | | | | |
| Total BREEAM credits achieved | 0 | | | |
| Total contribution to overall building score | 0.00% | | | |
| Total BREEAM innovation credits achieved | N/A | | | |
| Minimum standard(s) level | N/A | | | |
| | | | | |



Pol 01 Impact of Refrigerants

| No. of BREEAM credits available | N/A | Available contribution to overall score | N/A |
|--|-----|---|-----|
| No. of BREEAM innovation credits available | N/A | Minimum standards applicable | N/A |

| Assessment Criteria | | Credits available | Credits achieved |
|--|----------------------|-------------------|------------------|
| Refrigerant containing systems installed in the | assessed building? | | |
| Do all systems (with electric compressors) comply with the requirements of BS EN | 378:2008 (parts 2 | | |
| & 3) & where refrigeration systems containing ammonia are installed | , the IoR Ammonia | | |
| Refrigeration Systems | Code of Practice? | | |
| Global Warming Potential of the specified refrige | erant(s) 10 or less? | | |
| What is the target range Direct Effect Life Cycle CO2eq. emissio | ns for the system? | | |
| Cooling/Heating capa | acity of the system | | |
| Will a refrigerant leak detection and containment system be s | pecified/installed? | | |
| | NI / A | | |
| Total BREEAW credits achieved | N/A | | |
| Total contribution to overall building score | N/A | | |
| Total BREEAM innovation credits achieved | N/A | | |

Minimum standard(s) level

Comments/notes:

Assessment issue not applicable

Pol 02 NO_x Emissions

| core N/A | Available contribution to overall score | N/A | No. of BREEAM credits available |
|----------|---|-----|--|
| able N/A | Minimum standards applicable | N/A | No. of BREEAM innovation credits available |

N/A

Assessment Criteria

| NO _x emission level - space heating | | | | | |
|---|-------------------------------|--|--|--|--|
| evel - water heating | NOx emission le | | | | |
| Does this building meet BREEAM's definition of a highly insulated building? | | | | | |
| Energy consumption: heating and hot water | | | | | |
| | | | | | |
| N/A | Total BREEAM credits achieved | | | | |
| | | | | | |

| Total contribution to overall building score | N/A |
|--|-----|
| Total BREEAM innovation credits achieved | N/A |
| Minimum standard(s) level | N/A |



Pol 03 Surface Water Run off

| No. of BREEAM credits available | 5 | Available contribution to overall score | 5.00% |
|--|---|---|-------|
| No. of BREEAM innovation credits available | 0 | Minimum standards applicable | No |

| Assessment Criteria | | Compliant? | Credits available | Credits achieved |
|---|------------------------------|------------|-------------------|------------------|
| What is the actual/likely annual probability of flooding for the a | ssessed site? | Low | 2 | 2 |
| Will a Flood Risk Assessment be | undertaken? | Yes | 2 | 2 |
| Will the site meet the BREEAM criteria for peak rate surface w | ater run off? | Yes | 1 | 1 |
| Will the site meet the criteria for surface water run off volume, attenuation a | nd/or limiting discharge? | Yes | 1 | 1 |
| Will the site be designed to minimise watercourse pollution in accordance with | the BREEAM criteria? | Yes | 1 | 1 |
| | | | | |
| Total BREEAM credits achieved | 5 | | | |
| Total contribution to overall building score | 5.00% | | | |
| Total BREEAM innovation credits achieved | N/A | | | |

Minimum standard(s) level

Comments/notes:

N/A

Pol 04 Reduction of Night Time Light Pollution

| 1.00% | Available contribution to overall score | 1 | No. of BREEAM credits available |
|-------|---|---|--|
| No | Minimum standards applicable | 0 | No. of BREEAM innovation credits available |

| Assessment Criteria | | | Compliant? | Credits available | Credits achieved |
|---------------------|---|---------------------|------------|-------------------|------------------|
| ١ | Will the external lighting specification be designed to reduc | ce light pollution? | Yes | 1 | 1 |
| | | | | | |
| | Total BREEAM credits achieved | 1 | | | |
| | Total contribution to overall building score | 1.00% | | | |
| | Total BREEAM innovation credits achieved | N/A | | | |
| | Minimum standard(s) level | N/A | | | |



Pol 05 Noise Attenuation

| No. of BREEAM credits available | N/A | Available contribution to overall score | N/A |
|--|-----|---|-----|
| No. of BREEAM innovation credits available | N/A | Minimum standards applicable | N/A |

| Assessment Criteria | | Compliant | Credits available | Credits achieved |
|---|---|-----------|-------------------|------------------|
| Will there be noise-sensitive areas/buildings within 800m radius of t Will a noise impact assessment be carried out and, if applicable, noise atte | he development? nuation measures specified? | | | |
| | | | | |
| Total BREEAM credits achieved | N/A | | | |
| Total contribution to overall building score | N/A | | | |
| Total BREEAM innovation credits achieved | N/A | | | |
| Minimum standard(s) level | N/A | | | |

Comments/notes:

INNOVATION

Inn 01 Innovation

| | No. of BREEAM innovation credits available | 10 | | Available contril | oution to overall score | 10.00% |
|---------------------|--|--------------------|------------|-------------------|-------------------------|--------|
| | | | | Minimun | n standards applicable | No |
| | | | | | | |
| | | | | | | |
| Assessment Criteria | | | Compliant? | Credits available | Credits achieved | |
| | Man 03 Responsible cons | truction practices | No | 1 | 0 | |

| Wall 05 Responsible construction practices | INO | - | 0 |
|---|-----|-----|-----|
| Man 05 Aftercare | N/A | N/A | N/A |
| Hea 01 Visual Comfort | Yes | 1 | 1 |
| Hea 02 Indoor Air Quality | N/A | N/A | N/A |
| Ene 01 Reduction of energy use and carbon emissions | No | 5 | N/A |
| Wat 01 Water Consumption | N/A | N/A | N/A |
| Mat01 Life Cycle Impacts | No | 3 | 0 |
| Mat03 Responsible Sourcing of Materials | No | 1 | 0 |
| Wst01 Construction Waste Management | No | 1 | 0 |
| Wst02 Recycled Aggregates | No | 1 | 0 |
| Wst 05 Adaption to climate change | N/A | N/A | N/A |

| | Number of "approved" innovation credits achieved? | |
|--|---|--|
| | | |
| Total BREEAM innovation credits achieved | 1 | |
| Total contribution to overall building score | 1 00% | |

| Total contribution to overall building score | 1.00% |
|--|-------|
| Minimum standard(s) level | N/A |

Comments/notes:

0



Appendix 2 – London Borough of Richmond Sustainable Construction Checklist

LBRUT Sustainable Construction Checklist - January 2016

This document forms part of the Sustainable Construction Checklist SPD. This document **must** be filled out as part of the planning application for the following developments: all residential development providing **one or more new residential units (including conversions leading to one or more new units)**, and all other forms of development providing **100sqm or more of non-residential floor space**. Developments including new non-residential development of less than 100sqm floor space, extensions less than 100sqm, and other conversions are strongly encouraged to comply with this checklist. Where further information is requested, please either fill in the relevant section, or refer to the document where this information may be found in detail, e.g. Flood Risk Assessment or similar. **Further guidance** on completing the Checklist may be found in the Justification and Guidance section of this SPD.

| Property Name (if relevant): | Arlington Works, 23 Arlington Road, Twickenham | Application No. (if known): | |
|--|--|---|------------|
| Address (include. postcode) | Arlington Works, 23 Arlington Road, Twickenham | | |
| Completed by: | Ivan Ball | | |
| For Non-Residential | | For Residential | |
| Size of development (m2) | 610 | Number of dwellings 24 | |
| 1 MINIMUM COMPLIAN | NCE (RESIDENTIAL AND NON-RESIDENTIAL) | | |
| Energy Assessment | | · · · · · · · · · · · · · · · · · · · | Vec |
| Has an energy assess renewable energy mea | ment been submitted that demonstrates the expected energy and carbon dioxide errassing a submitted that demonstrates the expected energy and carbon dioxide errassing a submitted that demonstrates the expected energy and carbon dioxide errassing a submitted that demonstrates the expected energy and carbon dioxide errassing a submitted that demonstrates the expected energy and carbon dioxide errassing a submitted that demonstrates the expected energy and carbon dioxide errassing a submitted that demonstrates the expected energy and carbon dioxide errassing a submitted that demonstrates the expected energy and carbon dioxide errassing a submitted that demonstrates the expected energy and carbon dioxide err | s, please tick. | Yes |
| Carbon Dioxide emissions re | duction | | |
| What is the carbon did | oxide emissions reduction against a Building Regulations Part L (2013) baseline | ilding Regulations 2013 | 35.16 |
| | | iung Negulations 2013. | |
| Percentage of total sin | te CO2 emissions saved through renewable energy installation? | | 27.29 |
| 1A MINIMUM POLICY C | OMPLIANCE (NON-RESIDENTIAL AND DOMESTIC REFURBISHMENT) | | |
| | Please check the Guidance Section of this SPD for the p | olicy requirements | |
| Environmental Rating of deve Non-Residential new-build (100 | elopment: Osam or more) | | |
| BREEAM Level | Excellent | Have you attached a pre-assessment to support this? | Ţ |
| BREEAM Domestic R | efurbishment Please Select | Have you attached a pre-assessment to support this? | |
| Extensions and conversions fo BREEAM Level | r non-residential buildings Please Select | Have you attached a pre-assessment to support this? | |
| | | | |
| Score awarded for En | vironmental Rating: | | Subtotal 8 |
| BKEEAM: | $Good = 0$, very $Good = 4$, Excellent = δ , Outstanding = 70 | | |
| 1B MINIMUM POLICY C | OMPLIANCE (RESIDENTIAL) | | |
| Water Usage | | | |

Internal water usage limited to 105 litres person per day. (Excluding an allowance 5 litres per person per day for external water consumption). Calculations using the water efficiency calculator for new dwellings have been submitted.

J 1

Subtotal

| 2. EN | NERGY USE AND POLLUTION | |
|-------|--|------------|
| 2.1 | Need for Cooling | Score |
| a. | How does the development incorporate cooling measures? Tick all that apply: | |
| | Energy efficient design incorporating specific heat demand to less than or equal to 15 kWh/sqm | 6 |
| | Reduce heat entering a building through providng/improving insulation and living roofs and walls | 2 |
| | Reduce heat entering a building through shading | ✓ <u>3</u> |
| | Exposed thermal mass and high ceilings | ✓ 4 |
| | Passive ventilation | <u>√</u> 3 |
| | Mechanical ventilation with heat recovery | |
| | Active cooling systems, i.e. Air Conditioning Unit | □ 0 |
| 2.2 H | leat Generation | |
| b. | How have the heating and cooling systems, with preference to the heating system hierarchy, been selected (defined in London Plan policy 5.6)? Tick all heating and cooling systems that will be used in the development: | |
| | Connection to existing heating or cooling networks powered by renewable energy | |
| | Connection to existing heating or cooling networks powered by renewable energy | |
| | Site wide CHP network powered by renewable energy | $\Box 4$ |
| | Site wide CHP network powered by gas | |
| | Communal heating and cooling powered by renewable energy | 2 |
| | Communal heating and cooling powered by gas or electricity | 1 |
| | Individual heating and cooling | ✓ <u>0</u> |
| 2.3 P | Pollution: Air, Noise and Light | _ |
| a. | Does the development plan to implement reduction strategies for dust emissions from construction sites? | √ 2 |
| b. | Does the development plan include a biomass boiler? | □ - |
| | If yes, please refer to the biomass guidelines for the Borough of Richmond, please see guidance for supplementary | — |
| | information. If the proposed boiler is of a qualifying size, you may need to completed the information request form found | |
| | on the Richmond website. | - |
| C. | Please tick only one option below | _ |
| | Has the development taken measures to reduce existing noise and enhance the existing soundscape of the site? | √ 3 |
| | Has the development taken care to not create any new noise generation/transmission issues in its intended operation? | |
| d. | Has the development taken measures to reduce light pollution impacts on character, residential amenity and biodiversity? | J 3 |
| e. | Have you attached a Lighting Pollution Report? | - [] |
| | | Subtotal 1 |
| Pleas | se give any additional relevant comments to the Energy Use and Pollution Section below | |
| A Co | nstruction Plan will be prepared, which will seek to reduce dust, noise and other disturbances to immediate neighbours. | |

3. TRANSPORT

3.1 Provision for the safe efficient and sustainable movement of people and goods

a. Does your development provide opportunities for occupants to use innovative travel technologies?

| J |
|---------------|
| |
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| |
| Subtot |
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| |
| |

| 4 | | | | | |
|--|--|---|---|---------------------------|---|
| 4 / 1 M | DIODIVERSITY | | | | |
| 44.1 WI a | Does your development involve the loss of an ecological feature or babitat including a loss of o | narden or other ar | een space? (Indicate if ves) | | □-2 |
| u. | If so, please state how much in som? | garaon or other gro | | | Isan |
| | | | | | |
| э. | Does your development involve the removal of any tree(s)? (Indicate if yes) | | | | - |
| | If so, has a tree report been provided in support of your application? (Ir | ndicate if yes) | | | |
| | | | | | |
|). | Does your development plan to add (and not remove) any tree(s) on site? (Indicate if yes) | | | | |
| 4 | Please indicate which features and/or babitats that your development will incorporate to improv | e on site hiodivers | sity: | | |
| | Pond reedbed or extensive native planting | | Area provided: | | sa |
| | An extensive green roof | 5 🗆 | Area provided: | | sq. |
| | An intensive green roof | | Area provided: | | sq |
| | Garden space | 4 J | Area provided: | | sa |
| | Additional native and/or wildlife friendly planting to peripheral areas | 3 🗆 | Area provided: | | sa |
| | Additional planting to peripheral areas | 2 [] | Area provided: | | sq |
| | A living wall | 2 [] | Area provided: | | sq |
| | Bat boxes | <u>0.5</u> 기 | | | |
| | Bird boxes | <u>0.5</u> 고 | | | |
| | Other | 0.5 | | | |
| | | | | Sub | ototal |
| Pleas | arive any additional relevant comments to the Biodiversity Section below | | | | |
| Privat | e terraces are provided to ground floor apartments and private communal space is available. | | | | |
| Privat | ELOODING AND DRAINAGE | | | | |
| Privat 5 Mitiga | FLOODING AND DRAINAGE | | | | |
| Privat 5 Mitiga a. | FLOODING AND DRAINAGE ting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) | | | | □-2 |
| Privat Aitiga | FLOODING AND DRAINAGE ting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) Have you submitted a Flood Risk Assessment? (Indicate if yes) | | | | □-2 □ -2 |
| Privat litiga | FLOODING AND DRAINAGE ting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) Have you submitted a Flood Risk Assessment? (Indicate if yes) | | | | □-2 □ - |
| Aitiga | FLOODING AND DRAINAGE ting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) Have you submitted a Flood Risk Assessment? (Indicate if yes) Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick) | < all that apply) | | | □-2 □ - |
| Aitiga | FLOODING AND DRAINAGE ting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) Have you submitted a Flood Risk Assessment? (Indicate if yes) Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick | < all that apply) | | | □-2 □ - ☑ - |
| Aitiga | FLOODING AND DRAINAGE ting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) Have you submitted a Flood Risk Assessment? (Indicate if yes) Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick Store rainwater for later use Use of infiltration techniques such as porous surfacing materials to alloc | < all that apply) | e | | □-2 □ - ☑ 5 ☑ 3 |
| Privat Aitiga | FLOODING AND DRAINAGE ting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) Have you submitted a Flood Risk Assessment? (Indicate if yes) Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick Store rainwater for later use Use of infiltration techniques such as porous surfacing materials to allow | k all that apply) ow drainage on-site | e | | □-2 □ - ✓ 5 ✓ 3 □ 4 |
| Privat Aitiga I. | FLOODING AND DRAINAGE ting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) Have you submitted a Flood Risk Assessment? (Indicate if yes) Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick Store rainwater for later use Use of infiltration techniques such as porous surfacing materials to allow Attenuate rainwater in ponds or open water features Store rainwater in tanks for gradual release to a watercourse | < all that apply) ow drainage on-site | e | | □-2 □ - ✓ 5 ✓ 3 □ 4 □ 3 |
| Aitiga | FLOODING AND DRAINAGE ting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) Have you submitted a Flood Risk Assessment? (Indicate if yes) Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick Store rainwater for later use Use of infiltration techniques such as porous surfacing materials to allow Attenuate rainwater in ponds or open water features Store rainwater in tanks for gradual release to a watercourse Discharge rainwater directly to watercourse | < all that apply) ow drainage on-site | e | | □-2 □ - ✓ 5 ✓ 3 □ 4 □ 3 □ 2 |
| i i i i. | FLOODING AND DRAINAGE ting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) Have you submitted a Flood Risk Assessment? (Indicate if yes) Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick Store rainwater for later use Use of infiltration techniques such as porous surfacing materials to allow Attenuate rainwater in ponds or open water features Store rainwater for later use Discharge rainwater to surface water drain | < all that apply) | e | | □-2 □ - ✓ 5 ✓ 3 □ 4 □ 3 □ 2 □ 1 |
| Privat Aitiga I. | Frequencies FLOODING AND DRAINAGE ting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) Have you submitted a Flood Risk Assessment? (Indicate if yes) Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick Store rainwater for later use Use of infiltration techniques such as porous surfacing materials to allow Attenuate rainwater in ponds or open water features Store rainwater to surface water directly to watercourse Discharge rainwater to surface water drain Discharge rainwater to combined sewer | < all that apply) | e | | □-2 □ - ✓ 5 ✓ 3 □ 4 □ 3 □ 2 □ 1 ✓ 0 |
| Privat Aitiga I. | FLOODING AND DRAINAGE ting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) Have you submitted a Flood Risk Assessment? (Indicate if yes) Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick Store rainwater for later use Use of infiltration techniques such as porous surfacing materials to allow Attenuate rainwater in ponds or open water features Store rainwater of ure try to watercourse Discharge rainwater to surface water drain Discharge rainwater to combined sewer | k all that apply) ow drainage on-site | e | | □-2 □- ✓ 5 ✓ 3 □ 4 □ 3 □ 2 □ 1 ✓ 0 |
| Privat 5 Mitiga a. b. | FLOODING AND DRAINAGE ting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) Have you submitted a Flood Risk Assessment? (Indicate if yes) Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick Store rainwater for later use Use of infiltration techniques such as porous surfacing materials to allow Attenuate rainwater in ponds or open water features Store rainwater to surface water drain Discharge rainwater to surface water drain Discharge rainwater to combined sewer Please give the change in area of permeable surfacing which will result from your development | k all that apply) ow drainage on-site proposal: | e se represent a loss in permeable a | rea as a negative number | □ -2 □ - ✓ 5 ✓ 3 □ 4 □ 3 □ 2 □ 1 ✓ 0 sq |
| Privat Mitiga a. | FLOODING AND DRAINAGE FLOODING AND DRAINAGE ting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) Have you submitted a Flood Risk Assessment? (Indicate if yes) Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick Store rainwater for later use Use of infiltration techniques such as porous surfacing materials to allo Attenuate rainwater in ponds or open water features Store rainwater to surface water ourse Discharge rainwater to surface water drain Discharge rainwater to combined sewer Please give the change in area of permeable surfacing which will result from your development | k all that apply) bw drainage on-site proposal: <i>pleas</i> | e se represent a loss in permeable a | nrea as a negative number | □ -2 □ - □ 5 □ 3 □ 4 □ 3 □ 2 □ 1 □ 0 sqr |
| Privat Aitiga | FLOODING AND DRAINAGE The set of the boot of the boot | k all that apply) ow drainage on-site proposal: <i>pleas</i> | e se represent a loss in permeable a | irea as a negative number | □ -2 □ - □ - □ 3 □ 4 □ 3 □ 2 □ 1 □ 2 □ 1 □ 0 squ |
| Privat Aitiga I. Pleas Rainw | FLOODING AND DRAINAGE The terraces are provided to ground floor apartments and private communal space is available. FLOODING AND DRAINAGE ting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) Have you submitted a Flood Risk Assessment? (Indicate if yes) Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick Store rainwater for later use Use of infiltration techniques such as porous surfacing materials to allo Attenuate rainwater in ponds or open water features Store rainwater in tanks for gradual release to a watercourse Discharge rainwater to surface water drain Discharge rainwater to combined sewer Please give the change in area of permeable surfacing which will result from your development Please provide details of the permeable surfacing and Drainage Section below atter butts will be provided for landscape maintenance. | k all that apply) bw drainage on-site proposal: <i>pleas</i> | e se represent a loss in permeable a | nrea as a negative number | □ -2 □ - ✓ 5 ✓ 3 □ 4 □ 3 □ 2 □ 1 ☑ 0 squ ototal |
| litiga | FLOODING AND DRAINAGE ting the risks of flooding and other impacts of climate change in the borough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) Have you submitted a Flood Risk Assessment? (Indicate if yes) Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick Store rainwater for later use Use of infiltration techniques such as porous surfacing materials to allo Attenuate rainwater in tanks for gradual release to a watercourse Discharge rainwater to surface water drain Discharge rainwater to surface materials to allo attenuate and private to surface water drain Discharge rainwater of surface water drain Discharge rainwater to surface materials drain Discharge rainwater to surface water drain Discharge rainwater to surface materials for your development Please give the change in area of permeable surfacing which will result from your development Please provide details of the permeable surfacing below e give any additional relevant comments to the Flooding and Drainage Section below ater butts will be provided for landscape maintenance. | < all that apply) ow drainage on-site proposal: <i>pleas</i> | e se represent a loss in permeable a | nrea as a negative number | □-2 □-2 □- 95 3 14 3 2 1 2 1 7 0 sq |
| rivat Aitiga | FLOODING AND DRAINAGE The set of the set of the broad of the broad of the broad of the brough Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) Have you submitted a Flood Risk Assessment? (Indicate if yes) Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick Store rainwater for later use Use of infiltration techniques such as porous surfacing materials to allo Attenuater rainwater in ponds or open water features Store rainwater of users or open water features Discharge rainwater to surface water drain Discharge rainwater to combined sewer Please give the change in area of permeable surfacing which will result from your development Please provide details of the permeable surfacing below give any additional relevant comments to the Flooding and Drainage Section below ater butts will be provided for landscape maintenance. | k all that apply) ow drainage on-site proposal: <i>pleas</i> | e se represent a loss in permeable a | irea as a negative number | □-2 □- 2 0 - 3 0 4 3 0 2 1 0 0 sq |

| MPROVING RESOURCE EFFICIENCY G.1 Reduce waste generated and amount disposed of by landfill though increasing level of re-use and recycling a. Will demolition be required on your site prior to construction? [Points will only be awarded if 10% or greater of demolition waste is reused/recycled] I If so, what percentage of demolition waste will be reused in the new development? What percentage of demolition waste will be recycled? What percentage of demolition assessment of the site contamination? Have you submitted an assessment of the site contamination? Are plans in place to remediate the contamination? Are plans in place to include composting on site? 6.2 Reducing levels of water waste a. Will the following measures of water conservation be incorporated into the development? (Please tick all that apply): Fitting of water efficient taps, shower heads etc Use of water efficient A or B rated appliances Rainwater harvesting for internal use Greywater systems Fit a water meter | | | |
|--|---------------|---|------------------|
| | 6 IMP | ROVING RESOURCE EFFICIENCY | |
| a. Will demolition be required on your site prior to construction? [Points will only be awarded if 10% or greater of demolition waste is reused/recycled] If so, what percentage of demolition waste will be reused in the new development? What percentage of demolition waste will be recycled? What percentage of demolition waste will be recycled? Must percentage of the site contamination? Have you submitted an assessment of the site contamination? Have you submitted a remediation plan? Are plans in place to include composting on site? 6.2 Reducing levels of water waste a. Will the following measures of water conservation be incorporated into the development? (Please tick all that apply): Fitting of water efficient taps, shower heads etc Use of water efficient taps, shower heads etc Greywater harvesting for internal use Greywater systems Fit a water meter | 6.1 Reduce v | waste generated and amount disposed of by landfill though increasing level of re-use and recycling | |
| If so, what percentage of demolition waste will be reused in the new development? What percentage of demolition waste will be recycled? What percentage of demolition waste will be recycled? Maxe your site have any contaminated land? Have you submitted an assessment of the site contamination? Are plans in place to remediate the contamination? Are plans in place to remediate the contamination? Are plans in place to include composting on site? 6.2 Reducing levels of water waste a. Will the following measures of water conservation be incorporated into the development? (Please tick all that apply): Are plans in place to remedia to the development? (Please tick all that apply): Are plans in place to include compositing on site? Are pl | a. Will | demolition be required on your site prior to construction? [Points will only be awarded if 10% or greater of demolition waste is reused/recycled] | J 1 |
| If so, what percentage of demolition waste will be reused in the new development? 20 % What percentage of demolition waste will be recycled? 80 % b. Does your site have any contaminated land? 1 Have you submitted an assessment of the site contamination? 2 Are plans in place to remediate the contamination? 2 Have you submitted a remediation plan? 2 Are plans in place to include composting on site? 1 6.2 Reducing levels of water waste 1 a. Will the following measures of water conservation be incorporated into the development? (Please tick all that apply): 1 Fitting of water efficient taps, shower heads etc 1 1 Use of water efficient taps, shower heads etc 1 1 Use of water efficient taps, shower heads etc 1 1 Greywater systems 1 4 4 Greywater systems 1 4 4 Tit a water meter 1 1 1 | | | |
| What percentage of demolition waste will be recycled? 80 % b. Does your site have any contaminated land? 1 Have you submitted an assessment of the site contamination? 2 Are plans in place to remediate the contamination? 2 Have you submitted a remediation plan? 1 Are plans in place to include composing on site? 1 6.2 Reducing levels of water waste 1 a. Will the following measures of water conservation be incorporated into the development? (Please tick all that apply): 1 Fitting of water efficient taps, shower heads etc 1 Use of water efficient A or B rated appliances 1 Greywater systems 1 Fit a water meter 1 | | If so, what percentage of demolition waste will be reused in the new development? | 20 % |
| What percentage of demolition waste will be recycled? 80 % b. Does your site have any contaminated land? 1 Have you submitted an assessment of the site contamination? 2 Are plans in place to remediate the contamination? 2 Have you submitted a remediation plan? 2 Are plans in place to include composting on site? 1 6.2 Reducing levels of water waste 1 a. Will the following measures of water conservation be incorporated into the development? (Please tick all that apply): 1 Fitting of water efficient taps, shower heads etc 1 Use of water efficient A or B rated appliances 1 Rainwater harvesting for internal use 1 Greywater systems 1 Fit a water meter 1 | | | |
| b. Does your site have any contaminated land? Have you submitted an assessment of the site contamination? Are plans in place to remediate the contamination? Have you submitted a remediation plan? Are plans in place to include composting on site? 6.2 Reducing levels of water waste a. Will the following measures of water conservation be incorporated into the development? (Please tick all that apply): Fitting of water efficient taps, shower heads etc Use of water efficient taps, shower heads etc Greywater systems Fit a water meter | | What percentage of demolition waste will be recycled? | 80 % |
| b. Does your site have any contaminated land? Have you submitted an assessment of the site contamination? Are plans in place to remediate the contamination? Have you submitted a remediation plan? Have you submitted a remediation plan? Are plans in place to include composting on site? 6.2 Reducing levels of water waste a. Will the following measures of water conservation be incorporated into the development? (Please tick all that apply): Fitting of water efficient taps, shower heads etc Use of water inficient A or B rated appliances Greywater systems Fit a water meter | | | |
| Have you submitted an assessment of the site contamination? 2 Are plans in place to remediate the contamination? 2 Have you submitted a remediation plan? 1 Are plans in place to include composting on site? 1 6.2 Reducing levels of water waste 1 a. Will the following measures of water conservation be incorporated into the development? (Please tick all that apply): Fitting of water efficient taps, shower heads etc 1 Use of water efficient A or B rated appliances 1 Rainwater harvesting for internal use 4 Greywater systems 4 Fit a water meter 1 | b. Doe | s your site have any contaminated land? | |
| Are plans in place to remediate the contamination? | | Have you submitted an assessment of the site contamination? | ✓ 2 |
| Have you submitted a remediation plan? I Are plans in place to include composting on site? I 6.2 Reducing levels of water waste I a. Will the following measures of water conservation be incorporated into the development? (Please tick all that apply): I Fitting of water efficient taps, shower heads etc I I Use of water efficient A or B rated appliances I I Rainwater harvesting for internal use I I Greywater systems I I Fit a water meter I I | | Are plans in place to remediate the contamination? | √ 2 |
| Are plans in place to include composting on site? 6.2 Reducing levels of water waste a. Will the following measures of water conservation be incorporated into the development? (Please tick all that apply): Fitting of water efficient taps, shower heads etc Use of water efficient A or B rated appliances Rainwater harvesting for internal use Greywater systems Fit a water meter | | Have you submitted a remediation plan? | 고 1 |
| 6.2 Reducing levels of water waste a. Will the following measures of water conservation be incorporated into the development? (Please tick all that apply): Fitting of water efficient taps, shower heads etc Use of water efficient A or B rated appliances Rainwater harvesting for internal use Greywater systems Fit a water meter Subtered □ 1 4 Compared 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | | Are plans in place to include composting on site? | \Box |
| 6.2 Reducing levels of water waste a. Will the following measures of water conservation be incorporated into the development? (Please tick all that apply): Fitting of water efficient taps, shower heads etc | | | |
| a. Will the following measures of water conservation be incorporated into the development? (Please tick all that apply): Fitting of water efficient taps, shower heads etc ✓ 1 Use of water efficient A or B rated appliances ✓ 1 Rainwater harvesting for internal use ✓ 4 Greywater systems ✓ 4 Fit a water meter ✓ 1 | 6.2 Reducing | g levels of water waste | |
| Fitting of water efficient taps, shower heads etc I Use of water efficient A or B rated appliances I Rainwater harvesting for internal use I Greywater systems I Fit a water meter I | a. Will | the following measures of water conservation be incorporated into the development? (Please tick all that apply): | |
| Use of water efficient A or B rated appliances Rainwater harvesting for internal use Greywater systems Fit a water meter | | Fitting of water efficient taps, shower heads etc | J 1 |
| Rainwater harvesting for internal use Greywater systems Fit a water meter | | Use of water efficient A or B rated appliances | — 「 」 1 |
| Greywater systems ☐ 4 Fit a water meter ☑ 1 | | Rainwater harvesting for internal use | |
| Fit a water meter | | Grevwater systems | |
| | | Fit a water meter | रा 1 |
| Subtestel | | | |
| Subtotal 8 | | | Subtotal 8 |
| Please give any additional relevant comments to the Improving Resource Efficiency Section below | Please give a | any additional relevant comments to the Improving Resource Efficiency Section below | |

| 7 | | |
|--------|--|------------|
| 7.1 | Ensure flexible adaptable and long-term use of structures | |
| a. | If the development is residential, will it meet the requirements of the nationally described space standard for internal space and layout? | J 1 |
| | If the standards are not met, in the space below, please provide details of the functionality of the internal space and layout | |
| | The standards of the SPD will be met. | |
| | | |
| | | |
| | | |
| AND | | |
| b. | If the development is residential, will it meet Building Regulation Requirement M4 (2) 'accessible and adaptable dwellings'? | ✓ 2 |
| | If this is not met, in the space below, please provide details of any accessibility measures included in the development. | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | For major residential developments, are 10% or more of the units in the development to Building Regulation Requirement | □ 1 |
| | M4 (3) 'wheelchair user dwellings'? | |
| OR | | |
| C. | If the development is non-residential, does it comply with requirements included in Richmond's Design for Maximum Access SPG | ✓ 2 |
| | Please provide details of the accessibility measures specified in the Maximum Access SPG that will be included in the | |
| | development | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | Subtotal 5 |
| Please | give any additional relevant comments to the Design Standards and Accessibility Section below | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

LBRUT Sustainable Construction Checklist- Scoring Matrix for New Construction

(Non-Residential and domestic refurb) Score Rating Significance Project strives to achieve highest standard in energy efficient sustainable development 80 or more A+ Makes a major contribution towards achieving sustainable development in Richmond 71-79 Α 51-70 Helps to significantly improve the Borough's stock of sustainable developments В 36-50 С Minimal effort to increase sustainability beyond general compliance 35 or less FAIL Does not comply with SPD Policy

LBRUT Sustainable Construction Checklist- Scoring Matrix for New Construction

Residential new-build

| | | - | |
|------------|--------|---|--|
| Score | Rating | Significance | |
| 81 or more | A++ | Project strives to achieve highest standard in energy efficient sustainable development | |
| 64-80 | A+ | Project strives to achieve highest standard in energy efficient sustainable development | |
| 55-63 | А | Makes a major contribution towards achieving sustainable development in Richmond | |
| 35-54 | В | lelps to significantly improve the Borough's stock of sustainable developments | |
| 20-34 | С | Minimal effort to increase sustainability beyond general compliance | |
| 19 or less | FAIL | Does not comply with SPD Policy | |

60

TOTAL

Authorisation:

I herewith declare that I have filled in this form to the best of my knowledge

Signature

Date



Appendix 3 – Roof Plan showing Indicative Photovoltaic Panel Locations



Inclination of Sun at 21st June - 62 degrees Inclination of Sun at 21st December - 15 degrees 62° 15° 150

2

Photovoltaic Panel - 1.6m x 1.05m inclined at 15 degrees



Appendix 4 – Sample BRUKL Calculations – baseline

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Commercial Unit

Date: Fri Jun 22 17:39:12 2018

Administrative information

Building Details

Address:

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.4.b.0

Interface to calculation engine: iSBEM

Interface to calculation engine version: v5.4.b

BRUKL compliance check version: v5.4.b.0

Owner Details

Name: Information not provided by the user

Telephone number: Information not provided by the user

Address: Information not provided by the user, Information not provided by the user, Information not provided by the user

Certifier details

Name:

Telephone number:

Address:

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

| 1.1 | CO2 emission rate from the notional building, kgCO2/m2.annum | 19.9 |
|-----|--|---------------------|
| 1.2 | Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum | 19.9 |
| 1.3 | Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum | 16.2 |
| 1.4 | Are emissions from the building less than or equal to the target? | BER =< TER |
| 1.5 | Are as built details the same as used in the BER calculations? | Separate submission |

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

2.a Building fabric

| Element | Ua-Limit | Ua-Calc | Ui-Calc | Surface where the maximum value occurs* | | |
|--|----------|---------|---------|---|--|--|
| Wall** | 0.35 | 0.18 | 0.18 | External Wall | | |
| Floor | 0.25 | - | - | No floors in project | | |
| Roof | 0.25 | 0.12 | 0.12 | Roof | | |
| Windows***, roof windows, and rooflights | 2.2 | 1.42 | 1.42 | 1.5m*FH | | |
| Personnel doors | 2.2 | 2.18 | 2.18 | Door 0.9m*2m | | |
| Vehicle access & similar large doors | 1.5 | - | - | No vehicle doors in project | | |
| High usage entrance doors | 3.5 | - | - | No high usage entrance doors in project | | |
| Ua-Limit = Limiting area-weighted average U-values [W/(m ² K)] | | | | | | |
| Ua-Calc = Calculated area-weighted average U-values [W/(m ² K)] Ui-Calc = Calculated maximum individual element U-values [W/(m ² K)] | | | | | | |

P

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

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

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

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

| Air Permeability | Worst acceptable standard | This building |
|--------------------|---------------------------|---------------|
| m³/(h.m²) at 50 Pa | 10 • | 5 |

As designed

2.b Building services

The building services parameters listed below are expected to be checked by the BCO against guidance. No automatic checking is performed by the tool.

| Whole building lighting automatic monitoring & targeting with alarms for out-of-range values | NO |
|--|-------------|
| Whole building electric power factor achieved by power factor correction | 0.9 to 0.95 |

1- Mech Extract - Toilet (3 Zones)

| Heating seasonal efficiency | Cooling nominal efficiency | SFP [W/(l/s)] | HR seasonal e | efficiency |
|------------------------------|-----------------------------------|----------------------|---------------|------------|
| 4 | - | 0.8 | - | |
| Automatic monitoring & targe | ting with alarms for out-of-ran | ge values for this H | IVAC system | YES |

2- Nat Vent - Circulation

| Heating seasonal efficiency | Cooling nominal efficiency | SFP [W/(l/s)] | HR seasonal e | efficiency |
|------------------------------|---------------------------------|----------------------|---------------|------------|
| 4 | - | - | - | |
| Automatic monitoring & targe | ting with alarms for out-of-ran | ge values for this H | IVAC system | YES |

3- VRF with Mech Vent - Office (11 Zones)

| Heating seasonal efficiency | Cooling nominal efficiency | SFP [W/(l/s)] | HR seasonal e | efficiency |
|------------------------------|----------------------------------|----------------------|---------------|------------|
| 0.9 | 3.5 | 1.5 | 0.7 | |
| Automatic monitoring & targe | eting with alarms for out-of-ran | ge values for this H | IVAC system | YES |

1- Gas 90%

| Heating seasonal efficiency | Hot water storage loss factor [kWh/litre per day] |
|-----------------------------|---|
| 0.9 | 0.29 |

Local mechanical ventilation and exhaust

| Zone | Supply/extract SFP [W/(l/s)] | HR seasonal efficiency | Exhaust SFP [W/(I/s)] |
|--------------|------------------------------|------------------------|-----------------------|
| B1_Office 20 | 1.5 | - | - |
| B1_Office 22 | 1.5 | - | - |
| B1_Office 23 | 1.5 | - | - |
| B1_Toilet 10 | - | - | 0.8 |
| B1_Toilet 11 | - | - | 0.8 |
| B1_Toilet 12 | - | - | 0.8 |
| B1_Office 54 | 1.5 | - | - |
| B1_Office 55 | 1.5 | - | - * |
| B1_Office 56 | 1.5 | - | - |
| B1_Office 57 | 1.5 | - | - |
| B1_Office 58 | 1.5 | P_\ | - |
| B1_Office 59 | 1.5 | - | - |
| B1_Office 60 | 1.5 | - | - |
| B1_Office 61 | 1.5 | - 1 | - |

General lighting and display lighting

| Zone | General lighting [W] | Display lamps efficacy [Im/W] |
|-------------------|----------------------|-------------------------------|
| B1_Circulation 10 | 70 | - |
| B1_Circulation 11 | 120 | - |
| B1_Circulation 13 | 30 | - |
| B1_Office 20 | 500 | - |
| B1_Office 22 | 550 | - |
| B1_Office 23 | 290 | - |
| B1_Toilet 10 | 60 | - |

General lighting and display lighting

| Zone | General lighting [W] | Display lamps efficacy [lm/W] |
|--------------|----------------------|-------------------------------|
| B1_Toilet 11 | 90 | - |
| B1_Toilet 12 | 90 | - |
| B1_Office 54 | 30 | - |
| B1_Office 55 | 190 | - |
| B1_Office 56 | 10 | - |
| B1_Office 57 | 60 | - |
| B1_Office 58 | 10 | - |
| B1_Office 59 | 10 | - |
| B1_Office 60 | 10 | - |
| B1_Office 61 | 20 | - |

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

| Zone | Solar gain limit exceeded? (%) | Internal blinds used? |
|--------------|--------------------------------|-----------------------|
| B1_Office 20 | NO (-55%) | YES |
| B1_Office 22 | NO (-49%) | YES |
| B1_Office 23 | NO (-77%) | NO |
| B1_Office 54 | NO (-46%) | NO |
| B1_Office 55 | NO (-1%) | YES |
| B1_Office 56 | NO (-58%) | NO |
| B1_Office 57 | NO (-63%) | NO |
| B1_Office 58 | NO (-39%) | NO |
| B1_Office 59 | NO (-52%) | NO |
| B1_Office 60 | NO (-50%) | NO |
| B1_Office 61 | NO (-41%) | NO |

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

Separate submission

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

Separate submission

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

| | Actual | Notional | % |
|--------------------------------------|--------|----------|-----|
| Area [m ²] | 520 | 520 | |
| External area [m ²] | 488 | 488 | - |
| Weather | LON | LON | 100 |
| Infiltration [m³/hm²@ 50Pa] | 5 | 5 | |
| Average conductance [W/K] | 283 | 295 | |
| Average U-value [W/m ² K] | 0.58 | 0.61 | |
| Alpha value* [%] | 5.92 | 5.92 | |
| | | | |

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

Building Use

22

1

% Area Building Type

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

Energy Consumption by End Use [kWh/m²]

| | Actual | Notional |
|------------|--------|----------|
| Heating | 8.95 | 7.93 |
| Cooling | 7.91 | 7.66 |
| Auxiliary | 7.1 | 5.96 |
| Lighting | 12.34 | 22.7 |
| Hot water | 4.24 | 2.84 |
| Equipment* | 35.63 | 35.63 |
| TOTAL | 40.54 | 47.09 |

* Energy used by equipment does not count towards the total for calculating emissions.

Energy Production by Technology [kWh/m²]

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

Energy & CO₂ Emissions Summary

| | Actual | Indicative Target |
|---|--------|-------------------|
| Heating + cooling demand [MJ/m ²] | 130.97 | 132.08 |
| Total consumption [kWh/m ²] | 40.54 | 47.09 |
| Total emissions [kg/m ²] | 16.2 | 19.9 |

| ŀ | IVAC Sys | stems Per | formanc | e | | | | | | |
|---|--------------|-------------------|-------------------|--------------------|--------------------|-------------------|----------------|---------------|------------------|------------------|
| Sys | stem Type | Heat dem MJ/m2 | Cool dem MJ/m2 | Heat con kWh/m2 | Cool con kWh/m2 | Aux con kWh/m2 | Heat SSEEF | Cool SSEER | Heat gen SEFF | Cool gen SEER |
| [ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity | | | | | | | | | | |
| | Actual | 31.7 | 0 | 2.2 | 0 | 32.1 | 4 | 0 | 4 | 0 |
| | Notional | 88 | 0 | 10.1 | 0 | 16.2 | 2.43 | 0 | | |
| [51 |] Central he | eating using | y water: rad | iators, [HS] | LTHW boi | ler, [HFT] E | lectricity, [(| CFT] Electri | city | |
| | Actual | 34.9 | 0 | 2.4 | 0 | 1.8 | 4 | 0 | 4 | 0 |
| | Notional | 73.3 | 0 | 8.4 | 0 | 1.1 | 2.43 | 0 | | |
| [\$1 |] Split or m | ulti-split sy | stem, [HS] | LTHW boile | er, [HFT] Na | tural Gas, [| CFT] Electi | ricity | | |
| | Actual | 30.7 | 123.6 | 10.5 | 9.8 | 5.9 | 0.81 | 3.5 | 0 | 3.5 |
| | Notional | 21.9 | 123.1 | 7.7 | 9.5 | 9.1 | 0.79 | 3.6 | | |

Key to terms

Aux con [kWh/m2]

Heat gen SSEFF

Heat SSEFF

Cool SSEER

ST

HS

HFT

CFT

= Heating energy demand Heat dem [MJ/m2]

Cool dem [MJ/m2] = Cooling energy demand

Heat con [kWh/m2] = Heating energy consumption

Cool con [kWh/m2] = Cooling energy consumption

= Auxiliary energy consumption

= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)

2

= Cooling system seasonal energy efficiency ratio

= Heating generator seasonal efficiency

- = Cooling generator seasonal energy efficiency ratio
- Cool gen SSEER
- = System type = Heat source

- = Heating fuel type
 - = Cooling fuel type

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

| Element | U і-тур | Ui-Min | Surface where the minimum value occurs* | | |
|---|--|--------|---|--|--|
| Wall | 0.23 | 0.18 | External Wall | | |
| Floor | 0.2 | - | No floors in project | | |
| Roof | 0.15 | 0.12 | Roof | | |
| Windows, roof windows, and rooflights | 1.5 | 1.42 | 1.5m*FH | | |
| Personnel doors | 1.5 | 2.18 | Door 1.5m*2m | | |
| Vehicle access & similar large doors | 1.5 | - | No vehicle doors in project | | |
| High usage entrance doors | usage entrance doors 1.5 - No high usage entrance doors in project | | | | |
| Ui-Typ = Typical individual element U-values [W/(m ² K)] Ui-Min = Minimum individual element U-values [W/(m ² K)] | | | | | |
| * There might be more than one surface where the minimum U-value occurs. | | | | | |

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

20

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Shell and Core

As designed

Date: Fri Dec 18 18:08:23 2015

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache Calculation engine version: 7.0.4

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.4

BRUKL compliance check version: v5.2.d.2

Owner Details

Name: Name Telephone number: Phone Address: Street Address, City, Postcode

Certifier details Name: Telephone number: Phone Address: Street Address, London, Postcode

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

| CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum | 18.1 | |
|--|---------------------|---|
| Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum | 18.1 | - |
| Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum | 16.1 | |
| Are emissions from the building less than or equal to the target? | BER =< TER | _ |
| Are as built details the same as used in the BER calculations? | Separate submission | |

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

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

Building fabric

| Element | Ua-Limit | Ua-Calc | Ui-Calc | Surface where the maximum value occurs* |
|--|----------|---------|---------|--|
| Wall** | 0.35 | 0.13 | 0.13 | 5_000000:Surf[2] |
| Floor | 0.25 | 0.12 | 0.12 | 5_000000:Surf[0] |
| Roof | 0.25 | 0.12 | 0.12 | 5_000004:Surf[2] |
| Windows***, roof windows, and rooflights | 2.2 | 1.4 | 1.4 | 5_000000:Surf[1] |
| Personnel doors | 2.2 | - | | No Personnel doors in building |
| Vehicle access & similar large doors | 1.5 | • | - | No Vehicle access doors in building |
| High usage entrance doors | 3.5 | 4 | - | No High usage entrance doors in building |
| High usage entrance doors | 3.5 | 4 | - | No High usage entrance doors in b |

Ua-Limit = Limiting area-weighted average U-values [W/(m⁻K)] Ua-Calc = Calculated area-weighted average U-values [W/(m²K)]

Ui-calc = Calculated maximum individual element U-values [W/(m²K)]

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

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

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

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

| Air Permeability | Worst acceptable standard | This building | |
|--------------------|---------------------------|---------------|--|
| m³/(h.m²) at 50 Pa | 10 | 5 | |
Building services

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

| Whole building lighting automatic monitoring & targeting with alarms for out-of-range values | YES |
|--|-------|
| Whole building electric power factor achieved by power factor correction | >0.95 |

1- VRF heating and cooling (offices)

| | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(I/s)] | HR efficiency |
|----------------|----------------------|---------------------------|-----------------------|----------------|---------------|
| This system | 4.2 | 3.8 | 0 | 0 | 0.8 |
| Standard value | 2.5* | 3.2 | N/A | N/A | 0.5 |
| Automatic moni | toring & targeting w | ith alarms for out-of | -range values for thi | is HVAC system | n YES |

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

2- VRF heating (toilets)

| | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(I/s)] | HR efficiency |
|----------------|----------------------|---------------------------|-----------------------|---------------|---------------|
| This system | 4.2 | 80 | 0 | 0 | 0.8 |
| Standard value | 2.5* | 3.2 | N/A | N/A | 0.5 |
| Automatic moni | toring & targeting w | ith alarms for out-of | -range values for thi | s HVAC system | n YES |

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

1- Point of use electric heater

| | Water heating efficiency | Storage loss factor [kWh/litre per day] |
|----------------|--------------------------|---|
| This building | 1 | |
| Standard value | 1 | N/A |

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

Shell and core configuration

| Zone | Assumed shell? |
|------------------|----------------|
| GL-offices | YES |
| GL- staircase | YES |
| GL-Elevator | YES |
| L01- offices | YES |
| L01- circulation | YES |
| L01- toilet | YES |
| GL- toilet | YES |
| GL- toilet | YES |
| GL- toilet | YES |
| GL- toilet | YES |
| GL- circulation | YES |
| GL- circulation | YES |

| General lighting and display lighting | Lumino | ous effic | acy [lm/W] | |
|---------------------------------------|-----------|-----------|--------------|----------------------|
| Zone name | Luminaire | Lamp | Display lamp | General lighting [W] |
| Standard value | 60 | 60 | 22 | |
| GL-offices | 75 | - | - | 1853 |

| General lighting and display lighting | Lumino | ous effic | acy [lm/W] | |
|---------------------------------------|-----------|-----------|---|----------------------|
| Zone name | Luminaire | Lamp | Display lamp | General lighting [W] |
| Standard value | 60 | 60 | 22 | |
| GL- staircase | - | 75 | - | 117 |
| GL-Elevator | - | 75 | - | 53 |
| L01- offices | 75 | - | | 2063 |
| L01- circulation | - | 75 | - | 81 |
| L01- toilet | - | 75 | - | 63 |
| L01- toilet | - | 75 | - | 57 |
| L01- toilet | - | 75 | - | 53 |
| L01- toilet | ÷ | 75 | (** · · · · · · · · · · · · · · · · · · | 63 |
| GL- toilet | | 75 | (. | 67 |
| GL- toilet | | 75 | 3 | 53 |
| GL- toilet | | 75 | - | 55 |
| GL- toilet | 8 | 75 | | 55 |
| GL- circulation | - | 75 | | 162 |
| GL- circulation | | 75 | 96° i 1 | 31 |

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

| Zone | Solar gain limit exceeded? (%) | Internal blinds used? |
|------------------|--------------------------------|-----------------------|
| GL-offices | NO (-47.9%) | NO |
| L01- offices | NO (-32.1%) | NO |
| L01- circulation | N/A | N/A |
| GL- toilet | N/A | N/A |
| GL- circulation | NO (-34.2%) | NO |

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

| Were alternative energy systems considered and analysed as part of the design process? | NO |
|--|----|
| Is evidence of such assessment available as a separate submission? | NO |
| Are any such measures included in the proposed design? | NO |

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

| | Actual | Notional | % |
|---|--------|----------|-----|
| Area [m ²] | 498 | 498 | |
| External area [m ²] | 1212 | 1212 | |
| Weather | LON | LON | 100 |
| Infiltration [m ³ /hm ² @ 50Pa] | 5 | 3 | |
| Average conductance [W/K] | 384.8 | 572.38 | |
| Average U-value [W/m ² K] | 0.32 | 0.47 | |
| Alpha value* [%] | 10.05 | 10 | |

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

Energy Consumption by End Use [kWh/m²]

| | Actual | Notional |
|------------|--------|----------|
| Heating | 3.76 | 11.43 |
| Cooling | 9.04 | 5.5 |
| Auxiliary | 3.66 | 2.21 |
| Lighting | 13.07 | 15.15 |
| Hot water | 2.28 | 2.45 |
| Equipment* | 34.62 | 34.62 |
| TOTAL** | 31.81 | 36.74 |

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

Energy Production by Technology [kWh/m²]

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

Energy & CO₂ Emissions Summary

| | Actual | Notional |
|---|--------|----------|
| Heating + cooling demand [MJ/m ²] | 138.11 | 180.33 |
| Primary energy* [kWh/m ²] | 106.47 | 139.55 |
| Total emissions [kg/m ²] | 16.1 | 18.1 |

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

Building Use

% Area Building Type

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

| | IVAC Sys | stems Per | rformanc | е | | | | | | |
|-------------|---------------|-------------------|-------------------|--------------------|--------------------|-------------------|---------------|---------------|------------------|------------------|
| System Type | | Heat dem MJ/m2 | Cool dem MJ/m2 | Heat con kWh/m2 | Cool con kWh/m2 | Aux con kWh/m2 | Heat SSEEF | Cool SSEER | Heat gen SEFF | Cool gen SEER |
| [S | [] Split or m | ulti-split sy | stem, [HS] | Heat pump | (electric): | air source, | [HFT] Elect | ricity, [CFT] | Electricity | |
| | Actual | 100.8 | 77.3 | 6.8 | 0.4 | 2.4 | 4.12 | 59.79 | 4.2 | 80 |
| | Notional | 177.6 | 84.8 | 19.3 | 6.2 | 2.8 | 2.56 | 3.79 | | |
| [S | [] Split or m | ulti-split sy | stem, [HS] | Heat pump | (electric): a | air source, | [HFT] Elect | ricity, [CFT] | Electricity | |
| | Actual | 55.7 | 93.9 | 3.8 | 11.6 | 3.9 | 4.12 | 2.24 | 4.2 | 3 |
| £ | Notional | 107.2 | 83.3 | 11.6 | 6.1 | 2.1 | 2.56 | 3.79 | | |

Key to terms

CFT

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

- = Heating fuel type = Cooling fuel type

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

| Element | U і-Тур | Ui-Min | Surface where the minimum value occurs* |
|--|----------------|------------|---|
| Wall | 0.23 | 0.11 | 5_000004:Surf[6] |
| Floor | 0.2 | 0.12 | 5_000000:Surf[0] |
| Roof | 0.15 | 0.12 | 5_000004:Surf[2] |
| Windows, roof windows, and rooflights | 1.5 | 1.4 | 5_000000:Surf[1] |
| Personnel doors | 1.5 | - | No Personnel doors in building |
| Vehicle access & similar large doors | 1.5 | | No Vehicle access doors in building |
| High usage entrance doors | 1.5 | | No High usage entrance doors in building |
| UI-Typ = Typical individual element U-values [W/(m2) | <)] | | Ui-Min = Minimum individual element U-values [W/(m ² K)] |
| * There might be more than one surface where the | minimum L | J-value oc | curs. |

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



Appendix 5 – Sample SAP Calculations – baseline

Regulations Compliance Report

| Approved Document L1A, 2013 Edition Printed on 22 June 2018 at 10:46:59 | n, England assessed by S | Stroma FSAP 2012 program, Version: 1.0.3 | 3.11 |
|--|---|--|----------------|
| Project Information: | | | |
| Assossed By: () | | Building Type: Elet | |
| | | Building Type. Flat | |
| Dwelling Details: | | | |
| NEW DWELLING DESIGN STAGE | Tuislasshaas | I otal Floor Area: 50.6m ² | |
| Site Reference : Anington Works, | Iwickennam | Plot Reference: Ariington | 1 1 Bed GND 51 |
| Address : | | | |
| Client Details: | | | |
| Name: Sharpes Refinery Address : | ' Service | | |
| This report covers items included with the second sec | vithin the SAP calculatio itions compliance. | ins. | |
| 1a TER and DER | | | |
| Fuel for main heating system: Mains g | jas | | |
| Fuel factor: 1.00 (mains gas) | | 17 12 kg/m2 | |
| Dwelling Carbon Dioxide Emission Rate | ate (DER) | 16.05 kg/m ² | ОК |
| 1b TFEE and DFEE | | | |
| Target Fabric Energy Efficiency (TFE Dwelling Fabric Energy Efficiency (DF | E) ·EE) | 36.6 kWh/m² 32.2 kWh/m² | |
| | | | ОК |
| 2 Fabric U-values Element External wall Party wall Floor Roof Openings | Average 0.17 (max. 0.30) 0.00 (max. 0.20) 0.11 (max. 0.25) (no roof) 1.43 (max. 2.00) | Highest 0.17 (max. 0.70) - 0.11 (max. 0.70) 1.60 (max. 3.30) | ок ок ок |
| 2a Thermal bridging | | | |
| Thermal bridging calculated | from linear thermal transm | nittances for each junction | |
| 3 Air permeability | | | |
| Air permeability at 50 pascals Maximum | | 4.00 (design value) 10.0 | ок |
| 4 Heating efficiency | | | |
| Main Heating system: | Database: (rev 397, pro Boiler systems with rac Brand name: Alpha Model: InTec 34C Model qualifier: (Combi) Efficiency 88.8 % SED Minimum 88.0 % | oduct index 016661): Jiators or underfloor heating - mains gas BUK2009 | ОК |
| Secondary heating system: | None | | |

Regulations Compliance Report

| 5 Cylinder insulation | | | |
|---------------------------------------|-----------------------------------|-------------------------------|-----|
| Hot water Storage: | No cylinder | | |
| 6 Controls | | | |
| | | | |
| Space heating controls | Time and temperature zone control | ol by device in database | ОК |
| Hot water controls: | No cylinder | | 01/ |
| Boller Interlock: | Yes | | UK |
| T Low energy lights | | 100.0% | |
| Minimum | w-energy mangs | 75.0% | OK |
| 8 Machanical ventilation | | 73.078 | OK |
| Net emplicable | | | |
| | | | |
| 9 Summertime temperature | | | |
| Overheating risk (Thames valley) |): | Medium | OK |
| Based on: | | | |
| Overshading: | | Average or unknown | |
| Windows facing: South East | | 4.41m ² | |
| Windows facing: South East | | 4.41m ² | |
| Windows facing: South East | | 1.08m ² | |
| Ventilation rate: | | 3.00 | |
| Blinds/curtains: | | None | |
| | | Closed 100% of daylight hours | |
| 10 Key features | | | |
| Party Walls U-value Floors U-value | | 0 W/m²K 0.11 W/m²K | |

| | | | User D | etails: | | | | | | | | | | | |
|----------------------------------|---|-------------|--------------|------------------|---------------------|------------------|----------|-----------|------------------------|---------------|--|--|--|--|--|
| Assessor Name: Software Name: | Stroma FSAP 201 | 2 | | Stroma Softwa | a Num Ire Ver | ber: sion: | | Versio | n: 1.0.3.11 | | | | | | |
| | | Pr | operty A | Address: | Arlingto | on 1 Bec | GND 5 | 1 | | | | | | | |
| Address : | | | | | | | | | | | | | | | |
| 1. Overall dwelling dime | 1. Overall dwelling dimensions: Area(m ²) Av Height(m) Volume(m ³) | | | | | | | | | | | | | | |
| | | | Area | a(m²) | | Av. He | ight(m) | | Volume(m ³ |) | | | | | |
| Ground floor | 116.38 | (3a) | | | | | | | | | | | | | |
| Total floor area TFA = (1 | | | | | | | | | | | | | | | |
| Dwelling volume | 116.38 | (5) | | | | | | | | | | | | | |
| 2. Ventilation rate: | | | | | | | | | | _ | | | | | |
| | main se | econdary | / | other | | total | | | m ³ per hou | r | | | | | |
| Number of chimneys | | |] + [| 0 |] = [| 0 | x 4 | 40 = | 0 | (6a) | | | | | |
| Number of open flues | | 0 | 」 + - | 0 | 」 <u>「</u>] = 「 | 0 | x | 20 = | 0 | | | | | | |
| Number of intermittent fa | uns | • | | • | | 2 | x / | 10 = | 20 | () (7a) | | | | | |
| Number of passive vents | | | | | | | x / | 10 = | 0 | $\frac{1}{7}$ | | | | | |
| Number of flueloss gas fi | iroc | | | | | 0 | X | 40 – | 0 | | | | | | |
| Number of fideless gas in | changes per hour | | | | | | | | | | | | | | |
| Infiltration due to chimne | ys, flues and fans = (6 | a)+(6b)+(7a | a)+(7b)+(7 | 7c) = | Г | 20 | | ÷ (5) = | 0.17 | (8) | | | | | |
| If a pressurisation test has b | een carried out or is intende | ed, proceed | to (17), o | otherwise c | ontinue fro | om (9) to (| (16) | | | _ | | | | | |
| Number of storeys in the | he dwelling (ns) | | | | | | | 11.0.4 | 0 | (9) | | | | | |
| Structural infiltration: 0 | 25 for steel or timber | frame or | 0 35 for | maconr | v constr | uction | [(9) | -1]XU.1 = | 0 | (10) | | | | | |
| if both types of wall are p | resent, use the value corres | sponding to | the greate | er wall area | a (after | uction | | | 0 | | | | | | |
| deducting areas of openii | ngs); if equal user 0.35 floor_optor 0.2 (upooo) | lad) ar 0 (| 1 (00010 | d) alaa | ontor O | | | | | | | | | | |
| If no draught lobby on | tor 0.05 else enter 0.2 | ieu) 01 0. | i (Seale | u), eise | | | | | 0 | (12) | | | | | |
| Percentage of window | s and doors draught st | trinned | | | | | | | 0 | -(13) | | | | | |
| Window infiltration | s and doors dradgin si | inpped | | 0.25 - [0.2 | x (14) ÷ 1 | 00] = | | | 0 | -(14) | | | | | |
| Infiltration rate | | | | (8) + (10) - | + (11) + (1 | - 2) + (13) - | + (15) = | | 0 | | | | | | |
| Air permeability value. | a50. expressed in cut | oic metres | s per ho | ur per so | uare m | etre of e | envelope | area | 4 | -(17) | | | | | |
| If based on air permeabil | lity value, then $(18) = [(1)]$ | 7) ÷ 20]+(8 |), otherwis | se (18) = (| 16) | | | | 0.37 | (18) | | | | | |
| Air permeability value applie | s if a pressurisation test ha | s been done | e or a deg | ıree air per | meability | is being u | sed | I | | | | | | | |
| Number of sides sheltere | }d | | | | | | | | 2 | (19) | | | | | |
| Shelter factor | | | | (20) = 1 - [| 0.075 x (1 | 9)] = | | | 0.85 | (20) | | | | | |
| Infiltration rate incorporat | ting shelter factor | | | (21) = (18) | x (20) = | | | | 0.32 | (21) | | | | | |
| Infiltration rate modified f | or monthly wind speed | 1 | | | | | | | | | | | | | |
| Jan Feb | Mar Apr May | 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 $(22a)m = (2)$ | 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 | | | | | | | |
| | I | · · · · · | | | | | | | I | | | | | | |

| Adjust | ed infiltr | ation rat | e (allowi | ing for sh | nelter an | d wind s | peed) = | (21a) x | (22a)m | | | | | |
|----------------------|--------------------------|-------------------------|---------------------------|--------------------------|-------------|--------------|-----------------|--------------|-------------------|--|-----------------------|----------------------|------------------|---|
| | 0.4 | 0.4 | 0.39 | 0.35 | 0.34 | 0.3 | 0.3 | 0.29 | 0.32 | 0.34 | 0.36 | 0.37 | | |
| Calcul | ate effe | ctive air | change | rate for t | he appli | cable ca | se | | | | | | | |
| II IIIt | echanica | | ILION. Using Ann | andix N (2 | 3h) - (23a | a) v Emv (e | auation (N | (5)) other | wise (23h |) - (23a) | | | 0 | (23a) |
| If hal | anced with | heat reco | overv: effic | iency in % | allowing f | or in-use f | actor (from | n Table 4h |) – |) = (20u) | | | 0 | (230) |
| a) If | | d moob | | | with ho | | | | $a_{\rm n} = (2)$ | 2h)m i (| 226) v [/ | 1 (220) | 0 | (230) |
| a) II | | | | | | | | TR) (248 | 0m = (22) | 20)m + (1 0 | 230) × [[*] | 1 - (23C) | ÷ 100] | (24a) |
| (24a)III- | | | | | without | boot roo | | |)m ()(| |) 22h) | 0 | | (210) |
| 0) II | | | | | without | | | //v/) (240 | 0) m = (22 | $\frac{1}{2} \frac{1}{2} \frac{1}$ | 230) | 0 | | (24b) |
| (240)III- | | | tractiver | | or no oitiu | | | | | 0 | 0 | 0 | | (210) |
| C) II | if (22b)r | 005eex n < 0.5 x | (23b). 1 | then (24c | c) = (23b) |): otherv | ventilatic | c) = (22b |) m + 0. | .5 x (23b |)) | | | |
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (24c) |
| d) If | natural | ı ventilatio | n or wh | ole hous | e positiv | /e input v | ı ventilatio | on from l | oft | | | | | |
| | if (22b)r | n = 1, the | en (24d) | m = (22k | o)m othe | erwise (2 | 4d)m = | 0.5 + [(2 | 2b)m² x | 0.5] | | | | |
| (24d)m= | 0.58 | 0.58 | 0.57 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | | (24d) |
| Effe | ctive air | change | rate - er | nter (24a |) or (24b | o) or (240 | c) or (24 | d) in box | (25) | | | | | |
| (25)m= | 0.58 | 0.58 | 0.57 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | | (25) |
| 3 He | at losse | s and he | at loss i | naramete | ər. | | | | | | | | | _ |
| | | Gros | ss | Openin | as | Net Ar | ea | U-valu | Je | AXU | | k-value | | A X k |
| | | area | (m²) | m | 2 | A ,r | n² | W/m2 | K | (W/I | K) | kJ/m ² ·k | < | kJ/K |
| Doors | | | | | | 1.89 | x | 1.6 | = | 3.024 | | | | (26) |
| Windo | <mark>ws</mark> Type | e 1 | | | | 4.41 | x1, | /[1/(1.4)+ | 0.04] = | 5.85 | | | | (27) |
| Windo | ws Type | 2 | | | | 4.41 | x1, | /[1/(1.4)+ | 0.04] = | 5.85 | | | | (27) |
| Windo | ws Type | e 3 | | | | 1.08 | x1, | /[1/(1.4)+ | 0.04] = | 1.43 | 5 | | | (27) |
| Floor | | | | | | 50.6 | x | 0.11 | | 5.566 | Ξ r | | | (28) |
| Walls | | 23.1 | 3 | 11.79 | Э | 11.34 | L X | 0.17 | = [| 1.93 | | | = - | (29) |
| Total a | area of e | lements | , m² | | | 73.73 | 3 | | I | | | | | (31) |
| Party v | wall | | | | | 18.76 | | 0 | = [| 0 | | | | (32) |
| Party o | ceilina | | | | | 50.6 | | | I | | L | | \dashv | (32b) |
| * for win | ndows and | roof wind | ows, use e | effective wi | ndow U-va | alue calcula | ated using | ı formula 1, | /[(1/U-valu | ıe)+0.04] a | L as given in | paragraph | 3.2 | (020) |
| ** inclua | le the area | as on both | sides of ir | nternal wal | ls and part | titions | 0 | | | , <u>-</u> | 0 | , , , | | |
| Fabric | heat los | ss, W/K : | = S (A x | U) | | | | (26)(30) | + (32) = | | | | 23.64 | (33) |
| Heat c | apacity | Cm = S(| (Axk) | | | | | | ((28) | (30) + (32 | 2) + (32a). | (32e) = | 7821.48 | (34) |
| Therm | al mass | parame | ter (TMI | ⁻ = Cm ÷ | - TFA) ir | n kJ/m²K | | | Indica | tive Value | : Medium | | 250 | (35) |
| For desi can be u | ign asses: used inste | sments wh ad of a de | ere the de tailed calc | tails of the ulation. | constructi | ion are not | t known pr | ecisely the | indicative | e values of | TMP in Ta | able 1f | | |
| Therm | al bridg | es : S (L | x Y) cal | culated u | using Ap | pendix ł | < | | | | | | 4.57 | (36) |
| if details | of therma | al bridging | are not kr | nown (36) = | = 0.15 x (3 | 1) | | | | | | i | | |
| Total fa | abric he | at loss | | | | | | | (33) + | (36) = | | | 28.22 | (37) |
| Ventila | ation hea | at loss ca | alculated | d monthly | / | | | | (38)m | = 0.33 × (| 25)m x (5) | | l | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | (00) |
| (38)m= | 22.32 | 22.2 | 22.08 | 21.52 | 21.42 | 20.93 | 20.93 | 20.84 | 21.12 | 21.42 | 21.63 | 21.85 | | (38) |
| Heat tr | ransfer o | coefficier | nt, W/K | , | | | | | (39)m | = (37) + (3 | 38)m | | l | |
| (39)m= | 50.54 | 50.42 | 50.3 | 49.74 | 49.64 | 49.15 | 49.15 | 49.06 | 49.34 | 49.64 | 49.85 | 50.07 | | |
| Stroma | FSAP 201 | 2 Version: | 1.0.3.11 | (SAP 9.92) | - http://ww | ww.stroma | .com | | | Average = | Sum(39)1 | 12 /12= | 49.7 ∳ ao | <u>ge 2 o^f³⁹⁾</u> |

| Heat lo | ss para | meter (H | HLP), W | /m²K | | | | | (40)m | = (39)m ÷ | · (4) | | | | |
|-------------------------|---|--------------|--------------|--------------|----------------|-------------|------------|--------------------|---------------|---------------------|------------------------|----------|---------|--------------|--|
| (40)m= | 1 | 1 | 0.99 | 0.98 | 0.98 | 0.97 | 0.97 | 0.97 | 0.98 | 0.98 | 0.99 | 0.99 | | | |
| Numbe | r of day | s in mo | nth (Tab | le 1a) | | | | | / | Average = | Sum(40) _{1.} | 12 /12= | 0.98 | (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) | |
| `´ I | | | | | | | | | | | | | | | |
| 4. Wa | ter heat | ting ene | rgy requ | irement: | | | | | | | | kWh/ye | ear: | | |
| Assum if TF if TF | 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 Reduce | Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold) (43) | | | | | | | | | | | | | | |
| [| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | | |
| Hot wate | r usage ii | n litres per | r day for ea | ach month | Vd,m = fa | ctor from | Table 1c x | (43) | | | | | | | |
| (44)m= | 82.24 | 79.25 | 76.25 | 73.26 | 70.27 | 67.28 | 67.28 | 70.27 | 73.26 | 76.25 | 79.25 | 82.24 | | | |
| | | | | • | | | | | - | Total = Su | m(44) ₁₁₂ = | | 897.12 | (44) | |
| Energy o | ontent of | hot water | used - ca | culated m | onthly $= 4$. | 190 x Vd,r | m x nm x L | OTm / 3600 |) kWh/mor | oth (see Ta | ables 1b, 1 | c, 1d) | | | |
| (45)m= | 121.95 | 106.66 | 110.06 | 95.96 | 92.07 | 79.45 | 73.62 | 84.48 | 85.49 | <mark>9</mark> 9.63 | 108.76 | 118.11 | | _ | |
| lf instant | aneous w | ater heati | ng at point | t of use (no | o hot water | r storage), | enter 0 in | boxes (46 |) to (61) | Total = Su | m(45) ₁₁₂ = | | 1176.26 | (45) | |
| (46)m= | 1 <mark>8.29</mark> | 16 | 16.51 | 14.39 | 13.81 | 11.92 | 11.04 | 12.67 | 12.82 | 14.95 | 16.31 | 17.72 | | (46) | |
| Water | storage | loss: | | <u> </u> | | | | <u> </u> | | <u> </u> | | | | | |
| Storage | e volum | e (litres) | includir | ng any s | olar or N | /WHRS | storage | within sa | ame ves | sel | | 0 | | (47) | |
| If com | nunity h | eating a | and no ta | ank in dw | /elling, e | nter 110 | litres in | i (47) | | (0) : (| () | | | | |
| Otherw Water | ISE IT NO | o stored | hot wate | er (this ir | ICLUDES I | nstantar | neous co | | ers) ente | er '0' in (| 47) | | | | |
| a) If m | anufact | urer's de | eclared I | oss fact | or is kno | wn (kWł | n/dav): | | | | | 0 | | (48) | |
| Tempe | rature f | actor fro | m Table | 2b | | , | , | | | | | 0 | | (49) | |
| Enerav | lost fro | m water | storage | . kWh/v | ear | | | (48) x (49) |) = | | | 0 | | (50) | |
| b) If m | anufact | urer's de | eclared of | cylinder | loss fact | or is not | known: | | | | | 0 | | (00) | |
| Hot wa | ter stora | age loss | factor fi | rom Tab | le 2 (kW | h/litre/da | ay) | | | | | 0 | | (51) | |
| If comn | nunity h | from To | ee secti | on 4.3 | | | | | | | | - | l | (50) | |
| Tempe | rature f | actor fro | m Table | 2h | | | | | | | | 0 | | (52) (53) | |
| Energy | lost fro | m water | storage | ~ _S | oor | | | $(47) \times (51)$ |) y (52) y (| 53) - | | 0 | | (54) | |
| Enter | (50) or (| (54) in (5 | 55) | , KVVII/ yv | Jai | | | (47) X (31) | / (() ~ () | 00) - | | 0 | | (54) | |
| Water | storage | loss cal | culated | for each | month | | | ((56)m = (| 55) × (41)ı | m | | | | () | |
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (56) | |
| If cylinde | r contains | s dedicate | d solar sto | orage, (57) | m = (56)m | x [(50) – (| H11)] ÷ (5 | 50), 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) | |
| Primary | / circuit | loss (ar | nual) fro | om Table | e 3 | | | | | | | 0 | | (58) | |
| Primar | / circuit | loss cal | culated | for each | month (| 59)m = (| (58) ÷ 36 | 65 × (41) | m | | L | | I | | |
| (moc | lified by | factor f | rom Tab | le H5 if t | here is s | solar wat | ter heati | 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 | lculated | for eac | ch i | month (| 61)m = | (60 |) ÷ 36 | 65 × (41) | m | | | | | | |
|-----------------------|-----------------------|-------------------------|--------------------|------|-------------------------|------------|------|---------|--------------------------|------------|------------------------|---------------------|---------------|-------------|----------------------|------|
| (61)m= | 23.7 | 21.39 | 23.65 | | 22.85 | 23.59 | 2 | 2.81 | 23.55 | 23.58 | 22.83 | 23.63 | 22.9 | 23.69 | | (61) |
| Total h | eat req | uired for | water | he | ating ca | lculated | fo | r each | n month | (62)m | = 0.85 × | (45)m · | + (46)m + | (57)m + | - · (59)m + (61)m | |
| (62)m= | 145.65 | 128.05 | 133.7 | 1 | 118.81 | 115.67 | 10 |)2.26 | 97.17 | 108.06 | 108.33 | 123.26 | 3 131.66 | 141.79 |] | (62) |
| Solar DH | HW input | calculated | using A | ppe | ndix G or | Appendix | Н (| negativ | ve quantity |) (enter ' | 0' if no sola | r contrib | ution to wate | er heating) | - | |
| (add a | dditiona | al lines if | FGHR | Sa | and/or V | VWHRS | ар | plies, | , 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 | | | | | | | | | - | | - | _ | |
| (64)m= | 145.65 | 128.05 | 133.7 ⁻ | 1 | 118.81 | 115.67 | 10 | 02.26 | 97.17 | 108.06 | 108.33 | 123.26 | 5 131.66 | 141.79 | | _ |
| | | | | | | | | | | Ou | tput from w | ater hea | ter (annual) | 112 | 1454.42 | (64) |
| Heat g | ains fro | m water | heatin | g, l | kWh/mo | onth 0.2 | 5 í | [0.85 | × (45)m | + (61) | m] + 0.8 x | x [(46)r | n + (57)m | + (59)m |] | |
| (65)m= | 46.47 | 40.81 | 42.51 | | 37.62 | 36.51 | 3 | 2.12 | 30.37 | 33.99 | 34.13 | 39.04 | 41.89 | 45.19 | | (65) |
| inclu | de (57) | m in calo | culation | n of | f (65)m | only if c | ylir | nder is | s in the c | dwelling | g or hot w | ater is | from com | munity h | neating | |
| 5. Int | ernal g | ains (see | e Table | 5 | and 5a) | : | | | | | | | | | | |
| Metab | olic gair | ns (Table | e 5), W | atts | S | | | | | | | | | | | |
| | Jan | Feb | Ma | r | Apr | May | | Jun | Jul | Aug | Sep | Oct | Nov | Dec |] | |
| (66)m= | 85.39 | 85.39 | 85.39 | | 85.39 | 85.39 | 8 | 5.39 | 85.39 | 85.39 | 85.39 | 8 <mark>5.39</mark> | 85.39 | 85.39 | | (66) |
| Ligh <mark>tin</mark> | g gains | (calcula | ted in <i>l</i> | App | o <mark>en</mark> dix l | _, equati | ion | L9 or | ^r L9a), a | lso see | Table 5 | | | | | |
| (67)m= | 13.39 | 11.89 | 9.67 | | 7.32 | 5.47 | 4 | .62 | 4.99 | 6.49 | 8.71 | 11.06 | 12.91 | 13.76 | | (67) |
| App <mark>lia</mark> | nces ga | ins (ca <mark>lc</mark> | ulated | in . | Append | lix L, eq | uat | ion L' | 13 o <mark>r L</mark> 1: | 3a), als | <mark>o se</mark> e Ta | ble 5 | | | - | |
| (68)m= | 148.79 | 150.34 | 146.4 | 5 | <mark>138</mark> .16 | 127.71 | 11 | 17.88 | 111.31 | 109.77 | 113.66 | 121.94 | 132.4 | 142.23 | | (68) |
| Cookir | g gains | s (calcula | ited in | Ap | pendix | L, equat | ion | L15 | or L15a) | , also s | ee Table | 9 5 | | | - | |
| (69)m= | 31.54 | 31.54 | 31.54 | | <mark>31.</mark> 54 | 31.54 | 3 | 1.54 | 31.54 | 31.54 | 31.54 | 31.54 | 31.54 | 31.54 | | (69) |
| Pumps | and fa | ns gains | (Table | e 5a | a) | | | | | | | | | | · | |
| (70)m= | 3 | 3 | 3 | | 3 | 3 | | 3 | 3 | 3 | 3 | 3 | 3 | 3 |] | (70) |
| Losses | s e.g. e | , vaporatio | n (neg | jati | ve valu | es) (Tab | le : | 5) | | | 1 | | • | ! | - | |
| (71)m= | -68.31 | -68.31 | -68.31 | 1 | -68.31 | -68.31 | -6 | 8.31 | -68.31 | -68.31 | -68.31 | -68.31 | -68.31 | -68.31 |] | (71) |
| Water | heating | , gains (T | able 5 | 5) | | | | | | | • | | | <u>.</u> | - | |
| (72)m= | 62.46 | 60.73 | 57.14 | | 52.25 | 49.08 | 4 | 4.61 | 40.82 | 45.68 | 47.41 | 52.47 | 58.18 | 60.74 |] | (72) |
| Total i | nterna | l gains = | | | | | | (66) | m + (67)m | + (68)m | + (69)m + | (70)m + | (71)m + (72) |)m | - | |
| (73)m= | 276.26 | 274.58 | 264.8 | 7 | 249.35 | 233.87 | 21 | 18.73 | 208.74 | 213.56 | 221.4 | 237.09 | 255.1 | 268.35 |] | (73) |
| 6. So | lar gain | s: | | | | | | | | | | | | | 2 | |
| Solar g | ains are | calculated | using sc | olar | flux from | Table 6a a | and | associ | ated equa | tions to c | onvert to th | ne applic | able orientat | tion. | | |
| Orienta | ation: | Access F | actor | | Area | | | Flu | x | | g | | FF | | Gains | |
| | | Table 6d | | | m² | | | Tat | ble 6a | | Table 6b | | Table 6c | | (VV) | |
| Southe | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | × | 3 | 6.79 | x | 0.63 | x | 0.7 | = | 49.59 | (77) |
| Southe | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 3 | 6.79 | x | 0.63 | x | 0.7 | = | 49.59 | (77) |
| Southe | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | 3 | 6.79 | x | 0.63 | x | 0.7 | = | 12.14 | (77) |
| Southe | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 6 | 2.67 | x | 0.63 | x | 0.7 | = | 84.47 | (77) |
| Southe | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 6 | 2.67 | x | 0.63 | x | 0.7 | = | 84.47 | (77) |

| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | 6 | 62.67 | x | | 0.63 | x | 0.7 | - | - [| 20.69 | (77) |
|----------|-----------------------|-----------|--------|----------------------|-------------------|------------------|---------------|---------|------------|----------|------------|----------------|--------|----------|-------|------------|--------|------------|
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 1 | 35.75 |] × | | 0.63 | × | 0.7 | | - [| 115.57 |] (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 1 | 35.75 | x | | 0.63 | × | 0.7 | | - [| 115.57 |] (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | 1 | 35.75 | x | | 0.63 | × | 0.7 | | - [| 28.3 |] (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 1 | 06.25 | x | | 0.63 | × | 0.7 | | - [| 143.2 |] (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 1 | 06.25 | x | | 0.63 | × | 0.7 | | - [| 143.2 |] (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | 1 | 06.25 | x | | 0.63 | x | 0.7 | = | - [| 35.07 | - (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 1 | 19.01 | x | | 0.63 | x | 0.7 | - | - [| 160.4 | - (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 1 | 19.01 | x | | 0.63 | x | 0.7 | - | - [| 160.4 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | 1 | 19.01 | x | | 0.63 | x | 0.7 | | - [| 39.28 | - (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 1 | 18.15 | x | | 0.63 | x | 0.7 | = | = [| 159.24 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 1 | 18.15 | x | | 0.63 | x | 0.7 | = | = [| 159.24 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | 1 | 18.15 | x | | 0.63 | × | 0.7 | = | - [| 39 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | -1 | x | 1 | 13.91 | x | | 0.63 | x | 0.7 | = | - [| 153.52 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 1 | 13.91 | x | | 0.63 | x | 0.7 | = | - [| 153.52 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | 1 | 13.91 | x | | 0.63 | x | 0.7 | = | - [| 37.6 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 1 | 04.39 | x | | 0.63 | x | 0.7 | = | = [| 140.69 | (77) |
| Souther | ast 0.9x | 0.77 | | x | 4.4 | 1 | x | 1 | 04.39 | x | | 0.63 | × | 0.7 | = | - [| 140.69 | (77) |
| Souther | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | х | 1 | 04.39 |] x | | 0.63 | × | 0.7 | = | - [| 34.46 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | .1 | х | 9 | 92.85 |] × | | 0.63 | x | 0.7 | = | = [| 125.14 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | <u></u> | 92.85 | x | | 0.63 | x | 0.7 | = | = [| 125.14 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | 9 | 92.85 | x | | 0.63 | x | 0.7 | = | - [| 30.65 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | .1 | x | e | 69.27 | x | | 0.63 | x | 0.7 | = | = [| 93.36 | (77) |
| Southea | ast 0.9x | 0.77 | | x | 4.4 | 1 | x | E | 9.27 | x | | 0.63 | x | 0.7 | = | = [| 93.36 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | 6 | 69.27 | x | | 0.63 | x | 0.7 | = | - [| 22.86 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 4 | 14.07 | x | | 0.63 | x | 0.7 | = | = [| 59.4 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | | 14.07 | x | | 0.63 | × | 0.7 | = | = [| 59.4 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | 4 | 14.07 | x | | 0.63 | × | 0.7 | = | = [| 14.55 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | -1 | x | 3 | 31.49 | x | | 0.63 | × | 0.7 | = | = [| 42.44 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 3 | 31.49 | × | | 0.63 | × | 0.7 | = | = [| 42.44 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | 3 | 31.49 | x | | 0.63 | × | 0.7 | = | = [| 10.39 | (77) |
| | | | | | | | | | | | | | | | | | | |
| Solar g | ains in | watts, ca | alcula | ted | for eac | n mont | h 7 a | 057 47 | 244.64 | (83)m | n = Si | um(74)m | (82)m | 7 400.04 | 05.07 | ,] | | (83) |
| (83)m= | ains – i | nternal a | 259.4 | ^{io} Iar | 321.47 (84)m - | 360.07 | $\frac{1}{1}$ | 83)m | watts | 315 | 0.84 | 280.93 | 209.57 | 133.34 | 95.27 | , | | (03) |
| (84)m= | 387 59 | 464.2 | 524 3 | 32 | 570.82 | 593.95 | | 576.2 | 553.38 | 529 | 94 | 502 33 | 446 66 | 3 388 44 | 363.6 | 2 | | (84) |
| | 001.00 | | 02110 | - | | 000.00 | | 01 0.L | 000.00 | 020 | <u>, i</u> | 002.00 | 110.00 | | 000.0 | | | (-) |
| 7. Me | an inter | nal temp | peratu | re (a p | neating | seasc the liv | n) vina | oroo | from Tol | | Th | 1 (°C) | | | | 1 | 04 | |
| Litilioc | erature | tor for a | | y pe ar li | | | /ilig m (c | | | ole a | , 111 | I (C) | | | | l | 21 | (65) |
| Juiise | ,lan | Feh | Ma | $\frac{1}{1}$ | Anr | a, 111, Mav | / [| Jun | | Δ | un I | Sen | Oct | Nov | Der | | | |
| (86)m= | 0.99 | 0.98 | 0.95 | ; | 0.87 | 0.73 | <u></u> | 0.54 | 0.39 | 0.4 | 42 | 0.65 | 0.91 | 0.98 | 1 | _ | | (86) |
| NA | interre- | | | i | hdin n | | | | | 7 : 7 | | | | | I | | | . , |
| (87)m- | 111terna | | ature | in I 6 | 20 8 | 20 04 | | | 21 ps 3 to | | | = 9C) 20 98 | 20 70 | 20.41 | 20.08 | <u>,</u>] | | (87) |
| (07)11- | 20.12 | 20.02 | 20.5 | ~ | 20.0 | 20.94 | | _0.00 | | | ' | 20.00 | 20.19 | 20.41 | 20.00 | · _ | | (0) |

| Temp | perature | during h | neating p | eriods ir | n rest of | dwelling | from Ta | ble 9, Tl | h2 (°C) | | | | | | |
|--------------------|-------------------------|---------------------|------------|------------------------|-------------------------|----------------|--------------------------|-------------|-------------------------|-----------------------|-------------------------|-------------------------------|-------|--------|---------|
| (88)m= | 20.08 | 20.09 | 20.09 | 20.1 | 20.1 | 20.11 | 20.11 | 20.11 | 20.1 | 20.1 | 20.1 | 20.09 | | | (88) |
| Utilisa | ation fac | tor for g | ains for | rest of d | welling, I | h2,m (se | e Table | 9a) | | | | | | | |
| (89)m= | 0.99 | 0.98 | 0.94 | 0.84 | 0.67 | 0.47 | 0.31 | 0.34 | 0.58 | 0.87 | 0.98 | 0.99 | | | (89) |
| Mean | n interna | l temper | ature in | the rest | of dwelli | ng T2 (fo | ollow ste | eps 3 to 7 | 7 in Tabl | e 9c) | | | | | |
| (90)m= | 18.93 | 19.21 | 19.55 | 19.88 | 20.05 | 20.1 | 20.11 | 20.11 | 20.09 | 19.87 | 19.34 | 18.88 | | | (90) |
| | | | | | | | | | f | LA = Livin | g area ÷ (4 | •) = | 0.4 | 19 | (91) |
| Mean | n interna | l temper | ature (fo | or the wh | ole dwe | llina) = fl | LA x T1 | + (1 – fL | A) × T2 | | | | | | - |
| (92)m= | 19.52 | 19.76 | 20.05 | 20.34 | 20.49 | 20.54 | 20.55 | 20.55 | , 20.53 | 20.32 | 19.87 | 19.47 | | | (92) |
| Apply | adjustr | nent to t | he mear | interna | temper | ature fro | m Table | 4e, whe | ere appro | opriate | | | | | |
| (93)m= | 19.52 | 19.76 | 20.05 | 20.34 | 20.49 | 20.54 | 20.55 | 20.55 | 20.53 | 20.32 | 19.87 | 19.47 | | | (93) |
| 8. Sp | ace hea | ting req | uirement | | | | | | | | | | | | |
| Set T | i to the i | mean int | ternal ter | mperatu | re obtain | ed at ste | ep 11 of | Table 9 | o, so tha | t Ti,m=(| 76)m and | d re-calc | ulate | | |
| the ut | lilisation | | or gains | | able 9a | lun | lul. | Aug | Sen | Oct | Nev | Dee | | | |
| l Itilis: | Jan ation fac | tor for a | ains hm | Apr | iviay | Jun | Jui | Aug | Sep | Oci | INOV | Dec | | | |
| (94)m= | 0.99 | 0.97 | 0.94 | 0.85 | 0.7 | 0.5 | 0.35 | 0.38 | 0.61 | 0.88 | 0.98 | 0.99 | | | (94) |
| Usefu | L JI gains, | hmGm | . W = (94 | 1 4)m x (84 | L 4)m | | | | | | | | | | |
| (95)m= | 3 <mark>83.5</mark> | 451.85 | 491.08 | 484.89 | 413.62 | 289.14 | 193.73 | 202.99 | 308.36 | 39 <mark>3.97</mark> | 379.02 | 360.8 | | | (95) |
| Montl | hly aver | age exte | ernal tem | perature | e from Ta | able 8 | | 7- | | | | | | | |
| (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) |
| He <mark>at</mark> | los <mark>s rate</mark> | e for me | an intern | al tempe | erature, | Lm , W = | =[(39)m : | x [(93)m | <mark>– (96</mark>)m |] | | | | | |
| (97)m= | 769.13 | 749.15 | 681.49 | 568.81 | 436.32 | 2 92.03 | 194.02 | 203.49 | 317.05 | 482.6 | 636.47 | 764.65 | | | (97) |
| Space | e heatin | g requir | ement fo | <mark>r eac</mark> h n | nonth, <mark>k</mark> l | Nh/mont | t <mark>h = 0</mark> .02 | 24 x [(97) |) <mark>m – (9</mark> 5 |)m] <mark>x (4</mark> | 1)m | | | | |
| (98)m= | 286.91 | 199.79 | 141.67 | 60.42 | 16.89 | 0 | 0 | 0 | 0 | 65.94 | 185.36 | 300.47 | | | _ |
| | | | | | | | | Tota | l per year | (kWh/year | ') = Sum(98 | 3) _{15,912} = | 125 | ′.44 | (98) |
| Spac | e heatin | g require | ement in | kWh/m² | ²/year | | | | | | | | 24. | 85 | (99) |
| 9a. En | ergy rec | quiremer | nts – Indi | ividual h | eating sy | ystems i | ncluding | micro-C | CHP) | | | | | | - |
| Spac | e heatii | ng: | | | | | | | | | | | | | _ |
| Fract | ion of sp | bace hea | at from s | econdar | y/supple | mentary | system | | | | | | C |) | (201) |
| Fracti | ion of sp | bace hea | at from m | nain syst | em(s) | | | (202) = 1 - | - (201) = | | | | 1 | | (202) |
| Fract | ion of to | tal heati | ng from | main sys | stem 1 | | | (204) = (2 | 02) × [1 – (| (203)] = | | | 1 | | (204) |
| Efficie | ency of | main spa | ace heat | ing syste | em 1 | | | | | | | | 92 | .7 | (206) |
| Efficie | ency of a | seconda | ry/suppl | ementar | y heating | g system | n, % | | | | | ĺ | C |) | (208) |
| | Jan | Feb | Mar | Apr | Mav | Jun | Jul | Aua | Sep | Oct | Nov | Dec | k | Wh/vea | ⊐ ar |
| Space | e heatin | g require | ement (c | alculate | d above) |) | | - 5 | 1 | | | | | ., | |
| - | 286.91 | 199.79 | 141.67 | 60.42 | 16.89 | 0 | 0 | 0 | 0 | 65.94 | 185.36 | 300.47 | | | |
| (211)m | n = {[(98 |)m x (20 |)4)] } x 1 | 00 ÷ (20 |)6) | | | | | | | | | | (211) |
| () | 309.5 | 215.52 | 152.82 | 65.18 | , 18.22 | 0 | 0 | 0 | 0 | 71.13 | 199.96 | 324.13 | | | |
| | | | • | | | | | Tota | l (kWh/yea | ar) =Sum(2 | 211) _{15,1012} | = | 1356 | 5.46 | (211) |
| Space | e heatin | g fuel (s | econdar | y), kWh/ | month | | | | | | | L | | | - |
| = {[(98 |)m x (20 |)1)]}x ¹ | 00 ÷ (20 | 8) | | | | | | | | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | _ |
| | | | | | | | | Tota | l (kWh/yea | ar) = Sum(2) | 215) _{15,1012} | = [| C |) | (215) |

Water heating

| Output | from w | ater hea | ter (calc | ulated al | oove) | | - | • | - | | | | • | |
|---------------------|------------|----------------------|---------------------|--|----------|--------------------|-------------------------|-------------|------------|----------------|-------------------------|--------|--|----------------|
| | 145.65 | 128.05 | 133.71 | 118.81 | 115.67 | 102.26 | 97.17 | 108.06 | 108.33 | 123.26 | 131.66 | 141.79 | | |
| Efficier | ncy of w | ater hea | ter | | | | | _ | | - | - | - | 87 | (216) |
| (217)m= | 88.77 | 88.63 | 88.37 | 87.89 | 87.33 | 87 | 87 | 87 | 87 | 87.92 | 88.56 | 88.82 | | (217) |
| Fuel fo | r water | heating, | kWh/mo | onth | | | | | | | | | | |
| (219)m = | 1 = (64) | <u>m x 100</u> |) ÷ (217) 151.31 | m 135.18 | 132 44 | 117 54 | 111 69 | 124 21 | 124 51 | 140 19 | 148 67 | 159.65 | 1 | |
| (210) | 101.01 | | 101.01 | 100.10 | 102.11 | 111.01 | 111.00 | Tota | I = Sum(2 | 19a), ,, = | 110.07 | 100.00 | 1653.95 | (219) |
| Annua | l totals | | | | | | | | | k | Wh/vear | | kWh/vea | (_:o) r |
| Space | heating | fuel use | ed, main | system | 1 | | | | | Ň | , you | | 1356.46 |] |
| Water | heating | fuel use | d | | | | | | | | | | 1653.95 | |
| Electric | city for p | oumps, f | ans and | electric l | keep-ho | t | | | | | | | | _ |
| centra | al heatir | ng pump | : | | | | | | | | | 30 |] | (230c) |
| boiler | with a f | an-assis | sted flue | | | | | | | | | 45 |] | (230e) |
| Total e | lectricity | 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 | city for I | ighting | | | | | | | | | | | 236.49 | (232) |
| 12a. (| CO2 em | issions - | – Individ | ual heati | ng syste | ems inclu | uding mi | cro-CHF |) | | | | | |
| | Г | | | E | | En kW | e rgy /h/year | | | Emiss kg CO | ion fac 2/kWh | tor | Em<mark>issio</mark>ns kg CO2/ye | s ar |
| Spa <mark>ce</mark> | heating | (main <mark>s</mark> | ystem 1) |) | | (21 | 1) x | | | 0.2 | 16 | = | 293 | (261) |
| Spa <mark>ce</mark> | heating | (second | dary) | | | (21 | 5) x | | | 0.5 | 19 | = | 0 | (263) |
| Wat <mark>er</mark> | heating | | | | | (219 | 9) x | | | 0.2 | 16 | = | 357.25 | (264) |
| Space | and wa | ter heati | ng | | | (26 | 1) + (262) | + (263) + (| (264) = | | | | 650.25 | (265) |
| Electric | city for p | oumps, f | ans and | electric l | keep-ho | t (23 ⁻ | 1) x | | | 0.5 | 19 | = | 38.93 | (267) |
| Electric | city for l | ighting | | | | (232 | 2) x | | | 0.5 | 19 | = | 122.74 | (268) |
| Total C | :02, kg/ | /year | | | | | | | sum o | f (265)(2 | 271) = | | 811.91 | (272) |
| Dwelli | ng CO2 | Emissi | on Rate | | | | | | (272) | ÷ (4) = | | | 16.05 | (273) |
| EI ratin | ig (secti | ion 14) | | | | | | | | | | | 89 | (274) |

| | | ι | Jser De | etails: | | | | | | |
|--|--------------------------------|--------------------|-----------|------------------|-------------------|---------------|----------|-----------|------------------------|-----------------------|
| Assessor Name: Software Name: | Stroma FSAP 201 | 2 | ļ | Stroma Softwa | a Numi ire Ver | ber: sion: | | Versio | n: 1.0.3.11 | |
| | | Pro | perty A | Address: | Arlingto | n 1 Bed | GND 5 | 1 | | |
| Address : | | | | | | | | | | |
| 1. Overall dwelling dime | nsions: | | | (0) | | | | | | |
| Ground floor | | | Area | (m²) | (10) × | Av. Hei | ight(m) |](20) | Volume(m ³ | $\frac{1}{2}$ |
| | · //· · // · · // · · // | · · · · · | 5 | 0.6 | (1a) x | 2 | 2.3 | (2a) = | 116.38 | (3a) |
| Total floor area TFA = (1a | a)+(1b)+(1c)+(1d)+(1e) |)+(1n) | 5 | 0.6 | (4) | | | | | |
| Dwelling volume | | | | | (3a)+(3b) | +(3c)+(3d |)+(3e)+ | .(3n) = | 116.38 | (5) |
| 2. Ventilation rate: | | | | | | | | | | |
| | main se heating h | econdary eating | (| other | | total | | | m ³ per hou | * |
| Number of chimneys | | 0 | + | 0 |] = [| 0 | x 4 | 40 = | 0 | (6a) |
| Number of open flues | 0 + | 0 | + | 0 | i = Г | 0 | x 2 | 20 = | 0 | (6b) |
| Number of intermittent far | าร | ı | | | ' L | 2 | x 1 | 10 = | 20 |](7a) |
| Number of passive vents | | | | | | 0 | x 1 | 10 = | 0 | _](7b) |
| Number of flueless gas fir | res | | | | Ē | 0 | x 4 | 40 = | 0 | (7c) |
| | | | | | L | | | Air ch | anges per ho | ur |
| Infiltration due to chimney | rs, flues and fans = (6a | a)+(6b)+(7a) | +(7b)+(7 | (c) = | | 20 | - | ÷ (5) = | 0.17 | (8) |
| If a pressurisation test has be | en carried out or is intende | d, proceed t | 0 (17), 0 | therwise c | ontinue fro | om (9) to (| 16) | I | | |
| Additional infiltration | e dwennig (ns) | | | | | | [(9)- | -11x0.1 = | 0 | -(3) |
| Structural infiltration: 0. | 25 for steel or timber f | rame or 0 | .35 for | masonr | y constru | uction | 1(-) | | 0 | |
| if both types of wall are pr | esent, use the value corresp | conding to th | ne greate | er wall area | , a (after | | | I | _ | |
| deducting areas of openin | gs); if equal user 0.35 | ed) or 0 1 | (socio | d) olso | ontor O | | | I | 0 | |
| If no draught lobby, ent | rer 0.05 else enter 0 | | (Sealer | u), eise (| | | | | 0 | (12) |
| Percentage of windows | and doors draught str | ripped | | | | | | | 0 | $= \frac{(10)}{(14)}$ |
| Window infiltration | gg | | (| 0.25 - [0.2 | x (14) ÷ 1 | = [00 | | | 0 | |
| Infiltration rate | | | (| (8) + (10) - | + (11) + (1 | 2) + (13) + | + (15) = | | 0 | (16) |
| Air permeability value, | q50, expressed in cub | ic metres | per ho | ur per so | uare me | etre of e | nvelope | area | 5 | (17) |
| If based on air permeabili | ty value, then (18) = [(17 | 7) ÷ 20]+(8), | otherwis | se (18) = (| 16) | | | | 0.42 | (18) |
| Air permeability value applies | s if a pressurisation test has | been done | or a deg | ree air per | meability i | is being us | sed | | | _ |
| Number of sides sheltered | d | | (| (20) – 1 - [| 0 075 x (1 | 9)1 – | | | 2 | (19) |
| Infiltration rate incorporati | ing shalter factor | | | (20) - (18) | x (20) - | 0)] – | | l | 0.85 | (20) |
| Infiltration rate modified for | rig sheller factor | | | (21) = (10) | x (20) - | | | l | 0.36 | |
| | Mar Apr May | Jun | Jul | Aug | Sen | Oct | Nov | Dec | | |
| Monthly average wind sp | eed from Table 7 | oun | | , .ug | 000 | 000 | 1107 | | | |
| (22)m= 5.1 5 | 4.9 4.4 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 | | |
| | | I | | | | | 1 | | | |
| Wind Factor $(22a)m = (22a)m $ | 2)m ÷ 4 | | | | <u> </u> | | | | | |
| (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 | nelter an | d wind s | peed) = | (21a) x | (22a)m | - | | _ | | |
|----------------------|-------------------------|--------------------------|---------------------------|--------------------------|-------------|--------------|----------------|---------------|--------------|---------------------------------|------------------|----------------------|-----------------|------------------------|
| . | 0.46 | 0.45 | 0.44 | 0.39 | 0.39 | 0.34 | 0.34 | 0.33 | 0.36 | 0.39 | 0.4 | 0.42 | | |
| Calcula | ate effe | ctive air | change | rate for t | he appli | cable ca | se | | | | | | | (22.5) |
| lf exh | aust air h | eat pump i | using App | endix N (2 | 3b) = (23a | i) x Fmv (e | equation (N | (5)) other | wise (23h |) = (23a) | | | 0 | (238) |
| lf bala | anced with | n heat reco | overv: effic | iencv in % | allowing f | or in-use fa | actor (from | Table 4h |) = |) = (204) | | | 0 | (230) |
| a) If | halance | d moch | anical ve | ntilation | with bo | at recove | any (M)/F | - Pable III) | ()m - (2) | 2h)m ⊥ (| 23h) v [| 1 - (23c) | · 1001 | (230) |
| (24a)m= | | | | | | | | 0 | 0 | | | 1 - (230) | ÷ 100] | (24a) |
| () b) If | halance | | anical ve | | without | heat rec | | /\/) (2/b | m = (22) | $\int_{0}^{\infty} h(m + \ell)$ | 23h) | ů | | |
| (24b)m= | 0 | | | | 0 | | | 0 | 0 | | 0 | 0 | | (24b) |
| () If | whole h | | tract ver | | | | ventilatio | n from c | | ů | <u> </u> | <u> </u> | | |
| i c) | if (22b)n | $n < 0.5 \times$ | (23b), 1 | then (24c | c) = (23b |); otherv | vise (24 | c) = (22b |) 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 v | ventilatio | on from l | oft | Į | Į | | | |
| í | if (22b)n | n = 1, the | en (24d) | m = (22t | o)m othe | rwise (2 | 4d)m = | 0.5 + [(2 | 2b)m² x | 0.5] | | | | |
| (24d)m= | 0.6 | 0.6 | 0.6 | 0.58 | 0.57 | 0.56 | 0.56 | 0.56 | 0.56 | 0.57 | 0.58 | 0.59 | | (24d) |
| Effe | ctive air | change | rate - er | nter (24a |) or (24b | o) or (24 | c) or (24 | d) in box | (25) | | - | | | |
| (25)m= | 0.6 | 0.6 | 0.6 | 0.58 | 0.57 | 0.56 | 0.56 | 0.56 | 0.56 | 0.57 | 0.58 | 0.59 | | (25) |
| 3 He | at losse | s and he | at loss | naramete | ər. | | | | | | | _ | | |
| | | Gros | ss | Openin | as | Net Ar | ea | U-valu | Je | AXU | | k-value | 9 | AXk |
| | | area | (m²) | m | 2 | A ,r | n² | W/m2 | K | (W/I | K) | kJ/m ² ·l | < | kJ/K |
| Doo <mark>rs</mark> | | | | | | 1.89 | x | 1 | = [| 1.89 | | | | (26) |
| Windo | ws Type | e 1 | | | | 4.41 | x1, | /[1/(1.4)+ | 0.04] = | 5.85 | | | | (27) |
| Windo | ws Type | 92 | | | | 4.41 | x1, | /[1/(1.4)+ | 0.04] = | 5.85 | | | | (27) |
| Windo | ws Type | e 3 | | | | 1.08 | x1, | /[1/(1.4)+ | 0.04] = | 1.43 | 5 | | | (27) |
| Floor | | | | | | 50.6 | x | 0.13 |] = [| 6.578 | | | | (28) |
| Walls | | 23.1 | 3 | 11.79 | Э | 11.34 | × × | 0.18 | | 2.04 | i F | | i – | (29) |
| Total a | rea of e | lements | , m² | | | 73.73 | 3 | | เ | | L | | | (31) |
| Partv v | vall | | | | | 18.76 | | 0 | | 0 | | | | (32) |
| Party c | eilina | | | | | 50.6 | | | [| | L [| | \dashv | (32h) |
| * for win | dows and | roof wind | ows. use e | effective wi | ndow U-va | alue calcula | ated usino | formula 1 | /ī(1/U-valu | ıe)+0.041 a | L as aiven in | paragraph | | (020) |
| ** includ | le the area | as on both | sides of in | nternal wall | ls and part | titions | | | | , , . | 9 | 1 | | |
| Fabric | heat los | ss, W/K = | = S (A x | U) | | | | (26)(30) | + (32) = | | | | 23.63 | (33) |
| Heat c | apacity | Cm = S(| (Axk) | | | | | | ((28) | (30) + (32 | 2) + (32a). | (32e) = | 7821.48 | (34) |
| Therm | al mass | parame | ter (TMI | ⁻ = Cm ÷ | - TFA) in | ∩ kJ/m²K | | | Indica | tive Value | : Medium | | 250 | (35) |
| For desi can be u | gn assess ised inste | sments wh ad of a dei | ere the de tailed calc | tails of the ulation. | constructi | ion are not | t known pr | ecisely the | e indicative | e values of | TMP in T | able 1f | | |
| Therm | al bridg | es : S (L | x Y) cal | culated u | using Ap | pendix ł | < | | | | | | 4.85 | (36) |
| if details | of therma | al bridging | are not kr | nown (36) = | = 0.15 x (3 | 1) | | | | | | | | |
| Total fa | abric he | at loss | | | | | | | (33) + | (36) = | | | 28.48 | (37) |
| Ventila | tion hea | at loss ca | alculated | d monthly | / | | | | (38)m | = 0.33 × (| 25)m x (5 |) | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (38)m= | 23.22 | 23.06 | 22.91 | 22.19 | 22.06 | 21.43 | 21.43 | 21.32 | 21.67 | 22.06 | 22.33 | 22.61 | | (38) |
| Heat tr | ansfer o | coefficier | nt, W/K | | | | | | (39)m | = (37) + (| 38)m | | | |
| (39)m= | 51.7 | 51.55 | 51.39 | 50.67 | 50.54 | 49.92 | 49.92 | 49.8 | 50.16 | 50.54 | 50.81 | 51.1 | | |
| Stroma I | FSAP 201 | 2 Version: | 1.0.3.11 | (SAP 9.92) | - http://ww | ww.stroma | .com | | / | Average = | Sum(39)1 | 12 /12= | 50.6 ≱ a | ge 2 o ⁽³⁹⁾ |

| Heat lo | oss para | meter (H | HLP), W/ | /m²K | | | | | (40)m | = (39)m ÷ | - (4) | | | |
|--------------------|-------------------------|--------------------------|-------------------------|--------------------------|-----------------------------|---------------------------|------------------|--------------------------|---------------------------|-------------|------------------------|---------------|------------|--------------|
| (40)m= | 1.02 | 1.02 | 1.02 | 1 | 1 | 0.99 | 0.99 | 0.98 | 0.99 | 1 | 1 | 1.01 | | |
| Numbe | or of day | | nth (Tab | | | | | ! | , | Average = | Sum(40)1. | .12 /12= | 1 | (40) |
| Numbe | lan | Feb | Mar | | May | lun | 6.0 | Δυα | Sen | Oct | Nov | Dec | | |
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 31 | 30 | 31 | 30 | 31 | | (41) |
| () | | | 01 | | | | | | | | | 01 | | |
| 4. Wa | iter heat | ting ene | rgy requi | irement: | | | | | | | | kWh/ye | ear: | |
| Assum | ed occi | inancy | N | | | | | | | | | 74 | 1 | (42) |
| if TF | A > 13.9 A £ 13.9 | 9, N = 1 9. N = 1 | + 1.76 x | [1 - exp | (-0.0003 | 849 x (TF | FA -13.9 |)2)] + 0.0 | 0013 x (⁻ | ΓFA -13. | .9) | / 1 | | (42) |
| Annual | laverag | e hot wa | ater usag | ge in litre | es per da | ay Vd,av | erage = | (25 x N) | + 36 | | 74 | .76 | | (43) |
| Reduce not more | the annua e that 125 | al average litres per | hot water person per | usage by r day (all w | 5% if the a vater use, l | lwelling is hot and co | designed ld) | to achieve | a water us | se target o | f | | | |
| | 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= | 82.24 | 79.25 | 76.25 | 73.26 | 70.27 | 67.28 | 67.28 | 70.27 | 73.26 | 76.25 | 79.25 | 82.24 | | _ |
| Enorm | contant of | hatwater | upped and | aulated m | anthly A | 100 v Vd - | | Tm / 2600 | - | Total = Su | m(44) ₁₁₂ = | | 897.12 | (44) |
| Energy of | content or | not water | usea - cai | | Sontniy = 4. | 190 x va,r | | 1 | | ith (see Ta | | <i>c, 1a)</i> | | |
| (45)m= | 121.95 | 106.66 | 110.06 | 95.96 | 92.07 | 79.45 | 73.62 | 84.48 | 85.49 | 99.63 | 108.76 | 118.11 | 4470.00 | (45) |
| lf instant | aneous w | ater heati | ng at point | of use (no | o hot water | r storage), | enter 0 in | boxes (46 |) to (61) | l otal = Su | m(45) ₁₁₂ = | | 1176.26 | (45) |
| (46)m= | 18.29 | 16 | 16.51 | 14. <mark>39</mark> | 13.81 | 11.92 | 11.04 | 12.67 | 12.82 | 14.95 | 16.31 | 17.72 | | (46) |
| Water | storage | loss: | | | | | | | | | | | | |
| Storag | e volum | e (litres) | includir | ng any se | olar or N | /WHRS | storage | within sa | ame ves | sel | (| 0 | | (47) |
| If comr | nunity h | leating a | ind no ta | ink in dw | /elling, e | nter 110 |) litres in | (47) http://www.ikaii | | | 47) | | | |
| Water | /ise ii no | loss. | not wate | er (this ir | iciudes i | nstantar | ieous co | ווסם ומחזכ | ers) ente | er u in (| 47) | | | |
| a) If m | anufact | urer's de | eclared I | oss facto | or is kno | wn (kWł | n/day): | | | | |) | | (48) |
| Tempe | rature f | actor fro | m Table | 2b | | , | ., | | | | |) | | (49) |
| Energy | v lost fro | m water | storage | , kWh/ye | ear | | | (48) x (49) |) = | | |) | | (50) |
| b) If m | anufact | urer's de | eclared of | cylinder | loss fact | or is not | known: | | | | | | | () |
| Hot wa | ter stor | age loss | factor fr | om Tabl | le 2 (kW | h/litre/da | ay) | | | | (| 0 | | (51) |
| If comr | nunity h | from To | ee secti | on 4.3 | | | | | | | | | I | (50) |
| Tempe | erature f | actor fro | m Table | 2b | | | | | | | |)) | r | (52) (53) |
| Energy | lost fro | m water | storage | _~~ | aar | | | (47) x (51) |) x (52) x (¹ | 53) - | | | | (54) |
| Enter | (50) or (| (54) in (5 | 55) | ,, y | Jai | | | (11) x (01) | , x (0 <u></u> , x (| | |) | | (54) |
| Water | storage | loss cal | culated f | for each | month | | | ((56)m = (| 55) × (41)ı | m | | - | | |
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (56) |
| If cylinde | er contains | s dedicate | d solar sto | rage, (57) | I m = (56)m | x [(50) – (| I [H11)] ÷ (5 | 0), else (5 | 1 7)m = (56) | m where (| H11) is fro | m Append | l lix H | |
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (57) |
| Primar | y circuit | loss (ar | nual) fro | om Table | e 3 | | | | | | (|)) | | (58) |
| Primar | y circuit | loss cal | culated | for each | month (| 59)m = (| (58) ÷ 36 | 65 × (41) | m | | | | | |
| (moc | dified by | factor f | rom Tab | le H5 if t | here is s | solar wat | ter heati | 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 ea | ich | month (| 61)m = | (60 |)) ÷ 36 | 65 × (41) |)m | | | | | | |
|----------|-----------------------|--------------------------|----------------|------|---------------------|-----------|-------|----------|-------------|--------------|----------------|----------------------|----------------|-------------|---------------|------|
| (61)m= | 41.91 | 36.47 | 38.8 | 6 | 36.13 | 35.81 | 3 | 33.18 | 34.29 | 35.81 | 36.13 | 38.86 | 39.08 | 41.91 |] | (61) |
| Total h | neat rec | uired for | wate | r he | ating ca | lculated | d fo | r eacl | n month | (62)m = | = 0.85 × | (45)m | + (46)m + | (57)m + | (59)m + (61)m | |
| (62)m= | 163.86 | 143.14 | 148.9 | 92 | 132.09 | 127.88 | 1 | 12.63 | 107.91 | 120.3 | 121.62 | 138.4 | 9 147.84 | 160.01 | | (62) |
| Solar DI | -IW input | calculated | using A | Appe | ndix G or | Appendi | хH | (negativ | ve quantity | /) (enter '(|)' if no sola | r contrib | oution to wate | er heating) | - | |
| (add a | dditiona | al lines if | FGHF | RS a | and/or V | VWHRS | S ap | oplies | , see Ap | pendix | G) | | - | | • | |
| (63)m= | 0 | 0 | 0 | | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | J | (63) |
| Output | t from w | vater hea | ter | | | | | | | | | | | | 1 | |
| (64)m= | 163.86 | 143.14 | 148.9 | 92 | 132.09 | 127.88 | 1 | 12.63 | 107.91 | 120.3 | 121.62 | 138.4 | 9 147.84 | 160.01 | | ٦ |
| | | | | | | | | | | Out | put from w | ater hea | ter (annual) | 112 | 1624.7 | (64) |
| Heat g | ains fro | om water | heatii | ng, | kWh/mo | onth 0.2 | 25 ´ | [0.85 | × (45)m | + (61)r | n] + 0.8 x | x [(46)ı T | m + (57)m | + (59)m | ·] 1 | () |
| (65)m= | 51.03 | 44.58 | 46.3 | 1 | 40.94 | 39.57 | 3 | 84.71 | 33.05 | 37.04 | 37.46 | 42.84 | 45.93 | 49.75 | J | (65) |
| inclu | ıde (57) |)m in calo | culatio | on o | f (65)m | only if a | cylii | nder is | s in the o | dwelling | or hot w | ater is | from com | munity ł | neating | |
| 5. Int | ternal g | ains (see | e Tabl | e 5 | and 5a) | 1 | | | | | | | | | | |
| Metab | olic gai | ns (Table | <u>e 5), V</u> | /att | s | | - | | | | 1 | 1 | -1 | | 1 | |
| _ | Jan | Feb | Ma | ar | Apr | May | | Jun | Jul | Aug | Sep | Oct | : Nov | Dec | - | (|
| (66)m= | 85.39 | 85.39 | 85.3 | 9 | 85.39 | 85.39 | 8 | 35.39 | 85.39 | 85.39 | 85.39 | 85.39 | 85.39 | 85.39 | l i | (66) |
| Lightin | g gains | s (calcula | ted in | Ap | pendix I | _, equa | tion | L9 oi | r L9a), a | lso see | Table 5 | _ | | | , | |
| (67)m= | 13.39 | 11.89 | 9.67 | | 7.32 | 5.47 | Ŀ | 4.62 | 4.99 | 6.49 | 8.71 | 11.06 | 12.91 | 13.76 | | (67) |
| Applia | nces ga | ains (ca <mark>lc</mark> | ulated | d in | Append | lix L, ec | luat | tion L' | 13 or L1 | 3a), also | o see Ta | ble <mark>5</mark> | _ | | , | |
| (68)m= | 148.79 | 150.34 | 146.4 | 15 | 138.16 | 127.71 | 1 | 17.88 | 111.31 | 109.77 | 113.66 | 121.9 | 4 132.4 | 142.23 | J | (68) |
| Cookir | ng gains | s (calcula | ated in | ı Ap | pendix | L, equa | tion | ו L15 | or L15a) | , also s | ee Table | 5 | | | | |
| (69)m= | 31.54 | 31.54 | 31.5 | 4 | <mark>31.</mark> 54 | 31.54 | 3 | 31.54 | 31.54 | 31.54 | 31.54 | 3 <mark>1.5</mark> 4 | 31.54 | 31.54 | | (69) |
| Pumps | and fa | ins gains | (Tabl | e 5 | a) | | | | | | | | | | - | |
| (70)m= | 3 | 3 | 3 | | 3 | 3 | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | | (70) |
| Losses | s e.g. e | vaporatic | on (ne | gati | ve valu | es) (Tal | ole | 5) | | | | | - | | - | |
| (71)m= | -68.31 | -68.31 | -68.3 | 31 | -68.31 | -68.31 | -(| 58.31 | -68.31 | -68.31 | -68.31 | -68.3 | 1 -68.31 | -68.31 | | (71) |
| Water | heating | g gains (T | able | 5) | | | | | | | | | | - | - | |
| (72)m= | 68.58 | 66.34 | 62.2 | 5 | 56.86 | 53.18 | 4 | 8.21 | 44.42 | 49.79 | 52.03 | 57.58 | 63.79 | 66.86 | | (72) |
| Total i | nterna | l gains = | : | | | | | (66) | m + (67)m | ı + (68)m | + (69)m + | (70)m + | (71)m + (72 |)m | - | |
| (73)m= | 282.38 | 280.19 | 269.9 | 98 | 253.96 | 237.98 | 2 | 22.33 | 212.35 | 217.67 | 226.02 | 242.2 | 1 260.72 | 274.47 |] | (73) |
| 6. So | lar gain | IS: | | | | | | | | | | | | | | |
| Solar g | ains are | calculated | using s | olar | flux from | Table 6a | and | associ | ated equa | tions to c | onvert to th | ne applic | able orienta | tion. | Oping | |
| Orienta | ation: | Access F Table 6d | actor | | Area m² | | | Tab | x ole 6a | 7 | g_ Table 6b | | Table 6c | | Gains (W) | |
| Southe | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 3 | 6.79 | x | 0.63 | x | 0.7 | = | 49.59 | (77) |
| Southe | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 3 | 6.79 | x | 0.63 | x | 0.7 | = | 49.59 | (77) |
| Southe | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | 3 | 6.79 | x | 0.63 | x | 0.7 | = | 12.14 | (77) |
| Southe | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 6 | 2.67 | x | 0.63 | x | 0.7 | = | 84.47 | (77) |
| Southe | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 6 | 2.67 | x | 0.63 | x | 0.7 | = | 84.47 | (77) |

| Southeast | 0.9x | 0.77 | | x | 1.0 | 8 | × | 6 | 2.67 | x | | 0.63 | x | 0.7 | = | - [| 20.69 | (77) |
|-------------|------------------|--------------------|------------------|----------------------|----------------------|-------------------|-----------------|---------------|------------|----------|---------|--------------|------------|--------|------------|----------|--------|-----------|
| Southeast | 0.9x | 0.77 | | x | 4.4 | 1 | × | 8 | 5.75 |] × | | 0.63 | | 0.7 | = = | - Г | 115.57 | _ (77) |
| Southeast | 0.9x | 0.77 | | x | 4.4 | 1 | × | 8 | 5.75 |] × | | 0.63 | | 0.7 | = = | Ē | 115.57 | (77) |
| Southeast | 0.9x | 0.77 | | x | 1.0 | 8 | × | 8 | 5.75 |] × | | 0.63 | - × [| 0.7 | = | Ē | 28.3 | (77) |
| Southeast | 0.9x | 0.77 | | x | 4.4 | 1 | × | 10 | 06.25 |] × | | 0.63 | | 0.7 | = | Ē | 143.2 | - (77) |
| Southeast | 0.9x | 0.77 | | x | 4.4 | 1 | × | 1 | 06.25 | x | | 0.63 | | 0.7 | = | Ē | 143.2 | (77) |
| Southeast | 0.9x | 0.77 | | x | 1.0 | 8 | x | 10 | 06.25 |] × | | 0.63 | | 0.7 | - - | - | 35.07 | (77) |
| Southeast | 0.9x | 0.77 | | x | 4.4 | 1 | × | 1 | 19.01 | _ x | | 0.63 | | 0.7 | = - | - Г | 160.4 | (77) |
| Southeast | 0.9x | 0.77 | | x | 4.4 | 1 | × | 1 | 19.01 | x | | 0.63 | × [| 0.7 | = | Ē | 160.4 | (77) |
| Southeast | 0.9x | 0.77 | | x | 1.0 | 8 | × | 1 | 19.01 | x | | 0.63 |] × [| 0.7 | = = | Ē | 39.28 | (77) |
| Southeast | 0.9x | 0.77 | | x | 4.4 | 1 | × | 1 | 18.15 | x | | 0.63 |] × [| 0.7 | = | Ē | 159.24 | (77) |
| Southeast | 0.9x | 0.77 | | x | 4.4 | -1 | × | 1 | 18.15 | x | | 0.63 |] × [| 0.7 | = | - [| 159.24 | (77) |
| Southeast | 0.9x | 0.77 | | x | 1.0 | 8 | × | 1 | 18.15 | x | | 0.63 | x | 0.7 | = | - | 39 | (77) |
| Southeast | 0.9x | 0.77 | | x | 4.4 | 1 | × | 1 | 13.91 | x | | 0.63 | x | 0.7 | = | ۰Ľ | 153.52 | (77) |
| Southeast | 0.9x | 0.77 | | x | 4.4 | 1 | × | 1 | 13.91 | x | | 0.63 | × | 0.7 | = | - [| 153.52 | (77) |
| Southeast | 0.9x | 0.77 | | x | 1.0 | 8 | × | 1 | 13.91 | x | | 0.63 | _ x [| 0.7 | = | - | 37.6 | (77) |
| Southeast | 0.9x | 0.77 | | x | 4.4 | 1 | × | 10 | 04.39 | x | | 0.63 | x | 0.7 | = | - | 140.69 | (77) |
| Southeast | 0.9x | 0.77 | | x | 4.4 | 1 | × | 10 | 04.39 | x | | 0.63 | x | 0.7 | = | | 140.69 | (77) |
| Southeast | 0.9x | 0.77 | | x | 1.0 | 8 | x | 1 | 04.39 |] x | | 0.63 | × | 0.7 | = | | 34.46 | (77) |
| Southeast | 0.9x | 0.77 | | x | 4.4 | .1 | x | 9 | 2.85 |] × | | 0.63 | x | 0.7 | = | - | 125.14 | (77) |
| Southeast | 0.9x | 0.7 <mark>7</mark> | | x | 4.4 | 1 | x | 9 | 2.85 | x | | 0.63 | x | 0.7 | = | - | 125.14 | (77) |
| Southeast | 0.9x | 0.77 | | x | 1.0 | 8 | × | 9 | 2.85 | x | | 0.63 | × | 0.7 | = | - | 30.65 | (77) |
| Southeast | 0.9x | 0.77 | | x | 4.4 | 1 | x | 6 | 9.27 | x | | 0.63 | × | 0.7 | = | - | 93.36 | (77) |
| Southeast | 0.9x | 0.77 | | x | 4.4 | 1 | × | 6 | 9.27 | x | | 0.63 | x | 0.7 | = | | 93.36 | (77) |
| Southeast | 0.9x | 0.77 | | x | 1.0 | 8 | × | 6 | 9.27 | x | | 0.63 | × | 0.7 | = | - | 22.86 | (77) |
| Southeast | 0.9x | 0.77 | | x | 4.4 | 1 | × | 4 | 4.07 | x | | 0.63 | x | 0.7 | = | - | 59.4 | (77) |
| Southeast | 0.9x | 0.77 | | x | 4.4 | 1 | × | 4 | 4.07 | x | | 0.63 | _ × [| 0.7 | = | | 59.4 | (77) |
| Southeast | 0.9x | 0.77 | | x | 1.0 | 8 | × | 4 | 4.07 | x | | 0.63 | × | 0.7 | = | | 14.55 | (77) |
| Southeast | 0.9x | 0.77 | | x | 4.4 | 1 | × | 3 | 1.49 | x | | 0.63 | _ × [| 0.7 | = | | 42.44 | (77) |
| Southeast | 0.9x | 0.77 | | x | 4.4 | 1 | × | 3 | 1.49 | x | | 0.63 | × | 0.7 | = | - | 42.44 | (77) |
| Southeast | 0.9x | 0.77 | | x | 1.0 | 8 | × | 3 | 1.49 | x | | 0.63 | × | 0.7 | = | | 10.39 | (77) |
| | | | | | | | | | | | | | | | | | | |
| Solar gair | ns in | watts, ca | alcula | ted | for each | n mont | th | EZ 47 | 244.64 | (83)m | n = Sun | n(74)m | .(82)m | 122.24 | 05.07 | | | (83) |
| Total gain | 11.32 15 — İl | nternal a | 259.4 | ⁴⁵ Jar | 321.47 (84)m – | 360.07 (73)m | $\frac{1}{0+1}$ | 57.47 83)m | watts | 315 | 0.84 | 280.93 | 209.57 | 133.34 | 95.27 | | | (03) |
| (84)m= 39 | 93 71 | 469.81 | 529 | 43 | 575 43 | 598.0 | 5 4 | 579.8 | 556.99 | 533 | 51 | 506 95 | 451 78 | 394.06 | 369 74 | 1 | | (84) |
| | | 100.01 | 020. | 10 | | 000.00 | | 51 0.0 | 000.00 | 1 000 | | 000.00 | 101110 | | 000.11 | <u> </u> | | (-) |
| 7. Mean | Inter | nal temp | peratu | ire (a p | neating priode in | seaso | on) vina | aroa | from Tol | | Th1 | (°C) | | | | Г | 04 | |
| Litilisatio | aiure m foo | tor for a | icalli aine f | y pe or li | ving or | 1 110 IN 23 h1 | m (c | | | 216 9 | , 1111 | | | | | L | 21 | |
| | lan | Feh | M | $\frac{1}{2}$ | Anr | a, III, Mav | | Jun | , lul | Δ | | Sen | Oct | Nov | Dec | , | | |
| (86)m= (|).99 | 0.98 | 0.9 | 5 | 0.87 | 0.73 | , | 0.54 | 0.39 | 0.4 | 43 | 0.66 | 0.91 | 0.98 | 0.99 | ή | | (86) |
| | | | | | | | | | | 7 : 7 | | 00 | | 1 | | | | . , |
| $(87)_{m-}$ | | 1 temper | ature | in I | $\frac{1}{20.70}$ | 20 04 | | ow ste | 21 ps 3 to | | | 90) 20 97 | 20.78 | 20 30 | 20.07 | ٦ | | (87) |
| | -0.1 | 20.0 | 20.0 | · • | 20.19 | 20.94 | | _0.00 | | | · | 20.01 | 20.10 | 20.00 | 20.07 | | | (0.) |

| Temp | erature | during h | eating p | eriods ir | n rest of | dwelling | from Ta | ble 9, Tl | h2 (°C) | | | | | |
|---------------------|-------------------------|-----------|------------|---------------------------------------|-------------------------|-------------|--------------------------|-------------|--------------------------|-----------------------|---------------------------------|------------|---------|-------|
| (88)m= | 20.07 | 20.07 | 20.07 | 20.08 | 20.08 | 20.09 | 20.09 | 20.1 | 20.09 | 20.08 | 20.08 | 20.08 | | (88) |
| Utilisa | ation fac | tor for g | ains for | rest of d | welling, I | h2,m (se | e Table | 9a) | | | | | | |
| (89)m= | 0.99 | 0.98 | 0.94 | 0.84 | 0.68 | 0.47 | 0.31 | 0.34 | 0.58 | 0.87 | 0.98 | 0.99 | | (89) |
| Mean | interna | l temper | ature in | the rest | of dwelli | ing T2 (fo | ollow ste | eps 3 to 7 | 7 in Tabl | e 9c) | | | | |
| (90)m= | 18.88 | 19.17 | 19.51 | 19.85 | 20.03 | 20.09 | 20.09 | 20.1 | 20.07 | 19.85 | 19.31 | 18.84 | | (90) |
| | | | | | | | | | f | LA = Livin | g area ÷ (4 | 4) = | 0.49 | (91) |
| Mean | interna | l temper | ature (fo | r the wh | ole dwel | lling) = fl | _A × T1 | + (1 – fL | .A) × T2 | | | - | | |
| (92)m= | 19.48 | 19.73 | 20.02 | 20.32 | 20.48 | 20.53 | 20.54 | 20.54 | 20.52 | 20.31 | 19.85 | 19.44 | | (92) |
| Apply | adjustn | nent to t | he mear | interna | temper | ature fro | m Table | 4e, whe | ere appro | opriate | | | | |
| (93)m= | 19.48 | 19.73 | 20.02 | 20.32 | 20.48 | 20.53 | 20.54 | 20.54 | 20.52 | 20.31 | 19.85 | 19.44 | | (93) |
| 8. Spa | ace hea | ting requ | uirement | | | | | | | | | | | |
| Set Ti | i to the r | mean int | ernal ter | nperatui | re obtain | ned at ste | ep 11 of | Table 9 | o, so tha | t Ti,m=(| 76)m an | d re-calc | ulate | |
| the ut | liisation | Feb | Mar | | Ible 9a | lun | lul | Διια | San | Oct | Nov | Dec | | |
| Utilisa | ation fac | tor for a | ains hm | | iviay | Jun | Jui | Aug | Seb | 001 | INUV | Dec | | |
| (94)m= | 0.99 | 0.97 | 0.94 | 0.85 | 0.7 | 0.51 | 0.35 | 0.39 | 0.62 | 0.88 | 0.97 | 0.99 | | (94) |
| Us <mark>efu</mark> | l gains, | hmGm | , W = (94 | ـــــــــــــــــــــــــــــــــــــ | 4)m | | | | | | | | | |
| (95)m= | 389.34 | 457.09 | 495.99 | 489.85 | 418.96 | 293.02 | 196.38 | 205.69 | 312.5 | 398.45 | 384.19 | 366.69 | | (95) |
| Month | nly avera | age exte | ernal tem | perature | e from Ta | able 8 | | 7 | | | | | | |
| (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 | los <mark>s rate</mark> | e for mea | an intern | al tempe | erature, | Lm , W = | =[(<mark>3</mark> 9)m : | x [(93)m | – (96)m |] | | | | |
| (97)m= | 785.07 | 764.2 | 694.79 | 578.52 | 443. <mark>6</mark> 6 | 296.22 | 196.72 | 206.25 | 321.89 | 490.59 | 647.65 | 778.9 | | (97) |
| Sp <mark>ace</mark> | e heatin | g require | ement fo | <mark>r eac</mark> h n | honth, <mark>k</mark> l | Wh/mont | t <mark>h = 0</mark> .02 | 24 x [(97] |) <mark>m – (9</mark> 5) |)m] x (4 ⁻ | 1)m | | | |
| (98)m= | 294.42 | 206.37 | 147.91 | 63.84 | 18.37 | 0 | 0 | 0 | 0 | 68.55 | 189.69 | 306.69 | | |
| | | | | | | | | Tota | l per year (| (kWh/year |) = Sum(98 | 8)15,912 = | 1295.85 | (98) |
| Space | e heatin | g require | ement in | kWh/m ² | /year | | | | | | | | 25.61 | (99) |
| 9a. En | ergy rec | luiremer | nts – Indi | vidual h | eating sy | ystems i | ncluding | micro-C | CHP) | | | | | |
| Space | e heatir | ng: | | | | | | | | | | , | | |
| Fracti | on of sp | ace hea | at from s | econdar | y/supple | mentary | system | | | | | | 0 | (201) |
| Fracti | on of sp | ace hea | at from m | nain syst | em(s) | | | (202) = 1 - | - (201) = | | | | 1 | (202) |
| Fracti | on of to | tal heati | ng from | main sys | stem 1 | | | (204) = (2 | 02) × [1 – (| (203)] = | | | 1 | (204) |
| Efficie | ency of r | main spa | ace heat | ing syste | em 1 | | | | | | | | 93.4 | (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 | /vear |
| Space | e heatin | g require | ement (c | alculate | d above) |) | | | | | | | | |
| | 294.42 | 206.37 | 147.91 | 63.84 | 18.37 | 0 | 0 | 0 | 0 | 68.55 | 189.69 | 306.69 | | |
| (211)m | n = {[(98 |)m x (20 | 94)]}x 1 | 00 ÷ (20 |)6) | | | | | | | | | (211) |
| . , | 315.23 | 220.96 | 158.36 | 68.35 | 19.67 | 0 | 0 | 0 | 0 | 73.4 | 203.1 | 328.36 | | |
| I | | | | | | | | Tota | l (kWh/yea | ar) =Sum(2 | 2 11) _{15,1012} | - | 1387.42 | (211) |
| Space | e heatin | g fuel (s | econdar | y), kWh/ | month | | | | | | | L | | |
| = {[(98 |)m x (20 |)1)]}x1 | 00 ÷ (20 | 8) | | | | | | | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | | | | | | | | Tota | l (kWh/yea | ar) =Sum(2 | 215) _{15,1012} | = | 0 | (215) |

Water heating

| Output | from w | ater hea | ter (calc | ulated al | oove) | | | | | - | | - | | |
|-----------------------|------------|----------------------|-----------|------------|----------|--------------------|-------------------------|-------------|-------------|------------------------|-------------------------|--------|--------------------------------|--------|
| | 163.86 | 143.14 | 148.92 | 132.09 | 127.88 | 112.63 | 107.91 | 120.3 | 121.62 | 138.49 | 147.84 | 160.01 | | |
| Efficier | ncy of w | ater hea | iter | | | | | - | | | | | 80.3 | (216) |
| (217)m= | 86.51 | 85.97 | 85.03 | 83.33 | 81.44 | 80.3 | 80.3 | 80.3 | 80.3 | 83.38 | 85.68 | 86.66 | | (217) |
| Fuel fo | r water | heating, | kWh/mo | onth | | | | | | | | | | |
| (219)m | = (64) | m x 100 |) ÷ (217) | m | 457.00 | 440.07 | 404.00 | 4 40.04 | 454.40 | 400.00 | 470.55 | 404.04 | 1 | |
| (219)m= | 169.41 | 100.49 | 175.13 | 106.0 | 157.02 | 140.27 | 134.38 | 149.01 | 131.40 | 192) - | 172.55 | 164.04 | 4045 70 | |
| A nnuo | 1 404010 | | | | | | | 1010 | ii – Guin(2 | 1000) ₁₁₂ – | Mhhaa | | 1945.76 | (219) |
| Space | heating | fuel use | ed, main | system | 1 | | | | | ĸ | wn/year | | 1387.42 | 1 |
| Water I | heating | fuel use | d | | | | | | | | | | 1945.76 | Ī |
| Electric | city for p | oumps, fa | ans and | electric l | keep-ho | t | | | | | | | | |
| centra | al heatir | ng pump | : | | | | | | | | | 30 |] | (230c) |
| boiler | with a f | an-assis | sted flue | | | | | | | | | 45 |] | (230e) |
| Total e | lectricit | y for the | above, ł | (Wh/yea | r | | | sum | of (230a). | (230g) = | | | 75 | (231) |
| Electric | city for I | ighting | | | | | | | | | | | 236.49 | (232) |
| 12a. (| CO2 em | issions - | – Individ | ual heati | ng syste | ems inclu | uding mi | cro-CHF |) | | | | | |
| | Г | | | Г | | En kW | e rgy /h/year | | | Emiss kg CO | ion fac 2/kWh | tor | Emissions kg CO2/yea | ar |
| Spa <mark>ce</mark> | heating | (main <mark>s</mark> | ystem 1) |) | | (21 | 1) x | | | 0.2 | 16 | = | 299.68 | (261) |
| Spa <mark>ce</mark> | heating | (second | dary) | | | (21 | 5) x | | | 0.5 | 19 | = | 0 | (263) |
| Wat <mark>er I</mark> | heating | | | | | (219 | 9) x | | | 0.2 | 16 | = | 420.28 | (264) |
| Space | and wa | ter heati | ng | | | (26 | 1) + (262) | + (263) + (| (264) = | | • | | 719.97 | (265) |
| Electric | city for p | oumps, f | ans and | electric l | keep-ho | t (23 ⁻ | 1) x | | | 0.5 | 19 | = | 38.93 | (267) |
| Electric | city for I | ighting | | | | (23) | 2) x | | | 0.5 | 19 | = | 122.74 | (268) |
| Total C | :02, kg | /year | | | | | | | sum o | f (265)(| 271) = | | 881.63 | (272) |
| | | | | | | | | | | | | | | |

TER =

(273)

17.42

Regulations Compliance Report

| Approved Documen | t L1A, 2013 Edition, 2018 at 10:46:56 | England assessed by St | roma FSAP 2012 program, \ | /ersion: 1.0.3.11 | |
|--|--|---|---|-----------------------|----------------|
| Project Information |): | | | | |
| Assassad By: | 0 | | Building Type: | Flat | |
| Assessed by. | 0 | | Building Type. | Fidi | |
| Dweiling Details: | | | Total Floor Area | | |
| NEW DWELLING L | | vielcenhom | I otal Floor Area | 1: 50.6M ² | |
| Site Reference : | Anington works, T | vickennam | Plot Reference | Anington i be | |
| Address : | | | | | |
| Client Details: | | | | | |
| Name: Address : | Sharpes Refinery S | ervice | | | |
| This report covers It is not a complete | items included wite report of regulation | hin the SAP calculation | IS. | | |
| 1a TER and DER | | | | | |
| Fuel for main heatin | ng system: Mains ga | S | | | |
| Fuel factor: 1.00 (m | ains gas) ido Emission Boto <i>(</i> i | | $15.00 kg/m^{2}$ | | |
| Dwelling Carbon Diox | oxide Emission Rate (| (DFR) | 15.29 kg/m² 14 44 kg/m² | | ОК |
| 1b TFEE and DFE | E | | | | |
| Target Fabric Energ Dwelling Fabric Energe | gy Efficiency (TFEE) ergy Efficiency (DFE | E) | 25.8 kWh/m² 25.4 kWh/m² | | OK |
| Element External w Party wall Floor Roof Openings | all | Average 0.17 (max. 0.30) 0.00 (max. 0.20) (no floor) (no roof) 1.43 (max. 2.00) | Highest 0.17 (max. 0.70) - 1.60 (max. 3.30) |) | ок ок ок |
| 2a Thermal bridgi | ing | · · | · · | | |
| Thermal br | ridging calculated fro | om linear thermal transmi | ttances for each junction | | |
| 3 Air permeability | 1 | | | | |
| Air permeabi Maximum | lity at 50 pascals | | 4.00 (design v 10.0 | /alue) | ок |
| 4 Heating efficien | су | | | | |
| Main Heating | g system: | Database: (rev 397, pro Boiler systems with radi Brand name: Alpha Model: InTec 34C Model qualifier: (Combi) Efficiency 88.8 % SEDE Minimum 88.0 % | duct index 016661): ators or underfloor heating - SUK2009 | mains gas | ОК |
| Secondary h | eating system: | None | | | |

Regulations Compliance Report

| 5 Cylinder insulation | | | |
|-------------------------------------|---------------------------------|-------------------------------|----|
| Hot water Storage: | No cylinder | | |
| 6 Controls | | | |
| | | | |
| Space heating controls | Time and temperature zone contr | ol by device in database | ок |
| Hot water controls: | No cylinder | | |
| Boiler interlock: | Yes | | OK |
| 7 Low energy lights | | | |
| Percentage of fixed lights with low | w-energy fittings | 100.0% | |
| Minimum | | 75.0% | OK |
| 8 Mechanical ventilation | | | |
| Not applicable | | | |
| 9 Summertime temperature | | | |
| Overheating risk (Thames valley) | : | Medium | ОК |
| Based on: | | | |
| Overshading: | | Average or unknown | |
| Windows facing: South East | | 4.41m ² | |
| Windows facing: South East | | 4.41m ² | |
| Windows facing: South East | | 1.08m ² | |
| Ventilation rate: | | 3.00 | |
| Blinds/curtains: | | None | |
| | | Closed 100% of daylight hours | |
| 10 Key features | | | |
| Party Walls U-value | | 0 W/m²K | |

| | | | User D | etails: | | | | | | |
|----------------------------------|---------------------------------|-------------|-------------|------------------|------------------|---------------|----------|-----------|------------------------|----------|
| Assessor Name: Software Name: | Stroma FSAP 201 | 2 | | Stroma Softwa | a Num Ire Ver | ber: sion: | | Versio | n: 1.0.3.11 | |
| | | Pr | operty A | Address: | Arlingto | on 1 Bec | 1 MID 51 | | | |
| Address : | | | | | | | | | | |
| 1. Overall dwelling dime | ensions: | | | | | | | | | |
| • | | | Area | a(m²) | | Av. He | ight(m) | | Volume(m ³ |) |
| Ground floor | | | 5 | 50.6 | (1a) x | 2 | 2.3 | (2a) = | 116.38 | (3a) |
| Total floor area TFA = (1 | a)+(1b)+(1c)+(1d)+(1e | e)+(1n) |) 5 | 50.6 | (4) | | | | | |
| Dwelling volume | | | | | (3a)+(3b) | +(3c)+(3c | d)+(3e)+ | .(3n) = | 116.38 | (5) |
| 2. Ventilation rate: | | | | | | | | - | | |
| | main so | econdary | / | other | | total | | | m ³ per hou | r |
| Number of chimneys | | 0 |] + [| 0 |] = [| 0 | X 4 | 40 = | 0 | (6a) |
| Number of open flues | 0 + | 0 | i + F | 0 | 」] = 匚 | 0 | x 2 | 20 = | 0 | (6b) |
| Number of intermittent fa | ins | | | | | 2 | x ^ | 10 = | 20 | (7a) |
| Number of passive vents | 5 | | | | | 0 | x ^ | 10 = | 0 | (7b) |
| Number of flueless gas fi | ires | | | | | 0 | X | 40 = | 0 | (7c) |
| | | | | | L | | | Air ch | anges per ho | our |
| Infiltration due to chimne | ys, flues and fans = (6 | a)+(6b)+(7a | a)+(7b)+(7 | 7c) = | | 20 | | ÷ (5) = | 0.17 | (8) |
| If a pressurisation test has b | een carried out or is intende | ed, proceed | to (17), o | otherwise c | ontinue fro | om (9) to (| (16) | | | _ |
| Number of storeys in the | he dwelling (ns) | | | | | | (0) | 41-0-4 | 0 | (9) |
| Structural infiltration: 0 | 25 for steel or timber | frame or | 0 35 for | masonr | v constr | uction | [(9) | -1]XU.1 = | 0 | -(10) |
| if both types of wall are p | resent, use the value corres | ponding to | the greate | er wall area | a (after | uction | | | U | |
| deducting areas of openii | ngs); if equal user 0.35 | | | | | | | | | _ |
| If suspended wooden t | loor, enter 0.2 (unseal | led) or 0.7 | 1 (seale | d), else | enter 0 | | | | 0 | (12) |
| li no draught lobby, en | ter 0.05, else enter 0 | trippod | | | | | | | 0 | (13) |
| Window infiltration | s and doors draught si | inpped | | 0.25 - [0.2 | x (14) - 1 | 001 = | | | 0 | (14) |
| Infiltration rate | | | | (8) + (10) - | + (11) + (1 | 2) + (13) · | + (15) = | | 0 | (10) |
| Air permeability value | a50 expressed in cut | oic metres | s per ho | ur per so | ouare m | etre of e | envelope | area | 0 | -1(17) |
| If based on air permeabil | lity value, then $(18) = [(1)]$ | 7) ÷ 20]+(8 |), otherwis | se (18) = (| 16) | | molopo | aiou | 0.37 | |
| Air permeability value applie | es if a pressurisation test ha | s been done | e or a deg | ıree air per | meability | is being u | sed | | 0.01 | |
| Number of sides sheltere | эd | | | | | | | | 2 | (19) |
| Shelter factor | | | | (20) = 1 - [| 0.075 x (1 | 9)] = | | | 0.85 | (20) |
| Infiltration rate incorporat | ting shelter factor | | | (21) = (18) | x (20) = | | | | 0.32 | (21) |
| Infiltration rate modified f | or monthly wind speed | t t | | | | | | | l. | |
| Jan Feb | Mar Apr May | 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 $(22a)m = (2)$ | 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 | | |
| ······ | | · · · · | | | | | • | | • | |

| Adjust | ed infiltr | ation rat | e (allowi | ing for sh | nelter an | d wind s | peed) = | (21a) x | (22a)m | | | | | |
|------------|----------------------|---------------------|----------------------------|---------------------|-------------|-------------------------|------------------------|-------------------------|----------------|----------------|-------------|-----------|-----------------|-------------------------|
| | 0.4 | 0.4 | 0.39 | 0.35 | 0.34 | 0.3 | 0.3 | 0.29 | 0.32 | 0.34 | 0.36 | 0.37 | | |
| Calcul | ate effe | ctive air | change | rate for t | he appli | cable ca | se | | | - | | - | | (00-) |
| lf ovh | aust air b | | using Ann | andix N (2 | 3h) - (23a | a) v Emv (e | austion (N | (5)) other | wise (23h |) – (23a) | | | 0 | (238) |
| lf bala | anced with | | | iency in % | allowing f | or in-use f | actor (from | Table 4h |) – |) – (200) | | | 0 | (23D) |
| | | | | | | | | |) - .) | ⊃h.) | 00k) [| 1 (00-) | 0 | (230) |
| a) If | balance | | anical ve | | | at recove | | HR) (24a | m = (22) | 2b)m + (| 23b) × [| 1 - (23c) | ÷ 100] | (245) |
| (24a)m= | | | | | 0 | | 0 | | | | | 0 | | (24a) |
| b) If | balance | ed mecha | anical ve | entilation | without | heat rec | overy (N | /IV) (24b |)m = (22 | 2b)m + (2 I | 23b) | | | (0.45) |
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (240) |
| c) If | whole h | ouse ex | tract ver | ntilation of | or positiv | e input v | entilatio | on from c | outside | F (00k | | | | |
| (0.1 a) - | it (22b)n | n < 0.5 × | (23D), 1 | | c) = (230 |); otnerv | | c) = (22c | b) m + 0. | 5 × (230 |)) | | l | (24c) |
| (24c)m= | | 0 | | | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | | (240) |
| d) If | natural if (22b)n | ventilation = 1 the | on or wh en (24d) | ole hous $m = (22)$ | e positiv | /e input v erwise (2 | ventilatio 4d)m = (| on from 1 0 5 + [(2) | oft 2b)m² x | 0 51 | | | | |
| (24d)m= | 0.58 | 0.58 | 0.57 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | | (24d) |
| Effe | ctive air | change | rate - er | nter (24a |) or (24t |) or (24 | c) or (24 | d) in box | (25) | | | | | |
| (25)m= | 0.58 | 0.58 | 0.57 | 0.56 | 0.56 | 0.55 | 0.55 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 | | (25) |
| () | | | | | | | | | | | | | | |
| 3. He | at losse | s and he | eat loss | paramete | er: | | | | | | | | | |
| ELEN | | Gros | ss (m ²) | Openin | gs | Net Ar | ea | U-valu | le Ne | A X U | K) | k-value | | A X k |
| Doors | | area | (111) | | | 1.00 | | 1.0 | | 2 024 | | K0/111-1 | ` | (26) |
| Windo | | .1 | | | | 1.69 | | | | 3.024 | H | | | (20) |
| WINGO | ws Type | ;] | | | | 4.41 | | /[1/(1.4)+ | 0.04] = | 5.85 | | | | (27) |
| Windo | ws Type | e 2 | | | | 4.41 | x1/ | /[1/(1.4)+ | 0.04] = | 5.85 | | | | (27) |
| Windo | ws Type | e 3 | | | | 1.08 | x1, | /[1/(1.4)+ | 0.04] = | 1.43 | | | | (27) |
| Walls | | 23.1 | 3 | 11.79 | 9 | 11.34 | x | 0.17 | = | 1.93 | | | | (29) |
| Total a | rea of e | lements | , m² | | | 23.13 | 3 | | | | | | | (31) |
| Party v | vall | | | | | 18.76 | ; x | 0 | = | 0 | | | | (32) |
| Party f | loor | | | | | 50.6 | | | | | [| | $\neg \square$ | (32a) |
| Party o | ceiling | | | | | 50.6 | | | | | [| | i – | (32b) |
| * for win | dows and | roof wind | ows, use e | effective wi | ndow U-va | alue calcula | ated using | formula 1, | /[(1/U-valu | ie)+0.04] a | as given in | paragraph | 3.2 | |
| Eabria | boot loc | as on both N/K | | iternai wali | is and part | litions | | (26) (30) | + (32) - | | | | 10.00 | (22) |
| | | $c_m = c_1$ | = 3 (A X | 0) | | | | (20)(00) | ((20) | (20) + (2) | 2) + (22a) | (220) - | 18.08 | (33) |
| Thorm | | | (A X K) | | | 1/m21 | | | ((20) | (30) + (32) | 2) + (32a). | (32e) = | 5544.48 | 3 (34) |
| For dooi | ai mass | parame | | = $CIII =$ | | i KJ/III-K | known nr | raciaaly the | indiaatiwa | | | abla 1f | 250 | (35) |
| can be u | used inste | ad of a de | ere trie de tailed calc | ulation. | constructi | ion are not | known pr | ecisely the | Indicative | values of | | able II | | |
| Therm | al bridge | es : S (L | x Y) cal | culated u | using Ap | pendix ł | < | | | | | | 3.67 | (36) |
| if details | of therma | al bridging | are not kr | nown (36) = | = 0.15 x (3 | 1) | | | | | | | | |
| Total fa | abric he | at loss | | | | | | | (33) + | (36) = | | | 21.74 | (37) |
| Ventila | tion hea | at loss ca | alculated | monthly | / | | | | (38)m | = 0.33 × (| 25)m x (5 |) | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (38)m= | 22.32 | 22.2 | 22.08 | 21.52 | 21.42 | 20.93 | 20.93 | 20.84 | 21.12 | 21.42 | 21.63 | 21.85 | | (38) |
| Heat tr | ansfer o | coefficier | nt, W/K | | | | | | (39)m | = (37) + (| 38)m | | | |
| (39)m= | 44.07 | 43.95 | 43.83 | 43.27 | 43.16 | 42.68 | 42.68 | 42.59 | 42.87 | 43.16 | 43.38 | 43.6 | | |
| Stroma I | FSAP 201 | 2 Version: | 1.0.3.11 | (SAP 9.92) | - http://wv | ww.stroma | .com | • | | Average = | Sum(39) | 12 /12= | 43.2 p ; | age 2 o ⁽³⁹⁾ |

| Heat lo | ss para | meter (H | HLP), W/ | ′m²K | | | | | (40)m | = (39)m ÷ | - (4) | | | |
|--------------------------------|--|--------------------------------------|--------------------------------------|---------------------------------------|--|---------------------------------------|----------------------------|------------------------|------------------------|-------------|-------------------------|----------|------------|------|
| (40)m= | 0.87 | 0.87 | 0.87 | 0.86 | 0.85 | 0.84 | 0.84 | 0.84 | 0.85 | 0.85 | 0.86 | 0.86 | | |
| Numbo | r of day | vs in mo | nth (Tab | lo 12) | | | | • | | Average = | Sum(40)1. | 12 /12= | 0.86 | (40) |
| | lan | Feb | Mar | | May | lun | lul | Δυα | Sen | Oct | Nov | Dec | | |
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | | (41) |
| | | | | | | | | | | | | | | |
| 4. Wa | ter heat | ting ene | rgy requi | irement: | | | | | | | | kWh/ye | ear: | |
| Assum if TF/ if TF/ | ed occu A > 13.9 A £ 13.9 | ipancy, 9, N = 1 9, N = 1 | N + 1.76 x | [1 - exp | (-0.0003 | 349 x (TF | FA -13.9 |)2)] + 0.(| 0013 x (⁻ | TFA -13 | 1. .9) | 71 | | (42) |
| Annual Reduce t not more | averag the annua that 125 | e hot wa al average litres per | ater usag hot water person per | ge in litre usage by day (all w | es per da 5% if the a vater use, l | ay Vd,av Iwelling is hot and co | erage = designed ld) | (25 x N) to achieve | + 36 a water us | se target o | 74 of | .76 | | (43) |
| [| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Hot wate | r usage ii | n litres pei | r day for ea | ach month | Vd,m = fa | ctor from | Table 1c x | (43) | | | | | | |
| (44)m= | 82.24 | 79.25 | 76.25 | 73.26 | 70.27 | 67.28 | 67.28 | 70.27 | 73.26 | 76.25 | 79.25 | 82.24 | | |
| | | | | | | | | | | Total = Su | im(44) ₁₁₂ = | | 897.12 | (44) |
| Energy c | Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d) (45)m = 121.95 106.66 110.06 95.96 92.07 79.45 73.62 84.48 85.49 99.63 108.76 118.11 | | | | | | | | | | | | | |
| (45)m= | 5)m = 121.95 106.66 110.06 95.96 92.07 79.45 73.62 84.48 85.49 99.63 108.76 118.11 Total = Sum(45), $m = 100$ | | | | | | | | | | | | | |
| lf instanta | $45)m = 121.95 106.66 110.06 95.96 92.07 79.45 73.62 84.48 85.49 99.63 108.76 118.11$ $Total = Sum(45)_{112} = $ f instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61) | | | | | | | | | | | | | (45) |
| (46)m= | 1 <mark>8.29</mark> | 16 | 16.51 | 14. <mark>39</mark> | 13.81 | 11.92 | 11.04 | 12.67 | 12.82 | 14.95 | 16.31 | 17.72 | | (46) |
| Water s | storage | loss: | | | | | | | | | | | | |
| Storage | e volum | e (litres) |) includir | ng any se | olar or N | /WHRS | storage | within sa | ame ves | sel | | 0 | | (47) |
| If comn | nunity h | leating a | and no ta | ink in dw | /elling, e | nter 110 | litres in | (47) | | | (4 7) | | | |
| Water 9 | ise if no | o storea | not wate | er (this ir | iciudes i | nstantar | ieous co | iiod iamo | ers) ente | er 'O' in (| (47) | | | |
| a) If m | anufact | urer's de | eclared I | oss facto | or is kno | wn (kWł | n/day): | | | | | 0 | | (48) |
| Tempe | rature f | actor fro | m Table | 2b | | , | • • | | | | | 0 | | (49) |
| Energy | lost fro | m water | · storage | , kWh/ye | ear | | | (48) x (49) |) = | | | 0 | | (50) |
| b) If m | anufact | urer's de | eclared o | ylinder | loss fact | or is not | known: | | | | | | | |
| Hot wa | ter stora | age loss | factor fr | om Tabl | le 2 (kW | h/litre/da | ay) | | | | | 0 | | (51) |
| If comn | nunity n factor | from Ta | iee secti bla 2a | on 4.3 | | | | | | | | 0 | l | (52) |
| Tempe | rature f | actor fro | m Table | 2b | | | | | | | | 0 | | (52) |
| Energy | lost fro | m water | storage | kWh/ve | ear | | | (47) x (51) |) x (52) x (| 53) = | | 0 | | (54) |
| Enter (| (50) or (| (54) in (5 | 55) | ,, j | | | | | , , , , | , | | 0 | | (55) |
| Water s | storage | loss cal | culated f | 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 | r contains | s dedicate | d solar sto | rage, (57) | i m = (56)m | x [(50) – (| I H11)] ÷ (5 | 1 50), else (5 | 1 7)m = (56) | m where (| H11) is fro | m Append | l lix H | |
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (57) |
| Primary | / circuit | loss (ar | nnual) fro | om Table | e 3 | | | | | | | 0 | | (58) |
| Primary | / circuit | loss cal | culated | for each | month (| 59)m = (| (58) ÷ 36 | 65 × (41) | m | | | | - | |
| (mod | lified by | factor f | rom Tab | le H5 if t | here is s | solar wat | ter heati | ng and a | , cylinde | r thermo | ostat) | | L | |
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (59) |

| Combi | loss ca | lculated | for eac | ch i | month (| 61)m = | (60 |) ÷ 36 | 65 × (41) | m | | | | | | |
|-----------------------|-----------------------|-------------------------|--------------------|------|-------------------------|------------|------|---------|--------------------------|------------|------------------------|---------------------|---------------|-------------|----------------------|------|
| (61)m= | 23.7 | 21.39 | 23.65 | | 22.85 | 23.59 | 2 | 2.81 | 23.55 | 23.58 | 22.83 | 23.63 | 22.9 | 23.69 | | (61) |
| Total h | eat req | uired for | water | he | ating ca | lculated | fo | r each | n month | (62)m | = 0.85 × | (45)m · | + (46)m + | (57)m + | - · (59)m + (61)m | |
| (62)m= | 145.65 | 128.05 | 133.7 | 1 | 118.81 | 115.67 | 10 |)2.26 | 97.17 | 108.06 | 108.33 | 123.26 | 3 131.66 | 141.79 |] | (62) |
| Solar DH | HW input | calculated | using A | ppe | ndix G or | Appendix | Н (| negativ | ve quantity |) (enter ' | 0' if no sola | r contrib | ution to wate | er heating) | - | |
| (add a | dditiona | al lines if | FGHR | Sa | and/or V | VWHRS | ар | plies, | , 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 | | | | | | | | | - | | - | _ | |
| (64)m= | 145.65 | 128.05 | 133.7 ⁻ | 1 | 118.81 | 115.67 | 10 | 02.26 | 97.17 | 108.06 | 108.33 | 123.26 | 5 131.66 | 141.79 | | _ |
| | | | | | | | | | | Ou | tput from w | ater hea | ter (annual) | 112 | 1454.42 | (64) |
| Heat g | ains fro | m water | heatin | g, l | kWh/mo | onth 0.2 | 5 í | [0.85 | × (45)m | + (61) | m] + 0.8 x | x [(46)r | n + (57)m | + (59)m |] | |
| (65)m= | 46.47 | 40.81 | 42.51 | | 37.62 | 36.51 | 3 | 2.12 | 30.37 | 33.99 | 34.13 | 39.04 | 41.89 | 45.19 | | (65) |
| inclu | de (57) | m in calo | culation | n of | f (65)m | only if c | ylir | nder is | s in the c | dwelling | g or hot w | ater is | from com | munity h | neating | |
| 5. Int | ernal g | ains (see | e Table | 5 | and 5a) | : | | | | | | | | | | |
| Metab | olic gair | ns (Table | e 5), W | atts | 5 | | | | | | | | | | | |
| | Jan | Feb | Ma | r | Apr | May | | Jun | Jul | Aug | Sep | Oct | Nov | Dec |] | |
| (66)m= | 85.39 | 85.39 | 85.39 | | 85.39 | 85.39 | 8 | 5.39 | 85.39 | 85.39 | 85.39 | 8 <mark>5.39</mark> | 85.39 | 85.39 | | (66) |
| Ligh <mark>tin</mark> | g gains | (calcula | ted in <i>l</i> | App | o <mark>en</mark> dix l | _, equati | ion | L9 or | ^r L9a), a | lso see | Table 5 | | | | | |
| (67)m= | 13.39 | 11.89 | 9.67 | | 7.32 | 5.47 | 4 | .62 | 4.99 | 6.49 | 8.71 | 11.06 | 12.91 | 13.76 | | (67) |
| App <mark>lia</mark> | nces ga | ins (ca <mark>lc</mark> | ulated | in . | Append | lix L, eq | uat | ion L' | 13 o <mark>r L</mark> 1: | 3a), als | <mark>o se</mark> e Ta | ble 5 | | | - | |
| (68)m= | 148.79 | 150.34 | 146.4 | 5 | <mark>138</mark> .16 | 127.71 | 11 | 17.88 | 111.31 | 109.77 | 113.66 | 121.94 | 132.4 | 142.23 | | (68) |
| Cookir | g gains | s (calcula | ited in | Ap | pendix | L, equat | ion | L15 | or L15a) | , also s | ee Table | 9 5 | | | - | |
| (69)m= | 31.54 | 31.54 | 31.54 | | <mark>31.</mark> 54 | 31.54 | 3 | 1.54 | 31.54 | 31.54 | 31.54 | 31.54 | 31.54 | 31.54 | | (69) |
| Pumps | and fa | ns gains | (Table | e 5a | a) | | | | | | | | | | · | |
| (70)m= | 3 | 3 | 3 | | 3 | 3 | | 3 | 3 | 3 | 3 | 3 | 3 | 3 |] | (70) |
| Losses | s e.g. e | , vaporatio | n (neg | jati | ve valu | es) (Tab | le : | 5) | | | 1 | | • | ! | - | |
| (71)m= | -68.31 | -68.31 | -68.31 | 1 | -68.31 | -68.31 | -6 | 8.31 | -68.31 | -68.31 | -68.31 | -68.31 | -68.31 | -68.31 |] | (71) |
| Water | heating | , gains (T | able 5 | 5) | | | | | | | • | | | <u>.</u> | - | |
| (72)m= | 62.46 | 60.73 | 57.14 | | 52.25 | 49.08 | 4 | 4.61 | 40.82 | 45.68 | 47.41 | 52.47 | 58.18 | 60.74 |] | (72) |
| Total i | nterna | l gains = | | | | | | (66) | m + (67)m | + (68)m | + (69)m + | (70)m + | (71)m + (72) |)m | - | |
| (73)m= | 276.26 | 274.58 | 264.8 | 7 | 249.35 | 233.87 | 21 | 18.73 | 208.74 | 213.56 | 221.4 | 237.09 | 255.1 | 268.35 |] | (73) |
| 6. So | lar gain | s: | | | | | | | | | | | | | 2 | |
| Solar g | ains are | calculated | using sc | olar | flux from | Table 6a a | and | associ | ated equa | tions to c | onvert to th | ne applic | able orientat | tion. | | |
| Orienta | ation: | Access F | actor | | Area | | | Flu | x | | g | | FF | | Gains | |
| | | Table 6d | | | m² | | | Tat | ble 6a | | Table 6b | | Table 6c | | (VV) | |
| Southe | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | × | 3 | 6.79 | x | 0.63 | x | 0.7 | = | 49.59 | (77) |
| Southe | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 3 | 6.79 | x | 0.63 | x | 0.7 | = | 49.59 | (77) |
| Southe | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | 3 | 6.79 | x | 0.63 | x | 0.7 | = | 12.14 | (77) |
| Southe | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 6 | 2.67 | x | 0.63 | x | 0.7 | = | 84.47 | (77) |
| Southe | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 6 | 2.67 | x | 0.63 | x | 0.7 | = | 84.47 | (77) |

| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | 6 | 62.67 | x | | 0.63 | x | 0.7 | | = | 20.69 | (77) |
|---------|-----------------------|------------|--------|-----------|-----------|----------|----------------|--------|---------------------|----------|----------|---------|----------|----------|-------|--------|--------|---------------|
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | ε | 35.75 |] × | | 0.63 | × | 0.7 | | = | 115.57 | _ (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | -1 | x | 6 | 85.75 |] x | | 0.63 | × | 0.7 | | = | 115.57 |] (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | ε | 35.75 |] x | | 0.63 | × | 0.7 | | = | 28.3 | _ (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 1 | 06.25 | x | | 0.63 | × | 0.7 | | = | 143.2 | Ī(77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | -1 | x | 1 | 06.25 |] x | | 0.63 | × | 0.7 | | = | 143.2 |] (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | 1 | 06.25 | x | | 0.63 | - x | 0.7 | | = | 35.07 | _ (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 1 | 19.01 | x | | 0.63 | - x | 0.7 | | = | 160.4 | - (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 1 | 19.01 | x | | 0.63 | × | 0.7 | | = | 160.4 | - (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | 1 | 19.01 | x | | 0.63 | × | 0.7 | | = | 39.28 | - (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 1 | 18.15 | x | | 0.63 | × | 0.7 | | = | 159.24 | - (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 1 | 18.15 | x | | 0.63 | × | 0.7 | | = | 159.24 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | 1 | 18.15 | X | | 0.63 | × | 0.7 | | = | 39 | - (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | -1 | x | 1 | 13.91 |) x | | 0.63 | × | 0.7 | | = | 153.52 |] (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 1 | 13.91 | x | | 0.63 | × | 0.7 | | = | 153.52 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | 1 | 13.91 | x | | 0.63 | × | 0.7 | | = | 37.6 |](77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | -1 | x | 1 | 04.39 | x | | 0.63 | x | 0.7 | | = | 140.69 | (77) |
| Southea | ast 0.9x | 0.77 | | x | 4.4 | 1 | x | 1 | 04.39 | x | | 0.63 | x | 0.7 | | = | 140.69 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | 1 | 04.39 | x | | 0.63 | x | 0.7 | | - | 34.46 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | .1 | х | 9 | 92.85 |] × | | 0.63 | x | 0.7 | | = | 125.14 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 9 | 92.85 | x | | 0.63 | x | 0.7 | | = | 125.14 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | 9 | 92.8 <mark>5</mark> | x | | 0.63 | x | 0.7 | | = | 30.65 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | .1 | x | 6 | 69.27 | x | | 0.63 | x | 0.7 | | = | 93.36 | (77) |
| Southea | ast 0.9x | 0.77 | | x | 4.4 | 1 | x | e | 9.27 | x | | 0.63 | x | 0.7 | | = | 93.36 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | 6 | 9.27 | x | | 0.63 | x | 0.7 | | = | 22.86 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 4 | 4.07 | x | | 0.63 | × | 0.7 | | = | 59.4 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 4 | 4.07 | x | | 0.63 | × | 0.7 | | = | 59.4 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | 4 | 4.07 | x | | 0.63 | × | 0.7 | | = | 14.55 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | -1 | x | 3 | 31.49 | x | | 0.63 | x | 0.7 | | = | 42.44 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 3 | 31.49 | x | | 0.63 | x | 0.7 | | = | 42.44 | (77) |
| Southea | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | 3 | 31.49 | x | | 0.63 | × | 0.7 | | = | 10.39 | (77) |
| | | | | | | | | | | | | | | | | | | |
| Solar g | ains in | watts, c | alcula | ted | for eac | n mont | h | | | (83)m | n = Si | um(74)m | (82)m | | | | | (00) |
| (83)m= | 111.32 | 189.62 | 259.4 | 45 Nor | 321.47 | 360.07 | 7 3 | 57.47 | 344.64 | 315 | 5.84 | 280.93 | 209.57 | 7 133.34 | 95.2 | 7 | | (83) |
| Total g | | | | | (84)m = | = (73) | 1 + (- 1 , | 83)m | | 50 | 24 | 500.00 | 4.40.00 | 2000.44 | | ~ | | (94) |
| (84)m= | 387.59 | 464.2 | 524. | 32 | 570.82 | 593.95 | | 576.2 | 553.38 | 528 | 9.4 | 502.33 | 446.60 | 388.44 | 363.6 | 52 | | (04) |
| 7. Me | an inter | nal temp | peratu | ire (| (heating | seaso | n) | | · | | - | 4 (00) | | | | - 1 | | |
| Temp | erature | during r | neatin | g p | eriods ir | the liv | /ing | area | from Tai | ole 9 | , I h' | 1 (°C) | | | | | 21 | (85) |
| Utilisa | ation fac | ctor for g | ains f | or li | ving are | ea, h1,i | m (s , I | | | | | 600 | 0~* | Nov | | | | |
| (86)m- | | 0.07 | | | Apr | IVIA) | / | | | | ug 37 | Sep | | | | C A | | (86) |
| | 0.99 | 0.97 | 0.9 | <u></u> | 0.02 | 0.00 | | 0.47 | 0.54 | | | 0.00 | 0.07 | 0.90 | 0.99 | , | | (00) |
| Mean | interna | I temper | rature | in I | iving are | ea T1 (| follo | ow ste | ps 3 to 7 | 7 in T | | e 9c) | 00.00 | 00.50 | 00.0 | | | (07) |
| (87)m= | 20.31 | 20.5 | 20.7 | 1 | 20.9 | 20.98 | | 21 | 21 | 2 | 1 | 20.99 | 20.88 | 20.56 | 20.2 | 1 | | (07) |

| Temp | erature | during h | neating p | eriods ir | n rest of | dwelling | from Ta | ble 9, Tl | h2 (°C) | | | | | |
|---------|-------------------------|-----------|-----------------|------------------------|-------------|---------------------|--------------------------|-------------|--------------------------|-----------------------|---------------------------------|------------|--------|---------|
| =m(88) | 20.19 | 20.19 | 20.2 | 20.21 | 20.21 | 20.22 | 20.22 | 20.22 | 20.21 | 20.21 | 20.2 | 20.2 | 1 | (88) |
| Utilisa | ation fac | tor for g | ains for | rest of d | welling, | h2,m (se | e Table | 9a) | | | | | | |
| (89)m= | 0.99 | 0.97 | 0.91 | 0.79 | 0.61 | 0.42 | 0.28 | 0.31 | 0.52 | 0.83 | 0.97 | 0.99 | I | (89) |
| Mean | interna | l temper | ature in | the rest | of dwelli | ing T2 (fo | ollow ste | eps 3 to 7 | 7 in Tabl | e 9c) | | | | |
| (90)m= | 19.28 | 19.56 | 19.85 | 20.1 | 20.19 | 20.21 | 20.22 | 20.22 | 20.21 | 20.08 | 19.65 | 19.23 | L | (90) |
| | | | | | | | | | f | LA = Livin | g area ÷ (4 | +) = | 0.49 | (91) |
| Mean | interna | l temper | ature (fo | or the wh | ole dwe | lling) = fl | _A × T1 | + (1 – fL | .A) × T2 | | | | | |
| (92)m= | 19.79 | 20.02 | 20.28 | 20.49 | 20.58 | 20.6 | 20.6 | 20.6 | 20.6 | 20.48 | 20.1 | 19.75 | | (92) |
| Apply | adjustn | nent to t | he mear | interna | l temper | ature fro | m Table | 4e, whe | ere appro | opriate | | | | |
| (93)m= | 19.79 | 20.02 | 20.28 | 20.49 | 20.58 | 20.6 | 20.6 | 20.6 | 20.6 | 20.48 | 20.1 | 19.75 | | (93) |
| 8. Sp | ace hea | ting req | uirement | | | | | | | | | | | |
| Set T | i to the r | nean int | ternal ter | nperatur | re obtair | ned at ste | ep 11 of | Table 9 | o, so tha | t Ti,m=(| 76)m and | d re-calc | ulate | |
| the ut | liisation | Eeb | Mar | | | lup | lul | Δυσ | Son | Oct | Nov | Dec | | |
| Utilisa | ation fac | tor for a | ains hm | l. h | Iviay | Jun | Jui | Aug | Jeh | 001 | INUV | Dec | | |
| (94)m= | 0.99 | 0.97 | 0.92 | . 0.8 | 0.63 | 0.44 | 0.31 | 0.34 | 0.55 | 0.84 | 0.97 | 0.99 | | (94) |
| Usefu | l gains, | hmGm | . W = (9 | 4)m x (8 [,] | 1 4)m | | | | | | | | | |
| (95)m= | 382.82 | 448.65 | 480.64 | 458.52 | , 374.78 | 2 <mark>55.4</mark> | 170.79 | 178.93 | 275.65 | 377.14 | 376.58 | 360.4 | | (95) |
| Month | nly avera | age exte | ernal tem | perature | e from Ta | able 8 | | 7 | | | | | | |
| (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 | los <mark>s rate</mark> | e for me | an intern | al tempe | erature, | Lm , W = | =[(<mark>3</mark> 9)m : | x [(93)m | <mark>– (96</mark>)m |] | | | | |
| (97)m= | 6 <mark>82.7</mark> | 664.59 | 603.77 | 501.56 | 383.25 | 256.14 | 170.85 | 179.03 | 278.41 | 42 6.31 | 564.02 | 677.82 | | (97) |
| Space | e heatin | g requir | ement fo | <mark>r eac</mark> h m | nonth, k | Wh/mont | t <mark>h = 0</mark> .02 | 24 x [(97] |) <mark>m – (9</mark> 5) |)m] x (4 ⁻ | 1)m | | | |
| (98)m= | 223.11 | 145.11 | 91.61 | 30.99 | 6.3 | 0 | 0 | 0 | 0 | 36.58 | 134.96 | 236.16 | | |
| | | | | | | | | Tota | l per year (| (kWh/year | [•]) = Sum(98 | 8)15,912 = | 904.81 | (98) |
| Space | e heatin | g requir | ement in | kWh/m² | ?/year | | | | | | | | 17.88 | (99) |
| 9a. En | ergy rec | uiremer | nts – Ind | ividual h | eating s | ystems i | ncluding | micro-C | CHP) | | | • | | |
| Spac | e heatir | ng: | | | | | | | | | | | | |
| Fracti | on of sp | ace hea | at from s | econdar | y/supple | mentary | system | | | | | | 0 | (201) |
| Fracti | ion of sp | ace hea | at from m | nain syst | em(s) | | | (202) = 1 - | - (201) = | | | | 1 | (202) |
| Fracti | on of to | tal heati | ng from | main sys | stem 1 | | | (204) = (2 | 02) × [1 – (| (203)] = | | | 1 | (204) |
| Efficie | ency of r | main spa | ace heat | ing syste | em 1 | | | | | | | İ | 92.7 | (206) |
| Efficie | ency of s | seconda | ry/suppl | ementar | y heatin | g system | n, % | | | | | | 0 | (208) |
| | Jan | Feb | Mar | Apr | Mav | Jun | Jul | Aua | Sep | Oct | Nov | Dec | kWh/v | ear |
| Space | e heatin | g require | ement (c | alculate | d above |) | | | | | | | ·····, | |
| • | 223.11 | 145.11 | 91.61 | 30.99 | 6.3 | 0 | 0 | 0 | 0 | 36.58 | 134.96 | 236.16 | | |
| (211)m | n = {[(98 |)m x (20 | 1)4)] } x 1 | 00 ÷ (20 |)6) | | | | | | | | | (211) |
| () | 240.68 | 156.54 | 98.82 | 33.43 | 6.79 | 0 | 0 | 0 | 0 | 39.46 | 145.58 | 254.76 | 1 | |
| | | | 1 | | <u> </u> | | | Tota | l (kWh/yea | ar) =Sum(2 | 211) _{15,1012} | = | 976.07 | (211) |
| Space | e heatin | g fuel (s | econdar | y), kWh/ | month | | | | | | | l | | |
| = {[(98 |)m x (20 |)1)]}x1 | 00 ÷ (20 | 18) | | | | | | | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | |
| | | | | | | | | Tota | l (kWh/yea | ar) =Sum(2 | 2 15) _{15,1012} | = | 0 | (215) |

Water heating

| Output | from w | ater hea | ter (calc | ulated al | oove) | | | | | | | | _ | |
|---------------------|------------|------------------------|-----------|-------------|----------|--------------------|-------------------------|-------------|------------|-----------------|-------------------------|--------|--------------------------------|----------------|
| | 145.65 | 128.05 | 133.71 | 118.81 | 115.67 | 102.26 | 97.17 | 108.06 | 108.33 | 123.26 | 131.66 | 141.79 | | |
| Efficier | ncy of w | ater hea | iter | | | | | | | | | | 87 | (216) |
| (217)m= | 88.61 | 88.41 | 88.08 | 87.55 | 87.14 | 87 | 87 | 87 | 87 | 87.6 | 88.35 | 88.67 | | (217) |
| Fuel fo | r water | heating, | kWh/mo | onth | | | | | | | | | | |
| (219)m | 1 = (64) | m x 100 |) ÷ (217) | m 135.71 | 132 74 | 117 54 | 111 69 | 124 21 | 124 51 | 140.7 | 149.03 | 159.91 | 1 | |
| (210)11- | 104.00 | 144.00 | 101.01 | 100.71 | 102.74 | 117.54 | 111.00 | Tota | I = Sum(2) | 19a) = | 143.00 | 100.01 | 1657.06 | (210) |
| Δnnua | l totals | | | | | | | | , | /112 | Wh/veau | | kWh/vea | (210) r |
| Space | heating | fuel use | ed, main | system | 1 | | | | | | , you | | 976.07 | _ |
| Water | heating | fuel use | d | | | | | | | | | | 1657.06 | |
| Electric | city for p | oumps, fa | | | | | | | | | | | | |
| centra | al heatir | 30 |] | (230c) | | | | | | | | | | |
| boiler | with a f |] | (230e) | | | | | | | | | | | |
| Total e | lectricit | 75 | (231) | | | | | | | | | | | |
| Electric | city for I | ighting | | | | | | | | | | | 236.49 | (232) |
| 12a. (| CO2 em | issions - | – Individ | ual heati | ng syste | ems inclu | uding mi | cro-CHF |) | | | | | |
| | Г | | | Г | | En kW | e rgy /h/year | | | Emiss kg CO2 | ion fac 2/kWh | tor | Emissio ns kg CO2/ye | s ar |
| Spa <mark>ce</mark> | heating | ı (main <mark>s</mark> | ystem 1) |) | | (21 | 1) x | | | 0.2 | 16 | = | 2 <mark>10.83</mark> | (261) |
| Spa <mark>ce</mark> | heating | (second | dary) | | | (21 | 5) x | | | 0.5 | 19 | = | 0 | (263) |
| Wat <mark>er</mark> | heating | | | | | (219 | 9) x | | | 0.2 | 16 | = | 357.93 | (264) |
| Space | and wa | ter heati | ng | | | (26 | 1) + (262) | + (263) + (| 264) = | | • | | 568.76 | (265) |
| Electric | city for p | oumps, fa | ans and | electric l | keep-ho | t (23 ⁻ | 1) x | | | 0.5 | 19 | = | 38.93 | (267) |
| Electric | city for I | ighting | | | | (232 | 2) x | | | 0.5 | 19 | = | 122.74 | (268) |
| Total C | 02, kg | /year | | | | | | | sum o | f (265)(2 | 271) = | | 730.42 | (272) |
| Dwelli | ng CO2 | 2 Emissi | on Rate | | | | | | (272) | ÷ (4) = | | | 14.44 | (273) |
| El ratir | ig (sect | ion 14) | | | | | | | | | | | 90 | (274) |

| | | | User D | etails: | | | | | | |
|------------------------------------|---|--------------|------------|------------------|------------------|---------------|----------|-----------|-------------------------|---|
| Assessor Name: Software Name: | Stroma FSAP 201 | 2 | | Stroma Softwa | a Num ire Ver | ber: sion: | | Versio | on: 1.0.3.11 | |
| | | Pr | operty A | Address: | Arlingto | on 1 Bed | I MID 51 | | | |
| Address : | | | | | | | | | | |
| 1. Overall dwelling dimer | ISIONS: | | A | (| | A 11. | : | | | |
| Ground floor | | | Area | i(m²) | (10) X | AV. He | | (20) - | Volume(m ³) | |
| | \ . (4 - \ . (4 -) . (4 - \ . (4 - |). (4) | | 0.6 | | | 2.3 | (2a) = | 116.38 | _(3a) |
| 1 otal floor area 1 FA = (1 a) | l)+(1D)+(1C)+(1d)+(1e |)+(1h) |) 5 | 0.6 | (4) | | | (0,-) | | _ |
| Dwelling volume | | | | | (3a)+(3b) |)+(3C)+(3d | I)+(3e)+ | .(3n) = | 116.38 | (5) |
| 2. Ventilation rate: | | | | - 41 | | 4 - 4 - 1 | | | | |
| | main se heating h | eating | / | other | | total | | | m ³ per hou | • |
| Number of chimneys | 0 + | 0 | + | 0 |] = [| 0 | X 4 | 40 = | 0 | (6a) |
| Number of open flues | 0 + | 0 | + | 0 |] = [| 0 | x 2 | 20 = | 0 | (6b) |
| Number of intermittent fan | IS | | | | - E | 2 | x ^ | 10 = | 20 | (7a) |
| Number of passive vents | | | | | Γ | 0 | x ^ | 10 = | 0 | (7b) |
| Number of flueless gas fire | es | | | | Г | 0 | x 4 | 40 = | 0 | (7c) |
| | | | | | | | | Air ch | anges per ho | ur |
| Infiltration due to chimney | s, flues and fans = (63) | a)+(6b)+(7a | a)+(7b)+(7 | 7c) = | | 20 | | ÷ (5) = | 0.17 | (8) |
| It a pressurisation test has be | en carried out or is intende o dwolling (ns) | d, proceed | to (17), c | otherwise c | ontinue fro | om (9) to (| (16) | | | |
| Additional infiltration | e dwelling (lis) | | | | | | [(9)- | -11x0.1 = | 0 | -(3) |
| Structural infiltration: 0.2 | 25 for steel or timber f | rame or | 0.35 for | masonr | y constr | uction | | | 0 | |
| if both types of wall are pre | esent, use the value corresp | ponding to | the greate | er wall area | a (after | | | | - | |
| deducting areas of opening | gs); if equal user 0.35 | ad) ar 0 (| 1 (00010 | d) alaa | ontor O | | | | | |
| If no draught lobby, enter | 001, efficient 0.2 (ufficient) | | i (Seale | u), eise | | | | | 0 | $\begin{bmatrix} (12) \\ (12) \end{bmatrix}$ |
| Percentage of windows | and doors draught st | rinned | | | | | | | 0 | $= \begin{bmatrix} (13) \\ (14) \end{bmatrix}$ |
| Window infiltration | | nppou | | 0.25 - [0.2 | x (14) ÷ 1 | 00] = | | | 0 | $-1^{(11)}_{(15)}$ |
| Infiltration rate | | | | (8) + (10) - | + (11) + (1 | 2) + (13) + | + (15) = | | 0 | (16) |
| Air permeability value, o | q50, expressed in cub | ic metres | s per ho | ur per so | quare m | etre of e | nvelope | area | 5 | (17) |
| If based on air permeabilit | ty value, then (18) = [(1 | 7) ÷ 20]+(8) |), otherwi | se (18) = (| 16) | | | | 0.42 | (18) |
| Air permeability value applies | if a pressurisation test has | been done | e or a deg | ree air per | meability | is being us | sed | | | _ |
| Number of sides sheltered | t | | | (20) – 1 - [| 0 075 v (1 | 0)1 - | | | 2 | (19) |
| Infiltration rate incorporation | ng abaltar faatar | | | (20) - 1 - [| v (20) - | 5)] – | | | 0.85 | $ \begin{bmatrix} (20) \\ \hline (24) \end{bmatrix} $ |
| Infiltration rate modified for | ry sheller laciol | | | (21) = (10) | x (20) - | | | | 0.36 | |
| | Mar Apr May | lun | lul | Διια | Sen | Oct | Nov | Dec | | |
| Monthly average wind spe | and from Table 7 | oun | Uui | nug | Ocp | 001 | 1107 | 000 | | |
| (22)m= 5.1 5 | 4.9 4.4 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 | | |
| | | | | | - | | L | I | l | |
| Wind Factor $(22a)m = (22)$ |)m ÷ 4 | I | | | | | | | l | |
| (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 | | |

| Adjust | ed infiltr | ation rate | e (allowi | ng for sh | elter an | d wind s | peed) = | (21a) x | (22a)m | | | | | |
|------------------------|--------------------------|----------------------------|---------------------------|-------------------------------|--------------------------|-------------------------|-------------------------|------------------------|----------------|----------------|-------------|-----------------|----------------|-------------------------|
| | 0.46 | 0.45 | 0.44 | 0.39 | 0.39 | 0.34 | 0.34 | 0.33 | 0.36 | 0.39 | 0.4 | 0.42 | | |
| Calcul | ate effe | ctive air i | change | rate for t | he appli | cable ca | se | | | - | - | - | | (00-) |
| lf ovb | | | | andix N (2 | 3h) - (23a | a) x Emy (c | auation (N | (5)) other | wice (23h |) - (23a) | | | 0 | (238) |
| If bold | | | | | (23d) = (23d) | or in uno f | octor (from | $T_{able}(Ab)$ | wise (230 |) = (23a) | | | 0 | (23b) |
| | | | | iency in % | allowing | or in-use ia | | |) = | | | 4 (22.) | 0 | (23c) |
| a) If | balance | ed mecha | anical ve | entilation | with hea | at recove | ery (MVI | HR) (24a | ı)m = (22 | 2b)m + (| 23b) × [| 1 – (23c) | ÷ 100] | (0.4-) |
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (24a) |
| b) lf | balance | ed mecha | anical ve | entilation | without | heat rec | covery (N | ЛV) (24b |)m = (22 | 2b)m + (: 1 | 23b) | 1 | I | |
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (24b) |
| c) If | whole h | ouse ext | tract ver | tilation c | or positiv | ve input v | ventilatio | on from c | outside | - (00) | | | | |
| | if (22b)n | n < 0.5 × | : (23b), 1 | hen (240 | c) = (23b |); otherv | wise (24) | c) = (22b | o) m + 0. | 5 × (23b |)) | | l | (04-) |
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (24C) |
| d) If | natural if (22h)n | ventilation = 1 the | on or wh en (24d) | ole hous $m = (22)$ | e positiv | /e input v erwise (2 | ventilation = 0 | on from l 0 5 + [(2 | oft 2h)m² x | 0.51 | | | | |
| (24d)m= | 0.6 | 0.6 | 0.6 | 0.58 | 0.57 | 0.56 | 0.56 | 0.56 | 0.56 | 0.57 | 0.58 | 0.59 | | (24d) |
| Effe | ctive air | change | rate - er | Ll hter (24a |) or (24t |) or (24 | c) or (24 | d) in box | (25) | I | | | | |
| (25)m= | 0.6 | 0.6 | 0.6 | 0.58 | 0.57 | 0.56 | 0.56 | 0.56 | 0.56 | 0.57 | 0.58 | 0.59 | | (25) |
| | | | | | | | | | | | | | | |
| 3. He | at losse | s and he | at loss | baramete | er: | | | | | | | | | |
| ELEN | | Gros | SS (m²) | Openin | gs 2 | Net Ar | ea n² | U-valu W/m2 | k Ne | A X U | K) | k-value | e K | A X k |
| Doors | | area | (111) | | | 1.80 | | 1 | | 1.80 | | | ` | (26) |
| Windo | | 1 | | | | 1.09 | ≓ _î | /[1/(1 /)+ | 0.041 | 5.05 | H | | | (20) |
| Windo | | | | | | 4.41 | | | 0.04] | 5.85 | H | | | (27) |
| vvindo | ws Type | e Z | | | | 4.41 | x ¹ / | /[1/(1.4)+ | 0.04] = | 5.85 | 4 | | | (27) |
| Windo | ws Type | 93 | | | | 1.08 | x1, | /[1/(1.4)+ | 0.04] = | 1.43 | <u> </u> | | | (27) |
| Walls | | 23.1 | 3 | 11.79 | 9 | 11.34 | k X | 0.18 | = | 2.04 | | | | (29) |
| Total a | rea of e | elements | , m² | | | 23.13 | 3 | | | | | | | (31) |
| Party v | vall | | | | | 18.76 | 3 X | 0 | = | 0 | | | | (32) |
| Party f | loor | | | | | 50.6 | | | | | | | | (32a) |
| Party of | ceiling | | | | | 50.6 | | | | | | | $\neg \square$ | (32b) |
| * for win ** inclua | dows and le the area | l roof winde as on both | ows, use e sides of ir | effective wil nternal wall | ndow U-va 's and part | alue calcula titions | ated using | formula 1, | /[(1/U-valu | ıe)+0.04] a | as given in | n paragraph | 1 3.2 | |
| Fabric | heat los | ss, W/K = | = S (A x | U) | | | | (26)(30) | + (32) = | | | | 17.06 | (33) |
| Heat c | apacity | Cm = S(| Axk) | | | | | | ((28) | (30) + (32 | 2) + (32a) | (32e) = | 5544.48 | 3 (34) |
| Therm | al mass | parame | ter (TMI | ² = Cm ÷ | - TFA) ir | n kJ/m²K | | | Indica | tive Value | : Medium | | 250 | (35) |
| For desi can be i | ign assess used inste | sments wh ad of a dei | ere the de tailed calc | tails of the | construct | ion are not | t known pr | ecisely the | indicative | e values of | TMP in T | able 1f | | (``` |
| Therm | al brida | es : S (L | x Y) cal | culated u | usina Ap | pendix k | < | | | | | | 2 44 | (36) |
| if details | of therma | al bridging | are not kr | own (36) = | = 0.15 x (3 | 1) | | | | | | | 2.11 | () |
| Total fa | abric he | at loss | | | | , | | | (33) + | (36) = | | | 19.5 | (37) |
| Ventila | tion hea | at loss ca | alculated | d monthly | / | | | | (38)m | = 0.33 × (| (25)m x (5 |) | | |
| | Jan | Feb | Mar | Apr | Мау | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (38)m= | 23.22 | 23.06 | 22.91 | 22.19 | 22.06 | 21.43 | 21.43 | 21.32 | 21.67 | 22.06 | 22.33 | 22.61 | | (38) |
| Heat tr | ansfer o | coefficier | nt, W/K | | | | - | | (39)m | = (37) + (3 | - 38)m | - | | |
| (39)m= | 42.72 | 42.56 | 42.41 | 41.69 | 41.56 | 40.93 | 40.93 | 40.82 | 41.17 | 41.56 | 41.83 | 42.11 | | |
| Stroma I | FSAP 201 | 2 Version: | 1.0.3.11 | (SAP 9.92) | - http://ww | ww.stroma | .com | | | Average = | Sum(39) | 112 /12= | 41.6 9 | age 2 o ⁽³⁹⁾ |

| Heat lo | oss para | meter (H | HLP), W | /m²K | | | | | (40)m | = (39)m ÷ | - (4) | | | |
|-----------------------------|-------------------------------------|--------------------------------------|-------------------------------------|---|--|---------------------------------------|----------------------------|------------------------|-----------------------|--------------------|-----------------------------|----------|---------|------|
| (40)m= | 0.84 | 0.84 | 0.84 | 0.82 | 0.82 | 0.81 | 0.81 | 0.81 | 0.81 | 0.82 | 0.83 | 0.83 | | |
| Numb | er of day | us in mo | nth (Tab | le 12) | | | | 1 | , | Average = | Sum(40)1. | .12 /12= | 0.82 | (40) |
| Numbe | .lan | Feb | Mar | Anr | May | Jun | .lul | Aug | Sen | Oct | Nov | Dec | | |
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | | (41) |
| | | | | | | | | l | | | | | | |
| 4. Wa | ater heat | ting ene | rgy requ | irement: | | | | | | | | kWh/ye | ear: | |
| Assum if TF if TF | ed occu A > 13.9 A £ 13.9 | upancy, 9, N = 1 9, N = 1 | N + 1.76 × | : [1 - exp | 0(-0.0003 | 849 x (TF | FA -13.9 | 9)2)] + 0.0 | 0013 x (⁻ | TFA -13 | 1. ⁻ .9) | 71 | | (42) |
| Annua Reduce not more | l averag the annua e that 125 | e hot wa al average litres per | ater usag hot water person pe | ge in litre usage by r day (all w | es per da 5% if the a vater use, l | ay Vd,av lwelling is not and co | erage = designed ld) | (25 x N) to achieve | + 36 a water us | se target o | 74 f | .76 | | (43) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Hot wate | er usage i | n litres pei | r day for e | ach month | Vd,m = fa | ctor from | Table 1c x | (43) | | | | | | |
| (44)m= | 82.24 | 79.25 | 76.25 | 73.26 | 70.27 | 67.28 | 67.28 | 70.27 | 73.26 | 76.25 | 79.25 | 82.24 | | _ |
| Energy | content of | hot water | used - ca | lculated m | onthly - 4 | 190 x Vd r | m y nm y [| Tm / 3600 | -) kW/h/mor | Total = Su | <mark>m(44)</mark> 112 = | c 1d) | 897.12 | (44) |
| (4E)m- | 121.05 | 106 66 | 110.06 | | 02.07 | 70.45 | 72.62 | 04.40 | 05 40 | | 100 76 | 110 11 | | |
| (43)11= | 121.95 | 100.00 | 110.00 | 95.90 | 92.07 | 79.45 | 73.02 | 04.40 | - 05.49 | Total – Su | m(45), $m = 100.70$ | 110.11 | 1176.26 | (45) |
| lf instan | taneous w | ater heati | ng at poin | t of use (no | o hot water | storage), | enter 0 in | boxes (46 |) to (61) | | 1 <mark>11(40)</mark> 112 - | | 1170.20 | |
| (46)m= | 18.29 | 16 | 16.51 | 14.39 | 13.81 | 11.92 | 11.04 | 12.67 | 12.82 | 14.95 | 16.31 | 17.72 | | (46) |
| Water | storage | loss: | | | | | | | | | | | | |
| Storag | | e (litres) | rincludir | ng any s | olar or V | WHRS | storage | within sa | ame ves | sel | (|) | | (47) |
| If comi Otherv | munity r vise if no | eating a | nd no ta hot wate | ank in dv er (this ir | veiling, e ocludes i | nter 110 nstantar | nitres in | 1 (47) Smbi boil | ers) ente | er 'O' in <i>(</i> | 47) | | | |
| Water | storage | loss: | not hat | | | notantai | 10000 | | | | , | | | |
| a) If m | nanufact | urer's de | eclared l | oss fact | or is kno | wn (kWł | n/day): | | | | (| C | | (48) |
| Tempe | erature f | actor fro | m Table | e 2b | | | | | | | (| C | | (49) |
| Energy | y lost fro | m watei | storage | e, kWh/y | ear | | | (48) x (49) |) = | | (|) | | (50) |
| b) If m | nanufact | urer's de | eclared (| cylinder rom Tab | loss fact | or is not h/litro/da | known: | | | | | 2 | l | (51) |
| If com | munity h | leating s | ee secti | on 4.3 | | 1/1110/00 | xy) | | | | | J | | (31) |
| Volum | e factor | from Ta | ble 2a | | | | | | | | (| 0 | | (52) |
| Tempe | erature f | actor fro | m Table | 2b | | | | | | | (| 0 | | (53) |
| Energy | y lost fro | m water | storage | e, kWh/y | ear | | | (47) x (51) |) x (52) x (| 53) = | (|) | | (54) |
| Enter | (50) or (| (54) in (5 | 55) | | | | | | | | (| 0 | | (55) |
| Water | storage | loss cal | culated | for each | month | | | ((56)m = (| 55) × (41)ı | m | | | | |
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (56) |
| If cylinde | er contains | s dedicate | d solar sto | orage, (57) T | m = (56)m | x [(50) – (| [H11)] ÷ (5 1 | 50), else (5 | 7)m = (56) | m wnere (r | H11) IS Tro | m Append | | |
| (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 | | | | | | (|) | | (58) |
| Primar | y circuit | loss cal | culated | for each | month (| 59)m = (| (58) ÷ 36 | 65 × (41) | m | | atat) | | | |
| (MO) | | | | | | | | ng and a | | | | 0 | l | (50) |
| (59)11= | 0 | U | | | 0 | 0 | | | 0 | U | 0 | U | l | (00) |

| Combi | loss ca | alculated | for ea | ich | month (| 61)m = | (60 |)) ÷ 36 | 65 × (41) |)m | | | | | | |
|----------|-----------------------|--------------------------|-----------------|------|---------------------|-----------|-------|----------|-------------|--------------|----------------|----------------------|----------------|-------------|---------------|------|
| (61)m= | 41.91 | 36.47 | 38.8 | 6 | 36.13 | 35.81 | 3 | 33.18 | 34.29 | 35.81 | 36.13 | 38.86 | 39.08 | 41.91 |] | (61) |
| Total h | neat rec | uired for | wate | r he | ating ca | lculated | d fo | r eacl | n month | (62)m = | = 0.85 × | (45)m | + (46)m + | (57)m + | (59)m + (61)m | |
| (62)m= | 163.86 | 143.14 | 148.9 | 92 | 132.09 | 127.88 | 1 | 12.63 | 107.91 | 120.3 | 121.62 | 138.4 | 9 147.84 | 160.01 | | (62) |
| Solar DI | -IW input | calculated | using A | Appe | ndix G or | Appendi | хH | (negativ | ve quantity | /) (enter '(|)' if no sola | r contrib | oution to wate | er heating) | - | |
| (add a | dditiona | al lines if | FGHF | RS a | and/or V | VWHRS | S ap | oplies | , see Ap | pendix | G) | | | | • | |
| (63)m= | 0 | 0 | 0 | | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | J | (63) |
| Output | t from w | vater hea | ter | | | | | | | | | | | | 1 | |
| (64)m= | 163.86 | 143.14 | 148.9 | 92 | 132.09 | 127.88 | 1 | 12.63 | 107.91 | 120.3 | 121.62 | 138.4 | 9 147.84 | 160.01 | | ٦ |
| | | | | | | | | | | Out | put from w | ater hea | iter (annual) | 112 | 1624.7 | (64) |
| Heat g | ains fro | om water | heatii | ng, | kWh/mo | onth 0.2 | 25 ´ | [0.85 | × (45)m | + (61)r | n] + 0.8 x | x [(46)ı T | m + (57)m | + (59)m | ·] 1 | () |
| (65)m= | 51.03 | 44.58 | 46.3 | 1 | 40.94 | 39.57 | 3 | 84.71 | 33.05 | 37.04 | 37.46 | 42.84 | 45.93 | 49.75 | J | (65) |
| inclu | ıde (57) |)m in calo | culatio | on o | f (65)m | only if a | cylii | nder is | s in the o | dwelling | or hot w | ater is | from com | munity ł | neating | |
| 5. Int | ternal g | ains (see | e Tabl | e 5 | and 5a) | 1 | | | | | | | | | | |
| Metab | olic gai | ns (Table | <u>95), V</u> | /att | s | | - | | | | 1 | 1 | -1 | | 1 | |
| _ | Jan | Feb | Ma | ar | Apr | May | | Jun | Jul | Aug | Sep | Oct | : Nov | Dec | - | (|
| (66)m= | 85.39 | 85.39 | 85.3 | 9 | 85.39 | 85.39 | 8 | 35.39 | 85.39 | 85.39 | 85.39 | 85.39 | 85.39 | 85.39 | l i | (66) |
| Lightin | g gains | s (calcula | ted in | Ap | pendix I | _, equa | tion | L9 oi | r L9a), a | lso see | Table 5 | _ | | | , | |
| (67)m= | 13.39 | 11.89 | 9.67 | | 7.32 | 5.47 | Ŀ | 4.62 | 4.99 | 6.49 | 8.71 | 11.06 | 12.91 | 13.76 | | (67) |
| Applia | nces ga | ains (ca <mark>lc</mark> | ulated | d in | Append | lix L, ec | luat | tion L' | 13 or L1 | 3a), also | o see Ta | ble <mark>5</mark> | _ | | , | |
| (68)m= | 148.79 | 150.34 | 146.4 | 15 | 138.16 | 127.71 | 1 | 17.88 | 111.31 | 109.77 | 113.66 | 121.9 | 4 132.4 | 142.23 | J | (68) |
| Cookir | ng gains | s (calcula | ated in | ı Ap | pendix | L, equa | tion | 1 L15 | or L15a) | , also s | ee Table | 5 | | | | |
| (69)m= | 31.54 | 31.54 | 31.5 | 4 | <mark>31.</mark> 54 | 31.54 | 3 | 31.54 | 31.54 | 31.54 | 31.54 | 3 <mark>1.5</mark> 4 | 31.54 | 31.54 | | (69) |
| Pumps | and fa | ins gains | (Tabl | e 5 | a) | | | | | | | | | | - | |
| (70)m= | 3 | 3 | 3 | | 3 | 3 | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | | (70) |
| Losses | s e.g. e | vaporatic | on (ne | gati | ve valu | es) (Tal | ole | 5) | | | | | - | | - | |
| (71)m= | -68.31 | -68.31 | -68.3 | 31 | -68.31 | -68.31 | -(| 58.31 | -68.31 | -68.31 | -68.31 | -68.3 | 1 -68.31 | -68.31 | | (71) |
| Water | heating | g gains (T | able | 5) | | | | | | | | | | - | - | |
| (72)m= | 68.58 | 66.34 | 62.2 | 5 | 56.86 | 53.18 | 4 | 8.21 | 44.42 | 49.79 | 52.03 | 57.58 | 63.79 | 66.86 | | (72) |
| Total i | nterna | l gains = | : | | | | | (66) | m + (67)m | ı + (68)m | + (69)m + | (70)m + | (71)m + (72 |)m | - | |
| (73)m= | 282.38 | 280.19 | 269.9 | 98 | 253.96 | 237.98 | 2 | 22.33 | 212.35 | 217.67 | 226.02 | 242.2 | 1 260.72 | 274.47 |] | (73) |
| 6. So | lar gain | IS: | | | | | | | | | | | | | | |
| Solar g | ains are | calculated | using s | olar | flux from | Table 6a | and | associ | ated equa | tions to c | onvert to th | ne applic | able orienta | tion. | Oping | |
| Orienta | ation: | Access F Table 6d | actor | | Area m² | | | Tab | x ole 6a | 7 | g_ Fable 6b | | Table 6c | | Gains (W) | |
| Southe | ast <mark>0.9x</mark> | 0.77 | 7 x 4.41 x 36.7 | | | | | 6.79 | x | 0.63 | x | 0.7 | = | 49.59 | (77) | |
| Southe | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 3 | 6.79 | x | 0.63 | x | 0.7 | = | 49.59 | (77) |
| Southe | ast <mark>0.9x</mark> | 0.77 | | x | 1.0 | 8 | x | 3 | 6.79 | x | 0.63 | x | 0.7 | = | 12.14 | (77) |
| Southe | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 6 | 2.67 | x | 0.63 | x | 0.7 | = | 84.47 | (77) |
| Southe | ast <mark>0.9x</mark> | 0.77 | | x | 4.4 | 1 | x | 6 | 2.67 | x | 0.63 | x | 0.7 | = | 84.47 | (77) |

| Southeas | t 0.9x | 0.77 | | x | 1.0 | 8 | x | 6 | 2.67 | x | | 0.63 |] x [| 0.7 | = | - [| 20.69 | (77) |
|-----------|---------------------|-----------|--------|---------------|--------------------------|--------------|---------------|---------------|-----------|----------|--------------|--------|------------|--------|--------|-----|--------|-----------|
| Southeas | t 0.9x | 0.77 | | x | 4.4 | 1 | x | 8 | 5.75 |] x | | 0.63 | | 0.7 | ╡ - | - [| 115.57 | - (77) |
| Southeas | t 0.9x | 0.77 | | x | 4.4 | -1 | x | 8 | 5.75 | x | | 0.63 | - × [| 0.7 | | - [| 115.57 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 1.0 | 8 | x | 8 | 5.75 | x | | 0.63 | | 0.7 | = | - [| 28.3 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 4.4 | 1 | x | 10 | 06.25 | x | | 0.63 | - × [| 0.7 | | - [| 143.2 | - (77) |
| Southeas | t 0.9x | 0.77 | | x | 4.4 | 1 | x | 10 | 06.25 | x | | 0.63 | - × [| 0.7 | = | - [| 143.2 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 1.0 | 8 | x | 1(| 06.25 | x | | 0.63 | | 0.7 | = | - [| 35.07 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 4.4 | 1 | x | 1 | 19.01 | x | | 0.63 | | 0.7 | | - [| 160.4 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 4.4 | 1 | x | 1' | 19.01 | x | | 0.63 | | 0.7 | | ٠Ī | 160.4 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 1.0 | 8 | x | 1 | 19.01 | x | | 0.63 |] × [| 0.7 | = | - [| 39.28 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 4.4 | 1 | x | 1 | 18.15 | x | | 0.63 |] × [| 0.7 | = | - [| 159.24 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 4.4 | 1 | x | 1 | 18.15 | x | | 0.63 | _ × [| 0.7 | = | - [| 159.24 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 1.0 | 8 | x | 1 | 18.15 | x | | 0.63 | × | 0.7 | = | - [| 39 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 4.4 | 1 | x | 1. | 13.91 | x | | 0.63 | x | 0.7 | = | - [| 153.52 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 4.4 | 1 | x | 1' | 13.91 | x | | 0.63 | _ × [| 0.7 | = | - [| 153.52 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 1.0 | 8 | x | 1' | 13.91 | x | | 0.63 | × | 0.7 | = | - [| 37.6 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 4.4 | 1 | x | 1(| 04.39 | x | | 0.63 | x | 0.7 | = | - [| 140.69 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 4.4 | 1 | × | 10 | 04.39 | x | | 0.63 | x | 0.7 | = | | 140.69 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 1.0 | 8 | x | 10 | 04.39 |] x | | 0.63 | × | 0.7 | - | | 34.46 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 4.4 | .1 | x | 9 | 2.85 |] × | | 0.63 | x | 0.7 | = | - | 125.14 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 4.4 | 1 | x | 9 | 2.85 | x | | 0.63 | x | 0.7 | = | - | 125.14 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 1.0 | 8 | x | 9 | 2.85 | x | | 0.63 | × | 0.7 | = | - [| 30.65 | (77) |
| Southeas | t <mark>0.9x</mark> | 0.77 | | x | 4.4 | .1 | x | 6 | 9.27 | x | | 0.63 | x | 0.7 | = | - [| 93.36 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 4.4 | 1 | x | 6 | 9.27 | x | | 0.63 | x | 0.7 | = | - [| 93.36 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 1.0 | 8 | x | 6 | 9.27 | x | | 0.63 | × | 0.7 | = | - [| 22.86 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 4.4 | 1 | x | 4 | 4.07 | x | | 0.63 | x | 0.7 | = | - | 59.4 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 4.4 | 1 | x | 4 | 4.07 | x | | 0.63 | × | 0.7 | = | - | 59.4 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 1.0 | 8 | x | 4 | 4.07 | x | | 0.63 | × | 0.7 | = | - | 14.55 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 4.4 | 1 | x | 3 | 1.49 | x | | 0.63 | _ × [| 0.7 | = | - | 42.44 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 4.4 | 1 | x | 3 | 1.49 | x | | 0.63 | _ × [| 0.7 | = | - | 42.44 | (77) |
| Southeas | t 0.9x | 0.77 | | x | 1.0 | 8 | x | 3 | 1.49 | x | | 0.63 | × | 0.7 | = | - | 10.39 | (77) |
| | | | | | | | | | | | | | | | | | | |
| Solar gai | ins in | watts, ca | alcula | ted | for each | n mont | h | | | (83)m | n = Sur | m(74)m | .(82)m | | | | | (00) |
| (83)m = 1 | 111.32 | 189.62 | 259.4 | ¹⁵ | $\frac{321.47}{(84)m}$ = | 360.07 | $\frac{1}{3}$ | 57.47 83)m | 344.64 | 315 | 5.84 | 280.93 | 209.57 | 133.34 | 95.27 | | | (83) |
| | 115 - II 202 71 | | | 12 12 | (04)III = | = (73)II | | 53)III | , walls | 522 | 51 | 506.05 | 151 70 | 204.06 | 260.7/ | 4 | | (84) |
| (64)11= 3 | 593.71 | 409.01 | 529.4 | +3 | 575.45 | 596.0 | , ; | 579.0 | 556.99 | 555 | 5.51 | 506.95 | 431.76 | 394.00 | 309.72 | + | | (04) |
| 7. Mear | n inter | nal temp | peratu | ire (| heating | seaso | n) | | ···· | | T L 4 | (00) | | | | г | | |
| Temper | rature | auring r | ieatin | g pe | erioas ir | the liv | /ing | area | rom Tar | ole 9 | , IN1 | (°C) | | | | L | 21 | (85) |
| | UN TAC | LOF TOP G | | | | a, n1, Mo | m (s , | | ые ча) | <u>م</u> | | Son | Oct | Nov | Doc | , | | |
| (86)m- | 0.99 | 0.97 | | | 7.pi | 0.63 | / | 0 45 | 0 32 | | 35 | 0.56 | 0.85 | 0.97 | | - | | (86) |
| | | L | | - | | | | J1J | 0.02 | | <u> </u> | 0.00 | 0.00 | 0.07 | 0.33 | | | (00) |
| Mean ir | nterna | I temper | ature | in l | iving are | ea T1 (| | ow ste | ps 3 to 7 | (in T | able | 9c) | 20.0 | 20.64 | 20.22 | | | (87) |
| (07)11= | 20.30 | 20.55 | 20.7 | ິ | 20.92 | 20.98 | | 21 | 21 | | 1 | 20.99 | 20.9 | 20.01 | 20.33 | ' | | (07) |
| Temp | erature | during h | eating p | eriods ir | n rest of | dwelling | from Ta | ble 9, T | h2 (°C) | | | | | |
|---------------------|-------------------------|--------------------------|-------------------|-------------------------|-------------------------|-------------|--------------------------|-------------|-------------------------|--------------------------|-------------------------|------------|--------|-------|
| (88)m= | 20.22 | 20.22 | 20.22 | 20.23 | 20.23 | 20.25 | 20.25 | 20.25 | 20.24 | 20.23 | 20.23 | 20.23 | I | (88) |
| Utilisa | ation fac | tor for g | ains for | rest of d | welling, | h2,m (se | e Table | 9a) | | | | | | |
| (89)m= | 0.99 | 0.96 | 0.9 | 0.77 | 0.59 | 0.4 | 0.27 | 0.29 | 0.5 | 0.81 | 0.97 | 0.99 | I | (89) |
| Mean | interna | l temper | ature in | the rest | of dwelli | ing T2 (fo | ollow ste | eps 3 to 7 | 7 in Tabl | e 9c) | | | | |
| (90)m= | 19.38 | 19.64 | 19.92 | 20.15 | 20.22 | 20.24 | 20.25 | 20.25 | 20.24 | 20.14 | 19.74 | 19.34 | | (90) |
| | | | | | | | | | f | LA = Livin | g area ÷ (4 | ł) = | 0.49 | (91) |
| Mean | interna | l temper | ature (fo | or the wh | ole dwe | lling) = fl | _A × T1 | + (1 – fL | .A) × T2 | | | - | | |
| (92)m= | 19.86 | 20.09 | 20.33 | 20.53 | 20.6 | 20.62 | 20.62 | 20.62 | , 20.61 | 20.52 | 20.17 | 19.83 | | (92) |
| Apply | adjustn | nent to t | ne mear | internal | temper | ature fro | m Table | 4e, whe | ere appro | opriate | | | | |
| (93)m= | 19.86 | 20.09 | 20.33 | 20.53 | 20.6 | 20.62 | 20.62 | 20.62 | 20.61 | 20.52 | 20.17 | 19.83 | | (93) |
| 8. Spa | ace hea | ting requ | uirement | | | | | | | | | | | |
| Set Ti | i to the r | nean int | ernal ter | mperatui | re obtain | ned at ste | ep 11 of | Table 9 | o, so tha | t Ti,m=(| 76)m an | d re-calc | ulate | |
| the ut | linsation | Fob | Mar | | | lun | lul | Δυσ | Son | Oct | Nov | Dec | | |
| Utilisa | ation fac | tor for a | ains hm | <u>. чы</u> | iviay | Jun | Jui | Aug | Jeh | 001 | INOV | Dec | | |
| (94)m= | 0.99 | 0.96 | 0.91 | 0.78 | 0.61 | 0.42 | 0.3 | 0.32 | 0.53 | 0.83 | 0.96 | 0.99 | | (94) |
| Us <mark>efu</mark> | l gains, | hmGm | W = (9 | <u>ا</u> 4)m x (8 | 4)m | | | | | | | | | |
| (95)m= | 388.23 | 452.11 | 480.28 | 451.12 | 363.83 | 245.84 | 164.44 | 172.15 | 266.31 | 3 <mark>73.1</mark> | 380.24 | 366.01 | | (95) |
| Month | nly avera | age exte | rnal terr | perature | e from Ta | able 8 | | 7 | | | | | | |
| (96)m= | 4.3 | 4.9 | <mark>6</mark> .5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | | (96) |
| Heat | los <mark>s rate</mark> | e for m <mark>e</mark> a | an interr | al tempe | erature, | Lm , W = | =[(<mark>3</mark> 9)m : | x [(93)m | – <mark>(96</mark>)m |] | | | | |
| (97)m= | 664.88 | 646.57 | 586.6 | 484.8 | 369.79 | 246.29 | 164.47 | 172.21 | 268.11 | 412.07 | 546.75 | 658.07 | | (97) |
| Sp <mark>ace</mark> | e heatin | g require | ement fo | <mark>or eac</mark> h n | nonth, <mark>k</mark> l | Wh/mont | t <mark>h = 0</mark> .02 | 24 x [(97] |) <mark>m – (9</mark> 5 |)m <mark>] x (4</mark> ′ | 1)m | | | |
| (98)m= | 205.83 | 130.68 | 79.1 | 24.25 | 4.43 | 0 | 0 | 0 | 0 | 28.99 | 119.89 | 217.29 | | |
| | | | | | | | | Tota | l per year | (kWh/year |) = Sum(98 | 8)15,912 = | 810.47 | (98) |
| Space | e heatin | g require | ement in | kWh/m ² | /year | | | | | | | | 16.02 | (99) |
| 9a. En | ergy rec | quiremer | nts – Ind | ividual h | eating s | ystems i | ncluding | micro-C | CHP) | | | - | | |
| Space | e heatir | ng: | | | | | | | | | | - | | |
| Fracti | on of sp | ace hea | t from s | econdar | y/supple | mentary | system | | | | | | 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 heati | ng from | main sys | stem 1 | | | (204) = (2 | 02) × [1 – | (203)] = | | | 1 | (204) |
| Efficie | ency of r | main spa | ace heat | ing syste | em 1 | | | | | | | ĺ | 93.4 | (206) |
| Efficie | ency of s | seconda | ry/suppl | ementar | y heating | g system | n, % | | | | | ĺ | 0 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/ | year |
| Space | e heatin | g require | ement (c | alculate | d above) |) | | | | | | | · | |
| | 205.83 | 130.68 | 79.1 | 24.25 | 4.43 | 0 | 0 | 0 | 0 | 28.99 | 119.89 | 217.29 | | |
| (211)m | n = {[(98 |)m x (20 | 4)] } x 1 | 00 ÷ (20 |)6) | | | | | | | | | (211) |
| | 220.38 | 139.91 | 84.69 | 25.97 | 4.75 | 0 | 0 | 0 | 0 | 31.04 | 128.36 | 232.65 | | |
| | | | | | | | | Tota | l (kWh/yea | ar) =Sum(2 | 211) _{15,1012} | = | 867.74 | (211) |
| Space | e heatin | g fuel (s | econdar | y), kWh/ | month | | | | | | | L | | |
| = {[(98 |)m x (20 |)1)]}x ¹ | 00 ÷ (20 | 8) | | | | | | | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | | | | | | | | Tota | l (kWh/yea | ar) = Sum(2) | 215) _{15,1012} | - 7 | 0 | (215) |

Water heating

| Output | from w | ater hea | ter (calc | ulated al | oove) | | | | | | | | | |
|-----------------------|-----------------------|----------------------|-----------|-------------|----------|--------------------|-----------------|-------------|------------|-----------------------|-------------------------|--------|--------------------------------|--------|
| | 163.86 | 143.14 | 148.92 | 132.09 | 127.88 | 112.63 | 107.91 | 120.3 | 121.62 | 138.49 | 147.84 | 160.01 | | |
| Efficier | icy of w | ater hea | iter | | | | | | | | | | 80.3 | (216) |
| (217)m= | 85.63 | 84.82 | 83.54 | 81.72 | 80.6 | 80.3 | 80.3 | 80.3 | 80.3 | 81.88 | 84.53 | 85.82 | | (217) |
| Fuel fo | r water | heating, | kWh/mo | onth | | | | | | | | | | |
| (219)m | = (64) | m x 100 |) ÷ (217) | m 161.64 | 159.66 | 140.27 | 12/ 29 | 140.91 | 151 46 | 160.12 | 174.0 | 196.45 | 1 | |
| (219)11= | 191.37 | 100.75 | 170.27 | 101.04 | 156.00 | 140.27 | 134.30 | Tota | l = Sum(2) | 19a) = | 174.9 | 100.45 | 1065.08 | |
| Δηριιο | l totale | | | | | | | | | د در ۱۰۵۰ ایا | Whitea | | kWb/year | (219) |
| Space | heating | fuel use | ed, main | system | 1 | | | | | ĸ | vvi // year | | 867.74 | |
| Water I | neating | fuel use | d | | | | | | | | | | 1965.08 | |
| Electric | ity for p | oumps, f | ans and | electric | keep-ho | t | | | | | | | | _ |
| centra | ıl heatir | ng pump | : | | | | | | | | | 30 |] | (230c) |
| boiler | with a f | an-assis | sted flue | | | | | | | | | 45 | | (230e) |
| Total e | lectricit | y for the | above, k | (Wh/yea | r | | | sum | of (230a). | (230g) = | | | 75 | (231) |
| Electric | ity for I | ighting | | | | | | | | | | | 236.49 | (232) |
| 12a. (| CO2 em | issions - | – Individ | ual heati | ng syste | ems inclu | uding mi | cro-CHF |) | | | | | |
| | Г | | | Г | | En kW | ergy /h/year | | | Emiss kg CO | ion fac 2/kWh | tor | Emissions kg CO2/yea | ar |
| Spa <mark>ce</mark> | heating | (main <mark>s</mark> | ystem 1) |) | | (21 | 1) x | | | 0.2 | 16 | = | 187.43 | (261) |
| Spa <mark>ce</mark> | <mark>he</mark> ating | (second | dary) | | | (21 | 5) x | | | 0.5 | 19 | = | 0 | (263) |
| Wat <mark>er I</mark> | neating | | | | | (219 | 9) x | | | 0.2 | 16 | = | 424.46 | (264) |
| Space | and wa | ter heati | ng | | | (26 | 1) + (262) | + (263) + (| (264) = | | | | 611.89 | (265) |
| Electric | ity for p | oumps, f | ans and | electric | keep-ho | t (23 ⁻ | 1) x | | | 0.5 | 19 | = | 38.93 | (267) |
| Electric | ity for I | ighting | | | | (23) | 2) x | | | 0.5 | 19 | = | 122.74 | (268) |
| Total C | 02, kg | /year | | | | | | | sum o | of (265)(| 271) = | | 773.55 | (272) |
| | | | | | | | | | | | | | | |

TER =

(273)

15.29

Regulations Compliance Report

| Approved Documer Printed on 22 June | nt L1A, 2013 Edition, 2018 at 10:46:54 | England assessed by St | troma FSAP 2012 program, Ve | ersion: 1.0.3.11 |
|--|---|--|--|------------------------|
| Project Information | ו | | | |
| Assessed By: | () | | Building Type: | Flat |
| Dwelling Details: | | | | |
| NEW DWELLING | DESIGN STAGE | | Total Floor Area: | 76.1m² |
| Site Reference : | Arlington Works, Tv | vickenham | Plot Reference: | Arlington 3 Bed GND 76 |
| Address : | | | | |
| Client Details: | | | | |
| Name: Address : | Sharpes Refinery S | ervice | | |
| This report covers It is not a complete | items included wite e report of regulation | hin the SAP calculation ons compliance. | 1 S. | |
| 1a TER and DER | | | | |
| Fuel for main heatin | ng system: Mains ga | S | | |
| Fuel factor: 1.00 (m | ains gas) ide Emission Rate (| | 17 25 kg/m² | |
| Dwelling Carbon Die | oxide Emission Rate | (DER) | 15.56 kg/m ² | ОК |
| 1b TFEE and DFE | E | | Ŭ | |
| Target Fabric Energ Dwelling Fabric Energy | gy Efficiency (TFEE) ergy Efficiency (DFE | E) | 45.5 kWh/m² 37.8 kWh/m² | OK |
| Element External w Party wall Floor Roof Openings | all | Average 0.17 (max. 0.30) 0.00 (max. 0.20) 0.11 (max. 0.25) (no roof) 1.42 (max. 2.00) | Highest 0.17 (max. 0.70) - 0.11 (max. 0.70) 1.60 (max. 3.30) | ОК ОК ОК |
| 2a Thermal bridg | ing | | | |
| Thermal bi | ridging calculated fro | om linear thermal transmi | ttances for each junction | |
| 3 Air permeability Air permeabi | / lity at 50 pascals | | 4.00 (design va | lue) |
| Maximum | | | 10.0 | UK |
| 4 Heating efficien | icy | Detekses (m. 207 mm | duct in deux 04.0004). | |
| Main Heating | g system: | Boiler systems with radi Brand name: Alpha Model: InTec 34C Model qualifier: (Combi) Efficiency 88.8 % SEDE Minimum 88.0 % | auct index 010061): iators or underfloor heating - m BUK2009 | ains gas OK |
| Secondary h | eating system: | None | | |

Regulations Compliance Report

| 5 Cy | linder insulation | | | | |
|-------------|--|-------------------------------------|----------------|-------------------------------|----|
| | Hot water Storage: | No cylinder | | | |
| 6 Co | ontrols | | | | |
| | | | | | |
| | Space heating controls Hot water controls: | Time and temperature No cylinder | e zone control | by device in database | ОК |
| | Boiler interlock: | Yes | | | ОК |
| 7 Lo | w energy lights | | | | |
| | Percentage of fixed lights with low Minimum | w-energy fittings | | 100.0% 75.0% | ок |
| 8 Me | echanical ventilation | | | | |
| | Not applicable | | | | |
| 9 Su | mmertime temperature | | | | |
| | Overheating risk (Thames valley) | : | | Medium | ОК |
| Based | d on: | | | | |
| | Overshading: | | | Average or unknown | |
| | Windows facing: North West | | | 4.41m ² | |
| | Windows facing: North West | | | 4.41m ² | |
| | Windows facing: South East | | | 4.41m ² | |
| | Windows facing: South West | | | 2.52m ² | |
| _ | Ventilation rate: | | | 3.00 | |
| | Blinds/curtains: | | | None | |
| | | | | Closed 100% of daylight hours | |
| <u>10 K</u> | ey f <u>eatures</u> | | | | |
| | Party Walls U-value Floors U-value | | | 0 W/m²K 0.11 W/m²K | |

| | | | User D | etails: | | | | | | |
|----------------------------------|--------------------------------|--------------|--------------------|-------------------|------------------|---------------|----------|-----------|------------------------|-------------------|
| Assessor Name: Software Name: | Stroma FSAP 201 | 2 | : | Stroma Softwa | a Num ire Ver | ber: sion: | | Versio | n: 1.0.3.11 | |
| | | Pro | operty A | Address: | Arlingto | on 3 Bec | GND 7 | 6 | | |
| Address : | | | | | | | | | | |
| 1. Overall dwelling dime | ensions: | | | | | | | | | |
| | | | Area | 1 (m²) | | Av. He | ight(m) | | Volume(m ³ | <u>)</u> |
| Ground floor | | | 7 | 6.1 | (1a) x | 2 | 2.3 | (2a) = | 175.03 | (3a) |
| Total floor area TFA = (1 | a)+(1b)+(1c)+(1d)+(1e |)+(1n) | 7 | 6.1 | (4) | | | | | |
| Dwelling volume | | | | | (3a)+(3b) | +(3c)+(3c | l)+(3e)+ | .(3n) = | 175.03 | (5) |
| 2. Ventilation rate: | | | | | | | | | | |
| | main se | econdary | 1 | other | | total | | | m ³ per hou | r |
| Number of chimneys | | 0 |] + [| 0 |] = [| 0 | x 4 | 40 = | 0 | (6a) |
| Number of open flues | 0 + | 0 | i + [| 0 |] = [| 0 | × | 20 = | 0 | (6b) |
| Number of intermittent fa | ns | | J L | | · _ | 2 | x / | 10 = | 20 | (7a) |
| Number of passive vents | | | | | | 0 | x / | 10 = | 0 | (7b) |
| Number of flueless gas fi | res | | | | | 0 | X 4 | 40 = | 0 | (7c) |
| | | | | | _ | | | Air ch | anges per ho | our |
| Infiltration due to chimne | ys, flues and fans = (6) | a)+(6b)+(7a | ı)+(7 b)+(7 | ⁷ c) = | | 20 | | ÷ (5) = | 0.11 | (8) |
| If a pressurisation test has b | een carried out or is intende | ed, proceed | to (17), o | therwise c | ontinue fro | om (9) to (| (16) | | | |
| Additional infiltration | ne dweiling (ns) | | | | | | [(0)] | -11x0 1 - | 0 | (9) |
| Structural infiltration: 0 | .25 for steel or timber t | rame or (| 0.35 for | masonr | v constr | uction | [(0) | 1,0.1 - | 0 | $=_{(11)}^{(10)}$ |
| if both types of wall are p | resent, use the value corres | ponding to t | the greate | er wall area | a (after | | | | 0 | |
| deducting areas of openir | ngs); if equal user 0.35 | od) or 0 1 | | d) also | optor 0 | | | | 2 | |
| If no draught lobby en | ter 0.05 else enter 0 | | (Seale | u), eise | Sinter U | | | | 0 | -(12) |
| Percentage of windows | s and doors draught st | ripped | | | | | | | 0 | = (13) $=$ (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 cub | ic metres | per ho | ur per so | uare m | etre of e | envelope | area | 4 | (17) |
| If based on air permeabil | ity value, then (18) = [(1 | 7) ÷ 20]+(8) | , otherwis | se (18) = (| 16) | | | | 0.31 | (18) |
| Air permeability value applie | s if a pressurisation test has | been done | e or a deg | ree air per | meability | is being u | sed | | | _ |
| Number of sides sheltere | d | | | (20) 4 [| 0 07E v (4 | 0)] | | | 2 | (19) |
| Shelter factor | to a shallow factory | | | (20) = 1 - [| 0.075 X (1 | 9)] = | | | 0.85 | (20) |
| Infiltration rate incorporat | ing shelter factor | | | (21) = (18) | x (20) = | | | | 0.27 | (21) |
| Infiltration rate modified f | or monthly wind speed | . 1 | | | | 0.1 | | | | |
| Jan Feb | Mar Apr May | Jun | Jui | Aug | Sep | Oct | NOV | Dec | | |
| Monthly average wind sp | eed from Table 7 | | | 1 | | | 1 | | 1 | |
| (∠∠)m= 5.1 5 | 4.9 4.4 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4./ | | |
| 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 | peed) = | (21a) x | (22a)m | | | | | |
|------------------|------------------------|-------------------------|---------------------------|---------------|--------------|-------------|-------------|--------------------------|--------------|-------------------|-----------------------|----------------|-----------|--------------|
| <i>.</i> | 0.34 | 0.33 | 0.33 | 0.29 | 0.29 | 0.25 | 0.25 | 0.25 | 0.27 | 0.29 | 0.3 | 0.31 | | |
| Calcula If me | ate ette | ctive air al ventila | change | rate for t | he appli | cable ca | se | | | | | | 0 | (23a) |
| lf exh | aust air h | eat pump | using App | endix N, (2 | 3b) = (23a |) × Fmv (e | equation (N | N5)) , othe | rwise (23b |) = (23a) | | | 0 | (23b) |
| lf bala | anced with | heat reco | overy: effic | iency in % | allowing for | or in-use f | actor (from | n Table 4h |) = | , , , | | | 0 | (23c) |
| a) If | balance | ed mech | anical ve | entilation | with hea | at recove | erv (MVI | HR) (24a | a)m = (2) | 2b)m + (| 23b) x [[,] | l 1 – (23c) | ÷ 1001 | (200) |
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (24a) |
| b) If | balance | ed mech | anical ve | entilation | without | heat rec | overy (N | и ЛV) (24b | m = (22) | 1 2b)m + (2 | 23b) | | | |
| , (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (24b) |
| c) If | whole h | iouse ex | tract ver | ntilation c | or positiv | e input v | /entilatic | n from c | outside | | | | | |
| í | if (22b)r | n < 0.5 > | (23b), t | then (24c | c) = (23b |); otherv | vise (24 | c) = (22b | o) m + 0. | .5 × (23b |) | | | |
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (24c) |
| d) If | natural | ventilati | on or wh | ole hous | e positiv | e input | ventilatio | on from I | oft | | | | | |
| (0.1.1) | if (22b)r | n = 1, th | en (24d) | m = (22k) |)m othe | rwise (2 | 4d)m = (| 0.5 + [(2 | 2b)m² x | 0.5] | 0.55 | 0.55 | | (244) |
| (24d)m= | 0.56 | 0.56 | 0.55 | 0.54 | 0.54 | 0.53 | 0.53 | 0.53 | 0.54 | 0.54 | 0.55 | 0.55 | | (240) |
| Effe | ctive air | | rate - er | |) or (24b | o) or (240 | c) or (24 | | (25) | 0.54 | 0.55 | 0.55 | l | (25) |
| (25)m= | 0.56 | 0.00 | 0.55 | 0.54 | 0.54 | 0.53 | 0.53 | 0.53 | 0.54 | 0.54 | 0.55 | 0.55 | | (23) |
| 3. He | at l <mark>osse</mark> | s and he | eat loss | paramete | er: | | | | | | | | | |
| ELEN | IENT | Gros | SS (m ²) | Openin | gs | Net Ar | ea | U-valu | ue | AXU | | k-value | | A X k |
| Doors | | area | (1112) | III | | A ,r | | VV/112 | .r. | (V V / I | \sim | KJ/III-•r | | KJ/K (26) |
| Mindo | | . 1 | | | | 1.89 | | 1.6 | = | 3.024 | H | | | (20) |
| Windo | | . 2 | | | | 4.41 | | /[1/(1.4) + | 0.04] = | 5.85 | H | | | (27) |
| | ws type | 2 | | | | 4.41 | | /[1/(1.4)+ | 0.04] = | 5.85 | L. | | | (27) |
| windo | ws type T | 3 | | | | 4.41 | x1/ | /[1/(1.4)+ | 0.04] = | 5.85 | | | | (27) |
| Windo | ws Type | 94 | | | | 2.52 | x1, | /[1/(1.4)+ | 0.04] = | 3.34 | ╡, | | | (27) |
| Floor | | | | | | 76.1 | x | 0.11 | = | 8.37099 | 9 | | \exists | (28) |
| Walls | | 56.3 | 36 | 17.64 | 4 | 38.72 | <u>x</u> | 0.17 | = | 6.58 | | | | (29) |
| Total a | rea of e | elements | , m² | | | 132.4 | 6 | | | | | | | (31) |
| Party v | vall | | | | | 38.24 | x | 0 | = | 0 | | | | (32) |
| Party c | eiling | | | | | 76.1 | | | | | | | | (32b) |
| * for win | dows and | l roof wind | ows, use e sidos of ii | effective wil | ndow U-va | alue calcul | ated using | formula 1 | /[(1/U-valı | ıe)+0.04] a | is given in | paragraph | 3.2 | |
| Fabric | heat los | ss W/K | = S (A x) | | s anu part | IUONS | | (26)(30) |) + (32) = | | | ĺ | 29.96 | (33) |
| Heat c | anacity | Cm = Si | (A x k) | 0) | | | | (-/ (/ | ((28) | (30) + (32 | 2) + (32a). | (32e) = | 15712.00 | (34) |
| Therm | al mass | parame | eter (TMI | ⊃ = Cm ÷ | · TFA) in | ⊨k.J/m²K | | | Indica | tive Value | : Medium | | 250 | (35) |
| For desi | gn asses | sments wh | ere the de | etails of the | constructi | on are not | t known pr | ecisely the | e indicative | e values of | TMP in Ta | able 1f | 250 | |
| can be ı | ised inste | ad of a de | tailed calc | ulation. | | | | - | | | | | | |
| Therm | al bridg | es : S (L | x Y) cal | culated u | using Ap | pendix ł | < | | | | | | 8.22 | (36) |
| if details | of therma | al bridging | are not kr | nown (36) = | : 0.15 х (З | 1) | | | (22) - | (26) - | | I | | |
| Vontile | abilition here | at loss | alaulata | 1 months | , | | | | (33) + | = (30) = | 25)m v (5) | | 47.07 | (37) |
| venula | | | Mor | | Mov | lun | 11 | Δυσ | (30)m | $= 0.33 \times ($ | | | | |
| | Jan | | Iviai | Г чы | iviay | Jun | Jui | Aug | Seb | | | Dec | | |

| (38)m= | 32.23 | 32.1 | 31.97 | 31.37 | 31.26 | 30.74 | 30.74 | 30.64 | 30.94 | 31.26 | 31.49 | 31.73 | | (38) |
|-----------------|-------------------------------|---------------------------------|--------------------------|----------------------------|----------------------------|------------------------|-------------------|-------------|-----------------------|---------------------|------------------------|---------------------|---------|-------|
| Heat tra | ansfer o | coefficie | nt, W/K | | | | | | (39)m | = (37) + (3 | 38)m | | | |
| (39)m= | 79.3 | 79.17 | 79.05 | 78.45 | 78.34 | 77.81 | 77.81 | 77.72 | 78.02 | 78.34 | 78.56 | 78.8 | | |
| | | motor (l | אי (סור) | /m21/ | | | | | (40)~ | Average = | Sum(39)1 | 12 /12= | 78.45 | (39) |
| (40)m- | 1 04 | | ⊐LP), VV/ I 1.04 | 1.03 | 1.03 | 1.02 | 1.02 | 1.02 | (40)m | = (39)m - 1.03 | 1.03 | 1.04 | | |
| (40)11- | 1.04 | 1.04 | 1.04 | 1.00 | 1.00 | 1.02 | 1.02 | 1.02 | 1.00 | Average = | Sum(40)1 | | 1.03 | (40) |
| Numbe | r of day | /s in mo | nth (Tab | le 1a) | | - | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | | (41) |
| | | | | | | | | | | | | | | |
| 4. Wa | ter hea | ting ene | rgy requ | irement: | | | | | | | | kWh/yea | ar: | |
| Assum if TF | ed occu A > 13. A £ 13. | upancy, 9, N = 1 9, N = 1 | N + 1.76 x | : [1 - exp | (-0.0003 | 849 x (TF | FA -13.9) |)2)] + 0.(| 0013 x (⁻ | TFA -13. | 2. 9) | .38 | | (42) |
| Annual | averag | e hot wa | ater usag | ge in litre | es per da | ay Vd,av | erage = | (25 x N) | + 36 | | 90 |).84 | | (43) |
| not more | the annua that 125 | al average litres per | not water person pe | usage by : r day (all w | 5% If the d ater use, l | hot and co | aesignea t ld) | o achieve | a water us | se target o | T | | | |
| ſ | Jan | Feb | Mar | Apr | May | Jun | Jul | Αυα | Sep | Oct | Nov | Dec | | |
| Hot wate | er usage i | n litres pe | r day for ea | ach month | Vd,m = fa | ctor from T | Table 1c x | (43) | 000 | | 1101 | 200 | | |
| (44)m= | 9 <mark>9.92</mark> | 96.29 | 92.65 | 89.02 | 85.39 | 81.75 | 81.75 | 85.39 | 89.02 | 9 <mark>2.65</mark> | 96.29 | <mark>9</mark> 9.92 | | |
| | | | | | | | | | | Total = Su | m(44) ₁₁₂ = | = | 1090.04 | (44) |
| Energy o | content of | ^t hot water | used - cal | culated mo | onthly $= 4$. | 190 x Vd,r | n x nm x D |)Tm / 3600 |) kWh/mor | oth (see Ta | bles 1b, 1 | c, 1d) | | |
| (45)m= | 148.18 | 129.6 | 133.73 | 116.59 | 111.87 | 96.54 | 89.46 | 102.65 | 103.88 | 121.06 | 132.15 | 143.5 | | |
| lf instant | aneous v | vater heati | ing at point | t of use (no | o hot water | ⁻ storage), | enter 0 in | boxes (46 |) to (61) | Total = Su | m(45) ₁₁₂ = | = L | 1429.21 | (45) |
| (46)m= | 22.23 | 19.44 | 20.06 | 17.49 | 16.78 | 14.48 | 13.42 | 15.4 | 15.58 | 18.16 | 19.82 | 21.53 | | (46) |
| Water | storage | loss: | | | | | | | | | | | | |
| Storage | e volum | ne (litres) |) includir | ng any so | olar or W | /WHRS | storage | within sa | ame ves | sel | | 0 | | (47) |
| If comm | nunity h | neating a | and no ta | ank in dw | velling, e | nter 110 | litres in | (47) | ` | (0) : (| (-) | | | |
| Otherw Water | vise it no | o stored | hot wate | er (this ir | ICIUDES I | nstantar | ieous co | mbi boil | ers) ente | er '0' in (| 47) | | | |
| a) If m | anufact | turer's d | eclared I | oss facto | or is kno | wn (kWł | n/day): | | | | | 0 | | (48) |
| Tempe | rature f | actor fro | m Table | 2b | | | | | | | | 0 | | (49) |
| Energy | lost fro | om water | r storage | e, kWh/ye | ear | | | (48) x (49) |) = | | | 0 | | (50) |
| b) If m | anufact | turer's d | eclared (| cylinder l | oss fact | or is not | known: | | | | | | | (= .) |
| If com | ter stor nunitv k | age loss neating s | s lactor li see secti | on 4.3 | e z (kvv | n/iitre/da | iy) | | | | | 0 | | (51) |
| Volume | e factor | from Ta | ble 2a | | | | | | | | | 0 | | (52) |
| Tempe | rature f | actor fro | m Table | 2b | | | | | | | | 0 | | (53) |
| Energy | lost fro | om water | r storage | e, kWh/ye | ear | | | (47) x (51) | x (52) x (| 53) = | | 0 | | (54) |
| Enter | (50) or | (54) in (ধ | 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 | r contain | s dedicate | d solar sto | orage, (57)i | m = (56)m | x [(50) – (| H11)] ÷ (50 | 0), else (5 | 7)m = (56) | m where (| H11) is fro | m Appendix | ίΗ | |
| (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 | | | | | |
| (mo | dified by | factor f | rom Tab | le H5 if t | here is s | solar wat | ter heati | ng and a | cylinde | r thermo | stat) | | L | |
| (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) ÷ 36 | 65 × (41 |)m | | | | | | |
| (61)m= | 23.84 | 21.5 | 23.77 | 22.95 | 23.68 | 22.88 | 23.62 | 23.66 | 22.92 | 23.73 | 23.02 | 23.82 | | (61) |
| Total h | eat req | uired for | water h | eating ca | alculatec | l for eac | h month | (62)m = | 0.85 × (| (45)m + | (46)m + | (57)m + | (59)m + (61)m | |
| (62)m= | 172.01 | 151.1 | 157.5 | 139.54 | 135.56 | 119.42 | 113.07 | 126.31 | 126.8 | 144.79 | 155.17 | 167.33 | | (62) |
| Solar DI | W input | calculated | using App | endix G o | Appendix | H (negati | ve quantity | y) (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 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= | 172.01 | 151.1 | 157.5 | 139.54 | 135.56 | 119.42 | 113.07 | 126.31 | 126.8 | 144.79 | 155.17 | 167.33 | | |
| | | | | | | | | Outp | out from wa | ater heate | r (annual) | 12 | 1708.6 | (64) |
| Heat g | ains fro | m water | heating | , kWh/m | onth 0.2 | 5 ´ [0.85 | × (45)m | n + (61)m | n] + 0.8 x | ۲ ((46)m | + (57)m | + (59)m |] | |
| (65)m= | 55.23 | 48.47 | 50.41 | 44.5 | 43.12 | 37.82 | 35.65 | 40.05 | 40.27 | 46.19 | 49.69 | 53.67 | | (65) |
| in <mark>clu</mark> | ide (57) | m in calo | culation | of (65)m | only if c | ylinder i | s in the o | dwelling | or hot w | ate <mark>r is f</mark> r | om com | munity h | eating | |
| 5. Int | ernai ga | ains (see | Table 5 | 5 and 5a |): | | | | | | _ | | _ | |
| Metab | olic gair | s (Table | 5) Wat | ts | | | | | | | | | | |
| in o tono | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (66)m= | 119.23 | 119.23 | 11 <mark>9.23</mark> | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | | (66) |
| Lightin | g gains | (calcula | ted in A | pendix | L, equat | ion L9 o | r L9a), a | lso see ⁻ | Table 5 | | | | | |
| (67)m= | 18.89 | 16.78 | 13.65 | 10.33 | 7.72 | 6.52 | 7.04 | 9.16 | 12.29 | 15.61 | 18.21 | 19.42 | | (67) |
| Applia | nces ga | ins (calc | ulated ir | Append | dix L, eq | uation L | 13 or L1 | 3a), also | see Ta | ble 5 | | | | |
| (68)m= | 211.1 | 213.29 | 207.77 | 196.02 | 181.18 | 167.24 | 157.93 | 155.74 | 161.26 | 173.01 | 187.84 | 201.78 | | (68) |
| Cookir | na aains | (calcula | ted in A | n Dendix | L. equat | ion L15 | or L15a |), also se | e Table | 5 | 1 | | | |
| (69)m= | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | | (69) |
| Pumps | and fa | ns dains | (Table ! | 1 | | | | | | | | | | |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | | (70) |
| Losses | | l vaporatic | n (nega | i tive valu | es) (Tab | l le 5) | | | | | | | | |
| (71)m= | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | | (71) |
| Water | L heating | L nains (1 | I Table 5) | | | | I | | | I | I | | | |
| (72)m= | 74.23 | 72.12 | 67.75 | 61.81 | 57.96 | 52.53 | 47.92 | 53.83 | 55.93 | 62.08 | 69.02 | 72.14 | l | (72) |
| Total i | ntornal | asine - | | | | (66) | m + (67)m | 1 + (68)m + | - (69)m + (| (70)m + (7 | 1)m + (72) |)m | | |
| (73)m= | 365.99 | 363.96 | 350.94 | 329.93 | 308 63 | 288.06 | 274 66 | 280.49 | 291 25 | 312 46 | 336.84 | 355 11 | l | (73) |
| 6. So | lar gains | S: | | 1 | 1 | | 1 | 1 | | 1 | | 1 | | |
| Solar g | ains are o | alculated | using sola | r flux from | Table 6a | and assoc | iated equa | ations to co | nvert to th | e applicat | le orientat | tion. | | |
| Orienta | ation: / | Access F | actor | Area | | Flu | x | | g_ | | FF | | Gains | |

| Onentation. | Table 6d | | m² | | Table 6a | | 9_ Table 6b | | Table 6c | | (W) | |
|----------------|----------|---|------|---|----------|---|----------------|---|----------|---|-------|------|
| Southeast 0.9x | 0.77 | x | 4.41 | x | 36.79 | x | 0.63 | x | 0.7 | = | 49.59 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 62.67 | × | 0.63 | x | 0.7 | = | 84.47 | (77) |

| | | 1 | | 1 | | 1 | | | | 1 | | - |
|--|------|---|------|---|--------|-----|------|---|-----|------------|--------|-----------|
| Southeast 0.9x | 0.77 | x | 4.41 | x | 85.75 | x | 0.63 | X | 0.7 | = | 115.57 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 106.25 | x | 0.63 | x | 0.7 | = | 143.2 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 119.01 | x | 0.63 | x | 0.7 | = | 160.4 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 118.15 | x | 0.63 | x | 0.7 | = | 159.24 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 113.91 | x | 0.63 | x | 0.7 | = | 153.52 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 104.39 | x | 0.63 | x | 0.7 |] = | 140.69 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 92.85 | x | 0.63 | x | 0.7 |] = | 125.14 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 69.27 | x | 0.63 | x | 0.7 |] = | 93.36 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 44.07 | x | 0.63 | x | 0.7 | = | 59.4 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 31.49 | x | 0.63 | x | 0.7 | = | 42.44 | (77) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 36.79 |] | 0.63 | x | 0.7 | = | 28.34 | (79) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 62.67 |] | 0.63 | x | 0.7 | = | 48.27 | (79) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 85.75 |] | 0.63 | x | 0.7 |] = | 66.04 | (79) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 106.25 |] | 0.63 | x | 0.7 |] = | 81.83 | (79) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 119.01 | 1 | 0.63 | x | 0.7 | = | 91.66 | (79) |
| Southwest _{0.9x} | 0.77 | × | 2.52 | x | 118.15 |] | 0.63 | x | 0.7 | = | 90.99 | (79) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 113.91 | İ | 0.63 | x | 0.7 | j = | 87.73 | (79) |
| Sout <mark>hwest_{0.9x}</mark> | 0.77 | x | 2.52 | X | 104.39 | | 0.63 | х | 0.7 | = | 80.4 | (79) |
| Sout <mark>hwest_{0.9x}</mark> | 0.77 | × | 2.52 | x | 92.85 | İ. | 0.63 | x | 0.7 | = | 71.51 | (79) |
| Sout <mark>hwest_{0.9x}</mark> | 0.77 | x | 2.52 | x | 69.27 | i / | 0.63 | x | 0.7 | j = | 53.35 | (79) |
| Sout <mark>hwest_{0.9x}</mark> | 0.77 | x | 2.52 | x | 44.07 | i/ | 0.63 | x | 0.7 | i = | 33.94 | (79) |
| Sout <mark>hwest_{0.9x}</mark> | 0.77 | x | 2.52 | x | 31.49 | ĺ | 0.63 | x | 0.7 | i = | 24.25 | _ (79) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 11.28 | × | 0.85 | x | 0.7 | i = | 20.52 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 11.28 | × | 0.85 | x | 0.7 | i = | 20.52 | (81) |
| Northwest 0.9x | 0.77 | × | 4.41 | x | 22.97 | × | 0.85 | x | 0.7 | j = | 41.76 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 22.97 | x | 0.85 | x | 0.7 | j = | 41.76 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 41.38 | × | 0.85 | x | 0.7 | = | 75.24 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 41.38 | × | 0.85 | x | 0.7 | i = | 75.24 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 67.96 | x | 0.85 | x | 0.7 | i = | 123.57 | - (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 67.96 | × | 0.85 | x | 0.7 | i = | 123.57 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 91.35 | × | 0.85 | x | 0.7 | i = | 166.1 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 91.35 | × | 0.85 | x | 0.7 | i = | 166.1 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 97.38 | × | 0.85 | x | 0.7 | i = | 177.08 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 97.38 | x | 0.85 | x | 0.7 | i = | 177.08 | - (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 91.1 | x | 0.85 | x | 0.7 | i = | 165.66 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 91.1 | x | 0.85 | x | 0.7 | i = | 165.66 |] (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 72.63 | x | 0.85 | x | 0.7 | i = | 132.06 | - (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 72.63 | x | 0.85 | x | 0.7 | i = | 132.06 | _ (81) |
| Northwest 0.9x | 0.77 | × | 4.41 | x | 50.42 | × | 0.85 | x | 0.7 | i = | 91.68 | - (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 50.42 | × | 0.85 | x | 0.7 | i = | 91.68 | - (81) |
| Northwest 0.9x | 0.77 | × | 4.41 | x | 28.07 | × | 0.85 | x | 0.7 | i = | 51.04 |] (81) |
| 1 | | | | | | | | | | | | |

| Northw | est <mark>0.9x</mark> | 0.77 | x | 4. | 41 | x | 2 | 28.07 | x | 0.85 | × | 0.7 | = | 51.04 | (81) |
|--------------------|-----------------------|------------|-----------|--------------------|---------------|-------|---------|----------------|--------------|------------|----------------------|-------------|--------------------------------|--------|------|
| Northw | est 0.9x | 0.77 | x | 4. | 41 | x | | 14.2 | x | 0.85 | | 0.7 | = | 25.82 | (81) |
| Northw | est 0.9x | 0.77 | × | 4. | 41 | x | | 14.2 | x | 0.85 | | 0.7 | = | 25.82 | (81) |
| Northw | est 0.9x | 0.77 | × | 4. | 41 | x | 9 | 9.21 | x | 0.85 | _ × [| 0.7 | = | 16.76 | (81) |
| Northw | est 0.9x | 0.77 | x | 4. | 41 | x | 9 | 9.21 | x | 0.85 | | 0.7 | = | 16.76 | (81) |
| | - | | | | | | | | | | | | | | |
| Solar g | gains in | watts, ca | alculate | d for eac | h month | ۱ | | _ | (83)m = S | um(74)m . | (82)m | - | - | _ | |
| (83)m= | 118.96 | 216.26 | 332.1 | 472.17 | 584.26 | 6 | 604.4 | 572.56 | 485.22 | 380.02 | 248.78 | 144.97 | 100.2 | | (83) |
| Total g | gains – i | nternal a | and sola | r (84)m : | = (73)m | + (| 83)m | , watts | | | | | | | |
| (84)m= | 484.95 | 580.22 | 683.04 | 802.1 | 892.89 | 8 | 92.45 | 847.22 | 765.71 | 671.27 | 561.24 | 481.81 | 455.31 | | (84) |
| 7. Me | an inter | nal temp | perature | (heating | g seasor | ר) | | | | | | | | | |
| Temp | perature | during h | neating | periods i | n the livi | ing | area f | from Tab | ole 9, Th | 1 (°C) | | | | 21 | (85) |
| Utilisa | ation fac | ctor for g | ains for | living ar | ea, h1,m | า (s | ее Та | ble 9a) | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Γ | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (86)m= | 1 | 0.99 | 0.98 | 0.91 | 0.75 | | 0.55 | 0.4 | 0.46 | 0.74 | 0.96 | 0.99 | 1 | 1 | (86) |
| Mean | interna | l temper | ature in | living ar | ea T1 (f | | w ste | ns 3 to 7 | r in Tabl | e 9c) | | • | | | |
| (87)m= | 19.94 | 20.12 | 20.4 | 20.72 | 20.92 | 2 | 20.99 | 21 | 21 | 20.95 | 20.65 | 20.23 | 19.9 |] | (87) |
| Tamar | oroturo | | | l oriodo i | n root of | | alling | l from To | | L | | Į | | 1 | |
| (88)m- | | 20.05 | 20.05 | | 20.06 | | | 20.06 | | | 20.06 | 20.06 | 20.05 | | (88) |
| (00)11- | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | | 0.00 | 20.00 | 20.07 | 20.00 | 20.00 | 20.00 | 20.00 | | () |
| Utilisa | ation fac | ctor for g | ains for | rest of c | welling, | h2, | m (se | e Table | 9a) | | | | | 1 | (00) |
| (89)m= | | 0.99 | 0.97 | 0.88 | 0.69 | | 0.47 | 0.32 | 0.37 | 0.66 | 0.94 | 0.99 | 1 | J | (69) |
| Me <mark>ar</mark> | interna | l temper | ature in | the rest | of dwell | ling | T2 (f | ollow ste | eps 3 to | 7 in Tabl | le 9 <mark>c)</mark> | | i | , | |
| (90)m= | 18.64 | 18.9 | 19.29 | 19.75 | 19.99 | 2 | 20.06 | 20.06 | 20.06 | 20.02 | 19.66 | 19.06 | 18.59 | | (90) |
| | | | | | | | | | | I | fLA = Livir | ng area ÷ (| 4) = | 0.33 | (91) |
| Mean | n interna | l temper | ature (fo | or the wh | nole dwe | ellin | g) = fl | LA × T1 | + (1 – fL | .A) × T2 | | | | | |
| (92)m= | 19.07 | 19.3 | 19.66 | 20.07 | 20.3 | 2 | 20.36 | 20.37 | 20.37 | 20.33 | 19.99 | 19.44 | 19.02 | | (92) |
| Apply | v adjustr | nent to t | he mea | n interna | l tempe | ratu | ire fro | m Table | 4e, whe | ere appro | opriate | | | | |
| (93)m= | 19.07 | 19.3 | 19.66 | 20.07 | 20.3 | 2 | 20.36 | 20.37 | 20.37 | 20.33 | 19.99 | 19.44 | 19.02 | | (93) |
| 8. Sp | ace hea | ting requ | uiremen | t | | | | | | | | | | | |
| Set T | i to the | mean int | ernal te | mperatu | re obtai | ned | at ste | ep 11 of | Table 9 | b, so tha | ıt Ti,m=(| 76)m an | d re-cal | culate | |
| the u | | | Mor | | | Г | lun | lul | Δυσ | Son | Oct | Nov | Dec | 1 | |
| l Itilis: | ation fac | tor for a | ains hn | n. 1 <u>vhi</u> | Iviay | | Jun | Jui | Aug | Sep | | | Dec | J | |
| (94)m= | 1 | 0.99 | 0.96 | 0.88 | 0.71 | Г | 0.5 | 0.35 | 0.4 | 0.69 | 0.94 | 0.99 | 1 |] | (94) |
| Usefu | ul gains. | hmGm | W = (9 | 4)m x (8 | 4)m | | | | | | | | | J | |
| (95)m= | 482.6 | 572.95 | 657.71 | 706.34 | 631.7 | 4 | 43.46 | 292.88 | 307.37 | 460.15 | 524.85 | 476.52 | 453.7 |] | (95) |
| Mont | L hly aver | age exte | rnal ten | nperatur | I e from T | abl | e 8 | | | | | Į | | 1 | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | Γ | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 |] | (96) |
| Heat | loss rate | e for mea | an interi | nal temp | erature, | Lm | ı, W = | - =[(39)m : | r [(93)m | – (96)m |] | I | | 1 | |
| (97)m= | 1170.96 | 1140.02 | 1039.9 | 875.93 | 673.52 | 4 | 48.49 | 293.43 | 308.58 | 485.84 | 735.25 | 969.64 | 1167.74 | | (97) |
| Spac | e heatin | g require | ement fo | or each r | nonth, k | Wh | /mont | th = 0.02 | 24 x [(97 |)m – (95 | j)m] x (4 | 1)m | | | |
| (98)m= | 512.14 | 381.07 | 284.35 | 122.1 | 31.11 | | 0 | 0 | 0 | 0 | 156.54 | 355.04 | 531.25 | | |
| | | | | | | | | | Tota | l per year | (kWh/yea | r) = Sum(9 | (8) _{15,912} = | 2373.6 | (98) |
| Spac | e heatin | g require | ement ir | n kWh/m | ²/year | | | | | | | | | 31.19 | (99) |

| 9a. En | ergy re | quiremer | nts – Ind | ividual h | eating s | ystems i | ncluding | j micro-C | HP) | | | | | |
|---|--|-----------------------|--|--------------|-----------|-----------|-------------------------|---|------------|------------------------|-------------------------|--------|-------------------------|---|
| Space | e heati | ng: | at frame - | | 10 | manter | | | | | | | - | |
| Fracti | | pace nea | at from s | econdar | y/supple | mentary | system | (202) = 1 | - (201) - | | | | 0 | (201) |
| Fracti | | pace nea | at from m | nain syst | em(s) | | | (202) = 1 - (204) = | -(201) = | (202)] _ | | | 1 | |
| Fracti | | | ng from | main sys | | | | (204) = (2 | JZ) X [1 - | (203)] = | | | 1 | (204) |
| Efficie | ency of | main spa | ace neat | ing syste | em 1 | | . 0/ | | | | | | 92.7 | (206) |
| ETTICIE | ency of | seconda | iry/suppi | ementar | y neating | g system | n, % | | - | | | _ | 0 | (208) |
| Cross | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/ye | ar |
| Space | 512.14 | 381.07 | 284.35 | 122.1 | 31.11 | 0 | 0 | 0 | 0 | 156.54 | 355.04 | 531.25 | | |
| (211)m | | $\frac{1}{2}$ m x (20 | $\frac{1}{1} = \frac{1}{1} + \frac{1}$ | 1 ··· |)6) | Ů | | Ů | Ū | | | 001120 | | (211) |
| (211)11 | 552.47 | 411.08 | 306.74 | 131.71 | 33.56 | 0 | 0 | 0 | 0 | 168.86 | 383 | 573.08 | | (211) |
| | | | <u> </u> | | | | I | Tota | l (kWh/yea | ar) =Sum(2 | 211) _{15,1012} | F | 2560.51 | (211) |
| Space | e heatir | ng fuel (s | econdar | y), kWh/ | month | | | | | | | | | |
| = {[(98 |)m x (2 | 01)] } x 1 | 00 ÷ (20 |)8) | | | | | | | | | L | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | _ |
| Total (kWh/year) =Sum(215) _{15,1012} = | | | | | | | | | | | | | 0 | (215) |
| Water | heating | g | tor (oolo | ulated a | hours | | | | | | | | | |
| Output | 172.01 | 151.1 | 157.5 | 139.54 | 135.56 | 119.42 | 113.07 | 126.31 | 126.8 | 144.79 | 155.17 | 167.33 | | |
| Efficier | Efficiency of water heater | | | | | | | | | | | | | (216) |
| (217)m= | <mark>8</mark> 9.01 | 88.92 | 88.72 | 88.24 | 87.49 | 87 | 87 | 87 | 87 | 88.38 | 88.86 | 89.04 | | (217) |
| Fuel fo | r water | heating, | , <mark>kW</mark> h/m | onth | | | | | | | | | | |
| (219)m | 1 = (64) |)m x 100 |) ÷ (217) 177 53 |)m 158 14 | 154 94 | 137.26 | 129.97 | 145 19 | 145 74 | 163.83 | 174 62 | 187 93 | | |
| (210)11- | 100.20 | 100.04 | 117.00 | | 104.04 | 107.20 | 120.01 | Tota | I = Sum(2 | 19a) _{1.12} = | 174.02 | 107.00 | 1938.34 | (219) |
| Annua | l totals | 5 | | | | | | | | k | Wh/year | | kWh/year | , (_,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, |
| Space | heating | g fuel use | ed, main | system | 1 | | | | | | | | 2560.51 | 7 |
| Water | heating | fuel use | ed | | | | | | | | | | 1938.34 | 7 |
| Electric | city for | pumps, f | ans and | electric | keep-ho | t | | | | | | | | |
| centra | al heatii | na pump | : | | | | | | | | | 30 | | (230c) |
| boiler | with a | fan-assis | sted flue | | | | | | | | | 45 | | (230e) |
| Totol o | lootrioit | v for the | | | - | | | sum | of (230a) | (230a) – | | 40 | 75 | (2000) T(224) |
| | lectricit | y ior the | above, I | kvvn/yea | ſ | | | Sum | 01 (2008). | (2009) – | | | /5 | |
| Electric | city for | lighting | | | | | | | | | | | 333.64 | (232) |
| 12a. (| CO2 en | nissions · | – Individ | ual heat | ing syste | ems inclu | uding mi | cro-CHP | | | | | | |
| | | | | | | En kW | lergy /h/year | | | Emiss kg CO2 | ion fac 2/kWh | tor | Emissions kg CO2/yea | ar |
| Space | heating | g (main s | system 1 |) | | (21 | 1) x | | | 0.2 | 16 | = | 553.07 | (261) |
| Space | Space heating (secondary) (215) \times 0.519 = | | | | | | | | | | | 0 | (263) | |
| Water | heating | l | | | | (219 | 9) x | | | 0.2 | 16 | = | 418.68 | (264) |
| Space | and wa | ater heati | ing | | | (26 | 1) + (262) | + (263) + (| 264) = | |] | | 971.75 | (265) |

| Electricity for pumps, fans and electric keep-hot | (231) | x | | 0.519 | = | 38.93 | (267) |
|---|-------|---|-------------|-----------|---|---------|-------|
| Electricity for lighting | (232) | x | | 0.519 | = | 173.16 | (268) |
| Total CO2, kg/year | | | sum of (26 | 5)(271) = | | 1183.83 | (272) |
| Dwelling CO2 Emission Rate | | | (272) ÷ (4) | = | | 15.56 | (273) |
| EI rating (section 14) | | | | | | 87 | (274) |
| | | | | | | | |



| | | Use | er Details: | | | | | | |
|----------------------------------|---------------------------------------|-------------------|-----------------------|-------------------------|---------------|----------|-------------|---------------------------|--|
| Assessor Name: Software Name: | Stroma FSAP 201 | 2 | Stroma Softwa | a Num ire Ver | ber: sion: | | Versio | n: 1.0.3.11 | |
| | | Prope | erty Address: | Arlingto | on 3 Bed | GND 7 | 6 | | |
| Address : | | | | | | | | | |
| 1. Overall dwelling dime | nsions: | | | | | | | | |
| Ground floor | | | Area(m ²) | (10) × | Av. He | ight(m) |](20) - [| Volume(m ³ | |
| Total floor area $TEA = (1)$ | a) : (1b) : (1a) : (1d) : (1a |), (1p) [| 76.1 | (1a) X | 2 | 2.3 | (2d) = | 175.03 | _(3a) |
| Total noor area $TFA = (13)$ | a)+(1b)+(1c)+(1d)+(1e |)+(11) | 76.1 | (4) (20) (2b) | (2c) (2d | | (2n) = | | |
| | | | | (3a) + (3b) |)+(30)+(30 | I)+(3e)+ | .(31) = | 175.03 | (5) |
| 2. Ventilation rate: | main | | othou | | total | | | m ³ nor hou | |
| | heating h | eating | other | | total | | | m [°] per nou | |
| Number of chimneys | 0 + | 0 + | 0 |] = [| 0 | X 4 | 40 = | 0 | (6a) |
| Number of open flues | 0 + | 0 + | 0 |] = [| 0 | × | 20 = | 0 | (6b) |
| Number of intermittent fa | ns | | | | 3 | x ′ | 10 = | 30 | (7a) |
| Number of passive vents | | | | Γ | 0 | x ′ | 10 = | 0 | (7b) |
| Number of flueless gas fi | res | | | Γ | 0 | X 4 | 40 = | 0 | (7c) |
| | | | | | | | Air ch | anges <mark>per</mark> ho | ur |
| Infiltration due to chimne | ys, flues and fans = (6 | a)+(6b)+(7a)+(7 | ′b)+(7c) = | | 30 | | ÷ (5) = | 0.17 | (8) |
| If a pressurisation test has b | een carried out or is intende | ed, proceed to (| 17), otherwise o | ontinue fro | om (9) to (| (16) | | | _ |
| Number of storeys in the | ie dwelling (ns) | | | | | [(0) | 11-0.1 - | 0 | (9) |
| Structural infiltration: 0 | 25 for steel or timber f | rame or 0.34 | 5 for masonr | v constr | uction | [(9) | - 1]XU. 1 = | 0 | $ = \begin{bmatrix} (10) \\ - (11) \end{bmatrix} $ |
| if both types of wall are pl | resent, use the value corresp | ponding to the g | greater wall area | a (after | dottori | | l | 0 | |
| deducting areas of openir | ngs); if equal user 0.35 | | | | | | | | _ |
| If suspended wooden f | loor, enter 0.2 (unseal | ed) or 0.1 (s | ealed), else | enter 0 | | | | 0 | (12) |
| If no draught lobby, en | ter 0.05, else enter 0 | ulue e el | | | | | | 0 | |
| Window infiltration | s and doors draught st | npped | 0 25 - [0 2 | $\mathbf{x}(14) \div 1$ | 001 - | | ļ | 0 | |
| | | | (8) + (10) - | + (11) + (1 | 2) + (13) - | + (15) = | | 0 | $ \frac{(15)}{(16)} $ |
| Air permeability value | a50 expressed in cub | ic metres ne | r hour per so | nuare m | etre of e | nvelone | area | 0 | $-1^{(10)}_{(17)}$ |
| If based on air permeabil | ity value, then $(18) = [(1)]$ | 7) ÷ 20]+(8), oth | nerwise $(18) = ($ | 16) | | invelope | uicu | 0.42 | $= \frac{(17)}{(18)}$ |
| Air permeability value applie | s if a pressurisation test has | been done or a | a degree air pei | meability | is being u | sed | l | 0.12 | |
| Number of sides sheltere | d | | | | | | [| 2 | (19) |
| Shelter factor | | | (20) = 1 - [| 0.075 x (1 | 9)] = | | | 0.85 | (20) |
| Infiltration rate incorporat | ing shelter factor | | (21) = (18) | x (20) = | | | | 0.36 | (21) |
| Infiltration rate modified f | or monthly wind speed | | | | | | | | |
| Jan Feb | Mar Apr May | Jun Ju | ul Aug | Sep | Oct | Nov | Dec | | |
| Monthly average wind sp | eed from Table 7 | | | | | | . <u> </u> | | |
| (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 0.9 | 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 | peed) = | (21a) x | (22a)m | | | | | |
|----------------------|-------------------------|-------------------------|---------------------------|--------------------------|-------------|-------------|-------------|---------------|----------------------|--------------------|-------------|----------------|----------|--------|
| | 0.46 | 0.45 | 0.44 | 0.39 | 0.39 | 0.34 | 0.34 | 0.33 | 0.36 | 0.39 | 0.4 | 0.42 | | |
| Calcula | ate effe chanic | ctive air | change | rate for t | he appli | cable ca | se | | | | | 1 | 0 | (232) |
| lf exh | aust air h | eat pump | using App | endix N, (2 | 3b) = (23a | ı) × Fmv (e | equation (N | N5)) , othe | rwise (23b |) = (23a) | | l I | 0 | (23b) |
| lf bala | anced with | n heat reco | overy: effic | iency in % | allowing f | or in-use f | actor (from | n Table 4h |) = | , (, | | l I | 0 | (23c) |
| a) If | balance | d mech | anical ve | entilation | with he | at recove | erv (MVF | HR) (24a | a)m = (2) | 2h)m + (| 23b) x [′ | ا (23c) – 1 | - 1001 | (200) |
| (24a)m= | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |] | (24a) |
| b) If | balance | d mech | ı anical ve | entilation | without | heat rec | overv (N | і ЛV) (24b |)m = (22 | 1 2b)m + (2 | 23b) | | | |
| , (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (24b) |
| c) If | whole h | ouse ex | tract ver | ntilation c | or positiv | ve input v | /entilatic | n from c | outside | | | | | |
| í | f (22b)n | n < 0.5 > | (23b), t | then (24o | c) = (23b |); otherv | vise (24 | c) = (22b | o) m + 0. | .5 × (23b |) | | | |
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (24c) |
| d) If | natural | ventilati | on or wh | ole hous | e positiv | e input | ventilatio | on from I | oft | | | | | |
| (C. (.)) | f (22b)n | n = 1, th | en (24d) | m = (22k) |)m othe | erwise (2 | 4d)m = (| 0.5 + [(2 | 2b)m² x | 0.5] | 0.50 | | | (244) |
| (24d)m= | 0.6 | 0.6 | 0.6 | 0.58 | 0.57 | 0.56 | 0.56 | 0.55 | 0.56 | 0.57 | 0.58 | 0.59 | | (240) |
| Effec | ctive air | | rate - er | nter (24a |) or (24t | o f (24) | c) or (24 | | (25) | 0.57 | 0.59 | 0.50 | | (25) |
| (25)11= | 0.6 | 0.6 | 0.0 | 0.58 | 0.57 | 0.56 | 0.56 | -0.55 | 0.56 | 0.57 | 0.58 | 0.59 | | (23) |
| 3. He | at losse | s and he | eat loss | paramete | er: | | | | | | | | | |
| ELEN | | Gros | (m^2) | Openin | gs 2 | Net Ar | ea | U-valu | ue K | A X U | K) | k-value | | A X k |
| Doors | | area | (111) | | | 1.80 | | 1 | | 1.80 | | K0/111 -1 | ` | (26) |
| Window | | • 1 | | | | 1.03 | | /[1/(1.4)+ | 0.041 - | 5.95 | H | | | (27) |
| Window | | 2 | | | | 4.41 | | /[1/(1 4)+ | 0.041 - | 5.05 | H | | | (27) |
| Window | | 3 | | | | 4.41 | | /[1/(1 4)+ | 0.041 = | 5.05 | H | | | (27) |
| Window | NS TYPE | , О л Л | | | | 4.41 | | /[1/(1.4)+ | 0.041 = | 0.00 | | | | (27) |
| Floor | ws type | 7 - | | | | 2.52 | X'' | | 0.04] = | 3.34 | | | | (27) |
| | | | | | .] | /6.1 | | 0.13 | | 9.893 | ╡┟ | | | (28) |
| VVallS | roo of a | 56.3 | 36 | 17.64 | 1 | 38.72 | <u> </u> | 0.18 | = [| 6.97 | | | | (29) |
| Dominu | | ements | , 111- | | | 132.4 | 6 | | | | — | | | (31) |
| Party v | | | | | | 38.24 | X | 0 | = | 0 | [| | | (32) |
| Party c | elling | Iroofwind | | footivowi | ndow II. w | 76.1 | | formula 1 | 11/1/11/10/ | (0) (0) (1) | | noroaronh | | (32b) |
| ** includ | e the area | as on both | sides of i | nternal wall | s and part | titions | aleo using | ionnula I | /[(1/ 0- vait | <i>le)+0.04]</i> a | is given in | paragraph | 3.2 | |
| Fabric | heat los | s, W/K | = S (A x | U) | | | | (26)(30) |) + (32) = | | | [| 39.63 | (33) |
| Heat c | apacity | Cm = S | (Axk) | | | | | | ((28). | (30) + (32 | 2) + (32a). | (32e) = | 15713.95 | 5 (34) |
| Therma | al mass | parame | eter (TMI | ⁻ = Cm ÷ | - TFA) ir | n kJ/m²K | | | Indica | tive Value | : Medium | Ī | 250 | (35) |
| For desi can be u | gn assess ised inste | sments wh ad of a de | ere the de tailed calc | tails of the ulation. | constructi | ion are not | t known pr | ecisely 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 | < | | | | | [| 7.53 | (36) |
| if details | of therma | al bridging | are not kr | own (36) = | = 0.15 x (3 | 1) | | | | | | | | |
| Fotal fa | abric he | at loss | | | | | | | (33) + | (36) = | | | 47.16 | (37) |
| Ventila | tion hea | at loss ca | alculated | monthly | / | | | | (38)m | = 0.33 × (| 25)m x (5) | | | |
| | Jan | ⊦eb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |

| (38)m= | 34.9 | 34.67 | 34.44 | 33.36 | 33.16 | 32.22 | 32.22 | 32.05 | 32.59 | 33.16 | 33.57 | 34 | | (38) |
|-----------------|-----------------------|--------------------------|------------------------|--------------------------|-----------------------------|-----------------------|-------------------|--------------|--------------|---------------------------|------------------------|---------|------------|------|
| Heat tr | ansfer o | coefficie | nt, W/K | | | | | | (39)m | = (37) + (3 | 38)m | | | |
| (39)m= | 82.07 | 81.83 | 81.6 | 80.53 | 80.33 | 79.39 | 79.39 | 79.21 | 79.75 | 80.33 | 80.73 | 81.16 | | |
| Heatla | es nara | motor (l | | /m2k | | | | | (40)m | Average = | Sum(39) _{1.} | 12 /12= | 80.53 | (39) |
| (40)m= | 1.08 | 1.08 | 1.07 | 1.06 | 1.06 | 1.04 | 1.04 | 1.04 | 1.05 | 1.06 | 1.06 | 1.07 | | |
| | | | | | | | | | | Average = | Sum(40)1. | 12 /12= | 1.06 | (40) |
| Numbe | er of day | /s in mo | nth (Tab | le 1a) | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | | (41) |
| | | | | | | | | | | | | | | |
| 4. Wa | ter heat | ting ene | rgy requ | irement: | | | | | | | | kWh/ye | ar: | |
| Assum | ed occu | upancy, | N | _ | | | | | | | 2. | 38 | | (42) |
| if TF. | A > 13.9 A £ 13.9 | 9, N = 1 9. N = 1 | + 1.76 x | [1 - exp | (-0.0003 | 649 x (TF | -A -13.9 |)2)] + 0.(| 0013 x (| FFA -13. | .9) | | | |
| Annual | averag | je hot wa | ater usag | ge in litre | es per da | y Vd,av | erage = | (25 x N) | + 36 | | 90 | .84 | | (43) |
| Reduce | the annua that 125 | al average litres per | hot water person pe | usage by r dav (all w | 5% if the a rater use. I | welling is not and co | designed (Id) | to achieve | a water us | se target o | f | | | |
| | lon | Ech | Mor | Apr | Mov | lup | lul | Aug | Son | Oct | Nov | | | |
| Hot wate | er usage i | n litres per | r day for ea | ach month | Vd,m = fa | ctor from T | Table 1c x | (43) | Sep | Oci | INUV | Dec | | |
| (44)m= | 9 <mark>9.92</mark> | 96.29 | 92.65 | 89.02 | 85.39 | 81.75 | 81.75 | 85.39 | 89.02 | 92.65 | 96.29 | 99.92 | | |
| | | | | | | | | | | Total = Su | m(44) ₁₁₂ = | = | 1090.04 | (44) |
| Energy o | content of | hot water | used - ca | culated mo | onthly $= 4$. | 190 x Vd,n | n x nm x D |)Tm / 3600 | kWh/mor | nth (see Ta | bles 1b, 1 | c, 1d) | | |
| (45)m= | 148.18 | 129.6 | 133.73 | 116.59 | 111.87 | 96.54 | 89.46 | 102.65 | 103.88 | 121.06 | 132.15 | 143.5 | | _ |
| lf instant | aneous w | vater heati | na at poin | of use (no | o hot water | storage). | enter 0 in | boxes (46 |) to (61) | Tota <mark>l = S</mark> u | m(45) ₁₁₂ = | = [| 1429.21 | (45) |
| (46)m- | 22.23 | 19.44 | 20.06 | 17.49 | 16 78 | 14.48 | 13.42 | 15.4 | 15 58 | 18 16 | 19.82 | 21 53 | | (46) |
| Water | storage | loss: | 20.00 | 17.45 | 10.70 | 14.40 | 10.42 | 10.4 | 10.00 | 10.10 | 10.02 | 21.00 | | (10) |
| Storag | e volum | e (litres) |) includir | ng any so | olar or W | /WHRS | storage | within sa | ame ves | sel | | 0 | | (47) |
| If comr | nunity h | neating a | and no ta | nk in dw | velling, e | nter 110 | litres in | (47) | | | (—) | | | |
| Otherw Water | vise it no | o stored | hot wate | er (this in | icludes i | nstantar | ieous co | mbi boil | ers) ente | er '0' in (| 47) | | | |
| a) If m | anufact | urer's d | eclared I | oss facto | or is kno | wn (kWł | n/day): | | | | | 0 | | (48) |
| Tempe | rature f | actor fro | m Table | 2b | | , | • / | | | | | 0 | | (49) |
| Energy | lost fro | m water | ⁻ storage | , kWh/ye | ear | | | (48) x (49) | = | | | 0 | | (50) |
| b) If m | anufact | urer's d | eclared (| cylinder l | oss fact | or is not | known: | | | | | | | |
| Hot wa | ter stora nunitv h | age loss leating s | ee secti | om Tabi on 4.3 | е 2 (кии | n/litre/da | iy) | | | | | 0 | | (51) |
| Volume | e factor | from Ta | ble 2a | | | | | | | | | 0 | | (52) |
| Tempe | rature f | actor fro | m Table | 2b | | | | | | | | 0 | | (53) |
| Energy | lost fro | om water | ⁻ storage | e, 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 ⁻ | tor each | month | | | ((56)m = (| 55) × (41) | m | 1 | | | |
| (56)m= | | | 0 | 0 | 0 = (50) = 0 | 0 | | 0 | 0 | | | | <i>и</i> П | (56) |
| | | | u sular sto | aye, (57) I | וו = (סס)וז ו | ⊼ [(00) – (| (5) [| u), eise (5. | (0C) = III (| ni wnere (| i i i i) is tro I | | | |
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (57) |

| Primar | Primary circuit loss (annual) from Table 3 | | | | | | | | | | | 0 | | (58) |
|---------------------|--|------------|------------|-------------|-----------|-----------|-------------|--------------|--------------|---------------------------|--------------|-------------|--|------|
| Primar | y circuit | loss cal | culated | for each | month (| 59)m = (| (58) ÷ 36 | 65 × (41) | m | | | | | |
| (moo | dified by | factor fi | rom Tab | le H5 if t | here is s | solar wat | ter heatii | 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 | lculated | for each | month (| 61)m = | (60) ÷ 36 | 65 × (41) |)m | | | | | | |
| (61)m= | 50.92 | 44.32 | 47.22 | 43.9 | 43.51 | 40.32 | 41.66 | 43.51 | 43.9 | 47.22 | 47.48 | 50.92 | | (61) |
| Total h | eat requ | uired for | water he | eating ca | alculated | l for eac | h month | (62)m = | 0.85 × (| (45)m + | (46)m + | (57)m + | (59)m + (61)m | |
| (62)m= | 199.1 | 173.92 | 180.95 | 160.49 | 155.39 | 136.85 | 131.12 | 146.16 | 147.78 | 168.28 | 179.63 | 194.42 | | (62) |
| Solar DH | - IW input o | calculated | using App | endix G or | 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 \ | VWHRS | 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= | 199.1 | 173.92 | 180.95 | 160.49 | 155.39 | 136.85 | 131.12 | 146.16 | 147.78 | 168.28 | 179.63 | 194.42 | | |
| | | | | | | | | Outp | out from wa | ater heate | r (annual)₁ | 12 | 1974.08 | (64) |
| Heat g | ains fro | m water | heating, | kWh/m | onth 0.2 | 5 ´ [0.85 | × (45)m | + (61)m | n] + 0.8 x | (46)m | + (57)m | + (59)m |] | |
| (65)m= | 62 | 54.17 | 56.27 | 49.74 | 48.08 | 42.18 | 40.16 | 45.01 | 45.51 | 52.06 | 55.81 | 60.44 | | (65) |
| in <mark>clu</mark> | ide (57)i | m in calo | culation | of (65)m | only if c | vlinder i | s in the o | dwelling | or hot w | ate <mark>r is f</mark> r | om com | munity h | eating | |
| 5 Int | ernal da | ains (see | Table f | and 5a | | , | | 9 | | | | 5 | 5 | - |
| Motob | | o (Toblo | 5) Mot | to | | | | | | | | | | |
| Metabo | Jiic gain | Feb | Mar | Apr | May | Jun | lul | Αυσ | Sen | Oct | Nov | Dec | | |
| (66)m= | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | | (66) |
| Lightin | a daine | (calcula | ted in Ar | pendix | | | r (9a) -a | | Table 5 | | | | I and the second second second second second second second second second second second second second second se | |
| (67)m= | 18.89 | 16 78 | 13.65 | 10.33 | 2, Equal | 6.52 | 7 04 | 9 16 | 12 29 | 15.61 | 18 21 | 19.42 | 1 | (67) |
| | | | | | | untion L | 12 or 1 | 20) 000 | | | 10.21 | 10.12 | I and the second second second second second second second second second second second second second second se | () |
| | 211 1 | 213 20 | | | 181 18 | 167.24 | 15 UI LI | 3a), aisc | 161 26 | 173.01 | 187.84 | 201 78 | 1 | (68) |
| | 211.1 | (2010:20 | | | | 107.24 | or 1 4 5 o | | | F | 107.04 | 201.70 |] | (00) |
| COOKIN | | | | | L, equai | | |), also se | | 5 | 24.00 | 24.00 | l | (60) |
| (69)m= | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | Į | (09) |
| Pumps | and fai | ns gains | (Table 5 | ba) | | | | | | | | | I | (70) |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | l | (70) |
| Losses | s e.g. ev | aporatio | n (nega | tive valu | es) (Tab | le 5) | | | | | 1 | 1 | ı. | |
| (71)m= | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | | (71) |
| Water | heating | gains (T | able 5) | | | - | | - | | | | | | |
| (72)m= | 83.33 | 80.61 | 75.63 | 69.09 | 64.62 | 58.58 | 53.98 | 60.5 | 63.21 | 69.97 | 77.51 | 81.24 | | (72) |
| Total i | nternal | gains = | | | | (66) | m + (67)m | n + (68)m + | + (69)m + (| (70)m + (7 | 1)m + (72) | m | | |
| (73)m= | 375.09 | 372.45 | 358.82 | 337.2 | 315.29 | 294.11 | 280.72 | 287.16 | 298.53 | 320.35 | 345.34 | 364.21 | | (73) |
| 6. Sol | lar gains | 8: | | | | | | | | | | | | |
| Solar g | ains are o | calculated | using sola | r flux from | Table 6a | and assoc | iated equa | tions to co | onvert to th | e applicat | ole orientat | ion. | | |

| Orientation: | Access Factor Table 6d | • | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|----------------|---------------------------|---|------------|---|------------------|---|----------------|---|----------------|---|--------------|------|
| Southeast 0.9x | 0.77 | x | 4.41 | x | 36.79 | × | 0.63 | × | 0.7 | = | 49.59 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 62.67 | × | 0.63 | × | 0.7 | = | 84.47 | (77) |

| Southeast 0.9x | 0.77 | x | 4.41 | x | 85.75 | x | 0.63 | x | 0.7 |] = | 115.57 | (77) |
|--|------|---|------|---|---------------------|---|------|---|-----|------------|--------|------------------|
| Southeast 0.9x | 0.77 | × | 4.41 | x | 106.25 | × | 0.63 | x | 0.7 | i = | 143.2 | – (77) |
| Southeast 0.9x | 0.77 | × | 4.41 | x | 119.01 | × | 0.63 | x | 0.7 | i = | 160.4 | _ (77) |
| Southeast 0.9x | 0.77 | × | 4.41 | x | 118.15 | × | 0.63 | x | 0.7 | i = | 159.24 | _](77) |
| Southeast 0.9x | 0.77 | × | 4.41 | x | 113.91 | × | 0.63 | x | 0.7 | i = | 153.52 | - (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 104.39 | x | 0.63 | x | 0.7 | = | 140.69 | _ (77) |
| Southeast 0.9x | 0.77 | × | 4.41 | x | 92.85 | × | 0.63 | x | 0.7 |] = | 125.14 | (77) |
| Southeast 0.9x | 0.77 | × | 4.41 | x | 69.27 | × | 0.63 | x | 0.7 |] = | 93.36 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 44.07 | x | 0.63 | x | 0.7 | = | 59.4 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 31.49 | × | 0.63 | x | 0.7 | = | 42.44 | (77) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 36.79 |] | 0.63 | x | 0.7 | = | 28.34 | (79) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 62.67 |] | 0.63 | x | 0.7 | = | 48.27 | (79) |
| Southwest _{0.9x} | 0.77 | × | 2.52 | x | 85.75 |] | 0.63 | x | 0.7 |] = | 66.04 | (79) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 106.25 |] | 0.63 | x | 0.7 | = | 81.83 | (79) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 119.01 |] | 0.63 | x | 0.7 | = | 91.66 | (79) |
| Southwest _{0.9x} | 0.77 | × | 2.52 | x | 118.15 |] | 0.63 | x | 0.7 |] = | 90.99 | (79) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 113.91 |] | 0.63 | x | 0.7 | = | 87.73 | (79) |
| Southwest0.9x | 0.77 | x | 2.52 | x | 104.39 | | 0.63 | х | 0.7 | = | 80.4 | (79) |
| Sout <mark>hwest_{0.9x}</mark> | 0.77 | x | 2.52 | x | 92.85 | | 0.63 | x | 0.7 |] = | 71.51 | (79) |
| Sout <mark>hwest</mark> 0.9x | 0.77 | x | 2.52 | x | 69.27 | | 0.63 | x | 0.7 | = | 53.35 | (79) |
| Sout <mark>hwest_{0.9x}</mark> | 0.77 | x | 2.52 | x | 44.07 | | 0.63 | x | 0.7 | = | 33.94 | (79) |
| Sout <mark>hwest</mark> 0.9x | 0.77 | x | 2.52 | x | 31.4 <mark>9</mark> |] | 0.63 | x | 0.7 | = | 24.25 | (79) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 11.28 | × | 0.63 | x | 0.7 | = | 15.21 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 11.28 | x | 0.63 | x | 0.7 | = | 15.21 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 22.97 | x | 0.63 | x | 0.7 |] = | 30.95 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 22.97 | x | 0.63 | x | 0.7 |] = | 30.95 | (81) |
| Northwest 0.9x | 0.77 | × | 4.41 | x | 41.38 | × | 0.63 | x | 0.7 |] = | 55.77 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 41.38 | x | 0.63 | x | 0.7 |] = | 55.77 | (81) |
| Northwest 0.9x | 0.77 | × | 4.41 | x | 67.96 | × | 0.63 | x | 0.7 | = | 91.59 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 67.96 | x | 0.63 | x | 0.7 | = | 91.59 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 91.35 | x | 0.63 | x | 0.7 | = | 123.11 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 91.35 | x | 0.63 | x | 0.7 | = | 123.11 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 97.38 | x | 0.63 | x | 0.7 |] = | 131.25 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 97.38 | x | 0.63 | x | 0.7 | = | 131.25 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 91.1 | x | 0.63 | x | 0.7 |] = | 122.78 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 91.1 | x | 0.63 | x | 0.7 |] = | 122.78 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 72.63 | x | 0.63 | x | 0.7 | = | 97.88 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 72.63 | × | 0.63 | x | 0.7 | = | 97.88 | (81) |
| Northwest 0.9x | 0.77 | × | 4.41 | x | 50.42 | × | 0.63 | x | 0.7 | = | 67.95 | (81) |
| Northwest 0.9x | 0.77 | × | 4.41 | x | 50.42 | × | 0.63 | x | 0.7 | = | 67.95 | (81) |
| Northwest 0.9x | 0.77 | × | 4.41 | x | 28.07 | × | 0.63 | x | 0.7 | = | 37.83 | (81) |
| | | | | | | | | | | | | - |

| Northw | est <mark>0.9x</mark> | 0.77 | | ×「 | 4.4 | 1 | x | 2 | 28.07 |) x [| 0.63 | x | 0.7 | = | 37.83 | (81) |
|--------------------|-----------------------|------------------------|------------------------|----------|--------------------------|---------------------|-------|---------|--------------|----------------|-------------|----------------------|------------|------------|---------|------|
| Northw | /est 0.9x | 0.77 | | ×Ī | 4.4 | 1 | x | | 14.2 | × [| 0.63 | | 0.7 | = | 19.13 | (81) |
| Northw | est 0.9x | 0.77 | | ×Γ | 4.4 | 1 | x | | 14.2 | x [| 0.63 | | 0.7 | = | 19.13 | (81) |
| Northw | est 0.9x | 0.77 | | ×Γ | 4.4 | 1 | x | | 9.21 | x [| 0.63 | | 0.7 | = | 12.42 | (81) |
| Northw | est 0.9x | 0.77 | | ×Γ | 4.4 | 1 | x | | 9.21 | i x 🗖 | 0.63 | | 0.7 | = | 12.42 | (81) |
| | L | | | L | | | | | | J <u>L</u> | | | | | | |
| Solar | gains in | watts, ca | alculate | ed f | or each | n month | ו | | | (83)m = S | um(74)m . | (82)m | | | | |
| (83)m= | 108.34 | 194.64 | 293.15 | | 408.21 | 498.28 | 5 | 12.73 | 486.81 | 416.85 | 332.56 | 222.36 | 131.6 | 91.53 | | (83) |
| Total g | gains – i | nternal a | and sola | ar (| 84)m = | (73)m | + (| 83)m | , watts | | | | | | | |
| (84)m= | 483.43 | 567.09 | 651.97 | · · | 745.41 | 813.57 | 8 | 06.84 | 767.53 | 704.01 | 631.09 | 542.71 | 476.94 | 455.74 | | (84) |
| 7. Me | ean inter | rnal temp | perature | e (h | neating | seasor | า) | | | | | | | | | |
| Temp | oerature | during h | eating | ре | riods in | the liv | ing | area | from Tal | ole 9, Th | 1 (°C) | | | | 21 | (85) |
| Utilis | ation fac | ctor for g | ains for | r liv | ving are | a, h1,n | n (s | ee Ta | ble 9a) | | | | | | | |
| | Jan | Feb | Mar | Τ | Apr | May | Ť | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (86)m= | 1 | 0.99 | 0.98 | ╈ | 0.93 | 0.81 | | 0.61 | 0.45 | 0.51 | 0.78 | 0.96 | 0.99 | 1 | | (86) |
| Moor | | l temper | aturo ir | \li\ | /ing are | a T1 / 1 | | w sto | ns 3 to 7 | I 7 in Tahl | ا م (9م) | ļ | Į | Į | 1 | |
| (87)m= | 19.89 | 20.06 | 20.32 | T | 20.65 | 20.88 | | 20.98 | 21 | 20.99 | 20.93 | 20.61 | 20.19 | 19.86 | | (87) |
| - | | | | - | | | | | / <u> </u> | | | | | | | . , |
| | | | leating | pe I | riods in | | r dw | | from 1a | able 9, 1 | h^2 (°C) | 20.04 | 20.02 | 20.02 | | (88) |
| (00)11= | 20.02 | 20.02 | 20.02 | _ | 20.04 | 20.04 | | 0.05 | 20.05 | 20.05 | 20.04 | 20.04 | 20.03 | 20.03 | | (00) |
| Utilis | ation fac | tor for g | ains for | r re | st of dv | velling, | h2, | m (se | e Table | 9a) | | _ | | | | |
| (89)m= | 1 | 0.99 | 0.97 | | 0.91 | 0.75 | | 0.53 | 0.36 | 0.41 | 0.7 | 0.95 | 0.99 | 1 | | (89) |
| Me <mark>ar</mark> | n interna | l temp <mark>er</mark> | <mark>atu</mark> re ir | h th | n <mark>e r</mark> est o | of dwel | ling | T2 (f | ollow ste | eps 3 to | 7 in Tab | le 9 <mark>c)</mark> | | | | |
| (90)m= | 18.54 | 18.78 | 19.16 | | <mark>19.</mark> 63 | 19.93 | 2 | 20.03 | 20.05 | 20.05 | 19.99 | 19.59 | 18.98 | 18.5 | | (90) |
| | | | | | | | | | | | t | fLA = Livin | g area ÷ (| 4) = | 0.33 | (91) |
| Mear | n interna | ıl temper | ature (f | for | the who | ole dwe | ellin | g) = f | LA x T1 | + (1 – fL | _A) × T2 | | | | | |
| (92)m= | 18.98 | 19.2 | 19.54 | Τ | 19.97 | 20.24 | 2 | 20.35 | 20.36 | 20.36 | 20.3 | 19.92 | 19.38 | 18.95 | | (92) |
| Apply | / adjustr | nent to tl | he mea | n i | nternal | tempe | ratu | ire fro | m Table | 4e, whe | ere appro | opriate | | | | |
| (93)m= | 18.98 | 19.2 | 19.54 | | 19.97 | 20.24 | 2 | 20.35 | 20.36 | 20.36 | 20.3 | 19.92 | 19.38 | 18.95 | | (93) |
| 8. Sp | ace hea | ating requ | uiremer | nt | | | | | | | | | | | | |
| Set T | i to the | mean int | ernal te | em | peratur | e obtai | ned | at st | ep 11 of | Table 9 | b, so tha | t Ti,m=(| 76)m an | d re-calo | culate | |
| the u | tilisation | factor fo | or gains | s us | sing la | ble 9a | | 1 | | A | 0 | 0.4 | Neu | Dea | 1 | |
| Litilio | Jan ation for | Feb | iviar | | Apr | iviay | | Jun | Jui | Aug | Sep | Oct | INOV | Dec | | |
| (94)m= | | | 0.97 | <u> </u> | 0.91 | 0.76 | | 0.55 | 0.39 | 0.44 | 0.73 | 0.94 | 0.99 | 1 | 1 | (94) |
| l Isefi | | hmGm | W = (9) | عد/ | m x (84 | L)m | | 0.00 | 0.00 | 0.44 | 0.70 | 0.04 | 0.00 | ' | | () |
| (95)m= | 481.12 | 560.77 | 632.44 | . [| 676.74 | 621.46 | 4 | 46.95 | 297.31 | 311.39 | 458.22 | 512.47 | 472.01 | 454.11 | | (95) |
| Mont | hly aver | age exte | rnal ter | mp | erature | from T | abl | e 8 | | L | L | I | ļ | L | I | |
| (96)m= | 4.3 | 4.9 | 6.5 | T | 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 inter | ma | l tempe | erature, | Lm | ı, W = | - =[(39)m | x [(93)m | ⊢ (96)m |] | 1 | I | I | |
| (97)m= | 1204.92 | 1170.36 | 1064.4 | 3 | 891.19 | 686.27 | 4 | 56.1 | 298.38 | 313.53 | 494.23 | 748.87 | 991.32 | 1197.14 | | (97) |
| Spac | e heatin | ig require | ement f | or | each m | ionth, k | Wh | /mon | th = 0.02 | 24 x [(97 |)m – (95 | j)m] x (4 | 1)m | | | |
| (98)m= | 538.5 | 409.65 | 321.4 | | 154.41 | 48.21 | | 0 | 0 | 0 | 0 | 175.89 | 373.9 | 552.81 | | |
| | | | | | | | | | | Tota | al per year | (kWh/yea |) = Sum(9 | 8)15,912 = | 2574.77 | (98) |
| Spac | e heatin | ig require | ement i | n k | Wh/m² | /year | | | | | | | | | 33.83 | (99) |
| | | | | | | | | | | | | | | | | |

| 9a. En | ergy reo | quiremer | nts – Ind | ividual h | eating sy | /stems i | ncluding | micro-C | HP) | | | | | |
|----------|----------------------------------|-------------|--------------------|--------------------|------------|-------------------|--------------|-------------|-------------------------|-----------------------|-------------------------|--------|------------|--|
| Spac | e heatii | ng: | t frage - | | doursels | | 0.01 | | | | | | 2 | |
| Fracti | ion of sp | | it from S | econdary | | mentary | system | (202) - 1 | - (201) - | | | | 0 | |
| Fracti | ion of to | tal booting | n nom m | main syst | tor 1 | | | (204) = 12 | (201) = (2) × [1 - 1 | (203)] - | | | 1 | (202) |
| Efficie | | | | ing system | | | | (204) - (20 | ~_/ ^ [' - | (200)] - | | | | $\left \begin{array}{c} (204) \\ (206) \end{array} \right $ |
| Efficie | | nan spa | | amontor | v heating | n evetor | n ⁰⁄- | | | | | | 93.4 | |
| EIIICIE | | | suppl | | | JSYSLEIT | 1, 70 | Δ | 0 | Oct | N.L. | Det | | |
| Snac | Jan e heatin | require | Mar Ment (c | | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kwh/yea | ar |
| Opaci | 538.5 | 409.65 | 321.4 | 154.41 | 48.21 | 0 | 0 | 0 | 0 | 175.89 | 373.9 | 552.81 | | |
| (211)m | י 1 = {[(98 |)m x (20 | u4)] } x 1 | 00 ÷ (20 | I (6) | | 1 | I | | | 1 | 1 | I | (211) |
| . ,- | 576.56 | 438.59 | 344.11 | 165.32 | , 51.62 | 0 | 0 | 0 | 0 | 188.32 | 400.33 | 591.87 | | |
| | • | • | | • | | | | Tota | l (kWh/yea | ar) =Sum(2 | 211) _{15,1012} | 2= | 2756.72 | (211) |
| Space | e heatin | g fuel (s | econdar | y), kWh/ | month | | | | | | | | | |
| = {[(98 |)m x (20 | 01)] } x 1 | 00 ÷ (20 |)8) | | 0 | | | 0 | 0 | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 Tota | 0 L (kWb/vea | 0 ar) = Sum(2) | 0 | 0 | 0 | 7(215) |
| Water | heating | r | | | | | | 1014 | | | - • • • 15,1012 | 2 | U | |
| Output | from w | ater hea | ter (calc | ulated al | oove) | | | | | | | | | |
| | 199.1 | 173.92 | 180.95 | 160.49 | 155.39 | 136.85 | 131.12 | 146.16 | 147.78 | 168.28 | 179.63 | 194.42 | | |
| Efficier | ncy of w | ater hea | iter | | | | | | | | | | 80.3 | (216) |
| (217)m= | 87.43 | 87.13 | 86.48 | 84.95 | 82.48 | 80.3 | 80.3 | 80.3 | 80.3 | 85.16 | 86.85 | 87.54 | | (217) |
| Fuel fo | or water (64) | heating, | kWh/m) → (217) | onth | | | | | | | | | | |
| (219)m= | 227.72 | 199.6 | 209.23 | 188.92 | 188.39 | 170.43 | 163.28 | 182.02 | 184.03 | 197.59 | 206.82 | 222.11 | | |
| | | | | | | | | Tota | I = Sum(2 | 19a) ₁₁₂ = | | | 2340.14 | (219) |
| Annua | al totals | | | | | | | | | k | Wh/year | r | kWh/year | - |
| Space | heating | fuel use | ed, main | system | 1 | | | | | | | | 2756.72 | |
| Water | heating | fuel use | d | | | | | | | | | | 2340.14 | |
| Electri | city for p | oumps, fa | ans and | electric | keep-hot | t | | | | | | | | |
| centra | al heatir | ng pump: | : | | | | | | | | | 30 | | (230c) |
| boiler | with a f | an-assis | sted flue | | | | | | | | | 45 | | (230e) |
| Total e | electricit | y for the | above, l | kWh/yea | r | | | sum | of (230a). | (230g) = | | | 75 | (231) |
| Electri | city for I | ighting | | | | | | | | | | | 333.64 | (232) |
| 12a. (| CO2 <u>er</u> r | issions - | – Indivi <u>d</u> | ual hea <u>t</u> i | ng syste | ems inc <u>lu</u> | uding mi | cro-CHP | | | | | | |
| | Energy Emission factor Emissions | | | | | | | | | | | | | |
| | | | | | | ⊏n kW | /h/year | | | kg CO | 2/kWh | | kg CO2/yea | ır |
| Space | heating | (main s | ystem 1 |) | | (21 | 1) x | | | 0.2 | 16 | = | 595.45 | (261) |
| Space | heating | (second | dary) | | | (21 | 5) x | | | 0.5 | 19 | = | 0 |](263) |
| Water | heating | | ., | | | (219 | 9) x | | | 0.2 | 16 | = | 505.47 |](264) |
| Space | and wa | ter heati | ng | | | (26 | 1) + (262) · | + (263) + (| 264) = | <u>,</u> | - | | 1100.92 | 」`´´´](265) |

| Electricity for pumps, fans and electric keep-hot | (231) | x | | 0.519 | = | 38.93 | (267) |
|---|-------|---|--------|--------------|---|--------|-------|
| Electricity for lighting | (232) | x | [| 0.519 | = | 173.16 | (268) |
| Total CO2, kg/year | | | sum of | (265)(271) = | | 1313 | (272) |
| | | | | | | | |
| TER = | | | | | | 17.25 | (273) |

Regulations Compliance Report

| Approved Document L1 Printed on 22 June 2018 | A, 2013 Edition, England assessed | by Stroma FSAP 2012 program, Vers | ion: 1.0.3.11 |
|---|---|--|------------------------|
| Project Information: | 5 dt 10.40.02 | | |
| Assessed By: () | | Building Type: | Flat |
| Assessed By. () | | Bunding Type. | ridi |
| Dwelling Details: | | | 42 |
| NEW DWELLING DESI | | Total Floor Area: 76 | 0.1M ² |
| Site Reference : Anil | ngton works, Twickennam | Plot Reference: | Ariington 3 Bed MID 76 |
| Address : | | | |
| Client Details: | | | |
| Name: Sha Address : | arpes Refinery Service | | |
| This report covers iter It is not a complete rep | ns included within the SAP calcul port of regulations compliance. | ations. | |
| 1a TER and DER | | | |
| Fuel for main heating sy | stem: Mains gas | | |
| Fuel factor: 1.00 (mains | gas) Emission Rote (TER) | 15.02 kg/m² | |
| Dwelling Carbon Dioxide | e Emission Rate (DER) | 13.79 kg/m² | ОК |
| 1b TFEE and DFEE | | | •••• |
| Target Fabric Energy Ef Dwelling Fabric Energy | ficiency (TFEE) Efficiency (DFEE) | 34.3 kWh/m² 30.3 kWh/m² | ОК |
| Element External wall Party wall Floor Roof Openings | Average 0.17 (max. 0.30) 0.00 (max. 0.20) (no floor) (no roof) 1.42 (max. 2.00) | Highest 0.17 (max. 0.70) - 1.60 (max. 3.30) | ок ок ок |
| 2a Thermal bridging | | | |
| Thermal bridgi | ng calculated from linear thermal tra | nsmittances for each junction | |
| 3 Air permeability | | | |
| Air permeability a Maximum | tt 50 pascals | 4.00 (design valu 10.0 | e) OK |
| 4 Heating efficiency | | | |
| Main Heating sys | tem: Database: (rev 397 Boiler systems with Brand name: Alpha Model: InTec 34C Model qualifier: (Combi) Efficiency 88.8 % S Minimum 88.0 % | 7, product index 016661): n radiators or underfloor heating - mai | ns gas OK |
| Secondary heatir | ng system: None | | |

Regulations Compliance Report

| 5 Cylinder insulation | | | | |
|-----------------------------------|--------------------|--------------------|---|-------|
| Hot water Storage: | No cylinder | | | |
| 6 Controls | | | | |
| | | | | |
| Space heating controls | Time and temper | rature zone contro | I by device in database | ОК |
| Hot water controls: | No cylinder | | , | |
| Boiler interlock: | Yes | | | ОК |
| 7 Low energy lights | | | | |
| Percentage of fixed lights with I | ow-energy fittings | | 100.0% | |
| Minimum | | | 75.0% | OK |
| 8 Mechanical ventilation | | | | |
| Not applicable | | | | |
| 9 Summertime temperature | | | | |
| Overheating risk (Thames valle | y): | | Medium | ОК |
| Based on: | | | | |
| Overshading: | | | Average or unknown | |
| Windows facing: North West | | | 4.41m ² | |
| Windows facing: North West | | | 4.41m ² | |
| Windows facing: South East | | | 4.41m ² | |
| Windows facing: South West | | | 2.52m ² | |
| Ventilation rate: | | | 3.00 | |
| Blinds/curtains: | | | None | |
| | | | Close <mark>d 100% of daylight</mark> l | hours |
| | | | | |
| 10 Key features | | | | |
| Party Walls U-value | | | 0 W/m²K | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

| | | | User D | etails: | | | | | | |
|----------------------------------|--------------------------------|--------------|--------------------|------------------|------------------|---------------|------------|-----------|------------------------|-----------------------|
| Assessor Name: Software Name: | Stroma FSAP 201 | 2 | : | Stroma Softwa | a Num ire Ver | ber: sion: | | Versio | n: 1.0.3.11 | |
| | | Pro | operty A | Address: | Arlingto | on 3 Bec | 1 MID 76 | | | |
| Address : | | | | | | | | | | |
| 1. Overall dwelling dime | ensions: | | | | | | | | | |
| | | | Area | 1 (m²) | | Av. He | ight(m) | | Volume(m ³ |) |
| Ground floor | | | 7 | 6.1 | (1a) x | 2 | 2.3 | (2a) = | 175.03 | (3a) |
| Total floor area TFA = (1 | a)+(1b)+(1c)+(1d)+(1e | e)+(1n) | 7 | 6.1 | (4) | | | | | |
| Dwelling volume | | | | | (3a)+(3b) |)+(3c)+(3c | d)+(3e)+ | .(3n) = | 175.03 | (5) |
| 2. Ventilation rate: | | | | | | | | | | |
| | main s | econdary | | other | | total | | | m ³ per hou | r |
| Number of chimneys | | 0 | + [| 0 |] = [| 0 | x 4 | 40 = | 0 | (6a) |
| Number of open flues | 0 + | 0 | i + [| 0 |] = [| 0 | × | 20 = | 0 | (6b) |
| Number of intermittent fa | ins | | J L | | · _ | 2 | x 7 | 10 = | 20 | (7a) |
| Number of passive vents | i | | | | | 0 | x 7 | 10 = | 0 | (7b) |
| Number of flueless gas fi | res | | | | | 0 | X 4 | 40 = | 0 | (7c) |
| | | | | | | | | Air ch | anges per ho | our |
| Infiltration due to chimne | ys, flues and fans = (6 | a)+(6b)+(7a |) +(7 b)+(7 | (c) = | | 20 | | ÷ (5) = | 0.11 | (8) |
| If a pressurisation test has b | peen carried out or is intende | ed, proceed | to (17), o | therwise c | ontinue fro | om (9) to (| (16) | | | |
| Additional infiltration | ne dweiling (ns) | | | | | | [(0). | -11x0 1 - | 0 | (9) |
| Structural infiltration: 0 | .25 for steel or timber | frame or (|).35 for | masonr | v constr | uction | [(0) | 1,0.1 - | 0 | $= \frac{(10)}{(11)}$ |
| if both types of wall are p | resent, use the value corres | ponding to t | the greate | er wall area | a (after | | | | 0 | |
| deducting areas of openii | ngs); if equal user 0.35 | lod) or 0 1 | (coolo | d) also | optor 0 | | | | 2 | |
| If no draught lobby en | ter 0.05 else enter 0 | | (Seale | u), eise | Sinter U | | | | 0 | $-1^{(12)}_{(13)}$ |
| Percentage of windows | s and doors draught st | tripped | | | | | | | 0 | $= \frac{(10)}{(14)}$ |
| Window infiltration | | | (| 0.25 - [0.2 | x (14) ÷ 1 | 00] = | | | 0 | |
| Infiltration rate | | | | (8) + (10) - | + (11) + (1 | 2) + (13) - | + (15) = | | 0 | (16) |
| Air permeability value, | q50, expressed in cub | oic metres | per ho | ur per so | uare m | etre of e | envelope | area | 4 | (17) |
| If based on air permeabil | ity value, then (18) = [(1 | 7) ÷ 20]+(8) | , otherwis | se (18) = (| 16) | | | | 0.31 | (18) |
| Air permeability value applie | es if a pressurisation test ha | s been done | or a deg | ree air per | meability | is being u | sed | | | _ |
| Number of sides sheltere | ed | | | (20) 4 [| 0 07E v (4 | 0)] | | | 2 | (19) |
| Shelter factor | la substitue for the | | | (20) = 1 - [| 0.075 X (1 | 9)] = | | | 0.85 | (20) |
| Infiltration rate incorporat | ting shelter factor | | | (21) = (18) | x (20) = | | | | 0.27 | (21) |
| Infiltration rate modified f | or monthly wind speed | | | | | | | | | |
| Jan Feb | Mar Apr May | Jun | Jui | Aug | Sep | Oct | NOV | Dec | | |
| Monthly average wind sp | beed from Table 7 | | | | | | <u> </u> | | 1 | |
| (∠∠)m= 5.1 5 | 4.9 4.4 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4./ | | |
| Wind Factor $(22a)m = (22a)m$ | 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 | | |
| | | | | | | | | | | |

| Adjust | ed infiltr | ation rat | e (allowi | ing for sh | nelter an | d wind s | speed) = | (21a) x | (22a)m | | | | | | |
|----------------------|--------------------------|----------------------------|---------------------------|---------------------------|---------------------------|------------------------|----------------|-----------------|----------------|----------------|------------------|--------------------|------------|-------------|-------|
| | 0.34 | 0.33 | 0.33 | 0.29 | 0.29 | 0.25 | 0.25 | 0.25 | 0.27 | 0.29 | 0.3 | 0.31 | | | |
| Calcul If ma | ate etter | ctive air | change | rate for t | he appli | cable ca | se | | | | | | | | (220) |
| lf exh | aust air he | eat pump | usina App | endix N. (2 | 23b) = (23a | i) x Fmv (e | equation (N | N5)) . othe | rwise (23b |) = (23a) | | | 0 | | (23b) |
| If bala | anced with | heat reco | overv: effic | iencv in % | allowing f | or in-use f | actor (from | n Table 4h |) = | , (, | | | 0 | | (230) |
| a) If | halance | d mech | anical ve | ntilation | with he | at recove | orv (MI\/F | HR) (24a | / a)m – (2' | 2h)m + (| 23h) 🗸 [ʻ | l – (23c) | ∸ 1001 | | (230) |
| (24a)m= | | | | | 0 | 0 | | | | | | 0 | . 100] | | (24a) |
| b) If | balance | d mech | I anical ve | L entilation | without | heat rec | L coverv (N | L /\\/) (24b | l = (22) | I 2b)m + () | L 23b) | | | | |
| (24b)m= | 0 | 0 | | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | | | (24b) |
| c) If | whole h | ouse ex | ract ver | ntilation of | or positiv | re input v | ventilatio | n from c | utside | | | | | | |
| | if (22b)n | n < 0.5 × | (23b), t | then (24 | c) = (23b |); other | wise (24 | c) = (22b | 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 | se positiv | /e input | ventilatio | on from I | oft | - | - | - | | | |
| | if (22b)n | n = 1, th | en (24d) I | m = (22l | b)m othe | erwise (2 | 24d)m = 0 | 0.5 + [(2 | 2b)m² x | 0.5] | | | l | | |
| (24d)m= | 0.56 | 0.56 | 0.55 | 0.54 | 0.54 | 0.53 | 0.53 | 0.53 | 0.54 | 0.54 | 0.55 | 0.55 | | | (24d) |
| Effe | ctive air | change | rate - er | nter (24a | i) or (24b | o) or (24 | c) or (24 | d) in boy | (25) | 0.54 | 0.55 | 0.55 | I | | (05) |
| (25)m= | 0.56 | 0.56 | 0.55 | 0.54 | 0.54 | 0.53 | 0.53 | 0.53 | 0.54 | 0.54 | 0.55 | 0.55 | | | (25) |
| 3. He | at losse | s and he | eat loss | paramet | er: | | | | | | | | | | |
| ELEN | | Gros are <mark>a</mark> | ss (m²) | Openin m | lgs 1 ² | Net Ar A ,r | rea m² | U-valu W/m2 | ue K | A X U (W/I | K) | k-value kJ/m²·ł | ↔ ≺ | A X kJ/K | k |
| Doo <mark>rs</mark> | | | | | | 1.89 | x | 1.6 | = | 3.024 | | | | | (26) |
| Windo | <mark>ws</mark> Type | e 1 | | | | 4.41 | x1, | /[1/(1.4)+ | 0.04] = | 5.85 | F | | | | (27) |
| Windo | ws Type | 2 | | | | 4.41 | x1/ | /[1/(1.4)+ | 0.04] = | 5.85 | F | | | | (27) |
| Windo | ws Type | 93 | | | | 4.41 | | /[1/(1.4)+ | 0.04] = | 5.85 | 5 | | | | (27) |
| Windo | ws Type | e 4 | | | | 2.52 | | /[1/(1.4)+ | 0.04] = | 3.34 | = | | | | (27) |
| Walls | | 56.3 | 36 | 17.6 | 4 | 38.72 | 2 X | 0.17 | = [| 6.58 | | | | | (29) |
| Total a | area of e | lements | , m² | | | 56.36 | 3 | | | | | | | | (31) |
| Party v | wall | | | | | 38.24 | + x | 0 | = | 0 | | | | | (32) |
| Party f | loor | | | | | 76.1 | | | | | | | - - | | (32a) |
| Party of | ceiling | | | | | 76.1 | \exists | | | | ſ | | \dashv | | (32b) |
| * for win | dows and le the area | roof wind | ows, use e sides of ir | effective wi | indow U-va Is and part | alue calcul titions | ated using | formula 1 | /[(1/U-valı | ie)+0.04] a | L as given in | paragraph | | | 1, , |
| Fabric | heat los | s, W/K | = S (A x | U) | | | | (26)(30) |) + (32) = | | | | 30.4 | 19 | (33) |
| Heat c | apacity | Cm = S(| (Axk) | | | | | | ((28) | (30) + (32 | 2) + (32a). | (32e) = | 12289 | 9.45 | (34) |
| Therm | al mass | parame | eter (TMI | - = Cm - | + TFA) in | n kJ/m²K | | | Indica | tive Value | : Medium | | 250 | 0 | (35) |
| For desi can be u | ign assess used inste | sments wh ad of a de | ere the de tailed calc | etails of the ulation. | constructi | ion are noi | t known pr | ecisely the | e indicative | e values of | TMP in Ta | able 1f | | | |
| Therm | al bridge | es : S (L | x Y) cal | culated | using Ap | pendix l | < | | | | | | 6.0 | 1 | (36) |
| if details | s of therma | al bridging | are not kr | nown (36) = | = 0.15 x (3 | 1) | | | | | | | | | |
| Total f | abric he | at loss | | | | | | | (33) + | (36) = | | | 36. | 5 | (37) |
| Ventila | ation hea | at loss ca | alculateo | d monthly | y | | | | (38)m | = 0.33 × (| 25)m x (5) | | l | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | | |

| (38)m= | 32.23 | 32.1 | 31.97 | 31.37 | 31.26 | 30.74 | 30.74 | 30.64 | 30.94 | 31.26 | 31.49 | 31.73 | | (38) |
|--------------------|-------------------------------|---------------------------------|-------------------------|----------------------------|-----------------------------|--------------------------|-------------------|-------------|-----------------------|---------------------------|-----------------------------|---------------------|---------|------|
| Heat tr | ansfer o | coefficie | nt, W/K | | | | | | (39)m | = (37) + (3 | 38)m | | | |
| (39)m= | 68.73 | 68.6 | 68.47 | 67.87 | 67.76 | 67.24 | 67.24 | 67.14 | 67.44 | 67.76 | 67.99 | 68.22 | | |
| Heat lo | oss para | ameter (H | HLP), W | /m²K | | | | | (40)m | Average = = (39)m ÷ | Sum(39) ₁ (4) | 12 /12= | 67.87 | (39) |
| (40)m= | 0.9 | 0.9 | 0.9 | 0.89 | 0.89 | 0.88 | 0.88 | 0.88 | 0.89 | 0.89 | 0.89 | 0.9 | | |
| Numbe | er of day | , vs in mo | nth (Tab | le 1a) | | | | | | Average = | Sum(40)1. | 12 /12= | 0.89 | (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 | ter hea | ting ene | rgy requ | irement: | | | | | | | | kWh/yea | ar: | |
| Assum if TF | ed occu A > 13. A £ 13. | upancy, 9, N = 1 9, N = 1 | N + 1.76 x | : [1 - exp | (-0.0003 | 849 x (TF | FA -13.9 |)2)] + 0.0 |)013 x (⁻ | TFA -13. | 9) 2. | 38 | | (42) |
| Annual | averag | ge hot wa | ater usag | ge in litre | es per da | ay Vd,av | erage = | (25 x N) | + 36 | | 90 | .84 | | (43) |
| Reduce not more | the annua e that 125 | al average i litres per | hot water person per | usage by . r day (all w | 5% if the a rater use, l | welling is hot and co | designed (ld) | o achieve | a water us | se target o | Ť | | | |
| | Jan | Feb | Mar | Apr | May | Jun | , Jul | Aug | Sen | Oct | Nov | Dec | | |
| Hot wate | er usage i | in litres per | r day for ea | ach month | Vd,m = fa | ctor from | Table 1c x | (43) | | | 1101 | | | |
| (44)m= | 99.92 | 96.29 | 92.65 | 89.02 | 85.39 | 81.75 | 81.75 | 85.39 | 89.02 | 92.65 | 96.29 | <mark>9</mark> 9.92 | | |
| | | | | | | | | | | L Total = Su | l m(44) ₁₁₂ = | | 1090.04 | (44) |
| Energy o | content of | ^f hot water | used - cal | culated mo | onthly $= 4$. | 190 x Vd,r | n x nm x D | 0Tm / 3600 |) kWh/mor | nth (see Ta | bles 1b, 1 | c, 1d) | | |
| (45)m= | 148.18 | 129.6 | 133.73 | 116.59 | 111.87 | 96.54 | 89.46 | 102.65 | 103.88 | 121.06 | 132.15 | 143.5 | | _ |
| lf instant | aneous v | vater heati | na at point | t of use (no | o hot water | r storage). | enter 0 in | boxes (46 |) to (61) | Tota <mark>l = S</mark> u | m(45) ₁₁₂ = | - | 1429.21 | (45) |
| (46)m- | 22.23 | 19.44 | 20.06 | 17.49 | 16 78 | 14.48 | 13.42 | 15.4 | 15 58 | 18 16 | 19.82 | 21.53 | | (46) |
| Water | storage | loss: | 20.00 | 17.45 | 10.70 | 14.40 | 10.42 | 10.4 | 10.00 | 10.10 | 10.02 | 21.00 | | (10) |
| Storag | e volum | ne (litres) |) includir | ng any so | olar or W | /WHRS | storage | within sa | ame ves | sel | | 0 | | (47) |
| If comr | nunity ł | neating a | and no ta | ank in dw | velling, e | nter 110 |) litres in | (47) | | | | | | |
| Otherw | ise if no | o stored | hot wate | er (this ir | icludes i | nstantar | neous co | mbi boil | ers) ente | er '0' in (| 47) | | | |
| a) If m | storage | turer's di | eclared I | oss facto | or is kno | wn (kWł | n/dav). | | | | | 0 | | (48) |
| Tempe | rature f | actor fro | m Table | 2h | | | "day). | | | | | 0 | | (40) |
| Energy | lost fro | om water | r storage | . kWh/ve | ear | | | (48) x (49) |) = | | | 0 | | (50) |
| b) If m | anufact | turer's de | eclared of | cylinder l | oss fact | or is not | known: | (,,, | | | | 0 | | (00) |
| Hot wa | ter stor | age loss | factor fr | rom Tabl | e 2 (kW | h/litre/da | ay) | | | | | 0 | | (51) |
| If comr | nunity f | from Ta | see secti blo 20 | on 4.3 | | | | | | | | | | (50) |
| Tempe | rature f | actor fro | m Table | 2b | | | | | | | | 0 | | (52) |
| Enerav | lost fro | om water | r storage | . kWh/ve | ear | | | (47) x (51) |) x (52) x (| 53) = | | 0 | | (54) |
| Enter | (50) or | (54) in (5 | 55) | , , | | | | 、 / (- ·) | x- / (| , | | 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 Appendix | Ή | |
| (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 | | | | | |
| (mo | dified by | factor f | rom Tab | le H5 if t | here is s | solar wat | ter heati | ng and a | cylinde | r thermo | stat) | | L | |
| (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) ÷ 36 | 65 × (41 |)m | | | | | | |
| (61)m= | 23.84 | 21.5 | 23.77 | 22.95 | 23.68 | 22.88 | 23.62 | 23.66 | 22.92 | 23.73 | 23.02 | 23.82 | | (61) |
| Total h | eat req | uired for | water h | eating ca | alculatec | l for eac | h month | (62)m = | 0.85 × (| (45)m + | (46)m + | (57)m + | (59)m + (61)m | |
| (62)m= | 172.01 | 151.1 | 157.5 | 139.54 | 135.56 | 119.42 | 113.07 | 126.31 | 126.8 | 144.79 | 155.17 | 167.33 | | (62) |
| Solar DI | W input | calculated | using App | endix G o | Appendix | H (negati | ve quantity | y) (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 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= | 172.01 | 151.1 | 157.5 | 139.54 | 135.56 | 119.42 | 113.07 | 126.31 | 126.8 | 144.79 | 155.17 | 167.33 | | |
| | | | | | | | | Outp | out from wa | ater heate | r (annual) | 12 | 1708.6 | (64) |
| Heat g | ains fro | m water | heating | , kWh/m | onth 0.2 | 5 ´ [0.85 | × (45)m | n + (61)m | n] + 0.8 x | ۲ ((46)m | + (57)m | + (59)m |] | |
| (65)m= | 55.23 | 48.47 | 50.41 | 44.5 | 43.12 | 37.82 | 35.65 | 40.05 | 40.27 | 46.19 | 49.69 | 53.67 | | (65) |
| in <mark>clu</mark> | ide (57) | m in calo | culation | of (65)m | only if c | ylinder i | s in the o | dwelling | or hot w | ate <mark>r is f</mark> r | om com | munity h | eating | |
| 5. Int | ernai ga | ains (see | Table 5 | 5 and 5a |): | | | | | | _ | | _ | |
| Metab | olic gair | s (Table | 5) Wat | ts | | | | | | | | | | |
| in o tono | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (66)m= | 119.23 | 119.23 | 11 <mark>9.23</mark> | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | | (66) |
| Lightin | g gains | (calcula | ted in A | pendix | L, equat | ion L9 o | r L9a), a | lso see ⁻ | Table 5 | | | | | |
| (67)m= | 18.89 | 16.78 | 13.65 | 10.33 | 7.72 | 6.52 | 7.04 | 9.16 | 12.29 | 15.61 | 18.21 | 19.42 | | (67) |
| Applia | nces ga | ins (calc | ulated ir | Append | dix L, eq | uation L | 13 or L1 | 3a), also | see Ta | ble 5 | | | | |
| (68)m= | 211.1 | 213.29 | 207.77 | 196.02 | 181.18 | 167.24 | 157.93 | 155.74 | 161.26 | 173.01 | 187.84 | 201.78 | | (68) |
| Cookir | na aains | (calcula | ted in A | n Dendix | L. equat | ion L15 | or L15a |), also se | e Table | 5 | 1 | | | |
| (69)m= | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | | (69) |
| Pumps | and fa | ns dains | (Table ! | 1 | | | | | | | | | | |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | | (70) |
| Losses | | l vaporatic | n (nega | i tive valu | es) (Tab | l le 5) | | | | | | | | |
| (71)m= | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | | (71) |
| Water | L heating | L nains (1 | I Table 5) | | | | I | | | I | I | | | |
| (72)m= | 74.23 | 72.12 | 67.75 | 61.81 | 57.96 | 52.53 | 47.92 | 53.83 | 55.93 | 62.08 | 69.02 | 72.14 | l | (72) |
| Total i | ntornal | asine - | | | | (66) | m + (67)m | 1 + (68)m + | - (69)m + (| (70)m + (7 | 1)m + (72) |)m | | |
| (73)m= | 365.99 | 363.96 | 350.94 | 329.93 | 308 63 | 288.06 | 274 66 | 280.49 | 291 25 | 312 46 | 336.84 | 355 11 | l | (73) |
| 6. So | lar gains | S: | | 1 | 1 | | 1 | 1 | | 1 | | 1 | | |
| Solar g | ains are o | alculated | using sola | r flux from | Table 6a | and assoc | iated equa | ations to co | nvert to th | e applicat | le orientat | tion. | | |
| Orienta | ation: / | Access F | actor | Area | | Flu | x | | g_ | | FF | | Gains | |

| Onentation. | Table 6d | | m² | | Table 6a | | 9_ Table 6b | | Table 6c | | (W) | |
|----------------|----------|---|------|---|----------|---|----------------|---|----------|---|-------|------|
| Southeast 0.9x | 0.77 | x | 4.41 | x | 36.79 | x | 0.63 | x | 0.7 | = | 49.59 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 62.67 | × | 0.63 | x | 0.7 | = | 84.47 | (77) |

| | | 1 | | 1 | | 1 | | | | 1 | | - |
|--|------|---|------|---|--------|-----|------|---|-----|------------|--------|-----------|
| Southeast 0.9x | 0.77 | x | 4.41 | x | 85.75 | x | 0.63 | X | 0.7 | = | 115.57 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 106.25 | x | 0.63 | x | 0.7 | = | 143.2 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 119.01 | x | 0.63 | x | 0.7 | = | 160.4 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 118.15 | x | 0.63 | x | 0.7 | = | 159.24 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 113.91 | x | 0.63 | x | 0.7 | = | 153.52 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 104.39 | x | 0.63 | x | 0.7 |] = | 140.69 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 92.85 | x | 0.63 | x | 0.7 |] = | 125.14 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 69.27 | x | 0.63 | x | 0.7 |] = | 93.36 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 44.07 | x | 0.63 | x | 0.7 | = | 59.4 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 31.49 | x | 0.63 | x | 0.7 | = | 42.44 | (77) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 36.79 |] | 0.63 | x | 0.7 | = | 28.34 | (79) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 62.67 |] | 0.63 | x | 0.7 | = | 48.27 | (79) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 85.75 |] | 0.63 | x | 0.7 |] = | 66.04 | (79) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 106.25 |] | 0.63 | x | 0.7 |] = | 81.83 | (79) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 119.01 | 1 | 0.63 | x | 0.7 | = | 91.66 | (79) |
| Southwest <mark>0.9x</mark> | 0.77 | × | 2.52 | x | 118.15 |] | 0.63 | x | 0.7 | = | 90.99 | (79) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 113.91 | İ | 0.63 | x | 0.7 | j = | 87.73 | (79) |
| Sout <mark>hwest_{0.9x}</mark> | 0.77 | x | 2.52 | X | 104.39 | | 0.63 | х | 0.7 | = | 80.4 | (79) |
| Sout <mark>hwest_{0.9x}</mark> | 0.77 | × | 2.52 | x | 92.85 | İ. | 0.63 | x | 0.7 | = | 71.51 | (79) |
| Sout <mark>hwest_{0.9x}</mark> | 0.77 | x | 2.52 | x | 69.27 | i / | 0.63 | x | 0.7 | j = | 53.35 | (79) |
| Sout <mark>hwest_{0.9x}</mark> | 0.77 | x | 2.52 | x | 44.07 | i/ | 0.63 | x | 0.7 | i = | 33.94 | (79) |
| Sout <mark>hwest_{0.9x}</mark> | 0.77 | x | 2.52 | x | 31.49 | ĺ | 0.63 | x | 0.7 | i = | 24.25 | _ (79) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 11.28 | × | 0.85 | x | 0.7 | i = | 20.52 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 11.28 | × | 0.85 | x | 0.7 | i = | 20.52 | (81) |
| Northwest 0.9x | 0.77 | × | 4.41 | x | 22.97 | × | 0.85 | x | 0.7 | j = | 41.76 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 22.97 | x | 0.85 | x | 0.7 | j = | 41.76 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 41.38 | × | 0.85 | x | 0.7 | = | 75.24 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 41.38 | × | 0.85 | x | 0.7 | i = | 75.24 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 67.96 | x | 0.85 | x | 0.7 | i = | 123.57 | - (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 67.96 | × | 0.85 | x | 0.7 | i = | 123.57 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 91.35 | × | 0.85 | x | 0.7 | i = | 166.1 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 91.35 | × | 0.85 | x | 0.7 | i = | 166.1 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 97.38 | × | 0.85 | x | 0.7 | i = | 177.08 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 97.38 | x | 0.85 | x | 0.7 | i = | 177.08 | - (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 91.1 | x | 0.85 | x | 0.7 | i = | 165.66 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 91.1 | x | 0.85 | x | 0.7 | i = | 165.66 |] (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 72.63 | x | 0.85 | x | 0.7 | i = | 132.06 | - (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 72.63 | x | 0.85 | x | 0.7 | i = | 132.06 | _ (81) |
| Northwest 0.9x | 0.77 | × | 4.41 | x | 50.42 | × | 0.85 | x | 0.7 | i = | 91.68 | - (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 50.42 | × | 0.85 | x | 0.7 | i = | 91.68 | - (81) |
| Northwest 0.9x | 0.77 | × | 4.41 | x | 28.07 | × | 0.85 | x | 0.7 | i = | 51.04 | - (81) |
| 1 | | | | | | | | | | | | |

| Northw | est <mark>0.9x</mark> | 0.77 | x | 4.4 | ¥1 | x | 2 | 8.07 | x | 0.85 | x | 0.7 | = | 51.04 | (81) |
|----------|---------------------------|-----------|-----------|----------------------|--------------|----------|----------|-----------|------------|------------|---------------------|-------------|------------|---------|------|
| Northw | est 0.9x | 0.77 | x | 4.4 | 11 | x | 1 | 4.2 | x | 0.85 | = | 0.7 | = = | 25.82 | (81) |
| Northw | est 0.9x | 0.77 | x | 4.4 | 11 | x | 1 | 4.2 | x | 0.85 | | 0.7 | = | 25.82 | (81) |
| Northw | est 0.9x | 0.77 | x | 4.4 | 11 | x | |).21 | x | 0.85 | × [| 0.7 | = | 16.76 | (81) |
| Northw | /est 0.9x | 0.77 | × | 4.4 | 11 | x | |).21 | x | 0.85 | | 0.7 | = | 16.76 | (81) |
| | L | | | | | | | | | | | | | | |
| Solar | oains in | watts, ca | alculated | d for eac | h month | n | | | (83)m = S | um(74)m . | (82)m | | | | |
| (83)m= | 118.96 | 216.26 | 332.1 | 472.17 | 584.26 | 6 | 604.4 | 572.56 | 485.22 | 380.02 | 248.78 | 144.97 | 100.2 | | (83) |
| Total g | gains – i | nternal a | ind sola | r (84)m = | - = (73)m | + (| 83)m , | watts | | | 1 | | 1 | 1 | |
| (84)m= | 484.95 | 580.22 | 683.04 | 802.1 | 892.89 | 8 | 92.45 | 847.22 | 765.71 | 671.27 | 561.24 | 481.81 | 455.31 | | (84) |
| 7 Mc | an inter | nal temr | oraturo | (heating | | ן בו | | | | | | | | 1 | |
| Temr | perature | during b | eating r | | the liv | " ina | area f | rom Tab | | 1 (°C) | | | | 21 | (85) |
| Litilio | otion for | tor for a | aine for | | n une nv | y (c | | | ле э, тп | 1(0) | | | | 21 | (00) |
| Ullis | lan | Eeb | Mar | | May | | | | Δυσ | Sen | Oct | Nov | Dec |] | |
| (86)m- | 1 | 0.99 | 0.97 | 0.87 | 0.68 | + | 0.48 | 0.35 | Aug | 0.67 | 0.94 | 0.99 | | | (86) |
| (00)11- | ' | 0.99 | 0.97 | 0.07 | 0.00 | | 0.40 | 0.55 | 0.4 | 0.07 | 0.34 | 0.33 | | | (00) |
| Mear | n interna | l temper | ature in | living ar | ea T1 (f | ollo | w step | os 3 to 7 | in Tabl | e 9c) | | i | i | 1 | |
| (87)m= | 20.14 | 20.32 | 20.57 | 20.84 | 20.97 | | 21 | 21 | 21 | 20.98 | 20.77 | 20.4 | 20.1 | | (87) |
| Temp | perature | during h | eating p | periods i | n rest of | dw | velling | from Ta | ble 9, T | h2 (°C) | | - | | | |
| (88)m= | 20.16 | 20.17 | 20.17 | 20.17 | 20.18 | 2 | 0.18 | 20.18 | 20.18 | 20.18 | 2 <mark>0.18</mark> | 20.17 | 20.17 | | (88) |
| Utilis | ation fac | tor for g | ains for | rest of d | welling, | h2. | m (se | e Table | 9a) | | | | | | |
| (89)m= | 1 | 0.99 | 0.96 | 0.84 | 0.63 | | 0.42 | 0.28 | 0.33 | 0.6 | 0.92 | 0.99 | 1 | | (89) |
| Mear | | l temper | ature in | the rest | of dwel | ina | T2 (fc | ollow ste | ins 3 to 7 | 7 in Tabl | | | | | |
| (90)m= | 19.02 | 19.27 | 19.63 | 20 | 20.15 | | 20.18 | 20.18 | 20.18 | 20.16 | 19.92 | 19.39 | 18.97 | | (90) |
| (, | | | | | | | | | | f | fLA = Livir | ig area ÷ (| 4) = | 0.33 | (91) |
| | | | | | | | | | | | | | | | |
| Mear | | I temper | ature (fo | or the wh | ole dwe | ellin | g) = fL | _A × T1 | + (1 – †L | .A) × T2 | 00.0 | 10.70 | 10.04 | 1 | (02) |
| (92)m= | 19.39 | 19.61 | 19.94 | 20.28 | 20.42 | 2 | 20.45 | 20.45 | 20.45 | 20.43 | 20.2 | 19.72 | 19.34 | | (92) |
| Appiy | $\sqrt{\frac{10.20}{20}}$ | | ne mear | n interna | | ratu | | m Table | 4e, whe | ere appro | | 10.72 | 10.24 | 1 | (03) |
| (93)III= | 19.59 | ting root | uiromon | 20.20 | 20.42 | | .0.45 | 20.45 | 20.45 | 20.43 | 20.2 | 19.72 | 19.34 | | (00) |
| Sot T | i to the | mean int | arnal to | mporatu | ro obtai | nod | l at sta | on 11 of | Tabla Ol | a sa tha | t Ti m_(| 76)m an | d re-cale | sulato | |
| the u | tilisation | factor fo | or gains | using Ta | able 9a | neu | | p 11 01 | Table 31 | J, 50 IIIa | u 11,111–(| 70)11 an | u ie-cai | Julate | |
| | Jan | Feb | Mar | Apr | May | Τ | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Utilis | ation fac | tor for g | ains, hr | <u>ו י</u> ו | | | | | | | | | | 1 | |
| (94)m= | 0.99 | 0.99 | 0.95 | 0.84 | 0.64 | | 0.44 | 0.31 | 0.35 | 0.62 | 0.92 | 0.99 | 1 | | (94) |
| Usefu | ul gains, | hmGm , | W = (9 | 4)m x (8 | 4)m | | | | | | • | | | | |
| (95)m= | 482.48 | 571.8 | 651.05 | 677 | 574.51 | 3 | 91.89 | 258.77 | 271.69 | 417.38 | 514.08 | 475.76 | 453.67 | | (95) |
| Mont | hly aver | age exte | rnal terr | perature | e from T | abl | e 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 | nal temp | erature, | Lm | 1,W= | =[(39)m : | x [(93)m | – (96)m |] | i | i | 1 | |
| (97)m= | 1036.79 | 1009.26 | 920.27 | 772.16 | 590.79 | 3 | 93.22 | 258.88 | 271.97 | 427.05 | 650.39 | 858.09 | 1032.92 | | (97) |
| Spac | e heatin | g require | ement fo | or each r | nonth, k | Wh | /mont | h = 0.02 | 24 x [(97) |)m – (95 | 5)m] x (4 | 1)m | 1 | 1 | |
| (98)m= | 412.41 | 293.97 | 200.3 | 68.52 | 12.11 | | 0 | 0 | 0 | 0 | 101.42 | 275.28 | 430.97 | | _ |
| | | | | | | | | | Tota | l per year | (kWh/yea | r) = Sum(9 | 8)15,912 = | 1794.98 | (98) |
| Spac | e heatin | g require | ement ir | n kWh/m [;] | ²/year | | | | | | | | | 23.59 | (99) |
| | | | | | | | | | | | | | | | |

| 9a. En | ergy re | quiremer | nts – Ind | ividual h | eating sy | ystems i | including | j micro-C | HP) | | | | | |
|--|---|------------------------|----------------------|-----------|-----------|-----------|-------------------------|--------------|----------------------|------------------------|-------------------------|--------|--------------------------------|--|
| Spac | e heati | ng: | t from a | 000000- | | montor | , ovoto m | | | | | | 0 | |
| Fract | ion of c | pace hee | at from \sim | | y/supple | mentary | system | (202) – 1 - | - (201) - | | | | 0 | $\begin{bmatrix} (201) \\ (202) \end{bmatrix}$ |
| Fract | ion of to | vaue nea | na from | main syst | ciii(5) | | | (204) = (20) | ((i) (2) x [1) | $(203)^{1} =$ | | | 1 | (202) |
| Ffficia | ency of | main ene | ng nunn Ace haat | ina sveta | em 1 | | | / _ (2) | / ^ [' | ()] - | | | ۱ ۵۶ 7 | |
| Efficia | ency of | seconda | rv/sunnl | ementar | v heatin | n svsten | n % | | | | | | <u>عکار ا</u> | |
| | | Eab | Mar | Anr | Mou | | | Aug | Son | Oct | Nov | Dec | k\M/b/vor | |
| Spac | e heatir | ng require | ement (c | | d above |) | | Aug | Sep | | | Dec | | ai |
| • | 412.41 | 293.97 | 200.3 | 68.52 | 12.11 | 0 | 0 | 0 | 0 | 101.42 | 275.28 | 430.97 | | |
| (211)m | n = {[(98 | 3)m x (20 | 94)] } x 1 | 100 ÷ (20 |)6) | | | | | | | | | (211) |
| | 444.88 | 317.12 | 216.08 | 73.91 | 13.06 | 0 | 0 | 0 | 0 | 109.4 | 296.96 | 464.9 | | - |
| | | | | | | | | Tota | l (kWh/yea | ar) =Sum(2 | 211) _{15,1012} | = | 1936.33 | (211) |
| Spac | e heatir | ng fuel (s | econdar | y), kWh/ | month | | | | | | | | | |
| = {[(98 (215)m= | 0 0 0 | | 00÷(20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | | 1 | | | _ | | ļ | Tota | l (kWh/yea | ar) =Sum(2 | 215) _{15,1012} | = | 0 | (215) |
| Water | heating | g | I | | | | | | | | | | | |
| Output | t from w | ater hea | ter (calc | ulated a | bove) | | L | | 400 - | | 455 15 | 467 55 | | |
| 172.01 151.1 157.5 139.54 135.56 119.42 113.07 126.31 126.8 144.79 155.17 167. Efficiency of water heater | | | | | | | | | | | | | 07 | (216) |
| (217)m- | fficiency of water heater 88.89 88.76 88.49 87.72 87 87 87 87 88.09 88.71 88.09 | | | | | | | | | | | | 87 | (217) |
| Fuel fo | or water | heating | kWh/m | onth | OT.LL | | | | 01 | 00.00 | 00.71 | 00.00 | | () |
| (219)m | <u>1 = (64</u>) |)m x 100 |) ; (217) |)m | | | | | | | | | | |
| (219)m= | 193.52 | 170.23 | 177.98 | 158.81 | 155.43 | 137.26 | 129.97 | 145.19 | 145.74 | 164.36 | 174.92 | 188.16 | | |
| Annur | al totale | • | | | | | | rota | i = 3um(2 | 1 3a) ₁₁₂ = | White | | 1941.57 | (219) |
| Space | heating | , g fuel use | ed, main | system | 1 | | | | | K) | yeal | | 1936.33 | 7 |
| Water | heating | fuel use | d | | | | | | | | | | 1941.57 | Ī |
| Electri | city for | pumps, fa | ans and | electric | keep-ho | t | | | | | | | | _ |
| centra | al heatir | ng pump | : | | | | | | | | | 30 | | (230c) |
| boiler | with a | fan-assis | sted flue | | | | | | | | | 45 | | (230e) |
| Total e | electricit | y for the | above, l | kWh/yea | r | | | sum | of (230a). | (230g) = | | | 75 | (231) |
| Electri | city for I | lighting | | | | | | | | | | | 333.64 | (232) |
| 12a. | CO2 en | nissions - | – Individ | ual heat | ing syste | ems inclu | uding mi | cro-CHP |) | | | | | - |
| | | | | | | En kW | lergy /h/year | | | Emiss kg CO | ion fac 2/kWh | tor | Emissions kg CO2/yea | ar |
| Space | heating | g (main s | ystem 1 |) | | (21 | 1) x | | | 0.2 | 16 | = | 418.25 | (261) |
| Space | heating | g (second | dary) | | | (21 | 5) x | | | 0.5 | 19 | = | 0 | (263) |
| Water | heating | I | | | | (21 | 9) x | | | 0.2 | 16 | = | 419.38 | (264) |
| Space | and wa | ater heati | ng | | | (26 | 1) + (262) | + (263) + (| 264) = | | | | 837.63 | (265) |

| Electricity for pumps, fans and electric keep-hot | (231) | x | 0.519 = | 38.93 | (267) |
|---|-------|---|---------------------|---------|-------|
| Electricity for lighting | (232) | x | 0.519 = | 173.16 | (268) |
| Total CO2, kg/year | | | sum of (265)(271) = | 1049.71 | (272) |
| Dwelling CO2 Emission Rate | | | (272) ÷ (4) = | 13.79 | (273) |
| EI rating (section 14) | | | | 88 | (274) |
| | | | | | |



| | | ι | Jser De | etails: | | | | | | |
|--|--|-----------------------------|----------------------|------------------------|----------------------|---------------|--------------|-----------|------------------------|----------------------|
| Assessor Name: Software Name: | Stroma FSAP 201 | 2 | ļ | Stroma Softwa | a Num ire Ver | ber: sion: | | Versio | n: 1.0.3.11 | |
| | | Pro | perty A | Address: | Arlingto | n 3 Bed | MID 76 | | | |
| Address : | | | | | | | | | | |
| 1. Overall dwelling dime | ensions: | | - | () | | | | | | |
| Cround floor | | | Area | (m²) | (4 -) | Av. Hei | ight(m) | | Volume(m ³ | $\frac{1}{2}$ |
| | · · · · · · · · · · · · · · · · · · · | · · · · · | / | 6.1 | (1a) X | 2 | 2.3 | (2a) = | 175.03 | _(3a) |
| Total floor area TFA = (1 | a)+(1b)+(1c)+(1d)+(1e | e)+(1n) | 7 | 6.1 | (4) | | | | | |
| Dwelling volume | | | | | (3a)+(3b) | +(3c)+(3d |)+(3e)+ | .(3n) = | 175.03 | (5) |
| 2. Ventilation rate: | | | | | | | | | | |
| | main so heating h | econdary leating | (| other | | total | | | m ³ per hou | ٢ |
| Number of chimneys | | 0 | + | 0 |] = [| 0 | x 4 | 40 = | 0 | (6a) |
| Number of open flues | 0 + | 0 | + | 0 |] = [| 0 | x 2 | 20 = | 0 | (6b) |
| Number of intermittent fa | ans | | | | , r | 3 | x 1 | 10 = | 30 | (7a) |
| Number of passive vents | 3 | | | | | 0 | x 1 | 10 = | 0 | _ (7b) |
| Number of flueless gas f | ires | | | | | 0 | x 4 | 40 = | 0 | (7c) |
| | | | | | | | | Air ch | anges per ho | ur |
| Infiltration due to chimne | ys, flues and fans = (6 | a)+(6b)+(7a) | +(7b)+(7 | (c) = | | 30 | - | ÷ (5) = | 0.17 | (8) |
| Number of storeys in t Additional infiltration | he dwelling (ns) | ed, proceed t | 0 (17), 0 | therwise c | ontinue fro | om (9) to (| 16) [(9)- | -1]x0.1 = | 0 | (9) (10) |
| Structural infiltration: C if both types of wall are p | 1.25 for steel or timber in present, use the value corres | frame or 0 ponding to th | .35 for ne greate | masonr er wall area | y constr a (after | uction | | | 0 | (11) |
| If suspended wooden | floor. enter 0.2 (unseal | ed) or 0.1 | (seale | d). else (| enter 0 | | | | 0 | (12) |
| If no draught lobby, en | ter 0.05, else enter 0 | , | (| -,, | | | | | 0 | (13) |
| Percentage of window | s and doors draught st | ripped | | | | | | | 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 cub | oic metres | per ho | ur per so | quare m | etre of e | nvelope | area | 5 | (17) |
| If based on air permeabi | lity value, then $(18) = [(1)]$ | 7) ÷ 20]+(8), | otherwis | se (18) = (* | 16) | | | | 0.42 | (18) |
| Air permeability value applie | es if a pressurisation test has | s been done (| or a deg | ree air per | meability | is being us | sed | | | |
| Shelter factor | 30 | | (| (20) = 1 - [| 0.075 x (1 | 9)] = | | | 2 | (19) |
| Infiltration rate incorpora | ting shelter factor | | (| (21) = (18) | x (20) = | | | | 0.00 | $\Box_{(21)}^{(20)}$ |
| Infiltration rate modified t | for monthly wind speed | ł | | . , . , | . , | | | | 0.50 | |
| Jan Feb | Mar Apr May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Monthly average wind sp | beed 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 $(22a)m = (2a)m =$ | | · · · · · · · | | | | | | | I | |
| (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 | | | | • | - | 1 | |

| Adjust | ed infiltr | ation rat | e (allowi | ing for sl | nelter an | d wind s | peed) = | (21a) x | (22a)m | | | | _ | |
|----------------------|--------------------------|----------------------------|---------------------------|--------------------------|-----------------------|----------------|-------------|-----------------|----------------|-------------------|------------------|--------------------|----------|---------------|
| | 0.46 | 0.45 | 0.44 | 0.39 | 0.39 | 0.34 | 0.34 | 0.33 | 0.36 | 0.39 | 0.4 | 0.42 | | |
| Calcul If m | ate effe | ctive air al ventila | change | rate for t | he appli | cable ca | se | | | | | | 0 | (220) |
| lf exh | aust air h | eat pump i | using App | endix N. (2 | 23b) = (23a |) x Fmv (e | equation (N | (5)) othe | rwise (23b |) = (23a) | | | 0 | (23a) |
| If bala | anced with | n heat reco | overv: effic | iencv in % | allowing f | or in-use fa | actor (from | n Table 4h |) = |) (200) | | | 0 | (230) |
| a) If | halance | nech: | anical ve | ntilation | with he | at recove | ⊃rv (M\/⊦ | HR) (24a | / a)m = (22 | 2h)m + (| 23h) 🗙 [′ | 1 – (23c) | 1001 | (230) |
| (24a)m= | | | | 0 | 0 | 0 | 0 | 0 | | | | 0 |] | (24a) |
| b) If | balance | L d mech: | l anical ve | I | without | heat rec | :overv (N | L /\\/) (24b | l = (22) | I 2b)m + (; | L 23b) | I | 1 | |
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |] | (24b) |
| c) If | whole h | i ouse ex | tract ver | ntilation of | or positiv | e input v | /entilatic | n from c | utside | | | | 1 | |
| -, | if (22b)r | n < 0.5 × | : (23b), t | hen (24 | c) = (23b |); otherv | vise (24 | c) = (22b | 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 | se positiv | ve input | ventilatio | on from I | oft | - | - | - | - | |
| | if (22b)r | n = 1, th | en (24d) | m = (22 | b)m othe | rwise (2 | 4d)m = (| 0.5 + [(2 | 2b)m² x | 0.5] | | | 1 | (N |
| (24d)m= | 0.6 | 0.6 | 0.6 | 0.58 | 0.57 | 0.56 | 0.56 | 0.55 | 0.56 | 0.57 | 0.58 | 0.59 | | (24d) |
| Effe | ctive air | change | rate - er | nter (24a | ı) or (24b | o) or (240 | c) or (24 | d) in box | (25) | | | | 1 | |
| (25)m= | 0.6 | 0.6 | 0.6 | 0.58 | 0.57 | 0.56 | 0.56 | 0.55 | 0.56 | 0.57 | 0.58 | 0.59 | J | (25) |
| 3. He | at l <mark>osse</mark> | s and he | at loss | paramet | er: | | | | | | | | | |
| ELEN | | Gros are <mark>a</mark> | ss (m²) | Openin m | igs 1 ² | Net Ar A ,r | ea n² | U-valı W/m2 | ue K | A X U (W/I | K) | k-value kJ/m²·l | e K | A X k kJ/K |
| Doo <mark>rs</mark> | | | | | | 1.89 | x | 1 | = [| 1.89 | | | | (26) |
| Windo | <mark>ws</mark> Type | e 1 | | | | 4.41 | x1/ | /[1/(1.4)+ | 0.04] = | 5.85 | | | | (27) |
| Windo | ws Type | e 2 | | | | 4.41 | x1/ | /[1/(1.4)+ | 0.04] = | 5.85 | F | | | (27) |
| Windo | ws Type | e 3 | | | | 4.41 | x1/ | /[1/(1.4)+ | 0.04] = | 5.85 | 5 | | | (27) |
| Windo | ws Type |) 4 | | | | 2.52 | x1/ | /[1/(1.4)+ | 0.04] = | 3.34 | = | | | (27) |
| Walls | | 56.3 | 6 | 17.6 | 4 | 38.72 | 2 X | 0.18 | | 6.97 | Ξ r | | | (29) |
| Total a | area of e | elements | , m² | | | 56.36 | ; | | | | | | | (31) |
| Party v | wall | | | | | 38.24 | × | 0 | = [| 0 | | | | (32) |
| Party f | loor | | | | | 76.1 | | | I | | | | \dashv | (32a) |
| Party of | ceiling | | | | | 76.1 | | | | | Ĺ | | \dashv | (32b) |
| * for win | dows and | l roof wind | ows, use e | effective wi | indow U-va | lue calcula | ated using | formula 1 | /[(1/U-valu | ıe)+0.04] a | L as given in | paragraph | n 3.2 | |
| ** incluc | le the area | as on both | sides of ir | nternal wal | ls and part | itions | | | | | | | | |
| Fabric | heat los | ss, W/K : | = S (A x | U) | | | | (26)(30) |) + (32) = | | | | 29.74 | (33) |
| Heat c | apacity | Cm = S(| Axk) | | | | | | ((28) | (30) + (32 | 2) + (32a). | (32e) = | 12289.4 | 5 (34) |
| Therm | al mass | parame | ter (TMI | ⁻ = Cm - | - TFA) in | ı kJ/m²K | | | Indica | tive Value | : Medium | | 250 | (35) |
| For desi can be ι | ign asses: used inste | sments wh ad of a de | ere the de tailed calc | tails of the ulation. | constructi | on are not | t known pr | ecisely the | e indicative | e values of | TMP in Ta | able 1f | | |
| Therm | al bridg | es : S (L | x Y) cal | culated | using Ap | pendix ł | < | | | | | | 4 | (36) |
| if details | of therma | al bridging | are not kr | 10wn (36) = | = 0.15 x (3 | 1) | | | (22) · | (26) - | | | - | |
| Vontile | abilit ne | at loce or | alculator | monthly | | | | | (33) + | (30) = | 25)m v (5) | | 33.74 | (37) |
| venula | | | Mor | | y Mov | lun | [11] | Δυσ | (30)M | $= 0.33 \times ($ | 20)III X (5) | Doo | 1 | |
| | Jan | | iviai | Г чы | iviay | Jun | Jui | Aug | Seh | | | Dec | J | |

| (38)m= | 34.9 | 34.67 | 34.44 | 33.36 | 33.16 | 32.22 | 32.22 | 32.05 | 32.59 | 33.16 | 33.57 | 34 | | (38) |
|----------------|--------------------------------|--------------------------------|---------------|------------------|----------------|-----------------------------------|-------------------|-------------|-----------------------|---------------------------|------------------------|-------------|---------|------|
| Heat tra | ansfer o | coefficie | nt, W/K | | | | | | (39)m | = (37) + (3 | 38)m | | | |
| (39)m= | 68.64 | 68.4 | 68.18 | 67.1 | 66.9 | 65.96 | 65.96 | 65.79 | 66.32 | 66.9 | 67.3 | 67.73 | | |
| Hoot lo | | motor (l | אי (סוב) | /m2k | | | | | (40)m | Average = | Sum(39)1 | 12 /12= | 67.1 | (39) |
| (40)m= | 0.9 | | 0.9 | 0.88 | 0.88 | 0.87 | 0.87 | 0.86 | 0.87 | = (39)III ÷ | 0.88 | 0.89 | | |
| (, | 0.0 | 0.0 | 0.0 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | | Average = | Sum(40)1 | 12 /12= | 0.88 | (40) |
| Numbe | r of day | /s in mo | nth (Tab | le 1a) | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | | (41) |
| | | | | | | | | | | | | | | |
| 4. Wa | ter hea | ting ene | rgy requ | irement: | | | | | | | | kWh/ye | ar: | |
| Assum if TF | ed occu A > 13. A £ 13 : | upancy, 9, N = 1 9 N = 1 | N + 1.76 x | : [1 - exp | (-0.0003 | 849 x (TF | FA -13.9) |)2)] + 0.(|)013 x (⁻ | TFA -13. | 2. 9) | .38 | | (42) |
| Annual | averag | je hot wa | ater usag | ge in litre | es per da | ay Vd,av | erage = | (25 x N) | + 36 | | 90 |).84 | | (43) |
| Reduce a | the annua | al average litres per | hot water | usage by a | 5% if the a | welling is | designed t Id) | to achieve | a water us | se target o | f | | | |
| | | | | | Maier use, r | | | A | 0.00 | Ort | New | | | |
| Hot wate | Jan r usage i | n litres per | r day for ea | Apr ach month | Vd,m = fa | ctor from T | Jui Table 1c x | Aug (43) | Sep | Oct | INOV | Dec | | |
| (44)m= | 99.92 | 96.29 | 92.65 | 89.02 | 85.39 | 81.75 | 81.75 | 85.39 | 89.02 | 92.65 | 96.29 | 99.92 | | |
| (, | 00.02 | 00.20 | 02.00 | 00.02 | 00.00 | oniro | | 00.00 | | Total = Su | m(44) ₁₁₂ = | 00.02 | 1090.04 | (44) |
| Energy c | ontent of | ^t hot water | used - cal | lculated mo | onthly $= 4$. | 190 x Vd,r | n x nm x D |)Tm / 3600 | kWh/mor | oth (<mark>see Ta</mark> | bles 1b, 1 | c, 1d) | | |
| (45)m= | 148.18 | 129.6 | 133.73 | 116.59 | 111.87 | 96.54 | 89.46 | 102.65 | 103.88 | 121.06 | 132.15 | 143.5 | | |
| lf instant | aneous v | vater heati | ina at noint | t of use (no | hot water | r storage) | enter () in | hoxes (46 |) to (61) | Tota <mark>l = S</mark> u | m(45) ₁₁₂ = | = | 1429.21 | (45) |
| (46)- | 22.22 | | | 17.40 | 16 70 | 1 / 1 / 1 / 1 / 1 / 1 / 1 / 1 / 1 | 12 42 | 15 4 | 15 59 | 10.16 | 10.92 | 21.52 | | (46) |
| Water s | storage | loss: | 20.00 | 17.49 | 10.70 | 14.40 | 13.42 | 15.4 | 15.56 | 10.10 | 19.02 | 21.55 | | (40) |
| Storage | e volum | ne (litres) |) includir | ng any so | olar or W | /WHRS | storage | within sa | ame ves | sel | | 0 | | (47) |
| If comm | nunity ł | neating a | and no ta | ank in dw | velling, e | nter 110 | litres in | (47) | | | | | | |
| Otherw | ise if no | o stored | hot wate | er (this ir | icludes i | nstantar | neous co | mbi boil | ers) ente | er '0' in (| 47) | | | |
| a) If m | anufact | turer's de | eclared I | oss facto | or is kno | wn (kWł | n/dav): | | | | | 0 | | (48) |
| Tempe | rature f | actor fro | m Table | 2b | | | , , , . | | | | | 0 | | (49) |
| Energy | lost fro | om water | r storage | e, kWh/ye | ear | | | (48) x (49) | = | | | 0 | | (50) |
| b) If m | anufact | turer's de | eclared of | cylinder l | oss fact | or is not | known: | | | | L | | | |
| Hot wa | ter stor | age loss | s factor fr | rom Tabl | e 2 (kW | h/litre/da | ıy) | | | | | 0 | | (51) |
| Volume | e factor | from Ta | ble 2a | 011 4.5 | | | | | | | | 0 | | (52) |
| Tempe | rature f | actor fro | m Table | 2b | | | | | | | | 0 | | (53) |
| Energy | lost fro | om water | r storage | e, 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 | r contain | s dedicate | d solar sto | orage, (57)i | m = (56)m | x [(50) – (| H11)] ÷ (50 | 0), else (5 | 7)m = (56) | m where (| H11) is fro | om Appendix | κΗ | |
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (57) |

| Primar | rimary circuit loss (annual) from Table 3 | | | | | | | | | | | | | (58) |
|---------------------|---|-----------|------------|-------------|-----------|-----------|-------------|-------------|--------------|---------------------------|--------------|----------|---------------|------|
| Primar | y circuit | loss cal | culated | for each | month (| 59)m = (| (58) ÷ 36 | 65 × (41) | m | | | | | |
| (moo | dified by | factor fi | rom Tab | le H5 if t | here is s | solar wat | ter heatii | 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 | culated | for each | month (| 61)m = | (60) ÷ 36 | 65 × (41) |)m | | | | | | |
| (61)m= | 50.92 | 44.32 | 47.22 | 43.9 | 43.51 | 40.32 | 41.66 | 43.51 | 43.9 | 47.22 | 47.48 | 50.92 | | (61) |
| Total h | eat requ | uired for | water he | eating ca | alculated | l for eac | h month | (62)m = | 0.85 × (| (45)m + | (46)m + | (57)m + | (59)m + (61)m | |
| (62)m= | 199.1 | 173.92 | 180.95 | 160.49 | 155.39 | 136.85 | 131.12 | 146.16 | 147.78 | 168.28 | 179.63 | 194.42 | | (62) |
| Solar DH | Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating) | | | | | | | | | | | | | |
| (add a | 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 w | ater hea | ter | - | | | - | - | | | - | - | ' | |
| (64)m= | 199.1 | 173.92 | 180.95 | 160.49 | 155.39 | 136.85 | 131.12 | 146.16 | 147.78 | 168.28 | 179.63 | 194.42 | | |
| | | | | | | | | Outp | out from wa | ater heate | r (annual)₁ | 12 | 1974.08 | (64) |
| Heat g | ains fro | m water | heating, | kWh/mo | onth 0.2 | 5 ´ [0.85 | × (45)m | + (61)m | n] + 0.8 x | (46)m | + (57)m | + (59)m |] | |
| (65)m= | 62 | 54.17 | 56.27 | 49.74 | 48.08 | 42.18 | 40.16 | 45.01 | 45.51 | 52.06 | 55.81 | 60.44 | | (65) |
| in <mark>clu</mark> | ide (57)i | m in calc | culation | of (65)m | only if c | vlinder i | s in the o | dwelling | or hot w | ate <mark>r is f</mark> r | om com | munity h | eating | |
| 5 Int | ernal da | ains (see | Table f | and 5a | | , | | 9 | | | | 5 | 5 | - |
| Motob | | o (Toblo | | | | | | | | | | | | |
| Metabo | Jiic gain | Feb | Mar | Apr | May | Jun | lul | Αυσ | Sen | Oct | Nov | Dec | | |
| (66)m= | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | | (66) |
| Lightin | a daine | (calcula | ted in Ar | pendix | | | r (9a) -a | | Table 5 | | | | | |
| (67)m= | 18.89 | 16.78 | 13.65 | 10.33 | 2, Equal | 6.52 | 7 04 | 9 16 | 12 29 | 15.61 | 18 21 | 19.42 | | (67) |
| | | | | | | untion L | 12 or 1 | 20) 000 | | | 10.21 | 10.12 | | () |
| | 211 1 | 213 20 | | | 181 18 | 167.24 | 15 UI LI | 3a), aisc | 161 26 | 173.01 | 187.84 | 201 78 | 1 | (68) |
| | 211.1 | 213.23 | | | | 107.24 | or 1 4 5 o | | | F | 107.04 | 201.70 | | (00) |
| COOKIN | | | | ppenaix | L, equai | | |), also se | | 5 | 24.00 | 24.00 | l | (60) |
| (69)m= | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | I | (09) |
| Pumps | and fai | ns gains | (Table 5 | ba) | | | | | | | | | 1 | (70) |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | | (70) |
| Losses | s e.g. ev | aporatio | n (nega | tive valu | es) (Tab | le 5) | | | | | 1 | 1 | 1 | |
| (71)m= | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | | (71) |
| Water | heating | gains (T | able 5) | | | - | | - | | | | | | |
| (72)m= | 83.33 | 80.61 | 75.63 | 69.09 | 64.62 | 58.58 | 53.98 | 60.5 | 63.21 | 69.97 | 77.51 | 81.24 | | (72) |
| Total i | nternal | gains = | | | | (66) | m + (67)m | n + (68)m + | + (69)m + (| (70)m + (7 | 1)m + (72) | m | | |
| (73)m= | 375.09 | 372.45 | 358.82 | 337.2 | 315.29 | 294.11 | 280.72 | 287.16 | 298.53 | 320.35 | 345.34 | 364.21 | | (73) |
| 6. Sol | lar gains | 8: | | | | | | | | | | | | |
| Solar g | ains are o | alculated | using sola | r flux from | Table 6a | and assoc | iated equa | tions to co | onvert to th | e applicat | ole orientat | ion. | | |

| Orientation: | Access Factor Table 6d | • | Area m² | | Flux Table 6a | | g_ Table 6b | FF Table 6c | | | | |
|----------------|---------------------------|---|------------|---|------------------|---|----------------|----------------|-----|---|-------|------|
| Southeast 0.9x | 0.77 | x | 4.41 | x | 36.79 | × | 0.63 | × | 0.7 | = | 49.59 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 62.67 | × | 0.63 | × | 0.7 | = | 84.47 | (77) |

| Southeast 0.9x | 0.77 | x | 4.41 | x | 85.75 | x | 0.63 | x | 0.7 | = | 115.57 | (77) |
|---------------------------|------|----------|------|---|--------|---|------|---|-----|-----|--------|-----------|
| Southeast 0.9x | 0.77 | x | 4.41 | x | 106.25 | × | 0.63 | x | 0.7 | i = | 143.2 |] (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 119.01 | x | 0.63 | x | 0.7 | = | 160.4 | - (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 118.15 | × | 0.63 | x | 0.7 |] = | 159.24 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 113.91 | × | 0.63 | x | 0.7 |] = | 153.52 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 104.39 | × | 0.63 | x | 0.7 | = | 140.69 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 92.85 | x | 0.63 | x | 0.7 | = | 125.14 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 69.27 | x | 0.63 | x | 0.7 | = | 93.36 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 44.07 | × | 0.63 | x | 0.7 |] = | 59.4 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 31.49 | × | 0.63 | x | 0.7 | = | 42.44 | (77) |
| Southwest0.9x | 0.77 | x | 2.52 | x | 36.79 | | 0.63 | x | 0.7 | = | 28.34 | (79) |
| Southwest0.9x | 0.77 | x | 2.52 | x | 62.67 | | 0.63 | x | 0.7 | = | 48.27 | (79) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 85.75 | | 0.63 | x | 0.7 | = | 66.04 | (79) |
| Southwest0.9x | 0.77 | x | 2.52 | x | 106.25 | | 0.63 | x | 0.7 | = | 81.83 | (79) |
| Southwest0.9x | 0.77 | x | 2.52 | x | 119.01 | | 0.63 | x | 0.7 | = | 91.66 | (79) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 118.15 | | 0.63 | x | 0.7 | = | 90.99 | (79) |
| Southwest0.9x | 0.77 | x | 2.52 | x | 113.91 | | 0.63 | x | 0.7 | = | 87.73 | (79) |
| Southwest0.9x | 0.77 | x | 2.52 | X | 104.39 | | 0.63 | x | 0.7 |] = | 80.4 | (79) |
| Southwest0.9x | 0.77 | x | 2.52 | x | 92.85 | | 0.63 | x | 0.7 | = | 71.51 | (79) |
| Southwest0.9x | 0.77 | x | 2.52 | x | 69.27 | | 0.63 | x | 0.7 | = | 53.35 | (79) |
| Southwest0.9x | 0.77 |] x | 2.52 | x | 44.07 | | 0.63 | x | 0.7 | = | 33.94 | (79) |
| Southwest0.9x | 0.77 | x | 2.52 | × | 31.49 | | 0.63 | x | 0.7 |] = | 24.25 | (79) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 11.28 | × | 0.63 | x | 0.7 | = | 15.21 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 11.28 | × | 0.63 | x | 0.7 | = | 15.21 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 22.97 | x | 0.63 | x | 0.7 | = | 30.95 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 22.97 | x | 0.63 | x | 0.7 | = | 30.95 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 41.38 | × | 0.63 | x | 0.7 | = | 55.77 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 41.38 | x | 0.63 | x | 0.7 | = | 55.77 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 67.96 | x | 0.63 | x | 0.7 | = | 91.59 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 67.96 | × | 0.63 | x | 0.7 | = | 91.59 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 91.35 | x | 0.63 | x | 0.7 | = | 123.11 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 91.35 | x | 0.63 | x | 0.7 | = | 123.11 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 97.38 | × | 0.63 | x | 0.7 |] = | 131.25 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 97.38 | × | 0.63 | x | 0.7 |] = | 131.25 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 91.1 | × | 0.63 | x | 0.7 | = | 122.78 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 91.1 | × | 0.63 | x | 0.7 | = | 122.78 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 72.63 | × | 0.63 | x | 0.7 |] = | 97.88 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 72.63 | × | 0.63 | x | 0.7 | = | 97.88 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | × | 50.42 | × | 0.63 | x | 0.7 | = | 67.95 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 50.42 | x | 0.63 | x | 0.7 | = | 67.95 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | × | 28.07 | × | 0.63 | x | 0.7 | = | 37.83 | (81) |

| Northwest 0.9x 0.77 | | | x | 4.4 | 1 | x | 2 | 28.07 | x | 0.63 | x | 0.7 | = | 37.83 | (81) | |
|--|------------------------|------------|----------|-----------|----------------------|-------------------|------------|-----------|-----------|--------------|--------------------|----------------------|-------------|------------|---------|------|
| Northwest 0.9x 0.77 | | | x | 4.4 | 1 | x | | 14.2 | × | 0.63 | | 0.7 | = | 19.13 | (81) | |
| Northwest 0.9x 0.77 | | | x | 4.4 | 1 | x | · · | 14.2 | × | 0.63 | | 0.7 | = | 19.13 | (81) | |
| Northwest 0.9x 0.77 | | | x | 4.4 | 1 | x | 9 | 9.21 | × [| 0.63 | | 0.7 | = | 12.42 | (81) | |
| Northw | est 0.9x | 0.77 | | x | 4.4 | 1 | x | 9 | 9.21 | × [| 0.63 | | 0.7 | = | 12.42 | (81) |
| | L | | | | | | | | | | | | | | | |
| Solar g | gains in | watts, ca | alculate | ed | for eacl | n montl | h | | | (83)m = S | um(74)m . | (82)m | | | | |
| (83)m= | 108.34 | 194.64 | 293.15 | 5 | 408.21 | 498.28 | 5 | 12.73 | 486.81 | 416.85 | 332.56 | 222.36 | 131.6 | 91.53 | | (83) |
| Total g | gains – i | nternal a | and sol | ar | (84)m = | = (73)m | + (| 83)m | , watts | | | | | | | |
| (84)m= | 483.43 | 567.09 | 651.97 | 7 | 745.41 | 813.57 | 8 | 06.84 | 767.53 | 704.01 | 631.09 | 542.71 | 476.94 | 455.74 | | (84) |
| 7. Me | ean inter | rnal temp | peratur | e (| heating | seaso | n) | | | | | | | | | |
| Temp | perature | during h | eating | ре | eriods ir | n the liv | ring | area | from Tab | ole 9, Th | 1 (°C) | | | | 21 | (85) |
| Utilisa | ation fac | ctor for g | ains fo | r li | ving are | ea, h1,r | n (s | ee Ta | ble 9a) | | | | | | | |
| | Jan | Feb | Mar | · | Apr | May | , <u> </u> | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (86)m= | 1 | 0.99 | 0.97 | 1 | 0.9 | 0.73 | | 0.52 | 0.38 | 0.43 | 0.7 | 0.94 | 0.99 | 1 | | (86) |
| Mean | interns | l temper | ature i | _ Li | ving ar | | follo | w sta | ns 3 to 7 | r in Tahl | e 9c) | | | | 1 | |
| (87)m= | 20.14 | 20.3 | 20.54 | Т | 20.81 | 20.96 | T | 21 | 21 | 21 | 20.98 | 20.76 | 20.4 | 20.12 | | (87) |
| Taraa | | | | _ | a ni a ala i in | we at a | | e ll'in a | | | | | Į | I | l | |
| | 20.17 | 20 17 | 20 17 | pe T | 20 18 | 1 rest 0 | | | | DIE 9, 1 | $n_{2}(^{\circ}C)$ | 20.10 | 20.18 | 20.18 | | (88) |
| (00)11- | 20.17 | 20.17 | 20.17 | _ | 20.10 | 20.10 | | 20.2 | 20.2 | 20.2 | 20.15 | 20.13 | 20.10 | 20.10 | | (00) |
| Utilisa | ation fac | ctor for g | ains fo | r re | est of d | welling. | , h2 | m (se | e Table | 9a) | | | | | 1 | (00) |
| (89)m= | | 0.99 | 0.96 | | 0.87 | 0.67 | | 0.46 | 0.31 | 0.35 | 0.63 | 0.92 | 0.99 | 1 | | (09) |
| Me <mark>an</mark> | interna | l temper | ature i | n tl | he rest | of dwel | lling | T2 (f | ollow ste | eps 3 to | 7 in Tabl | le 9 <mark>c)</mark> | | 1 | | |
| (90)m= | 19.02 | 19.25 | 19.6 | | 19.97 | 20.15 | 2 | 20.19 | 20.2 | 20.2 | 20.17 | 19.92 | 19.41 | 18.99 | | (90) |
| | | | | | | | | | | | | fLA = Livir | ig area ÷ (| 4) = | 0.33 | (91) |
| Mean | interna | l temper | ature (| for | the wh | ole dw | ellin | g) = fl | LA × T1 | + (1 – fL | A) × T2 | | | | | |
| (92)m= | 19.39 | 19.6 | 19.91 | | 20.25 | 20.41 | 2 | 20.46 | 20.46 | 20.46 | 20.44 | 20.2 | 19.73 | 19.36 | | (92) |
| Apply | v adjustr | ment to t | he mea | an | internal | tempe | ratu | ire fro | m Table | 4e, whe | ere appro | opriate | | | 1 | |
| (93)m= | 19.39 | 19.6 | 19.91 | | 20.25 | 20.41 | 2 | 20.46 | 20.46 | 20.46 | 20.44 | 20.2 | 19.73 | 19.36 | | (93) |
| 8. Sp | ace hea | ating requ | uireme | nt | | | | | | - | | | | | | |
| Set I | i to the tilisatior | mean int | ernal te | em s u | iperatur Ising Ta | e obtai ble 9a | ined | at ste | ep 11 of | I able 9 | b, so tha | it II,m=(| 76)m an | d re-calo | culate | |
| | Jan | Feb | Mar | | Apr | Mav | , | Jun | Jul | Aua | Sep | Oct | Nov | Dec | | |
| Utilisa | ation fac | ctor for g | ains, h | m: | | | _ | | | | F | | | | l | |
| (94)m= | 0.99 | 0.99 | 0.96 | Τ | 0.87 | 0.69 | | 0.48 | 0.33 | 0.38 | 0.65 | 0.92 | 0.99 | 1 | | (94) |
| Usefu | ul gains, | hmGm | , W = (| 94 |)m x (84 | 4)m | | | | | | | | | 1 | |
| (95)m= | 481.01 | 559.66 | 626.44 | t | 649.37 | 560.52 | 3 | 84.42 | 254.43 | 266.79 | 408.96 | 501.15 | 471.16 | 454.09 | | (95) |
| Montl | hly aver | age exte | rnal te | mp | perature | e from T | Fabl | e 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 rat | e for mea | an inte | rna | al tempe | erature, | , Lm | ı , W = | =[(39)m : | x [(93)m | – (96)m |] | i | i | 1 | |
| (97)m= | 1035.46 | 1005.4 | 913.99 | <u>}</u> | 761.59 | 582.99 | 3 | 86.31 | 254.59 | 267.14 | 420.34 | 641.93 | 850.21 | 1026.56 | | (97) |
| Space | e heatir | ig require | ement | for | each m | nonth, k | wh ۲ | /mont | th = 0.02 | 24 x [(97 |)m – (95 | 5)m] x (4 | 1)m | 407 | 1 | |
| (98)m= | 412.52 | 299.53 | 213.94 | ł | 80.8 | 16.71 | | 0 | 0 | 0 | 0 | 104.74 | 272.92 | 425.92 | 4007.00 | |
| | | | | | | | | | | Tota | al per year | (kWh/yea | r) = Sum(9 | 8)15,912 = | 1827.08 | (98) |
| Space heating requirement in kWh/m²/year | | | | | | | | | | | 24.01 | (99) | | | | |
| 9a. En | ergy reo | quiremer | nts – Ind | ividual h | eating sy | /stems i | ncluding | micro-C | HP) | | | | | |
|--|--------------------|--------------------|-------------------------------|---------------|-----------|-----------|------------------------|-------------|------------|------------------------|-------------------------|-----------|--------------------------------|-------------------|
| Spac | e heatii | ng: | t frage - | | 40.00-1- | m 0 - 1 | | | | | | | | |
| Fracti | ion of sp | | it from S | econdar | y/supple | mentary | system | (202) = 1 | _ (201) - | | | | 0 | |
| Fracti | ion of sp | bace hea | it from m | nain syst | em(s) | | | (202) = 1 - | -(201) = | (202)] | | | 1 | (202) |
| Fracti | ion of to | tal heati | ng from | main sys | stem 1 | | | (204) = (20 | 02) × [1 – | (203)] = | | | 1 | (204) |
| Efficie | ency of | main spa | ace heat | ing syste | em 1 | | | | | | | | 93.4 | (206) |
| Efficie | ency of : | seconda 1 | ry/suppl r | ementar 1 | y heating | g system | n, % r | | | | | I | 0 | (208) |
| Creek | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/yea | ar |
| Space | e neatin 412.52 | g require | 213 94 | | d above) | 0 | 0 | 0 | 0 | 104 74 | 272 92 | 425 92 |] | |
| (211)m | | m x (20) | /)] \ v 1 | | | • | Ů | Ŭ | Ŭ | 101.11 | 272.02 | 120.02 | | (211) |
| (211)11 | 441.67 | 320.7 | 229.06 | 86.51 | 17.89 | 0 | 0 | 0 | 0 | 112.14 | 292.21 | 456.02 | | (211) |
| | | | | | | | | Tota | l (kWh/yea | l ar) =Sum(2 | 211) _{15,1012} | <u></u> = | 1956.19 | (211) |
| Space | e heatin | g fuel (s | econdar | y), kWh/ | month | | | | | | | | | |
| = {[(98 |)m x (20 | 01)] } x 1 | 00 ÷ (20 |)8) | | | | | | - | - | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | - |
| | | | | | | | | Tota | l (kWh/yea | ar) =Sum(2 | 215) _{15,1012} | 7 | 0 | (215) |
| Water heating Output from water heater (calculated above) | | | | | | | | | | | | | | |
| Output | 199.1 | ater nea 173.92 | 180.95 | 160.49 | 155.39 | 136.85 | 131.12 | 146.16 | 147.78 | 168.28 | 179.63 | 194.42 | | |
| Efficier | ncy of w | i ater hea | iter | | | | | | | | | <u> </u> | 80.3 | (216) |
| (217)m= | 86.84 | 86.41 | 85.47 | 83.42 | 81.18 | 80.3 | 80.3 | 80.3 | 80.3 | 83.9 | 86.1 | 86.97 | | (217) |
| Fuel fo | or water | heating, | kWh/m | onth | | | | | | | | • | 1 | |
| (219)m | 1 = (64) | m x 100 |) ÷ (217) 211 7 | m | 101 41 | 170.43 | 163.28 | 182.02 | 184.03 | 200.58 | 208.63 | 223 55 | | |
| (213)11- | 223.20 | 201.27 | 211.7 | 102.00 | 101.41 | 170.43 | 103.20 | Tota | I = Sum(2 | 19a) _{1 12} = | 200.00 | 220.00 | 2358.55 | (219) |
| Annua | al totals | | | | | | | | · | k | Wh/vear | | kWh/vear | |
| Space | heating | fuel use | ed, main | system | 1 | | | | | | | | 1956.19 | 7 |
| Water | heating | fuel use | d | | | | | | | | | | 2358.55 | Ī |
| Electri | city for p | oumps, fa | ans and | electric | keep-ho | t | | | | | | | | |
| centra | al heatir | na numn | | | • | | | | | | | 30 |] | (230c) |
| boiler | with a f | an-accie | tod fluo | | | | | | | | | 45 |] | (230e) |
| | | | | 111 h h i a a | _ | | | cum | of (220a) | (220a) - | | 40 | | |
| i otal e | ectricit | y for the | above, i | kvvn/yea | ſ | | | Sum | 01 (230a). | (230 <u>y</u>) = | | | 75 | (231) |
| Electri | city for I | ighting | | | | | | | | | | | 333.64 | (232) |
| 12a. (| CO2 em | issions - | – Individ | ual heat | ing syste | ems inclu | uding mi | cro-CHP | | | | | | |
| | | | | | | En kW | ergy /h/year | | | Emiss kg CO | ion fac 2/kWh | tor | Emissions kg CO2/yea | ar |
| Space | heating | ı (main s | ystem 1 |) | | (21 | 1) x | | | 0.2 | 16 | = | 422.54 | (261) |
| Space | heating | (second | darv) | <u>.</u> | | (21 | 5) x | | | 0.5 | 19 | = | | $\frac{1}{(263)}$ |
| Water beating | | | | | | | | | | | | E00.45 | $\Box_{(264)}$ | |
| Space | and wa | tor boot | na | | | (26) | 1) + (262) | + (263) + (| 264) – | L0.2 | 10 | | 009.45 | |
| Space | and wa | ter heati | ng | | | (26 | 1) + (262) | + (263) + (| 264) = | | | | 931.98 | (265) |

| (231) x | 0.510 |] = | 28.02 | 7(267) |
|---------|---------------------|---|---|--|
| (232) x | 0.519 |] 1 _ | 470.40 | |
| (202) | 0.519 | | 173.16 | _(200) _(200) |
| | Sun Of (205)(271) = | | 1144.07 | (272) |
| | | | | _ |
| | | | 15.03 | (273) |
| | (231) x (232) x | (231) x 0.519 (232) x 0.519 sum of (265)(271) = | (231) x $0.519 =$ (232) x $0.519 =$ sum of (265)(271) = | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ |

Regulations Compliance Report

| Approved Document Printed on 22 June 2 | t L1A, 2013 Edition, 2018 at 10:46:50 | England assessed by St | troma FSAP 2012 program, Vers | ion: 1.0.3.11 |
|---|---|--|--|------------------------|
| Project Information | : | | | |
| Assessed By: | () | | Building Type: | Flat |
| Dwelling Details: | | | | |
| NEW DWELLING D | ESIGN STAGE | | Total Floor Area: 76 | .1m² |
| Site Reference : | Arlington Works, Tv | vickenham | Plot Reference: | Arlington 3 Bed TOP 76 |
| Address : | | | | |
| Client Details: | | | | |
| Name: Address : | Sharpes Refinery S | ervice | | |
| This report covers It is not a complete | items included wit report of regulation | hin the SAP calculation ons compliance. | IS . | |
| 1a TER and DER | | | | |
| Fuel for main heating | g system: Mains gas | 3 | | |
| Fuel factor: 1.00 (ma | ains gas) de Emission Pate (| | 16 67 ka/m² | |
| Dwelling Carbon Dick | xide Emission Rate | (DER) | 15.82 kg/m² | ОК |
| 1b TFEE and DFE | E | | Ŭ | |
| Target Fabric Energy Dwelling Fabric Ene | y Efficiency (TFEE) rgy Efficiency (DFEI | | 42.5 kWh/m ² 39.0 kWh/m ² | ОК |
| Element External wa Party wall Floor Roof Openings | | Average 0.17 (max. 0.30) 0.00 (max. 0.20) (no floor) 0.16 (max. 0.20) 1.42 (max. 2.00) | Highest 0.17 (max. 0.70) - 0.16 (max. 0.35) 1.60 (max. 3.30) | ок ок ок ок |
| 2a Thermal bridgi | ng | | | |
| Thermal bri | idging calculated fro | m linear thermal transmi | ttances for each junction | |
| 3 Air permeability Air permeabil | ity at 50 pascals | | 4.00 (design value | e) |
| Maximum | | | 10.0 | UK |
| 4 Heating efficient | су | Deteboool (rev 207 pre | duct index 010001) | |
| Main Heating | system: | Boiler systems with radi Brand name: Alpha Model: InTec 34C Model qualifier: (Combi) Efficiency 88.8 % SEDE Minimum 88.0 % | auct index 016661). iators or underfloor heating - mai | ns gas OK |
| Secondary he | eating system: | None | | |

Regulations Compliance Report

| 5 Cylinder insulation | | | | |
|-----------------------------------|--------------------|--------------------|---|-------|
| Hot water Storage: | No cylinder | | | |
| 6 Controls | | | | |
| | | | | |
| Space heating controls | Time and temper | rature zone contro | I by device in database | ОК |
| Hot water controls: | No cylinder | | , | |
| Boiler interlock: | Yes | | | ОК |
| 7 Low energy lights | | | | |
| Percentage of fixed lights with I | ow-energy fittings | | 100.0% | |
| Minimum | | | 75.0% | OK |
| 8 Mechanical ventilation | | | | |
| Not applicable | | | | |
| 9 Summertime temperature | | | | |
| Overheating risk (Thames valle | y): | | Medium | ОК |
| Based on: | | | | |
| Overshading: | | | Average or unknown | |
| Windows facing: North West | | | 4.41m ² | |
| Windows facing: North West | | | 4.41m ² | |
| Windows facing: South East | | | 4.41m ² | |
| Windows facing: South West | | | 2.52m ² | |
| Ventilation rate: | | | 3.00 | |
| Blinds/curtains: | | | None | |
| | | | Close <mark>d 100% of daylight</mark> l | hours |
| | | | | |
| 10 Key features | | | | |
| Party Walls U-value | | | 0 W/m²K | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

| | | | User D | etails: | | | | | | |
|----------------------------------|---------------------------------|--------------|--------------------|------------------|------------------|------------------|----------|-----------|------------------------|-------------------------|
| Assessor Name: Software Name: | Stroma FSAP 201 | 2 | : | Stroma Softwa | a Num ire Ver | ber: sion: | | Versio | n: 1.0.3.11 | |
| | | Pro | operty A | Address: | Arlingto | on 3 Bec | TOP 76 | 6 | | |
| Address : | | | | | | | | | | |
| 1. Overall dwelling dime | ensions: | | | | | | | | | |
| | | | Area | 1 (m²) | | Av. He | ight(m) | | Volume(m ³ |) |
| Ground floor | | | 7 | 6.1 | (1a) x | 2 | 2.3 | (2a) = | 175.03 | (3a) |
| Total floor area TFA = (1 | a)+(1b)+(1c)+(1d)+(1e | e)+(1n) | 7 | 6.1 | (4) | | | | | |
| Dwelling volume | | | | | (3a)+(3b) | +(3c)+(3c | l)+(3e)+ | .(3n) = | 175.03 | (5) |
| 2. Ventilation rate: | | | | | | | | | | |
| | main s | econdary | / | other | | total | | | m ³ per hou | r |
| Number of chimneys | | 0 | + [| 0 |] = [| 0 | x 4 | 40 = | 0 | (6a) |
| Number of open flues | 0 + | 0 | , + [| 0 |] = [| 0 | × | 20 = | 0 | (6b) |
| Number of intermittent fa | ins | | J L | | · _ | 2 | x / | 10 = | 20 | (7a) |
| Number of passive vents | i | | | | | 0 | x / | 10 = | 0 | (7b) |
| Number of flueless gas fi | res | | | | | 0 | X 4 | 40 = | 0 | (7c) |
| | | | | | _ | | | Air ch | anges per ho | our |
| Infiltration due to chimne | ys, flues and fans = (6 | a)+(6b)+(7a |) +(7 b)+(7 | (c) = | | 20 | | ÷ (5) = | 0.11 | (8) |
| If a pressurisation test has b | een carried out or is intende | ed, proceed | to (17), o | therwise c | ontinue fre | om (9) to (| (16) | | | - |
| Additional infiltration | ne dweiling (ns) | | | | | | [(0)] | 11×0.1 - | 0 | (9) |
| Structural infiltration: 0 | 25 for steel or timber | frame or (|) 35 for | masonr | v constr | uction | [(9) | -1]x0.1 = | 0 | -(10) |
| if both types of wall are p | resent, use the value corres | ponding to t | the greate | er wall area | a (after | Gottori | | | 0 | |
| deducting areas of openii | ngs); if equal user 0.35 | lad) ar 0 1 | | d) alaa | ontor O | | | | _ | |
| If suspended wooden i | tor 0.05 also optor 0 | ied) of 0.1 | (seale | a), eise | enter u | | | | 0 | (12) |
| Percentage of windows | s and doors draught st | trinned | | | | | | | 0 | $ - \frac{(13)}{(14)} $ |
| Window infiltration | s and doors draught s | inpped | (| 0.25 - [0.2 | x (14) ÷ 1 | 00] = | | | 0 | (14) |
| Infiltration rate | | | | (8) + (10) - | + (11) + (1 | - 2) + (13) - | + (15) = | | 0 | $= \frac{(10)}{(16)}$ |
| Air permeability value. | a50. expressed in cub | oic metres | per ho | ur per so | uare m | etre of e | envelope | area | 4 | |
| If based on air permeabil | lity value, then $(18) = [(1)]$ | 7) ÷ 20]+(8) | , otherwis | se (18) = (| 16) | | | | 0.31 | |
| Air permeability value applie | s if a pressurisation test ha | s been done | or a deg | ree air per | meability | is being u | sed | | | |
| Number of sides sheltere | ed | | | | | | | | 2 | (19) |
| Shelter factor | | | | (20) = 1 - [| 0.075 x (1 | 9)] = | | | 0.85 | (20) |
| Infiltration rate incorporat | ting shelter factor | | | (21) = (18) | x (20) = | | | | 0.27 | (21) |
| Infiltration rate modified f | or monthly wind speed | tt | | | | | | | l. | |
| Jan Feb | Mar Apr May | 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 $(22a)m = (2)$ | 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 (allowi | ing for sh | elter an | d wind s | peed) = | (21a) x | (22a)m | | | | | |
|------------------|------------------------|-------------------------|-------------------------|---------------|--------------|-------------|-------------|---------------|--------------|----------------|------------------------------|----------------------|------------|-----------|
| | 0.34 | 0.33 | 0.33 | 0.29 | 0.29 | 0.25 | 0.25 | 0.25 | 0.27 | 0.29 | 0.3 | 0.31 | | |
| Calcula If me | ate ette | ctive air al ventila | change | rate for t | he appli | cable ca | se | | | | | | 0 | (232) |
| lf exh | aust air h | eat pump | using App | endix N, (2 | 3b) = (23a |) × Fmv (e | equation (N | N5)) , othe | rwise (23b |) = (23a) | | | 0 | (23b) |
| lf bala | anced with | heat reco | overy: effic | iency in % | allowing for | or in-use f | actor (from | n Table 4h |) = | , , , | | | 0 | (23c) |
| a) If | balance | ed mech | , anical ve | entilation | with her | at recove | erv (MVI | HR) (24a |) m = (2) | 2b)m + (| 23b) x [[,] | 1 – (23c) | → 1001 | (200) |
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (24a) |
| b) If | balance | d mech | ı anical ve | entilation | without | heat rec | covery (N | и ЛV) (24b |)m = (22 | 1 2b)m + (2 | 23b) | | 1 | |
| , (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (24b) |
| c) If | whole h | ouse ex | tract ver | ntilation c | or positiv | e input v | ventilatic | n from o | outside | 1 | | | 1 | |
| i | f (22b)n | n < 0.5 > | < (23b), t | hen (24a | c) = (23b |); otherv | wise (24 | c) = (22k | 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 | oft | 1 | | | | |
| | f (22b)n | n = 1, th | en (24d) | m = (22k) | b)m othe | rwise (2 | (4d)m = 0 | 0.5 + [(2 | 2b)m² x | 0.5] | 0.55 | 0.55 | 1 | (244) |
| (240)m= | 0.56 | 0.56 | 0.55 | 0.54 | 0.54 | 0.53 | 0.53 | 0.53 | 0.54 | 0.54 | 0.55 | 0.55 | | (240) |
| | | | rate - er | nter (24a |) or (240 | o 52 | c) or (24 | | (25) | 0.54 | 0.55 | 0.55 | 1 | (25) |
| (25)11= | 0.56 | 0.50 | 0.55 | 0.54 | 0.54 | 0.55 | 0.55 | 0.55 | 0.54 | 0.34 | 0.55 | 0.55 | | (23) |
| 3. He | at l <mark>osse</mark> | s and he | eat loss | paramete | er: | | | | | | | | | |
| ELEN | 1ENT | Gros | SS (m ²) | Openin | gs | Net Ar | ea | U-valu | ue | AXU | | k-value | | AXk |
| Doors | | area | (1112) | - m | | A ,r | | VV/11/2 | .r. | (V V / I | <pre></pre> | KJ/M ² ·M | | KJ/K (26) |
| Windo | | 1 | | | | 1.89 | | 1.0 | 0.041 | 3.024 | 8 | | | (20) |
| Windo | | | | | | 4.41 | | /[1/(1.4)+ | 0.04] | 5.85 | H | | | (27) |
| Windo | ws Type | 2 | | | | 4.41 | | /[1/(1.4)+ | 0.04] = | 5.85 | L. | | | (27) |
| VVINdov | ws type | 3 | | | | 4.41 | x1/ | /[1/(1.4)+ | 0.04] = | 5.85 | | | | (27) |
| vvindov | ws Type | 94 | | | | 2.52 | x1, | /[1/(1.4)+ | 0.04] = | 3.34 | ╡, | | | (27) |
| walls | | 56.3 | 36 | 17.64 | 1 | 38.72 | <u>×</u> | 0.17 | = | 6.58 | | | \dashv | (29) |
| Roof | | 76. | 1 | 0 | | 76.1 | × | 0.16 | = | 12.18 | | | | (30) |
| Total a | rea of e | elements | s, m² | | | 132.4 | 6 | | | | | | | (31) |
| Party v | vall | | | | | 38.24 | x | 0 | = | 0 | | | | (32) |
| Party f | loor | | | | | 76.1 | | | | | | | | (32a) |
| * for wind | dows and | l roof wind | ows, use e | effective wil | ndow U-va | alue calcul | ated using | formula 1 | /[(1/U-valı | ıe)+0.04] a | as given in | paragraph | 1 3.2 | |
| Fabric | heat los | s W/K | = S (A x) | | s anu pan | 1110115 | | (26)(30) |) + (32) = | | | | 12.66 | (33) |
| Heat c | apacity | Cm = Si | (A x k) | 0) | | | | | ((28). | (30) + (32 | 2) + (32a). | (32e) = | 42.00 | 5 (34) |
| Therm | al mass | parame | eter (TMF | ⊃ = Cm ÷ | - TFA) in | ı kJ/m²K | | | Indica | tive Value | : Medium | (/ | 250 | (35) |
| For desi | gn assess | sments wh | ere the de | tails of the | constructi | on are not | t known pr | ecisely the | e indicative | e values of | TMP in Ta | able 1f | 200 | (00) |
| can be u | ised inste | ad of a de | tailed calc | ulation. | | | | | | | | | | |
| Therm | al bridg | es : S (L | x Y) cal | culated u | using Ap | pendix ł | < | | | | | | 6.01 | (36) |
| if details | of therma | al bridging | are not kr | 10wn (36) = | = 0.15 x (3 | 1) | | | (22) · | (36) - | | | | |
| Ventilo | tion bor | at loss of | alculator | monthly | , | | | | (32)~ | (30) = | 25)m v (F) | | 48.67 | (37) |
| venuid | lan | Fob | Mar | | May | lun | Iul | Διια | Sen | | Nov | Dec |] | |
| | Jan | | | | ivicity | Juli | | l Aug | l ogh | | | | l | |

| (38)m= | 32.23 | 32.1 | 31.97 | 31.37 | 31.26 | 30.74 | 30.74 | 30.64 | 30.94 | 31.26 | 31.49 | 31.73 | | (38) |
|-------------------------|-----------------------|-------------------------|---------------------------|-------------------------|--------------------------|-------------------------|-----------------------|------------------------|--------------------|---------------------------|------------------------|------------|---------|------|
| Heat tr | ansfer o | coefficie | nt, W/K | | | | | | (39)m | = (37) + (3 | 38)m | | | |
| (39)m= | 80.9 | 80.77 | 80.65 | 80.05 | 79.94 | 79.41 | 79.41 | 79.32 | 79.62 | 79.94 | 80.16 | 80.4 | | |
| | | | | / | | | | | (10) | Average = | Sum(39)1 | 12 /12= | 80.05 | (39) |
| Heat lo | ss para | ameter (I | HLP), W/ | /m²K | 4.05 | 4.04 | 4.04 | 4.04 | (40)m | = (39)m ÷ | (4) | 4.00 | | |
| (40)m= | 1.06 | 1.06 | 1.06 | 1.05 | 1.05 | 1.04 | 1.04 | 1.04 | 1.05 | | 1.05 Sum(40). | 1.06 | 1.05 | (40) |
| Numbe | er of day | /s in mo | nth (Tab | le 1a) | | | | | , | -verage - | Curr(+0)1 | 12712- | 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 | ter hea | ting ene | rgy requ | irement: | | | | | | | | kWh/yea | ar: | |
| Assum | ed occi | inancy | N | | | | | | | | | | | (42) |
| if TF. | A > 13. | 9, N = 1 | + 1.76 x | [1 - exp | (-0.0003 | 849 x (TF | -13.9) |)2)] + 0.0 |)013 x (| TFA -13. | 9) | .30 | | (42) |
| if TF. | A £ 13. | 9, N = 1 | | | | | | | | | | | | (10) |
| Annual <i>Reduce</i> | averag | je not wa al average | ater usag hot water | ge in litre usage by | es per da 5% if the d | ay va,av Iwelling is | erage = designed t | (25 X N) to achieve | + 36 a water us | se target o | 90 f | .84 | | (43) |
| not more | e that 125 | litres per | person pel | r day (all w | ater use, l | hot and co | ld) | | | | | | | |
| | Jan | Feb | Mar | Apr | Мау | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Hot wate | er usage i | n litres pe | r day for ea | ach month | Vd,m = fa | ctor from T | Table 1c x | (43) | | | | | | |
| (44)m= | <mark>9</mark> 9.92 | 96.29 | 92.65 | 89.02 | 85.39 | 81.75 | 81.75 | 85.39 | 89.02 | 9 <mark>2.65</mark> | 96.29 | 99.92 | | _ |
| Energy (| content of | hot water | used - cal | culated m | onthly – 4 | 190 x Vd r | n x nm x D |)Tm / 3600 | kWh/mor | Total = Su oth (see Ta | m(44) ₁₁₂ = | = [| 1090.04 | (44) |
| (45)m- | 1/9/19 | 120.6 | 122 72 | 116 50 | 111 97 | 06.54 | 80.46 | 102.65 | 102.99 | 121.06 | 122.15 | 1425 | | |
| (45)11= | 140.10 | 129.0 | 133.73 | 110.59 | 111.07 | 90.54 | 09.40 | 102.05 | 103.00 | $\frac{121.00}{121 - Su}$ | m(45), | 143.5 | 1/20 21 | (45) |
| lf instant | aneous v | vater heati | ng at point | of use (no | hot water | r storage), | enter 0 in | boxes (46 |) to (61) | | n(-10)112 - | - L | 1720.21 | |
| (46)m= | 22.23 | 19.44 | 20.06 | 17.49 | 16.78 | 14.48 | 13.42 | 15.4 | 15.58 | 18.16 | 19.82 | 21.53 | | (46) |
| Water | storage | loss: | | | | | | | | | · | · | | |
| Storag | e volum | ne (litres) |) includir | ng any so | olar or W | /WHRS | storage | within sa | ame ves | sel | | 0 | | (47) |
| If comr | nunity h vise if n | neating a | and no ta | nk in dw r (this in | elling, e | nter 110 nstantar | litres in | (47) mbi boil | ore) onto | ar '∩' in <i>(</i> | 17) | | | |
| Water | storage | loss: | not wate | 51 (1115 11 | iciuues i | nstantai | 10003 00 | | | | <i></i> | | | |
| a) If m | anufact | turer's d | eclared I | oss facto | or is kno | wn (kWł | n/day): | | | | | 0 | | (48) |
| Tempe | rature f | actor fro | m Table | 2b | | | | | | | | 0 | | (49) |
| Energy | lost fro | om water | r storage | e, kWh/y€ | ear | | | (48) x (49) | = | | | 0 | | (50) |
| b) If m | anufact | turer's d | eclared of the factor for | cylinder l | oss fact | or is not | known: | | | | | | | (54) |
| If comr | nunity h | neating s | see secti | on 4.3 | | | ly) | | | | | 0 | | (51) |
| Volume | e factor | from Ta | ble 2a | | | | | | | | | 0 | | (52) |
| Tempe | rature f | actor fro | m Table | 2b | | | | | | | | 0 | | (53) |
| Energy | lost fro | om water | r storage | e, kWh/y€ | ear | | | (47) x (51) | x (52) x (| 53) = | | 0 | | (54) |
| Enter | (50) or | (54) in (! | 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)i | m = (56)m | x [(50) – (| H11)] ÷ (50 | 0), else (5 | ()m = (56) | m where (| H11) is fro | m Appendix | (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 | | | 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 wat | ter heati | ng and a | cylinde | r thermo | stat) | | L | |
| (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) ÷ 36 | 65 × (41 |)m | | | | | | |
| (61)m= | 23.84 | 21.5 | 23.77 | 22.95 | 23.68 | 22.88 | 23.62 | 23.66 | 22.92 | 23.73 | 23.02 | 23.82 | | (61) |
| Total h | eat req | uired for | water h | eating ca | alculatec | l for eac | h month | (62)m = | 0.85 × (| (45)m + | (46)m + | (57)m + | (59)m + (61)m | |
| (62)m= | 172.01 | 151.1 | 157.5 | 139.54 | 135.56 | 119.42 | 113.07 | 126.31 | 126.8 | 144.79 | 155.17 | 167.33 | | (62) |
| Solar DI | W input | calculated | using App | endix G o | Appendix | H (negati | ve quantity | y) (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 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= | 172.01 | 151.1 | 157.5 | 139.54 | 135.56 | 119.42 | 113.07 | 126.31 | 126.8 | 144.79 | 155.17 | 167.33 | | |
| | | | | | | | | Outp | out from wa | ater heate | r (annual) | 12 | 1708.6 | (64) |
| Heat g | ains fro | m water | heating | , kWh/m | onth 0.2 | 5 ´ [0.85 | × (45)m | n + (61)m | n] + 0.8 x | ۲ ((46)m | + (57)m | + (59)m |] | |
| (65)m= | 55.23 | 48.47 | 50.41 | 44.5 | 43.12 | 37.82 | 35.65 | 40.05 | 40.27 | 46.19 | 49.69 | 53.67 | | (65) |
| in <mark>clu</mark> | ide (57) | m in calo | culation | of (65)m | only if c | ylinder i | s in the o | dwelling | or hot w | ate <mark>r is f</mark> r | om com | munity h | eating | |
| 5. Int | ernai ga | ains (see | Table 5 | 5 and 5a |): | | | | | | _ | | _ | |
| Metab | olic gair | s (Table | 5) Wat | ts | | | | | | | | | | |
| in o tono | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (66)m= | 119.23 | 119.23 | 11 <mark>9.23</mark> | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | | (66) |
| Lightin | g gains | (calcula | ted in A | pendix | L, equat | ion L9 o | r L9a), a | lso see ⁻ | Table 5 | | | | | |
| (67)m= | 18.89 | 16.78 | 13.65 | 10.33 | 7.72 | 6.52 | 7.04 | 9.16 | 12.29 | 15.61 | 18.21 | 19.42 | | (67) |
| Applia | nces ga | ins (calc | ulated ir | Append | dix L, eq | uation L | 13 or L1 | 3a), also | see Ta | ble 5 | | | | |
| (68)m= | 211.1 | 213.29 | 207.77 | 196.02 | 181.18 | 167.24 | 157.93 | 155.74 | 161.26 | 173.01 | 187.84 | 201.78 | | (68) |
| Cookir | na aains | (calcula | ted in A | n Dendix | L. equat | ion L15 | or L15a |), also se | e Table | 5 | 1 | | | |
| (69)m= | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | | (69) |
| Pumps | and fa | ns dains | (Table ! | 1 | | | | | | | | | | |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | | (70) |
| Losses | | l vaporatic | n (nega | i tive valu | es) (Tab | l le 5) | | | | | | | | |
| (71)m= | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | | (71) |
| Water | L heating | L nains (1 | I Table 5) | | | | I | | | I | I | | | |
| (72)m= | 74.23 | 72.12 | 67.75 | 61.81 | 57.96 | 52.53 | 47.92 | 53.83 | 55.93 | 62.08 | 69.02 | 72.14 | l | (72) |
| Total i | ntornal | asine - | | | | (66) | m + (67)m | 1 + (68)m + | - (69)m + (| (70)m + (7 | 1)m + (72) |)m | | |
| (73)m= | 365.99 | 363.96 | 350.94 | 329.93 | 308 63 | 288.06 | 274 66 | 280.49 | 291 25 | 312 46 | 336.84 | 355 11 | l | (73) |
| 6. So | lar gains | S: | | 1 | 1 | | 1 | 1 | | 1 | | 1 | | |
| Solar g | ains are o | alculated | using sola | r flux from | Table 6a | and assoc | iated equa | ations to co | nvert to th | e applicat | ole orientat | tion. | | |
| Orienta | ation: / | Access F | actor | Area | | Flu | x | | g_ | | FF | | Gains | |

| Onentation. | Table 6d | | m² | | Table 6a | | 9_ Table 6b | | Table 6c | | (W) | |
|----------------|----------|---|------|---|----------|---|----------------|---|----------|---|-------|------|
| Southeast 0.9x | 0.77 | x | 4.41 | x | 36.79 | x | 0.63 | x | 0.7 | = | 49.59 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 62.67 | × | 0.63 | x | 0.7 | = | 84.47 | (77) |

| | | 1 | | 1 | | 1 | | | | 1 | | - |
|--|------|---|------|---|--------|-----|------|---|-----|------------|--------|-----------|
| Southeast 0.9x | 0.77 | x | 4.41 | x | 85.75 | x | 0.63 | X | 0.7 | = | 115.57 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 106.25 | x | 0.63 | x | 0.7 | = | 143.2 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 119.01 | x | 0.63 | x | 0.7 | = | 160.4 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 118.15 | x | 0.63 | x | 0.7 | = | 159.24 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 113.91 | x | 0.63 | x | 0.7 | = | 153.52 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 104.39 | x | 0.63 | x | 0.7 |] = | 140.69 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 92.85 | x | 0.63 | x | 0.7 |] = | 125.14 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 69.27 | x | 0.63 | x | 0.7 |] = | 93.36 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 44.07 | x | 0.63 | x | 0.7 | = | 59.4 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 31.49 | x | 0.63 | x | 0.7 | = | 42.44 | (77) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 36.79 |] | 0.63 | x | 0.7 | = | 28.34 | (79) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 62.67 |] | 0.63 | x | 0.7 | = | 48.27 | (79) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 85.75 |] | 0.63 | x | 0.7 |] = | 66.04 | (79) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 106.25 |] | 0.63 | x | 0.7 |] = | 81.83 | (79) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 119.01 | 1 | 0.63 | x | 0.7 | = | 91.66 | (79) |
| Southwest <mark>0.9x</mark> | 0.77 | × | 2.52 | x | 118.15 |] | 0.63 | x | 0.7 | = | 90.99 | (79) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 113.91 | İ | 0.63 | x | 0.7 | j = | 87.73 | (79) |
| Sout <mark>hwest_{0.9x}</mark> | 0.77 | x | 2.52 | X | 104.39 | | 0.63 | х | 0.7 | = | 80.4 | (79) |
| Sout <mark>hwest_{0.9x}</mark> | 0.77 | × | 2.52 | x | 92.85 | İ. | 0.63 | x | 0.7 | = | 71.51 | (79) |
| Sout <mark>hwest_{0.9x}</mark> | 0.77 | x | 2.52 | x | 69.27 | i / | 0.63 | x | 0.7 | j = | 53.35 | (79) |
| Sout <mark>hwest_{0.9x}</mark> | 0.77 | x | 2.52 | x | 44.07 | i/ | 0.63 | x | 0.7 | = | 33.94 | (79) |
| Sout <mark>hwest_{0.9x}</mark> | 0.77 | x | 2.52 | x | 31.49 | ĺ | 0.63 | x | 0.7 | i = | 24.25 | _ (79) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 11.28 | × | 0.85 | x | 0.7 | i = | 20.52 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 11.28 | × | 0.85 | x | 0.7 | i = | 20.52 | (81) |
| Northwest 0.9x | 0.77 | × | 4.41 | x | 22.97 | × | 0.85 | x | 0.7 | j = | 41.76 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 22.97 | x | 0.85 | x | 0.7 | j = | 41.76 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 41.38 | × | 0.85 | x | 0.7 | = | 75.24 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 41.38 | × | 0.85 | x | 0.7 | i = | 75.24 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 67.96 | x | 0.85 | x | 0.7 | i = | 123.57 | - (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 67.96 | × | 0.85 | x | 0.7 | i = | 123.57 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 91.35 | × | 0.85 | x | 0.7 | i = | 166.1 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 91.35 | × | 0.85 | x | 0.7 | i = | 166.1 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 97.38 | × | 0.85 | x | 0.7 | i = | 177.08 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 97.38 | x | 0.85 | x | 0.7 | i = | 177.08 | - (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 91.1 | x | 0.85 | x | 0.7 | i = | 165.66 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 91.1 | x | 0.85 | x | 0.7 | i = | 165.66 |] (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 72.63 | x | 0.85 | x | 0.7 | i = | 132.06 | - (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 72.63 | x | 0.85 | x | 0.7 | i = | 132.06 | _ (81) |
| Northwest 0.9x | 0.77 | × | 4.41 | x | 50.42 | × | 0.85 | x | 0.7 | i = | 91.68 | - (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 50.42 | × | 0.85 | x | 0.7 | i = | 91.68 | - (81) |
| Northwest 0.9x | 0.77 | × | 4.41 | x | 28.07 | × | 0.85 | x | 0.7 | i = | 51.04 |] (81) |
| 1 | | | | | | | | | | | | |

| Northwest 0.9x 0.77 x 4.41 | | | | 1 | x | 2 | 28.07 | x | 0.85 | x | 0.7 | = | 51.04 | (81) | | |
|----------------------------|------------------|------------|----------|-------------|-----------|--------------|-------------|--------------|----------------|----------------|---------------|----------------|-------------|------------|--------|------|
| Northw | est 0.9x | 0.77 | | х | 4.4 | 1 | x | · · | 14.2 | × | 0.85 | | 0.7 | = | 25.82 | (81) |
| Northw | est 0.9x | 0.77 | | x | 4.4 | 1 | x | | 14.2 | x | 0.85 | = | 0.7 | = | 25.82 | (81) |
| Northw | est 0.9x | 0.77 | | x | 4.4 | 1 | x | | 9.21 | x | 0.85 | = × [| 0.7 | = | 16.76 | (81) |
| Northw | vest 0.9x | 0.77 | | х | 4.4 | 1 | x | | 9.21 | x [| 0.85 | ╡ <u>×</u> | 0.7 | = | 16.76 | (81) |
| | L | | | | | | | | | | | | | | | |
| Solar | nains in | watts, ca | alculate | ъ | for eacl | h mont | h | | | (83)m = S | um(74)m . | (82)m | | | | |
| (83)m= | 118.96 | 216.26 | 332.1 | Ĩ | 472.17 | 584.26 | 6 | 604.4 | 572.56 | 485.22 | 380.02 | 248.78 | 144.97 | 100.2 | | (83) |
| Total g | gains – i | nternal a | and sol | ar | (84)m = | - = (73)m | + (| 83)m | , watts | | 1 | I | 1 | 1 | 1 | |
| (84)m= | 484.95 | 580.22 | 683.04 | 1 | 802.1 | 892.89 | 8 | 92.45 | 847.22 | 765.71 | 671.27 | 561.24 | 481.81 | 455.31 |] | (84) |
| 7 Mc | an inter | nal temr | oratur | <u>م</u> (| beating | 60260 | n) | | | | | | 1 | | 1 | |
| Tomr | | during k | eating | | ariode ir | the liv | vina | area | from Tak | | 1 (°C) | | | | 21 | (85) |
| Litilio | | tor for a | oine fe | pe - III | | | miy m (a | | | JE 3, 11 | n (C) | | | | 21 | (00) |
| Utilisa | | T Tab | ains io | r II . T | ving are | a, ni,r | n (s . T | | | A 110 | San | Oct | Nov | Dee | 1 | |
| (00) m | Jan | | | ╉ | Apr | 0.76 | | Jun | | Aug | Sep | | | | | (86) |
| (00)11= | I | 0.99 | 0.98 | | 0.91 | 0.76 | | 0.56 | 0.41 | 0.47 | 0.75 | 0.96 | 0.99 | |] | (00) |
| Mear | n interna | l temper | ature i | n li | iving are | ea T1 (| follc | w ste | ps 3 to 7 | ' in Tabl | e 9c) | | | | 1 | |
| (87)m= | 19.91 | 20.09 | 20.37 | | 20.7 | 20.92 | 2 | 20.99 | 21 | 21 | 20.94 | 20.63 | 20.2 | 19.87 | | (87) |
| Temp | perature | during h | neating | pe | eriods ir | n rest o | f dw | elling | from Ta | ble 9, T | h2 (°C) | | | | | |
| (88)m= | 20.03 | 20.03 | 20.03 | Τ | 20.04 | 20.04 | 2 | 0.05 | 20.05 | 20.05 | 20.05 | 20.04 | 20.04 | 20.04 | | (88) |
| Utilis | ation fac | tor for a | ains fo | r re | est of d | welling | h2 | m (se | e Table | 9a) | | | | | | |
| (89)m= | 1 | 0.99 | 0.97 | T | 0.88 | 0.7 | | 0.48 | 0.32 | 0.38 | 0.67 | 0.94 | 0.99 | 1 | | (89) |
| | · . | | | | | | | TO // | | | | | | | | |
| Mear | | l temper | ature I | n ti | he rest | of dwe | lling | 12 (f | ollow ste | eps 3 to | / in Tabl | | 10.01 | 40.50 | 1 | (00) |
| (90)m= | 18.58 | 18.84 | 19.24 | _ | 19.71 | 19.97 | | 20.04 | 20.05 | 20.05 | 20 | 19.62 | 19.01 | 18.53 | | |
| | | | | | | | | | | | | | iy alea ÷ (| +) = | 0.33 | (91) |
| Mear | n interna | l temper | ature (| for | the wh | ole dw | ellin | g) = fl | $LA \times T1$ | + (1 – fL | A) × T2 | | | | | |
| (92)m= | 19.02 | 19.25 | 19.61 | | 20.03 | 20.28 | 2 | 20.35 | 20.36 | 20.36 | 20.31 | 19.95 | 19.4 | 18.97 | | (92) |
| Apply | / adjustr | nent to t | he mea | an | internal | tempe | ratu | ire fro | m Table | 4e, whe | ere appro | opriate | | | 1 | |
| (93)m= | 19.02 | 19.25 | 19.61 | | 20.03 | 20.28 | 2 | 20.35 | 20.36 | 20.36 | 20.31 | 19.95 | 19.4 | 18.97 | | (93) |
| 8. Sp | ace hea | ting requ | uireme | nt | | | | | | | | | | | | |
| Set T | i to the | mean int | ernal t | em | nperatur | re obtai | ined | at ste | ep 11 of | Table 9 | b, so tha | t Ti,m=(| 76)m an | d re-cald | culate | |
| the u | | | or gains | s u . T | | ible 9a | | | | <u> </u> | San | Oct | Nov | Dee | 1 | |
| l Itilie | Jan ation fac | tor for a | _ iviai | | Арг | Iviay | | Jun | Jui | Aug | Sep | Oci | | Dec | J | |
| (94)m= | | | 0.96 | <u> </u> | 0.88 | 0.72 | | 0.51 | 0.35 | 0.41 | 0.69 | 0.94 | 0.99 | 1 | 1 | (94) |
| | | hmGm | W = (| 04 |)m x (8/ | 4)m | | 0.01 | 0.00 | 0.41 | 0.00 | 0.04 | 0.00 | | J | () |
| (95)m= | 482.6 | 573.05 | 658.37 | 7 | 709.52 | 638.91 | 4 | 50.75 | 297.85 | 312.52 | 465.61 | 525.95 | 476.59 | 453.69 |] | (95) |
| Mont | hlv aver | ade exte | rnal te | mr | rature | from | Fahl | e 8 | | 0.2.02 | | 020100 | | | J | |
| (96)m= | 4.3 | 4.9 | 6.5 | T | 8.9 | 11.7 | T | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 |] | (96) |
| Heat | loss rate | e for me | an inte | rna | al tempe | erature | _L_m | 1.W= | L =[(39)m | L x [(93)m | L (96)m | 1 | L | | 1 | |
| (97)m= | 1190.78 | 1159.33 | 1057.5 | 4 | 891.14 | 685.68 | 4 | 56.66 | 298.52 | 313.97 | 494.45 | 747.7 | 986.09 | 1187.66 |] | (97) |
| Spac | e heatin | a require | ement | for | each m | nonth. | ⊥ ⟨Wh | /mon | h = 0.02 | 1 24 x [(97 | ı)m — (95 | i 5)ml x (4 | 1)m | I | 1 | |
| (98)m= | 526.89 | 393.98 | 296.98 | 3 | 130.76 | 34.8 | | 0 | 0 | 0 | 0 | 164.98 | 366.84 | 546.07 |] | |
| | L | I | 1 | | | | | | I | r Tota | l per year | ı (kWh/yea | r) = Sum(9 | 8)15,912 = | 2461.3 | (98) |
| Snoo | a haatin | a requir | amont | in ' | k\//h/m? | wear | | | | | | | | | 22.24 | |
| Spac | enealli | ig require | ement | | | year | | | | | | | | | 32.34 | (99) |

| 9a. En | ergy rea | quireme | nts – Ind | lividual h | eating sy | ystems i | including | g micro-C | CHP) | | | | | |
|---------------------------------------|---|------------------|-----------------------|---------------------|------------|----------|-------------------------|-------------|------------|----------------|---------------------------------|---------------------|-------------------------|-----------------|
| Spac | e heati | ng: | | _ | , <u>-</u> | | | | | | | | | ٦ |
| Fract | ion of sp | bace hea | at from s | econdar | y/supple | mentary | v system | (0.0.0) | (0.0.1) | | | | 0 | (201) |
| Fract | ion of sp | bace hea | at from n | nain syst | em(s) | | | (202) = 1 - | - (201) = | | | | 1 | (202) |
| Fract | ion of to | otal heati | ng from | main sys | stem 1 | | | (204) = (2 | 02) × [1 – | (203)] = | | | 1 | (204) |
| Effici | ency of | main spa | ace heat | ting syste | em 1 | | | | | | | | 92.7 | (206) |
| Effici | ency of | seconda | ary/suppl | ementar | y heating | g systen | n, % | | | | | - | 0 | (208) |
| _ | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/yea | ar |
| Spac | e heatin | ng requir | ement (c | | d above) |) | | | 0 | 164.09 | 266.04 | F46 07 | l | |
| (011)- | 020.09 | 393.90 | 290.90 | 100 . (00 | 34.0 () | 0 | 0 | 0 | 0 | 104.90 | 300.04 | 540.07 | | (014) |
| (211)n | $n = \{[(98) \\ 568, 38]$ | 3)m x (20 425 | [320.36] | 100 ÷ (20 141.06 | 37 54 | 0 | 0 | 0 | 0 | 177 97 | 395 73 | 589.07 | | (211) |
| | 000.00 | 120 | 020.00 | 111.00 | 01.01 | ů | Ů | Tota | l (kWh/yea | ar) =Sum(2 | 211) ₁₅₁₀₁₂ | = | 2655.13 | (211) |
| Spac | e heatin | ng fuel (s | econdar | v), kWh/ | month | | | | | | | | | |
| = {[(98 | 3)m x (20 | 01)] } x 1 | 00 ÷ (20 |)8) | | - | | | - | - | - | - | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | _ |
| | | | | | | | | Tota | l (kWh/yea | ar) =Sum(2 | 2 15) _{15,1012} | 2 | 0 | (215) |
| Water | heating | g | 1 (I - | late lat | | | | | | | | | | |
| Outpu | 172.01 | 151.1 | 157.5 | 139.54 | 135.56 | 119.42 | 113.07 | 126.31 | 126.8 | 144.79 | 155.17 | 167.33 | | |
| Efficie | ncy of w | l ater hea | ater | | | | | | | | | | 87 | (216) |
| (217)m= | 8 <mark>9.02</mark> | 88.93 | 88.75 | 88.29 | 87.54 | 87 | 87 | 87 | 87 | 88.42 | 88.88 | <mark>8</mark> 9.05 | | (217) |
| Fuel fo | or water | heating | , <mark>kW</mark> h/m | onth | | | | · · · · | | | | | | |
| (219)n | n = (64) |)m x 100 | 0 ÷ (217) |)m | 154.95 | 127.26 | 120.07 | 145 10 | 145 74 | 162.76 | 174 59 | 197.0 | | |
| (219)11- | 195.25 | 109.9 | 1 177.47 | 138.00 | 134.05 | 137.20 | 129.91 | Tota | I = Sum(2) | 19a), = | 174.30 | 107.9 | 1937 92 | 7(219) |
| Annua | al totals | | | | | | | | , | /112 k | Wh/vear | • | kWh/vear | |
| Space | heating | g fuel use | ed, main | system | 1 | | | | | | , , | | 2655.13 | 7 |
| Water | heating | fuel use | ed | | | | | | | | | | 1937.92 | Ī |
| Electri | city for p | oumps, f | ans and | electric | keep-ho | t | | | | | | | | |
| centr | al heatir | ng pump | : | | | | | | | | | 30 | | (230c) |
| boile | r with a | fan-assis | sted flue | | | | | | | | | 45 | | (230e) |
| Total e | electricit | v for the | above. | kWh/vea | r | | | sum | of (230a). | (230g) = | | | 75 |] (231) |
| Flectri | city for I | iahtina | , | | | | | | | | | | 333.64 | $\frac{1}{232}$ |
| 120 | | | Individ | lual hoat | ing evet | me incl | udina mi | |) | | | | 555.04 | |
| IZd. | CO2 en | 115510115 | | iual neat | ing syste | | uaing mi | | | | | | | |
| | | | | | | En kW | lergy Vh/year | | | Emiss kg CO | ion fac 2/kWh | tor | Emissions kg CO2/yea | ar |
| Space | heating | g (main s | system 1 |) | | (21 | 1) x | | | 0.2 | 16 | = | 573.51 | (261) |
| Space | heating | g (secon | dary) | | | (21 | 5) x | | | 0.5 | 19 | = | 0 | (263) |
| Water heating $(219) \times 0.216 = $ | | | | | | | | | | | 418.59 | (264) | | |
| Space | ater heating (219) x 0.216 = bace and water heating (261) + (262) + (263) + (264) = = | | | | | | | | | | | 992.1 | (265) | |

| Electricity for pumps, fans and electric keep-hot | (231) | x | | 0.519 | = | 38.93 | (267) |
|---|-------|---|---------------|---------|---|---------|-------|
| Electricity for lighting | (232) | x | | 0.519 | = | 173.16 | (268) |
| Total CO2, kg/year | | | sum of (265) | (271) = | | 1204.18 | (272) |
| Dwelling CO2 Emission Rate | | | (272) ÷ (4) = | | | 15.82 | (273) |
| EI rating (section 14) | | | | | | 87 | (274) |
| | | | | | | | |



| | | Use | er Details: | | | | | | |
|----------------------------------|-----------------------------------|-------------------|-----------------|---------------------------|----------------|----------|-----------|---------------------------|--|
| Assessor Name: Software Name: | Stroma FSAP 201 | 2 | Strom Softwa | a Num are Ver | ber: rsion: | | Versio | n: 1.0.3.11 | |
| | | Prope | rty Address | : Arlingto | on 3 Bec | TOP 76 | 6 | | |
| Address : | | | | | | | | | |
| 1. Overall dwelling dime | nsions: | - | () | | | | | | |
| Ground floor | | ۹ | (m²) | (10) × | Av. He | ight(m) | | Volume(m ³ |) |
| Total floor area TEA = (1) | -) . (1 h) . (1 o) . (1 d) . (1 o |) (1p) [| 76.1 | (1a) X | 2 | 2.3 | (2a) = | 175.03 | (34) |
| Total noor area $TFA = (13)$ | a)+(1b)+(1c)+(1d)+(1e |)+(111) | 76.1 | (4) (20) (2b) |) . (20) . (20 | | (2n) = | | – |
| | | | | (Ja)+(Jb) |)+(30)+(30 | I)+(3e)+ | .(31) = | 175.03 | (5) |
| 2. Ventilation rate: | moin | | othow | | totol | | | | - |
| | heating h | eating | other | | total | | | m ³ per nou | |
| Number of chimneys | 0 + | 0 + | 0 | = | 0 | X 4 | 40 = | 0 | (6a) |
| Number of open flues | 0 + | 0 + | 0 | = | 0 | × | 20 = | 0 | (6b) |
| Number of intermittent fa | ns | | | | 3 | x ′ | 10 = | 30 | (7a) |
| Number of passive vents | | | | | 0 | x ′ | 10 = | 0 | (7b) |
| Number of flueless gas fi | res | | | | 0 | X 4 | 40 = | 0 | (7c) |
| | | | | | | | Air ch | anges <mark>per</mark> ho | ur |
| Infiltration due to chimne | y_{s} , flues and fans = (6) | a)+(6b)+(7a)+(7 | o)+(7c) = | | 30 | | ÷ (5) = | 0.17 | (8) |
| If a pressurisation test has b | een carried out or is intende | ed, proceed to (1 | 7), otherwise o | continue fr | om (9) to (| (16) | | | _ |
| Number of storeys in the | he dwelling (ns) | | | | | [(0) | 11-0.1 - | 0 | (9) |
| Structural infiltration: 0 | 25 for steel or timber f | rame or 0.35 | for mason | v constr | uction | [(9) | -1]x0.1 = | 0 | $ = \begin{bmatrix} (10) \\ - (11) \end{bmatrix} $ |
| if both types of wall are pr | resent, use the value corresp | ponding to the g | reater wall are | a (after | dottorr | | | 0 | |
| deducting areas of openir | ngs); if equal user 0.35 | | | | | | | | _ |
| If suspended wooden f | loor, enter 0.2 (unseal | ed) or 0.1 (se | ealed), else | enter 0 | | | | 0 | (12) |
| If no draught lobby, en | ter 0.05, else enter 0 | n'a a a al | | | | | | 0 | (13) |
| Window infiltration | s and doors draught st | nppea | 0 25 - [0 2 | $\mathbf{x}(14) \doteq 1$ | 001 - | | | 0 | |
| | | | (8) + (10) | + (11) + (1 | 2) + (13) - | + (15) = | | 0 | $ \frac{(15)}{(16)} $ |
| Air permeability value | a50 expressed in cub | ic metres nei | hour per s | nuare m | etre of e | nvelone | area | 0 | $-1^{(10)}_{(17)}$ |
| If based on air permeabil | ity value, then $(18) = [(1)]$ | 7) ÷ 20]+(8), oth | erwise (18) = (| (16) | | invelope | uicu | 0.42 | $= \frac{(17)}{(18)}$ |
| Air permeability value applie | s if a pressurisation test has | been done or a | degree air pe | rmeability | is being u | sed | | 0.12 | |
| Number of sides sheltere | d | | | | | | | 2 | (19) |
| Shelter factor | | | (20) = 1 - | [0.075 x (1 | 9)] = | | | 0.85 | (20) |
| Infiltration rate incorporat | ing shelter factor | | (21) = (18 |) x (20) = | | | | 0.36 | (21) |
| Infiltration rate modified f | or monthly wind speed | i | | | | | | | |
| Jan Feb | Mar Apr May | Jun Ju | Il 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 0.9 | 5 0.92 | 1 | 1.08 | 1.12 | 1.18 | | |
| | | | | | | | | | |

| Adjuste | ed infiltr | ation rat | e (allowi | ng for sh | elter an | d wind s | peed) = | (21a) x | (22a)m | | | | | |
|------------------|------------------------|------------------------|---------------------------|---------------|-------------|-------------|-------------|----------------|----------------|----------------|-------------|----------------|----------|-------|
| | 0.46 | 0.45 | 0.44 | 0.39 | 0.39 | 0.34 | 0.34 | 0.33 | 0.36 | 0.39 | 0.4 | 0.42 | | |
| Calcula If me | ate ette | ctive air | change i ation: | rate for ti | he appli | cable ca | se | | | | | ſ | 0 | (23a) |
| lf exh | aust air h | eat pump | usina Appe | endix N. (2 | 3b) = (23a |) × Fmv (e | equation (N | N5)) . othe | rwise (23b |) = (23a) | | l | 0 | (23b) |
| lf bala | anced with | heat reco | overy: effic | iency in % | allowing f | or in-use f | actor (from | n Table 4h |) = | , (, | | l I | 0 | (23c) |
| a) If | halance | d mech | , anical ve | ntilation | with he | at recove | ≥rv (M\/⊦ | HR) (24a | , a)m = (2; | 2h)m + (| 23h) x [1 | ا (23c) – 1 | ÷ 1001 | (200) |
| (24a)m= | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | | . 100] | (24a) |
| b) If | balance | d mech | ı anical ve | ntilation | without | heat rec | coverv (N | I /IV) (24b | m = (22) | 1 2b)m + () | 1 23b) | II | | |
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (24b) |
| c) If | whole h | use ex | tract ver | ntilation c | or positiv | e input v | /entilatic | n from o | utside | | | I | | |
| i | f (22b)r | n < 0.5 > | (23b), t | hen (24c | c) = (23b |); otherv | wise (24 | c) = (22k | 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 | ve input | ventilatio | on from I | oft | | | | | |
| i | f (22b)r | n = 1, th | en (24d) 1 | m = (22k |)m othe | rwise (2 | 4d)m = (| 0.5 + [(2 | 2b)m² x | 0.5] | | | | |
| (24d)m= | 0.6 | 0.6 | 0.6 | 0.58 | 0.57 | 0.56 | 0.56 | 0.55 | 0.56 | 0.57 | 0.58 | 0.59 | | (24d) |
| Effec | ctive air | change | rate - er | nter (24a |) or (24b | o) or (240 | c) or (24 | d) in box | k (25) | | | | | |
| (25)m= | 0.6 | 0.6 | 0.6 | 0.58 | 0.57 | 0.56 | 0.56 | 0.55 | 0.56 | 0.57 | 0.58 | 0.59 | | (25) |
| 3. He | at l <mark>osse</mark> | s and he | eat loss p | oaramete | er: | | | | | | | | | |
| ELEN | IENT | Gros | SS | Openin | gs | Net Ar | ea | U-val | ue | AXU | | k-value | | AXk |
| Deere | | area | (m²) | m | 2 | A ,r | n² | VV/m2 | 2K | (VV/ | K) | KJ/m²∙ł | | KJ/K |
| Doors | . . . | | | | | 1.89 | | | = | 1.89 | = | | | (26) |
| vvindov | ws Type | 91 | | | | 4.41 | | /[1/(1.4)+ | 0.04] = | 5.85 | | | | (27) |
| Window | ws Type | e 2 | | | | 4.41 | ×1/ | /[1/(1.4)+ | 0.04] = | 5.85 | Ľ | | | (27) |
| Window | ws Type | 93 | | | | 4.41 | x1/ | /[1/(1.4)+ | 0.04] = | 5.85 | | | | (27) |
| Window | ws Type | 94 | | | | 2.52 | x1/ | /[1/(1.4)+ | 0.04] = | 3.34 | | | | (27) |
| Walls | | 56.3 | 36 | 17.64 | L . | 38.72 | <u>x</u> | 0.18 | = | 6.97 | | | | (29) |
| Roof | | 76. | 1 | 0 | | 76.1 | x | 0.13 | = | 9.89 | | | | (30) |
| Total a | rea of e | lements | , m² | | | 132.4 | 6 | | | | | | | (31) |
| Party v | vall | | | | | 38.24 | x | 0 | = | 0 | | | | (32) |
| Party f | loor | | | | | 76.1 | | | | | [| | | (32a) |
| * for win | dows and | roof wind | ows, use e sides of ir | effective wil | ndow U-va | alue calcul | ated using | formula 1 | /[(1/U-valu | ıe)+0.04] a | as given in | paragraph | 3.2 | |
| Fabric | heat los | s. W/K | = S (A x) | U) | s and part | 110/13 | | (26)(30) |) + (32) = | | | [| 30.63 | (33) |
| Heat c | apacity | Cm = Si | (A x k) | 0) | | | | . , . , | ((28). | (30) + (32 | 2) + (32a). | (32e) = | 11452 35 | (34) |
| Therma | al mass | parame | eter (TMF | ⊃ = Cm ÷ | · TFA) in | ı kJ/m²K | | | Indica | tive Value | : Medium | 、 <i>′</i> [| 250 | (35) |
| For desi | gn asses | sments wh | ere the de | tails of the | constructi | on are not | t known pr | ecisely the | e indicative | e values of | TMP in Ta | able 1f | 230 | (00) |
| can be u | ised inste | ad of a de | tailed calc | ulation. | | | | | | | | - | | |
| Therma | al bridg | es : S (L | x Y) cal | culated ι | ising Ap | pendix ł | < | | | | | [| 4 | (36) |
| if details | of therma | al bridging at loss | are not kn | own (36) = | : 0.15 x (3 | 1) | | | (22) • | (36) - | | ſ | 10.00 | (07) |
| | tion be | at loss of | alculated | monthly | , | | | | (32)+ | (30) = | 25)m v (5) | l | 43.63 | (37) |
| ventila | Jan | Feh | Mar | Anr | May | Jun | . lul | Aug | Sen | | Nov | Dec | | |
| | 0.011 | I | 1 | · ۳۰ ا | | 0.011 | | 1 | | 1 200 | 1 | 00 | | |

| (38)m= | 34.9 | 34.67 | 34.44 | 33.36 | 33.16 | 32.22 | 32.22 | 32.05 | 32.59 | 33.16 | 33.57 | 34 | | (38) |
|--------------------|-----------------------|----------------------------|--------------------------|--------------------------|----------------------------|---------------------------|-------------------|-------------|--------------|---------------------------|------------------------|---------------------|---------|------|
| Heat tr | ansfer o | coefficie | nt, W/K | | | | | | (39)m | = (37) + (3 | 38)m | | | |
| (39)m= | 78.53 | 78.3 | 78.07 | 76.99 | 76.79 | 75.85 | 75.85 | 75.68 | 76.21 | 76.79 | 77.2 | 77.62 | | |
| Heatle | ee nara | motor (l | | /m2k | | | | | (40)m | Average = | Sum(39)1 | 12 /12= | 76.99 | (39) |
| (40)m= | 1.03 | 1.03 | 1.03 | 1.01 | 1.01 | 1 | 1 | 0.99 | (40)11 | - (33) II + | 1.01 | 1.02 | | |
| (- / | | | | | | | | | l, | Average = | Sum(40)1 | ₁₂ /12= | 1.01 | (40) |
| Numbe | er of day | /s in mo | nth (Tab | le 1a) | | | | | | | | - 1 | | |
| | 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 | ter hea | ting ene | rgy requ | irement: | | | | | | | | kWh/ye | ar: | |
| Assum | ed occu | upancy, | N | •. | | | | | | | 2. | .38 | | (42) |
| if TF. | A > 13.9 A £ 13.9 | 9, N = 1 9. N = 1 | + 1.76 x | (1 - exp | (-0.0003 | 849 x (TH | -A -13.9 |)2)] + 0.0 | 0013 x (| IFA -13. | 9) | | | |
| Annual | averag | e hot w | ater usa | ge in litre | es per da | ay Vd,av | erage = | (25 x N) | + 36 | | 90 |).84 | | (43) |
| Reduce not more | the annua that 125 | al average i litres per | e hot water person pe | usage by r dav (all w | 5% if the a ater use. I | lwelling is hot and co | designed t ld) | to achieve | a water us | se target o | f | | | |
| | lan | Eeb | Mar | Apr | May | lup | | Αμα | Sen | Oct | Nov | Dec | | |
| Hot wate | er usage i | n litres pe | r day for ea | ach month | Vd,m = fa | ctor from | Table 1c x | (43) | Sep | | NUV | Dec | | |
| (44)m= | 9 <mark>9.92</mark> | 96.29 | 92.65 | 89.02 | 85.39 | 81.75 | 81.75 | 85.39 | 89.02 | 9 <mark>2.65</mark> | 96.29 | <mark>9</mark> 9.92 | | |
| | | | | | | | | | | L Total = Su | L | = | 1090.04 | (44) |
| Energy o | content of | ^f hot water | [·] used - cal | lculated mo | onthly $= 4$. | 190 x Vd,r | n x nm x D | 0Tm / 3600 |) kWh/mor | nth (<mark>see Ta</mark> | bles 1b, 1 | c, 1d) | | |
| (45)m= | 148.18 | 129.6 | 133.73 | 116.59 | 111.87 | 96.54 | 89.46 | 102.65 | 103.88 | 121.06 | 132.15 | 143.5 | | |
| lf instant | aneous w | vater heati | ing at point | t of use (no | o hot water | r storage), | enter 0 in | boxes (46 |) to (61) | Tota <mark>l = Su</mark> | m(45) ₁₁₂ = | = [| 1429.21 | (45) |
| (46)m= | 22.23 | 19.44 | 20.06 | 17.49 | 16.78 | 14.48 | 13.42 | 15.4 | 15.58 | 18.16 | 19.82 | 21.53 | | (46) |
| Water | storage | loss: | | | | _ | | _ | | | | | | |
| Storag | e volum | ne (litres |) includir | ng any so | olar or W | /WHRS | storage | within sa | ame ves | sel | | 0 | | (47) |
| If comr | nunity h | neating a | and no ta | ank in dw | velling, e | nter 110 | litres in | (47) | | or (0) in (| 47) | | | |
| Water | ise it no storage | o storea loss: | not wate | er (this ir | iciudes i | nstantar | ieous co | iioa iamo | ers) ente | er 'O' in (| 47) | | | |
| a) If m | anufact | turer's d | eclared I | oss facto | or is kno | wn (kWł | n/day): | | | | | 0 | | (48) |
| Tempe | rature f | actor fro | om Table | 2b | | | | | | | | 0 | | (49) |
| Energy | lost fro | om wate | r storage | e, kWh/ye | ear | | | (48) x (49) |) = | | | 0 | | (50) |
| b) If m | anufact | turer's d | eclared (| cylinder l | loss fact | or is not b/litro/da | known: | | | | | | | (51) |
| If comr | nunity h | neating s | see secti | on 4.3 | | n/ntre/ue | (y) | | | | | 0 | | (31) |
| Volume | e factor | from Ta | ble 2a | | | | | | | | | 0 | | (52) |
| Tempe | rature f | actor fro | om Table | 2b | | | | | | | | 0 | | (53) |
| Energy | lost fro | m wate | r storage | e, kWh/ye | ear | | | (47) x (51) |) x (52) x (| 53) = | | 0 | | (54) |
| Enter | (5U) Or (| (54) IN (8 | 05) Ioulotest | for oach | marth | | | ((EC) | | ~ | | 0 | | (55) |
| vvater | siorage | | | | | | | ((σc))) = (| ວວ) × (41) | | | | | (50) |
| (56)m= | 0 er contain | 0 s dedicate | 0 ed solar sto | 0 prage (57) | $\frac{0}{m = (56)m}$ | $0 \times [(50) - ($ | 0 H11)1 ∸ (5) | 0), else (5 | 0 = (56) | 0 m where (| 0 H11) is fro | 0 m Annendi | хH | (56) |
| (57) | | | | | | | · · · ·)] ÷ (0 | | . , = (00) | | | | | (57) |
| (57)m= | U | 0 | 0 | 0 | 0 | 0 | Ů | 0 | 0 | 0 | U | U | | (57) |

| Primar | y circuit | loss (an | nual) fro | om Table | 93 | | | | | | | 0 | | (58) |
|---------------------|-----------------|------------|------------|-------------|-----------|-----------|-------------|--------------|--------------|---------------------------|--------------|-------------|---------------|------|
| Primar | y circuit | loss cal | culated | for each | month (| 59)m = (| (58) ÷ 36 | 65 × (41) | m | | | | | |
| (moo | dified by | factor fi | rom Tab | le H5 if t | here is s | solar wat | ter heatii | 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 | culated | for each | month (| 61)m = | (60) ÷ 36 | 65 × (41) |)m | | | | | | |
| (61)m= | 50.92 | 44.32 | 47.22 | 43.9 | 43.51 | 40.32 | 41.66 | 43.51 | 43.9 | 47.22 | 47.48 | 50.92 | | (61) |
| Total h | eat requ | uired for | water he | eating ca | alculated | l for eac | h month | (62)m = | 0.85 × (| (45)m + | (46)m + | (57)m + | (59)m + (61)m | |
| (62)m= | 199.1 | 173.92 | 180.95 | 160.49 | 155.39 | 136.85 | 131.12 | 146.16 | 147.78 | 168.28 | 179.63 | 194.42 | | (62) |
| Solar DH | - IW input o | calculated | using App | endix G or | Appendix | H (negati | ve quantity | /) (enter '0 | ' if no sola | r contribut | ion to wate | er heating) | I | |
| (add a | dditiona | l lines if | FGHRS | and/or V | VWHRS | 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= | 199.1 | 173.92 | 180.95 | 160.49 | 155.39 | 136.85 | 131.12 | 146.16 | 147.78 | 168.28 | 179.63 | 194.42 | | |
| | | | | | | | | Outp | out from wa | ater heate | r (annual)₁ | 12 | 1974.08 | (64) |
| Heat g | ains fro | m water | heating, | kWh/mo | onth 0.2 | 5 ´ [0.85 | × (45)m | + (61)m | n] + 0.8 x | (46)m | + (57)m | + (59)m |] | |
| (65)m= | 62 | 54.17 | 56.27 | 49.74 | 48.08 | 42.18 | 40.16 | 45.01 | 45.51 | 52.06 | 55.81 | 60.44 | | (65) |
| in <mark>clu</mark> | ide (57)i | m in calc | culation | of (65)m | only if c | vlinder i | s in the o | dwelling | or hot w | ate <mark>r is f</mark> r | om com | munity h | eating | |
| 5 Int | ernal da | ains (see | Table f | and 5a | | , | | 9 | | | | 5 | 5 | - |
| Motob | | o (Toblo | | | | | | | | | | | | |
| Metabo | Jiic gain | Feb | Mar | Apr | May | Jun | lul | Αυσ | Sen | Oct | Nov | Dec | | |
| (66)m= | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | 119.23 | | (66) |
| Lightin | a daine | (calcula | ted in Ar | pendix | | | r (9a) -a | | Table 5 | | | | | |
| (67)m= | 18.89 | 16.78 | 13.65 | 10.33 | 2, Equal | 6.52 | 7 04 | 9 16 | 12 29 | 15.61 | 18 21 | 19.42 | | (67) |
| | | | | | | untion L | 12 or 1 | 20) 000 | | | 10.21 | 10.12 | | () |
| | 211 1 | 213 20 | | | 181 18 | 167.24 | 15 UI LI | 3a), aisc | 161 26 | 173.01 | 187.84 | 201 78 | 1 | (68) |
| | 211.1 | 213.23 | | | | 107.24 | or 1 4 5 o | | | F | 107.04 | 201.70 | | (00) |
| COOKIN | | | | ppenaix | L, equai | | |), also se | | 5 | 24.00 | 24.00 | l | (60) |
| (69)m= | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | 34.92 | I | (09) |
| Pumps | and fai | ns gains | (Table 5 | ba) | | | | | | | | | 1 | (70) |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | | (70) |
| Losses | s e.g. ev | aporatio | n (nega | tive valu | es) (Tab | le 5) | | | | | 1 | 1 | 1 | |
| (71)m= | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | -95.39 | | (71) |
| Water | heating | gains (T | able 5) | | | - | | - | | | | | | |
| (72)m= | 83.33 | 80.61 | 75.63 | 69.09 | 64.62 | 58.58 | 53.98 | 60.5 | 63.21 | 69.97 | 77.51 | 81.24 | | (72) |
| Total i | nternal | gains = | | | | (66) | m + (67)m | n + (68)m + | + (69)m + (| (70)m + (7 | 1)m + (72) | m | | |
| (73)m= | 375.09 | 372.45 | 358.82 | 337.2 | 315.29 | 294.11 | 280.72 | 287.16 | 298.53 | 320.35 | 345.34 | 364.21 | | (73) |
| 6. Sol | lar gains | 8: | | | | | | | | | | | | |
| Solar g | ains are o | alculated | using sola | r flux from | Table 6a | and assoc | iated equa | tions to co | onvert to th | e applicat | ole orientat | ion. | | |

| Orientation: | Access Factor Table 6d | • | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|----------------|---------------------------|---|------------|---|------------------|---|----------------|---|----------------|---|--------------|------|
| Southeast 0.9x | 0.77 | x | 4.41 | x | 36.79 | × | 0.63 | x | 0.7 | = | 49.59 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 62.67 | × | 0.63 | × | 0.7 | = | 84.47 | (77) |

| Southeast 0.9x | 0.77 | x | 4.41 | x | 85.75 | x | 0.63 | x | 0.7 | = | 115.57 | (77) |
|---------------------------|------|----------|------|---|--------|---|------|---|-----|-----|--------|---------------|
| Southeast 0.9x | 0.77 | x | 4.41 | x | 106.25 | × | 0.63 | x | 0.7 | i = | 143.2 | <u> </u> (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 119.01 | x | 0.63 | x | 0.7 | = | 160.4 | - (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 118.15 | × | 0.63 | x | 0.7 |] = | 159.24 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 113.91 | × | 0.63 | x | 0.7 |] = | 153.52 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 104.39 | × | 0.63 | x | 0.7 |] = | 140.69 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 92.85 | x | 0.63 | x | 0.7 | = | 125.14 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 69.27 | x | 0.63 | x | 0.7 | = | 93.36 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 44.07 | × | 0.63 | x | 0.7 |] = | 59.4 | (77) |
| Southeast 0.9x | 0.77 | x | 4.41 | x | 31.49 | × | 0.63 | x | 0.7 | = | 42.44 | (77) |
| Southwest0.9x | 0.77 | x | 2.52 | x | 36.79 | | 0.63 | x | 0.7 | = | 28.34 | (79) |
| Southwest0.9x | 0.77 | x | 2.52 | x | 62.67 | | 0.63 | x | 0.7 | = | 48.27 | (79) |
| Southwest0.9x | 0.77 | x | 2.52 | x | 85.75 | | 0.63 | x | 0.7 | = | 66.04 | (79) |
| Southwest0.9x | 0.77 | x | 2.52 | x | 106.25 | | 0.63 | x | 0.7 | = | 81.83 | (79) |
| Southwest0.9x | 0.77 | x | 2.52 | x | 119.01 | | 0.63 | x | 0.7 | = | 91.66 | (79) |
| Southwest _{0.9x} | 0.77 | x | 2.52 | x | 118.15 | | 0.63 | x | 0.7 | = | 90.99 | (79) |
| Southwest0.9x | 0.77 | x | 2.52 | x | 113.91 | | 0.63 | x | 0.7 | = | 87.73 | (79) |
| Southwest0.9x | 0.77 | x | 2.52 | X | 104.39 | | 0.63 | x | 0.7 |] = | 80.4 | (79) |
| Southwest0.9x | 0.77 | x | 2.52 | x | 92.85 | | 0.63 | x | 0.7 | = | 71.51 | (79) |
| Southwest0.9x | 0.77 | x | 2.52 | x | 69.27 | | 0.63 | x | 0.7 | = | 53.35 | (79) |
| Southwest0.9x | 0.77 |] x | 2.52 | x | 44.07 | | 0.63 | x | 0.7 | = | 33.94 | (79) |
| Southwest0.9x | 0.77 | x | 2.52 | × | 31.49 | | 0.63 | x | 0.7 |] = | 24.25 | (79) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 11.28 | × | 0.63 | x | 0.7 | = | 15.21 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 11.28 | × | 0.63 | x | 0.7 | = | 15.21 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 22.97 | x | 0.63 | x | 0.7 | = | 30.95 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 22.97 | x | 0.63 | x | 0.7 | = | 30.95 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 41.38 | × | 0.63 | x | 0.7 | = | 55.77 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 41.38 | x | 0.63 | x | 0.7 | = | 55.77 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 67.96 | x | 0.63 | x | 0.7 | = | 91.59 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 67.96 | × | 0.63 | x | 0.7 | = | 91.59 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 91.35 | x | 0.63 | x | 0.7 | = | 123.11 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 91.35 | x | 0.63 | x | 0.7 | = | 123.11 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 97.38 | × | 0.63 | x | 0.7 | = | 131.25 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 97.38 | × | 0.63 | x | 0.7 | = | 131.25 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 91.1 | x | 0.63 | x | 0.7 | = | 122.78 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 91.1 | × | 0.63 | x | 0.7 |] = | 122.78 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 72.63 | × | 0.63 | x | 0.7 |] = | 97.88 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 72.63 | × | 0.63 | x | 0.7 | = | 97.88 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | × | 50.42 | × | 0.63 | x | 0.7 | = | 67.95 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | x | 50.42 | × | 0.63 | x | 0.7 | = | 67.95 | (81) |
| Northwest 0.9x | 0.77 | x | 4.41 | × | 28.07 | × | 0.63 | x | 0.7 | = | 37.83 | (81) |

| Northw | est 0.9x | 0.77 | | x | 4.4 | 1 | x | 2 | 28.07 | x | 0.63 | x | 0.7 | = | 37.83 | (81) |
|----------|------------------------|------------|----------|------------|----------------------|--------------------|-------|---------|-------------|--------------|---------------|----------------------|-------------|---------------------------------|--------|------|
| Northw | est 0.9x | 0.77 | | x | 4.4 | 1 | x | | 14.2 | × | 0.63 | × [| 0.7 | = | 19.13 | (81) |
| Northw | est 0.9x | 0.77 | | x | 4.4 | 1 | x | | 14.2 | × | 0.63 | | 0.7 | = | 19.13 | (81) |
| Northw | est 0.9x | 0.77 | | x | 4.4 | 1 | x | | 9.21 | × | 0.63 | | 0.7 | = | 12.42 | (81) |
| Northw | est 0.9x | 0.77 | | x | 4.4 | 1 | x | | 9.21 | × | 0.63 | | 0.7 | = | 12.42 | (81) |
| | L | | | | | | | | | | | | | | | |
| Solar g | gains in | watts, ca | alculate | ed | for eac | h mont | h | | | (83)m = S | um(74)m . | (82)m | | | | |
| (83)m= | 108.34 | 194.64 | 293.15 | 5 | 408.21 | 498.28 | 3 5 | 12.73 | 486.81 | 416.85 | 332.56 | 222.36 | 131.6 | 91.53 | | (83) |
| Total g | gains – i | nternal a | ind sol | ar | (84)m = | = (73)m | n + (| 83)m | , watts | | | | | | | |
| (84)m= | 483.43 | 567.09 | 651.97 | 7 | 745.41 | 813.57 | 7 8 | 06.84 | 767.53 | 704.01 | 631.09 | 542.71 | 476.94 | 455.74 | | (84) |
| 7. Me | ean inter | rnal temp | peratur | e (| heating | seaso | n) | | | | | | | | | |
| Temp | perature | during h | eating | ре | eriods ir | n the liv | /ing | area | from Tab | ole 9, Th | 1 (°C) | | | | 21 | (85) |
| Utilisa | ation fac | ctor for g | ains fo | r liv | ving are | ea, h1,i | m (s | ee Ta | ble 9a) | | | | | | | |
| | Jan | Feb | Mar | · | Apr | May | / Ì | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (86)m= | 1 | 0.99 | 0.98 | | 0.93 | 0.79 | | 0.59 | 0.43 | 0.49 | 0.76 | 0.96 | 0.99 | 1 | | (86) |
| Mean | interns | l temper | ature i | n li | ving ar | | follo | w sto | $rac{1}{1}$ | r in Tahl | e 9c) | | <u> </u> | | | |
| (87)m= | 19.95 | 20.12 | 20.38 | Т | 20.69 | 20.91 | | 20.99 | 21 | 21 | 20.94 | 20.65 | 20.24 | 19.93 | | (87) |
| T | | | | _ | uta da tu | | | | | | | | <u> </u> | <u> </u> | | |
| | | | | pe T | 20.07 | 1 rest c | | | | DIE 9, 1 | nz (°C) | 20.08 | 20.07 | 20.07 | | (88) |
| (00)11- | 20.00 | 20.00 | 20.00 | - | 20.07 | 20.00 | | 0.03 | 20.03 | 20.03 | 20.00 | 20.00 | 20.07 | 20.07 | | (00) |
| Utilisa | ation fac | ctor for g | ains fo | r re | est of d | welling | , h2 | m (se | e Table | 9a) | | | | | | (00) |
| (89)m= | 1 | 0.99 | 0.97 | | 0.9 | 0.73 | | 0.51 | 0.34 | 0.4 | 0.69 | 0.94 | 0.99 | 1 | | (89) |
| Mean | interna | l temper | ature i | n tł | he rest | of dwe | lling | T2 (f | ollow ste | eps 3 to | 7 in Tabl | le 9 <mark>c)</mark> | | 1 | | |
| (90)m= | 18.66 | 18.9 | 19.28 | | 19.72 | 19.99 | 2 | 20.08 | 20.09 | 20.09 | 20.04 | 19.67 | 19.09 | 18.63 | | (90) |
| | | | | | | | | | | | | fLA = Livir | ng area ÷ (| 4) = | 0.33 | (91) |
| Mear | interna | l temper | ature (| for | the wh | ole dw | ellin | g) = f | LA × T1 | + (1 – fL | A) × T2 | - | | - | | |
| (92)m= | 19.09 | 19.3 | 19.64 | | 20.04 | 20.29 | 2 | 20.38 | 20.39 | 20.39 | 20.34 | 19.99 | 19.47 | 19.05 | | (92) |
| Apply | / adjustr | ment to t | he mea | an | interna | tempe | eratu | ire fro | m Table | 4e, whe | ere appro | opriate | i | | | |
| (93)m= | 19.09 | 19.3 | 19.64 | | 20.04 | 20.29 | 2 | 20.38 | 20.39 | 20.39 | 20.34 | 19.99 | 19.47 | 19.05 | | (93) |
| 8. Sp | ace hea | ating requ | uireme | nt | | | _ | | | | | | | | | |
| Set T | i to the tilisation | mean int | ernal te | em s II | iperatui Ising Ta | re obta Ible 9a | inec | at st | ep 11 of | Table 9 | b, so tha | t Ti,m=(| 76)m an | d re-calo | culate | |
| | Jan | Feb | Mar | . T | Apr | May | , [| Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Utilisa | ation fac | ctor for g | ains, h | m: | 7.01 | iviay | | Uarr | Uui | , lug | | | | 000 | | |
| (94)m= | 1 | 0.99 | 0.97 | Τ | 0.9 | 0.75 | | 0.53 | 0.37 | 0.43 | 0.71 | 0.94 | 0.99 | 1 | | (94) |
| Usefu | ul gains, | hmGm | W = (| 94) |)m x (84 | 4)m | - | | 1 | | | | | | | |
| (95)m= | 481.12 | 560.59 | 631.35 | 5 | 671.41 | 608.09 |) 4 | 31.6 | 286.41 | 300.15 | 447.16 | 510.35 | 471.87 | 454.12 | | (95) |
| Mont | hly aver | age exte | rnal te | mp | perature | from ⁻ | Tabl | e 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 rat | e for mea | an inte | rna | al tempe | erature | , Lm | ı, W = | =[(39)m | x [(93)m | – (96)m |] | | i | 1 | |
| (97)m= | 1161.15 | 1127.77 | 1025.6 | 4 | 857.91 | 659.76 | 6 4 | 38.08 | 287.11 | 301.58 | 475.29 | 721.4 | 954.92 | 1153.08 | | (97) |
| Spac | e heatir | ig require | ement | for | each n | nonth, | kWh | /mon | th = 0.02 | 24 x [(97 |)m – (95 I | 5)m] x (4 | 1)m | | 1 | |
| (98)m= | 505.94 | 381.14 | 293.36 | 5 | 134.28 | 38.44 | | 0 | 0 | 0 | 0 | 157.03 | 347.79 | 520.02 | | |
| | | | | | | | | | | Tota | al per year | (kWh/yea | r) = Sum(9 | 108) _{15,912} = | 2378 | (98) |
| Spac | e heatir | ig require | ement | in l | kWh/m² | /year | | | | | | | | | 31.25 | (99) |

| 9a. En | ergy reo | quiremer | nts – Ind | ividual h | eating sy | /stems i | ncluding | micro-C | HP) | | | | | |
|-----------------------|----------------|----------------------|------------|-----------------|-----------|-------------|------------------------|-------------------|------------------------|-----------------------|---------------------------------|-----------|-------------------------|------------|
| Spac | e heati | ng: | t frage - | | 10 | m o = 1 = - | | | | | | | 2 | |
| Fract | ion of sp | | at from S | econdar | y/supple | mentary | system | (202) = 1 | - (201) - | | | | 0 | |
| Fract | ion of sp | | at from m | nain syst | em(s) | | | (202) = 1 - (202) | -(201) = | (202)1 - | | | 1 | |
| Fract | | tal neatil | ng trom | main sys | | | | (204) = (20 | J2) x [1 – | (203)] = | | | 1 | |
| | ency of | main spa | ace neat | ing syste | em 1 | | - 0/ | | | | | | 93.4 | (206) |
| ETTICI | ency of | seconda | ry/suppi | ementar I | y neating | g system | 1, % 1 | | | | | _ | 0 | (208) |
| Snoo | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/yea | ar |
| эрас | 505.94 | 381.14 | 293.36 | 134.28 | 38.44 | 0 | 0 | 0 | 0 | 157.03 | 347.79 | 520.02 | | |
| (211)m | $L = \{[(98)]$ | l)m x (20 | (4)] } x 1 | $100 \div (20)$ |)6) | _ | | _ | - | | | | | (211) |
| (211) | 541.69 | 408.08 | 314.08 | 143.77 | 41.15 | 0 | 0 | 0 | 0 | 168.12 | 372.37 | 556.77 | | (2) |
| | | ! | 1 | ! | | | Į | Tota | l (kWh/yea | ar) =Sum(2 | 2 11) _{15,1012} | <u></u> = | 2546.04 | (211) |
| Spac | e heatin | g fuel (s | econdar | y), kWh/ | month | | | | | | | | | |
| = {[(98 |)m x (20 | 01)] | 00 ÷ (20 |)8) | | | | | | | | i | I | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | | | | | | | | Tota | Г (КУУЛ/УӨЗ | ar) =5um(2 | 215) _{15,1012} | 2 | 0 | (215) |
| Output | heating | g ater hea | ter (calc | ulated al | hove) | | | | | | | | | |
| Carpa | 199.1 | 173.92 | 180.95 | 160.49 | 155.39 | 136.85 | 131.12 | 146.16 | 147.78 | 1 <mark>6</mark> 8.28 | 179.63 | 194.42 | | |
| Effic <mark>ie</mark> | ncy of w | ater hea | iter | | | 7 | | 7 | | | | | 80.3 | (216) |
| (217)m= | 87.3 | 86.97 | 86.26 | 84.61 | 82.12 | 80.3 | 80.3 | 80.3 | 80.3 | 84.88 | 86.69 | 87.41 | | (217) |
| Fuel fo | or water | heating, | kWh/m | onth | | | | | | | | | | |
| (219)m (219)m= | 1 = (64) | 199.97 | 209.77 |)m 189.69 | 189.22 | 170.43 | 163.28 | 182.02 | 184.03 | 198.26 | 207.22 | 222.43 | | |
| | | | | | | | | Tota | I = Sum(2 ⁻ | 19a) ₁₁₂ = | | <u> </u> | 2344.39 | (219) |
| Annua | al totals | i | | | | | | | | k | Wh/year | • | kWh/year | _ |
| Space | heating | fuel use | ed, main | system | 1 | | | | | | | | 2546.04 | |
| Water | heating | fuel use | d | | | | | | | | | | 2344.39 | |
| Electri | city for p | oumps, fa | ans and | electric | keep-ho | t | | | | | | | | |
| centra | al heatir | ng pump | : | | | | | | | | | 30 | | (230c) |
| boiler | with a | fan-assis | sted flue | | | | | | | | | 45 | | (230e) |
| Total e | electricit | y for the | above, l | kWh/yea | r | | | sum | of (230a). | (230g) = | | | 75 | (231) |
| Electri | citv for I | iahtina | | , | | | | | | | | | 333.64 |] (232) |
| 12a | CO2 em | | – Individ | ual heati | ina svete | ms inclu | udina mi | cro-CHP | | | | | 000.01 | |
| 120. | | 113310113 - | | iuai neati | ing syste | | | | | | | | | |
| | | | | | | En kW | ergy /h/year | | | Emiss kg CO | ion fac 2/kWh | tor | Emissions kg CO2/yea | ar |
| Space | heating |) (main s | ystem 1 |) | | (21 | 1) x | | | 0.2 | 16 | = | 549.94 | (261) |
| Space | heating | (second | dary) | | | (21 | 5) x | | | 0.5 | 19 | = | 0 | (263) |
| Water | heating | | | | | (219 | 9) x | | | 0.2 | 16 | = | 506.39 | (264) |
| Space | and wa | iter heati | ng | | | (26 | 1) + (262) | + (263) + (| 264) = | | | | 1056.33 |](265) |

| Electricity for pumps, fans and electric keep-hot | (231) | x | | 0.519 | = | 38.93 | (267) |
|---|-------|---|--------|--------------|---|---------|-------|
| Electricity for lighting | (232) | x | [| 0.519 | = | 173.16 | (268) |
| Total CO2, kg/year | | | sum of | (265)(271) = | | 1268.41 | (272) |
| | | | | | | | |
| TER = | | | | | | 16.67 | (273) |
| | | | | | | | |



Appendix 6 – Details of an Air Source Heat Pump

Heating

Product Information

PUHZ-(H)W50-140VHA(2)/YHA2(-BS) Ecodan Monobloc Air Source Heat Pumps Making a World of Difference



Designed to meet the demands of today's heating needs







Our range of Ecodan monobloc air source heat pumps includes 5, 8.5, 11.2 and 14kW sizes. Now with the ability to cascade up to six units of the same output, Ecodan monobloc systems offer a capacity range from 5 through to 84kW. Designed to suit a wide number of applications, these models offer a viable solution for the varying requirements that domestic and small commercial applications demand.

Key Features

- Self-contained unit, only requiring water and electric connections
- No need for gas supply, flues or ventilation
 - Single phase power supply with a low starting current (3 phase available for 14kW)

Renewable Heating Technology

- Low maintenance and quiet operation
- Operates with outside temperatures as low as -25°C
- Multiple unit connection
- Hybrid function, for use with conventional boilers
- 2-zone energy efficient space heating control
- Available as a standalone, packaged or semi packaged system
- Energy monitoring as standard
 Coastal protection models available (-BS)

Coastal protection models available

- Application Examples
- The vast majority of UK homes
- Small Retail Outlets
- Dental / Doctor's Surgeries
- Public Sector / Commercial Buildings



Air Conditioning | Heating Ventilation | Controls

Heat

Product Information

PUHZ-(H)W50-140VHA(2)/YHA2(-BS) Ecodan Monobloc Air Source Heat Pumps Making a World of Difference

| OUTDOOR UNIT | | PUHZ-W50VHA2(-BS) | PUHZ-W85VHA2(-BS) | PUHZ-W112VHA(-BS) | PUHZ-HW140VHA2(-BS) | PUHZ-HW140YHA2(-BS) |
|-----------------------------|--|-------------------|-------------------|-------------------|----------------------|----------------------|
| HEAT PUMP SPACE | ErP Rating | A++ | A++ | A++ | A++ | A++ |
| HEATER - 55°C | η, | 127% | 128% | 125% | 126% | 126% |
| | SCOP | 3.25 | 3.27 | 3.20 | 3.22 | 3.22 |
| HEAT PUMP SPACE | ErP Rating | A++ | A++ | A++ | A++ | A++ |
| HEATER - 35°C | η. | 162% | 162% | 164% | 157% | 157% |
| | SCOP | 4.12 | 4.12 | 4.18 | 3.99 | 3.99 |
| HEAT PUMP COMBINATION | ErP Rating | A | A | A | A | A |
| HEATER - Large Profile | η _{wh} | 99% | 97% | 100% | 96% | 96% |
| HEATING ^{*2} | Capacity (kW) | 4.8 | 8.3 | 11.0 | 14.0 | 14.0 |
| (A-3/W35) | Power Input (kW) | 1.63 | 2.96 | 3.65 | 4.81 | 4.81 |
| | COP | 2.95 | 2.80 | 3.01 | 2.91 | 2.91 |
| OPERATING AMBIENT TE | MPERATURE (°C DB) | -15 ~ +35°C | -20 ~ +35°C | -20 ~ +35°C | -25 ~ +35°C | -25 ~ +35°C |
| SOUND PRESSURE LEVE | L AT 1M (dBA) ^{*3*4} | 45 | 48 | 53 | 53 | 53 |
| LOW NOISE MODE (dBA) | "3 | 40 | 42 | 46 | 46 | 46 |
| WATER DATA | Pipework Size (mm) | 22 | 22 | 28 | 28 | 28 |
| | Flow Rate (I/min) | 14.3 | 25.8 | 32.1 | 40.1 | 40.1 |
| | Water Pressure Drop (kPa) | 12 | 13.5 | 6.3 | 9 | 9 |
| DIMENSIONS (mm)*7 | Width | 950 | 950 | 1020 | 1020 | 1020 |
| | Depth | 330+305 | 330+305 | 330+30'5 | 330+30 ⁻⁵ | 330+30 ⁻⁵ |
| | Height | 740 | 943 | 1350 | 1350 | 1350 |
| WEIGHT (kg) | | 64 | 77 | 133 | 134 | 148 |
| ELECTRICAL DATA | Electrical Supply | 220-240v, 50Hz | 220-240v, 50Hz | 220-240v, 50Hz | 220-240v, 50Hz | 380-415v, 50Hz |
| | Phase | Single | Single | Single | Single | 3 |
| | Nominal Running Current [MAX] (A) | 5.4 [13] | 10.3 [23] | 11.2 [29.5] | 14.9 [35] | 5.1 [13] |
| | Fuse Rating - MCB Sizes (A) ⁶ | 16 | 25 | 32 | 40 | 16 |

"1 Combination with EHPT20X-MHCW Cylinder
 "2 Under normal heating conditions at outdoor temp: -3"CDB / -4"CWB, outlet water temp 35"C, inlet water temp 30"C.
 "3 Under normal heating conditions at outdoor temp: -3"CDB / 6"CWB, outlet water temp 35"C, inlet water temp 30"C.
 "4 Sound power level of the PUHZ-WS0VHA2 is 61:05A, PUHZ-WBSVHA2 is 62:36BA, PUHZ-HW140VHA2 is 65:56BA, PUHZ-HW140VHA2 is 67:5dBA. Tested to BS EN12102.
 "5 Grile.
 "6 MCB Sizes BS EN60898-2 & BS EN60947-2.
 "7 FOW Temperature Controller (FTC) for standalone systems PAC-IF062B-E Dimensions WXDxH (mm) - 520x150x450

 η_{a} is the seasonal space heating energy efficiency (SSHEE) η_{ab} is the water heating energy efficiency

DIMENSIONS

PUHZ-W50VHA2(-BS)

PUHZ-W85VHA2(-BS)



Front View





Front View



PUHZ-(H)W112-140VHA(2) / YHA2(-BS)





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