

Sustainability Update

**Rev A** 

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### **ISSUE HISTORY**

| Issue | Date     | Description         |
|-------|----------|---------------------|
| *     | 09/08/19 | Draft for Comment   |
| А     | 16/08/19 | Update for Planning |
|       |          |                     |
|       |          |                     |
|       |          |                     |

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### 1.0 EXECUTIVE SUMMARY

A Planning Application for the Regeneration of the Agar Grove Estate was submitted in December 2013. Construction of this development is phased to ensure existing residents only move once. The phasing has allowed the designs for plots I and JKL to be revisited. This energy statement provides details of the updated energy strategies for Blocks I and JKL of the Agar Grove Development.

This report is included as an update as part of the planning amendment for Blocks I and JKL.

As described in the initial application the PassivHaus standard will be used to deliver enhanced 'be lean' performance. Block by block heating systems are still proposed but will now be supplied in Blocks I and JKL by air source heat pumps. This is in line with the draft new London plan and the government's plan to phase out gas boilers. Photovoltaic panels will be located on the uppermost roofs of each building.

As a result of these measures a total carbon reduction of 64% is achieved across the residential areas of the development.

### 1.1 Carbon Dioxide Reduction Targets

The carbon reduction target at the time of the original application was 40% reduction over 2010 Part L requirements. This 40% overall reduction was to include a 20% reduction in carbon dioxide emissions from onsite renewables.

As the carbon intensity of the grid continues to reduce new emission factors have been released and are proposed for use by the draft London Plan. To reflect this, the carbon reduction has been calculated using SAP 10 carbon emission factors in line with the draft new London Plan and to reflect the decarbonisation of the grid. According to the Greater London Authority document 'Energy Assessment Guidance' a 35% reduction against Part L 2013 is equivalent to a 40% reduction against Part L 2010.

#### 1.2 Emissions Factors

Unless otherwise stated SAP 10 carbon emissions have been used throughout.

Existing and new carbon dioxide emissions factors

|             | SAP 2012 (existing) | SAP 10 (new)     |
|-------------|---------------------|------------------|
| Natural Gas | 0.216 kg CO2/kWh    | 0.210 kg CO2/kWh |
| Electricity | 0.519 kg CO2/kWh    | 0.233 kg CO2/kWh |

The SAP 10 carbon factors better reflect the decarbonisation of grid electricity. This results in electrically powered heat pumps being favoured for heating and means CHP engines are less beneficial in carbon terms. It also results in the perceived benefit of PVs being reduced.

### 1.3 Key Strategies

The key energy strategies are described below:

Be Lean- Demand Reduction



- High fabric performance- Passive House standards
- Mechanical Ventilation with Heat Recovery (MVHR) throughout

Be Clean- Efficient Energy Supply

• High efficiency MVHR

Be Green- Renewable Energy

- Air Source Heat Pumps used to provide heating and generate hot water
- PV array

### 1.4 Summary of Results

The proposed development has been remodelled in SAP incorporating the fabric and servicing strategy changes described above.

# Domestic Block I – SAP Summary

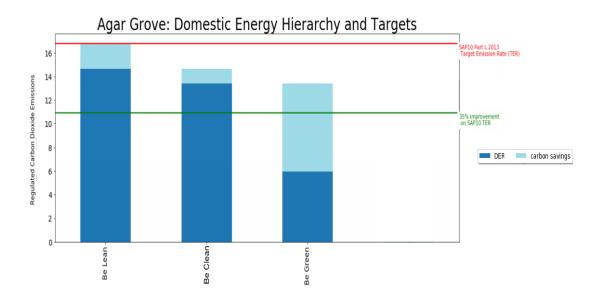


Figure 1: Domestic energy hierarchy and targets Block I, kgC02/m2

Table 1: CO2 emissions after each stage of the Energy Hierarchy for Block I

|  | Carbon dioxide emissions for domestic buildings (tonnes CO2 per annum) |
|--|--|
|  | Regulated  |
| Baseline: Part L 2013 of the Building<br>Regulations Compliant Development | 37.6   |
| After energy demand reduction  | 32.7   |
| After heat network / CHP   | 30.1   |
| After renewable energy   | 13.2   |

### **Block JKL Summary**

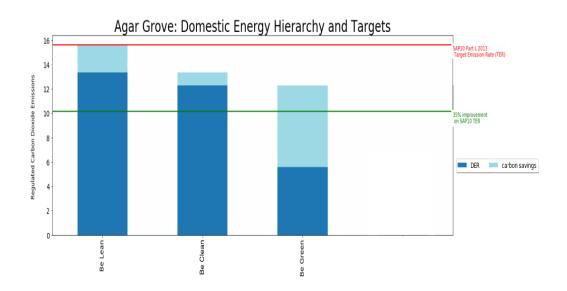


Figure 2 Domestic energy hierarchy and targets Block JKL, kgC02/m2

Table 2: CO2 emissions after each stage of the Energy Hierarchy for **Block JKL** 

|  | Carbon dioxide emissions for domestic buildings |
|--|---|
|  | (tonnes CO2 per annum)                          |
|  | Regulated                                       |
| Baseline: Part L 2013 of the Building<br>Regulations Compliant Development | 85.2  |
| After energy demand reduction  | 73.2  |
| After heat network / CHP   | 67.2  |
| After renewable energy   | 30.6  |

Table 3: Regulated carbon dioxide savings from each stage of the Energy Hierarchy for domestic buildings

|                                      | Regulated domesti savings-Block |      |
|--------------------------------------|---------------------------------|------|
|                                      | (Tonnes CO₂ per annum)          | (%)  |
| Savings from energy demand reduction | 16.95                           | 13.8 |
| Savings from heat network / CHP      | 8.7                             | 7.1  |
| Savings from renewable energy        | 53.4                            | 43.5 |
| Cumulative on site savings           | 79.1                            | 64.3 |

# 2.0 CO<sub>2</sub> EMISSIONS

The carbon footprints as shown in the tables above have been calculated using the following methods:

### **Dwellings:**

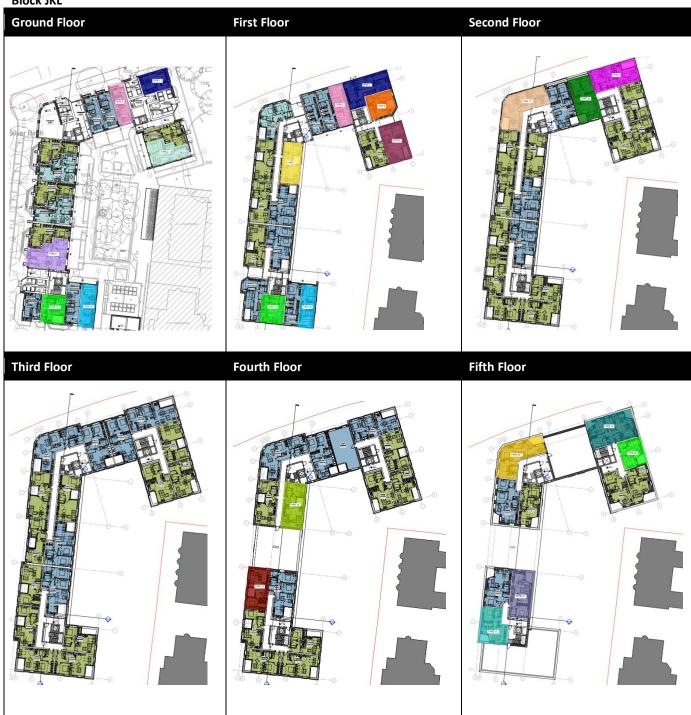
A Dwelling Emissions Rate (DER) has been calculated in line with the Building Regulations Part L 2013 methodology SAP 2012. The results have then been converted using SAP 10 carbon factors.

These calculations were carried out on a representative sample of properties as shown below. Details of the results of these calculations can be found in Appendix 1

Block I



### **Block JKL**



#### Shop:

The non-domestic unit in block JKL will be provided as a shell and core shop. This has been excluded from the modelling as it will have the same thermal envelope as the domestic units and will be provided without services.

### 3.0 FABRIC PERFORMANCE (BE LEAN)

As described in the previous planning report carbon emissions will be reduced primarily b implementing 'passive' energy efficiency measures. Blocks I and JKL have been designed based on the Passivhaus approach.

It is recognised that Passivhaus is better at delivering lower energy in use than the SAP methodology. This is in part because it is much more rigorous in its requirements for certification in terms of the Passivhaus Planning Package model, the certified mechanical equipment, and the construction detailing.

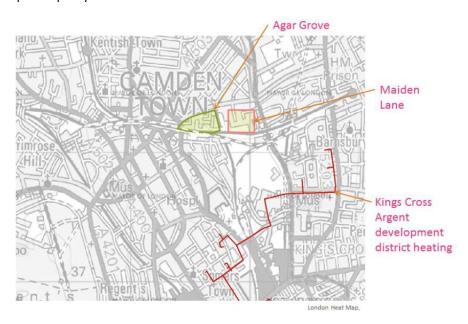
Fabric performance targets have not changed since the original planning application.

### 4.0 HEATING INFRASTRUCTURE (BE CLEAN)

High efficiency gas condensing boilers were previously selected; as guidance has changed the heat source selection has been revisited.

#### **Connection to existing networks**

As described in the original planning application connection to the existing King's Cross Argent network would not be feasible as the route would require crossing a major railway line and the existing boiler house has no spare capacity.



No new heat networks have been developed in the area since the previous application.

#### Site wide district heating network

The GLA have allowed that CHP is not required for this scheme.

A site wide network was deemed inappropriate due to the phased delivery of the development and objections raised by residents during consultation.

The new blocks will not connect to a site wide heat network; a block-by-block system will be installed. This allows a lower system temperature, and shorter pipe runs, hence reduced losses. This improves efficiency.

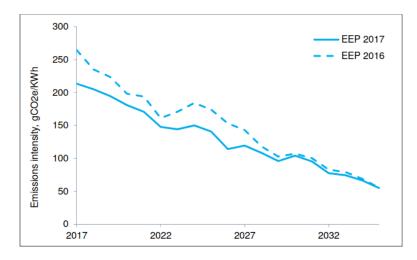
#### **Decarbonisation of the Grid**

When looking at energy efficiency it is also useful to consider fuel sources and their carbon efficiency. Heating and hot water provided by natural gas boilers was previously proposed for the site. This is becoming a relatively carbon intense fuel. Meanwhile mains electricity is becoming a relatively low carbon fuel.

The current carbon intensity of the UK electricity grid is considerably lower than the factors written into the 2013 Part L of the Building Regulations. An update to Part L is expected in 2019/2020. This will include updating carbon emission factors which are more representative of the real world. These updated carbon emission factors have already been released as part of the latest version of the standard Assessment Procedure (SAP 10). These carbon factors have been used for our analysis where stated as they give a more accurate representation of current carbon emissions factors.

As more renewable technologies are used to supply the electricity grid it is expected that this figure will continue to reduce. In terms of carbon reduction, efficient all electric systems are preferable. This is shown in the Department of Energy and Climate Change Energy and Emissions Predictions.

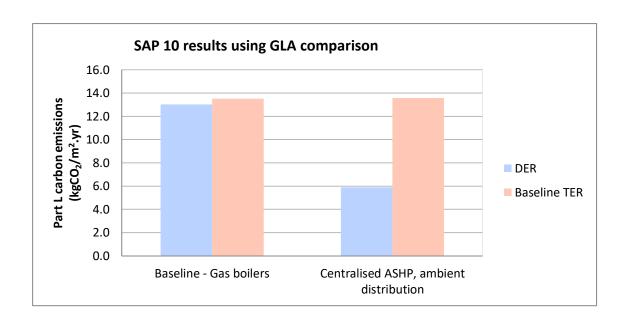
The solid blue line in the following graph shows how the carbon intensity of the UK grid is predicted to drop based on 2017 predictions, and the dashed blue line is the same measure based on 2016 predictions.



Department of Energy and Climate Change (DECC) Energy and Emissions Predictions (EEP) for 2017 and 2016.

#### **Heat Source Selection**

As previously discussed the new SAP 10 carbon emission rates more accurately reflect the carbon intensity of the electricity grid. Electricity driven heat pumps are more favourable using these values. This is shown below, a study was undertaken to compare gas fired boilers and electricity driven air source heat pumps using SAP10 emissions rates.



Air source heat pumps show much lower Dwelling Emission Rates (DERs) compared to gas boilers. Air source heat pumps will be discussed in further detail in the renewables section below.

### 5.0 RENEWABLE ENERGY (BE GREEN)

Heat pumps have been identified in the previous section as a more suitable heat source than gas boilers due to decarbonisation of the grid. This change in heat source will impact the selection of supplementary renewable technologies chosen.

#### **Air Source Heat Pumps**

A heat pump is akin to a domestic fridge: it uses electricity to move heat from one material to another. An air source heat pump moves heat from the outside air to a fluid (water). It uses a refrigerant to achieve this, and generally uses electricity as a power source. Figure 1 shows the four stages of a typical ASHP cycle.

As the ASHP is moving heat from one location to another, it is possible to transfer more heat than the energy put in. This is generally defined by the Coefficient of Performance (COP):

$$COP = \frac{\textit{Useful heat transferred}}{\textit{Energy Input}}$$

So a heat pump that moved 3kW of heat for 1kW of electrical power input would have a COP of 3. The COP is generally higher the closer the air and water temperatures are to each other.

This heat pump is generally mounted externally, and pipework then brought to within the building - Figure 2 shows example units.

#### **Climate Change**

Recent years have seen particularly warm summers, which are anticipated to continue with ongoing climate change, as shown in Figure 4. Carbon emissions contribute to climate change, so there is a responsibility to choose low-carbon solutions where possible.

The increasing temperatures also mean that summer comfort is increasingly becoming a concern. This means designs should allow for future climate change, and ideally ensure comfortable conditions can be achieved, including the provision of comfort cooling where passive measures will be inadequate.

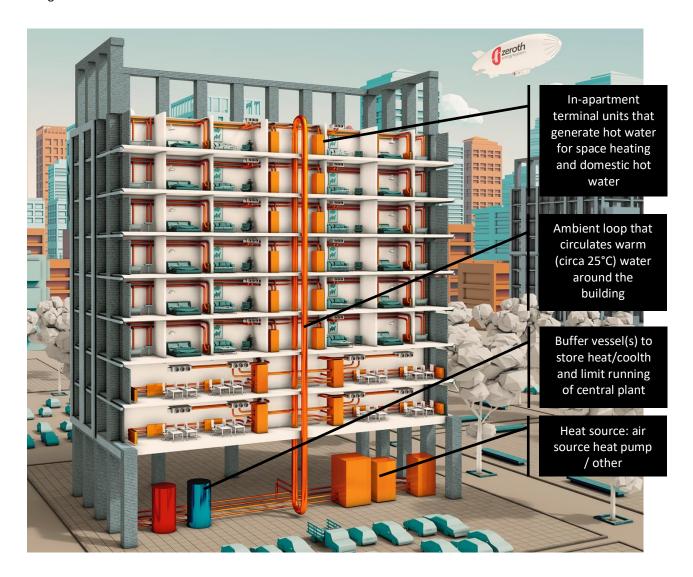
#### **Passivhaus Primary Energy Assessment**

For the Passivhaus standard, the anticipated total energy consumption of the building is modelled. Whereas this has been done for specifically Agar Grove which is designed to Passivhaus standards, the results give a useful indication of in-use energy consumption, with numbers more reliable than those associated with Building Regulations compliance.

#### **Proposed System and Rationale**

The proposed system uses an external air source heat pump to generate warm water. This warm water is then circulated around the building at low temperatures (circa 25°C). The distribution losses are therefore significantly lower than a conventional system (which would have water temperatures around 55-70°C, depending on the system choice), and once a space reaches 25°C they become zero. As these losses are lower, the risk of overheating in corridors and other circulation spaces is significantly reduced.

In-apartment water to water heat pumps then produce warm water at suitable temperatures for both domestic hot water production and space heating. These in-apartment proprietary units contain a hot water tank, water to water heat pump, and associated controls. The principal elements of the system are shown in the images below.



The principal benefits of this system are:

- Efficiency: the use of air source heat pumps in this arrangement mean distribution losses are minimised, and space heating and domestic hot water production are achieved efficiently
- Environmental impact: the use of electricity is consistent with a decarbonising electricity grid, and a design that is aligned with limiting environmental impact
- Compliance: the use of electricity is in line with the draft new London Plan
- Air quality: the use of electricity means there is no combustion on the site, and so no omission of particulates, or incomplete products of combustion (NO<sub>x</sub> etc.)
- Future-proofing: the terminal units can provide both heating and cooling, which allows for the provision of comfort cooling within apartments either initially or in the future, without requiring a change in infrastructure throughout the building
- Passivhaus compliance: the use of electricity, and low energy consumption of the system align with the stringent energy requirements of Passivhaus.
- The ambient loop can readily make use of low-grade waste heat in the area, should it become available in future.

The principal risks are related to the relatively new technology: there are two manufacturers in the UK offering a system of this type (Dimplex and Daikin), with demonstration systems but not completed projects



#### Supplementary renewable technologies

The original planning application identified solar thermal collectors and photovoltaic (PV) panels as the most appropriate renewable technologies for the site. As the heat source for Block I and JKL is being changed the suitability of these technologies has been reviewed.

Incorporating solar thermal collectors into the proposed system would be difficult. Hot water generated by the solar thermal collectors will be at a higher temperature than the warm water generated by the air source heat pump and cannot be added to the ambient loop system. A separate system would be required to provide the hot water from the solar thermal collectors to dwellings. Additionally the in-apartment terminal units are not capable of taking a secondary heat source.

It is instead proposed that PV panels only are installed on the highest roofs.

### 6.0 WATER, OTHER RESOURCES AND SUSTAIBLE CONSTRUCTION

The sustainability approach beyond energy and carbon dioxide remains largely unchanged from the original planning application.

#### 6.1 Water

Domestic water consumption is deigned to achieve 105 litres/person/day.

The landscaping strategy also includes the provision of SUDS to the Mayor's preferred standard through green roofs, permeable paving and rain gardens.

#### 6.2 Materials and Sustainable Construction

The aspiration for Passivhaus means a higher embodied energy than a typical building because of the additional insulation required and additional glazing in the triple glazed windows. Wherever possible preference will be given to environmentally low impact materials: cement replacements will be specified in order to reduce the impact of concrete elements; the insulation used will not contain substances known to contribute to ozone depletion or have the potential to contribute to global warming.

#### 7.0 SUMMERTIME COMFORT AND CLIMATE CHANGE ADAPTION

#### Introduction

Anthropomorphic climate change is a becoming prominent global concern, with significant potential detrimental results, primarily due to the speed of change and the difficulty in adapting to this. Climate change is shifting Britain's climate towards hotter summers with increased probabilities of extended heatwaves. The UK government and Camden council have both introduced legislation to ensure new developments address this issue on two fronts.

- 1. Reduce carbon emissions to limit the severity of climate change- minimise energy use.
- 2. Ensure developments are resilient to increased overheating risks from future climate scenarios.

The Camden Local Plan 2017 calls for following the London Plan Cooling Hierarchy which aims to reduce overheating risk whilst also reducing reliance on air conditioning systems.

As described in the original application, the design team has been aware from an early stage of the need to mitigate the risk of overheating; and to create thermally comfortable spaces that will continue to operate successfully in future climates. The fact that the development is targeting Passivhaus certification reinforces the requirement for acute attention to detail with respect to overheating, as Passivhaus relies on a highly insulated thermal envelope resulting very low heat loss. In the winter, this allows the dwelling to take advantage of Solar Gains for free heating, but in the summer affective strategies to control gain and flush away heat must be considered.

To reduce energy demand from cooling, the design follows the London Plan Cooling Hierarchy by adopting a passive design - opening windows for natural ventilation. However, there is a greater risk of overheating, both with the current and predicted future climate with a natural ventilation strategy. Therefore an overheating analysis was completed with the aims of showing compliance with legislation whilst also driving the design.

#### Methodology

The design standards for residential summer comfort have advanced since the original application. In line with the draft New London Plan, CIBSE's TM59 was used as the framework to assess overheating risk and to guide design to militate against this. TM59 has two criteria to pass – daytime comfort for all rooms, and night-time comfort for bedrooms. Ten apartments which represent the most onerous examples were analysed. This included apartments with higher solar gains due to being south facing and/or limited shading, single aspect glazing which doesn't allow cross flow and ground floor apartments where security issues mean limited opening of windows.

#### Results

• 2020 Climate:

Results showed it was feasible to adopt a passive cooling design ONLY if certain features are adopted, such as solar irradiance filters on the glazing, ensuring sufficient opening areas on the glazing and adopting external shading. Refer to the TM59 Summer Comfort report for full details.

• 2050 Climate

Current passive design measures will not be sufficient in mitigating the overheating risk. Solar irradiance is the most significant heat gain.

Following the London Plan Energy Hierarchy 'Be Lean, be clean, be green', the first option should 'be lean' adopting more passive design measures which will bring down energy demand. Measures that could be adopted now include adding blinds/shades/louvres to limit solar gains and the removal of fixed low level glazing which adds to solar gains but does not aid natural ventilation. Retrofit options in the future include providing solar control film, fitting more external shading/louvres and adding ceiling fans.

The above measures will reduce the demand for active cooling but not eliminate it. Following 'be clean', active cooling could be retrofitted by modifying the currently proposed underfloor heating system to be able to also provide underfloor cooling, or alternatively add cooling to the mechanical ventilation system. To 'be clean' this should utilise air source heat pumps with high efficiency ratings (SCOP and SEER).

Further details can be found in Appendix 2.

### 8.0 APPENDIX 1 – SAP MODELLING OUTPUT

Modelling of regulated energy in the dwellings was carried out using STROMA FSAP software in line with the methodology and occupancy profiles described in Part L 2013 of the Building Regulations. Results were then converted using SAP10 factors in line with the guidance provided by the GLA. The following pages contain examples of the modelling output at each stage of the energy hierarchy.

|  |                                |   | User E           | Details: _               |              |              |          |           |                       |          |
|--|--------------------------------|---|------------------|--------------------------|--------------|--------------|----------|-----------|-----------------------|----------|
| Assessor Name:<br>Software Name:   | Stroma FSAP 2                  |   | le o o o o o o o | Strom                    | are Ve       | rsion:       |          | Versio    | on: 1.0.4.18          |          |
| Address :  | Block I, Agar Gro              |   |                  | Address:<br>lon, NW1     |              | n            |          |           |                       |          |
| 1. Overall dwelling dime   | ensions:                       |   |                  |                          |              |              |          |           |                       |          |
|  |                                |   | Are              | a(m²)                    | ī            | Av. He       | ight(m)  | 7         | Volume(m <sup>3</sup> | <u>^</u> |
| Ground floor   |                                |   |                  | 77.6                     | (1a) x       | 3            | .15      | (2a) =    | 244.44                | (3a)     |
| Total floor area TFA = (1  | a)+(1b)+(1c)+(1d)+             | (1e)+(1r                                      | n)               | 77.6                     | (4)          |              |          |           |                       |          |
| Dwelling volume  |                                |   |                  |                          | (3a)+(3b     | )+(3c)+(3c   | d)+(3e)+ | .(3n) =   | 244.44                | (5)      |
| 2. Ventilation rate:   |                                |   |                  |                          |              |              |          |           |                       |          |
|  | main<br>heating                | secondar<br>heating                           | ·у<br>           | other                    | _            | total        |          |           | m³ per hou            | ır<br>   |
| 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 fa  | ins                            |   |                  |                          |              | 0            | Χ.       | 10 =      | 0                     | (7a)     |
| Number of passive vents  | <b>;</b>                       |   |                  |                          |              | 0            | χ.       | 10 =      | 0                     | (7b)     |
| Number of flueless gas fi  | ires                           |   |                  |                          | Ī            | 0            | X 4      | 40 =      | 0                     | (7c)     |
|  |                                |   |                  |                          |              |              |          | Air ch    | nanges per ho         | our      |
| Infiltration due to chimne   | vs. flues and fans =           | (6a)+(6b)+(7                                  | 7a)+(7b)+(       | (7c) =                   | Г            | 0            |          | ÷ (5) =   | 0                     | (8)      |
| If a pressurisation test has b   |                                |   |                  |                          | continue fi  |              |          | . (0)     | 0                     | (0)      |
| Number of storeys in the   | he dw <mark>elling</mark> (ns) |   |                  |                          |              |              |          |           | 0                     | (9)      |
| Additional infiltration  |                                |   |                  |                          |              |              | [(9)     | -1]x0.1 = | 0                     | (10)     |
| Structural infiltration: 0  if both types of wall are p.   |                                |   |                  |                          | •            | ruction      |          |           | 0                     | (11)     |
| deducting areas of openii  |                                | rresponding to                                | ine grea         | lei wali are             | a (anter     |              |          |           |                       |          |
| If suspended wooden f  | ,                              | ,   | .1 (seale        | ed), else                | enter 0      |              |          |           | 0                     | (12)     |
| If no draught lobby, en  |                                |   |                  |                          |              |              |          |           | 0                     | (13)     |
| Percentage of windows Window infiltration  | s and doors draugh             | t stripped                                    |                  | 0.25 - [0.2              | ) v (14) ± 1 | 1001 -       |          |           | 0                     | (14)     |
| Infiltration rate  |                                |   |                  |                          | . ,          | 12) + (13) · | + (15) = |           | 0                     | (15)     |
| Air permeability value,  | a50. expressed in              | cubic metre                                   | s per ho         |                          |              |              |          | area      | 1                     | (17)     |
| If based on air permeabil  | •                              |   | •                | •                        | •            |              | •        |           | 0.05                  | (18)     |
| Air permeability value applie  | es if a pressurisation test    | has been dor                                  | ne or a de       | gree air pe              | rmeability   | is being u   | sed      |           |                       | _        |
| Number of sides sheltere   | ed                             |   |                  | (20) = 1 -               | [0 075 v /   | 10\1         |          |           | 2                     | (19)     |
| Shelter factor Infiltration rate incorporat  | ting chalter factor            |   |                  | (20) = 12<br>(21) = (18) | `            | 19)] =       |          |           | 0.85                  | (20)     |
| Infiltration rate modified f   |                                | aad   |                  | (21) = (10)              | ) X (20) =   |              |          |           | 0.04                  | (21)     |
| Jan Feb  | Mar Apr Ma                     |   | Jul              | Aug                      | Sep          | Oct          | Nov      | Dec       | ]                     |          |
| Monthly average wind sp  | 1 1                            | <u>.,                                    </u> | <u> </u>         | 7 7 10 9                 | T GOP        |              | 1.101    |           | l                     |          |
| (22)m= 5.1 5   | 4.9 4.4 4.3                    | 3.8   | 3.8              | 3.7                      | 4            | 4.3          | 4.5      | 4.7       | ]                     |          |
|  |                                |   |                  | •                        | 1            |              | •        | 1         | 1                     |          |
| Wind Factor $(22a)m = (22a)m $ | <del>'</del>                   | 0   0 ==                                      |                  | 1 000                    |              | 4.00         |          |           | 1                     |          |
| (22a)m= 1.27 1.25  | 1.23 1.1 1.08                  | 8 0.95  | 0.95             | 0.92                     | 1            | 1.08         | 1.12     | 1.18      | ]                     |          |

| Calculate offer  | 0.05   | 0.05   | 0.05   | 0.05                                       | 0.04                     | 0.04              | 0.04                  | 0.04   | 0.05  | 0.05   | 0.05               | ]             |               |
|--|--|--|--|--|--------------------------|-------------------|-----------------------|--|---|--|--------------------|---------------|---------------|
|  |  | change i   | rate for t   | he appli                                   | cable ca                 | se                | ı                     |  | l   | ı  |                    |               |               |
| If mechanica   |  |  | on div. N. (O  | ah) (aa-                                   | · \                      | (N                | 15\\ atlaa            |  | ) (00-)   |  |                    | 0.5           | (2:           |
| If exhaust air h   |  | 0 11   |  | , ,  | ,                        | . ,               | ,, .                  | ,  | ) = (23a)   |  |                    | 0.5           | (2:           |
| If balanced with   |  | •  |  | _  |                          |                   |                       |  |   |  |                    | 76.5          | (2:           |
| a) If balance  |  |  |  |  |                          | <del>- ` ` </del> | <del>- ` ` - </del>   | <del>``</del>  | <del>–                                     </del>       | <del>-                                    </del>       | <del>- ` ` `</del> | ) ÷ 100]<br>1 | (2)           |
| 24a)m= 0.17  | 0.17   | 0.17   | 0.16   | 0.16                                       | 0.16                     | 0.16              | 0.16                  | 0.16   | 0.16  | 0.17   | 0.17               |               | (2            |
| b) If balance  | ı  |  |  |  | ı —                      | <del></del>       | <del>- ^ ` ` - </del> | ŕ  | <del>r ´       `</del>                                  | <u> </u>   | Ι ,                | 1             | (2            |
| 24b)m= 0   | 0  | 0  | 0  | 0  |                          | 0                 | 0                     | 0  | 0   | 0  | 0                  |               | (2            |
| c) If whole h  |  | tract ven<br>‹ (23b), t  |  |  | •                        |                   |                       |  | 5 v (22k  | <b>,</b> )   |                    |               |               |
| 24c)m= 0   | 0.5 7  | 0  | 0  | ) = (23L<br>0                              | 0                        | 0                 | $C_{i} = (221)$       | 0  | 0   | 0  | 0                  | 1             | (2            |
| d) If natural  |  |  |  |  | <u> </u>                 |                   |                       |  |   |  |                    | J             | (-            |
| ,  |  | en (24d)   |  |  | •                        |                   |                       |  | 0.5]  |  |                    |               |               |
| 24d)m= 0   | 0  | 0  | 0  | 0  | 0                        | 0                 | 0                     | 0  | 0   | 0  | 0                  | ]             | (2            |
| Effective air  | change   | rate - er  | iter (24a  | or (24k                                    | o) or (24                | c) or (24         | d) in box             | (25)   |   |  |                    |               |               |
| 25)m= 0.17   | 0.17   | 0.17   | 0.16   | 0.16                                       | 0.16                     | 0.16              | 0.16                  | 0.16   | 0.16  | 0.17   | 0.17               |               | (2            |
|  |  |  |  |  |                          |                   |                       | L  |   |  |                    |               |               |
| 3. Heat losse  |  |  |  |  | N . A                    |                   |                       |  | A >< 1.1  |  |                    | _             | A 37 I        |
| LEMENT   | Gros<br>area   |  | Openin<br>m  |  | Net Ar<br>A ,r           |                   | U-valı<br>W/m2        |  | A X U<br>(W/  | K)   | k-value<br>kJ/m²-l |               | A X k<br>kJ/K |
| Vindows Type   |  | ,  |  |  | 5.6                      |                   | [1/( 0.85 )-          |  | 4.6   |  |                    |               | (2            |
| Vin <mark>dows</mark> Type   |  |  |  |  | 11.1                     | _                 | -<br>[1/( 0.85 )-     | , i  | 9.12  | Ħ  |                    |               | (2            |
| Valls Type1  | 38.4   |  | 11.1   |  | 27.3                     | X                 | 0.2                   |  | 5.46  | Ħ r  |                    |               | (2            |
| Valls Type2  |  | =  | _  | = \  |                          |                   |                       | 4  |   | 븍 ¦  |                    | ╡╞            | =             |
|  | 8.5  |  | 5.6  |  | 2.9                      | ×                 | 0.2                   | = [  | 0.58  |  |                    |               | (2            |
| otal area of e   |  |  | .ffootivo wi   | ndowlly                                    | 46.9                     | otod vojna        | formula 1             | /[/1/  L.volu  | (0) ( 0 (04) (  | no airen in  | norograni          | 5.22          | (3            |
| ior wiridows and<br>include the area   |  |  |  |  |                          | ateu using        | i iorriiula T         | /[(  | ie)+0.04j a   | is giveri iri  | грагаугарг         | 1 3.2         |               |
| and the second   | s, W/K   | = S (A x   | U)   |  |                          |                   | (26)(30)              | + (32) =   |   |  |                    | 19.77         | (3            |
| apric heat los   | Cm - S/  | (  |  |  |                          |                   | ()()                  |  |   |  |                    |               | 1,5           |
|  | Ciii = 3   | AXK)   |  |  |                          |                   | (==):::(==)           |  | (30) + (32  | 2) + (32a).  | (32e) =            | 513.4         |               |
| abric heat los<br>leat capacity<br>hermal mass   |  | ,  | P = Cm ÷   | - TFA) ir                                  | n kJ/m²K                 |                   | (==)(==)              | ((28)  | (30) + (32<br>tive Value                                | , , ,  | (32e) =            | 513.4<br>100  | (3            |
| leat capacity<br>hermal mass   | parame   | ter (TMF   |  | •  |                          |                   |                       | ((28)<br>Indica  | tive Value  | : Low  | ` ,                |               | (3            |
| leat capacity<br>hermal mass<br>or design assess<br>an be used inste   | parame<br>sments wh<br>ad of a de  | eter (TMF<br>ere the de<br>tailed calcu  | tails of the<br>ulation.   | construct                                  | ion are no               | t known pr        |                       | ((28)<br>Indica  | tive Value  | : Low  | ` ,                |               | (3            |
| leat capacity hermal mass or design assess an be used inste hermal bridge  | parame<br>sments wh<br>ad of a de<br>es: S (L  | eter (TMF<br>ere the de<br>tailed calcu<br>x Y) cal  | tails of the<br>ulation.<br>culated u                            | construct                                  | ion are not<br>opendix l | t known pr        |                       | ((28)<br>Indica  | tive Value  | : Low  | ` ,                |               | (3            |
| leat capacity hermal mass for design assess an be used inste hermal bridge details of therma   | parame<br>sments wh<br>ad of a de<br>es: S (L<br>al bridging                                   | eter (TMF<br>ere the de<br>tailed calcu<br>x Y) cal  | tails of the<br>ulation.<br>culated u                            | construct                                  | ion are not<br>opendix l | t known pr        |                       | ((28)<br>Indica  | tive Value  | : Low  | ` ,                | 7.04          | (3)           |
| leat capacity Thermal mass or design assess an be used inste Thermal bridge details of thermal Total fabric he   | parame<br>sments wh<br>ad of a de<br>es:S(L<br>al bridging<br>at loss                          | eter (TMF<br>ere the de<br>tailed calcu<br>x Y) calcu<br>are not kn                            | tails of the<br>ulation.<br>culated u<br>own (36) =              | constructusing Ap                          | ion are not<br>opendix l | t known pr        |                       | ((28)<br>Indica<br>e indicative                            | tive Value e values of (36) =                           | : Low<br>TMP in T                                      | able 1f            | 100           | (3)           |
| leat capacity hermal mass or design assess an be used inste hermal bridge details of therma fotal fabric he entilation hea   | parame<br>sments wh<br>ad of a de<br>es: S (L<br>al bridging<br>at loss<br>at loss ca          | ere the de<br>tailed calcu<br>x Y) calcu<br>are not kn   | tails of the<br>ulation.<br>culated u<br>own (36) =              | constructusing Ap                          | ppendix I                | t known pr        | ecisely the           | ((28)<br>Indica<br>e indicative<br>(33) +<br>(38)m         | tive Values of values of (36) = = 0.33 × (              | : Low<br>: TMP in T                                    | able 1f            | 7.04          | (3)           |
| eat capacity hermal mass or design assess an be used inste hermal bridge details of therma otal fabric he entilation hea   | parame<br>sments wh<br>ad of a de<br>es: S (L<br>al bridging<br>at loss<br>at loss ca          | ere the de<br>tailed calcu<br>x Y) calcu<br>are not kn   | tails of the<br>ulation.<br>culated u<br>own (36) =<br>I monthly | construct using Ap = 0.05 x (3             | ppendix I                | t known pr        | ecisely the           | ((28) Indica e indicative (33) + (38)m Sep                 | (36) =<br>= 0.33 × (                                    | : Low<br>: TMP in T<br>25)m x (5                       | able 1f            | 7.04          | (3            |
| eat capacity hermal mass or design assess an be used inste hermal bridge details of therma otal fabric he entilation hea  Jan 13.85  | parame sments wh ad of a de es: S (L al bridging at loss at loss ca Feb 13.76                  | eter (TMF ere the de tailed calcu x Y) calc are not kn alculated Mar 13.68                     | tails of the<br>ulation.<br>culated u<br>own (36) =              | constructusing Ap                          | ppendix I                | t known pr        | ecisely the           | ((28) Indica e indicative (33) + (38)m Sep 12.91           | (36) =<br>= 0.33 × (<br>Oct                             | 25)m x (5<br>Nov<br>13.33                              | able 1f            | 7.04          | (3            |
| hermal mass or design assess an be used inste hermal bridge details of therma otal fabric hermal trillation head assume transfer of the transf | parame sments wh ad of a de es: S (L al bridging at loss at loss ca Feb 13.76                  | ter (TMF<br>ere the de<br>tailed calcu<br>x Y) calc<br>are not kn<br>alculated<br>Mar<br>13.68 | tails of the ulation. culated to own (36) = I monthly Apr 13.25  | construct using Ap = 0.05 x (3 / May 13.16 | ppendix I  Jun  12.74    | Jul               | Aug                   | ((28) Indica indicative (33) + (38)m Sep 12.91 (39)m       | (36) =<br>= 0.33 × (<br>Oct<br>13.16<br>= (37) + (      | 25)m x (5<br>Nov<br>13.33                              | Dec 13.51          | 7.04          | (3            |
| eat capacity hermal mass or design assess an be used inste hermal bridge details of therma otal fabric he entilation hea  Jan 13.85 eat transfer of  | parame sments wh ad of a de es: S (L al bridging at loss at loss ca Feb 13.76                  | eter (TMF ere the de tailed calcu x Y) calc are not kn alculated Mar 13.68                     | tails of the<br>ulation.<br>culated u<br>own (36) =<br>I monthly | construct using Ap = 0.05 x (3             | ppendix I                | t known pr        | ecisely the           | ((28) Indica indicative (33) + (38)m Sep 12.91 (39)m 39.71 | (36) = = 0.33 × ( Oct 13.16 = (37) + ( 39.97            | 25)m x (5<br>Nov<br>13.33<br>38)m<br>40.14             | Dec 13.51          | 7.04          | (3            |
| hermal mass or design assess an be used inste hermal bridge details of thermal otal fabric hermal and instentiation head and instentiatio | parame sments wh ad of a de es: S (L al bridging at loss at loss ca Feb 13.76 coefficien 40.57 | ere the de tailed calculated are not kn alculated Mar 13.68  nt, W/K 40.48                     | tails of the ulation. culated to own (36) = I monthly Apr 13.25  | construct using Ap = 0.05 x (3 / May 13.16 | ppendix I  Jun  12.74    | Jul               | Aug                   | ((28) Indica indicative (33) + (38)m Sep 12.91 (39)m 39.71 | (36) = = 0.33 × ( Oct 13.16 = (37) + ( 39.97  Average = | 25)m x (5<br>Nov<br>13.33<br>38)m<br>40.14<br>Sum(39); | Dec 13.51          | 7.04          | (3            |
| leat capacity Thermal mass For design assess In be used inste Thermal bridge details of thermal Total fabric he Tentilation hea  38)m= 13.85  Ideat transfer of  | parame sments wh ad of a de es: S (L al bridging at loss at loss ca Feb 13.76 coefficien 40.57 | ere the de tailed calculated are not kn alculated Mar 13.68  nt, W/K 40.48                     | tails of the ulation. culated to own (36) = I monthly Apr 13.25  | construct using Ap = 0.05 x (3 / May 13.16 | ppendix I  Jun  12.74    | Jul               | Aug                   | ((28) Indica indicative (33) + (38)m Sep 12.91 (39)m 39.71 | (36) = = 0.33 × ( Oct 13.16 = (37) + ( 39.97            | 25)m x (5<br>Nov<br>13.33<br>38)m<br>40.14<br>Sum(39); | Dec 13.51          | 7.04          | (3)           |

Number of days in month (Table 1a)

| Numbe                                   | er or day              | s in mor                 | ıın (Tab                | ie ra)                    |                | 1          | 1          | ,                      |                    | 1           |                        |          | 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 \\/\                                  | tor boot               | ing oner                 | av roqui                | romont:                   |                |            |            |                        |                    |             |                        | kWh/ye   | oor:    |            |
| 4. ۷۷                                   | ilei neai              | ing ener                 | gy requi                | rement.                   |                |            |            |                        |                    |             |                        | KVVII/yt | sai.    |            |
| Assum                                   | ed occu                | pancy, I                 | N                       |                           |                |            |            |                        |                    |             | 2.                     | 42       |         | (42)       |
|   |                        |                          | + 1.76 x                | [1 - exp                  | (-0.0003       | 849 x (TF  | FA -13.9   | )2)] + 0.0             | 0013 x (           | TFA -13.    | .9)                    |          |         |            |
|   | A £ 13.9               | -                        |                         |                           |                |            |            | (O.5. N.I)             | 00                 |             |                        |          | •       |            |
|   |                        |                          |                         |                           |                |            |            | (25 x N)<br>to achieve | + 36<br>a water us | se target o |                        | .57      |         | (43)       |
|   |                        | _                        | person per              |                           |                | _          | -          |                        |                    | J           |                        |          |         |            |
|   | Jan                    | Feb                      | Mar                     | Apr                       | May            | Jun        | Jul        | Aug                    | Sep                | Oct         | Nov                    | Dec      |         |            |
| Hot wate                                |                        |                          | day for ea              |                           |                | l .        |            |                        | СОР                | 1 000       | 1101                   | 200      |         |            |
| (44)m=                                  | 100.73                 | 97.07                    | 93.41                   | 89.74                     | 86.08          | 82.42      | 82.42      | 86.08                  | 89.74              | 93.41       | 97.07                  | 100.73   |         |            |
| (11)                                    | 100.70                 | 07.07                    | 00.11                   | 00.7 1                    | 00.00          | 02.12      | 02.12      | 00.00                  |                    |             | m(44) <sub>112</sub> = |          | 1098.89 | (44)       |
| Energy o                                | content of             | hot water                | used - cal              | culated mo                | onthly $= 4$ . | 190 x Vd,r | n x nm x E | OTm / 3600             |                    |             | ables 1b, 1            |          | 1000.00 |            |
| (45)m=                                  | 149.38                 | 130.65                   | 134.82                  | 117.54                    | 112.78         | 97.32      | 90.18      | 103.49                 | 104.72             | 122.04      | 133.22                 | 144.67   |         |            |
|   |                        |                          |                         |                           |                |            |            |                        |                    |             | m(45) <sub>112</sub> = |          | 1440.81 | (45)       |
| If inst <mark>ant</mark>                | taneous w              | ater heatin              | ng at point             | of use (no                | hot water      | storage),  | enter 0 in | boxes (46              |                    |             | ( )2                   |          |         |            |
| (46)m=                                  | 22.41                  | 19.6                     | 20.22                   | 17.63                     | 16.92          | 14.6       | 13.53      | 15.52                  | 15.71              | 18.31       | 19.98                  | 21.7     |         | (46)       |
|   | storage                | loss:                    |                         |                           |                |            |            |                        |                    |             |                        |          |         |            |
| Storag                                  | <mark>e v</mark> olum  | e (litre <mark>s)</mark> | inc <mark>ludir</mark>  | ng any so                 | olar or W      | WHRS       | storage    | within sa              | ame ves            | sel         |                        | 0        |         | (47)       |
| If co <mark>m</mark> r                  | <mark>nu</mark> nity h | eating a                 | nd no ta                | nk in dw                  | elling, e      | nter 110   | litres in  | (47)                   |                    |             |                        |          |         |            |
| Otherw                                  | vise if no             | stored                   | hot wate                | er (th <mark>is in</mark> | ıcludes i      | nstantar   | neous co   | mbi boil               | ers) ente          | er '0' in ( | <b>4</b> 7)            |          |         |            |
|   | storage                |                          |                         |                           |                |            |            |                        |                    |             |                        |          |         |            |
| a) If m                                 | anufact                | urer's de                | eclared l               | oss facto                 | or is kno      | wn (kWl    | n/day):    |                        |                    |             |                        | 0        |         | (48)       |
| Tempe                                   | rature fa              | actor fro                | m Table                 | 2b                        |                |            |            |                        |                    |             |                        | 0        |         | (49)       |
| • |                        |                          | storage                 | -                         |                |            |            | (48) x (49)            | ) =                |             | 1                      | 10       |         | (50)       |
|   |                        |                          | eclared o               |                           |                |            |            |                        |                    |             |                        |          | -<br>I  |            |
|   |                        |                          | factor fr<br>ee section |                           | e∠(KVV         | n/litre/da | iy)        |                        |                    |             | 0.                     | 02       |         | (51)       |
|   | e factor               | _                        |                         | 011 4.3                   |                |            |            |                        |                    |             |                        | 03       | l       | (52)       |
|   |                        |                          | m Table                 | 2b                        |                |            |            |                        |                    |             | -                      | .6       |         | (53)       |
| •                                       |                        |                          | storage                 |                           | ar             |            |            | (47) x (51)            | ) x (52) x (       | 53) =       |                        | 03       |         | (54)       |
|   | (50) or (              |                          | _                       | , 100 viii, y 0           | Jui            |            |            | (11)11(01)             | ,                  |             | -                      | 03       |         | (55)       |
|   | ` , , ,                | , ,                      | culated f               | or each                   | month          |            |            | ((56)m = (             | 55) × (41)ı        | m           |                        | 00       |         | ()         |
| (56)m=                                  | 32.01                  | 28.92                    | 32.01                   | 30.98                     | 32.01          | 30.98      | 32.01      | 32.01                  | 30.98              | 32.01       | 30.98                  | 32.01    |         | (56)       |
| , ,                                     |                        |                          |                         |                           |                |            |            |                        |                    |             | H11) is fro            |          | liv H   | (30)       |
| -                                       | ı                      |                          |                         |                           |                | 1          |            |                        |                    |             |                        |          | I       | <b>,</b> \ |
| (57)m=                                  | 32.01                  | 28.92                    | 32.01                   | 30.98                     | 32.01          | 30.98      | 32.01      | 32.01                  | 30.98              | 32.01       | 30.98                  | 32.01    |         | (57)       |
| Primar                                  | y circuit              | loss (an                 | nual) fro               | m Table                   | 3              |            |            |                        |                    |             |                        | 0        |         | (58)       |
| Primar                                  | y circuit              | loss cal                 | culated t               | for each                  | month (        | 59)m = (   | (58) ÷ 36  | 65 × (41)              | m                  |             |                        |          |         |            |
| (mod                                    | dified by              | factor fr                | om Tab                  | le H5 if t                | here is s      | solar wat  | ter heati  | ng and a               | cylinde            | r thermo    | stat)                  |          | •       |            |
| (59)m=                                  | 23.26                  | 21.01                    | 23.26                   | 22.51                     | 23.26          | 22.51      | 23.26      | 23.26                  | 22.51              | 23.26       | 22.51                  | 23.26    |         | (59)       |
| Combi                                   | loss cal               | culated                  | for each                | month (                   | (61)m =        | (60) ÷ 36  | 65 × (41   | )m                     |                    |             |                        |          |         |            |
| (61)m=                                  | 0                      | 0                        | 0                       | 0                         | 0              | 0          | 0          | 0                      | 0                  | 0           | 0                      | 0        |         | (61)       |
|   |                        |                          |                         |                           |                | •          | •          |                        | •                  | •           | •                      |          |         |            |

| Total heat re                  | quired for   | water h    | eating ca      | alculated  | for        | each month       | (62)        | m = (          | 0.85 × (4  | 45)m +                  | (46)m +            | (57)m +     | (59)m + (61)m |                            |
|--------------------------------|--------------|------------|----------------|------------|------------|------------------|-------------|----------------|--|-------------------------|--------------------|-------------|---------------|----------------------------|
| (62)m= 204.66                  | <del>`</del> | 190.1      | 171.03         | 168.06     |            | 0.82 145.46      | 158         |                | 158.22   | 177.32                  | 186.71             | 199.94      |               | (62)                       |
| Solar DHW inpu                 | t calculated | using App  | endix G o      | · Appendix | H (n       | egative quantity | /) (ent     | er '0' i       | if no solar                                      | contribu                | tion to wate       | er heating) |               |                            |
| (add addition                  | al lines if  | FGHRS      | and/or \       | WWHRS      | app        | olies, see Ap    | pend        | lix G          | )  |                         |                    |             |               |                            |
| (63)m= 0                       | 0            | 0          | 0              | 0          | (          | 0                | 0           |                | 0  | 0                       | 0                  | 0           |               | (63)                       |
| Output from                    | water hea    | ter        | •              | •          |            | •                |             |                | •  |                         | •                  | •           |               |                            |
| (64)m= 204.66                  | 180.58       | 190.1      | 171.03         | 168.06     | 150        | 0.82 145.46      | 158         | .76            | 158.22   | 177.32                  | 186.71             | 199.94      |               |                            |
|                                |              |            |                |            |            |                  |             | Outpu          | ut from wa                                       | iter heate              | er (annual)₁       | 12          | 2091.65       | (64)                       |
| Heat gains fr                  | om water     | heating    | , kWh/m        | onth 0.2   | 5 ′ [0     | ).85 × (45)m     | + (6        | 1)m]           | + 0.8 x  | [(46)m                  | + (57)m            | + (59)m     | ]             | _                          |
| (65)m= 93.89                   | 83.38        | 89.05      | 81.88          | 81.72      | 75         | .15 74.21        | 78.         | 63             | 77.62  | 84.8                    | 87.09              | 92.32       |               | (65)                       |
| include (57                    | ')m in cal   | culation   | of (65)m       | only if c  | ylind      | der is in the o  | dwell       | ing c          | or hot wa  | ater is f               | rom com            | munity h    | neating       |                            |
| 5. Internal                    | <u> </u>     |            | , ,            | •          | ,          |                  |             |                |  |                         |                    | <u> </u>    |               |                            |
| Metabolic ga                   |              |            |                | ,          |            |                  |             |                |  |                         |                    |             |               |                            |
| Jan                            |              | Mar        | Apr            | May        | J          | un Jul           | A           | ug             | Sep  | Oct                     | Nov                | Dec         |               |                            |
| (66)m= 144.94                  | +            | 144.94     | 144.94         | 144.94     | 144        | -                | 144         | <del>-</del> + | 144.94   | 144.94                  | 144.94             | 144.94      |               | (66)                       |
| Lighting gain                  | s (calcula   | ted in Aı  | opendix        | L. eguat   | on I       | 9 or L9a), a     | lso s       | ee T           | able 5   |                         |                    |             | l             |                            |
| (67)m= 48.49                   | <del>`</del> | 35.03      | 26.52          | 19.82      | 16         | <del></del>      | 23.         | _              | 31.55  | 40.06                   | 46.75              | 49.84       |               | (67)                       |
| Appliances g                   | ains (calc   |            | Annend         |            |            |                  | 3a) :       | also           |  |                         |                    |             |               |                            |
| (68)m= 319.93                  | - "          | 314.88     | 297.07         | 274.59     | 253        |                  | 236         |                | 244.39   | 262.2                   | 284.68             | 305.81      | 1             | (68)                       |
| Cooking gain                   |              |            |                |            | —          |                  | <del></del> | $\vdash$       |  |                         |                    |             |               | , ,                        |
| (69)m= 51.91                   | <u> </u>     | 51.91      | 51.91          | 51.91      | 51.        |                  | 51.         | _              | 51.91  | 51.91                   | 51.91              | 51.91       | 1             | (69)                       |
| ` '                            |              |            |                | 01.01      | 01.        | 01.01            | 01.         | <u> </u>       | 01.01  | 01.01                   | 01.01              | 01.01       |               | ()                         |
| Pumps and f                    |              | 0          | 0              | 0          |            | 0                | 0           |                | 0  | 0                       | 0                  | 0           | 1             | (70)                       |
| ` '                            |              | l          |                |            |            |                  |             |                | 0  | 0                       |                    | U           |               | (10)                       |
| Losses e.g. 6<br>(71)m= -96.63 | <del></del>  | n (nega    | -96.63         | -96.63     |            | .63 -96.63       | -96.        | 62             | -96.63   | -96.63                  | -96.63             | -96.63      | 1             | (71)                       |
| ` '                            |              | ļ          | -90.03         | -90.03     | -90        | -90.03           | -90.        | .03            | -90.03   | -90.03                  | -90.03             | -90.03      |               | (7-1)                      |
| Water heatin (72)m= 126.2      |              |            | 142.72         | 100.04     | 10/        | 120 00.74        | 105         | 60 T           | 407.0  | 112.00                  | 120.96             | 124.00      | 1             | (72)                       |
|                                | _            |            | 113.72         | 109.84     | 104        |                  | 105         |                | 107.8  |                         |                    |             |               | (72)                       |
| Total interna                  | <del>_</del> |            | T 507.50       | 504.40     | 47         | (66)m + (67)m    | ·           | <del></del>    | <del>`                                    </del> | , ,                     | <del>, ` ` '</del> |             | 1             | (72)                       |
| (73)m= 594.84                  |              | 569.82     | 537.53         | 504.48     | 47         | 4.8 457.39       | 465         | .44            | 483.96   | 516.46                  | 552.62             | 579.97      |               | (73)                       |
| 6. Solar gains are             |              | ueina eola | ır fluv from   | Table 6a   | and a      | ssociated equa   | tione       | to con         | wert to the                                      | a annlica               | ble orientat       | ion         |               |                            |
| Orientation:                   |              | •          | Area           |            | anu a      | Flux             | 110113      |                |  | е аррііса               | FF                 |             | Gains         |                            |
| Onemation.                     | Table 6d     |            | m <sup>2</sup> |            |            | Table 6a         |             |                | g_<br>able 6b                                    | Т                       | able 6c            |             | (W)           |                            |
| East 0.9x                      | 0.54         | x          | 11             | 1          | хГ         | 19.64            | x           |                | 0.5  | 7 x [                   | 0.8                |             | 42.38         | (76)                       |
| East 0.9x                      |              |            |                |            | ^ L<br>x Г | 38.42            | x           |                |  | 」^L<br>ヿ <sub>×</sub> 「 | 0.8                |             | 82.91         | ](76)                      |
| East 0.9x                      |              |            |                |            | F          |                  |             |                | 0.5  | ╡╞                      |                    | =           |               | _                          |
| East 0.9x                      |              |            |                |            | ×          | 63.27            | X           |                | 0.5  | _  ×                    | 0.8                | =           | 136.53        | (76)                       |
|                                |              |            |                |            | х <u>Г</u> | 92.28            | X           |                | 0.5  | 」×↓<br>□、┌              | 0.8                | _           | 199.13        | (76)                       |
| _                              |              |            |                |            | х <u>Г</u> | 113.09           | X           |                | 0.5  | _                       | 0.8                | =           | 244.04        | (76)                       |
|                                |              |            |                |            | x _        | 115.77           | X           |                | 0.5  | _                       | 0.8                | =           | 249.81        | ](76)<br>] <sub>(70)</sub> |
| East 0.9x                      |              |            |                | _          | × L        | 110.22           | X           |                | 0.5  | _                       | 0.8                | =           | 237.83        | (76)                       |
| East 0.9x                      | 0.54         | X          | 11             | .1 l       | X          | 94.68            | X           | I              | 0.5  | X                       | 0.8                | =           | 204.3         | (76)                       |

| East  | 0.9x   | 0.54   | X  | 11.1  | 1  | x  | 73.59  | ×   | 0.5  | X  | 0.8   | =  | 158.79 | (76)   |
|---|--|--|--|---|--|--|--|---|--|--|---|--|--------|--|
| East  | 0.9x   | 0.54   | x  | 11.1  | 1  | X  | 45.59  | х   | 0.5  | x  | 0.8   | =  | 98.37  | (76)   |
| East  | 0.9x   | 0.54   | X  | 11.1  | 1  | X  | 24.49  | x   | 0.5  | x  | 0.8   | =  | 52.84  | (76)   |
| East  | 0.9x   | 0.54   | x  | 11.1  | 1  | X  | 16.15  | X   | 0.5  | x  | 0.8   | =  | 34.85  | (76)   |
| West  | 0.9x   | 0.77   | x  | 5.6   | ;  | X  | 19.64  | x   | 0.5  | x  | 0.8   | =  | 30.49  | (80)   |
| West  | 0.9x   | 0.77   | x  | 5.6   |  | X  | 38.42  | X   | 0.5  | x  | 0.8   | =  | 59.64  | (80)   |
| West  | 0.9x   | 0.77   | x  | 5.6   |  | X  | 63.27  | X   | 0.5  | ×  | 0.8   |  | 98.22  | (80)   |
| West  | 0.9x   | 0.77   | x  | 5.6   |  | X  | 92.28  | X   | 0.5  | ×  | 0.8   | _ =  | 143.25 | (80)   |
| West  | 0.9x   | 0.77   | X  | 5.6   |  | X  | 113.09   | ×   | 0.5  | x  | 0.8   | =  | 175.56 | (80)   |
| West  | 0.9x   | 0.77   | x  | 5.6   | ;  | X  | 115.77   | X   | 0.5  | x  | 0.8   | =  | 179.71 | (80)   |
| West  | 0.9x   | 0.77   | x  | 5.6   |  | X  | 110.22   | X   | 0.5  | ×  | 0.8   | _ =  | 171.09 | (80)   |
| West  | 0.9x   | 0.77   | X  | 5.6   |  | X  | 94.68  | ×   | 0.5  | x  | 0.8   | =  | 146.97 | (80)   |
| West  | 0.9x   | 0.77   | x  | 5.6   | ;  | X  | 73.59  | X   | 0.5  | ×  | 0.8   | =  | 114.23 | (80)   |
| West  | 0.9x   | 0.77   | X  | 5.6   | ;  | X  | 45.59  | x   | 0.5  | x  | 0.8   | =  | 70.77  | (80)   |
| West  | 0.9x   | 0.77   | X  | 5.6   | ;  | X  | 24.49  | X   | 0.5  | x  | 0.8   | =  | 38.01  | (80)   |
| West  | 0.9x   | 0.77   | x  | 5.6   | ;  | X  | 16.15  | X   | 0.5  | ×  | 0.8   | =  | 25.07  | (80)   |
|   | _  |  |  |   |  |  |  | _   |  |  |   |  |        |  |
| Solar g   | ains in  | watts, calc  | ulated   | for each  | month  | 1  |  | (83)n   | n = Sum(74)m.  | (82)m  |   |  |        |  |
| (83)m=  | 72.87  | 142.55   | 234.75   | 342.37  | 419.59   | 4:   | 29.53 408.93   | 351   | .26 273.03   | 169.1  | 4 90.86   | 59.92  |        | (83)   |
| Total g   | ains – i   | nternal and  | solar  | (84)m =   | (73)m  | + (8   | 33)m , watts   |   |  |  |   |  |        |  |
| (84)m=  | 667.71   | 733.17 8   | 304.58   | 879.9   | 924.07   | 9  | 04.33 866.32   | 810   | 5.7 756.99   | 685.6  | 643.48  | 639.89   |        | (84)   |
| - 1 A   |  |  |  |   | _  |  |  |   |  |  |   |  |        |  |
| 7. Me   | an inter   | mal temper   | rature (   | heating:  | seasor   | n)   |  |   |  |  |   |  |        |  |
|   |  |  |  | heating :<br>eriods in  |  |  | area from Ta   | able 9  | , Th1 (°C)   | ٠.   |   |  | 21     | (85)   |
| Temp  | erature  | during hea   | ating p  | eriods in   | the liv  | ing  |  |   | , Th1 (°C)   | ī  | г   |  | 21     | (85)   |
| Temp  | erature  | during hea   | ating p  | eriods in   | the liv<br>a, h1,n   | ing<br>n (s  | area from Ta<br>ee Table 9a)<br>Jun Jul  |   | , Th1 (°C)   | Oct  | Nov   | Dec  | 21     | (85)   |
| Temp  | erature<br>ition fac   | during hea   | ating pons   | eriods in   | the liv  | ing<br>n (s  | ee Table 9a)   |   | ug Sep   | Oct  | Nov<br>0.76                                     | Dec<br>0.84                                    | 21     | (85)   |
| Temp<br>Utilisa<br>(86)m=   | erature<br>tion fac<br>Jan<br>0.83   | during heater for gain Feb 0.77  | ns for li<br>Mar   | eriods in<br>ving area<br>Apr   | the liv<br>a, h1,n<br>May  | ing<br>n (s  | ee Table 9a)<br>Jun Jul<br>0.28 0.2  | A 0.2   | ug Sep<br>22 0.36  |  | +   |  | 21     |  |
| Temp<br>Utilisa<br>(86)m=   | erature<br>tion fac<br>Jan<br>0.83<br>interna  | during heater for gair Feb 0.77 It temperate   | ating pons for line Mar 0.67   | eriods in ving area Apr 0.53 iving are  | the liv<br>a, h1,n<br>May<br>0.4<br>ea T1 (f   | ing<br>n (s  | Jun Jul<br>0.28 0.2<br>w steps 3 to  | 7 in 7  | ug Sep<br>22 0.36<br>Table 9c)   | 0.58   | 0.76  | 0.84   | 21     | (86)   |
| Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=   | erature Jan 0.83 interna 20.63   | during heater for gair Feb 0.77 lt temperate 20.74   | Mar 0.67<br>ure in l   | Apr 0.53 iving are 20.96  | the liv<br>a, h1,n<br>May<br>0.4<br>ea T1 (f<br>20.99  | ing<br>n (s<br>follo   | ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21   | 7 in 1  | ug Sep<br>22 0.36<br>Table 9c)   |  | 0.76  |  | 21     |  |
| Temp Utilisa (86)m= Mean (87)m= Temp  | ution factories Jan 0.83 interna 20.63 erature   | during heater for gair Feb 0.77 Il temperate 20.74 during heater   | ating points for line Mar 0.67 ure in 1 20.87  | eriods in ving area Apr 0.53 iving are 20.96 eriods in  | the liv<br>a, h1,n<br>May<br>0.4<br>ea T1 (f<br>20.99  | ing<br>n (s<br>follo   | Jun Jul  Jun Jul  Jun Jul  Jun  Jun  Jun  Jun  Jun  Jun  Jun   | 7 in 7  | ug Sep<br>22 0.36<br>Table 9c)<br>1 21<br>9, Th2 (°C)  | 20.95  | 0.76  | 20.59  | 21     | (86)   |
| Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=   | erature Jan 0.83 interna 20.63   | during heater for gair Feb 0.77 lt temperate 20.74   | Mar 0.67<br>ure in l   | Apr 0.53 iving are 20.96  | the liv<br>a, h1,n<br>May<br>0.4<br>ea T1 (f<br>20.99  | ing<br>n (s<br>follo   | ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21   | 7 in 7  | ug Sep<br>22 0.36<br>Table 9c)<br>1 21<br>9, Th2 (°C)  | 0.58   | 0.76  | 0.84   | 21     | (86)   |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=   | Jan 0.83 interna 20.63 erature 20.5  | during heater for gair Feb 0.77 lt temperate 20.74 ct during heater 20.5   | ms for ling points for ling mar 0.67 ure in lagonary ating points 20.5   | Apr 0.53 iving are 20.96 eriods in 20.51  | the liv<br>a, h1,n<br>May<br>0.4<br>ea T1 (f<br>20.99<br>rest of<br>20.51  | ing (s   | Jun Jul  Jun Jul  Jun Jul  Jun  Jun  Jun  Jun  Jun  Jun  Jun   | 7 in 1 2 Table 2                                  | ug Sep<br>22 0.36<br>Table 9c)<br>1 21<br>9, Th2 (°C)  | 20.95  | 0.76  | 20.59  | 21     | (86)   |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=   | Jan 0.83 interna 20.63 erature 20.5  | during heater for gair Feb 0.77 It temperate 20.74 during heater 20.5 ctor for gair  | ms for ling points for ling mar 0.67 ure in lagonary ating points 20.5   | Apr 0.53 iving are 20.96 eriods in 20.51  | the liv<br>a, h1,n<br>May<br>0.4<br>ea T1 (f<br>20.99<br>rest of<br>20.51  | m (s<br>follo  | Dun Jul Dun Jul Dun Jul Dun Jul Dun Dun Jul Dun Dun Jul Dun Dun Jul Du | 7 in 1 2 Table 2                                  | ug Sep<br>22 0.36<br>Table 9c)<br>1 21<br>9, Th2 (°C)<br>51 20.51  | 20.95  | 0.76  | 20.59  | 21     | (86)   |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=   | Jan 0.83 interna 20.63 erature 20.5 tion fac   | during heater to for gair Feb 0.77 lt temperate 20.74 20.5 ctor for gair 0.75  | ns for line of | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw  | the liv<br>a, h1,n<br>May<br>0.4<br>ea T1 (f<br>20.99<br>rest of<br>20.51<br>velling,<br>0.38                      | m (s   | Dun Jul Dun Jul Dun Jul Dun  | 7 in 7 2 5able 9 20.                              | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51   | 0.58<br>20.95<br>20.51   | 20.79   | 20.59  | 21     | (86)<br>(87)<br>(88)                                 |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=   | Jan 0.83 interna 20.63 erature 20.5 tion fac   | during heater for gair Feb 0.77 lt temperate 20.74 ctor for gair 0.75 lt temperate 1.75 lt temperate 1 | ns for line of | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw  | the liv<br>a, h1,n<br>May<br>0.4<br>ea T1 (f<br>20.99<br>rest of<br>20.51<br>velling,<br>0.38                      | follo<br>follo<br>h2,  | Dun Jul Dun Jul Dun Jul Dun  | 7 in 7 2 5able 9 20.                              | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Table  | 0.58<br>20.95<br>20.51   | 0.76<br>20.79<br>20.51<br>0.74                  | 20.59  |        | (86)<br>(87)<br>(88)                                 |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean   | Jan 0.83 interna 20.63 erature 20.5 tion fac   | during heater for gair Feb 0.77 lt temperate 20.74 ctor for gair 0.75 lt temperate 1.75 lt temperate 1 | ns for line of the | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw 0.51 he rest of                                      | the liv a, h1,n May 0.4 ea T1 (f 20.99 rest of 20.51 velling, 0.38 of dwel   | follo<br>follo<br>h2,  | Dun Jul Dun Jul Dun Jul Dun  | A 0.2 7 in 7 2 Table 9 20. teps 3                 | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Table 51 20.51   | 0.58 20.95 20.51 0.56 e 9c) 20.45                                    | 0.76<br>20.79<br>20.51<br>0.74                  | 0.84<br>20.59<br>20.5<br>0.83                  | 21     | (86)<br>(87)<br>(88)<br>(89)                         |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean (90)m=                                    | Jan 0.83 interna 20.63 erature 20.5 tion fac 0.81 interna  | during heater to for gair Feb 0.77 lt temperate 20.74 20.5 etor for gair 0.75 lt temperate 20.16 20.16   | ns for line of | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw 0.51 he rest of 20.45                                | the liv<br>a, h1,n<br>May<br>0.4<br>a T1 (f<br>20.99<br>rest of<br>20.51<br>velling,<br>0.38<br>of dwel<br>20.5    | follo<br>h2,   | ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21 relling from T 0.51 20.51 m (see Table 0.26 0.18 T2 (follow steps)  | A 0.2 7 in 7 2 5able 9 20. e 9a) 0. teps 3        | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Table 51 20.51   | 0.58 20.95 20.51 0.56 e 9c) 20.45                                    | 0.76<br>20.79<br>20.51<br>0.74                  | 0.84<br>20.59<br>20.5<br>0.83                  |        | (86)<br>(87)<br>(88)<br>(89)                         |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean (90)m=                                    | Jan 0.83 interna 20.63 erature 20.5 tion fac 0.81 interna  | during heater to represent the during heater the dur | ns for line of | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw 0.51 he rest of 20.45                                | the liv<br>a, h1,n<br>May<br>0.4<br>a T1 (f<br>20.99<br>rest of<br>20.51<br>velling,<br>0.38<br>of dwel<br>20.5    | follo h2,  | Dun Jul Dun Jul Dun Jul Dun  | A 0.2 7 in 7 2 5able 9 20. e 9a) 0. teps 3        | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Table 51 20.51   | 0.58 20.95 20.51 0.56 e 9c) 20.45                                    | 0.76  20.79  20.51  0.74  20.24  ving area ÷ (- | 0.84<br>20.59<br>20.5<br>0.83                  |        | (86)<br>(87)<br>(88)<br>(89)                         |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean (90)m=  Mean (92)m=                       | Jan 0.83 interna 20.63 erature 20.5 tion fac 0.81 interna 20 interna 20                              | during heater tor for gair Feb 0.77 lt temperate 20.74 20.75 etor for gair 0.75 lt temperate 20.16 20.16 ctor for gair 20.16 c | ating pons for line Mar 0.67 ure in l 20.87 ating pons for r 0.66 ure in t 20.33 ure (for 20.64  | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw 0.51 he rest of 20.45 r the who 20.75                | the liv a, h1,n May 0.4 ta T1 (f 20.99 rest of 20.51 velling, 0.38 of dwel 20.5                                    | follo h2, h2, elling   | ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21 relling from T 0.51 20.51 m (see Table 0.26 0.18 T2 (follow steps) 0.51 20.51 g) = fLA × T2   | A 0.2 7 in 7 2 5able 9 20. 1 + (1 20.             | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Tabl 51 20.51  f  - fLA) × T2  8 20.79   | 0.58 20.95 20.51 0.56 e 9c) 20.45 LA = Liv                           | 0.76  20.79  20.51  0.74  20.24  ving area ÷ (  | 0.84<br>20.59<br>20.5<br>0.83<br>19.96<br>4) = |        | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91)         |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean (90)m=  Mean (92)m=                       | Jan 0.83 interna 20.63 erature 20.5 tion fac 0.81 interna 20 interna 20                              | during heater to the during he | ating pons for line Mar 0.67 ure in l 20.87 ating pons for r 0.66 ure in t 20.33 ure (for 20.64  | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw 0.51 he rest of 20.45 r the who 20.75                | the liv a, h1,n May 0.4 ta T1 (f 20.99 rest of 20.51 velling, 0.38 of dwel 20.5                                    | m (s follo follo h2, h2, c elling 2  | ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21 relling from T 0.51 20.51 m (see Table 0.26 0.18 T2 (follow steps 3) 0.51 20.51 g) = fLA × T 0.79 20.79   | A 0.2 7 in 7 2 5able 9 20. 1 + (1 20.             | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Tabl 51 20.51  - fLA) × T2  8 20.79  where approximates a second content of the cont | 0.58 20.95 20.51 0.56 e 9c) 20.45 LA = Liv                           | 0.76  20.79  20.51  0.74  20.24  ving area ÷ (  | 0.84<br>20.59<br>20.5<br>0.83<br>19.96<br>4) = |        | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91)         |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean (90)m=  Mean (92)m=  Apply (93)m=         | Jan 0.83 interna 20.63 erature 20.5 tion fac 0.81 interna 20 interna 20 adjustr 20.36                | during heater to the during he | ating pons for line at line pons for rouse in the line pons for rouse in th | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw 0.51 he rest of 20.45 r the who 20.75 internal       | the liv a, h1,n May 0.4 a T1 (f 20.99 rest of 20.51 velling, 0.38 of dwel 20.5                                     | m (s follo follo h2, h2, c elling 2  | ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21 relling from T 0.51 20.51 m (see Table 0.26 0.18 T2 (follow steps) 0.51 20.51 g) = fLA × T 0.79 20.79 ure from Table  | A 0.3 7 in 7 2 Table 9 20. teps 3 1 + (1 20 e 4e, | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Tabl 51 20.51  - fLA) × T2  8 20.79  where approximates a second content of the cont | 0.58  20.95  20.51  0.56 e 9c)  20.45 LA = Liv                       | 0.76  20.79  20.51  0.74  20.24  ving area ÷ (  | 0.84<br>20.59<br>20.5<br>0.83<br>19.96<br>4) = |        | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91)<br>(92) |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean (90)m=  Mean (92)m=  Apply (93)m=  8. Spa | Jan 0.83 interna 20.63 erature 20.5 tion fac 0.81 interna 20 interna 20 adjustr 20.36 ace hea        | during heactor for gair Feb 0.77 Il temperate 20.74 20.5 ctor for gair 0.75 Il temperate 20.16 20.49 20.49 ctor for gair 20.49 | mating points for limited and  | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw 0.51 he rest of 20.45 r the who 20.75 internal 20.75 | the liv a, h1,n May 0.4 ea T1 (f 20.99 rest of 20.51 velling, 0.38 of dwel 20.5 ble dwe 20.78 tempe 20.78          | ing (second second seco | ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21 relling from T 0.51 20.51 m (see Table 0.26 0.18 T2 (follow steps) 0.51 20.51 g) = fLA × T 0.79 20.79 ure from Table  | A 0.3 7 in 7 2 5able 9 20. 1 + (1 20 e 4e, 20     | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Tabl 51 20.51  - fLA) × T2  8 20.79  where approx 8 20.79  | 0.58  20.95  20.51  0.56 e 9c)  20.45 FLA = Livitation private 20.74 | 0.76  20.79  20.51  0.74  20.24  ving area ÷ (  | 0.84<br>20.59<br>20.5<br>0.83<br>19.96<br>4) = | 0.58   | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91)<br>(92) |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean (90)m=  Mean (92)m=  Apply (93)m=  8. Spa | Jan 0.83 interna 20.63 erature 20.5 tion fac 0.81 interna 20 interna 20 adjustr 20.36 ace hea to the | during heactor for gair Feb 0.77 Il temperate 20.74 20.5 ctor for gair 0.75 Il temperate 20.16 20.49 20.49 ctor for gair 20.49 | ating pons for line and line a | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw 0.51 he rest of 20.45 r the who 20.75 internal 20.75 | the liv a, h1,n May 0.4 ea T1 (f 20.99 rest of 20.51 velling, 0.38 of dwel 20.5  ble dwe 20.78 tempe 20.78 e obtai | ing (second second seco | ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21 relling from T 0.51 20.51 m (see Table 0.26 0.18 T2 (follow st 0.51 20.51 g) = fLA × T 0.79 20.79 re from Table 0.79 20.79  | A 0.3 7 in 7 2 5able 9 20. 1 + (1 20 e 4e, 20     | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Tabl 51 20.51  - fLA) × T2  8 20.79  where approx 8 20.79  | 0.58  20.95  20.51  0.56 e 9c)  20.45 FLA = Livitation private 20.74 | 0.76  20.79  20.51  0.74  20.24  ving area ÷ (  | 0.84<br>20.59<br>20.5<br>0.83<br>19.96<br>4) = | 0.58   | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91)<br>(92) |

Apr

May

Jun

Jul

Aug

Sep

Oct

Nov

Dec

Mar

Jan

Feb

| Lietta  | -4: <b>f</b> |                   | -:                         |            |                    |             |           |           |             |             |            |                           |           |                  |
|---------|--------------|-------------------|----------------------------|------------|--------------------|-------------|-----------|-----------|-------------|-------------|------------|---------------------------|-----------|------------------|
| (94)m=  | 0.81         | tor for g         | ains, hm                   | 0.52       | 0.39               | 0.27        | 0.19      | 0.21      | 0.35        | 0.57        | 0.74       | 0.83                      |           | (94)             |
|         |              |                   | , W = (9 <sup>2</sup>      | <u> </u>   |                    | 0.27        | 0.13      | 0.21      | 0.00        | 0.07        | 0.74       | 0.00                      |           | (0.)             |
| (95)m=  | 540.92       | 553.11            | 531.08                     | 461.17     | 359.97             | 244.46      | 165.79    | 173.3     | 264.26      | 389.56      | 477.82     | 529.03                    |           | (95)             |
| Montl   | hly avera    | age exte          | rnal tem                   | perature   | from Ta            | able 8      |           | !         | ļ.          | ļ.          |            |                           |           |                  |
| (96)m=  | 4.3          | 4.9               | 6.5                        | 8.9        | 11.7               | 14.6        | 16.6      | 16.4      | 14.1        | 10.6        | 7.1        | 4.2                       |           | (96)             |
| Heat    | loss rate    | for mea           | an intern                  | al tempe   | erature,           | Lm , W =    | =[(39)m : | x [(93)m  | – (96)m     | ]           |            |                           |           |                  |
| (97)m=  | 653.04       | 632.59            | 572.42                     | 474.44     | 362.99             | 244.88      | 165.86    | 173.4     | 265.64      | 405.16      | 540.27     | 650.13                    |           | (97)             |
| -       |              |                   | ement fo                   |            |                    |             |           |           |             | <u> </u>    | i          | T 1                       |           |                  |
| (98)m=  | 83.42        | 53.41             | 30.76                      | 9.56       | 2.25               | 0           | 0         | 0         | 0           | 11.6        | 44.97      | 90.1                      |           | 7,000            |
|         |              |                   |                            |            |                    |             |           | lota      | ıl per year | (kwn/year   | r) = Sum(9 | 98) <sub>15,912</sub> = [ | 326.06    | <u> </u> (98)    |
| Spac    | e heatin     | g require         | ement in                   | kWh/m²     | <sup>2</sup> /year |             |           |           |             |             |            |                           | 4.2       | (99)             |
|         |              |                   | nts – Cor                  |            |                    |             |           |           |             |             |            |                           |           |                  |
|         |              |                   | ace hea<br>from se         |            |                    |             |           |           |             |             | unity scl  | heme.<br>[                | 0         | (301)            |
|         | •            |                   |                            | •          | • •                | •           |           | (Table T  | 1) 0 11 11  | One         |            | [<br>[                    |           |                  |
|         | •            |                   | from co                    | •          | •                  | ,           | ,         |           |             |             |            | l                         | 1         | (302)            |
|         |              |                   | y obtain he<br>s, geotherr |            |                    |             |           |           |             | up to four  | other heat | t sources; th             | ne latter |                  |
|         |              |                   | commun                     |            |                    |             |           |           | \           |             |            |                           | 1         | (303a)           |
| Fractio | on of tota   | al space          | heat fro                   | m Comn     | nunity bo          | oilers      |           |           |             | (3          | 02) x (303 | Ba) =                     | 1         | (304a)           |
|         |              |                   | charging                   |            |                    |             | r commu   | unity hea | ating sys   | tem         |            |                           | 1         | (305)            |
| Distrib | ution los    | s factor          | (Table 1                   | 12c) for o | commun             | ity heatii  | ng syste  | m         |             |             |            | ĺ                         | 1.15      | (306)            |
| Space   | heating      |                   |                            |            |                    |             |           |           |             |             |            | L                         | kWh/year  | _                |
|         | `            |                   | requiren                   | nent       |                    |             |           |           |             |             |            | [                         | 326.06    | ]                |
| Space   | heat fro     | m Com             | munity b                   | oilers     |                    |             |           |           | (98) x (30  | 04a) x (30  | 5) x (306) | =                         | 374.97    | (307a)           |
| Efficie | ncy of se    | econdar           | y/supple                   | mentary    | heating            | system      | in % (fro | om Table  | 4a or A     | ppendix     | E)         |                           | 0         | (308             |
| Space   | heating      | require           | ment fro                   | m secon    | dary/su            | oplemen     | tary syst | tem       | (98) x (30  | 01) x 100 - | ÷ (308) =  | [                         | 0         | (309)            |
| Water   | heating      | ı                 |                            |            |                    |             |           |           |             |             |            |                           |           |                  |
|         | -            |                   | equirem                    | ent        |                    |             |           |           |             |             |            |                           | 2091.65   |                  |
|         |              |                   | ty schem<br>nunity bo      |            |                    |             |           |           | (64) x (30  | 03a) x (30  | 5) x (306) | = [                       | 2405.4    | (310a)           |
| Electri | city used    | d for hea         | at distribu                | ution      |                    |             |           | 0.01      | × [(307a)   | (307e) +    | - (310a)   | (310e)] =                 | 27.8      | (313)            |
| Coolin  | g Syster     | m Energ           | y Efficie                  | ncy Rati   | 0                  |             |           |           |             |             |            | [                         | 0         | ]<br>(314)       |
| Space   | cooling      | (if there         | is a fixe                  | d coolin   | g systen           | n, if not e | enter 0)  |           | = (107) ÷   | · (314) =   |            | [                         | 0         | ]<br>(315)       |
| •       | •            | ,                 | nd fans v                  |            | •                  |             | ,         |           |             |             |            | L                         |           | J                |
|         |              |                   | - balanc                   |            |                    |             |           | outside   |             |             |            |                           | 250.5     | (330a)           |
|         | air baati    | ~ ~ ~ · · · · · · |                            |            |                    |             |           |           |             |             |            |                           |           |                  |
| warm a  | ali neali    | ng syste          | m fans                     |            |                    |             |           |           |             |             |            |                           | 0         | (330b)           |
|         | for solar    | •                 |                            |            |                    |             |           |           |             |             |            | [                         | 0         | (330b)<br>(330g) |
| pump    | for solar    | water h           |                            | κWh/yea    | ır                 |             |           |           | =(330a) ·   | + (330b) +  | (330g) =   | [<br>[<br>]               |           | _                |

| Energy for lighting (calculated in Appendi                                 | x L)   |                                    | 342.54               | (332)           |
|--|--|------------------------------------|----------------------|-----------------|
| 10b. Fuel costs – Community heating so                                     | heme   |                                    |                      |                 |
|  | <b>Fuel</b><br>kWh/year                                | Fuel Price<br>(Table 12)           | Fuel Cost<br>£/year  |                 |
| Space heating from CHP   | (307a) x   | 4.24 x 0                           | 0.01 = 15.9          | (340a)          |
| Water heating from CHP   | (310a) x   | 4.24 x 0                           | 0.01 = 101.99        | (342a)          |
| Pumps and fans   | (331)  | Fuel Price                         | 0.01 = 33.04         | (349)           |
| Energy for lighting  | (332)  | 13.19 × 0                          | 0.01 = 45.18         | (350)           |
| Additional standing charges (Table 12)                                     |  |                                    | 120                  | (351)           |
| Total energy cost  | = (340a)(342e) + (345)(354) =                          |                                    | 316.11               | (355)           |
| 11b. SAP rating - Community heating so                                     | heme   |                                    |                      |                 |
| Energy cost deflator (Table 12)  |  |                                    | 0.42                 | (356)           |
| Energy cost factor (ECF)   | $[(355) \times (356)] \div [(4) + 45.0] =$             |                                    | 1.08                 | (357)           |
| SAP rating (section12)   |  |                                    | 84.89                | (358)           |
| CO2 from other sources of space and was Efficiency of heat source 1 (%)    | ter heating (not CHP)  If there is CHP using two fuels | h/year kg CO2/kWl                  | and fuel 89.5        | (367a           |
| CO2 associated with heat source 1  Electrical energy for heat distribution | [(307b)+(310b)] x 1<br>[(313) x                        | 0.22<br>0.52                       | = 671.02             | (367)           |
| Total CO2 associated with community sy                                     | stems (363)(36   | 66) + (368)(372)                   | = 685.45             | (373)           |
| CO2 associated with space heating (second                                  | ondary) (309) x  | 0                                  | = 0                  | (374)           |
| CO2 associated with water from immersion                                   | on heater or instantaneous hea                         | ater (312) x 0.22                  | = 0                  | (375)           |
| Total CO2 associated with space and wa                                     | ter heating (373) + (373)                              | 74) + (375) =                      | 685.45               | (376)           |
| CO2 associated with electricity for pumps                                  | and fans within dwelling (331                          | )) x 0.52                          | = 130.01             | (378)           |
| CO2 associated with electricity for lighting                               | (332))) x  | 0.52                               | = 177.78             | (379)           |
| rotar ooz, kgrycar   | sum of (376)(382) =                                    |                                    | 993.24               | (383)           |
| Dwelling 002 Ellission Rate  | (383) ÷ (4) =  |                                    | 12.8                 | (384)           |
| El rating (section 14)   |  |                                    | 89.14                | (385)           |
| 13b. Primary Energy – Community heatin                                     | Ene  | ergy Primary<br>h/year factor      | P.Energy<br>kWh/year |                 |
| Energy from other sources of space and Efficiency of heat source 1 (%)     |  | repeat (363) to (366) for the seco | and fuel             | (2676)          |
| Energy associated with heat source 1                                       | [(307b)+(310b)] x 1                                    |                                    | = 3790               | (367a)<br>(367) |
| Electrical energy for heat distribution                                    |  | 1.22                               | 3790                 | (372)           |
| Licothodi chergy for ficat distribution                                    | [(313) x   | İ                                  | = 85.36              | (3/2)           |

| Total Primary Energy, kWh/year sum of (37                      | 6)(382) =                |      |   | 5696    | (383) |
|--|--------------------------|------|---|---------|-------|
| Energy associated with electricity for lighting                | (332))) x                | 3.07 | = | 1051.61 | (379) |
| Energy associated with electricity for pumps and fans within   | dwelling (331)) x        | 3.07 | = | 769.04  | (378) |
| Energy associated with space cooling                           | (315) x                  | 3.07 | = | 0       | (377) |
| Total Energy associated with space and water heating           | (373) + (374) + (375) =  |      |   | 3875.36 | (376) |
| Energy associated with water from immersion heater or insta    | ntaneous heater(312) x   | 1.22 | = | 0       | (375) |
| Energy associated with space heating (secondary)               | (309) x                  | 0    | = | 0       | (374) |
| if it is negative set (373) to zero (unless specified otherwis | e, see C7 in Appendix C) |      |   | 3875.36 | (373) |
| Total Energy associated with community systems                 | (363)(366) + (368)(372)  |      | = | 3875.36 | (373) |



|  |                                |   | User E           | Details: _               |              |              |          |           |                       |          |
|--|--------------------------------|---|------------------|--------------------------|--------------|--------------|----------|-----------|-----------------------|----------|
| Assessor Name:<br>Software Name:   | Stroma FSAP 2                  |   | le o o o o o o o | Strom                    | are Ve       | rsion:       |          | Versio    | on: 1.0.4.18          |          |
| Address :  | Block I, Agar Gro              |   |                  | Address:<br>lon, NW1     |              | n            |          |           |                       |          |
| 1. Overall dwelling dime   | ensions:                       |   |                  |                          |              |              |          |           |                       |          |
|  |                                |   | Are              | a(m²)                    | ī            | Av. He       | ight(m)  | 7         | Volume(m <sup>3</sup> | <u>^</u> |
| Ground floor   |                                |   |                  | 77.6                     | (1a) x       | 3            | .15      | (2a) =    | 244.44                | (3a)     |
| Total floor area TFA = (1  | a)+(1b)+(1c)+(1d)+             | (1e)+(1r                                      | n)               | 77.6                     | (4)          |              |          |           |                       |          |
| Dwelling volume  |                                |   |                  |                          | (3a)+(3b     | )+(3c)+(3c   | d)+(3e)+ | .(3n) =   | 244.44                | (5)      |
| 2. Ventilation rate:   |                                |   |                  |                          |              |              |          |           |                       |          |
|  | main<br>heating                | secondar<br>heating                           | ·у<br>           | other                    | _            | total        |          |           | m³ per hou            | ır<br>   |
| 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 fa  | ins                            |   |                  |                          |              | 0            | Χ.       | 10 =      | 0                     | (7a)     |
| Number of passive vents  | <b>;</b>                       |   |                  |                          |              | 0            | χ.       | 10 =      | 0                     | (7b)     |
| Number of flueless gas fi  | ires                           |   |                  |                          | Ī            | 0            | X 4      | 40 =      | 0                     | (7c)     |
|  |                                |   |                  |                          |              |              |          | Air ch    | nanges per ho         | our      |
| Infiltration due to chimne   | vs. flues and fans =           | (6a)+(6b)+(7                                  | 7a)+(7b)+(       | (7c) =                   | Г            | 0            |          | ÷ (5) =   | 0                     | (8)      |
| If a pressurisation test has b   |                                |   |                  |                          | continue fi  |              |          | . (0)     | 0                     | (0)      |
| Number of storeys in the   | he dw <mark>elling</mark> (ns) |   |                  |                          |              |              |          |           | 0                     | (9)      |
| Additional infiltration  |                                |   |                  |                          |              |              | [(9)     | -1]x0.1 = | 0                     | (10)     |
| Structural infiltration: 0  if both types of wall are p.   |                                |   |                  |                          | •            | ruction      |          |           | 0                     | (11)     |
| deducting areas of openii  |                                | rresponding to                                | ine grea         | lei wali are             | a (anter     |              |          |           |                       |          |
| If suspended wooden f  | ,                              | ,   | .1 (seale        | ed), else                | enter 0      |              |          |           | 0                     | (12)     |
| If no draught lobby, en  |                                |   |                  |                          |              |              |          |           | 0                     | (13)     |
| Percentage of windows Window infiltration  | s and doors draugh             | t stripped                                    |                  | 0.25 - [0.2              | ) v (14) ± 1 | 1001 -       |          |           | 0                     | (14)     |
| Infiltration rate  |                                |   |                  |                          | . ,          | 12) + (13) · | + (15) = |           | 0                     | (15)     |
| Air permeability value,  | a50. expressed in              | cubic metre                                   | s per ho         |                          |              |              |          | area      | 1                     | (17)     |
| If based on air permeabil  | •                              |   | •                | •                        | •            |              | •        |           | 0.05                  | (18)     |
| Air permeability value applie  | es if a pressurisation test    | has been dor                                  | ne or a de       | gree air pe              | rmeability   | is being u   | sed      |           |                       | _        |
| Number of sides sheltere   | ed                             |   |                  | (20) = 1 -               | [0 075 v /   | 10\1         |          |           | 2                     | (19)     |
| Shelter factor Infiltration rate incorporat  | ting chalter factor            |   |                  | (20) = 12<br>(21) = (18) | `            | 19)] =       |          |           | 0.85                  | (20)     |
| Infiltration rate modified f   |                                | aad   |                  | (21) = (10)              | ) X (20) =   |              |          |           | 0.04                  | (21)     |
| Jan Feb  | Mar Apr Ma                     |   | Jul              | Aug                      | Sep          | Oct          | Nov      | Dec       | ]                     |          |
| Monthly average wind sp  | 1 1                            | <u>.,                                    </u> | <u> </u>         | 7 7 10 9                 | 000          |              | 1.101    |           | l                     |          |
| (22)m= 5.1 5   | 4.9 4.4 4.3                    | 3.8   | 3.8              | 3.7                      | 4            | 4.3          | 4.5      | 4.7       | ]                     |          |
|  |                                |   |                  | •                        | 1            |              | •        | 1         | 1                     |          |
| Wind Factor $(22a)m = (22a)m $ | <del>'</del>                   | 0   0 ==                                      |                  | 1 000                    |              | 4.00         |          |           | 1                     |          |
| (22a)m= 1.27 1.25  | 1.23 1.1 1.08                  | 8 0.95  | 0.95             | 0.92                     | 1            | 1.08         | 1.12     | 1.18      | ]                     |          |

| Calculate offer  | 0.05   | 0.05   | 0.05   | 0.05                                       | 0.04                     | 0.04  | 0.04                  | 0.04   | 0.05  | 0.05   | 0.05               | ]             |               |
|--|--|--|--|--|--------------------------|---|-----------------------|--|---|--|--------------------|---------------|---------------|
|  |  | change i   | rate for t   | he appli                                   | cable ca                 | se  | ı                     |  | l   | ı  |                    |               |               |
| If mechanica   |  |  | on div. N. (O  | ah) (aa-                                   | · \                      | (N  | 15\\ atlaa            |  | ) (00-)   |  |                    | 0.5           | (2:           |
| If exhaust air h   |  | 0 11   |  | , ,  | ,                        | . ,   | ,, .                  | ,  | ) = (23a)   |  |                    | 0.5           | (2:           |
| If balanced with   |  | •  |  | _  |                          |   |                       |  |   |  |                    | 76.5          | (2:           |
| a) If balance  |  |  |  |  |                          | <del>- `                                     </del> | <del>- ` ` - </del>   | <del>``</del>  | <del> </del>  | <del>-                                    </del>       | <del>- ` ` `</del> | ) ÷ 100]<br>1 | (2)           |
| 24a)m= 0.17  | 0.17   | 0.17   | 0.16   | 0.16                                       | 0.16                     | 0.16  | 0.16                  | 0.16   | 0.16  | 0.17   | 0.17               |               | (2            |
| b) If balance  | ı  |  |  |  | ı —                      | <del></del>   | <del>- ^ ` ` - </del> | ŕ  | <del>r ´       `</del>                                  | <u> </u>   | Ι ,                | 1             | (2            |
| 24b)m= 0   | 0  | 0  | 0  | 0  |                          | 0   | 0                     | 0  | 0   | 0  | 0                  |               | (2            |
| c) If whole h  |  | tract ven<br>‹ (23b), t  |  |  | •                        |   |                       |  | 5 v (22k  | <b>,</b> )   |                    |               |               |
| 24c)m= 0   | 0.5 7  | 0  | 0  | ) = (23L<br>0                              | 0                        | 0   | $C_{i} = (221)$       | 0  | 0   | 0  | 0                  | 1             | (2            |
| d) If natural  |  |  |  |  | <u> </u>                 |   |                       |  |   |  |                    | J             | (-            |
| ,  |  | en (24d)   |  |  | •                        |   |                       |  | 0.5]  |  |                    |               |               |
| 24d)m= 0   | 0  | 0  | 0  | 0  | 0                        | 0   | 0                     | 0  | 0   | 0  | 0                  | ]             | (2            |
| Effective air  | change   | rate - er  | iter (24a  | or (24k                                    | o) or (24                | c) or (24   | d) in box             | (25)   |   |  |                    |               |               |
| 25)m= 0.17   | 0.17   | 0.17   | 0.16   | 0.16                                       | 0.16                     | 0.16  | 0.16                  | 0.16   | 0.16  | 0.17   | 0.17               |               | (2            |
|  |  |  |  |  |                          |   |                       | L  |   |  |                    |               |               |
| 3. Heat losse  |  |  |  |  | N . A                    |   |                       |  | A >< 1.1  |  |                    | _             | A 37 I        |
| LEMENT   | Gros<br>area   |  | Openin<br>m  |  | Net Ar<br>A ,r           |   | U-valı<br>W/m2        |  | A X U<br>(W/  | K)   | k-value<br>kJ/m²-l |               | A X k<br>kJ/K |
| Vindows Type   |  | ,  |  |  | 5.6                      |   | [1/( 0.85 )-          |  | 4.6   |  |                    |               | (2            |
| Vin <mark>dows</mark> Type   |  |  |  |  | 11.1                     | _   | -<br>[1/( 0.85 )-     | , i  | 9.12  | Ħ  |                    |               | (2            |
| Valls Type1  | 38.4   |  | 11.1   |  | 27.3                     | X   | 0.2                   |  | 5.46  | Ħ r  |                    |               | (2            |
| Valls Type2  |  | =  | _  | = \  |                          |   |                       | 4  |   | 븍 ¦  |                    | ╡╞            | =             |
|  | 8.5  |  | 5.6  |  | 2.9                      | ×   | 0.2                   | = [  | 0.58  |  |                    |               | (2            |
| otal area of e   |  |  | .ffootivo wi   | ndow II v                                  | 46.9                     | otod vojna  | formula 1             | /[/1/  L.volu  | (0) ( 0 (04) (  | no airen in  | norograni          | 5.22          | (3            |
| ior wiridows and<br>include the area   |  |  |  |  |                          | ateu using  | i iorriiula T         | /[(  | ie)+0.04j a   | is giveri iri  | грагаугарг         | 1 3.2         |               |
| and the second   | s, W/K   | = S (A x   | U)   |  |                          |   | (26)(30)              | + (32) =   |   |  |                    | 19.77         | (3            |
| apric heat los   | Cm - S/  | (  |  |  |                          |   | ()()                  |  |   |  |                    |               | 1,5           |
|  | Ciii = 3   | AXK)   |  |  |                          |   | (==):::(==)           |  | (30) + (32  | 2) + (32a).  | (32e) =            | 513.4         |               |
| abric heat los<br>leat capacity<br>hermal mass   |  | ,  | P = Cm ÷   | - TFA) ir                                  | n kJ/m²K                 |   | (==)(==)              | ((28)  | (30) + (32<br>tive Value                                | , , ,  | (32e) =            | 513.4<br>100  | (3            |
| leat capacity<br>hermal mass   | parame   | ter (TMF   |  | •  |                          |   |                       | ((28)<br>Indica  | tive Value  | : Low  | ` ,                |               | (3            |
| leat capacity<br>hermal mass<br>or design assess<br>an be used inste   | parame<br>sments wh<br>ad of a de  | eter (TMF<br>ere the de<br>tailed calcu  | tails of the<br>ulation.   | construct                                  | ion are no               | t known pr  |                       | ((28)<br>Indica  | tive Value  | : Low  | ` ,                |               | (3            |
| leat capacity hermal mass or design assess an be used inste hermal bridge  | parame<br>sments wh<br>ad of a de<br>es: S (L  | eter (TMF<br>ere the de<br>tailed calcu<br>x Y) cal  | tails of the<br>ulation.<br>culated u                            | construct                                  | ion are not<br>opendix l | t known pr  |                       | ((28)<br>Indica  | tive Value  | : Low  | ` ,                |               | (3            |
| leat capacity hermal mass for design assess an be used inste hermal bridge details of therma   | parame<br>sments wh<br>ad of a de<br>es: S (L<br>al bridging                                   | eter (TMF<br>ere the de<br>tailed calcu<br>x Y) cal  | tails of the<br>ulation.<br>culated u                            | construct                                  | ion are not<br>opendix l | t known pr  |                       | ((28)<br>Indica  | tive Value  | : Low  | ` ,                | 7.04          | (3)           |
| leat capacity Thermal mass or design assess an be used inste Thermal bridge details of thermal Total fabric he   | parame<br>sments wh<br>ad of a de<br>es:S(L<br>al bridging<br>at loss                          | eter (TMF<br>ere the de<br>tailed calcu<br>x Y) calcu<br>are not kn                            | tails of the<br>ulation.<br>culated u<br>own (36) =              | constructusing Ap                          | ion are not<br>opendix l | t known pr  |                       | ((28)<br>Indica<br>e indicative                            | tive Value e values of (36) =                           | : Low<br>TMP in T                                      | able 1f            | 100           | (3)           |
| leat capacity hermal mass or design assess an be used inste hermal bridge details of therma fotal fabric he entilation hea   | parame<br>sments wh<br>ad of a de<br>es: S (L<br>al bridging<br>at loss<br>at loss ca          | ere the de<br>tailed calcu<br>x Y) calcu<br>are not kn   | tails of the<br>ulation.<br>culated u<br>own (36) =              | constructusing Ap                          | ppendix I                | t known pr  | ecisely the           | ((28)<br>Indica<br>e indicative<br>(33) +<br>(38)m         | tive Values of values of (36) = = 0.33 × (              | : Low<br>: TMP in T                                    | able 1f            | 7.04          | (3)           |
| eat capacity hermal mass or design assess an be used inste hermal bridge details of therma otal fabric he entilation hea   | parame<br>sments wh<br>ad of a de<br>es: S (L<br>al bridging<br>at loss<br>at loss ca          | ere the de<br>tailed calcu<br>x Y) calcu<br>are not kn   | tails of the<br>ulation.<br>culated u<br>own (36) =<br>I monthly | construct using Ap = 0.05 x (3             | ppendix I                | t known pr  | ecisely the           | ((28) Indica e indicative (33) + (38)m                     | (36) =<br>= 0.33 × (                                    | : Low<br>: TMP in T<br>25)m x (5                       | able 1f            | 7.04          | (3            |
| eat capacity hermal mass or design assess an be used inste hermal bridge details of therma otal fabric he entilation hea  Jan 13.85  | parame sments wh ad of a de es: S (L al bridging at loss at loss ca Feb 13.76                  | eter (TMF ere the de tailed calcu x Y) calc are not kn alculated Mar 13.68                     | tails of the<br>ulation.<br>culated u<br>own (36) =              | constructusing Ap                          | ppendix I                | t known pr  | ecisely the           | ((28) Indica e indicative (33) + (38)m Sep 12.91           | (36) =<br>= 0.33 × (<br>Oct                             | 25)m x (5<br>Nov<br>13.33                              | able 1f            | 7.04          | (3            |
| hermal mass or design assess an be used inste hermal bridge details of therma otal fabric hermal trillation head assume transfer of the transf | parame sments wh ad of a de es: S (L al bridging at loss at loss ca Feb 13.76                  | ter (TMF<br>ere the de<br>tailed calcu<br>x Y) calc<br>are not kn<br>alculated<br>Mar<br>13.68 | tails of the ulation. culated to own (36) = I monthly Apr 13.25  | construct using Ap = 0.05 x (3 / May 13.16 | ppendix I  Jun  12.74    | Jul   | Aug                   | ((28) Indica indicative (33) + (38)m Sep 12.91 (39)m       | (36) =<br>= 0.33 × (<br>Oct<br>13.16<br>= (37) + (      | 25)m x (5<br>Nov<br>13.33                              | Dec 13.51          | 7.04          | (3            |
| eat capacity hermal mass or design assess an be used inste hermal bridge details of therma otal fabric he entilation hea  Jan 13.85 eat transfer of  | parame sments wh ad of a de es: S (L al bridging at loss at loss ca Feb 13.76                  | eter (TMF ere the de tailed calcu x Y) calc are not kn alculated Mar 13.68                     | tails of the<br>ulation.<br>culated u<br>own (36) =<br>I monthly | construct using Ap = 0.05 x (3             | ppendix I                | t known pr  | ecisely the           | ((28) Indica indicative (33) + (38)m Sep 12.91 (39)m 39.71 | (36) = = 0.33 × ( Oct 13.16 = (37) + ( 39.97            | 25)m x (5<br>Nov<br>13.33<br>38)m<br>40.14             | Dec 13.51          | 7.04          | (3            |
| hermal mass or design assess an be used inste hermal bridge details of thermal otal fabric hermal and instentiation head and instentiatio | parame sments wh ad of a de es: S (L al bridging at loss at loss ca Feb 13.76 coefficien 40.57 | ere the de tailed calculated are not kn alculated Mar 13.68  nt, W/K 40.48                     | tails of the ulation. culated to own (36) = I monthly Apr 13.25  | construct using Ap = 0.05 x (3 / May 13.16 | ppendix I  Jun  12.74    | Jul   | Aug                   | ((28) Indica indicative (33) + (38)m Sep 12.91 (39)m 39.71 | (36) = = 0.33 × ( Oct 13.16 = (37) + ( 39.97  Average = | 25)m x (5<br>Nov<br>13.33<br>38)m<br>40.14<br>Sum(39); | Dec 13.51          | 7.04          | (3            |
| leat capacity Thermal mass For design assess In be used inste Thermal bridge details of thermal Total fabric he Tentilation hea  38)m= 13.85  Ideat transfer of  | parame sments wh ad of a de es: S (L al bridging at loss at loss ca Feb 13.76 coefficien 40.57 | ere the de tailed calculated are not kn alculated Mar 13.68  nt, W/K 40.48                     | tails of the ulation. culated to own (36) = I monthly Apr 13.25  | construct using Ap = 0.05 x (3 / May 13.16 | ppendix I  Jun  12.74    | Jul   | Aug                   | ((28) Indica indicative (33) + (38)m Sep 12.91 (39)m 39.71 | (36) = = 0.33 × ( Oct 13.16 = (37) + ( 39.97            | 25)m x (5<br>Nov<br>13.33<br>38)m<br>40.14<br>Sum(39); | Dec 13.51          | 7.04          | (3)           |

Number of days in month (Table 1a)

| Numbe                                   | er or day              | s in mor                 | ıın (Tab                | ie ra)                    |                | 1          | 1          | ,                      |                    | 1           |                        |          | 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 \\/\                                  | tor boot               | ing oner                 | av roqui                | romont:                   |                |            |            |                        |                    |             |                        | kWh/ye   | oor:    |            |
| 4. ۷۷                                   | ilei neai              | ing ener                 | gy requi                | rement.                   |                |            |            |                        |                    |             |                        | KVVII/yt | sai.    |            |
| Assum                                   | ed occu                | pancy, I                 | N                       |                           |                |            |            |                        |                    |             | 2.                     | 42       |         | (42)       |
|   |                        |                          | + 1.76 x                | [1 - exp                  | (-0.0003       | 849 x (TF  | FA -13.9   | )2)] + 0.0             | 0013 x (           | TFA -13.    | .9)                    |          |         |            |
|   | A £ 13.9               | -                        |                         |                           |                |            |            | (O.5. N.I)             | 00                 |             |                        |          | •       |            |
|   |                        |                          |                         |                           |                |            |            | (25 x N)<br>to achieve | + 36<br>a water us | se target o |                        | .57      |         | (43)       |
|   |                        | _                        | person per              |                           |                | _          | -          |                        |                    | J           |                        |          |         |            |
|   | Jan                    | Feb                      | Mar                     | Apr                       | May            | Jun        | Jul        | Aug                    | Sep                | Oct         | Nov                    | Dec      |         |            |
| Hot wate                                |                        |                          | day for ea              |                           |                | l .        |            |                        | ГООР               | 1 001       | 1101                   | 200      |         |            |
| (44)m=                                  | 100.73                 | 97.07                    | 93.41                   | 89.74                     | 86.08          | 82.42      | 82.42      | 86.08                  | 89.74              | 93.41       | 97.07                  | 100.73   |         |            |
| (11)                                    | 100.70                 | 07.07                    | 00.11                   | 00.7 1                    | 00.00          | 02.12      | 02.12      | 00.00                  |                    |             | m(44) <sub>112</sub> = |          | 1098.89 | (44)       |
| Energy o                                | content of             | hot water                | used - cal              | culated mo                | onthly $= 4$ . | 190 x Vd,r | n x nm x E | OTm / 3600             |                    |             | ables 1b, 1            |          | 1000.00 |            |
| (45)m=                                  | 149.38                 | 130.65                   | 134.82                  | 117.54                    | 112.78         | 97.32      | 90.18      | 103.49                 | 104.72             | 122.04      | 133.22                 | 144.67   |         |            |
|   |                        |                          |                         |                           |                |            |            |                        |                    |             | m(45) <sub>112</sub> = |          | 1440.81 | (45)       |
| If inst <mark>ant</mark>                | taneous w              | ater heatin              | ng at point             | of use (no                | hot water      | storage),  | enter 0 in | boxes (46              |                    |             | ( )2                   |          |         |            |
| (46)m=                                  | 22.41                  | 19.6                     | 20.22                   | 17.63                     | 16.92          | 14.6       | 13.53      | 15.52                  | 15.71              | 18.31       | 19.98                  | 21.7     |         | (46)       |
|   | storage                | loss:                    |                         |                           |                |            |            |                        |                    |             |                        |          |         |            |
| Storag                                  | <mark>e v</mark> olum  | e (litre <mark>s)</mark> | inc <mark>ludir</mark>  | ng any so                 | olar or W      | WHRS       | storage    | within sa              | ame ves            | sel         |                        | 0        |         | (47)       |
| If co <mark>m</mark> r                  | <mark>mu</mark> nity h | eating a                 | nd no ta                | nk in dw                  | elling, e      | nter 110   | litres in  | (47)                   |                    |             |                        |          |         |            |
| Otherw                                  | vise if no             | stored                   | hot wate                | er (th <mark>is in</mark> | ıcludes i      | nstantar   | neous co   | mbi boil               | ers) ente          | er '0' in ( | <b>4</b> 7)            |          |         |            |
|   | storage                |                          |                         |                           |                |            |            |                        |                    |             |                        |          |         |            |
| a) If m                                 | anufact                | urer's de                | eclared l               | oss facto                 | or is kno      | wn (kWl    | n/day):    |                        |                    |             |                        | 0        |         | (48)       |
| Tempe                                   | rature fa              | actor fro                | m Table                 | 2b                        |                |            |            |                        |                    |             |                        | 0        |         | (49)       |
| • |                        |                          | storage                 | -                         |                |            |            | (48) x (49)            | ) =                |             | 1                      | 10       |         | (50)       |
|   |                        |                          | eclared o               |                           |                |            |            |                        |                    |             |                        |          | -<br>I  |            |
|   |                        |                          | factor fr<br>ee section |                           | e∠(KVV         | n/litre/da | iy)        |                        |                    |             | 0.                     | 02       |         | (51)       |
|   | e factor               | _                        |                         | 011 4.3                   |                |            |            |                        |                    |             |                        | 03       | l       | (52)       |
|   |                        |                          | m Table                 | 2b                        |                |            |            |                        |                    |             | -                      | .6       |         | (53)       |
| •                                       |                        |                          | storage                 |                           | ar             |            |            | (47) x (51)            | ) x (52) x (       | 53) =       |                        | 03       |         | (54)       |
|   | (50) or (              |                          | _                       | , 100 viii, y 0           | Jui            |            |            | (11)11(01)             | ,                  |             | -                      | 03       |         | (55)       |
|   | ` , , ,                | , ,                      | culated f               | or each                   | month          |            |            | ((56)m = (             | 55) × (41)ı        | m           |                        | 00       |         | ()         |
| (56)m=                                  | 32.01                  | 28.92                    | 32.01                   | 30.98                     | 32.01          | 30.98      | 32.01      | 32.01                  | 30.98              | 32.01       | 30.98                  | 32.01    |         | (56)       |
| , ,                                     |                        |                          |                         |                           |                |            |            |                        |                    |             | H11) is fro            |          | liv H   | (30)       |
| -                                       | ı                      |                          |                         |                           |                | 1          |            |                        |                    |             |                        |          | I       | <b>,</b> \ |
| (57)m=                                  | 32.01                  | 28.92                    | 32.01                   | 30.98                     | 32.01          | 30.98      | 32.01      | 32.01                  | 30.98              | 32.01       | 30.98                  | 32.01    |         | (57)       |
| Primar                                  | y circuit              | loss (an                 | nual) fro               | m Table                   | 3              |            |            |                        |                    |             |                        | 0        |         | (58)       |
| Primar                                  | y circuit              | loss cal                 | culated t               | for each                  | month (        | 59)m = (   | (58) ÷ 36  | 65 × (41)              | m                  |             |                        |          |         |            |
| (mod                                    | dified by              | factor fr                | om Tab                  | le H5 if t                | here is s      | solar wat  | ter heati  | ng and a               | cylinde            | r thermo    | stat)                  |          | •       |            |
| (59)m=                                  | 23.26                  | 21.01                    | 23.26                   | 22.51                     | 23.26          | 22.51      | 23.26      | 23.26                  | 22.51              | 23.26       | 22.51                  | 23.26    |         | (59)       |
| Combi                                   | loss cal               | culated                  | for each                | month (                   | (61)m =        | (60) ÷ 36  | 65 × (41   | )m                     |                    |             |                        |          |         |            |
| (61)m=                                  | 0                      | 0                        | 0                       | 0                         | 0              | 0          | 0          | 0                      | 0                  | 0           | 0                      | 0        |         | (61)       |
|   |                        |                          |                         |                           |                | •          | •          |                        | •                  | •           | •                      |          |         |            |

| Total heat re                  | quired for   | water h    | eating ca      | alculated  | for        | each month       | (62)        | m = (          | 0.85 × (4  | 45)m +                  | (46)m +            | (57)m +     | (59)m + (61)m |                            |
|--------------------------------|--------------|------------|----------------|------------|------------|------------------|-------------|----------------|--|-------------------------|--------------------|-------------|---------------|----------------------------|
| (62)m= 204.66                  | <del>`</del> | 190.1      | 171.03         | 168.06     |            | 0.82 145.46      | 158         |                | 158.22   | 177.32                  | 186.71             | 199.94      |               | (62)                       |
| Solar DHW inpu                 | t calculated | using App  | endix G o      | · Appendix | H (n       | egative quantity | /) (ent     | er '0' i       | if no solar                                      | contribu                | tion to wate       | er heating) |               |                            |
| (add addition                  | al lines if  | FGHRS      | and/or \       | WWHRS      | app        | olies, see Ap    | pend        | lix G          | )  |                         |                    |             |               |                            |
| (63)m= 0                       | 0            | 0          | 0              | 0          | (          | 0                | 0           |                | 0  | 0                       | 0                  | 0           |               | (63)                       |
| Output from                    | water hea    | ter        | •              | •          |            | •                |             |                | •  |                         | •                  | •           |               |                            |
| (64)m= 204.66                  | 180.58       | 190.1      | 171.03         | 168.06     | 150        | 0.82 145.46      | 158         | .76            | 158.22   | 177.32                  | 186.71             | 199.94      |               |                            |
|                                |              |            |                |            |            |                  |             | Outpu          | ut from wa                                       | iter heate              | er (annual)₁       | 12          | 2091.65       | (64)                       |
| Heat gains fr                  | om water     | heating    | , kWh/m        | onth 0.2   | 5 ′ [0     | ).85 × (45)m     | + (6        | 1)m]           | + 0.8 x  | [(46)m                  | + (57)m            | + (59)m     | ]             | _                          |
| (65)m= 93.89                   | 83.38        | 89.05      | 81.88          | 81.72      | 75         | .15 74.21        | 78.         | 63             | 77.62  | 84.8                    | 87.09              | 92.32       |               | (65)                       |
| include (57                    | ')m in cal   | culation   | of (65)m       | only if c  | ylind      | der is in the o  | dwell       | ing c          | or hot wa  | ater is f               | rom com            | munity h    | neating       |                            |
| 5. Internal                    | <u> </u>     |            | , ,            | •          | ,          |                  |             |                |  |                         |                    | <u> </u>    |               |                            |
| Metabolic ga                   |              |            |                | ,          |            |                  |             |                |  |                         |                    |             |               |                            |
| Jan                            |              | Mar        | Apr            | May        | J          | un Jul           | A           | ug             | Sep  | Oct                     | Nov                | Dec         |               |                            |
| (66)m= 144.94                  | +            | 144.94     | 144.94         | 144.94     | 144        | -                | 144         | <del>-</del> - | 144.94   | 144.94                  | 144.94             | 144.94      |               | (66)                       |
| Lighting gain                  | s (calcula   | ted in Aı  | opendix        | L. eguat   | on I       | 9 or L9a), a     | lso s       | ee T           | able 5   |                         |                    |             | l             |                            |
| (67)m= 48.49                   | <del>`</del> | 35.03      | 26.52          | 19.82      | 16         | <del></del>      | 23.         | _              | 31.55  | 40.06                   | 46.75              | 49.84       |               | (67)                       |
| Appliances g                   | ains (calc   |            | Annend         |            |            |                  | 3a) :       | also           |  |                         |                    |             |               |                            |
| (68)m= 319.93                  | - "          | 314.88     | 297.07         | 274.59     | 253        |                  | 236         |                | 244.39   | 262.2                   | 284.68             | 305.81      | 1             | (68)                       |
| Cooking gain                   |              |            |                |            | —          |                  | <del></del> | $\vdash$       |  |                         |                    |             |               | , ,                        |
| (69)m= 51.91                   | <u> </u>     | 51.91      | 51.91          | 51.91      | 51.        |                  | 51.         | _              | 51.91  | 51.91                   | 51.91              | 51.91       | 1             | (69)                       |
| ` '                            |              |            |                | 01.01      | 01.        | 01.01            | 01.         | <u> </u>       | 01.01  | 01.01                   | 01.01              | 01.01       |               | ()                         |
| Pumps and f                    |              | 0          | 0              | 0          |            | 0                | 0           |                | 0  | 0                       | 0                  | 0           | 1             | (70)                       |
| ` '                            |              | l          |                |            |            |                  |             |                | 0  | 0                       |                    | U           |               | (10)                       |
| Losses e.g. 6<br>(71)m= -96.63 | <del></del>  | n (nega    | -96.63         | -96.63     |            | .63 -96.63       | -96.        | 62             | -96.63   | -96.63                  | -96.63             | -96.63      | 1             | (71)                       |
| ` '                            |              | ļ          | -90.03         | -90.03     | -90        | -90.03           | -90.        | .03            | -90.03   | -90.03                  | -90.03             | -90.03      |               | (7-1)                      |
| Water heatin (72)m= 126.2      |              |            | 142.72         | 100.04     | 10/        | 120 00.74        | 105         | 60 T           | 407.0  | 112.00                  | 120.96             | 124.00      | 1             | (72)                       |
|                                | _            |            | 113.72         | 109.84     | 104        |                  | 105         |                | 107.8  |                         |                    |             |               | (72)                       |
| Total interna                  | <del>_</del> |            | T 507.50       | 504.40     | 47         | (66)m + (67)m    | ·           | <del></del>    | <del>`                                    </del> | , ,                     | <del>, ` ` '</del> |             | 1             | (72)                       |
| (73)m= 594.84                  |              | 569.82     | 537.53         | 504.48     | 47         | 4.8 457.39       | 465         | .44            | 483.96   | 516.46                  | 552.62             | 579.97      |               | (73)                       |
| 6. Solar gains are             |              | ueina eola | ır fluv from   | Table 6a   | and a      | ssociated equa   | tione       | to con         | wert to the                                      | a annlica               | ble orientat       | ion         |               |                            |
| Orientation:                   |              | •          | Area           |            | anu a      | Flux             | 110113      |                |  | е аррііса               | FF                 |             | Gains         |                            |
| Onemation.                     | Table 6d     |            | m <sup>2</sup> |            |            | Table 6a         |             |                | g_<br>able 6b                                    | Т                       | able 6c            |             | (W)           |                            |
| East 0.9x                      | 0.54         | x          | 11             | 1          | хГ         | 19.64            | x           |                | 0.5  | 7 x [                   | 0.8                |             | 42.38         | (76)                       |
| East 0.9x                      |              |            |                |            | ^ L<br>x Г | 38.42            | x           |                |  | 」^L<br>ヿ <sub>×</sub> 「 | 0.8                |             | 82.91         | ](76)                      |
| East 0.9x                      |              |            |                |            | F          |                  |             |                | 0.5  | ╡╞                      |                    | =           |               | _                          |
| East 0.9x                      |              |            |                |            | ×          | 63.27            | X           |                | 0.5  | _  ×                    | 0.8                | =           | 136.53        | (76)                       |
|                                |              |            |                |            | х <u>Г</u> | 92.28            | X           |                | 0.5  | 」×↓<br>□、┌              | 0.8                | _           | 199.13        | (76)                       |
| _                              |              |            |                |            | х <u>Г</u> | 113.09           | X           |                | 0.5  | _                       | 0.8                | =           | 244.04        | (76)                       |
|                                |              |            |                |            | x _        | 115.77           | X           |                | 0.5  | _                       | 0.8                | =           | 249.81        | ](76)<br>] <sub>(70)</sub> |
| East 0.9x                      |              |            |                | _          | × L        | 110.22           | X           |                | 0.5  | _                       | 0.8                | =           | 237.83        | (76)                       |
| East 0.9x                      | 0.54         | X          | 11             | .1 l       | X          | 94.68            | X           | I              | 0.5  | X                       | 0.8                | =           | 204.3         | (76)                       |

| East  | 0.9x   | 0.54   | X  | 11.1  | 1  | x  | 73.59  | ×   | 0.5  | X  | 0.8   | =  | 158.79 | (76)   |
|---|--|--|--|---|--|--|--|---|--|--|---|--|--------|--|
| East  | 0.9x   | 0.54   | x  | 11.1  | 1  | X  | 45.59  | х   | 0.5  | x  | 0.8   | =  | 98.37  | (76)   |
| East  | 0.9x   | 0.54   | X  | 11.1  | 1  | X  | 24.49  | x   | 0.5  | x  | 0.8   | =  | 52.84  | (76)   |
| East  | 0.9x   | 0.54   | x  | 11.1  | 1  | X  | 16.15  | x   | 0.5  | x  | 0.8   | =  | 34.85  | (76)   |
| West  | 0.9x   | 0.77   | x  | 5.6   | ;  | X  | 19.64  | X   | 0.5  | x  | 0.8   | =  | 30.49  | (80)   |
| West  | 0.9x   | 0.77   | x  | 5.6   |  | X  | 38.42  | X   | 0.5  | x  | 0.8   | =  | 59.64  | (80)   |
| West  | 0.9x   | 0.77   | x  | 5.6   |  | X  | 63.27  | X   | 0.5  | ×  | 0.8   | _ =  | 98.22  | (80)   |
| West  | 0.9x   | 0.77   | x  | 5.6   |  | X  | 92.28  | X   | 0.5  | ×  | 0.8   | _ =  | 143.25 | (80)   |
| West  | 0.9x   | 0.77   | X  | 5.6   |  | X  | 113.09   | ×   | 0.5  | x  | 0.8   | =  | 175.56 | (80)   |
| West  | 0.9x   | 0.77   | x  | 5.6   | ;  | X  | 115.77   | X   | 0.5  | x  | 0.8   | =  | 179.71 | (80)   |
| West  | 0.9x   | 0.77   | x  | 5.6   |  | X  | 110.22   | X   | 0.5  | ×  | 0.8   | _ =  | 171.09 | (80)   |
| West  | 0.9x   | 0.77   | X  | 5.6   |  | X  | 94.68  | ×   | 0.5  | x  | 0.8   | =  | 146.97 | (80)   |
| West  | 0.9x   | 0.77   | x  | 5.6   | ;  | X  | 73.59  | X   | 0.5  | ×  | 0.8   | =  | 114.23 | (80)   |
| West  | 0.9x   | 0.77   | X  | 5.6   | ;  | X  | 45.59  | x   | 0.5  | x  | 0.8   | =  | 70.77  | (80)   |
| West  | 0.9x   | 0.77   | X  | 5.6   | ;  | X  | 24.49  | X   | 0.5  | x  | 0.8   | =  | 38.01  | (80)   |
| West  | 0.9x   | 0.77   | x  | 5.6   | ;  | X  | 16.15  | X   | 0.5  | ×  | 0.8   | =  | 25.07  | (80)   |
|   | _  |  |  |   |  |  |  | _   |  |  |   |  |        |  |
| Solar g   | ains in  | watts, calc  | ulated   | for each  | month  | 1  |  | (83)n   | n = Sum(74)m.  | (82)m  |   |  |        |  |
| (83)m=  | 72.87  | 142.55   | 234.75   | 342.37  | 419.59   | 4:   | 29.53 408.93   | 351   | .26 273.03   | 169.1  | 4 90.86   | 59.92  |        | (83)   |
| Total g   | ains – i   | nternal and  | solar  | (84)m =   | (73)m  | + (8   | 33)m , watts   |   |  |  |   |  |        |  |
| (84)m=  | 667.71   | 733.17 8   | 304.58   | 879.9   | 924.07   | 9  | 04.33 866.32   | 810   | 5.7 756.99   | 685.6  | 643.48  | 639.89   |        | (84)   |
| - 1 A   |  |  |  |   | _  |  |  |   |  |  |   |  |        |  |
| 7. Me   | an inter   | mal temper   | rature (   | heating:  | seasor   | n)   |  |   |  |  |   |  |        |  |
|   |  |  |  | heating :<br>eriods in  |  |  | area from Ta   | able 9  | , Th1 (°C)   | ٠.   |   |  | 21     | (85)   |
| Temp  | erature  | during hea   | ating p  | eriods in   | the liv  | ing  |  |   | , Th1 (°C)   | ī  | г   |  | 21     | (85)   |
| Temp  | erature  | during hea   | ating p  | eriods in   | the liv<br>a, h1,n   | ing<br>n (s  | area from Ta<br>ee Table 9a)<br>Jun Jul  |   | , Th1 (°C)   | Oct  | Nov   | Dec  | 21     | (85)   |
| Temp  | erature<br>ition fac   | during hea   | ating pons   | eriods in   | the liv  | ing<br>n (s  | ee Table 9a)   |   | ug Sep   | Oct  | Nov<br>0.76                                     | Dec<br>0.84                                    | 21     | (85)   |
| Temp<br>Utilisa<br>(86)m=   | erature<br>tion fac<br>Jan<br>0.83   | during heater for gain Feb 0.77  | ns for li<br>Mar   | eriods in<br>ving area<br>Apr   | the liv<br>a, h1,n<br>May  | ing<br>n (s  | ee Table 9a)<br>Jun Jul<br>0.28 0.2  | A 0.2   | ug Sep<br>22 0.36  |  | +   |  | 21     |  |
| Temp<br>Utilisa<br>(86)m=   | erature<br>tion fac<br>Jan<br>0.83<br>interna  | during heater for gair Feb 0.77 It temperate   | ating pons for line Mar 0.67   | eriods in ving area Apr 0.53 iving are  | the liv<br>a, h1,n<br>May<br>0.4<br>ea T1 (f   | ing<br>n (s  | Jun Jul<br>0.28 0.2<br>w steps 3 to  | 7 in 7  | ug Sep<br>22 0.36<br>Table 9c)   | 0.58   | 0.76  | 0.84   | 21     | (86)   |
| Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=   | erature Jan 0.83 interna 20.63   | during heater for gair Feb 0.77 lt temperate 20.74   | Mar 0.67<br>ure in l   | eriods in ving area 0.53 iving are 20.96  | the liv<br>a, h1,n<br>May<br>0.4<br>ea T1 (f<br>20.99  | ing<br>n (s<br>follo   | ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21   | 7 in 7  | ug Sep<br>22 0.36<br>Table 9c)   |  | 0.76  |  | 21     |  |
| Temp Utilisa (86)m= Mean (87)m= Temp  | ution factories Jan 0.83 interna 20.63 erature   | during heater for gair Feb 0.77 Il temperate 20.74 during heater   | ating points for line Mar 0.67 ure in 1 20.87  | eriods in ving area Apr 0.53 iving are 20.96 eriods in  | the liv<br>a, h1,n<br>May<br>0.4<br>ea T1 (f<br>20.99  | ing<br>n (s<br>follo   | Jun Jul  Jun Jul  Jun Jul  Jun  Jun  Jun  Jun  Jun  Jun  Jun   | 7 in 7  | ug Sep<br>22 0.36<br>Table 9c)<br>1 21<br>9, Th2 (°C)  | 20.95  | 0.76  | 20.59  | 21     | (86)   |
| Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=   | erature Jan 0.83 interna 20.63   | during heater for gair Feb 0.77 lt temperate 20.74   | Mar 0.67<br>ure in l   | eriods in ving area 0.53 iving are 20.96  | the liv<br>a, h1,n<br>May<br>0.4<br>ea T1 (f<br>20.99  | ing<br>n (s<br>follo   | ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21   | 7 in 7  | ug Sep<br>22 0.36<br>Table 9c)<br>1 21<br>9, Th2 (°C)  | 0.58   | 0.76  | 0.84   | 21     | (86)   |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=   | Jan 0.83 interna 20.63 erature 20.5  | during heater for gair Feb 0.77 lt temperate 20.74 ct during heater 20.5   | ms for ling points for ling mar 0.67 ure in lagonary ating points 20.5   | Apr 0.53 iving are 20.96 eriods in 20.51  | the liv<br>a, h1,n<br>May<br>0.4<br>ea T1 (f<br>20.99<br>rest of<br>20.51  | ing (s   | Jun Jul  Jun Jul  Jun Jul  Jun  Jun  Jun  Jun  Jun  Jun  Jun   | 7 in 1 2 Table 2                                  | ug Sep<br>22 0.36<br>Table 9c)<br>1 21<br>9, Th2 (°C)  | 20.95  | 0.76  | 20.59  | 21     | (86)   |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=   | Jan 0.83 interna 20.63 erature 20.5  | during heater for gair Feb 0.77 It temperate 20.74 during heater 20.5 ctor for gair  | ms for ling points for ling mar 0.67 ure in lagonary ating points 20.5   | Apr 0.53 iving are 20.96 eriods in 20.51  | the liv<br>a, h1,n<br>May<br>0.4<br>ea T1 (f<br>20.99<br>rest of<br>20.51  | m (s<br>follo  | Dun Jul Dun Jul Dun Jul Dun Jul Dun Dun Jul Dun Dun Jul Dun Dun Jul Du | 7 in 1 2 Table 2                                  | ug Sep<br>22 0.36<br>Table 9c)<br>1 21<br>9, Th2 (°C)<br>51 20.51  | 20.95  | 0.76  | 20.59  | 21     | (86)   |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=   | Jan 0.83 interna 20.63 erature 20.5 tion fac   | during heater to for gair Feb 0.77 lt temperate 20.74 20.5 ctor for gair 0.75  | ns for line of | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw  | the liv<br>a, h1,n<br>May<br>0.4<br>ea T1 (f<br>20.99<br>rest of<br>20.51<br>velling,<br>0.38                      | m (s   | Dun Jul Dun Jul Dun Jul Dun  | 7 in 7 2 5able 9 20.                              | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51   | 0.58<br>20.95<br>20.51   | 20.79   | 20.59  | 21     | (86)<br>(87)<br>(88)                                 |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=   | Jan 0.83 interna 20.63 erature 20.5 tion fac   | during heater for gair Feb 0.77 lt temperate 20.74 ctor for gair 0.75 lt temperate 1.75 lt temperate 1 | ns for line of | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw  | the liv<br>a, h1,n<br>May<br>0.4<br>ea T1 (f<br>20.99<br>rest of<br>20.51<br>velling,<br>0.38                      | follo<br>follo<br>h2,  | Dun Jul Dun Jul Dun Jul Dun  | 7 in 7 2 5able 9 20.                              | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Table  | 0.58<br>20.95<br>20.51   | 0.76<br>20.79<br>20.51<br>0.74                  | 20.59  |        | (86)<br>(87)<br>(88)                                 |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean   | Jan 0.83 interna 20.63 erature 20.5 tion fac   | during heater for gair Feb 0.77 lt temperate 20.74 ctor for gair 0.75 lt temperate 1.75 lt temperate 1 | ns for line of the | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw 0.51 he rest of                                      | the liv a, h1,n May 0.4 ea T1 (f 20.99 rest of 20.51 velling, 0.38 of dwel   | follo<br>follo<br>h2,  | Dun Jul Dun Jul Dun Jul Dun  | A 0.2 7 in 7 2 Table 9 20. teps 3                 | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Table 51 20.51   | 0.58 20.95 20.51 0.56 e 9c) 20.45                                    | 0.76<br>20.79<br>20.51<br>0.74                  | 0.84<br>20.59<br>20.5<br>0.83                  | 21     | (86)<br>(87)<br>(88)<br>(89)                         |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean (90)m=                                    | Jan 0.83 interna 20.63 erature 20.5 tion fac 0.81 interna  | during heater to for gair Feb 0.77 lt temperate 20.74 20.5 etor for gair 0.75 lt temperate 20.16 20.16   | ns for line of | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw 0.51 he rest of 20.45                                | the liv<br>a, h1,n<br>May<br>0.4<br>a T1 (f<br>20.99<br>rest of<br>20.51<br>velling,<br>0.38<br>of dwel<br>20.5    | follo<br>h2,   | ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21 relling from T 0.51 20.51 m (see Table 0.26 0.18 T2 (follow steps)  | A 0.2 7 in 7 2 5able 9 20. e 9a) 0. teps 3        | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Table 51 20.51   | 0.58 20.95 20.51 0.56 e 9c) 20.45                                    | 0.76<br>20.79<br>20.51<br>0.74                  | 0.84<br>20.59<br>20.5<br>0.83                  |        | (86)<br>(87)<br>(88)<br>(89)                         |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean (90)m=                                    | Jan 0.83 interna 20.63 erature 20.5 tion fac 0.81 interna  | during heater to represent the during heater the dur | ns for line of | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw 0.51 he rest of 20.45                                | the liv<br>a, h1,n<br>May<br>0.4<br>a T1 (f<br>20.99<br>rest of<br>20.51<br>velling,<br>0.38<br>of dwel<br>20.5    | follo h2,  | Dun Jul Dun Jul Dun Jul Dun  | A 0.2 7 in 7 2 5able 9 20. e 9a) 0. teps 3        | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Table 51 20.51   | 0.58 20.95 20.51 0.56 e 9c) 20.45                                    | 0.76  20.79  20.51  0.74  20.24  ving area ÷ (- | 0.84<br>20.59<br>20.5<br>0.83                  |        | (86)<br>(87)<br>(88)<br>(89)                         |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean (90)m=  Mean (92)m=                       | Jan 0.83 interna 20.63 erature 20.5 tion fac 0.81 interna 20 interna 20                              | during heater tor for gair Feb 0.77 lt temperate 20.74 20.75 etor for gair 0.75 lt temperate 20.16 20.16 ctor for gair 20.16 c | ating pons for line Mar 0.67 ure in l 20.87 ating pons for r 0.66 ure in t 20.33 ure (for 20.64  | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw 0.51 he rest of 20.45 r the who 20.75                | the liv a, h1,n May 0.4 ta T1 (f 20.99 rest of 20.51 velling, 0.38 of dwel 20.5                                    | follo h2, h2, elling   | ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21 relling from T 0.51 20.51 m (see Table 0.26 0.18 T2 (follow steps) 0.51 20.51 g) = fLA × T2   | A 0.2 7 in 7 2 5able 9 20. 1 + (1 20.             | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Tabl 51 20.51  f  - fLA) × T2  8 20.79   | 0.58 20.95 20.51 0.56 e 9c) 20.45 LA = Liv                           | 0.76  20.79  20.51  0.74  20.24  ving area ÷ (  | 0.84<br>20.59<br>20.5<br>0.83<br>19.96<br>4) = |        | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91)         |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean (90)m=  Mean (92)m=                       | Jan 0.83 interna 20.63 erature 20.5 tion fac 0.81 interna 20 interna 20                              | during heater to the during he | ating pons for line Mar 0.67 ure in l 20.87 ating pons for r 0.66 ure in t 20.33 ure (for 20.64  | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw 0.51 he rest of 20.45 r the who 20.75                | the liv a, h1,n May 0.4 ta T1 (f 20.99 rest of 20.51 velling, 0.38 of dwel 20.5                                    | m (s follo follo h2, h2, c elling 2  | ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21 relling from T 0.51 20.51 m (see Table 0.26 0.18 T2 (follow steps 3) 0.51 20.51 g) = fLA × T 0.79 20.79   | A 0.2 7 in 7 2 5able 9 20. 1 + (1 20.             | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Tabl 51 20.51  - fLA) × T2  8 20.79  where approximates a second content of the cont | 0.58 20.95 20.51 0.56 e 9c) 20.45 LA = Liv                           | 0.76  20.79  20.51  0.74  20.24  ving area ÷ (  | 0.84<br>20.59<br>20.5<br>0.83<br>19.96<br>4) = |        | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91)         |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean (90)m=  Mean (92)m=  Apply (93)m=         | Jan 0.83 interna 20.63 erature 20.5 tion fac 0.81 interna 20 interna 20 adjustr 20.36                | during heater to the during he | ating pons for line at line pons for rouse in the line pons for rouse in th | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw 0.51 he rest of 20.45 r the who 20.75 internal       | the liv a, h1,n May 0.4 a T1 (f 20.99 rest of 20.51 velling, 0.38 of dwel 20.5                                     | m (s follo follo h2, h2, c elling 2  | ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21 relling from T 0.51 20.51 m (see Table 0.26 0.18 T2 (follow steps) 0.51 20.51 g) = fLA × T 0.79 20.79 ure from Table  | A 0.3 7 in 7 2 Table 9 20. teps 3 1 + (1 20 e 4e, | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Tabl 51 20.51  - fLA) × T2  8 20.79  where approximates a second content of the cont | 0.58  20.95  20.51  0.56 e 9c)  20.45 LA = Liv                       | 0.76  20.79  20.51  0.74  20.24  ving area ÷ (  | 0.84<br>20.59<br>20.5<br>0.83<br>19.96<br>4) = |        | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91)<br>(92) |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean (90)m=  Mean (92)m=  Apply (93)m=  8. Spa | Jan 0.83 interna 20.63 erature 20.5 tion fac 0.81 interna 20 interna 20 adjustr 20.36 ace hea        | during heactor for gair Feb 0.77 Il temperate 20.74 20.5 ctor for gair 0.75 Il temperate 20.16 20.49 20.49 ctor for gair 20.49 | mating points for limited and  | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw 0.51 he rest of 20.45 r the who 20.75 internal 20.75 | the liv a, h1,n May 0.4 ea T1 (f 20.99 rest of 20.51 velling, 0.38 of dwel 20.5 ble dwe 20.78 tempe 20.78          | ing (second second seco | ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21 relling from T 0.51 20.51 m (see Table 0.26 0.18 T2 (follow steps) 0.51 20.51 g) = fLA × T 0.79 20.79 ure from Table  | A 0.3 7 in 7 2 5able 9 20. 1 + (1 20 e 4e, 20     | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Tabl 51 20.51  - fLA) × T2  8 20.79  where approx 8 20.79  | 0.58  20.95  20.51  0.56 e 9c)  20.45 FLA = Livitation private 20.74 | 0.76  20.79  20.51  0.74  20.24  ving area ÷ (  | 0.84<br>20.59<br>20.5<br>0.83<br>19.96<br>4) = | 0.58   | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91)<br>(92) |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean (90)m=  Mean (92)m=  Apply (93)m=  8. Spa | Jan 0.83 interna 20.63 erature 20.5 tion fac 0.81 interna 20 interna 20 adjustr 20.36 ace hea to the | during heactor for gair Feb 0.77 Il temperate 20.74 20.5 ctor for gair 0.75 Il temperate 20.16 20.49 20.49 ctor for gair 20.49 | ating pons for line and line a | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw 0.51 he rest of 20.45 r the who 20.75 internal 20.75 | the liv a, h1,n May 0.4 ea T1 (f 20.99 rest of 20.51 velling, 0.38 of dwel 20.5  ble dwe 20.78 tempe 20.78 e obtai | ing (second second seco | ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21 relling from T 0.51 20.51 m (see Table 0.26 0.18 T2 (follow st 0.51 20.51 g) = fLA × T 0.79 20.79 re from Table 0.79 20.79  | A 0.3 7 in 7 2 5able 9 20. 1 + (1 20 e 4e, 20     | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Tabl 51 20.51  - fLA) × T2  8 20.79  where approx 8 20.79  | 0.58  20.95  20.51  0.56 e 9c)  20.45 FLA = Livitation private 20.74 | 0.76  20.79  20.51  0.74  20.24  ving area ÷ (  | 0.84<br>20.59<br>20.5<br>0.83<br>19.96<br>4) = | 0.58   | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91)<br>(92) |

Apr

May

Jun

Jul

Aug

Sep

Oct

Nov

Dec

Mar

Jan

Feb

| 1 14:11: |             |           | -:                          |           |                    |             |           |             |             |              |            |                           |           |               |
|----------|-------------|-----------|-----------------------------|-----------|--------------------|-------------|-----------|-------------|-------------|--------------|------------|---------------------------|-----------|---------------|
| (94)m=   | 0.81        | 0.75      | ains, hm<br><sub>0.66</sub> | 0.52      | 0.39               | 0.27        | 0.19      | 0.21        | 0.35        | 0.57         | 0.74       | 0.83                      |           | (94)          |
|          |             |           | W = (94)                    |           |                    | 0.21        | 0.13      | 0.21        | 0.00        | 0.07         | 0.74       | 0.00                      |           | (0.)          |
| (95)m=   | 540.92      | 553.11    | 531.08                      | 461.17    | 359.97             | 244.46      | 165.79    | 173.3       | 264.26      | 389.56       | 477.82     | 529.03                    |           | (95)          |
| Month    | nly avera   | age exte  | rnal tem                    | perature  | from Ta            | able 8      |           |             | ļ.          |              | ļ.         |                           |           |               |
| (96)m=   | 4.3         | 4.9       | 6.5                         | 8.9       | 11.7               | 14.6        | 16.6      | 16.4        | 14.1        | 10.6         | 7.1        | 4.2                       |           | (96)          |
| Heat     | loss rate   | for mea   | an intern                   | al tempe  | erature,           | Lm , W =    | =[(39)m : | x [(93)m    | – (96)m     | ]            |            |                           |           |               |
| (97)m=   | 653.04      | 632.59    | 572.42                      | 474.44    | 362.99             | 244.88      | 165.86    | 173.4       | 265.64      | 405.16       | 540.27     | 650.13                    |           | (97)          |
| -        |             |           | ement fo                    |           |                    |             |           |             |             | <del></del>  | r          |                           |           |               |
| (98)m=   | 83.42       | 53.41     | 30.76                       | 9.56      | 2.25               | 0           | 0         | 0           | 0           | 11.6         | 44.97      | 90.1                      |           | 7,000         |
| _        |             |           |                             |           |                    |             |           | lota        | ıl per year | (kvvn/year   | r) = Sum(9 | 18) <sub>15,912</sub> = [ | 326.06    | <u> </u> (98) |
| Space    | e heating   | g require | ement in                    | kWh/m²    | <sup>2</sup> /year |             |           |             |             |              |            |                           | 4.2       | (99)          |
|          |             |           | nts – Cor                   |           |                    |             |           |             |             |              |            |                           |           |               |
|          |             |           | ace hea<br>from se          |           |                    |             |           |             |             |              | unity sch  | neme.<br>I                | 0         | (301)         |
|          |             |           |                             | •         | • •                | ,           |           | (Table I    | 1) 0 11 11  | OHE          |            | [<br>                     |           |               |
|          | •           |           | from co                     | •         | •                  | ,           | •         |             |             |              |            |                           | 1         | (302)         |
|          |             |           | y obtain he<br>s, geotherr  |           |                    |             |           |             |             | up to four ( | other heat | sources; th               | he latter |               |
|          |             |           | ommun                       |           |                    | om power    | otations. | occ / ippol | idix o.     |              |            |                           | 1         | (303a)        |
| Fractio  | n of tota   | l space   | heat fro                    | m Comn    | nunity bo          | oilers      |           |             |             | (3           | 02) x (303 | a) =                      | 1         | ]<br>(304a)   |
|          |             |           | charging                    |           |                    |             | r commu   | unity hea   | ating sys   |              | , ,        |                           | 1         | ]<br>(305)    |
| Distrib  | ution los   | s factor  | (Table 1                    | 2c) for o | commun             | itv heatir  | na svste  | m           |             |              |            | [                         | 1.07      | ]<br>(306)    |
|          | heating     |           |                             |           |                    |             |           |             |             |              |            | l                         | kWh/year  | ]             |
| -        |             |           | requiren                    | nent      |                    |             |           |             |             |              |            | [                         | 326.06    |               |
| Space    | heat fro    | m Comr    | munity b                    | oilers    |                    |             |           |             | (98) x (30  | 04a) x (30   | 5) x (306) | = [                       | 348.88    | (307a)        |
| Efficier | ncy of se   | econdary  | y/supple                    | mentary   | heating            | system      | in % (fro | m Table     | 4a or A     | ppendix      | E)         |                           | 0         | (308          |
| Space    | heating     | require   | ment fro                    | m secon   | dary/sup           | plemen      | tary syst | tem         | (98) x (30  | 01) x 100 -  | ÷ (308) =  |                           | 0         | (309)         |
| Water    | heating     |           |                             |           |                    |             |           |             |             |              |            | _                         |           | _             |
| Annua    | l water h   | eating r  | equirem                     | ent       |                    |             |           |             |             |              |            |                           | 2091.65   |               |
|          |             |           | ty schem<br>nunity bo       |           |                    |             |           |             | (64) x (30  | 03a) x (30   | 5) x (306) | = [                       | 2238.07   | (310a)        |
| Electric | city used   | for hea   | ıt distribu                 | ution     |                    |             |           | 0.01        | × [(307a)   | (307e) +     | · (310a)   | (310e)] =                 | 25.87     | (313)         |
| Cooling  | g Syster    | n Energ   | y Efficie                   | ncy Ratio | 0                  |             |           |             |             |              |            | Ï                         | 0         | (314)         |
| Space    | cooling     | (if there | is a fixe                   | d cooling | g system           | n, if not e | enter 0)  |             | = (107) ÷   | (314) =      |            | ĺ                         | 0         | (315)         |
|          |             |           | nd fans v<br>- baland       |           |                    |             |           | outside     |             |              |            | ,<br>[                    | 250.5     | (330a)        |
|          | air heatir  |           |                             |           | •                  | ·           |           |             |             |              |            | [                         | 0         | (330b)        |
| pump f   | for solar   | water h   | eating                      |           |                    |             |           |             |             |              |            | [                         | 0         | (330g)        |
| Total e  | electricity | for the   | above, k                    | kWh/yea   | r                  |             |           |             | =(330a) ·   | + (330b) +   | (330g) =   | [                         | 250.5     | (331)         |
|          | -           |           |                             |           |                    |             |           |             |             |              |            | L                         |           | J             |

| Energy for lighting (calculated in Append                                  | ix L)                            |                                     | 342.54 (3  |
|--|----------------------------------|-------------------------------------|--|
| 10b. Fuel costs – Community heating so                                     | cheme                            |                                     |  |
|  | <b>Fuel</b><br>kWh/year          | Fuel Price<br>(Table 12)            | Fuel Cost<br>£/year                                  |
| Space heating from CHP   | (307a) x                         | 4.24 x 0.                           | 01 = 14.79 (3-                                       |
| Water heating from CHP   | (310a) x                         | 4.24 x 0.                           | 01 = 94.89 (3-                                       |
| Pumps and fans   | (331)                            | Fuel Price  13.19 × 0.              | 01 = 33.04 (3-                                       |
| Energy for lighting  | (332)                            | 13.19 x 0.                          | 01 = 45.18 (3  |
| Additional standing charges (Table 12)                                     |                                  |                                     | 120 (3   |
| Total energy cost  | = (340a)(342e) + (345)(354) =    |                                     | 307.91 (3  |
| 11b. SAP rating - Community heating so                                     | cheme                            |                                     |  |
| Energy cost deflator (Table 12)  |                                  |                                     | 0.42   |
| Energy cost factor (ECF)   | [(355) x (356)] ÷ [(4) + 45.0] = |                                     | 1.05   |
| SAP rating (section12)   |                                  |                                     | 85.29 (3   |
| CO2 from other sources of space and wa<br>Efficiency of heat source 1 (%)  | If there is CHP using two fuels  | repeat (363) to (366) for the secon | nd fuel 92 (3  |
| CO2 associated with heat source 1  Electrical energy for heat distribution | [(307b)+(310b)] x 1<br>[(313) x  | 00 ÷ (367b) x 0.22                  | = 607.37 (3 <sup>1</sup> ) = 13.43 (3 <sup>1</sup> ) |
| Total CO2 associated with community sy                                     |                                  | 6) + (368)(372)                     | = 620.8 (3   |
| CO2 associated with space heating (second                                  |                                  | 0                                   | = 0 (3   |
| CO2 associated with water from immersion                                   | on heater or instantaneous hea   | ter (312) x 0.22                    | = 0 (3   |
| Total CO2 associated with space and wa                                     | ter heating (373) + (37          | 74) + (375) =                       | 620.8  |
| CO2 associated with electricity for pumps                                  | s and fans within dwelling (331) | 0.52                                | = 130.01 (3  |
| CO2 associated with electricity for lighting                               | g (332))) x                      | 0.52                                | = 177.78 (3  |
| Total OOL, Ng/year   | sum of (376)(382) =              |                                     | 928.59 (3  |
| Dwelling OOZ Ellission Rate  | (383) ÷ (4) =                    |                                     | 11.97  |
| El rating (section 14)   |                                  |                                     | 89.85  |
| 13b. Primary Energy – Community heatir                                     | Ene                              | rgy Primary<br>n/year factor        | P.Energy<br>kWh/year                                 |
| Energy from other sources of space and Efficiency of heat source 1 (%)     |                                  | repeat (363) to (366) for the secon | nd fuel  |
| Energy associated with heat source 1                                       | [(307b)+(310b)] x 1              | . , , , ,                           | 1  |
| Electrical energy for heat distribution                                    |                                  | 00 ÷ (367b) x 1.22                  |  |
| Licotrical cricity for fieat distribution                                  | [(313) x                         |                                     | =   79.42   (3°                                      |

| Total Energy associated with community systems                  | (363)(366) + (368)(372)  |      | = | 3509.94 | (373) |
|---|--------------------------|------|---|---------|-------|
| if it is negative set (373) to zero (unless specified otherwise | e, see C7 in Appendix C) |      |   | 3509.94 | (373) |
| Energy associated with space heating (secondary)                | (309) x                  | 0    | = | 0       | (374) |
| Energy associated with water from immersion heater or instal    | ntaneous heater(312) x   | 1.22 | = | 0       | (375) |
| Total Energy associated with space and water heating            | (373) + (374) + (375) =  |      |   | 3509.94 | (376) |
| Energy associated with space cooling                            | (315) x                  | 3.07 | = | 0       | (377) |
| Energy associated with electricity for pumps and fans within o  | lwelling (331)) x        | 3.07 | = | 769.04  | (378) |
| Energy associated with electricity for lighting                 | (332))) x                | 3.07 | = | 1051.61 | (379) |
| Total Primary Energy, kWh/year sum of (376                      | 5)(382) =                |      |   | 5330.59 | (383) |



|  |                                |   | User E           | Details: _               |              |              |          |           |                       |          |
|--|--------------------------------|---|------------------|--------------------------|--------------|--------------|----------|-----------|-----------------------|----------|
| Assessor Name:<br>Software Name:   | Stroma FSAP 2                  |   | le o o o o o o o | Strom                    | are Ve       | rsion:       |          | Versio    | on: 1.0.4.18          |          |
| Address :  | Block I, Agar Gro              |   |                  | Address:<br>lon, NW1     |              | n            |          |           |                       |          |
| 1. Overall dwelling dime   | ensions:                       |   |                  |                          |              |              |          |           |                       |          |
|  |                                |   | Are              | a(m²)                    | ī            | Av. He       | ight(m)  | 7         | Volume(m <sup>3</sup> | <u>^</u> |
| Ground floor   |                                |   |                  | 77.6                     | (1a) x       | 3            | .15      | (2a) =    | 244.44                | (3a)     |
| Total floor area TFA = (1  | a)+(1b)+(1c)+(1d)+             | (1e)+(1r                                      | n)               | 77.6                     | (4)          |              |          |           |                       |          |
| Dwelling volume  |                                |   |                  |                          | (3a)+(3b     | )+(3c)+(3c   | d)+(3e)+ | .(3n) =   | 244.44                | (5)      |
| 2. Ventilation rate:   |                                |   |                  |                          |              |              |          |           |                       |          |
|  | main<br>heating                | secondar<br>heating                           | ·у<br>           | other                    | _            | total        |          |           | m³ per hou            | ır<br>   |
| 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 fa  | ins                            |   |                  |                          |              | 0            | Χ.       | 10 =      | 0                     | (7a)     |
| Number of passive vents  | <b>;</b>                       |   |                  |                          |              | 0            | χ.       | 10 =      | 0                     | (7b)     |
| Number of flueless gas fi  | ires                           |   |                  |                          | Ī            | 0            | X 4      | 40 =      | 0                     | (7c)     |
|  |                                |   |                  |                          |              |              |          | Air ch    | nanges per ho         | our      |
| Infiltration due to chimne   | vs. flues and fans =           | (6a)+(6b)+(7                                  | 7a)+(7b)+(       | (7c) =                   | Г            | 0            |          | ÷ (5) =   | 0                     | (8)      |
| If a pressurisation test has b   |                                |   |                  |                          | continue fi  |              |          | . (0)     | 0                     | (0)      |
| Number of storeys in the   | he dw <mark>elling</mark> (ns) |   |                  |                          |              |              |          |           | 0                     | (9)      |
| Additional infiltration  |                                |   |                  |                          |              |              | [(9)     | -1]x0.1 = | 0                     | (10)     |
| Structural infiltration: 0  if both types of wall are p.   |                                |   |                  |                          | •            | ruction      |          |           | 0                     | (11)     |
| deducting areas of openii  |                                | rresponding to                                | ine grea         | lei wali are             | a (anter     |              |          |           |                       |          |
| If suspended wooden f  | ,                              | ,   | .1 (seale        | ed), else                | enter 0      |              |          |           | 0                     | (12)     |
| If no draught lobby, en  |                                |   |                  |                          |              |              |          |           | 0                     | (13)     |
| Percentage of windows Window infiltration  | s and doors draugh             | t stripped                                    |                  | 0.25 - [0.2              | ) v (14) ± 1 | 1001 -       |          |           | 0                     | (14)     |
| Infiltration rate  |                                |   |                  |                          | . ,          | 12) + (13) · | + (15) = |           | 0                     | (15)     |
| Air permeability value,  | a50. expressed in              | cubic metre                                   | s per ho         |                          |              |              |          | area      | 1                     | (17)     |
| If based on air permeabil  | •                              |   | •                | •                        | •            |              | •        |           | 0.05                  | (18)     |
| Air permeability value applie  | es if a pressurisation test    | has been dor                                  | ne or a de       | gree air pe              | rmeability   | is being u   | sed      |           |                       | _        |
| Number of sides sheltere   | ed                             |   |                  | (20) = 1 -               | [0 075 v /   | 10\1         |          |           | 2                     | (19)     |
| Shelter factor Infiltration rate incorporat  | ting chalter factor            |   |                  | (20) = 12<br>(21) = (18) | `            | 19)] =       |          |           | 0.85                  | (20)     |
| Infiltration rate modified f   |                                | aad   |                  | (21) = (10)              | ) X (20) =   |              |          |           | 0.04                  | (21)     |
| Jan Feb  | Mar Apr Ma                     |   | Jul              | Aug                      | Sep          | Oct          | Nov      | Dec       | ]                     |          |
| Monthly average wind sp  | 1 1                            | <u>.,                                    </u> | <u> </u>         | 7 7 10 9                 | 000          |              | 1.101    |           | l                     |          |
| (22)m= 5.1 5   | 4.9 4.4 4.3                    | 3.8   | 3.8              | 3.7                      | 4            | 4.3          | 4.5      | 4.7       | ]                     |          |
|  |                                |   |                  | •                        | 1            |              | •        | 1         | 1                     |          |
| Wind Factor $(22a)m = (22a)m $ | <del>'</del>                   | 0   0 ==                                      |                  | 1 000                    |              | 4.00         |          |           | 1                     |          |
| (22a)m= 1.27 1.25  | 1.23 1.1 1.08                  | 8 0.95  | 0.95             | 0.92                     | 1            | 1.08         | 1.12     | 1.18      | ]                     |          |

| Calculate offer  | 0.05   | 0.05   | 0.05   | 0.05                                       | 0.04                     | 0.04  | 0.04                  | 0.04   | 0.05  | 0.05   | 0.05               | ]             |               |
|--|--|--|--|--|--------------------------|---|-----------------------|--|---|--|--------------------|---------------|---------------|
|  |  | change i   | rate for t   | he appli                                   | cable ca                 | se  | ı                     |  | l   | ı  |                    |               |               |
| If mechanica   |  |  | on div. N. (O  | ah) (aa-                                   | · \                      | (N  | 15\\ atlaa            |  | ) (00-)   |  |                    | 0.5           | (2:           |
| If exhaust air h   |  | 0 11   |  | , ,  | ,                        | . ,   | ,, .                  | ,  | ) = (23a)   |  |                    | 0.5           | (2:           |
| If balanced with   |  | •  |  | _  |                          |   |                       |  |   |  |                    | 76.5          | (2:           |
| a) If balance  |  |  |  |  |                          | <del>- `                                     </del> | <del>- ` ` - </del>   | <del>``</del>  | <del> </del>  | <del>-                                    </del>       | <del>- ` ` `</del> | ) ÷ 100]<br>1 | (2)           |
| 24a)m= 0.17  | 0.17   | 0.17   | 0.16   | 0.16                                       | 0.16                     | 0.16  | 0.16                  | 0.16   | 0.16  | 0.17   | 0.17               |               | (2            |
| b) If balance  | ı  |  |  |  | ı —                      | <del></del>   | <del>- ^ ` ` - </del> | ŕ  | <del>r ´       `</del>                                  | <u> </u>   | Ι ,                | 1             | (2            |
| 24b)m= 0   | 0  | 0  | 0  | 0  |                          | 0   | 0                     | 0  | 0   | 0  | 0                  |               | (2            |
| c) If whole h  |  | tract ven<br>‹ (23b), t  |  |  | •                        |   |                       |  | 5 v (22k  | <b>,</b> )   |                    |               |               |
| 24c)m= 0   | 0.5 7  | 0  | 0  | 0 = (230)                                  | 0                        | 0   | $C_{i} = (221)$       | 0  | 0   | 0  | 0                  | 1             | (2            |
| d) If natural  |  |  |  |  | <u> </u>                 |   |                       |  |   |  |                    | J             | (-            |
| ,  |  | en (24d)   |  |  | •                        |   |                       |  | 0.5]  |  |                    |               |               |
| 24d)m= 0   | 0  | 0  | 0  | 0  | 0                        | 0   | 0                     | 0  | 0   | 0  | 0                  | ]             | (2            |
| Effective air  | change   | rate - er  | iter (24a  | or (24k                                    | o) or (24                | c) or (24   | d) in box             | (25)   |   |  |                    |               |               |
| 25)m= 0.17   | 0.17   | 0.17   | 0.16   | 0.16                                       | 0.16                     | 0.16  | 0.16                  | 0.16   | 0.16  | 0.17   | 0.17               |               | (2            |
|  |  |  |  |  |                          |   |                       | L  |   |  |                    |               |               |
| 3. Heat losse  |  |  |  |  | N . A                    |   |                       |  | A >< 1.1  |  |                    | _             | A 37 I        |
| LEMENT   | Gros<br>area   |  | Openin<br>m  |  | Net Ar<br>A ,r           |   | U-valı<br>W/m2        |  | A X U<br>(W/  | K)   | k-value<br>kJ/m²-l |               | A X k<br>kJ/K |
| Vindows Type   |  | ,  |  |  | 5.6                      |   | [1/( 0.85 )-          |  | 4.6   |  |                    |               | (2            |
| Vin <mark>dows</mark> Type   |  |  |  |  | 11.1                     | _   | -<br>[1/( 0.85 )-     | , i  | 9.12  | Ħ  |                    |               | (2            |
| Valls Type1  | 38.4   |  | 11.1   |  | 27.3                     | X   | 0.2                   |  | 5.46  | Ħ r  |                    |               | (2            |
| Valls Type2  |  | =  | _  | = \  |                          |   |                       | 4  |   | 븍 ¦  |                    | ╡╞            | =             |
|  | 8.5  |  | 5.6  |  | 2.9                      | ×   | 0.2                   | = [  | 0.58  |  |                    |               | (2            |
| otal area of e   |  |  | .ffootivo wi   | ndow II v                                  | 46.9                     | otod vojna  | formula 1             | /[/1/  L.volu  | (0) ( 0 (04) (  | no airen in  | norograni          | 5.2.2         | (3            |
| ior wiridows and<br>include the area   |  |  |  |  |                          | ateu using  | i iorriiula T         | /[(  | ie)+0.04j a   | is giveri iri  | грагаугарг         | 1 3.2         |               |
| and the second   | s, W/K   | = S (A x   | U)   |  |                          |   | (26)(30)              | + (32) =   |   |  |                    | 19.77         | (3            |
| apric heat los   | Cm - S/  | (  |  |  |                          |   | ()()                  |  |   |  |                    |               | 1,5           |
|  | Ciii = 3   | AXK)   |  |  |                          |   | (==):::(==)           |  | (30) + (32  | 2) + (32a).  | (32e) =            | 513.4         |               |
| abric heat los<br>leat capacity<br>hermal mass   |  | ,  | P = Cm ÷   | - TFA) ir                                  | n kJ/m²K                 |   | (==)(==)              | ((28)  | (30) + (32<br>tive Value                                | , , ,  | (32e) =            | 513.4<br>100  | (3            |
| leat capacity<br>hermal mass   | parame   | ter (TMF   |  | •  |                          |   |                       | ((28)<br>Indica  | tive Value  | : Low  | ` ,                |               | (3            |
| leat capacity<br>hermal mass<br>or design assess<br>an be used inste   | parame<br>sments wh<br>ad of a de  | eter (TMF<br>ere the de<br>tailed calcu  | tails of the<br>ulation.   | construct                                  | ion are no               | t known pr  |                       | ((28)<br>Indica  | tive Value  | : Low  | ` ,                |               | (3            |
| leat capacity hermal mass or design assess an be used inste hermal bridge  | parame<br>sments wh<br>ad of a de<br>es: S (L  | eter (TMF<br>ere the de<br>tailed calcu<br>x Y) cal  | tails of the<br>ulation.<br>culated u                            | construct                                  | ion are not<br>opendix l | t known pr  |                       | ((28)<br>Indica  | tive Value  | : Low  | ` ,                |               | (3            |
| leat capacity hermal mass for design assess an be used inste hermal bridge details of therma   | parame<br>sments wh<br>ad of a de<br>es: S (L<br>al bridging                                   | eter (TMF<br>ere the de<br>tailed calcu<br>x Y) cal  | tails of the<br>ulation.<br>culated u                            | construct                                  | ion are not<br>opendix l | t known pr  |                       | ((28)<br>Indica  | tive Value  | : Low  | ` ,                | 7.04          | (3)           |
| leat capacity Thermal mass or design assess an be used inste Thermal bridge details of thermal Total fabric he   | parame<br>sments wh<br>ad of a de<br>es:S(L<br>al bridging<br>at loss                          | eter (TMF<br>ere the de<br>tailed calcu<br>x Y) calcu<br>are not kn                            | tails of the<br>ulation.<br>culated u<br>own (36) =              | constructusing Ap                          | ion are not<br>opendix l | t known pr  |                       | ((28)<br>Indica<br>e indicative                            | tive Value e values of (36) =                           | : Low<br>TMP in T                                      | able 1f            | 100           | (3)           |
| leat capacity hermal mass or design assess an be used inste hermal bridge details of therma fotal fabric he entilation hea   | parame<br>sments wh<br>ad of a de<br>es: S (L<br>al bridging<br>at loss<br>at loss ca          | ere the de<br>tailed calcu<br>x Y) calcu<br>are not kn   | tails of the<br>ulation.<br>culated u<br>own (36) =              | constructusing Ap                          | ppendix I                | t known pr  | ecisely the           | ((28)<br>Indica<br>e indicative<br>(33) +<br>(38)m         | tive Values of values of (36) = = 0.33 × (              | : Low<br>: TMP in T                                    | able 1f            | 7.04          | (3)           |
| eat capacity hermal mass or design assess an be used inste hermal bridge details of therma otal fabric he entilation hea   | parame<br>sments wh<br>ad of a de<br>es: S (L<br>al bridging<br>at loss<br>at loss ca          | ere the de<br>tailed calcu<br>x Y) calcu<br>are not kn   | tails of the<br>ulation.<br>culated u<br>own (36) =<br>I monthly | construct using Ap = 0.05 x (3             | ppendix I                | t known pr  | ecisely the           | ((28) Indica e indicative (33) + (38)m                     | (36) =<br>= 0.33 × (                                    | : Low<br>: TMP in T<br>25)m x (5                       | able 1f            | 7.04          | (3            |
| eat capacity hermal mass or design assess an be used inste hermal bridge details of therma otal fabric he entilation hea  Jan 13.85  | parame sments wh ad of a de es: S (L al bridging at loss at loss ca Feb 13.76                  | eter (TMF ere the de tailed calcu x Y) calc are not kn alculated Mar 13.68                     | tails of the<br>ulation.<br>culated u<br>own (36) =              | constructusing Ap                          | ppendix I                | t known pr  | ecisely the           | ((28) Indica e indicative (33) + (38)m Sep 12.91           | (36) =<br>= 0.33 × (<br>Oct                             | 25)m x (5<br>Nov<br>13.33                              | able 1f            | 7.04          | (3            |
| hermal mass or design assess an be used inste hermal bridge details of therma otal fabric hermal trillation head assume transfer of the transf | parame sments wh ad of a de es: S (L al bridging at loss at loss ca Feb 13.76                  | ter (TMF<br>ere the de<br>tailed calcu<br>x Y) calc<br>are not kn<br>alculated<br>Mar<br>13.68 | tails of the ulation. culated to own (36) = I monthly Apr 13.25  | construct using Ap = 0.05 x (3 / May 13.16 | ppendix I  Jun  12.74    | Jul   | Aug                   | ((28) Indica indicative (33) + (38)m Sep 12.91 (39)m       | (36) =<br>= 0.33 × (<br>Oct<br>13.16<br>= (37) + (      | 25)m x (5<br>Nov<br>13.33                              | Dec 13.51          | 7.04          | (3            |
| eat capacity hermal mass or design assess an be used inste hermal bridge details of therma otal fabric he entilation hea  Jan 13.85 eat transfer of  | parame sments wh ad of a de es: S (L al bridging at loss at loss ca Feb 13.76                  | eter (TMF ere the de tailed calcu x Y) calc are not kn alculated Mar 13.68                     | tails of the<br>ulation.<br>culated u<br>own (36) =<br>I monthly | construct using Ap = 0.05 x (3             | ppendix I                | t known pr  | ecisely the           | ((28) Indica indicative (33) + (38)m Sep 12.91 (39)m 39.71 | (36) = = 0.33 × ( Oct 13.16 = (37) + ( 39.97            | 25)m x (5<br>Nov<br>13.33<br>38)m<br>40.14             | Dec 13.51          | 7.04          | (3            |
| hermal mass or design assess an be used inste hermal bridge details of thermal otal fabric hermal and instentiation head and instentiatio | parame sments wh ad of a de es: S (L al bridging at loss at loss ca Feb 13.76 coefficien 40.57 | ere the de tailed calculated are not kn alculated Mar 13.68  nt, W/K 40.48                     | tails of the ulation. culated to own (36) = I monthly Apr 13.25  | construct using Ap = 0.05 x (3 / May 13.16 | ppendix I  Jun  12.74    | Jul   | Aug                   | ((28) Indica indicative (33) + (38)m Sep 12.91 (39)m 39.71 | (36) = = 0.33 × ( Oct 13.16 = (37) + ( 39.97  Average = | 25)m x (5<br>Nov<br>13.33<br>38)m<br>40.14<br>Sum(39); | Dec 13.51          | 7.04          | (3            |
| leat capacity Thermal mass For design assess In be used inste Thermal bridge details of thermal Total fabric he Tentilation hea  38)m= 13.85  Ideat transfer of  | parame sments wh ad of a de es: S (L al bridging at loss at loss ca Feb 13.76 coefficien 40.57 | ere the de tailed calculated are not kn alculated Mar 13.68  nt, W/K 40.48                     | tails of the ulation. culated to own (36) = I monthly Apr 13.25  | construct using Ap = 0.05 x (3 / May 13.16 | ppendix I  Jun  12.74    | Jul   | Aug                   | ((28) Indica indicative (33) + (38)m Sep 12.91 (39)m 39.71 | (36) = = 0.33 × ( Oct 13.16 = (37) + ( 39.97            | 25)m x (5<br>Nov<br>13.33<br>38)m<br>40.14<br>Sum(39); | Dec 13.51          | 7.04          | (3)           |

Number of days in month (Table 1a)

| Numbe                                   | er or day              | s in mor                 | ıın (Tab                | ie ra)                    |                | 1          | 1          | ,                      |                    | 1           |                        |          | 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 \\/\                                  | tor boot               | ing oner                 | av roqui                | romont:                   |                |            |            |                        |                    |             |                        | kWh/ye   | oor:    |            |
| 4. ۷۷                                   | ilei neai              | ing ener                 | gy requi                | rement.                   |                |            |            |                        |                    |             |                        | KVVII/yt | sai.    |            |
| Assum                                   | ed occu                | pancy, I                 | N                       |                           |                |            |            |                        |                    |             | 2.                     | 42       |         | (42)       |
|   |                        |                          | + 1.76 x                | [1 - exp                  | (-0.0003       | 849 x (TF  | FA -13.9   | )2)] + 0.0             | 0013 x (           | TFA -13.    | .9)                    |          |         |            |
|   | A £ 13.9               | -                        |                         |                           |                |            |            | (O.5. N.I)             | 00                 |             |                        |          | •       |            |
|   |                        |                          |                         |                           |                |            |            | (25 x N)<br>to achieve | + 36<br>a water us | se target o |                        | .57      |         | (43)       |
|   |                        | _                        | person per              |                           |                | _          | -          |                        |                    | J           |                        |          |         |            |
|   | Jan                    | Feb                      | Mar                     | Apr                       | May            | Jun        | Jul        | Aug                    | Sep                | Oct         | Nov                    | Dec      |         |            |
| Hot wate                                |                        |                          | day for ea              |                           |                | l .        |            |                        | Гоор               | 1 001       | 1101                   | 200      |         |            |
| (44)m=                                  | 100.73                 | 97.07                    | 93.41                   | 89.74                     | 86.08          | 82.42      | 82.42      | 86.08                  | 89.74              | 93.41       | 97.07                  | 100.73   |         |            |
| (11)                                    | 100.70                 | 07.07                    | 00.11                   | 00.7 1                    | 00.00          | 02.12      | 02.12      | 00.00                  |                    |             | m(44) <sub>112</sub> = |          | 1098.89 | (44)       |
| Energy o                                | content of             | hot water                | used - cal              | culated mo                | onthly $= 4$ . | 190 x Vd,r | n x nm x E | OTm / 3600             |                    |             | ables 1b, 1            |          | 1000.00 |            |
| (45)m=                                  | 149.38                 | 130.65                   | 134.82                  | 117.54                    | 112.78         | 97.32      | 90.18      | 103.49                 | 104.72             | 122.04      | 133.22                 | 144.67   |         |            |
|   |                        |                          |                         |                           |                |            |            |                        |                    |             | m(45) <sub>112</sub> = |          | 1440.81 | (45)       |
| If inst <mark>ant</mark>                | taneous w              | ater heatin              | ng at point             | of use (no                | hot water      | storage),  | enter 0 in | boxes (46              |                    |             | ( )2                   |          |         |            |
| (46)m=                                  | 22.41                  | 19.6                     | 20.22                   | 17.63                     | 16.92          | 14.6       | 13.53      | 15.52                  | 15.71              | 18.31       | 19.98                  | 21.7     |         | (46)       |
|   | storage                | loss:                    |                         |                           |                |            |            |                        |                    |             |                        |          |         |            |
| Storag                                  | <mark>e v</mark> olum  | e (litre <mark>s)</mark> | inc <mark>ludir</mark>  | ng any so                 | olar or W      | WHRS       | storage    | within sa              | ame ves            | sel         |                        | 0        |         | (47)       |
| If co <mark>m</mark> r                  | <mark>mu</mark> nity h | eating a                 | nd no ta                | nk in dw                  | elling, e      | nter 110   | litres in  | (47)                   |                    |             |                        |          |         |            |
| Otherw                                  | vise if no             | stored                   | hot wate                | er (th <mark>is in</mark> | ıcludes i      | nstantar   | neous co   | mbi boil               | ers) ente          | er '0' in ( | <b>4</b> 7)            |          |         |            |
|   | storage                |                          |                         |                           |                |            |            |                        |                    |             |                        |          |         |            |
| a) If m                                 | anufact                | urer's de                | eclared l               | oss facto                 | or is kno      | wn (kWl    | n/day):    |                        |                    |             |                        | 0        |         | (48)       |
| Tempe                                   | rature fa              | actor fro                | m Table                 | 2b                        |                |            |            |                        |                    |             |                        | 0        |         | (49)       |
| • |                        |                          | storage                 | -                         |                |            |            | (48) x (49)            | ) =                |             | 1                      | 10       |         | (50)       |
|   |                        |                          | eclared o               |                           |                |            |            |                        |                    |             |                        |          | -<br>I  |            |
|   |                        |                          | factor fr<br>ee section |                           | e∠(KVV         | n/litre/da | iy)        |                        |                    |             | 0.                     | 02       |         | (51)       |
|   | e factor               | _                        |                         | 011 4.3                   |                |            |            |                        |                    |             |                        | 03       | l       | (52)       |
|   |                        |                          | m Table                 | 2b                        |                |            |            |                        |                    |             | -                      | .6       |         | (53)       |
| •                                       |                        |                          | storage                 |                           | ar             |            |            | (47) x (51)            | ) x (52) x (       | 53) =       |                        | 03       |         | (54)       |
|   | (50) or (              |                          | _                       | , 100 viii, y 0           | Jui            |            |            | (11)11(01)             | ,                  |             | -                      | 03       |         | (55)       |
|   | ` , , ,                | , ,                      | culated f               | or each                   | month          |            |            | ((56)m = (             | 55) × (41)ı        | m           |                        | 00       |         | ()         |
| (56)m=                                  | 32.01                  | 28.92                    | 32.01                   | 30.98                     | 32.01          | 30.98      | 32.01      | 32.01                  | 30.98              | 32.01       | 30.98                  | 32.01    |         | (56)       |
| , ,                                     |                        |                          |                         |                           |                |            |            |                        |                    |             | H11) is fro            |          | liv H   | (30)       |
| -                                       | ı                      |                          |                         |                           |                | 1          |            |                        |                    |             |                        |          | I       | <b>,</b> \ |
| (57)m=                                  | 32.01                  | 28.92                    | 32.01                   | 30.98                     | 32.01          | 30.98      | 32.01      | 32.01                  | 30.98              | 32.01       | 30.98                  | 32.01    |         | (57)       |
| Primar                                  | y circuit              | loss (an                 | nual) fro               | m Table                   | 3              |            |            |                        |                    |             |                        | 0        |         | (58)       |
| Primar                                  | y circuit              | loss cal                 | culated t               | for each                  | month (        | 59)m = (   | (58) ÷ 36  | 65 × (41)              | m                  |             |                        |          |         |            |
| (mod                                    | dified by              | factor fr                | om Tab                  | le H5 if t                | here is s      | solar wat  | ter heati  | ng and a               | cylinde            | r thermo    | stat)                  |          | •       |            |
| (59)m=                                  | 23.26                  | 21.01                    | 23.26                   | 22.51                     | 23.26          | 22.51      | 23.26      | 23.26                  | 22.51              | 23.26       | 22.51                  | 23.26    |         | (59)       |
| Combi                                   | loss cal               | culated                  | for each                | month (                   | (61)m =        | (60) ÷ 36  | 65 × (41   | )m                     |                    |             |                        |          |         |            |
| (61)m=                                  | 0                      | 0                        | 0                       | 0                         | 0              | 0          | 0          | 0                      | 0                  | 0           | 0                      | 0        |         | (61)       |
|   |                        |                          |                         |                           |                | •          | •          |                        | •                  | •           | •                      |          |         |            |

| Total heat re                  | quired for   | water h    | eating ca      | alculated  | for        | each month       | (62)        | m = (          | 0.85 × (4  | 45)m +       | (46)m +            | (57)m +     | (59)m + (61)m |                            |
|--------------------------------|--------------|------------|----------------|------------|------------|------------------|-------------|----------------|--|--------------|--------------------|-------------|---------------|----------------------------|
| (62)m= 204.66                  | <del>`</del> | 190.1      | 171.03         | 168.06     |            | 0.82 145.46      | 158         |                | 158.22   | 177.32       | 186.71             | 199.94      |               | (62)                       |
| Solar DHW inpu                 | t calculated | using App  | endix G o      | · Appendix | H (n       | egative quantity | /) (ent     | er '0' i       | if no solar                                      | contribu     | tion to wate       | er heating) | l             |                            |
| (add addition                  | al lines if  | FGHRS      | and/or \       | WWHRS      | app        | olies, see Ap    | pend        | lix G          | )  |              |                    |             |               |                            |
| (63)m= 0                       | 0            | 0          | 0              | 0          | (          | 0                | 0           |                | 0  | 0            | 0                  | 0           |               | (63)                       |
| Output from                    | water hea    | ter        | •              | •          |            | •                |             |                | •  |              | •                  | •           |               |                            |
| (64)m= 204.66                  | 180.58       | 190.1      | 171.03         | 168.06     | 150        | 0.82 145.46      | 158         | .76            | 158.22   | 177.32       | 186.71             | 199.94      |               |                            |
|                                |              |            |                |            |            |                  |             | Outpu          | ut from wa                                       | iter heate   | er (annual)₁       | 12          | 2091.65       | (64)                       |
| Heat gains fr                  | om water     | heating    | , kWh/m        | onth 0.2   | 5 ′ [0     | ).85 × (45)m     | + (6        | 1)m]           | + 0.8 x  | [(46)m       | + (57)m            | + (59)m     | ]             | _                          |
| (65)m= 93.89                   | 83.38        | 89.05      | 81.88          | 81.72      | 75         | .15 74.21        | 78.         | 63             | 77.62  | 84.8         | 87.09              | 92.32       |               | (65)                       |
| include (57                    | ')m in cal   | culation   | of (65)m       | only if c  | ylind      | der is in the o  | dwell       | ing c          | or hot wa  | ater is f    | rom com            | munity h    | neating       |                            |
| 5. Internal                    | <u> </u>     |            | , ,            | •          | ,          |                  |             |                |  |              |                    | <u> </u>    |               |                            |
| Metabolic ga                   |              |            |                | ,          |            |                  |             |                |  |              |                    |             |               |                            |
| Jan                            |              | Mar        | Apr            | May        | J          | un Jul           | A           | ug             | Sep  | Oct          | Nov                | Dec         |               |                            |
| (66)m= 144.94                  | +            | 144.94     | 144.94         | 144.94     | 144        | -                | 144         | <del>-</del> - | 144.94   | 144.94       | 144.94             | 144.94      |               | (66)                       |
| Lighting gain                  | s (calcula   | ted in Aı  | opendix        | L. eguat   | on I       | 9 or L9a), a     | lso s       | ee T           | able 5   |              |                    |             | l             |                            |
| (67)m= 48.49                   | <del>`</del> | 35.03      | 26.52          | 19.82      | 16         | <del></del>      | 23.         | _              | 31.55  | 40.06        | 46.75              | 49.84       |               | (67)                       |
| Appliances g                   | ains (calc   |            | Annend         |            |            |                  | 3a) :       | also           |  |              |                    |             |               |                            |
| (68)m= 319.93                  |              | 314.88     | 297.07         | 274.59     | 253        |                  | 236         |                | 244.39   | 262.2        | 284.68             | 305.81      | 1             | (68)                       |
| Cooking gain                   |              |            |                |            | —          |                  | <del></del> | $\vdash$       |  |              |                    |             |               | , ,                        |
| (69)m= 51.91                   | <u> </u>     | 51.91      | 51.91          | 51.91      | 51.        |                  | 51.         | _              | 51.91  | 51.91        | 51.91              | 51.91       | 1             | (69)                       |
| ` '                            |              |            |                | 01.01      | 01.        | 01.01            | 01.         | <u> </u>       | 01.01  | 01.01        | 01.01              | 01.01       |               | ()                         |
| Pumps and f                    |              | 0          | 0              | 0          |            | 0                | 0           |                | 0  | 0            | 0                  | 0           | 1             | (70)                       |
| ` '                            |              | l          |                |            |            |                  |             |                | 0  | 0            |                    | U           |               | (10)                       |
| Losses e.g. 6<br>(71)m= -96.63 | <del></del>  | n (nega    | -96.63         | -96.63     |            | .63 -96.63       | -96.        | 62             | -96.63   | -96.63       | -96.63             | -96.63      | 1             | (71)                       |
| ` '                            |              | ļ          | -90.03         | -90.03     | -90        | -90.03           | -90.        | .03            | -90.03   | -90.03       | -90.03             | -90.03      |               | (7-1)                      |
| Water heatin (72)m= 126.2      |              |            | 142.72         | 100.04     | 10/        | 120 00.74        | 105         | 60 T           | 407.0  | 112.00       | 120.96             | 124.00      | 1             | (72)                       |
|                                | _            |            | 113.72         | 109.84     | 104        |                  | 105         |                | 107.8  |              |                    |             |               | (72)                       |
| Total interna                  | <del>_</del> |            | T 507.50       | 504.40     | 47         | (66)m + (67)m    | ·           | <del></del>    | <del>`                                    </del> | , ,          | <del>, ` ` '</del> |             | 1             | (72)                       |
| (73)m= 594.84                  |              | 569.82     | 537.53         | 504.48     | 47         | 4.8 457.39       | 465         | .44            | 483.96   | 516.46       | 552.62             | 579.97      |               | (73)                       |
| 6. Solar gains are             |              | ueina eola | ır fluv from   | Table 6a   | and a      | ssociated equa   | tione       | to con         | wert to the                                      | a annlica    | ble orientat       | ion         |               |                            |
| Orientation:                   |              | •          | Area           |            | anu a      | Flux             | 110113      |                |  | е аррііса    | FF                 |             | Gains         |                            |
| Onemation.                     | Table 6d     |            | m <sup>2</sup> |            |            | Table 6a         |             |                | g_<br>able 6b                                    | Т            | able 6c            |             | (W)           |                            |
| East 0.9x                      | 0.54         | x          | 11             | 1          | хГ         | 19.64            | x           |                | 0.5  | 7 x [        | 0.8                |             | 42.38         | (76)                       |
| East 0.9x                      |              |            |                |            | ^ L<br>x Г | 38.42            | x           |                |  | 」^L<br>ヿ x 「 | 0.8                |             | 82.91         | ](76)                      |
| East 0.9x                      |              |            |                |            | F          |                  |             |                | 0.5  | ╡╞           |                    | =           |               | _                          |
| East 0.9x                      |              |            |                |            | ×          | 63.27            | X           |                | 0.5  | _  ×         | 0.8                | =           | 136.53        | (76)                       |
|                                |              |            |                |            | х <u>Г</u> | 92.28            | X           |                | 0.5  | 」×↓<br>□、┌   | 0.8                | _           | 199.13        | (76)                       |
| _                              |              |            |                |            | х <u>Г</u> | 113.09           | X           |                | 0.5  | _            | 0.8                | =           | 244.04        | (76)                       |
|                                |              |            |                |            | x _        | 115.77           | X           |                | 0.5  | _            | 0.8                | =           | 249.81        | ](76)<br>] <sub>(70)</sub> |
| East 0.9x                      |              |            |                | _          | × L        | 110.22           | X           |                | 0.5  | _            | 0.8                | =           | 237.83        | (76)                       |
| East 0.9x                      | 0.54         | X          | 11             | .1 l       | X          | 94.68            | X           | I              | 0.5  | X            | 0.8                | =           | 204.3         | (76)                       |

| East   | 0.9x   | 0.54   | X  | 11.1  | 1  | x  | 73.59  | ×   | 0.5  | X  | 0.8   | =  | 158.79 | (76)   |
|--|--|--|--|---|--|--|--|---|--|--|---|--|--------|--|
| East   | 0.9x   | 0.54   | x  | 11.1  | 1  | X  | 45.59  | x   | 0.5  | x  | 0.8   | =  | 98.37  | (76)   |
| East   | 0.9x   | 0.54   | X  | 11.1  | 1  | X  | 24.49  | x   | 0.5  | x  | 0.8   | =  | 52.84  | (76)   |
| East   | 0.9x   | 0.54   | x  | 11.1  | 1  | X  | 16.15  | X   | 0.5  | x  | 0.8   | =  | 34.85  | (76)   |
| West   | 0.9x   | 0.77   | x  | 5.6   | ;  | X  | 19.64  | x   | 0.5  | x  | 0.8   | =  | 30.49  | (80)   |
| West   | 0.9x   | 0.77   | x  | 5.6   |  | X  | 38.42  | X   | 0.5  | x  | 0.8   | =  | 59.64  | (80)   |
| West   | 0.9x   | 0.77   | x  | 5.6   |  | X  | 63.27  | X   | 0.5  | ×  | 0.8   |  | 98.22  | (80)   |
| West   | 0.9x   | 0.77   | x  | 5.6   |  | X  | 92.28  | X   | 0.5  | ×  | 0.8   | _ =  | 143.25 | (80)   |
| West   | 0.9x   | 0.77   | X  | 5.6   |  | X  | 113.09   | ×   | 0.5  | x  | 0.8   | =  | 175.56 | (80)   |
| West   | 0.9x   | 0.77   | x  | 5.6   | ;  | X  | 115.77   | X   | 0.5  | x  | 0.8   | =  | 179.71 | (80)   |
| West   | 0.9x   | 0.77   | x  | 5.6   |  | X  | 110.22   | X   | 0.5  | ×  | 0.8   | _ =  | 171.09 | (80)   |
| West   | 0.9x   | 0.77   | X  | 5.6   |  | X  | 94.68  | ×   | 0.5  | x  | 0.8   | =  | 146.97 | (80)   |
| West   | 0.9x   | 0.77   | x  | 5.6   | ;  | X  | 73.59  | X   | 0.5  | ×  | 0.8   | =  | 114.23 | (80)   |
| West   | 0.9x   | 0.77   | X  | 5.6   | ;  | X  | 45.59  | x   | 0.5  | x  | 0.8   | =  | 70.77  | (80)   |
| West   | 0.9x   | 0.77   | X  | 5.6   | ;  | X  | 24.49  | X   | 0.5  | x  | 0.8   | =  | 38.01  | (80)   |
| West   | 0.9x   | 0.77   | x  | 5.6   | ;  | X  | 16.15  | X   | 0.5  | ×  | 0.8   | =  | 25.07  | (80)   |
|  | _  |  |  |   |  |  |  | _   |  |  |   |  |        |  |
| Solar g  | ains in  | watts, calc  | ulated   | for each  | month  | 1  |  | (83)n   | n = Sum(74)m.  | (82)m  |   |  |        |  |
| (83)m=   | 72.87  | 142.55   | 234.75   | 342.37  | 419.59   | 4:   | 29.53 408.93   | 351   | .26 273.03   | 169.1  | 4 90.86   | 59.92  |        | (83)   |
| Total g  | ains – i   | nternal and  | solar  | (84)m =   | (73)m  | + (8   | 33)m , watts   |   |  |  |   |  |        |  |
| (84)m=   | 667.71   | 733.17 8   | 304.58   | 879.9   | 924.07   | 9  | 04.33 866.32   | 810   | 5.7 756.99   | 685.6  | 643.48  | 639.89   |        | (84)   |
| - 1 A  |  |  |  |   | _  |  |  |   |  |  |   |  |        |  |
| 7. Me  | an inter   | mal temper   | rature (   | heating:  | seasor   | n)   |  |   |  |  |   |  |        |  |
|  |  |  |  | heating :<br>eriods in  |  |  | area from Ta   | able 9  | , Th1 (°C)   | ٠.   |   |  | 21     | (85)   |
| Temp   | erature  | during hea   | ating p  | eriods in   | the liv  | ing  |  |   | , Th1 (°C)   | ī  | г   |  | 21     | (85)   |
| Temp   | erature  | during hea   | ating p  | eriods in   | the liv<br>a, h1,n   | ing<br>n (s  | area from Ta<br>ee Table 9a)<br>Jun Jul  |   | , Th1 (°C)   | Oct  | Nov   | Dec  | 21     | (85)   |
| Temp   | erature<br>ition fac   | during hea   | ating pons   | eriods in   | the liv  | ing<br>n (s  | ee Table 9a)   |   | ug Sep   | Oct  | Nov<br>0.76                                     | Dec<br>0.84                                    | 21     | (85)   |
| Temp<br>Utilisa<br>(86)m=  | erature<br>tion fac<br>Jan<br>0.83   | during heater for gain Feb 0.77  | ns for li<br>Mar   | eriods in<br>ving area<br>Apr   | the liv<br>a, h1,n<br>May  | ing<br>n (s  | ee Table 9a)<br>Jun Jul<br>0.28 0.2  | A 0.2   | ug Sep<br>22 0.36  |  | +   |  | 21     |  |
| Temp<br>Utilisa<br>(86)m=  | erature<br>tion fac<br>Jan<br>0.83<br>interna  | during heater for gair Feb 0.77 It temperate   | ating pons for line Mar 0.67   | eriods in ving area Apr 0.53 iving are  | the liv<br>a, h1,n<br>May<br>0.4<br>ea T1 (f   | ing<br>n (s  | Jun Jul<br>0.28 0.2<br>w steps 3 to  | 7 in 7  | ug Sep<br>22 0.36<br>Table 9c)   | 0.58   | 0.76  | 0.84   | 21     | (86)   |
| Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=  | erature Jan 0.83 interna 20.63   | during heater for gair Feb 0.77 lt temperate 20.74   | Mar 0.67<br>ure in l   | eriods in ving area 0.53 iving are 20.96  | the liv<br>a, h1,n<br>May<br>0.4<br>ea T1 (f<br>20.99  | ing<br>n (s<br>follo   | ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21   | 7 in 1  | ug Sep<br>22 0.36<br>Table 9c)   |  | 0.76  |  | 21     |  |
| Temp Utilisa (86)m= Mean (87)m= Temp   | ution factories Jan 0.83 interna 20.63 erature   | during heater for gair Feb 0.77 Il temperate 20.74 during heater   | ating points for line Mar 0.67 ure in 1 20.87  | Apr 0.53 iving area 20.96 eriods in   | the liv<br>a, h1,n<br>May<br>0.4<br>ea T1 (f<br>20.99  | ing<br>n (s<br>follo   | Jun Jul  Jun Jul  Jun Jul  Jun  Jun  Jun  Jun  Jun  Jun  Jun   | 7 in 7  | ug Sep<br>22 0.36<br>Table 9c)<br>1 21<br>9, Th2 (°C)  | 20.95  | 0.76  | 20.59  | 21     | (86)   |
| Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=  | erature Jan 0.83 interna 20.63   | during heater for gair Feb 0.77 lt temperate 20.74   | Mar 0.67<br>ure in l   | eriods in ving area 0.53 iving are 20.96  | the liv<br>a, h1,n<br>May<br>0.4<br>ea T1 (f<br>20.99  | ing<br>n (s<br>follo   | ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21   | 7 in 1  | ug Sep<br>22 0.36<br>Table 9c)<br>1 21<br>9, Th2 (°C)  | 0.58   | 0.76  | 0.84   | 21     | (86)   |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  | Jan 0.83 interna 20.63 erature 20.5  | during heater for gair Feb 0.77 lt temperate 20.74 ct during heater 20.5   | ns for ling pons for ling Mar 0.67 ure in lagonary ating pons 20.5   | Apr 0.53 iving are 20.96 eriods in 20.51  | the liv<br>a, h1,n<br>May<br>0.4<br>ea T1 (f<br>20.99<br>rest of<br>20.51  | f dw   | Jun Jul  Jun Jul  Jun Jul  Jun  Jun  Jun  Jun  Jun  Jun  Jun   | 7 in 1 2 Table 2                                  | ug Sep<br>22 0.36<br>Table 9c)<br>1 21<br>9, Th2 (°C)  | 20.95  | 0.76  | 20.59  | 21     | (86)   |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  | Jan 0.83 interna 20.63 erature 20.5  | during heater for gair Feb 0.77 It temperate 20.74 during heater 20.5 ctor for gair  | ns for ling pons for ling Mar 0.67 ure in lagonary ating pons 20.5   | Apr 0.53 iving are 20.96 eriods in 20.51  | the liv<br>a, h1,n<br>May<br>0.4<br>ea T1 (f<br>20.99<br>rest of<br>20.51  | m (s<br>follo  | Dun Jul Dun Jul Dun Jul Dun Jul Dun Dun Jul Dun Dun Jul Dun Dun Jul Du | 7 in 1 2 Table 2                                  | ug Sep<br>22 0.36<br>Table 9c)<br>1 21<br>9, Th2 (°C)<br>51 20.51  | 20.95  | 0.76  | 20.59  | 21     | (86)   |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  | Jan 0.83 interna 20.63 erature 20.5 tion fac   | during heater to for gair Feb 0.77 lt temperate 20.74 20.5 ctor for gair 0.75  | mating points for limited Mar 0.67 ure in la 20.87 ating points for r 0.66   | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw  | the liv<br>a, h1,n<br>May<br>0.4<br>ea T1 (f<br>20.99<br>rest of<br>20.51<br>velling,<br>0.38                      | m (s   | Dun Jul D.28 0.2  w steps 3 to 21 21  relling from T D.51 20.51  m (see Table  | 7 in 7 2 5able 9 20.                              | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51   | 0.58<br>20.95<br>20.51   | 20.79   | 20.59  | 21     | (86)<br>(87)<br>(88)                                 |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  | Jan 0.83 interna 20.63 erature 20.5 tion fac   | during heater for gair Feb 0.77 lt temperate 20.74 ctor for gair 0.75 lt temperate 1.75 lt temperate 1 | mating points for limited Mar 0.67 ure in la 20.87 ating points for r 0.66   | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw  | the liv<br>a, h1,n<br>May<br>0.4<br>ea T1 (f<br>20.99<br>rest of<br>20.51<br>velling,<br>0.38                      | follo<br>follo<br>h2,  | Dun Jul Dun Jul Dun Jul Dun  | 7 in 7 2 5able 9 20.                              | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Table  | 0.58<br>20.95<br>20.51   | 0.76<br>20.79<br>20.51<br>0.74                  | 20.59  |        | (86)<br>(87)<br>(88)                                 |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean  | Jan 0.83 interna 20.63 erature 20.5 tion fac   | during heater for gair Feb 0.77 lt temperate 20.74 ctor for gair 0.75 lt temperate 1.75 lt temperate 1 | ns for ling pons for ling pons for rouse in the line line line line line line line lin   | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw 0.51 he rest of                                      | the liv a, h1,n May 0.4 ea T1 (f 20.99 rest of 20.51 velling, 0.38 of dwel   | follo<br>follo<br>h2,  | Dun Jul Dun Jul Dun Jul Dun  | A 0.2 7 in 7 2 Table 9 20. teps 3                 | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Table 51 20.51   | 0.58 20.95 20.51 0.56 e 9c) 20.45  | 0.76<br>20.79<br>20.51<br>0.74                  | 0.84<br>20.59<br>20.5<br>0.83                  | 21     | (86)<br>(87)<br>(88)<br>(89)                         |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean (90)m=                                     | Jan 0.83 interna 20.63 erature 20.5 tion fac 0.81 interna  | during heactor for gair Feb 0.77 Il temperate 20.74 20.5 ctor for gair 0.75 Il temperate 20.16   | ns for line of | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw 0.51 he rest of 20.45                                | the liv<br>a, h1,n<br>May<br>0.4<br>a T1 (f<br>20.99<br>rest of<br>20.51<br>velling,<br>0.38<br>of dwel<br>20.5    | follo<br>h2,   | ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21 relling from T 0.51 20.51 m (see Table 0.26 0.18 T2 (follow steps)  | A 0.2 7 in 7 2 5able 9 20. e 9a) 0. teps 3        | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Table 51 20.51   | 0.58 20.95 20.51 0.56 e 9c) 20.45  | 0.76<br>20.79<br>20.51<br>0.74                  | 0.84<br>20.59<br>20.5<br>0.83                  |        | (86)<br>(87)<br>(88)<br>(89)                         |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean (90)m=                                     | Jan 0.83 interna 20.63 erature 20.5 tion fac 0.81 interna  | during heater to represent the during heater the dur | ns for line of | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw 0.51 he rest of 20.45                                | the liv<br>a, h1,n<br>May<br>0.4<br>a T1 (f<br>20.99<br>rest of<br>20.51<br>velling,<br>0.38<br>of dwel<br>20.5    | follo h2,  | Dun Jul Dun Jul Dun Jul Dun  | A 0.2 7 in 7 2 5able 9 20. e 9a) 0. teps 3        | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Table 51 20.51   | 0.58 20.95 20.51 0.56 e 9c) 20.45  | 0.76  20.79  20.51  0.74  20.24  ving area ÷ (- | 0.84<br>20.59<br>20.5<br>0.83                  |        | (86)<br>(87)<br>(88)<br>(89)                         |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean (90)m=  Mean (92)m=                        | Jan 0.83 interna 20.63 erature 20.5 tion fac 0.81 interna 20 interna 20                              | during heater tor for gair Feb 0.77 lt temperate 20.74 20.75 etor for gair 0.75 lt temperate 20.16 20.16 ctor for gair 20.16 c | ating pons for line Mar 0.67 ure in l 20.87 ating pons for r 0.66 ure in t 20.33 ure (for 20.64  | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw 0.51 he rest of 20.45 r the who 20.75                | the liv a, h1,n May 0.4 ta T1 (f 20.99 rest of 20.51 velling, 0.38 of dwel 20.5                                    | follo h2, h2, elling   | ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21 relling from T 0.51 20.51 m (see Table 0.26 0.18 T2 (follow steps) 0.51 20.51 g) = fLA × T2   | A 0.2 7 in 7 2 5able 9 20. 1 + (1 20.             | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Tabl 51 20.51  f  - fLA) × T2  8 20.79   | 0.58 20.95 20.51 0.56 e 9c) 20.45 LA = Liv   | 0.76  20.79  20.51  0.74  20.24  ving area ÷ (  | 0.84<br>20.59<br>20.5<br>0.83<br>19.96<br>4) = |        | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91)         |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean (90)m=  Mean (92)m=                        | Jan 0.83 interna 20.63 erature 20.5 tion fac 0.81 interna 20 interna 20                              | during heater to the during he | ating pons for line Mar 0.67 ure in l 20.87 ating pons for r 0.66 ure in t 20.33 ure (for 20.64  | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw 0.51 he rest of 20.45 r the who 20.75                | the liv a, h1,n May 0.4 ta T1 (f 20.99 rest of 20.51 velling, 0.38 of dwel 20.5                                    | m (s follo follo h2, h2, c elling 2  | ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21 relling from T 0.51 20.51 m (see Table 0.26 0.18 T2 (follow steps 3) 0.51 20.51 g) = fLA × T 0.79 20.79   | A 0.2 7 in 7 2 5able 9 20. 1 + (1 20.             | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Tabl 51 20.51  - fLA) × T2  8 20.79  where approximates a second content of the cont | 0.58 20.95 20.51 0.56 e 9c) 20.45 LA = Liv   | 0.76  20.79  20.51  0.74  20.24  ving area ÷ (  | 0.84<br>20.59<br>20.5<br>0.83<br>19.96<br>4) = |        | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91)         |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean (90)m=  Mean (92)m=  Apply (93)m=          | Jan 0.83 interna 20.63 erature 20.5 tion fac 0.81 interna 20 interna 20 adjustr 20.36                | during heater to the during he | ating pons for line at line pons for rouse in the line pons for rouse in th | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw 0.51 he rest of 20.45 r the who 20.75 internal       | the liv a, h1,n May 0.4 a T1 (f 20.99 rest of 20.51 velling, 0.38 of dwel 20.5                                     | m (s follo follo h2, h2, c elling 2  | ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21 relling from T 0.51 20.51 m (see Table 0.26 0.18 T2 (follow steps) 0.51 20.51 g) = fLA × T 0.79 20.79 ure from Table  | A 0.3 7 in 7 2 Table 9 20. teps 3 1 + (1 20 e 4e, | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Tabl 51 20.51  - fLA) × T2  8 20.79  where approximates a second content of the cont | 0.58  20.95  20.51  0.56  e 9c)  20.45  LA = Livery particular par | 0.76  20.79  20.51  0.74  20.24  ving area ÷ (  | 0.84<br>20.59<br>20.5<br>0.83<br>19.96<br>4) = |        | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91)<br>(92) |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean (90)m=  Mean (92)m=  Apply (93)m=  8. Spa  | Jan 0.83 interna 20.63 erature 20.5 tion fac 0.81 interna 20 interna 20 adjustr 20.36 ace hea        | during heactor for gair Feb 0.77 Il temperate 20.74 20.5 ctor for gair 0.75 Il temperate 20.16 20.49 20.49 ctor for gair 20.49 | mating points for limited and  | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw 0.51 he rest of 20.45 r the who 20.75 internal 20.75 | the liv a, h1,n May 0.4 ea T1 (f 20.99 rest of 20.51 velling, 0.38 of dwel 20.5 ble dwe 20.78 tempe 20.78          | ing (second second seco | ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21 relling from T 0.51 20.51 m (see Table 0.26 0.18 T2 (follow steps) 0.51 20.51 g) = fLA × T 0.79 20.79 ure from Table  | A 0.3 7 in 7 2 5able 9 20. 1 + (1 20 e 4e, 20     | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Tabl 51 20.51  - fLA) × T2 8 20.79  where approx 8 20.79   | 0.58  20.95  20.51  0.56 e 9c)  20.45 FLA = Livitation private 20.74   | 0.76  20.79  20.51  0.74  20.24  ving area ÷ (  | 0.84<br>20.59<br>20.5<br>0.83<br>19.96<br>4) = | 0.58   | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91)<br>(92) |
| Temp Utilisa  (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean (90)m=  Mean (92)m=  Apply (93)m=  8. Spa | Jan 0.83 interna 20.63 erature 20.5 tion fac 0.81 interna 20 interna 20 adjustr 20.36 ace hea to the | during heactor for gair Feb 0.77 Il temperate 20.74 20.5 ctor for gair 0.75 Il temperate 20.16 20.49 20.49 ctor for gair 20.49 | ating pons for line and line a | Apr 0.53 iving are 20.96 eriods in 20.51 est of dw 0.51 he rest of 20.45 r the who 20.75 internal 20.75 | the liv a, h1,n May 0.4 ea T1 (f 20.99 rest of 20.51 velling, 0.38 of dwel 20.5  ble dwe 20.78 tempe 20.78 e obtai | ing (second second seco | ee Table 9a) Jun Jul 0.28 0.2 w steps 3 to 21 21 relling from T 0.51 20.51 m (see Table 0.26 0.18 T2 (follow st 0.51 20.51 g) = fLA × T 0.79 20.79 re from Table 0.79 20.79  | A 0.3 7 in 7 2 5able 9 20. 1 + (1 20 e 4e, 20     | ug Sep 22 0.36  Table 9c) 1 21  9, Th2 (°C) 51 20.51  2 0.33  1 to 7 in Tabl 51 20.51  - fLA) × T2 8 20.79  where approx 8 20.79   | 0.58  20.95  20.51  0.56 e 9c)  20.45 FLA = Livitation private 20.74   | 0.76  20.79  20.51  0.74  20.24  ving area ÷ (  | 0.84<br>20.59<br>20.5<br>0.83<br>19.96<br>4) = | 0.58   | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91)<br>(92) |

Apr

May

Jun

Jul

Aug

Sep

Oct

Nov

Dec

Mar

Jan

Feb

| Utilisa   |   | £  | -:   | _  |  |                        |                     |            |  |   |  |               |  |  |
|---|---|--|--|--|--|------------------------|---------------------|------------|--|---|--|---------------|--|--|
| (94)m=  | ation factor  | 0.75   | 0.66   | 0.52   | 0.39   | 0.27                   | 0.19                | 0.21       | 0.35                                     | 0.57  | 0.74   | 0.83          |  | (94)   |
|   | ıl gains, h   |  |  |  |  | 0.27                   | 0.10                | 0.21       | 0.00                                     | 0.07  | 0.7 4  | 0.00          |  | (= -)  |
| (95)m=  |   | 553.11   | 531.08   | 461.17   | 359.97   | 244.46                 | 165.79              | 173.3      | 264.26                                   | 389.56  | 477.82   | 529.03        |  | (95)   |
| Montl   | hly avera   | ge exte  | rnal tem   | perature   | from Ta  | able 8                 |                     |            |  |   |  |               |  |  |
| (96)m=  | 4.3   | 4.9  | 6.5  | 8.9  | 11.7   | 14.6                   | 16.6                | 16.4       | 14.1                                     | 10.6  | 7.1  | 4.2           |  | (96)   |
|   | loss rate   |  |  |  |  | _m , W =               | =[(39)m :           | x [(93)m   | – (96)m                                  | ]   |  | , ,           |  |  |
| (97)m=  |   | 632.59   | 572.42   | 474.44   | 362.99   | 244.88                 | 165.86              | 173.4      | 265.64                                   | 405.16  | 540.27   | 650.13        |  | (97)   |
| -   | e heating<br>83.42  | require<br>53.41   | ement fo<br>30.76  |  | onth, k\<br>2.25                                     | Vh/mont<br>0           | h = 0.02            |            |  |   |  | 00.4          |  |  |
| (98)m=  | 03.42   | 55.41  | 30.76  | 9.56   | 2.25   | U                      | U                   | 0<br>Tota  | 0<br>I per year                          | 11.6  | 44.97  | 90.1          | 326.06   | (98)   |
| •   |   |  | , .  |  | ,  |                        |                     | TOLA       | прегуеат                                 | (KVVII/yeai                                       | ) = Sum(9  | O)15,912 =    |  | ] ` ` ` ` .  |
| Space   | e heating   | require  | ement in   | kVVh/m²  | /year  |                        |                     |            |  |   |  | l             | 4.2  | (99)   |
|   | ergy requ   |  |  |  |  |                        |                     |            |  |   |  |               |  |  |
|   | art is use<br>on of spac  |  |  | • .  |  | •                      |                     | <b>.</b>   | •  |   | unity sch  | neme.<br>[    | 0  | (301)  |
|   |   |  |  | •  |  | •                      |                     | 1 4510 1   | 1, 0 11 11                               | 0110  |  |               |  |  |
|   | on of space   |  |  | •  | •  | ,                      | ,                   |            | 0.15                                     |   |  | [             | 1  | (302)  |
|   | nmunity sch<br>boilers, he  | -  |  |  |  |                        |                     |            |  | up to four o                                      | other heat   | sources; th   | ne latter  |  |
|   | on of heat  |  | -  |  |  |                        |                     |            |  |   |  |               | 1  | (303a)   |
| Fractic   | on of total   | space  | heat fro   | m Comn   | nunity he  | eat pump               |                     |            |  | (3  | 02) x (303   | a) =          | 1  | (304a)   |
| Factor  | for contr   | ol and o   | charging   | method   | (Table   | 4c(3)) fo              | r commu             | unity hea  | ating sys                                | tem   |  |               | 1  | (305)  |
| Distrib   | ution loss  | factor   | (Table 1   | 2c) for c  | ommun  | ty heatir              | ng syste            | m          |  |   |  | Ī             | 1.05   | (306)  |
| Space   | heating   |  |  |  |  |                        |                     |            |  |   |  | L             | kWh/year   | _  |
|   | l space h   | eating i   | requiren   | nent   |  |                        |                     |            |  |   |  |               | 326.06   | ]  |
| Space   | heat fror   | n Comr   | nunity h   | eat pum  | )  |                        |                     |            |  |   |  | _             |  |  |
| Efficie   | ncy of se   | oondon   |  |  |  |                        |                     |            | (98) x (30                               | 04a) x (305                                       | 5) x (306) :   | =             | 342.36   | (307a)   |
| _   |   | conuary  | //supple   | mentary  | heating  | system                 | in % (fro           | m Table    | , , ,                                    | , ,   | , , ,  | = [<br>[      | 342.36<br>0  | (307a)<br>(308   |
| Space   | heating i   | •  |  | •  | _  | •                      | ,                   |            | 4a or A                                  | , ,   | E)   | = [<br>[      |  |  |
|   | heating i   | •  |  | •  | _  | •                      | ,                   |            | 4a or A                                  | ppendix   | E)   | =<br>[<br>[   | 0  | (308   |
| <b>Water</b><br>Annua   | heating<br>I water he   | requirer   | ment from  | m secon  | _  | •                      | ,                   |            | 4a or A                                  | ppendix   | E)   | = [<br>[<br>[ | 0  | (308   |
| Water<br>Annua  | heating   | requirer<br>eating re  | ment from<br>equirem<br>by schem   | m secon<br>ent<br>ne:                                | dary/sup   | •                      | ,                   |            | 98) x (30                                | ppendix   | E)<br>- (308) =  | [<br>]<br>]   | 0  | (308   |
| Water<br>Annua<br>If DHW<br>Water   | heating<br>I water he<br>V from co  | requirer<br>eating re<br>mmunit<br>n Comm  | ment from<br>equirem<br>y schem<br>nunity he   | m secon<br>ent<br>ne:<br>eat pump                    | dary/sup   | •                      | ,                   | em         | 98) x (30                                | ppendix<br>01) x 100 ÷                            | E) :- (308) = :- (306) :- (306 | [<br>[<br>=   | 0 0 2091.65  | (308)  |
| Water<br>Annua<br>If DHW<br>Water<br>Electric   | heating<br>I water he<br>V from co<br>heat from   | eating remunited Communited For hear   | ment from<br>equirem<br>y schem<br>nunity he<br>t distribu                                 | m secon ent ne: eat pump                             | dary/sup   | •                      | ,                   | em         | 98) x (30<br>(64) x (30                  | ppendix<br>01) x 100 ÷                            | E) :- (308) = :- (306) :- (306 | [<br>[<br>=   | 0<br>0<br>2091.65<br>2196.24                             | (308<br>(309)<br>(310a)  |
| Water<br>Annua<br>If DHW<br>Water<br>Electric   | heating<br>I water he<br>V from co<br>heat from<br>city used  | eating remains a comment of the comm | ment from<br>equirem<br>y schem<br>nunity he<br>t distribu                                 | m secon ent ne: eat pump ution ncy Ratio             | dary/sup   | pplemen                | tary syst           | em         | 98) x (30<br>(64) x (30                  | ppendix<br>01) x 100 ÷<br>03a) x (305<br>(307e) + | E) :- (308) = :- (306) :- (306 | [<br>[<br>=   | 0<br>0<br>2091.65<br>2196.24<br>25.39                    | (308<br>(309)<br>(310a)<br>(313)                                       |
| Water<br>Annua<br>If DHW<br>Water<br>Electric<br>Coolin<br>Space                      | heating<br>I water he<br>V from co<br>heat from<br>city used<br>g System                            | requirer eating re mmunit n Comm for hea n Energy if there umps ar   | equirem y schem nunity he t distribu y Efficier is a fixe                                  | m secon ent ne: eat pump ution ncy Ration d cooling  | dary/sup   | pplemen<br>n, if not e | tary systementer 0) | em<br>0.01 | (98) x (30<br>(64) x (30<br>x [(307a).   | ppendix<br>01) x 100 ÷<br>03a) x (305<br>(307e) + | E) :- (308) = :- (306) :- (306 | [<br>[<br>=   | 0<br>0<br>2091.65<br>2196.24<br>25.39<br>0               | (308<br>(309)<br>(310a)<br>(313)<br>(314)                              |
| Water<br>Annua<br>If DHW<br>Water<br>Electric<br>Coolin<br>Space<br>Electric<br>mecha | heating I water he V from co heat from city used g System cooling (                                 | eating remains and the comments of the comment | equirem y schem nunity he t distribu y Efficier is a fixe nd fans v balanc                 | m secon ent ne: eat pump ution ncy Ration d cooling  | dary/sup   | pplemen<br>n, if not e | tary systementer 0) | em<br>0.01 | (98) x (30<br>(64) x (30<br>x [(307a).   | ppendix<br>01) x 100 ÷<br>03a) x (305<br>(307e) + | E) :- (308) = :- (306) :- (306 | [<br>[<br>=   | 0<br>0<br>2091.65<br>2196.24<br>25.39<br>0               | (308<br>(309)<br>(310a)<br>(313)<br>(314)<br>(315)                     |
| Water Annua If DHW Water Electric Coolin Space Electric mecha                         | heating I water he V from co heat from city used g System cooling ( city for pu                     | eating remained and Energy if there umps are stillation g system.  | equirem y schem nunity he t distribu y Efficier is a fixe nd fans v - balanc m fans        | m secon ent ne: eat pump ution ncy Ration d cooling  | dary/sup   | pplemen<br>n, if not e | tary systementer 0) | em<br>0.01 | (98) x (30<br>(64) x (30<br>x [(307a).   | ppendix<br>01) x 100 ÷<br>03a) x (305<br>(307e) + | E) = (308) = (5) x (306) =   | [<br>[<br>=   | 0<br>0<br>2091.65<br>2196.24<br>25.39<br>0<br>0          | (308<br>(309)<br>(310a)<br>(313)<br>(314)<br>(315)<br>(330a)           |
| Water Annua If DHW Water Electric Coolin Space Electric mecha warm a                  | heating I water he V from co heat from city used g System cooling ( city for punical ven air heatin | eating remained and Energy if there umps are utilation g systematics.  | equirem y schem nunity he t distribu y Efficier is a fixe nd fans v - balanc m fans eating | ent ne: eat pump ution ncy Ratio d cooling within dw | dary/sup<br>o<br>g system<br>velling (1<br>act or po | pplemen<br>n, if not e | tary systementer 0) | em<br>0.01 | (98) x (30)<br>(64) x (30)<br>x [(307a). | ppendix<br>01) x 100 ÷<br>03a) x (305<br>(307e) + | E) - (308) = - (5) x (306) = - (310a)(   | [<br>[<br>=   | 0<br>0<br>2091.65<br>2196.24<br>25.39<br>0<br>0<br>250.5 | (308<br>(309)<br>(310a)<br>(313)<br>(314)<br>(315)<br>(330a)<br>(330b) |

| Energy for lighting (calculated in Appe                             | ndix L)                     |                          |                                 | 342.54                     | (332)  |
|---|-----------------------------|--------------------------|---------------------------------|----------------------------|--------|
| Electricity generated by PVs (Appendi                               | x M) (negative quantity)    | )                        |                                 | -331.63                    | (333)  |
| Electricity generated by wind turbine (                             | Appendix M) (negative       | quantity)                |                                 | 0                          | (334)  |
| 10b. Fuel costs – Community heating                                 | g scheme                    |                          |                                 |                            |        |
|   | <b>Fuel</b><br>kWh/yea      |                          | <b>Fuel Price</b><br>(Table 12) | Fuel Cost<br>£/year        |        |
| Space heating from CHP  | (307a) x                    | [                        | 4.24 × 0.01 =                   | 14.52                      | (340a) |
| Water heating from CHP  | (310a) x                    | [                        | 4.24 × 0.01 =                   | 93.12                      | (342a) |
| Pumps and fans  | (331)                       | <br>                     | Fuel Price  13.19 × 0.01 =      | 33.04                      | (349)  |
| Energy for lighting   | (332)                       | [                        | 13.19 × 0.01 =                  | 45.18                      | (350)  |
| Additional standing charges (Table 12                               | )                           | •                        |                                 | 120                        | (351)  |
| Energy saving/generation technologie                                | s                           | Γ                        | 13.19 × 0.01 =                  | -43.74                     | (352)  |
| Total energy cost   | = (340a)(342e) + (345).     | (354) =                  | 13.19                           | 262.12                     | (355)  |
| 11b. SAP rating - Community heating                                 | scheme                      |                          |                                 | 202.12                     |        |
| Energy cost deflator (Table 12) Energy cost factor (ECF)            | [(355) × (356)] ÷ [(4) + 45 | .0] =                    |                                 | 0.42                       | (356)  |
| SAP rating (section12)  |                             |                          |                                 | 87.47                      | (358)  |
| 12b. CO2 Emissions – Community he                                   | ating scheme                | Energy<br>kWh/year       | Emission facto                  | r Emissions<br>kg CO2/year |        |
| CO2 from other sources of space and Efficiency of heat source 1 (%) |                             | P)                       | 3) to (366) for the second for  |                            | (367a) |
| CO2 associated with heat source 1                                   | [(307)                      | o)+(310b)] x 100 ÷ (367b | ) x 0.52                        | = 601.61                   | (367)  |
| Electrical energy for heat distribution                             |                             | [(313) x                 | 0.52                            | = 13.18                    | (372)  |
| Total CO2 associated with community                                 | systems                     | (363)(366) + (368)       | (372)                           | = 614.79                   | (373)  |
| CO2 associated with space heating (s                                | econdary)                   | (309) x                  | 0                               | = 0                        | (374)  |
| CO2 associated with water from imme                                 | rsion heater or instanta    | neous heater (312        | ) x 0.22                        | = 0                        | (375)  |
| Total CO2 associated with space and                                 | water heating               | (373) + (374) + (375)    | =                               | 614.79                     | (376)  |
| CO2 associated with electricity for pur                             | mps and fans within dwe     | elling (331)) x          | 0.52                            | = 130.01                   | (378)  |
| CO2 associated with electricity for ligh                            | ting                        | (332))) x                | 0.52                            | = 177.78                   | (379)  |
| Energy saving/generation technologie Item 1                         | s (333) to (334) as appl    | icable<br>[              | 0.52 × 0.01 =                   | -172.12                    | (380)  |
| Total CO2, kg/year  | sum of (376)(382) =         |                          |                                 | 750.46                     | (383)  |
| <b>Dwelling CO2 Emission Rate</b>                                   | $(383) \div (4) =$          |                          |                                 | 9.67                       | (384)  |
| El rating (section 14)  |                             |                          |                                 | 91.8                       | (385)  |

| 13b. Primary Energy – Community heating scheme   |                          |                      |                                  |
|--|--------------------------|----------------------|----------------------------------|
|  | Energy<br>kWh/year       | Primary factor       | P.Energy<br>kWh/year             |
| Energy from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)  If there is CHP using to | wo fuels repeat (363) to | (366) for the second | fuel 219 (367a)                  |
| Energy associated with heat source 1 [(307b)+(37b)   | 10b)] x 100 ÷ (367b) x   | 3.07                 | = 3558.67 (367)                  |
| Electrical energy for heat distribution [(3  | 13) x                    |                      | = 77.93 (372)                    |
| Total Energy associated with community systems (36)  | 63)(366) + (368)(372     | 2)                   | = 3636.61 (373)                  |
| if it is negative set (373) to zero (unless specified otherwise, see   | e C7 in Appendix C       | )                    | 3636.61 (373)                    |
| Energy associated with space heating (secondary) (30   | 09) x                    | 0                    | = 0 (374)                        |
| Energy associated with water from immersion heater or instantant   | eous heater(312) x       | 1.22                 | = 0 (375)                        |
| Total Energy associated with space and water heating (37   | 73) + (374) + (375) =    |                      | 3636.61 (376)                    |
| Energy associated with space cooling (34   | 15) x                    | 3.07                 | = 0 (377)                        |
| Energy associated with electricity for pumps and fans within dwell   | ing (331)) x             | 3.07                 | = 769.04 (378)                   |
| Energy associated with electricity for lighting (33  | 32))) x                  | 3.07                 | = 1051.61 (379)                  |
| Energy saving/generation technologies Item 1  Total Primary Energy, kWh/year  sum of (376)(3                             | 382) =                   | 3.07 × 0.01          | = -1018.1 (380)<br>4439.15 (383) |
|  |                          |                      |                                  |

|   |                 |            |            | User D       | etails:          |              |                        |          |           |                       |          |
|---|-----------------|------------|------------|--------------|------------------|--------------|------------------------|----------|-----------|-----------------------|----------|
| Assessor Name:  |                 |            | _          | 000. 2       | Strom            |              |                        |          |           |                       |          |
| Software Name:  | Stroma FS       | SAP 2012   |            | was a who    | Softwa           |              |                        |          | Versio    | on: 1.0.4.18          |          |
| Address :   | Block JKL,      | Agar Gro   |            |              | Address          |              |                        |          |           |                       |          |
| 1. Overall dwelling dime                                |                 | rigar Oro  | vo, can    | 14011, 20    | oridori, re      |              |                        |          |           |                       |          |
|   |                 |            |            | Area         | a(m²)            |              | Av. He                 | ight(m)  |           | Volume(m <sup>3</sup> | )        |
| Ground floor  |                 |            |            | -            | 72.1             | (1a) x       | 3                      | .15      | (2a) =    | 227.12                | (3a)     |
| Total floor area TFA = (1                               | a)+(1b)+(1c)+   | (1d)+(1e)  | )+(1r      | 1)           | 72.1             | (4)          |                        |          |           |                       |          |
| Dwelling volume   |                 |            |            |              |                  | (3a)+(3b     | )+(3c)+(3c             | d)+(3e)+ | .(3n) =   | 227.12                | (5)      |
| 2. Ventilation rate:                                    |                 |            |            |              |                  |              |                        |          |           |                       |          |
|   | main<br>heating |            | condar     | У            | other            |              | total                  |          |           | m³ per hou            | r        |
| Number of chimneys                                      | 0               | +          | 0          | + [          | 0                | = [          | 0                      | X ·      | 40 =      | 0                     | (6a)     |
| Number of open flues                                    | 0               | _ + _      | 0          | Ī + Ē        | 0                | Ī = [        | 0                      | x        | 20 =      | 0                     | (6b)     |
| Number of intermittent fa                               | ans             |            |            |              |                  |              | 0                      | x '      | 10 =      | 0                     | (7a)     |
| Number of passive vents                                 | 5               |            |            |              |                  | Ē            | 0                      | x        | 10 =      | 0                     | (7b)     |
| Number of flueless gas f                                | ires            |            |            |              |                  | Ė            | 0                      | X ·      | 40 =      | 0                     | (7c)     |
|   |                 |            |            |              |                  | _            |                        |          |           |                       |          |
|   |                 |            |            |              |                  | _            |                        | <u> </u> | Air ch    | nanges per ho         | our<br>— |
| Infiltration due to chimne                              |                 |            |            |              |                  | a antinua fu | 0                      |          | ÷ (5) =   | 0                     | (8)      |
| Number of storeys in t                                  |                 |            | u, procee  | u 10 (17), ( | ourer wise (     | Continue II  | OIII (9) 10 (          | (10)     |           | 0                     | (9)      |
| Additional infiltration                                 | , i             |            |            |              |                  |              |                        | [(9)     | -1]x0.1 = | 0                     | (10)     |
| Structural infiltration: 0                              |                 |            |            |              |                  | •            | ruction                |          |           | 0                     | (11)     |
| if both types of wall are p<br>deducting areas of openi |                 |            | oonding to | the great    | ter wall are     | a (after     |                        |          |           |                       |          |
| If suspended wooden                                     |                 |            | ed) or 0   | .1 (seale    | ed), else        | enter 0      |                        |          |           | 0                     | (12)     |
| If no draught lobby, en                                 | nter 0.05, else | enter 0    |            |              |                  |              |                        |          |           | 0                     | (13)     |
| Percentage of window                                    | s and doors d   | raught str | ripped     |              |                  |              |                        |          |           | 0                     | (14)     |
| Window infiltration                                     |                 |            |            |              | 0.25 - [0.2      |              | 100] =<br>12) + (13) · | . (15) _ |           | 0                     | (15)     |
| Infiltration rate Air permeability value,               | a50 eynress     | ad in cubi | ic metre   | s ner ho     |                  |              |                        |          | area      | 0                     | (16)     |
| If based on air permeabi                                |                 |            |            | •            | •                | •            | ictic oi c             | листорс  | arca      | 0.05                  | (17)     |
| Air permeability value applie                           | -               |            |            |              |                  |              | is being u             | sed      |           | 0.00                  |          |
| Number of sides sheltered                               | ed              |            |            |              | (00) 4           | IO 075 · · / | 40)1                   |          |           | 2                     | (19)     |
| Shelter factor  | tina abaltar fa | .4         |            |              | (20) = 1 -       |              | 19)] =                 |          |           | 0.85                  | (20)     |
| Infiltration rate incorpora                             | -               |            |            |              | (21) = (18       | ) X (20) =   |                        |          |           | 0.04                  | (21)     |
| Infiltration rate modified to                           | Mar Apr         | May        | Jun        | Jul          | Aug              | Sep          | Oct                    | Nov      | Dec       | 1                     |          |
| Monthly average wind sp                                 |                 |            | Juli       | Jui          | <sub>I</sub> Aug | Г оер        | 1 001                  | 1 1404   | l Dec     | ]                     |          |
| (22)m= 5.1 5  | 4.9 4.4         | 4.3        | 3.8        | 3.8          | 3.7              | 4            | 4.3                    | 4.5      | 4.7       | 1                     |          |
| · · · <u>L </u>   |                 |            |            | 1            | 1                | <u> </u>     |                        | <u> </u> | 1         | 1                     |          |
| Wind Factor (22a)m = (2                                 | <del></del>     | 1 4 25 1   | 0.05       | 0.0-         | I 6.05           |              | 400                    |          |           | 1                     |          |
| (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      | ]                     |          |

|  | 0.05   | 0.05   | 0.05   | 0.05   | 0.04                  | 0.04         | 0.04             | 0.04  | 0.05   | 0.05   | 0.05              | ]             |               |
|--|--|--|--|--|-----------------------|--------------|------------------|---|--|--|-------------------|---------------|---------------|
| Calculate effe   |  | _  | rate for t   | he appli                                     | cable ca              | se           | ļ                |   |  | <u>I</u>   | !                 |               |               |
| If mechanic  |  |  | andis N. (O  | 2h) (22a                                     | .) Fm. (a             | auatian (N   | VIEVV othor      | muiaa (22h  | \ (225\  |  |                   | 0.5           | (23           |
| If exhaust air h   |  | 0  |  | , ,  | ,                     | . `          | ,, .             | •   | ) = (23a)  |  |                   | 0.5           | (23           |
| If balanced with   |  | -  | -  | _  |                       |              |                  |   | SI.) (   | 001) [   | 4 (00.)           | 76.5          | (23           |
| a) If balance  | ed mech  | anical ve  | ntilation<br>0.16  | 0.16   | o.16                  | 0.16         | TR) (24a<br>0.16 | 0.16 0.16   | 2b)m + ()<br>0.16  | 23b) × [<br>0.17   | <del>1 ` '</del>  | ) ÷ 100]<br>] | (24           |
| , L  |  |  |  |  |                       |              |                  |   |  | <u> </u>   | 0.17              | J             | (2)           |
| b) If balance  | 1  |  |  |  |                       |              | <u> </u>         | í `   | <u> </u>   | <del></del>  | Ι ,               | 1             | (2            |
| 24b)m= 0   | 0  | 0  | 0  | 0  | 0                     | 0            | 0                | 0   | 0  | 0  | 0                 | J             | (2            |
| c) If whole h  |  | tract ven<br>‹ (23b), t  |  | •  | •                     |              |                  |   | 5 v (23h   | ,)   |                   |               |               |
| $\frac{11(225)1}{24c)m=0}$   | 0.5 7  | 0  | 0  | 0  | 0                     | 0            | 0                | 0   | 0  | 0  | 0                 | 1             | (2            |
| d) If natural  |  |  | ole hous   |  |                       |              |                  |   |  |  |                   | J             | `             |
| ,  |  | en (24d)   |  | •  | •                     |              |                  |   | 0.5]   |  |                   |               |               |
| 24d)m= 0   | 0  | 0  | 0  | 0  | 0                     | 0            | 0                | 0   | 0  | 0  | 0                 | ]             | (2            |
| Effective air  | change   | rate - er  | iter (24a  | or (24b                                      | o) or (24             | c) or (24    | d) in box        | (25)  |  | •  | •                 |               |               |
| 25)m= 0.17   | 0.17   | 0.17   | 0.16   | 0.16   | 0.16                  | 0.16         | 0.16             | 0.16  | 0.16   | 0.17   | 0.17              |               | (2            |
| 2  |  | VII COO  |  |  |                       |              |                  |   |  |  |                   |               | -             |
| 3. Heat losse  |  |  |  |  | Not Ar                | 00           | LI voli          |   | A V I I  |  | برامد با          |               | 1 V I         |
| LEMENT   | Gros<br>area   |  | Openin<br>m  |  | Net Ar<br>A ,r        |              | U-valı<br>W/m2   |   | A X U<br>(W/I  | <)   | k-value<br>kJ/m²- |               | A X k<br>kJ/K |
| Vin <mark>dows</mark> Type   |  |  |  |  | 17.6                  |              | [1/( 0.85 )+     | _   | 14.47  |  |                   |               | (2            |
| Vin <mark>dows</mark> Type   |  |  |  |  | 7.9                   | _            | [1/( 0.85 )+     | <u> </u>  | 6.49   | Ħ  |                   |               | (2            |
| Valls Type1  | 41   |  | 17.6   | $\neg \setminus$                             | 23.4                  | X            | 0.2              | <b>—</b>  | 4.68   | Ħ,   |                   |               | (2            |
| Valls Type2  | 18.9   |  | 7.9  | ╡╹   |                       | ×            | 0.2              |   | 2.2  | 븍 ¦  |                   | = =           | (2            |
| otal area of e   | L  |  | 7.9  |  | 11                    | ╡ ^          | 0.2              |   |  |  |                   |               |               |
| for windows and  |  |  | ffective wi  | ndow H-vs                                    | 59.9                  | ated using   | r formula 1      | /[(1/  L.v.alu                                    | D) L() (A)   | e aiven in   | naragrani         | 1 2 2         | (3            |
| * include the are  |  |  |  |  |                       | aled using   | i Torritula 1    | /[( 1/O-valu                                      | <del>0</del> )+0.0+j a   | is giveri iii  | paragrapi         | 1 3.2         |               |
| abric heat lo  | ss, W/K :  | = S (A x   | U)   |  |                       |              | (26)(30)         | + (32) =  |  |  |                   | 27.84         | (3            |
| leat capacity  | Cm = S(  | (Axk)  |  |  |                       |              |                  | ((28)   | .(30) + (32  | 2) + (32a).  | (32e) =           | 584.8         | (3            |
|  | parame   | ter (TMF   | P = Cm ÷   | - TFA) ir                                    | kJ/m²K                |              |                  | Indica  | tive Value   | Low  |                   | 100           | (3            |
| hermal mass  | sments wh  | ere the de   | taila af tha   | 00004=104                                    | ion are not           | known nr     |                  |   | values of  | TMD in T   | able 1f           |               |               |
|  |  |  | ians or trie   | CONSTRUCT                                    | on are not            | KIIOWII PI   | ecisely the      | indicative  | values of  | TIVIT III I  |                   |               |               |
| or design asses<br>an be used inste  | ead of a de  | tailed calcu   | ulation.   |  |                       | ·            | ecisely the      | indicative  | values of  | TIVIP III I  |                   |               |               |
| or design asses<br>an be used inste<br>hermal bridg  | ead of a de<br>es : S (L   | tailed calcu<br>x Y) calc  | <i>ulation.</i><br>culated ι   | using Ap                                     | pendix ł              | ·            | ecisely the      | e indicative                                      | values or  | TIVIP III T  |                   | 8.99          | (3            |
| for design asses<br>an be used inste<br>Thermal bridg<br>details of therm  | ead of a de<br>es : S (L<br>al bridging                              | tailed calcu<br>x Y) calc  | <i>ulation.</i><br>culated ι   | using Ap                                     | pendix ł              | ·            | ecisely the      |   |  | TIVIF III 1  |                   |               |               |
| for design asses<br>an be used inste<br>Thermal bridg<br>details of therma<br>Total fabric he  | ead of a dea<br>es:S(L<br>al bridging<br>eat loss                    | tailed calcu<br>x Y) calc<br>are not kn                            | ulation.<br>culated (<br>own (36) =  | using Ap<br>= 0.05 x (3                      | pendix ł              | ·            | ecisely the      | (33) +  | (36) =   |  |                   | 8.99<br>36.83 |               |
| for design assessan be used instead in the following in t | ead of a decest : S (Leal bridging eat loss can                      | tailed calcu<br>x Y) calculare not known                           | ulation. culated to  | using Ap<br>= 0.05 x (3                      | pendix ł              | · (          |                  | (33) +<br>(38)m                                   | (36) =<br>= 0.33 × (   | 25)m x (5  | 1                 |               |               |
| for design assessan be used inste<br>Thermal bridg<br>details of thermation her<br>Total fabric her<br>dentilation her   | es : S (L<br>al bridging<br>eat loss<br>at loss ca                   | x Y) calc<br>x Y) calc<br>are not known<br>alculated               | ulation. culated to own (36) = I monthly   | using Ap<br>- 0.05 x (3<br>/<br>May          | pendix ł<br>1)<br>Jun | Jul          | Aug              | (33) +<br>(38)m<br>Sep                            | (36) =<br>= 0.33 × (   | 25)m x (5<br>Nov   | Dec               |               | (3            |
| for design assessan be used instead in the integral bridge details of thermal fotal fabric here. The integral of the integral  | es : S (L<br>al bridging<br>eat loss<br>at loss ca<br>Feb            | x Y) calc<br>x Y) calc<br>are not known<br>alculated<br>Mar        | ulation. culated to  | using Ap<br>= 0.05 x (3                      | pendix ł              | · (          |                  | (33) +<br>(38)m<br>Sep<br>11.99                   | (36) =<br>= 0.33 × (<br>Oct<br>12.23                                     | 25)m x (5<br>Nov<br>12.39  | 1                 |               | (3            |
| for design assessan be used instead in hermal bridge details of thermal fotal fabric hermal design and the desi | es : S (L al bridging eat loss at loss ca Feb 12.79 coefficier       | x Y) calc<br>x Y) calc<br>are not kn<br>alculated<br>Mar<br>12.71  | ulation. culated to own (36) = I monthly Apr 12.31                                   | using Ap<br>= 0.05 x (3<br>/<br>May<br>12.23 | Jun                   | Jul<br>11.83 | Aug<br>11.75     | (33) +<br>(38)m<br>Sep<br>11.99<br>(39)m          | (36) =<br>= 0.33 × (<br>Oct<br>12.23<br>= (37) + (3                      | 25)m x (5)<br>Nov<br>12.39<br>38)m                                 | Dec 12.55         |               | (3            |
| for design assessan be used instead in hermal bridge details of thermal fotal fabric hermal design and the desi | es : S (L<br>al bridging<br>eat loss<br>at loss ca<br>Feb            | x Y) calc<br>x Y) calc<br>are not known<br>alculated<br>Mar        | ulation. culated to own (36) = I monthly   | using Ap<br>- 0.05 x (3<br>/<br>May          | pendix ł<br>1)<br>Jun | Jul          | Aug              | (33) +<br>(38)m<br>Sep<br>11.99<br>(39)m<br>48.82 | $(36) =$ $= 0.33 \times ($ Oct $12.23$ $= (37) + (34)$ $49.06$           | 25)m x (5<br>Nov<br>12.39<br>38)m<br>49.22                         | Dec 12.55         | 36.83         | (3            |
| For design assessan be used instead in the used instead in the integral of the | es : S (L al bridging eat loss at loss ca Feb 12.79 coefficier 49.62 | x Y) calc<br>are not known<br>alculated<br>Mar<br>12.71<br>nt, W/K | ulation.<br>  culated to<br>  own (36) =<br>  monthly<br>  Apr<br>  12.31<br>  49.14 | using Ap<br>= 0.05 x (3<br>/<br>May<br>12.23 | Jun                   | Jul<br>11.83 | Aug<br>11.75     | (33) +<br>(38)m<br>Sep<br>11.99<br>(39)m<br>48.82 | $(36) =$ $= 0.33 \times ($ Oct $12.23$ $= (37) + (34)$ $49.06$ Average = | 25)m x (5<br>Nov<br>12.39<br>38)m<br>49.22<br>Sum(39) <sub>1</sub> | Dec 12.55         |               | (3            |
| 38)m= 12.87<br>Heat transfer   | es : S (L al bridging eat loss at loss ca Feb 12.79 coefficier 49.62 | x Y) calc<br>are not known<br>alculated<br>Mar<br>12.71<br>nt, W/K | ulation.<br>  culated to<br>  own (36) =<br>  monthly<br>  Apr<br>  12.31<br>  49.14 | using Ap<br>= 0.05 x (3<br>/<br>May<br>12.23 | Jun                   | Jul<br>11.83 | Aug<br>11.75     | (33) +<br>(38)m<br>Sep<br>11.99<br>(39)m<br>48.82 | $(36) =$ $= 0.33 \times ($ Oct $12.23$ $= (37) + (34)$ $49.06$           | 25)m x (5<br>Nov<br>12.39<br>38)m<br>49.22<br>Sum(39) <sub>1</sub> | Dec 12.55         | 36.83         | (3            |

Number of days in month (Table 1a)

| Numbe              |                  |            | IIII (Tab               | <del></del> |            | Ι.           | ı                 |             | Γ.           | I a .              | l                      | I _      | İ         |             |
|--------------------|------------------|------------|-------------------------|-------------|------------|--------------|-------------------|-------------|--------------|--------------------|------------------------|----------|-----------|-------------|
|                    | Jan              | Feb        | Mar                     | Apr         | May        | Jun          | Jul               | Aug         | Sep          | Oct                | Nov                    | Dec      |           | (44)        |
| (41)m=             | 31               | 28         | 31                      | 30          | 31         | 30           | 31                | 31          | 30           | 31                 | 30                     | 31       |           | (41)        |
|                    |                  |            |                         |             |            |              |                   |             |              |                    |                        |          |           |             |
| 4. Wa              | ater heat        | ing ener   | rgy requi               | irement:    |            |              |                   |             |              |                    |                        | kWh/ye   | ear:      |             |
| Veerim             | ned occu         | nancy I    | NI                      |             |            |              |                   |             |              |                    |                        |          | 1         | (42)        |
|                    |                  |            |                         | [1 - exp    | (-0.0003   | 349 x (TF    | -A -13.9          | )2)1 + 0.0  | 0013 x (     | TFA -13.           |                        | .3       |           | (42)        |
|                    | A £ 13.9         |            |                         |             | (          | •            |                   | , ,,        |              |                    | - /                    |          |           |             |
|                    |                  |            | ater usaç               |             |            |              |                   |             |              |                    |                        | 3.73     |           | (43)        |
|                    |                  | _          | hot water<br>person pei |             |            | -            | -                 | to achieve  | a water us   | se target o        | f                      |          |           |             |
| not more           |                  |            | · ·                     |             | i          | <del> </del> |                   |             |              |                    |                        |          | I         |             |
| Hot wot            | Jan              | Feb        | Mar<br>day for ea       | Apr         | May        | Jun          | Jul<br>Table 10 Y | Aug         | Sep          | Oct                | Nov                    | Dec      |           |             |
|                    |                  |            |                         |             |            |              |                   | · ·         | 1            |                    | 1                      |          | 1         |             |
| (44)m=             | 97.6             | 94.05      | 90.5                    | 86.96       | 83.41      | 79.86        | 79.86             | 83.41       | 86.96        | 90.5               | 94.05                  | 97.6     |           | <del></del> |
| Energy             | content of       | hot water  | used - cal              | culated m   | anthly – 1 | 100 v Vd r   | m v nm v F        | Tm / 360(   | O kWh/mor    | Total = Su         |                        |          | 1064.76   | (44)        |
| 0,                 |                  |            | i                       | i           |            |              |                   |             |              |                    |                        | ,        |           |             |
| (45)m=             | 144.74           | 126.59     | 130.63                  | 113.89      | 109.28     | 94.3         | 87.38             | 100.27      | 101.47       | 118.25             | 129.08                 | 140.18   |           |             |
| If instan          | taneous w        | ater heati | ng at point             | of use (no  | hot water  | etoraga)     | enter∩in          | hoves (46   |              | Total = Su         | m(45) <sub>112</sub> = |          | 1396.07   | (45)        |
|                    |                  |            | ,                       |             |            |              |                   |             |              |                    | r                      |          |           | (10)        |
| (46)m=<br>\/\/ator | 21.71<br>storage | 18.99      | 19.59                   | 17.08       | 16.39      | 14.14        | 13.11             | 15.04       | 15.22        | 17.74              | 19.36                  | 21.03    |           | (46)        |
|                    | _                |            | includir                | na any sa   | olar or M  | WHE          | ctorage           | within e    | ame ves      | col                |                        | 0        |           | (47)        |
|                    |                  | `          |                         |             |            |              |                   |             | arrie ves    | 361                |                        | 0        |           | (47)        |
|                    |                  | 7          | ind no ta               |             |            |              |                   | , ,         | ers) ente    | er 'O' in <i>(</i> | <b>4</b> 7)            |          |           |             |
|                    | storage          |            | not wate                | ) (till ii  | ioidaes i  | Hotaritar    | icous oc          | ///IDI DOII | Olo) Chi     | 31 0 111 (         | ,,                     |          |           |             |
|                    |                  |            | eclared I               | oss facto   | or is kno  | wn (kWł      | n/day):           |             |              |                    |                        | 0        |           | (48)        |
| •                  |                  |            | m Table                 |             |            | `            | • /               |             |              |                    |                        | 0        |           | (49)        |
| •                  |                  |            | storage                 |             | ar         |              |                   | (48) x (49  | ) =          |                    |                        | 10       |           | (50)        |
|                    |                  |            | eclared o               | -           |            | or is not    | known:            | (10) X (10  | , –          |                    | '                      | 10       |           | (30)        |
|                    |                  |            | factor fr               | -           |            |              |                   |             |              |                    | 0.                     | 02       |           | (51)        |
|                    | •                | •          | ee secti                | on 4.3      |            |              |                   |             |              |                    |                        |          |           |             |
|                    | e factor         | -          |                         |             |            |              |                   |             |              |                    | 1.                     | .03      |           | (52)        |
| Tempe              | erature fa       | actor fro  | m Table                 | 2b          |            |              |                   |             |              |                    | 0                      | .6       |           | (53)        |
| •                  |                  |            | storage                 | , kWh/ye    | ear        |              |                   | (47) x (51  | ) x (52) x ( | 53) =              | 1.                     | .03      |           | (54)        |
| Enter              | (50) or (        | 54) in (5  | 55)                     |             |            |              |                   |             |              |                    | 1.                     | .03      |           | (55)        |
| Water              | storage          | loss cal   | culated t               | for each    | month      |              |                   | ((56)m = (  | (55) × (41)  | m                  |                        |          |           |             |
| (56)m=             | 32.01            | 28.92      | 32.01                   | 30.98       | 32.01      | 30.98        | 32.01             | 32.01       | 30.98        | 32.01              | 30.98                  | 32.01    |           | (56)        |
| If cylinde         | er contains      | dedicated  | d solar sto             | rage, (57)  | m = (56)m  | x [(50) – (  | H11)] ÷ (5        | 0), else (5 | 7)m = (56)   | m where (          | H11) is fro            | m Append | ı<br>ix H |             |
| (57)m=             | 32.01            | 28.92      | 32.01                   | 30.98       | 32.01      | 30.98        | 32.01             | 32.01       | 30.98        | 32.01              | 30.98                  | 32.01    |           | (57)        |
| , ,                |                  |            | <u> </u>                | ļ           | <u> </u>   | 1 00.00      | 1 02.01           | 02.01       | 1 00.00      | 02.01              | ļ                      | <u> </u> |           | , ,         |
|                    | -                |            | nual) fro               |             |            | TO)          | (EO) 00           | NE . (44)   |              |                    |                        | 0        |           | (58)        |
|                    | -                |            | culated t               |             |            | •            | . ,               | , ,         |              | r tharma           | otot)                  |          |           |             |
| •                  |                  |            |                         |             |            |              |                   | <del></del> | cylinde      |                    |                        | 22.26    |           | (59)        |
| (59)m=             | 23.26            | 21.01      | 23.26                   | 22.51       | 23.26      | 22.51        | 23.26             | 23.26       | 22.51        | 23.26              | 22.51                  | 23.26    |           | (38)        |
| Combi              | loss cal         | culated    | for each                | month       | (61)m =    | (60) ÷ 30    | 65 × (41)         | )m          |              |                    |                        |          | •         |             |
| (61)m=             | 0                | 0          | 0                       | 0           | 0          | 0            | 0                 | 0           | 0            | 0                  | 0                      | 0        |           | (61)        |

| Total heat    | equired for                | water he    | eating ca  | alculated  | l for ea | ch month       | (62)r    | n = 0.8     | 85 × (4    | 45)m +    | (46)m +                  | (57)m +    | (59)m + (61)m |                            |
|---------------|----------------------------|-------------|------------|------------|----------|----------------|----------|-------------|------------|-----------|--------------------------|------------|---------------|----------------------------|
| (62)m= 200    | <del>-i</del>              | 185.91      | 167.38     | 164.56     | 147.7    |                | 155.     |             | 54.96      | 173.53    | ì                        | 195.45     |               | (62)                       |
| Solar DHW in  | put calculated             | using App   | endix G oı | · Appendix | H (neg   | ative quantity | y) (ent  | er '0' if n | no solar   | contribu  | tion to wate             | r heating) | l             |                            |
| (add addition | onal lines if              | FGHRS       | and/or \   | vwhrs      | applie   | s, see Ap      | pend     | ix G)       |            |           |                          |            |               |                            |
| (63)m= 0      | 0                          | 0           | 0          | 0          | 0        | 0              | 0        |             | 0          | 0         | 0                        | 0          |               | (63)                       |
| Output from   | n water hea                | ter         |            |            | •        | •              |          |             | •          |           |                          |            | •             |                            |
| (64)m= 200    | .02 176.52                 | 185.91      | 167.38     | 164.56     | 147.7    | 142.66         | 155.     | 55 15       | 54.96      | 173.53    | 182.58                   | 195.45     |               |                            |
|               | •                          |             |            |            |          |                | •        | Output f    | from wa    | ter heate | er (annual) <sub>1</sub> | 12         | 2046.91       | (64)                       |
| Heat gains    | from water                 | heating,    | kWh/m      | onth 0.2   | 5 ′ [0.8 | 5 × (45)m      | + (6     | 1)m] +      | - 0.8 x    | [(46)m    | + (57)m                  | + (59)m    | ]             |                            |
| (65)m= 92.    | 35 82.03                   | 87.66       | 80.66      | 80.56      | 74.15    | 73.28          | 77.5     | 6 7         | 6.53       | 83.54     | 85.72                    | 90.83      |               | (65)                       |
| include (     | 57)m in cal                | culation of | of (65)m   | only if c  | ylinde   | is in the      | dwelli   | ng or       | hot wa     | ater is f | rom com                  | munity h   | eating        |                            |
| 5. Interna    | l gains (see               | e Table 5   | and 5a     | ):         |          |                |          |             |            |           |                          |            |               |                            |
| Metabolic o   | gains (Table               | e 5), Wat   | ts         |            |          |                |          |             |            |           |                          |            |               |                            |
| Ja            |                            | Mar         | Apr        | May        | Jun      | Jul            | Αι       | ıg          | Sep        | Oct       | Nov                      | Dec        |               |                            |
| (66)m= 137    | .76 137.76                 | 137.76      | 137.76     | 137.76     | 137.7    | 137.76         | 137.     | 76 13       | 37.76      | 137.76    | 137.76                   | 137.76     |               | (66)                       |
| Lighting ga   | ins (calcula               | ted in Ap   | pendix     | L, equat   | ion L9   | or L9a), a     | lso s    | ee Tab      | ole 5      |           |                          | -          |               |                            |
| (67)m= 45.    | 05 40.02                   | 32.54       | 24.64      | 18.42      | 15.55    | 16.8           | 21.8     | 34 2        | 9.31       | 37.22     | 43.44                    | 46.31      |               | (67)                       |
| Appliances    | gains (calc                | ulated ir   | Append     | dix L, eq  | uation   | L13 or L1      | 3a), a   | also se     | ee Tab     | ole 5     |                          |            |               |                            |
| (68)m= 301    | .71 304.84                 | 296.95      | 280.16     | 258.96     | 239.0    | 3 225.72       | 222.     | 59 23       | 30.48      | 247.27    | 268.47                   | 288.4      |               | (68)                       |
| Cooking ga    | ins (calcu <mark>la</mark> | ated in A   | ppendix    | L, equa    | tion L1  | 5 or L15a      | ), also  | see         | Table      | 5         |                          |            |               |                            |
| (69)m= 51.    | 07 51.07                   | 51.07       | 51.07      | 51.07      | 51.07    | 51.07          | 51.0     | 7 5         | 1.07       | 51.07     | 51.07                    | 51.07      |               | (69)                       |
| Pumps and     | l fans gains               | (Table 5    | ōa)        |            |          |                |          |             |            |           |                          |            |               |                            |
| (70)m = 0     | 0                          | 0           | 0          | 0          | 0        | 0              | 0        |             | 0          | 0         | 0                        | 0          |               | (70)                       |
| Losses e.g    | . evaporatio               | n (nega     | tive valu  | es) (Tab   | le 5)    |                |          |             |            |           |                          |            |               |                            |
| (71)m= -91    | 84 -91.84                  | -91.84      | -91.84     | -91.84     | -91.8    | -91.84         | -91.     | 84 -9       | 91.84      | -91.84    | -91.84                   | -91.84     |               | (71)                       |
| Water heat    | ing gains (1               | Table 5)    |            |            |          |                |          | -           |            |           |                          |            |               |                            |
| (72)m= 124    | .12 122.07                 | 117.82      | 112.03     | 108.28     | 102.9    | 98.49          | 104.     | 25 1        | 06.3       | 112.29    | 119.05                   | 122.08     |               | (72)                       |
| Total inter   | nal gains =                | •           |            |            | (6       | 6)m + (67)n    | า + (68  | )m + (69    | 9)m + (7   | 70)m + (  | 71)m + (72)              | m          |               |                            |
| (73)m= 567    | .88 563.93                 | 544.31      | 513.82     | 482.64     | 454.5    | 438            | 445.     | 67 46       | 63.08      | 493.77    | 527.95                   | 553.78     |               | (73)                       |
| 6. Solar g    |                            |             |            |            |          |                |          |             |            |           |                          |            |               |                            |
| ŭ             | are calculated             | Ü           |            |            |          | •              | itions t | o conve     | ert to the | e applica |                          | ion.       |               |                            |
| Orientation   | : Access F<br>Table 6d     |             | Area<br>m² |            |          | lux<br>able 6a |          | g_<br>Tabl  | _<br>le 6b | 7         | FF<br>able 6c            |            | Gains<br>(W)  |                            |
| North 0.      |                            |             |            |            | _        |                | 1 [      |             |            |           |                          |            |               | 7(74)                      |
|               | 9x 0.77<br>9x 0.77         |             | 17         |            | ×        | 10.63          | X        |             | 0.5        | _         | 0.8                      | =          | 51.88         | (74)                       |
|               |                            | <del></del> |            |            | x        | 20.32          | X        |             | 0.5        | _         | 0.8                      | =          | 99.14         | ∫(74)<br>¬(74)             |
|               | 9x 0.77                    | X           | 17         |            | ×        | 34.53          | ] X [    |             | 0.5        | _         | 0.8                      | _          | 168.46        | (74)                       |
|               | 9x 0.77<br>9x 0.77         |             | 17         |            | ×        | 55.46          | ]        |             | 0.5        | _         | 0.8                      | ┥ =        | 270.6         |                            |
|               |                            |             |            |            | ×        | 74.72          | ]        |             | ).5        | 」 ×       | 0.8                      | _ =        | 364.52        | ](74)<br>] <sub>(74)</sub> |
|               |                            | ×           | 17         |            | ×        | 79.99          | ]        |             | ).5        | _  ×      | 0.8                      | <b></b>    | 390.23        | ╡                          |
|               | 9x 0.77                    | X           | 17         | .0         | X        | 74.68          | X        | 0           | ).5        | X         | 0.8                      | =          | 364.33        | (74)                       |
| INOLLU V      | 9x 0.77                    | X           | 17         | _          | x        | 59.25          | X        | _           | ).5        | 7 x [     | 0.8                      |            | 289.05        | (74)                       |

| North   | 0.9x   | 0.77   | X  | 17.   | 6   | x  | 41.52   | 2   | x  | 0.5   | X  | 0.8  | =   | 202.55 | (74)   |
|---|--|--|--|---|---|--|---|---|--|---|--|--|---|--------|--|
| North   | 0.9x   | 0.77   | X  | 17.   | 6   | x  | 24.19   | )   | x  | 0.5   | x  | 0.8  | =   | 118.01 | (74)   |
| North   | 0.9x   | 0.77   | X  | 17.   | 6   | x  | 13.12   | 2   | x  | 0.5   | x  | 0.8  | =   | 64     | (74)   |
| North   | 0.9x   | 0.77   | X  | 17.   | 6   | x  | 8.86  |   | x  | 0.5   | x  | 0.8  | =   | 43.25  | (74)   |
| East  | 0.9x   | 0.77   | x  | 7.9   | )   | x  | 19.64   |   | x  | 0.5   | ×  | 0.8  | _ =   | 43.01  | (76)   |
| East  | 0.9x   | 0.77   | x  | 7.9   | )   | x  | 38.42   | 2   | x  | 0.5   | x  | 0.8  | =   | 84.14  | (76)   |
| East  | 0.9x   | 0.77   | x  | 7.9   | )   | x  | 63.27   | ,   | x  | 0.5   | ×  | 0.8  |   | 138.56 | (76)   |
| East  | 0.9x   | 0.77   | x  | 7.9   | )   | x  | 92.28   | 3   | x  | 0.5   | ×  | 0.8  | _ =   | 202.08 | (76)   |
| East  | 0.9x   | 0.77   | X  | 7.9   | 9   | x  | 113.09  | 9   | x  | 0.5   | x  | 0.8  | =   | 247.66 | (76)   |
| East  | 0.9x   | 0.77   | X  | 7.9   | 9   | X  | 115.77  | 7   | x  | 0.5   | ×  | 0.8  | =   | 253.52 | (76)   |
| East  | 0.9x   | 0.77   | X  | 7.9   | 9   | X  | 110.22  | 2   | x  | 0.5   | ×  | 0.8  | =   | 241.36 | (76)   |
| East  | 0.9x   | 0.77   | X  | 7.9   | 9   | x  | 94.68   | 3   | x  | 0.5   | x  | 0.8  | =   | 207.33 | (76)   |
| East  | 0.9x   | 0.77   | x  | 7.9   | )   | x  | 73.59   | )   | x  | 0.5   | ×  | 0.8  | =   | 161.15 | (76)   |
| East  | 0.9x   | 0.77   | X  | 7.9   | 9   | x  | 45.59   | )   | x  | 0.5   | x  | 0.8  | =   | 99.83  | (76)   |
| East  | 0.9x   | 0.77   | X  | 7.9   | 9   | x  | 24.49   | )   | x  | 0.5   | x  | 0.8  | =   | 53.63  | (76)   |
| East  | 0.9x   | 0.77   | x  | 7.9   | 9   | x  | 16.15   | 5   | x  | 0.5   | x  | 0.8  |   | 35.37  | (76)   |
|   |  |  |  |   |   |  |   |   |  |   |  |  |   |        |  |
| Solar g   | ains in  | watts, calc  | culated  | for each  | n mont  | h  |   | (8  | 83)m   | Sum(74)m .  | (8 <mark>2</mark> )m   |  |   |        |  |
| (83)m=  | 94.89  |  | 307.02   | 472.68  | 612.18  |  | 43.75 60  | 5.69  | 496.   | 363.7   | 217.8  | 5 117.63                                       | 78.62   |        | (83)   |
| Total g   | ains – i   | nternal and  | d solar  | (84)m =   | : (73)m   | + (  | 33)m , wa   | atts  |  |   |  |  | •   |        |  |
| (84)m=  | 662.77   | 747.2  | 351.33   | 986.5   | 1094.82   | 2 10   | 98.31 104   | 43.69   | 942.   | 04 826.78   | 711.6  | 2 645.58                                       | 632.4   |        | (84)   |
| 7 Me  | on inter   | nal tarana   |  | /1 7  |   |  |   |   |  |   |  |  |   |        |  |
|   | arınter  | nai terribe  | rature (   | heating   | seaso   | ท)   |   |   |  |   |  |  |   |        |  |
|   |  |  |  | (heating<br>eriods in   |   |  | area from   | n Tabl  | le 9.  | Th1 (°C)  | •  | •  |   | 21     | (85)   |
| Temp  | erature  | during he  | ating po   | eriods in   | the liv   | ring   |   |   | le 9,  | Th1 (°C)  | ī  | г  |   | 21     | (85)   |
| Temp  | erature<br>ition fac   | during hea   | ating pons   | eriods in   | the live<br>a, h1,r   | ving<br>m (s   | ee Table  |   |  |   | Oct  | Nov  | Dec   | 21     | (85)   |
| Temp  | erature  | during he  | ating po   | eriods in   | the liv   | ring<br>m (s   | ee Table<br>Jun J   | 9a)   | le 9,  | ug Sep  | Oct  | Nov<br>0.81                                    | Dec<br>0.88                                     | 21     | (85)   |
| Temp<br>Utilisa<br>(86)m=   | erature<br>Ition fac<br>Jan<br>0.87  | during heater for gain   | ating points for line Mar  | eriods in<br>iving are<br>Apr<br>0.56   | the live<br>ea, h1,r<br>May   | ring<br>m (s   | ee Table<br>Jun J<br>0.28 0   | 9a)<br>Jul  | At<br>0.2  | ug Sep<br>4 0.4   |  | +  |   | 21     |  |
| Temp<br>Utilisa<br>(86)m=<br>Mean   | erature<br>Ition fac<br>Jan<br>0.87<br>interna   | during heater for gain Feb 0.81  | ating points for line Mar 0.72 ure in I  | eriods in iving are Apr 0.56  | n the livea, h1,r<br>May<br>0.41  | m (s   | ee Table Jun J 0.28 0 w steps 3   | 9a) Jul 0.2 3 to 7  | Au<br>0.2<br>in T  | ug Sep<br>4 0.4<br>able 9c)   | 0.64   | 0.81   | 0.88  | 21     | (86)   |
| Temp<br>Utilisa<br>(86)m=   | erature<br>Ition fac<br>Jan<br>0.87  | during heater for gain Feb 0.81  | ating points for line Mar  | eriods in<br>iving are<br>Apr<br>0.56   | the live<br>ea, h1,r<br>May   | m (s   | ee Table Jun J 0.28 0 w steps 3   | 9a)<br>Jul  | At<br>0.2  | ug Sep<br>4 0.4<br>able 9c)   |  | 0.81   |   | 21     |  |
| Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=   | erature  Jan  0.87  interna  20.24  erature  | during heater for gain Feb 0.81 I temperat 20.43 during heater for gain for | ns for li<br>Mar<br>0.72<br>ure in l<br>20.68  | eriods in iving are 0.56 iving are 20.88 eriods in  | n the live<br>ea, h1,r<br>May<br>0.41<br>ea T1 (<br>20.97   | ring<br>m (s<br>follo  | Jun J<br>Jun J<br>J<br>J<br>J<br>J<br>J<br>J<br>J<br>J<br>J<br>J<br>J<br>J<br>J   | 9a) Jul 0.2 3 to 7  | 0.2<br>in T  | ug Sep<br>4 0.4<br>(able 9c)<br>1 20.98   | 0.64   | 0.81   | 0.88  | 21     | (86)   |
| Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=   | erature Jan 0.87 interna 20.24   | during heater for gain Feb 0.81 I temperat 20.43 during heater for gain for | ns for li<br>Mar<br>0.72<br>ure in l   | eriods in iving are Apr 0.56 iving are 20.88  | n the live<br>ea, h1,r<br>May<br>0.41<br>ea T1 (<br>20.97   | follo  | Jun J<br>0.28 0<br>w steps 3<br>0.99 2<br>relling from  | 9a) Jul 0.2 3 to 7  | 0.2<br>in T  | ug Sep 4 0.4 able 9c) 1 20.98 0, Th2 (°C)   | 0.64   | 0.81   | 0.88  | 21     | (86)   |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m=   | ution factors Jan 0.87 interna 20.24 erature 20.35   | during heater for gain Feb 0.81 I temperat 20.43 during heater for gain for | ns for li<br>Mar<br>0.72<br>ure in l<br>20.68<br>ating po  | eriods in iving are 0.56 iving are 20.88 eriods in 20.36  | n the lives, h1,r<br>May<br>0.41<br>ea T1 (<br>20.97<br>n rest o<br>20.36   | follo  | Jun Jo.28 0  w steps 3  velling from 10:36 20   | 9a) Jul 0.2 3 to 7 21 m Tab 0.36  | 0.2<br>in T<br>21<br>ole 9                                 | ug Sep 4 0.4 able 9c) 1 20.98 0, Th2 (°C)   | 20.84  | 0.81   | 0.88  | 21     | (86)   |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m=   | ution factors Jan 0.87 interna 20.24 erature 20.35   | during heater for gain Feb 0.81 ltemperat 20.43 during heater 20.35  | ns for li<br>Mar<br>0.72<br>ure in l<br>20.68<br>ating po  | eriods in iving are 0.56 iving are 20.88 eriods in 20.36  | n the lives, h1,r<br>May<br>0.41<br>ea T1 (<br>20.97<br>n rest o<br>20.36   | ring (s  | Jun J<br>Jun J<br>J<br>J<br>J<br>J<br>J<br>J<br>J<br>J<br>J<br>J<br>J<br>J<br>J | 9a) Jul 0.2 3 to 7 21 m Tab 0.36  | 0.2<br>in T<br>21<br>ole 9                                 | Ig Sep 4 0.4 able 9c) 20.98 0, Th2 (°C) 36 20.36  | 20.84  | 0.81   | 0.88  | 21     | (86)   |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m=  | ution factors Jan 0.87 interna 20.24 erature 20.35 ution factors 0.85  | during heat control of the control o | ns for ling por ns for ling por ns for room ns for roo | eriods in iving are Apr 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54   | n the livea, h1,1<br>May<br>0.41<br>ea T1 (<br>20.97<br>n rest o<br>20.36<br>welling<br>0.38  | follo  | Jun J 0.28 0 w steps 3 20.99 2 relling from 0.36 20 m (see T 0.25 0.  | 9a) Jul 0.2 3 to 7 21 m Tab 0.36 Table 9                                | Au<br>0.2<br>in T<br>2 <sup>4</sup><br>20.3<br>20.3<br>0.2 | lig Sep 4 0.4  (able 9c) 1 20.98  0, Th2 (°C) 36 20.36  | 0.64<br>20.84<br>20.36                                       | 20.52  | 0.88<br>20.19<br>20.35                          |        | (86)<br>(87)<br>(88)                         |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m=  | ution factors Jan 0.87 interna 20.24 erature 20.35 ution factors 0.85  | during heater for gain Feb 0.81 ltemperat 20.43 during heater for gain 0.8 ltemperat   | ns for ling por ns for ling por ns for room ns for roo | eriods in iving are Apr 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54   | n the livea, h1,1<br>May<br>0.41<br>ea T1 (<br>20.97<br>n rest o<br>20.36<br>welling<br>0.38  | folloging folloging from (s  | Jun Jun Jun Jun Jun Jun Jun Jun Jun Jun   | 9a) Jul 0.2 3 to 7 21 m Tab 0.36 Table 9                                | Au<br>0.2<br>in T<br>2 <sup>4</sup><br>20.3<br>20.3<br>0.2 | ug Sep 4 0.4 able 9c) 1 20.98 0, Th2 (°C) 36 20.36 to 7 in Tabl   | 0.64<br>20.84<br>20.36                                       | 0.81<br>20.52<br>20.36<br>0.79                 | 0.88<br>20.19<br>20.35                          |        | (86)<br>(87)<br>(88)                         |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean   | erature Jan 0.87 interna 20.24 erature 20.35 ation factors 0.85 interna  | during heater for gain Feb 0.81 ltemperat 20.43 during heater for gain 0.8 ltemperat   | ns for li Mar 0.72 ure in l 20.68 ating per 20.35 ns for r 0.7 ure in t  | eriods in ving are 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54 the rest of  | ea, h1,r<br>May<br>0.41<br>ea T1 (<br>20.97<br>erest o<br>20.36<br>welling<br>0.38  | folloging folloging from (s  | Jun Jun Jun Jun Jun Jun Jun Jun Jun Jun   | 9a) Jul 0.2 3 to 7 21 m Tab 0.36 Table 9 .18                            | Au 0.2 in T 2 in T 2 20.3 20.3 20.3 3                      | ug Sep 4 0.4  able 9c) 1 20.98  0, Th2 (°C) 36 20.36  to 7 in Tabl 36 20.34   | 0.64<br>20.84<br>20.36<br>0.61<br>e 9c)<br>20.17             | 0.81<br>20.52<br>20.36<br>0.79                 | 0.88<br>20.19<br>20.35<br>0.87                  | 21     | (86)<br>(87)<br>(88)<br>(89)                 |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m=                                  | erature Jan 0.87 interna 20.24 erature 20.35 ation fact 0.85 interna 19.35   | during heat tor for gain leading heat leadin | ns for ling por ns for roure in the second s | eriods in iving are 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54 the rest of 20.22   | ea, h1,1<br>May<br>0.41<br>ea T1 (<br>20.97<br>n rest o<br>20.36<br>welling<br>0.38<br>of dwel<br>20.32                             | ring m (s  | Dun Jun Jun Jun Jun Jun Jun Jun Jun Jun J   | 9a) Jul 0.2 3 to 7 21 m Tab 0.36 Table 9 .18 w step 0.36                | Au 0.2 in T 22 20.3 20.3 20.3                              | ug Sep 4 0.4 able 9c) 1 20.98 0, Th2 (°C) 36 20.36 to 7 in Tabl 36 20.34  | 0.64<br>20.84<br>20.36<br>0.61<br>e 9c)<br>20.17             | 0.81<br>20.52<br>20.36<br>0.79                 | 0.88<br>20.19<br>20.35<br>0.87                  |        | (86)<br>(87)<br>(88)<br>(89)                 |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m=                                  | erature Jan 0.87 interna 20.24 erature 20.35 etion fac 0.85 interna 19.35  | during heater to represent the second | ns for li Mar 0.72 ure in l 20.68 ating po 20.35 ns for r 0.7 ure in t 19.95   | eriods in iving are Apr 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54 the rest of 20.22 er the who                                    | ea, h1,r<br>May<br>0.41<br>ea T1 (<br>20.97<br>n rest o<br>20.36<br>welling<br>0.38<br>of dwel<br>20.32                             | ring (s) (s) (s) (s) (s) (s) (s) (s) (s) (s)   | Un Jun Jun Jun Jun Jun Jun Jun Jun Jun Ju   | 9a) Jul 0.2 3 to 7 21 m Tab 0.36 Table 9 .18 w step 0.36                | Au 0.2 in T 2 in T 2 20.3 0.2 20.3                         | ug Sep 4 0.4 fable 9c) 20.98 0, Th2 (°C) 36 20.36 to 7 in Tabl 36 20.34 f fLA) x T2   | 0.64  20.84  20.36  0.61  e 9c)  20.17  LA = Liv             | 0.81 20.52 20.36 0.79 19.74 ving area ÷ (-     | 0.88<br>20.19<br>20.35<br>0.87<br>19.28<br>4) = |        | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91) |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m=                                  | erature  Jan 0.87  interna 20.24  erature 20.35  ation fact 0.85  interna 19.35  interna 19.71   | during heat tor for gain leading heat leadin | ns for li Mar 0.72 ure in l 20.68 ating pe 20.35 ns for r 0.7 ure in t 19.95 ure (for  | eriods in iving are 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54 the rest of 20.22 r the who 20.48                                   | n the lives, h1,1 May 0.41 ea T1 (20.97 n rest of 20.36 welling 0.38 of dwelling 20.32 ole dwelling 20.58                           | ring m (s  | Dun Jun Jun Jun Jun Jun Jun Jun Jun Jun J   | 9a) Jul 0.2 3 to 7 21 m Tab 0.36 Table 9 .18 w step 0.36                | Au 0.2 in T 22 20.3 20.3 20.3 20.6                         | ug Sep 4 0.4 able 9c) 1 20.98 0, Th2 (°C) 36 20.36 to 7 in Tabl 36 20.34 f fLA) x T2 62 20.6  | 0.64<br>20.84<br>20.36<br>0.61<br>e 9c)<br>20.17<br>LA = Liv | 0.81  20.52  20.36  0.79  19.74  ving area ÷ ( | 0.88<br>20.19<br>20.35<br>0.87                  |        | (86)<br>(87)<br>(88)<br>(89)                 |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m=  Mean (92)m= Apply               | erature Jan 0.87 interna 20.24 erature 20.35 etion fac 0.85 interna 19.35 interna 19.71 adjustr  | during heat tor for gain leading heat 20.43 during heat 20.35 ctor for gain 0.8 ltemperat 19.61 ltemperat 19.94 ment to the  | ating points for line Mar 0.72 ure in l 20.68 ating points for r 0.7 ure in t 19.95 ure (for 20.24 at mean   | eriods in iving are Apr 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54 the rest of 20.22 r the who 20.48 internal                      | the lives, h1,r May 0.41  ea T1 (20.97  rest of 20.36  welling 0.38  of dwelling 20.32  ole dwelling 20.58  tempe                   | ring m (s follows) follows fol | y steps 3 0.28 0 w steps 3 0.99 2 relling from 1 0.25 0. T2 (follow 10.36 20 g) = fLA > 1 0.61 20 ure from T  | 9a) Jul 0.2 3 to 7 21 m Tab 0.36  Fable 9 0.36  × T1 + 0.62  Table 4    | Au 0.2 in T 2 2 in T 2 2 20.3 0.2 0.2 0.3 4 4 0.4          | ag Sep 4 0.4 able 9c) 20.98 0, Th2 (°C) 36 20.36 to 7 in Tabl 36 20.34 f - fLA) x T2 62 20.6 where approximates   | 0.64  20.84  20.36  0.61  e 9c)  20.17  LA = Liv             | 0.81 20.52 20.36 0.79 19.74 ving area ÷ (      | 0.88<br>20.19<br>20.35<br>0.87<br>19.28<br>4) = |        | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91) |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m= Mean (92)m= Apply (93)m=         | erature  Ition fact  Jan  0.87  interna  20.24  erature  20.35  Ition fact  0.85  interna  19.35  interna  19.71  adjustr  19.71                       | during heat tor for gain leading heat 20.43 during heat 20.35 etor for gain leading heat 19.61 leading heat 19.94 leading heat  | ating pons for line ating pons for roure in the second sec | eriods in iving are 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54 the rest of 20.22 r the who 20.48                                   | n the lives, h1,1 May 0.41 ea T1 (20.97 n rest of 20.36 welling 0.38 of dwelling 20.32 ole dwelling 20.58                           | ring m (s follows) follows fol | y steps 3 0.28 0 w steps 3 0.99 2 relling from 1 0.25 0. T2 (follow 10.36 20 g) = fLA > 1 0.61 20 ure from T  | 9a) Jul 0.2 3 to 7 21 m Tab 0.36 Table 9 .18 w step 0.36                | Au 0.2 in T 22 20.3 20.3 20.3 20.6                         | ag Sep 4 0.4 able 9c) 20.98 0, Th2 (°C) 36 20.36 to 7 in Tabl 36 20.34 f - fLA) x T2 62 20.6 where approximates   | 0.64<br>20.84<br>20.36<br>0.61<br>e 9c)<br>20.17<br>LA = Liv | 0.81 20.52 20.36 0.79 19.74 ving area ÷ (      | 0.88<br>20.19<br>20.35<br>0.87<br>19.28<br>4) = |        | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91) |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m=  Mean (92)m= Apply (93)m= 8. Spa | erature  Jan  0.87  interna 20.24  erature 20.35  etion fac  0.85  interna 19.35  interna 19.71  adjustr 19.71  ace hea                                | during heat tor for gain leading heat 20.43 during heat 20.35 etor for gain leading heat 19.61 leading heat 19.94 leading require ting require to the leading require ting require to the leading require ting require to the leading require ting require to the leading require ting require to the leading require ting re | ns for ling por line in line i | eriods in iving are Apr 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54 che rest of 20.22 r the who 20.48 internal 20.48                | n the lives, h1,1 May 0.41 ea T1 (20.97 n rest o 20.36 welling 0.38 of dwel 20.32 ole dwel 20.58 tempe 20.58                        | ring m (s follow 2 f dw | w steps 3 0.28 0 w steps 3 0.99 2 relling from 1 0.25 0. T2 (follow 10.36 20 0.36 20 0.36 20 0.61 20 0.61 20 0.61 20  | 9a) Jul 0.2 3 to 7 21 m Tab 0.36 Table 9 0.36  × T1 + 0.62 Table 4 0.62 | Au 0.2 in T 2 in T 2 20.6  0.2  1. (1 - 1) 20.6  20.6      | alg Sep 4 0.4  able 9c) 20.98  0, Th2 (°C) 36 20.36  to 7 in Tabl 36 20.34  f  fLA) x T2 62 20.6  where approximates a series of the control | 0.64  20.84  20.36  0.61  e 9c)  20.17  LA = Liv             | 0.81  20.52  20.36  0.79  19.74  ving area ÷ ( | 0.88  20.19  20.35  0.87  19.28  4) =  19.65    | 0.4    | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91) |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m=  Mean (92)m= Apply (93)m= 8. Spa | erature  Ition factor  Jan  0.87  interna 20.24  erature 20.35  Ition factor 0.85  interna 19.35  interna 19.71 adjustr 19.71 ace head to the internal | during heat tor for gain leading heat 20.43 during heat 20.35 etor for gain leading heat 19.61 leading heat 19.94 leading require ting require to the leading require ting require to the leading require ting require to the leading require ting require to the leading require ting require to the leading require ting re | ating points for line of the content | eriods in iving are Apr 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54 the rest of 20.22 r the who 20.48 internal 20.48 internal 20.48 | n the lives, h1,1 May 0.41 ea T1 (20.97 n rest of 20.36 welling 0.38 of dwelling 20.32 ole dwelling 20.58 temper 20.58 temper 20.58 | ring m (s follow 2 f dw | w steps 3 0.28 0 w steps 3 0.99 2 relling from 1 0.25 0. T2 (follow 10.36 20 0.36 20 0.36 20 0.61 20 0.61 20 0.61 20  | 9a) Jul 0.2 3 to 7 21 m Tab 0.36 Table 9 0.36  × T1 + 0.62 Table 4 0.62 | Au 0.2 in T 2 in T 2 20.6  0.2  1. (1 - 1) 20.6  20.6      | ag Sep 4 0.4 able 9c) 20.98 0, Th2 (°C) 36 20.36 to 7 in Tabl 36 20.34 f - fLA) x T2 62 20.6 where approximates   | 0.64  20.84  20.36  0.61  e 9c)  20.17  LA = Liv             | 0.81  20.52  20.36  0.79  19.74  ving area ÷ ( | 0.88  20.19  20.35  0.87  19.28  4) =  19.65    | 0.4    | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91) |

Mar

Apr

May

Jun

Jul

Aug

Sep

Oct

Nov

Dec

Jan

Feb

| Utilisation factor for gains, hm:  |                   |                   |                         |             |                     |             |  |  |  |  |  |  |  |
|--|-------------------|-------------------|-------------------------|-------------|---------------------|-------------|--|--|--|--|--|--|--|
| (94)m= 0.84 0.79 0.69 0.54 0.39 0.27 0.19 0.22   | 0.38              | 0.62              | 0.78                    | 0.85        |                     | (94)        |  |  |  |  |  |  |  |
| Useful gains, hmGm , W = (94)m x (84)m   | 0.00              | 0.02              | 00                      | 0.00        |                     | ` '         |  |  |  |  |  |  |  |
| (95)m= 556.34 587.58 588.84 535.55 427.2 291.1 195.22 204.38   | 311.68            | 439.25            | 505.48                  | 540.24      |                     | (95)        |  |  |  |  |  |  |  |
| Monthly average external temperature from Table 8  |                   |                   | _                       |             |                     |             |  |  |  |  |  |  |  |
| (96)m= 4.3 4.9 6.5 8.9 11.7 14.6 16.6 16.4   | 14.1              | 10.6              | 7.1                     | 4.2         |                     | (96)        |  |  |  |  |  |  |  |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m  | <del>_ `</del>    | Ī                 | 1                       | т 1         |                     |             |  |  |  |  |  |  |  |
| (97)m= 765.67 746.33 680.62 569.25 435.82 292.62 195.52 204.9  | 317.2             | 482.91            | 637.76                  | 762.66      |                     | (97)        |  |  |  |  |  |  |  |
| Space heating requirement for each month, kWh/month = $0.024 \times [(97)]$ (98)m= $155.74$ 106.68 68.28 24.27 6.42 0 0 0  | ')m – (95<br>0    | )m] x (4<br>32.49 | 1)m<br><sub>95.24</sub> | 165.48      |                     |             |  |  |  |  |  |  |  |
|  |                   |                   | <u> </u>                |             | 654.6               | (98)        |  |  |  |  |  |  |  |
|  | al per year       | (KVVII/yeai       | ) = Sum(9               | O)15,912 =  |                     | <u></u>     |  |  |  |  |  |  |  |
| Space heating requirement in kWh/m²/year  9.08  (9)  |                   |                   |                         |             |                     |             |  |  |  |  |  |  |  |
| 9b. Energy requirements – Community heating scheme   |                   |                   |                         |             |                     |             |  |  |  |  |  |  |  |
| This part is used for space heating, space cooling or water heating provided by a community scheme.  Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none  0 (301) |                   |                   |                         |             |                     |             |  |  |  |  |  |  |  |
| Fraction of space heat from community system 1 – (301) =   | ., •              | 0110              |                         | ]<br>[      |                     | (302)       |  |  |  |  |  |  |  |
|  | 01101             | ( - (             | - 11 1 1                | [           | 1                   | (302)       |  |  |  |  |  |  |  |
| The community scheme may obtain heat from several sources. The procedure allows for includes boilers, heat pumps, geothermal and waste heat from power stations. See Appe                        |                   | up to four        | other neat              | sources; tr | ne latter           |             |  |  |  |  |  |  |  |
| Fraction of heat from Community boilers  |                   |                   |                         |             | 1                   | (303a)      |  |  |  |  |  |  |  |
| Fraction of total space heat from Community boilers  |                   | (3                | 02) x (303              | sa) =       | 1                   | (304a)      |  |  |  |  |  |  |  |
| Factor for control and charging method (Table 4c(3)) for community her   | ating syst        | tem               |                         |             | 1                   | (305)       |  |  |  |  |  |  |  |
| Distribution loss factor (Table 12c) for community heating system  |                   |                   |                         | Ī           | 1.15                | (306)       |  |  |  |  |  |  |  |
| Space heating  |                   |                   |                         | ľ           | kWh/year            | ]           |  |  |  |  |  |  |  |
| Annual space heating requirement  Space heat from Community boilers  | (98) x (30        | 04a) x (304       | 5) x (306)              | _ [<br>_ [  | 752.79              | ]<br>(307a) |  |  |  |  |  |  |  |
|  | , , ,             | , ,               | , , ,                   | [<br>[      |                     | ]           |  |  |  |  |  |  |  |
| Efficiency of secondary/supplementary heating system in % (from Table  |                   |                   | ,                       | Į           | 0                   | (308        |  |  |  |  |  |  |  |
| Space heating requirement from secondary/supplementary system  | (98) x (30        | 01) x 100 -       | ÷ (308) =               |             | 0                   | (309)       |  |  |  |  |  |  |  |
| Water heating  |                   |                   |                         |             |                     | _           |  |  |  |  |  |  |  |
| Annual water heating requirement   |                   |                   |                         |             | 2046.91             |             |  |  |  |  |  |  |  |
| If DHW from community scheme: Water heat from Community boilers  | (64) x (30        | 03a) x (30        | 5) x (306)              | = [         | 2353.95             | (310a)      |  |  |  |  |  |  |  |
| Electricity used for heat distribution 0.0   | 1 × [(307a).      | (307e) +          | · (310a)                | (310e)] =   | 31.07               | (313)       |  |  |  |  |  |  |  |
| Cooling System Energy Efficiency Ratio   |                   |                   |                         |             | 0                   | (314)       |  |  |  |  |  |  |  |
| Space cooling (if there is a fixed cooling system, if not enter 0)   | = (107) ÷         | (314) =           |                         |             | 0                   | (315)       |  |  |  |  |  |  |  |
| Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside   | ı                 |                   |                         | [           | 240.51              | (330a)      |  |  |  |  |  |  |  |
| warm air heating system fans   |                   |                   |                         | [           | 0                   | (330b)      |  |  |  |  |  |  |  |
| pump for solar water heating   |                   |                   |                         | [           | 0                   | ]<br>(330g) |  |  |  |  |  |  |  |
| Total electricity for the above, kWh/year  | =(330a) -         | + (330b) +        | (330a) =                | ا<br>[      | 240.51              | (331)       |  |  |  |  |  |  |  |
| istal sloutibity for the above, kevilly sail   | _( <b>000a)</b> 1 | . (5555) +        | (5509) -                |             | 2 <del>1</del> 0.01 | ](501)      |  |  |  |  |  |  |  |

| 401 5 1 4 0 2 11 11  | dix L)   |  | 318.27  | (332)                                     |
|--|--|--|---|---|
| 10b. Fuel costs – Community heating  | scheme   |  |   |   |
|  | <b>Fuel</b><br>kWh/year  | Fuel Price<br>(Table 12)                                   | Fuel Co<br>£/year   | est                                       |
| Space heating from CHP   | (307a) x   | 4.24 X   | 0.01 = 31.92  | (340a)                                    |
| Water heating from CHP   | (310a) x   | 4.24 ×   | 0.01 = 99.81  | (342a)                                    |
| Pumps and fans   | (331)  | Fuel Price   | 0.01 = 31.72  | (349)                                     |
| Energy for lighting  | (332)  | 13.19 ×  | 0.01 = 41.98  | (350)                                     |
| Additional standing charges (Table 12)   |  |  | 120   | (351)                                     |
| Total energy cost  | = (340a)(342e) + (345)(354) =  |  | 325.43  | (355)                                     |
| 11b. SAP rating - Community heating  | scheme   |  |   |   |
| Energy cost deflator (Table 12)  |  |  | 0.42  | (356)                                     |
| Energy cost factor (ECF)   | [(355) x (356)] ÷ [(4) + 45.0] =   |  | 1.17  | (357)                                     |
| SAP rating (section12)   |  |  | 83.72   | (358)                                     |
| CO2 from other sources of space and v Efficiency of heat source 1 (%)  | vater heating (not CHP)  | Wh/year kg CO2/kW<br>els repeat (363) to (366) for the sec |   | <b>ar</b><br>(367a                        |
| Efficiency of heat source 1 (%) CO2 associated with heat source 1  |  |  | 00.0  |   |
| Electrical energy for heat distribution  | [(313) x   | x 100 ÷ (367b) x 0.22 0.52                                 | = 749.7   |   |
| Total CO2 associated with community s  | systems (363)  | (366) + (368)(372)   | = 765.9   | 1 (373)                                   |
| CO2 associated with space heating (se  | condary) (309) x   | 0  | = 0   | (374)                                     |
| CO2 associated with water from immers  | sion heater or instantaneous h   | eater (312) x 0.22   | = 0   | (375)                                     |
| Total CO2 associated with space and w  | vater heating (373) +  | (374) + (375) =  | 765.9   | 1 (376)                                   |
| '  |  | 0.41)  | = 124.8   |   |
| CO2 associated with electricity for pum  | ps and fans within dwelling (3   | 31)) x 0.52  | 124.0   | 2 (378)                                   |
| ·  |  |  | = 165.1   | <del></del>                               |
| CO2 associated with electricity for pum  | ng (332)))<br>sum of (376)(382) =  | "  |   | 8 (379)                                   |
| CO2 associated with electricity for pum<br>CO2 associated with electricity for lighti<br>Total CO2, kg/year<br>Dwelling CO2 Emission Rate  | ng (332)))   | "  | = 165.1   | 8 (379)<br>91 (383)<br>5 (384)            |
| CO2 associated with electricity for pum<br>CO2 associated with electricity for lighti<br>Total CO2, kg/year<br>Dwelling CO2 Emission Rate<br>El rating (section 14)  | ng (332))) sum of (376)(382) = (383) ÷ (4) =   | "  | 1055.9  | 8 (379)<br>91 (383)<br>5 (384)            |
| CO2 associated with electricity for pum<br>CO2 associated with electricity for lighti<br>Total CO2, kg/year<br>Dwelling CO2 Emission Rate  | ng (332))) sum of (376)(382) = (383) ÷ (4) =  ting scheme  | "  | = 165.1<br>1055.9<br>14.65                                  | 8 (379)<br>91 (383)<br>5 (384)            |
| CO2 associated with electricity for pump<br>CO2 associated with electricity for lighting<br>Total CO2, kg/year<br>Dwelling CO2 Emission Rate<br>El rating (section 14)<br>13b. Primary Energy – Community heat | ng (332))) sum of (376)(382) = (383) ÷ (4) =  ting scheme  E k d water heating (not CHP)                                   | x 0.52   | = 165.1<br>1055.9<br>14.65<br>87.92<br>P.Energy<br>kWh/year | 8 (379)<br>21 (383)<br>5 (384)<br>2 (385) |
| CO2 associated with electricity for pum<br>CO2 associated with electricity for lighti<br>Total CO2, kg/year<br>Dwelling CO2 Emission Rate<br>El rating (section 14)<br>13b. Primary Energy – Community heat    | ng (332)))  sum of (376)(382) =  (383) ÷ (4) =  ting scheme  E  k  d water heating (not CHP)  If there is CHP using two fu | nergy Primary<br>Wh/year factor                            | = 165.1<br>1055.9<br>14.65<br>87.92<br>P.Energy<br>kWh/year | 8 (379)<br>21 (383)<br>5 (384)<br>2 (385) |

| Total Energy associated with community systems                  | (363)(366) + (368)(372)  |      | = | 4330.26 | (373) |
|---|--------------------------|------|---|---------|-------|
| if it is negative set (373) to zero (unless specified otherwise | e, see C7 in Appendix C) |      |   | 4330.26 | (373) |
| Energy associated with space heating (secondary)                | (309) x                  | 0    | = | 0       | (374) |
| Energy associated with water from immersion heater or instal    | ntaneous heater(312) x   | 1.22 | = | 0       | (375) |
| Total Energy associated with space and water heating            | (373) + (374) + (375) =  |      |   | 4330.26 | (376) |
| Energy associated with space cooling                            | (315) x                  | 3.07 | = | 0       | (377) |
| Energy associated with electricity for pumps and fans within o  | lwelling (331)) x        | 3.07 | = | 738.35  | (378) |
| Energy associated with electricity for lighting                 | (332))) x                | 3.07 | = | 977.08  | (379) |
| Total Primary Energy, kWh/year sum of (376                      | 5)(382) =                |      |   | 6045.7  | (383) |



|   |                 |            |            | User D       | etails:          |              |                        |          |           |                       |          |
|---|-----------------|------------|------------|--------------|------------------|--------------|------------------------|----------|-----------|-----------------------|----------|
| Assessor Name:  |                 |            | _          | 000. 2       | Strom            |              |                        |          |           |                       |          |
| Software Name:  | Stroma FS       | SAP 2012   |            | was a who    | Softwa           |              |                        |          | Versio    | on: 1.0.4.18          |          |
| Address :   | Block JKL,      | Agar Gro   |            |              | Address          |              |                        |          |           |                       |          |
| 1. Overall dwelling dime                                |                 | rigar Oro  | vo, can    | 14011, 20    | oridori, re      |              |                        |          |           |                       |          |
|   |                 |            |            | Area         | a(m²)            |              | Av. He                 | ight(m)  |           | Volume(m <sup>3</sup> | )        |
| Ground floor  |                 |            |            | -            | 72.1             | (1a) x       | 3                      | .15      | (2a) =    | 227.12                | (3a)     |
| Total floor area TFA = (1                               | a)+(1b)+(1c)+   | (1d)+(1e)  | )+(1r      | 1)           | 72.1             | (4)          |                        |          |           |                       |          |
| Dwelling volume   |                 |            |            |              |                  | (3a)+(3b     | )+(3c)+(3c             | d)+(3e)+ | .(3n) =   | 227.12                | (5)      |
| 2. Ventilation rate:                                    |                 |            |            |              |                  |              |                        |          |           |                       |          |
|   | main<br>heating |            | condar     | У            | other            |              | total                  |          |           | m³ per hou            | r        |
| Number of chimneys                                      | 0               | +          | 0          | + [          | 0                | = [          | 0                      | X ·      | 40 =      | 0                     | (6a)     |
| Number of open flues                                    | 0               | _ + _      | 0          | Ī + Ē        | 0                | Ī = [        | 0                      | x        | 20 =      | 0                     | (6b)     |
| Number of intermittent fa                               | ans             |            |            |              |                  |              | 0                      | x -      | 10 =      | 0                     | (7a)     |
| Number of passive vents                                 | 5               |            |            |              |                  | Ē            | 0                      | x        | 10 =      | 0                     | (7b)     |
| Number of flueless gas f                                | ires            |            |            |              |                  | Ė            | 0                      | X ·      | 40 =      | 0                     | (7c)     |
|   |                 |            |            |              |                  | _            |                        |          |           |                       |          |
|   |                 |            |            |              |                  | _            |                        | <u> </u> | Air ch    | nanges per ho         | our<br>— |
| Infiltration due to chimne                              |                 |            |            |              |                  | a antinua fu | 0                      |          | ÷ (5) =   | 0                     | (8)      |
| Number of storeys in t                                  |                 |            | u, procee  | u 10 (17), ( | ourer wise (     | Continue II  | OIII (9) 10 (          | (10)     |           | 0                     | (9)      |
| Additional infiltration                                 | , i             |            |            |              |                  |              |                        | [(9)     | -1]x0.1 = | 0                     | (10)     |
| Structural infiltration: 0                              |                 |            |            |              |                  | •            | ruction                |          |           | 0                     | (11)     |
| if both types of wall are p<br>deducting areas of openi |                 |            | oonding to | the great    | ter wall are     | a (after     |                        |          |           |                       |          |
| If suspended wooden                                     |                 |            | ed) or 0   | .1 (seale    | ed), else        | enter 0      |                        |          |           | 0                     | (12)     |
| If no draught lobby, en                                 | nter 0.05, else | enter 0    |            |              |                  |              |                        |          |           | 0                     | (13)     |
| Percentage of window                                    | s and doors d   | raught str | ripped     |              |                  |              |                        |          |           | 0                     | (14)     |
| Window infiltration                                     |                 |            |            |              | 0.25 - [0.2      |              | 100] =<br>12) + (13) · | . (15) _ |           | 0                     | (15)     |
| Infiltration rate Air permeability value,               | a50 eynress     | ad in cubi | ic metre   | s ner ho     |                  |              |                        |          | area      | 0                     | (16)     |
| If based on air permeabi                                |                 |            |            | •            | •                | •            | ictic oi c             | листорс  | arca      | 0.05                  | (17)     |
| Air permeability value applie                           | -               |            |            |              |                  |              | is being u             | sed      |           | 0.00                  |          |
| Number of sides sheltered                               | ed              |            |            |              | (00) 4           | IO 075 · · / | 40)1                   |          |           | 2                     | (19)     |
| Shelter factor  | tina abaltar fa | .4         |            |              | (20) = 1 -       |              | 19)] =                 |          |           | 0.85                  | (20)     |
| Infiltration rate incorpora                             | -               |            |            |              | (21) = (18       | ) X (20) =   |                        |          |           | 0.04                  | (21)     |
| Infiltration rate modified to                           | Mar Apr         | May        | Jun        | Jul          | Aug              | Sep          | Oct                    | Nov      | Dec       | 1                     |          |
| Monthly average wind sp                                 |                 |            | Juli       | Jui          | <sub>I</sub> Aug | Г оер        | 1 001                  | 1 1404   | l Dec     | ]                     |          |
| (22)m= 5.1 5  | 4.9 4.4         | 4.3        | 3.8        | 3.8          | 3.7              | 4            | 4.3                    | 4.5      | 4.7       | 1                     |          |
| · · · <u>L </u>   |                 |            |            | 1            | 1                | <u> </u>     |                        | <u> </u> | 1         | 1                     |          |
| Wind Factor (22a)m = (2                                 | <del></del>     | 1 4 25 1   | 0.05       | 0.0-         | I 6.05           |              | 400                    |          |           | 1                     |          |
| (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      | ]                     |          |

|  | 0.05   | 0.05   | 0.05   | 0.05   | 0.04                  | 0.04         | 0.04             | 0.04  | 0.05   | 0.05   | 0.05              | ]             |               |
|--|--|--|--|--|-----------------------|--------------|------------------|---|--|--|-------------------|---------------|---------------|
| Calculate effe   |  | _  | rate for t   | he appli                                     | cable ca              | se           | ļ                |   |  | <u>I</u>   | !                 |               |               |
| If mechanic  |  |  | andis N. (O  | 2h) (22a                                     | .) Fm. (a             | auatian (N   | VIEVV othor      | muiaa (22h  | \ (225\  |  |                   | 0.5           | (23           |
| If exhaust air h   |  | 0  |  | , ,  | ,                     | . `          | ,, .             | •   | ) = (23a)  |  |                   | 0.5           | (23           |
| If balanced with   |  | -  | -  | _  |                       |              |                  |   | SI.) (   | 001) [   | 4 (00.)           | 76.5          | (23           |
| a) If balance  | ed mech  | anical ve  | ntilation<br>0.16  | 0.16   | o.16                  | 0.16         | TR) (24a<br>0.16 | 0.16 0.16   | 2b)m + ()<br>0.16  | 23b) × [<br>0.17   | <del>1 ` '</del>  | ) ÷ 100]<br>] | (24           |
| , L  |  |  |  |  |                       |              |                  |   |  | <u> </u>   | 0.17              | J             | (2)           |
| b) If balance  | 1  |  |  |  |                       |              | <u> </u>         | í `   | <u> </u>   | <del></del>  | Ι ,               | 1             | (2            |
| 24b)m= 0   | 0  | 0  | 0  | 0  | 0                     | 0            | 0                | 0   | 0  | 0  | 0                 | J             | (2            |
| c) If whole h  |  | tract ven<br>‹ (23b), t  |  | •  | •                     |              |                  |   | 5 v (23h   | ,)   |                   |               |               |
| $\frac{11(225)1}{24c)m=0}$   | 0.5 7  | 0  | 0  | 0  | 0                     | 0            | 0                | 0   | 0  | 0  | 0                 | 1             | (2            |
| d) If natural  |  |  | ole hous   |  |                       |              |                  |   |  |  |                   | J             | `             |
| ,  |  | en (24d)   |  | •  | •                     |              |                  |   | 0.5]   |  |                   |               |               |
| 24d)m= 0   | 0  | 0  | 0  | 0  | 0                     | 0            | 0                | 0   | 0  | 0  | 0                 | ]             | (2            |
| Effective air  | change   | rate - er  | iter (24a  | or (24b                                      | o) or (24             | c) or (24    | d) in box        | (25)  |  | •  | •                 |               |               |
| 25)m= 0.17   | 0.17   | 0.17   | 0.16   | 0.16   | 0.16                  | 0.16         | 0.16             | 0.16  | 0.16   | 0.17   | 0.17              |               | (2            |
| 2  |  | VII COO  |  |  |                       |              |                  |   |  |  |                   |               | -             |
| 3. Heat losse  |  |  |  |  | Not Ar                | 00           | LI voli          |   | A V I I  |  | برامد با          |               | 1 V I         |
| LEMENT   | Gros<br>area   |  | Openin<br>m  |  | Net Ar<br>A ,r        |              | U-valı<br>W/m2   |   | A X U<br>(W/I  | <)   | k-value<br>kJ/m²- |               | A X k<br>kJ/K |
| Vin <mark>dows</mark> Type   |  |  |  |  | 17.6                  |              | [1/( 0.85 )+     | _   | 14.47  |  |                   |               | (2            |
| Vin <mark>dows</mark> Type   |  |  |  |  | 7.9                   | _            | [1/( 0.85 )+     | <u> </u>  | 6.49   | Ħ  |                   |               | (2            |
| Valls Type1  | 41   |  | 17.6   | $\neg \setminus$                             | 23.4                  | X            | 0.2              | <b>—</b>  | 4.68   | Ħ,   |                   |               | (2            |
| Valls Type2  | 18.9   |  | 7.9  | ╡╹   |                       | ×            | 0.2              |   | 2.2  | 븍 ¦  |                   | ╡             | (2            |
| otal area of e   | L  |  | 7.9  |  | 11                    | ╡ ^          | 0.2              |   |  |  |                   |               |               |
| for windows and  |  |  | ffective wi  | ndow H-vs                                    | 59.9                  | ated using   | r formula 1      | /[(1/  L.v.alu                                    | D) L() (A)   | e aiven in   | naragrani         | 1 2 2         | (3            |
| * include the are  |  |  |  |  |                       | aled using   | i Torritula 1    | /[( 1/O-valu                                      | <del>0</del> )+0.0+j a   | is giveri iii  | paragrapi         | 1 3.2         |               |
| abric heat lo  | ss, W/K :  | = S (A x   | U)   |  |                       |              | (26)(30)         | + (32) =  |  |  |                   | 27.84         | (3            |
| leat capacity  | Cm = S(  | (Axk)  |  |  |                       |              |                  | ((28)   | .(30) + (32  | 2) + (32a).  | (32e) =           | 584.8         | (3            |
|  | parame   | ter (TMF   | P = Cm ÷   | - TFA) ir                                    | kJ/m²K                |              |                  | Indica  | tive Value   | Low  |                   | 100           | (3            |
| hermal mass  | sments wh  | ere the de   | taila af tha   | 00004=104                                    | ion are not           | known nr     |                  |   | values of  | TMD in T   | able 1f           |               |               |
|  |  |  | ians or trie   | CONSTRUCT                                    | on are not            | KIIOWII PI   | ecisely the      | indicative  | values of  | TIVIT III I  |                   |               |               |
| or design asses<br>an be used inste  | ead of a de  | tailed calcu   | ulation.   |  |                       | ·            | ecisely the      | indicative  | values of  | TIVIP III I  |                   |               |               |
| or design asses<br>an be used inste<br>hermal bridg  | ead of a de<br>es : S (L   | tailed calcu<br>x Y) calc  | <i>ulation.</i><br>culated ι   | using Ap                                     | pendix ł              | ·            | ecisely the      | e indicative                                      | values or  | TIVIP III T  |                   | 8.99          | (3            |
| for design asses<br>an be used inste<br>Thermal bridg<br>details of therm  | ead of a de<br>es : S (L<br>al bridging                              | tailed calcu<br>x Y) calc  | <i>ulation.</i><br>culated ι   | using Ap                                     | pendix ł              | ·            | ecisely the      |   |  | TIVIF III 1  |                   |               |               |
| for design asses<br>an be used inste<br>Thermal bridg<br>details of therma<br>Total fabric he  | ead of a dea<br>es:S(L<br>al bridging<br>eat loss                    | tailed calcu<br>x Y) calc<br>are not kn                            | ulation.<br>culated (<br>own (36) =  | using Ap<br>= 0.05 x (3                      | pendix ł              | ·            | ecisely the      | (33) +  | (36) =   |  |                   | 8.99<br>36.83 |               |
| for design assessan be used instead in the following in t | ead of a decest : S (Leal bridging eat loss can                      | tailed calcu<br>x Y) calculare not known                           | ulation. culated to  | using Ap<br>= 0.05 x (3                      | pendix ł              | · (          |                  | (33) +<br>(38)m                                   | (36) =<br>= 0.33 × (   | 25)m x (5  | 1                 |               |               |
| for design assessan be used inste<br>Thermal bridg<br>details of thermation her<br>Total fabric her<br>dentilation her   | es : S (L<br>al bridging<br>eat loss<br>at loss ca                   | x Y) calc<br>x Y) calc<br>are not known<br>alculated               | ulation. culated to own (36) = I monthly   | using Ap<br>- 0.05 x (3<br>/<br>May          | pendix ł<br>1)<br>Jun | Jul          | Aug              | (33) +<br>(38)m<br>Sep                            | (36) =<br>= 0.33 × (   | 25)m x (5<br>Nov   | Dec               |               | (3            |
| for design assessan be used instead in the integral bridge details of thermal fotal fabric here. The integral of the integral  | es : S (L<br>al bridging<br>eat loss<br>at loss ca<br>Feb            | x Y) calc<br>x Y) calc<br>are not known<br>alculated<br>Mar        | ulation. culated to  | using Ap<br>= 0.05 x (3                      | pendix ł              | · (          |                  | (33) +<br>(38)m<br>Sep<br>11.99                   | (36) =<br>= 0.33 × (<br>Oct<br>12.23                                     | 25)m x (5<br>Nov<br>12.39  | 1                 |               | (3            |
| for design assessan be used instead in hermal bridge details of thermal fotal fabric hermal design and the desi | es : S (L al bridging eat loss at loss ca Feb 12.79 coefficier       | x Y) calc<br>x Y) calc<br>are not kn<br>alculated<br>Mar<br>12.71  | ulation. culated to own (36) = I monthly Apr 12.31                                   | using Ap<br>= 0.05 x (3<br>/<br>May<br>12.23 | Jun                   | Jul<br>11.83 | Aug<br>11.75     | (33) +<br>(38)m<br>Sep<br>11.99<br>(39)m          | (36) =<br>= 0.33 × (<br>Oct<br>12.23<br>= (37) + (3                      | 25)m x (5)<br>Nov<br>12.39<br>38)m                                 | Dec 12.55         |               | (3            |
| for design assessan be used instead in hermal bridge details of thermal fotal fabric hermal design and the desi | es : S (L<br>al bridging<br>eat loss<br>at loss ca<br>Feb            | x Y) calc<br>x Y) calc<br>are not known<br>alculated<br>Mar        | ulation. culated to own (36) = I monthly   | using Ap<br>- 0.05 x (3<br>/<br>May          | pendix ł<br>1)<br>Jun | Jul          | Aug              | (33) +<br>(38)m<br>Sep<br>11.99<br>(39)m<br>48.82 | $(36) =$ $= 0.33 \times ($ Oct $12.23$ $= (37) + (34)$ $49.06$           | 25)m x (5<br>Nov<br>12.39<br>38)m<br>49.22                         | Dec 12.55         | 36.83         | (3            |
| For design assessan be used instead in the used instead in the integral of the | es : S (L al bridging eat loss at loss ca Feb 12.79 coefficier 49.62 | x Y) calc<br>are not known<br>alculated<br>Mar<br>12.71<br>nt, W/K | ulation.<br>  culated to<br>  own (36) =<br>  monthly<br>  Apr<br>  12.31<br>  49.14 | using Ap<br>= 0.05 x (3<br>/<br>May<br>12.23 | Jun                   | Jul<br>11.83 | Aug<br>11.75     | (33) +<br>(38)m<br>Sep<br>11.99<br>(39)m<br>48.82 | $(36) =$ $= 0.33 \times ($ Oct $12.23$ $= (37) + (34)$ $49.06$ Average = | 25)m x (5<br>Nov<br>12.39<br>38)m<br>49.22<br>Sum(39) <sub>1</sub> | Dec 12.55         |               | (3            |
| 38)m= 12.87<br>Heat transfer   | es : S (L al bridging eat loss at loss ca Feb 12.79 coefficier 49.62 | x Y) calc<br>are not known<br>alculated<br>Mar<br>12.71<br>nt, W/K | ulation.<br>  culated to<br>  own (36) =<br>  monthly<br>  Apr<br>  12.31<br>  49.14 | using Ap<br>= 0.05 x (3<br>/<br>May<br>12.23 | Jun                   | Jul<br>11.83 | Aug<br>11.75     | (33) +<br>(38)m<br>Sep<br>11.99<br>(39)m<br>48.82 | $(36) =$ $= 0.33 \times ($ Oct $12.23$ $= (37) + (34)$ $49.06$           | 25)m x (5<br>Nov<br>12.39<br>38)m<br>49.22<br>Sum(39) <sub>1</sub> | Dec 12.55         | 36.83         | (3            |

Number of days in month (Table 1a)

| Numbe              |                  |            | IIII (Tab               | <del></del> |            | Ι.           | ı                 |             | Γ.           | I a .              | l                      | I _      | İ         |             |
|--------------------|------------------|------------|-------------------------|-------------|------------|--------------|-------------------|-------------|--------------|--------------------|------------------------|----------|-----------|-------------|
|                    | Jan              | Feb        | Mar                     | Apr         | May        | Jun          | Jul               | Aug         | Sep          | Oct                | Nov                    | Dec      |           | (44)        |
| (41)m=             | 31               | 28         | 31                      | 30          | 31         | 30           | 31                | 31          | 30           | 31                 | 30                     | 31       |           | (41)        |
|                    |                  |            |                         |             |            |              |                   |             |              |                    |                        |          |           |             |
| 4. Wa              | ater heat        | ing ener   | rgy requi               | irement:    |            |              |                   |             |              |                    |                        | kWh/ye   | ear:      |             |
| Veerim             | ned occu         | nancy I    | NI                      |             |            |              |                   |             |              |                    |                        |          | 1         | (42)        |
|                    |                  |            |                         | [1 - exp    | (-0.0003   | 349 x (TF    | -A -13.9          | )2)1 + 0.0  | 0013 x (     | TFA -13.           |                        | .3       |           | (42)        |
|                    | A £ 13.9         |            |                         |             | (          | •            |                   | , ,,        |              |                    | - /                    |          |           |             |
|                    |                  |            | ater usaç               |             |            |              |                   |             |              |                    |                        | 3.73     |           | (43)        |
|                    |                  | _          | hot water<br>person pei |             |            | -            | -                 | to achieve  | a water us   | se target o        | f                      |          |           |             |
| not more           |                  |            | · ·                     |             | i          | <del> </del> |                   |             |              |                    |                        |          | I         |             |
| Hot wot            | Jan              | Feb        | Mar<br>day for ea       | Apr         | May        | Jun          | Jul<br>Table 10 Y | Aug         | Sep          | Oct                | Nov                    | Dec      |           |             |
|                    |                  |            |                         |             |            |              |                   | · ·         | 1            |                    | 1                      |          | 1         |             |
| (44)m=             | 97.6             | 94.05      | 90.5                    | 86.96       | 83.41      | 79.86        | 79.86             | 83.41       | 86.96        | 90.5               | 94.05                  | 97.6     |           | <del></del> |
| Energy             | content of       | hot water  | used - cal              | culated m   | anthly – 1 | 100 v Vd r   | m v nm v F        | Tm / 360(   | O kWh/mor    | Total = Su         |                        |          | 1064.76   | (44)        |
| 0,                 |                  |            | i                       | i           |            |              |                   |             |              |                    |                        | ,        |           |             |
| (45)m=             | 144.74           | 126.59     | 130.63                  | 113.89      | 109.28     | 94.3         | 87.38             | 100.27      | 101.47       | 118.25             | 129.08                 | 140.18   |           |             |
| If instan          | taneous w        | ater heati | ng at point             | of use (no  | hot water  | etoraga)     | enter∩in          | hoves (46   |              | Total = Su         | m(45) <sub>112</sub> = |          | 1396.07   | (45)        |
|                    |                  |            | ,                       |             |            |              |                   |             |              |                    | r                      |          |           | (10)        |
| (46)m=<br>\/\/ator | 21.71<br>storage | 18.99      | 19.59                   | 17.08       | 16.39      | 14.14        | 13.11             | 15.04       | 15.22        | 17.74              | 19.36                  | 21.03    |           | (46)        |
|                    | _                |            | includir                | na any sa   | olar or M  | WHE          | ctorage           | within e    | ame ves      | col                |                        | 0        |           | (47)        |
|                    |                  | `          |                         |             |            |              |                   |             | arrie ves    | 361                |                        | 0        |           | (47)        |
|                    |                  | 7          | ind no ta               |             |            |              |                   | , ,         | ers) ente    | er 'O' in <i>(</i> | <b>4</b> 7)            |          |           |             |
|                    | storage          |            | not wate                | ) (till i   | ioidaes i  | Hotaritar    | icous oc          | ///IDI DOII | Olo) Chi     | 31 0 111 (         | ,,                     |          |           |             |
|                    |                  |            | eclared I               | oss facto   | or is kno  | wn (kWł      | n/day):           |             |              |                    |                        | 0        |           | (48)        |
| •                  |                  |            | m Table                 |             |            | `            | • /               |             |              |                    |                        | 0        |           | (49)        |
| •                  |                  |            | storage                 |             | ar         |              |                   | (48) x (49  | ) =          |                    |                        | 10       |           | (50)        |
|                    |                  |            | eclared o               | -           |            | or is not    | known:            | (10) X (10  | , –          |                    | '                      | 10       |           | (30)        |
|                    |                  |            | factor fr               | -           |            |              |                   |             |              |                    | 0.                     | 02       |           | (51)        |
|                    | •                | •          | ee secti                | on 4.3      |            |              |                   |             |              |                    |                        |          |           |             |
|                    | e factor         | -          |                         |             |            |              |                   |             |              |                    | 1.                     | .03      |           | (52)        |
| Tempe              | erature fa       | actor fro  | m Table                 | 2b          |            |              |                   |             |              |                    | 0                      | .6       |           | (53)        |
| •                  |                  |            | storage                 | , kWh/ye    | ear        |              |                   | (47) x (51  | ) x (52) x ( | 53) =              | 1.                     | .03      |           | (54)        |
| Enter              | (50) or (        | 54) in (5  | 55)                     |             |            |              |                   |             |              |                    | 1.                     | .03      |           | (55)        |
| Water              | storage          | loss cal   | culated t               | for each    | month      |              |                   | ((56)m = (  | (55) × (41)  | m                  |                        |          |           |             |
| (56)m=             | 32.01            | 28.92      | 32.01                   | 30.98       | 32.01      | 30.98        | 32.01             | 32.01       | 30.98        | 32.01              | 30.98                  | 32.01    |           | (56)        |
| If cylinde         | er contains      | dedicated  | d solar sto             | rage, (57)  | m = (56)m  | x [(50) – (  | H11)] ÷ (5        | 0), else (5 | 7)m = (56)   | m where (          | H11) is fro            | m Append | ı<br>ix H |             |
| (57)m=             | 32.01            | 28.92      | 32.01                   | 30.98       | 32.01      | 30.98        | 32.01             | 32.01       | 30.98        | 32.01              | 30.98                  | 32.01    |           | (57)        |
| , ,                |                  |            | <u> </u>                | ļ           | <u> </u>   | 1 00.00      | 1 02.01           | 02.01       | 1 00.00      | 02.01              | ļ                      | <u> </u> |           | , ,         |
|                    | -                |            | nual) fro               |             |            | TO)          | (EO) 00           | NE . (44)   |              |                    |                        | 0        |           | (58)        |
|                    | -                |            | culated t               |             |            | •            | . ,               | , ,         |              | r tharma           | otot)                  |          |           |             |
| •                  |                  |            |                         |             |            |              |                   | <del></del> | cylinde      |                    |                        | 22.26    |           | (59)        |
| (59)m=             | 23.26            | 21.01      | 23.26                   | 22.51       | 23.26      | 22.51        | 23.26             | 23.26       | 22.51        | 23.26              | 22.51                  | 23.26    |           | (38)        |
| Combi              | loss cal         | culated    | for each                | month       | (61)m =    | (60) ÷ 30    | 65 × (41)         | )m          |              |                    |                        |          | •         |             |
| (61)m=             | 0                | 0          | 0                       | 0           | 0          | 0            | 0                 | 0           | 0            | 0                  | 0                      | 0        |           | (61)        |

| Total heat    | equired for                | water he    | eating ca  | alculated  | l for ea | ch month       | (62)r    | n = 0.8     | 85 × (4    | 45)m +    | (46)m +                  | (57)m +    | (59)m + (61)m |                            |
|---------------|----------------------------|-------------|------------|------------|----------|----------------|----------|-------------|------------|-----------|--------------------------|------------|---------------|----------------------------|
| (62)m= 200    | <del>-i</del>              | 185.91      | 167.38     | 164.56     | 147.7    |                | 155.     |             | 54.96      | 173.53    | ì                        | 195.45     |               | (62)                       |
| Solar DHW in  | put calculated             | using App   | endix G oı | · Appendix | H (neg   | ative quantity | y) (ent  | er '0' if n | no solar   | contribu  | tion to wate             | r heating) | l             |                            |
| (add addition | onal lines if              | FGHRS       | and/or \   | vwhrs      | applie   | s, see Ap      | pend     | ix G)       |            |           |                          |            |               |                            |
| (63)m= 0      | 0                          | 0           | 0          | 0          | 0        | 0              | 0        |             | 0          | 0         | 0                        | 0          |               | (63)                       |
| Output from   | n water hea                | ter         |            |            | •        | •              |          |             | •          |           |                          |            | •             |                            |
| (64)m= 200    | .02 176.52                 | 185.91      | 167.38     | 164.56     | 147.7    | 142.66         | 155.     | 55 15       | 54.96      | 173.53    | 182.58                   | 195.45     |               |                            |
|               | •                          |             |            |            |          |                | •        | Output f    | from wa    | ter heate | er (annual) <sub>1</sub> | 12         | 2046.91       | (64)                       |
| Heat gains    | from water                 | heating,    | kWh/m      | onth 0.2   | 5 ′ [0.8 | 5 × (45)m      | + (6     | 1)m] +      | 0.8 x      | [(46)m    | + (57)m                  | + (59)m    | ]             |                            |
| (65)m= 92.    | 35 82.03                   | 87.66       | 80.66      | 80.56      | 74.15    | 73.28          | 77.5     | 6 7         | 6.53       | 83.54     | 85.72                    | 90.83      |               | (65)                       |
| include (     | 57)m in cal                | culation of | of (65)m   | only if c  | ylinde   | is in the      | dwelli   | ng or       | hot wa     | ater is f | rom com                  | munity h   | eating        |                            |
| 5. Interna    | l gains (see               | e Table 5   | and 5a     | ):         |          |                |          |             |            |           |                          |            |               |                            |
| Metabolic o   | gains (Table               | e 5), Wat   | ts         |            |          |                |          |             |            |           |                          |            |               |                            |
| Ja            |                            | Mar         | Apr        | May        | Jun      | Jul            | Αι       | ıg          | Sep        | Oct       | Nov                      | Dec        |               |                            |
| (66)m= 137    | .76 137.76                 | 137.76      | 137.76     | 137.76     | 137.7    | 137.76         | 137.     | 76 13       | 37.76      | 137.76    | 137.76                   | 137.76     |               | (66)                       |
| Lighting ga   | ins (calcula               | ted in Ap   | pendix     | L, equat   | ion L9   | or L9a), a     | lso s    | ee Tab      | ole 5      |           |                          | -          |               |                            |
| (67)m= 45.    | 05 40.02                   | 32.54       | 24.64      | 18.42      | 15.55    | 16.8           | 21.8     | 34 2        | 9.31       | 37.22     | 43.44                    | 46.31      |               | (67)                       |
| Appliances    | gains (calc                | ulated ir   | Append     | dix L, eq  | uation   | L13 or L1      | 3a), a   | also se     | ee Tab     | ole 5     |                          |            |               |                            |
| (68)m= 301    | .71 304.84                 | 296.95      | 280.16     | 258.96     | 239.0    | 3 225.72       | 222.     | 59 23       | 30.48      | 247.27    | 268.47                   | 288.4      |               | (68)                       |
| Cooking ga    | ins (calcu <mark>la</mark> | ated in A   | ppendix    | L, equa    | tion L1  | 5 or L15a      | ), also  | see         | Table      | 5         |                          |            |               |                            |
| (69)m= 51.    | 07 51.07                   | 51.07       | 51.07      | 51.07      | 51.07    | 51.07          | 51.0     | 7 5         | 1.07       | 51.07     | 51.07                    | 51.07      |               | (69)                       |
| Pumps and     | l fans gains               | (Table 5    | ōa)        |            |          |                |          |             |            |           |                          |            |               |                            |
| (70)m = 0     | 0                          | 0           | 0          | 0          | 0        | 0              | 0        |             | 0          | 0         | 0                        | 0          |               | (70)                       |
| Losses e.g    | . evaporatio               | n (nega     | tive valu  | es) (Tab   | le 5)    |                |          |             |            |           |                          |            |               |                            |
| (71)m= -91    | 84 -91.84                  | -91.84      | -91.84     | -91.84     | -91.8    | -91.84         | -91.     | 84 -9       | 91.84      | -91.84    | -91.84                   | -91.84     |               | (71)                       |
| Water heat    | ing gains (1               | Table 5)    |            |            |          |                |          | -           |            |           |                          |            |               |                            |
| (72)m= 124    | .12 122.07                 | 117.82      | 112.03     | 108.28     | 102.9    | 98.49          | 104.     | 25 1        | 06.3       | 112.29    | 119.05                   | 122.08     |               | (72)                       |
| Total inter   | nal gains =                | •           |            |            | (6       | 6)m + (67)n    | า + (68  | )m + (69    | 9)m + (7   | 70)m + (  | 71)m + (72)              | m          |               |                            |
| (73)m= 567    | .88 563.93                 | 544.31      | 513.82     | 482.64     | 454.5    | 438            | 445.     | 67 46       | 63.08      | 493.77    | 527.95                   | 553.78     |               | (73)                       |
| 6. Solar g    |                            |             |            |            |          |                |          |             |            |           |                          |            |               |                            |
| ŭ             | are calculated             | Ü           |            |            |          | •              | itions t | o conve     | ert to the | e applica |                          | ion.       |               |                            |
| Orientation   | : Access F<br>Table 6d     |             | Area<br>m² |            |          | lux<br>able 6a |          | g_<br>Tabl  | _<br>le 6b | 7         | FF<br>able 6c            |            | Gains<br>(W)  |                            |
| North 0.      |                            |             |            |            | _        |                | 1 [      |             |            |           |                          |            |               | 7(74)                      |
|               | 9x 0.77<br>9x 0.77         |             | 17         |            | ×        | 10.63          | X        |             | 0.5        | _         | 0.8                      | =          | 51.88         | (74)                       |
|               |                            | <del></del> |            |            | x        | 20.32          | X        |             | 0.5        | _         | 0.8                      | =          | 99.14         | ∫(74)<br>¬(74)             |
|               | 9x 0.77                    | X           | 17         |            | ×        | 34.53          | ] X [    |             | 0.5        | _         | 0.8                      | _          | 168.46        | (74)                       |
|               | 9x 0.77<br>9x 0.77         |             | 17         |            | ×        | 55.46          | ]        |             | 0.5        | _         | 0.8                      | ┥ =        | 270.6         |                            |
|               |                            |             |            |            | ×        | 74.72          | ]        |             | ).5        | 」 ×       | 0.8                      | _ =        | 364.52        | ](74)<br>] <sub>(74)</sub> |
|               |                            | ×           | 17         |            | ×        | 79.99          | ]        |             | ).5        | _  ×      | 0.8                      | <b></b>    | 390.23        | ╡                          |
|               | 9x 0.77                    | X           | 17         | .0         | X        | 74.68          | X        | 0           | ).5        | X         | 0.8                      | =          | 364.33        | (74)                       |
| INOLLU V      | 9x 0.77                    | X           | 17         | _          | x        | 59.25          | X        | _           | ).5        | 7 x [     | 0.8                      |            | 289.05        | (74)                       |

| North   | 0.9x   | 0.77   | X  | 17.   | 6   | x  | 41.52   | 2   | x  | 0.5   | X  | 0.8  | =   | 202.55 | (74)   |
|---|--|--|--|---|---|--|---|---|--|---|--|--|---|--------|--|
| North   | 0.9x   | 0.77   | X  | 17.   | 6   | x  | 24.19   | )   | x  | 0.5   | x  | 0.8  | =   | 118.01 | (74)   |
| North   | 0.9x   | 0.77   | X  | 17.   | 6   | x  | 13.12   | 2   | x  | 0.5   | x  | 0.8  | =   | 64     | (74)   |
| North   | 0.9x   | 0.77   | X  | 17.   | 6   | x  | 8.86  |   | x  | 0.5   | x  | 0.8  | =   | 43.25  | (74)   |
| East  | 0.9x   | 0.77   | x  | 7.9   | )   | x  | 19.64   |   | x  | 0.5   | ×  | 0.8  | _ =   | 43.01  | (76)   |
| East  | 0.9x   | 0.77   | x  | 7.9   | )   | x  | 38.42   | 2   | x  | 0.5   | x  | 0.8  | =   | 84.14  | (76)   |
| East  | 0.9x   | 0.77   | x  | 7.9   | )   | x  | 63.27   | ,   | x  | 0.5   | ×  | 0.8  |   | 138.56 | (76)   |
| East  | 0.9x   | 0.77   | x  | 7.9   | )   | x  | 92.28   | 3   | x  | 0.5   | ×  | 0.8  | _ =   | 202.08 | (76)   |
| East  | 0.9x   | 0.77   | X  | 7.9   | 9   | x  | 113.09  | 9   | x  | 0.5   | x  | 0.8  | =   | 247.66 | (76)   |
| East  | 0.9x   | 0.77   | X  | 7.9   | 9   | X  | 115.77  | 7   | x  | 0.5   | ×  | 0.8  | =   | 253.52 | (76)   |
| East  | 0.9x   | 0.77   | X  | 7.9   | 9   | X  | 110.22  | 2   | x  | 0.5   | ×  | 0.8  | =   | 241.36 | (76)   |
| East  | 0.9x   | 0.77   | X  | 7.9   | 9   | x  | 94.68   | 3   | x  | 0.5   | x  | 0.8  | =   | 207.33 | (76)   |
| East  | 0.9x   | 0.77   | X  | 7.9   | 9   | x  | 73.59   | )   | x  | 0.5   | x  | 0.8  | =   | 161.15 | (76)   |
| East  | 0.9x   | 0.77   | X  | 7.9   | 9   | x  | 45.59   | )   | x  | 0.5   | x  | 0.8  | =   | 99.83  | (76)   |
| East  | 0.9x   | 0.77   | X  | 7.9   | 9   | x  | 24.49   | )   | x  | 0.5   | x  | 0.8  | =   | 53.63  | (76)   |
| East  | 0.9x   | 0.77   | X  | 7.9   | )   | x  | 16.15   | 5   | x  | 0.5   | x  | 0.8  |   | 35.37  | (76)   |
|   |  |  |  |   |   |  |   |   |  |   |  |  |   |        |  |
| Solar g   | ains in  | watts, calc  | culated  | for each  | n mont  | h  |   | (8  | 83)m   | Sum(74)m .  | (8 <mark>2</mark> )m   |  |   |        |  |
| (83)m=  | 94.89  |  | 307.02   | 472.68  | 612.18  |  | 43.75 60  | 5.69  | 496.   | 363.7   | 217.8  | 5 117.63                                       | 78.62   |        | (83)   |
| Total g   | ains – i   | nternal and  | d solar  | (84)m =   | : (73)m   | + (  | 33)m , wa   | atts  |  |   |  |  | •   |        |  |
| (84)m=  | 662.77   | 747.2  | 351.33   | 986.5   | 1094.82   | 2 10   | 98.31 104   | 43.69   | 942.   | 04 826.78   | 711.6  | 2 645.58                                       | 632.4   |        | (84)   |
| 7 Me  | on inter   | nal tarana   |  | /1 7  |   |  |   |   |  |   |  |  |   |        |  |
|   | arınter  | nai terribe  | rature (   | heating   | seaso   | ท)   |   |   |  |   |  |  |   |        |  |
|   |  |  |  | (heating<br>eriods in   |   |  | area from   | n Tabl  | le 9.  | Th1 (°C)  | •  | •  |   | 21     | (85)   |
| Temp  | erature  | during he  | ating po   | eriods in   | the liv   | ring   |   |   | le 9,  | Th1 (°C)  | ī  | г  |   | 21     | (85)   |
| Temp  | erature<br>ition fac   | during hea   | ating pons   | eriods in   | the live<br>a, h1,r   | ving<br>m (s   | ee Table  |   |  |   | Oct  | Nov  | Dec   | 21     | (85)   |
| Temp  | erature  | during he  | ating po   | eriods in   | the liv   | ring<br>m (s   | ee Table<br>Jun J   | 9a)   | le 9,  | ug Sep  | Oct  | Nov<br>0.81                                    | Dec<br>0.88                                     | 21     | (85)   |
| Temp<br>Utilisa<br>(86)m=   | erature<br>Ition fac<br>Jan<br>0.87  | during heater for gain   | ating points for line Mar  | eriods in<br>iving are<br>Apr<br>0.56   | the live<br>ea, h1,r<br>May   | ring<br>m (s   | ee Table<br>Jun J<br>0.28 0   | 9a)<br>Jul  | At<br>0.2  | ug Sep<br>4 0.4   |  | +  |   | 21     |  |
| Temp<br>Utilisa<br>(86)m=<br>Mean   | erature<br>Ition fac<br>Jan<br>0.87<br>interna   | during heater for gain Feb 0.81  | ating points for line Mar 0.72 ure in I  | eriods in iving are Apr 0.56  | n the livea, h1,r<br>May<br>0.41  | m (s   | ee Table Jun J 0.28 0 w steps 3   | 9a) Jul 0.2 3 to 7  | Au<br>0.2<br>in T  | ug Sep<br>4 0.4<br>able 9c)   | 0.64   | 0.81   | 0.88  | 21     | (86)   |
| Temp<br>Utilisa<br>(86)m=   | erature<br>Ition fac<br>Jan<br>0.87  | during heater for gain Feb 0.81  | ating points for line Mar  | eriods in<br>iving are<br>Apr<br>0.56   | the live<br>ea, h1,r<br>May   | m (s   | ee Table Jun J 0.28 0 w steps 3   | 9a)<br>Jul  | At<br>0.2  | ug Sep<br>4 0.4<br>able 9c)   |  | 0.81   |   | 21     |  |
| Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=   | erature  Jan  0.87  interna  20.24  erature  | during heater for gain Feb 0.81 I temperat 20.43 during heater for gain for | ns for li<br>Mar<br>0.72<br>ure in l<br>20.68  | eriods in iving are 0.56 iving are 20.88 eriods in  | n the live<br>ea, h1,r<br>May<br>0.41<br>ea T1 (<br>20.97   | ring<br>m (s<br>follo  | Jun J<br>Jun >J<br>J<br>J<br>J<br>J<br>J<br>J<br>J<br>J<br>J<br>J<br>J   | 9a) Jul 0.2 3 to 7  | 0.2<br>in T  | ug Sep<br>4 0.4<br>(able 9c)<br>1 20.98   | 0.64   | 0.81   | 0.88  | 21     | (86)   |
| Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=   | erature Jan 0.87 interna 20.24   | during heater for gain Feb 0.81 I temperat 20.43 during heater for gain for | ns for li<br>Mar<br>0.72<br>ure in l   | eriods in iving are Apr 0.56 iving are 20.88  | n the live<br>ea, h1,r<br>May<br>0.41<br>ea T1 (<br>20.97   | follo  | Jun J<br>0.28 0<br>w steps 3<br>0.99 2<br>relling from  | 9a) Jul 0.2 3 to 7  | 0.2<br>in T  | ug Sep 4 0.4 able 9c) 1 20.98 0, Th2 (°C)   | 0.64   | 0.81   | 0.88  | 21     | (86)   |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m=   | ution factors Jan 0.87 interna 20.24 erature 20.35   | during heater for gain Feb 0.81 I temperat 20.43 during heater for gain for | ns for li<br>Mar<br>0.72<br>ure in l<br>20.68<br>ating po  | eriods in iving are 0.56 iving are 20.88 eriods in 20.36  | n the lives, h1,r<br>May<br>0.41<br>ea T1 (<br>20.97<br>n rest o<br>20.36   | follo  | Jun Jo.28 0  w steps 3  velling from 10:36 20   | 9a) Jul 0.2 3 to 7 21 m Tab 0.36  | 0.2<br>in T<br>21<br>ole 9                                 | ug Sep 4 0.4 able 9c) 1 20.98 0, Th2 (°C)   | 20.84  | 0.81   | 0.88  | 21     | (86)   |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m=   | ution factors Jan 0.87 interna 20.24 erature 20.35   | during heater for gain Feb 0.81 ltemperat 20.43 during heater 20.35  | ns for li<br>Mar<br>0.72<br>ure in l<br>20.68<br>ating po  | eriods in iving are 0.56 iving are 20.88 eriods in 20.36  | n the lives, h1,r<br>May<br>0.41<br>ea T1 (<br>20.97<br>n rest o<br>20.36   | ring (s  | Jun J<br>Jun >J<br>J<br>J<br>J<br>J<br>J<br>J<br>J<br>J<br>J<br>J<br>J | 9a) Jul 0.2 3 to 7 21 m Tab 0.36  | 0.2<br>in T<br>21<br>ole 9                                 | Ig Sep 4 0.4 able 9c) 20.98 0, Th2 (°C) 36 20.36  | 20.84  | 0.81   | 0.88  | 21     | (86)   |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m=  | ution factors Jan 0.87 interna 20.24 erature 20.35 ution factors 0.85  | during heat control of the control o | ns for ling por ns for ling por ns for room ns for roo | eriods in iving are Apr 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54   | n the livea, h1,1<br>May<br>0.41<br>ea T1 (<br>20.97<br>n rest o<br>20.36<br>welling<br>0.38  | follo  | Jun J 0.28 0 w steps 3 20.99 2 relling from 0.36 20 m (see T 0.25 0.  | 9a) Jul 0.2 3 to 7 21 m Tab 0.36 Table 9                                | Au<br>0.2<br>in T<br>2 <sup>4</sup><br>20.3<br>20.3<br>0.2 | lig Sep 4 0.4  (able 9c) 1 20.98  0, Th2 (°C) 36 20.36  | 0.64<br>20.84<br>20.36                                       | 20.52  | 0.88<br>20.19<br>20.35                          |        | (86)<br>(87)<br>(88)                         |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m=  | ution factors Jan 0.87 interna 20.24 erature 20.35 ution factors 0.85  | during heater for gain Feb 0.81 ltemperat 20.43 during heater for gain 0.8 ltemperat   | ns for ling por ns for ling por ns for room ns for roo | eriods in iving are Apr 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54   | n the livea, h1,1<br>May<br>0.41<br>ea T1 (<br>20.97<br>n rest o<br>20.36<br>welling<br>0.38  | folloging folloging from (s  | Jun Jun Jun Jun Jun Jun Jun Jun Jun Jun   | 9a) Jul 0.2 3 to 7 21 m Tab 0.36 Table 9                                | Au<br>0.2<br>in T<br>2 <sup>4</sup><br>20.3<br>20.3<br>0.2 | ug Sep 4 0.4 able 9c) 1 20.98 0, Th2 (°C) 36 20.36 to 7 in Tabl   | 0.64<br>20.84<br>20.36                                       | 0.81<br>20.52<br>20.36<br>0.79                 | 0.88<br>20.19<br>20.35                          |        | (86)<br>(87)<br>(88)                         |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean   | erature Jan 0.87 interna 20.24 erature 20.35 ation factors 0.85 interna  | during heater for gain Feb 0.81 ltemperat 20.43 during heater for gain 0.8 ltemperat   | ns for li Mar 0.72 ure in l 20.68 ating per 20.35 ns for r 0.7 ure in t  | eriods in ving are 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54 the rest of  | ea, h1,r<br>May<br>0.41<br>ea T1 (<br>20.97<br>erest o<br>20.36<br>welling<br>0.38  | folloging folloging from (s  | Jun Jun Jun Jun Jun Jun Jun Jun Jun Jun   | 9a) Jul 0.2 3 to 7 21 m Tab 0.36 Table 9 .18                            | Au 0.2 in T 2 in T 2 20.3 20.3 20.3 3                      | ug Sep 4 0.4  able 9c) 1 20.98  0, Th2 (°C) 36 20.36  to 7 in Tabl 36 20.34   | 0.64<br>20.84<br>20.36<br>0.61<br>e 9c)<br>20.17             | 0.81<br>20.52<br>20.36<br>0.79                 | 0.88<br>20.19<br>20.35<br>0.87                  | 21     | (86)<br>(87)<br>(88)<br>(89)                 |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m=                                  | erature Jan 0.87 interna 20.24 erature 20.35 ation fact 0.85 interna 19.35   | during heat tor for gain leading heat leadin | ns for ling por ns for roure in the second s | eriods in iving are 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54 the rest of 20.22   | ea, h1,1<br>May<br>0.41<br>ea T1 (<br>20.97<br>n rest o<br>20.36<br>welling<br>0.38<br>of dwel<br>20.32                             | ring m (s  | Dun Jun Jun Jun Jun Jun Jun Jun Jun Jun J   | 9a) Jul 0.2 3 to 7 21 m Tab 0.36 Table 9 .18 w step 0.36                | Au 0.2 in T 22 20.3 20.3 20.3                              | ug Sep 4 0.4 able 9c) 1 20.98 0, Th2 (°C) 36 20.36 to 7 in Tabl 36 20.34  | 0.64<br>20.84<br>20.36<br>0.61<br>e 9c)<br>20.17             | 0.81<br>20.52<br>20.36<br>0.79                 | 0.88<br>20.19<br>20.35<br>0.87                  |        | (86)<br>(87)<br>(88)<br>(89)                 |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m=                                  | erature Jan 0.87 interna 20.24 erature 20.35 etion fac 0.85 interna 19.35  | during heater to represent the second | ns for li Mar 0.72 ure in l 20.68 ating po 20.35 ns for r 0.7 ure in t 19.95   | eriods in iving are Apr 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54 the rest of 20.22 er the who                                    | ea, h1,r<br>May<br>0.41<br>ea T1 (<br>20.97<br>n rest o<br>20.36<br>welling<br>0.38<br>of dwel<br>20.32                             | ring (s) (s) (s) (s) (s) (s) (s) (s) (s) (s)   | Un Jun Jun Jun Jun Jun Jun Jun Jun Jun Ju   | 9a) Jul 0.2 3 to 7 21 m Tab 0.36 Table 9 .18 w step 0.36                | Au 0.2 in T 2 in T 2 20.3 0.2 20.3                         | ug Sep 4 0.4 fable 9c) 20.98 0, Th2 (°C) 36 20.36 to 7 in Tabl 36 20.34 f fLA) x T2   | 0.64  20.84  20.36  0.61  e 9c)  20.17  LA = Liv             | 0.81 20.52 20.36 0.79 19.74 ving area ÷ (-     | 0.88<br>20.19<br>20.35<br>0.87<br>19.28<br>4) = |        | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91) |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m=                                  | erature  Jan 0.87  interna 20.24  erature 20.35  ation fact 0.85  interna 19.35  interna 19.71   | during heat tor for gain leading heat leadin | ns for li Mar 0.72 ure in l 20.68 ating pe 20.35 ns for r 0.7 ure in t 19.95 ure (for  | eriods in iving are 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54 the rest of 20.22 r the who 20.48                                   | n the lives, h1,1 May 0.41 ea T1 (20.97 n rest of 20.36 welling 0.38 of dwelling 20.32 ole dwelling 20.58                           | ring m (s  | Dun Jun Jun Jun Jun Jun Jun Jun Jun Jun J   | 9a) Jul 0.2 3 to 7 21 m Tab 0.36 Table 9 .18 w step 0.36                | Au 0.2 in T 22 20.3 20.3 20.3 20.6                         | ug Sep 4 0.4 able 9c) 1 20.98 0, Th2 (°C) 36 20.36 to 7 in Tabl 36 20.34 f fLA) x T2 62 20.6  | 0.64<br>20.84<br>20.36<br>0.61<br>e 9c)<br>20.17<br>LA = Liv | 0.81  20.52  20.36  0.79  19.74  ving area ÷ ( | 0.88<br>20.19<br>20.35<br>0.87                  |        | (86)<br>(87)<br>(88)<br>(89)                 |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m=  Mean (92)m= Apply               | erature Jan 0.87 interna 20.24 erature 20.35 etion fac 0.85 interna 19.35 interna 19.71 adjustr  | during heat tor for gain leading heat 20.43 during heat 20.35 ctor for gain 0.8 ltemperat 19.61 ltemperat 19.94 ment to the  | ating points for line Mar 0.72 ure in l 20.68 ating points for r 0.7 ure in t 19.95 ure (for 20.24 at mean   | eriods in iving are Apr 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54 the rest of 20.22 r the who 20.48 internal                      | the lives, h1,r May 0.41  ea T1 (20.97  rest of 20.36  welling 0.38  of dwelling 20.32  ole dwelling 20.58  tempe                   | ring m (s follows) follows fol | y steps 3 0.28 0 w steps 3 0.99 2 relling from 1 0.25 0. T2 (follow 10.36 20 g) = fLA > 1 0.61 20 ure from T  | 9a) Jul 0.2 3 to 7 21 m Tab 0.36  Fable 9 0.36  × T1 + 0.62  Table 4    | Au 0.2 in T 2 2 in T 2 2 20.3 0.2 0.2 0.3 4 4 0.4          | ag Sep 4 0.4 able 9c) 20.98 0, Th2 (°C) 36 20.36 to 7 in Tabl 36 20.34 f - fLA) x T2 62 20.6 where approximates   | 0.64  20.84  20.36  0.61  e 9c)  20.17  LA = Liv             | 0.81 20.52 20.36 0.79 19.74 ving area ÷ (      | 0.88<br>20.19<br>20.35<br>0.87<br>19.28<br>4) = |        | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91) |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m= Mean (92)m= Apply (93)m=         | erature  Ition fact  Jan  0.87  interna  20.24  erature  20.35  Ition fact  0.85  interna  19.35  interna  19.71  adjustr  19.71                       | during heat tor for gain leading heat 20.43 during heat 20.35 etor for gain leading heat 19.61 leading heat 19.94 leading heat  | ating pons for line ating pons for roure in the second sec | eriods in iving are 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54 the rest of 20.22 r the who 20.48                                   | n the lives, h1,1 May 0.41 ea T1 (20.97 n rest of 20.36 welling 0.38 of dwelling 20.32 ole dwelling 20.58                           | ring m (s follows) follows fol | y steps 3 0.28 0 w steps 3 0.99 2 relling from 1 0.25 0. T2 (follow 10.36 20 g) = fLA > 1 0.61 20 ure from T  | 9a) Jul 0.2 3 to 7 21 m Tab 0.36 Table 9 .18 w step 0.36                | Au 0.2 in T 22 20.3 20.3 20.3 20.6                         | ag Sep 4 0.4 able 9c) 20.98 0, Th2 (°C) 36 20.36 to 7 in Tabl 36 20.34 f - fLA) x T2 62 20.6 where approximates   | 0.64<br>20.84<br>20.36<br>0.61<br>e 9c)<br>20.17<br>LA = Liv | 0.81 20.52 20.36 0.79 19.74 ving area ÷ (      | 0.88<br>20.19<br>20.35<br>0.87<br>19.28<br>4) = |        | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91) |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m=  Mean (92)m= Apply (93)m= 8. Spa | erature  Jan  0.87  interna 20.24  erature 20.35  etion fac  0.85  interna 19.35  interna 19.71  adjustr 19.71  ace hea                                | during heat tor for gain leading heat 20.43 during heat 20.35 etor for gain leading heat 19.61 leading heat 19.94 leading require ting require to the leading require ting require to the leading require ting require to the leading require ting require to the leading require ting require to the leading require ting re | ns for ling por line in line i | eriods in iving are Apr 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54 che rest of 20.22 r the who 20.48 internal 20.48                | n the lives, h1,1 May 0.41 ea T1 (20.97 n rest o 20.36 welling 0.38 of dwel 20.32 ole dwel 20.58 tempe 20.58                        | ring m (s follow 2 f dw | w steps 3 0.28 0 w steps 3 0.99 2 relling from 1 0.25 0. T2 (follow 10.36 20 0.36 20 0.36 20 0.61 20 0.61 20 0.61 20  | 9a) Jul 0.2 3 to 7 21 m Tab 0.36 Table 9 0.36  × T1 + 0.62 Table 4 0.62 | Au 0.2 in T 2 in T 2 20.6  0.2  1. (1 - 1) 20.6  20.6      | alg Sep 4 0.4  able 9c) 20.98  0, Th2 (°C) 36 20.36  to 7 in Tabl 36 20.34  f  fLA) x T2 62 20.6  where approximates a series of the control | 0.64  20.84  20.36  0.61  e 9c)  20.17  LA = Liv             | 0.81  20.52  20.36  0.79  19.74  ving area ÷ ( | 0.88  20.19  20.35  0.87  19.28  4) =  19.65    | 0.4    | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91) |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m=  Mean (92)m= Apply (93)m= 8. Spa | erature  Ition factor  Jan  0.87  interna 20.24  erature 20.35  Ition factor 0.85  interna 19.35  interna 19.71 adjustr 19.71 ace head to the internal | during heat tor for gain leading heat 20.43 during heat 20.35 etor for gain leading heat 19.61 leading heat 19.94 leading require ting require to the leading require ting require to the leading require ting require to the leading require ting require to the leading require ting require to the leading require ting re | ating points for line of the content | eriods in iving are Apr 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54 the rest of 20.22 r the who 20.48 internal 20.48 internal 20.48 | n the lives, h1,1 May 0.41 ea T1 (20.97 n rest of 20.36 welling 0.38 of dwelling 20.32 ole dwelling 20.58 temper 20.58 temper 20.58 | ring m (s follow 2 f dw | w steps 3 0.28 0 w steps 3 0.99 2 relling from 1 0.25 0. T2 (follow 10.36 20 0.36 20 0.36 20 0.61 20 0.61 20 0.61 20  | 9a) Jul 0.2 3 to 7 21 m Tab 0.36 Table 9 0.36  × T1 + 0.62 Table 4 0.62 | Au 0.2 in T 2 in T 2 20.6  0.2  1. (1 - 1) 20.6  20.6      | ag Sep 4 0.4 able 9c) 20.98 0, Th2 (°C) 36 20.36 to 7 in Tabl 36 20.34 f - fLA) x T2 62 20.6 where approximates   | 0.64  20.84  20.36  0.61  e 9c)  20.17  LA = Liv             | 0.81  20.52  20.36  0.79  19.74  ving area ÷ ( | 0.88  20.19  20.35  0.87  19.28  4) =  19.65    | 0.4    | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91) |

Mar

Apr

May

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Nov

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Jan

Feb

| 1 14:11: 4: |                                     |                   |            |                       |             |           |           |             |             |            |               |           |                  |
|-------------|-------------------------------------|-------------------|------------|-----------------------|-------------|-----------|-----------|-------------|-------------|------------|---------------|-----------|------------------|
| (94)m=      | ion factor for<br>0.84 0.79         | gains, nn<br>0.69 | n:<br>0.54 | 0.39                  | 0.27        | 0.19      | 0.22      | 0.38        | 0.62        | 0.78       | 0.85          |           | (94)             |
| _           | gains, hmGm                         |                   |            |                       | 0.27        | 0.19      | 0.22      | 0.36        | 0.02        | 0.76       | 0.65          |           | (04)             |
|             | 556.34 587.58                       | <u> </u>          | 535.55     | 427.2                 | 291.1       | 195.22    | 204.38    | 311.68      | 439.25      | 505.48     | 540.24        |           | (95)             |
| Monthly     | y average ex                        | ternal ten        | nperature  | e from Ta             | able 8      | l         |           |             |             |            |               |           |                  |
| (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 lo     | ss rate for m                       | ean interr        | nal temp   | erature,              | Lm , W =    | =[(39)m   | x [(93)m  | – (96)m     | ]           |            |               |           |                  |
| ` ′         | 765.67 746.33                       |                   | <u> </u>   | 435.82                | 292.62      | 195.52    | 204.9     | 317.2       | 482.91      | 637.76     | 762.66        |           | (97)             |
|             | heating requi                       |                   |            |                       |             |           | T         |             | <u> </u>    | i          | 1 1           |           |                  |
| (98)m=      | 155.74 106.68                       | 68.28             | 24.27      | 6.42                  | 0           | 0         | 0         | 0           | 32.49       | 95.24      | 165.48        | 054.0     | 7,000            |
| _           |                                     |                   |            |                       |             |           | lota      | ıı per year | (kWh/yeai   | r) = Sum(9 | 98)15,912 =   | 654.6     | <u> </u> (98)    |
| Space       | heating requi                       | rement ir         | n kWh/m²   | <sup>2</sup> /year    |             |           |           |             |             |            |               | 9.08      | (99)             |
|             | rgy requireme                       |                   |            |                       |             |           |           |             |             |            |               |           |                  |
|             | t is used for so<br>of space hea    | •                 | • .        |                       | •           |           | • .       | •           |             | unity scl  | heme.<br>I    | 0         | (301)            |
|             | •                                   |                   | •          |                       | •           | ·         | (Table T  | 1) 0 11 11  | OHE         |            | l             |           |                  |
|             | of space hea                        |                   | •          | •                     | ,           | ,         |           |             |             |            |               | 1         | (302)            |
|             | nunity scheme m<br>oilers, heat pum | -                 |            |                       |             |           |           |             | up to four  | other heat | t sources; th | he latter |                  |
|             | of heat from                        | -                 |            |                       | Tom power   | dianona.  | occ rippo | ndix o.     |             |            |               | 1         | (303a)           |
| Fraction    | of total space                      | e heat fro        | om Comr    | nunity be             | oilers      |           |           |             | (3          | 02) x (303 | Ba) =         | 1         | ]<br>(304a)      |
|             | or control and                      |                   |            |                       |             | r commi   | unity hea | ating sys   |             |            |               | 1         | ]<br>(305)       |
|             | ion loss facto                      |                   |            |                       |             |           |           |             |             |            |               | 1.07      | ]<br>(306)       |
| Space h     |                                     |                   |            |                       |             |           |           |             |             |            | l             | kWh/year  | J` ′             |
| -           | space heating                       | g requirer        | ment       |                       |             |           |           |             |             |            |               | 654.6     | ]                |
| Space h     | eat from Cor                        | nmunity b         | ooilers    |                       |             |           |           | (98) x (3   | 04a) x (30  | 5) x (306) | =             | 700.42    | (307a)           |
| Efficienc   | cy of seconda                       | ry/supple         | ementary   | heating               | system      | in % (fro | om Table  | 4a or A     | ppendix     | E)         |               | 0         | (308             |
| Space h     | eating requir                       | ement fro         | m secor    | ıdary/su <sub>l</sub> | oplemen     | tary sys  | tem       | (98) x (3   | 01) x 100 · | ÷ (308) =  |               | 0         | (309)            |
| Water h     | eating                              |                   |            |                       |             |           |           |             |             |            |               |           |                  |
| Annual v    | water heating                       | requirem          | nent       |                       |             |           |           |             |             |            |               | 2046.91   |                  |
|             | from commur<br>eat from Com         |                   |            |                       |             |           |           | (64) x (3   | 03a) x (30  | 5) x (306) | = [           | 2190.2    | (310a)           |
| Electrici   | ty used for he                      | eat distrib       | ution      |                       |             |           | 0.01      | × [(307a)   | (307e) +    | - (310a)   | (310e)] =     | 28.91     | (313)            |
| Cooling     | System Ener                         | gy Efficie        | ency Rati  | 0                     |             |           |           |             |             |            | [             | 0         | ]<br>(314)       |
| Space c     | ooling (if ther                     | e is a fixe       | ed coolin  | g systen              | n, if not e | enter 0)  |           | = (107) ÷   | - (314) =   |            | [             | 0         | ]<br>(315)       |
| •           | ty for pumps                        |                   |            |                       |             | ,         |           |             |             |            | l             |           | J                |
|             | ical ventilatio                     |                   |            |                       |             |           | outside   |             |             |            |               | 240.51    | (330a)           |
| warm ai     | r heating sys                       |                   |            |                       |             |           |           |             |             |            |               |           | 1                |
|             | . Housing cyc                       | em fans           |            |                       |             |           |           |             |             |            |               | 0         | (330b)           |
| pump fo     | r solar water                       |                   |            |                       |             |           |           |             |             |            |               | 0         | (330b)<br>(330g) |
|             |                                     | heating           | kWh/yea    | ır                    |             |           |           | =(330a)     | + (330b) +  | (330g) =   | [             |           | _                |

| Energy for lighting (calculated in Appendi                                       | x L)                                       |   | 318.27 (332          |
|--|--|---|----------------------|
| 10b. Fuel costs – Community heating so   | heme                                       |   |                      |
|  | <b>Fuel</b><br>kWh/year                    | Fuel Price<br>(Table 12)                                  | Fuel Cost<br>£/year  |
| Space heating from CHP   | (307a) x                                   | 4.24 x 0.   | 01 = 29.7 (340       |
| Water heating from CHP   | (310a) x                                   | 4.24 x 0.   | 01 = 92.86 (342      |
| Pumps and fans   | (331)                                      | Fuel Price  13.19 x 0.                                    | 01 = 31.72 (349      |
| Energy for lighting  | (332)                                      | 13.19 × 0.  | 01 = 41.98 (350      |
| Additional standing charges (Table 12)   |  |   | 120 (351             |
| Total energy cost  | = (340a)(342e) + (345)(354) =              |   | 316.26 (355          |
| 11b. SAP rating - Community heating so   | heme                                       |   |                      |
| Energy cost deflator (Table 12)  |  |   | 0.42 (356            |
| Energy cost factor (ECF)   | $[(355) \times (356)] \div [(4) + 45.0] =$ |   | 1.13 (357            |
| SAP rating (section12)   |  |   | 84.18 (358           |
| CO2 from other sources of space and wa<br>Efficiency of heat source 1 (%)        | ter heating (not CHP)                      | h/year kg CO2/kWh Is repeat (363) to (366) for the second |                      |
| CO2 associated with heat source 1  | [(307b)+(310b)] x                          | 100 ÷ (367b) x 0.22                                       | = 678.67 (367        |
| Electrical energy for heat distribution  | [(313) x                                   | 0.52  | = 15 (372            |
| Total CO2 associated with community sy   |  | 366) + (368)(372)   | = 693.67 (373        |
| CO2 associated with space heating (seco  | , ,  | 0   | = 0 (374             |
| CO2 associated with water from immersion   |  | , ,   | = 0 (375             |
| Total CO2 associated with space and wa CO2 associated with electricity for pumps | -  | 374) + (375) =  | 693.67 (376          |
| CO2 associated with electricity for lighting                                     |  |   |                      |
|  | sum of (376)(382) =                        | 0.52  | 983.67 (383          |
| rotar ooz, kg/year   | (383) ÷ (4) =                              |   | 13.64 (384           |
| El rating (section 14)   |  |   | 88.74 (385           |
| 13b. Primary Energy – Community heatir   | g scheme                                   |   |                      |
|  |  | ergy Primary<br>Vh/year factor                            | P.Energy<br>kWh/year |
| Energy from other sources of space and Efficiency of heat source 1 (%)           |  | Is repeat (363) to (366) for the secon                    | nd fuel 92 (367      |
| Energy associated with heat source 1   | [(307b)+(310b)] x                          |   | 92 (367              |
| Electrical energy for heat distribution  | [(313) x                                   | 1.22  |                      |
| Liberious oriorgy for float distribution   | [(313) X                                   | L   | = 88.74 (372         |

| Total Energy associated with community systems                 | (363)(366) + (368)(372)  | )    | = | 3921.95 | (373) |
|--|--------------------------|------|---|---------|-------|
| if it is negative set (373) to zero (unless specified otherwis | e, see C7 in Appendix C) | )    |   | 3921.95 | (373) |
| Energy associated with space heating (secondary)               | (309) x                  | 0    | = | 0       | (374) |
| Energy associated with water from immersion heater or insta    | intaneous heater(312) x  | 1.22 | = | 0       | (375) |
| Total Energy associated with space and water heating           | (373) + (374) + (375) =  |      |   | 3921.95 | (376) |
| Energy associated with space cooling                           | (315) x                  | 3.07 | = | 0       | (377) |
| Energy associated with electricity for pumps and fans within   | dwelling (331)) x        | 3.07 | = | 738.35  | (378) |
| Energy associated with electricity for lighting                | (332))) x                | 3.07 | = | 977.08  | (379) |
| Total Primary Energy, kWh/year sum of (37                      | 6)(382) =                |      |   | 5637.39 | (383) |



|   |                 |            |            | User D       | etails:          |              |                        |          |           |                       |          |
|---|-----------------|------------|------------|--------------|------------------|--------------|------------------------|----------|-----------|-----------------------|----------|
| Assessor Name:  |                 |            | _          | 000. 2       | Strom            |              |                        |          |           |                       |          |
| Software Name:  | Stroma FS       | SAP 2012   |            | was a who    | Softwa           |              |                        |          | Versio    | on: 1.0.4.18          |          |
| Address :   | Block JKL,      | Agar Gro   |            |              | Address          |              |                        |          |           |                       |          |
| 1. Overall dwelling dime                                |                 | rigar Oro  | vo, can    | 14011, 20    | oridori, re      |              |                        |          |           |                       |          |
|   |                 |            |            | Area         | a(m²)            |              | Av. He                 | ight(m)  |           | Volume(m <sup>3</sup> | )        |
| Ground floor  |                 |            |            | -            | 72.1             | (1a) x       | 3                      | .15      | (2a) =    | 227.12                | (3a)     |
| Total floor area TFA = (1                               | a)+(1b)+(1c)+   | (1d)+(1e)  | )+(1r      | 1)           | 72.1             | (4)          |                        |          |           |                       |          |
| Dwelling volume   |                 |            |            |              |                  | (3a)+(3b     | )+(3c)+(3c             | d)+(3e)+ | .(3n) =   | 227.12                | (5)      |
| 2. Ventilation rate:                                    |                 |            |            |              |                  |              |                        |          |           |                       |          |
|   | main<br>heating |            | condar     | У            | other            |              | total                  |          |           | m³ per hou            | r        |
| Number of chimneys                                      | 0               | +          | 0          | + [          | 0                | = [          | 0                      | X ·      | 40 =      | 0                     | (6a)     |
| Number of open flues                                    | 0               | _ + _      | 0          | Ī + Ē        | 0                | Ī = [        | 0                      | x        | 20 =      | 0                     | (6b)     |
| Number of intermittent fa                               | ans             |            |            |              |                  |              | 0                      | x '      | 10 =      | 0                     | (7a)     |
| Number of passive vents                                 | 5               |            |            |              |                  | Ē            | 0                      | x        | 10 =      | 0                     | (7b)     |
| Number of flueless gas f                                | ires            |            |            |              |                  | Ė            | 0                      | X ·      | 40 =      | 0                     | (7c)     |
|   |                 |            |            |              |                  | _            |                        |          |           |                       |          |
|   |                 |            |            |              |                  | _            |                        | <u> </u> | Air ch    | nanges per ho         | our<br>— |
| Infiltration due to chimne                              |                 |            |            |              |                  | a antinua fu | 0                      |          | ÷ (5) =   | 0                     | (8)      |
| Number of storeys in t                                  |                 |            | u, procee  | u 10 (17), ( | ourer wise (     | Continue II  | OIII (9) 10 (          | (10)     |           | 0                     | (9)      |
| Additional infiltration                                 | , i             |            |            |              |                  |              |                        | [(9)     | -1]x0.1 = | 0                     | (10)     |
| Structural infiltration: 0                              |                 |            |            |              |                  | •            | ruction                |          |           | 0                     | (11)     |
| if both types of wall are p<br>deducting areas of openi |                 |            | oonding to | the great    | ter wall are     | a (after     |                        |          |           |                       |          |
| If suspended wooden                                     |                 |            | ed) or 0   | .1 (seale    | ed), else        | enter 0      |                        |          |           | 0                     | (12)     |
| If no draught lobby, en                                 | nter 0.05, else | enter 0    |            |              |                  |              |                        |          |           | 0                     | (13)     |
| Percentage of window                                    | s and doors d   | raught str | ripped     |              |                  |              |                        |          |           | 0                     | (14)     |
| Window infiltration                                     |                 |            |            |              | 0.25 - [0.2      |              | 100] =<br>12) + (13) · | . (15) _ |           | 0                     | (15)     |
| Infiltration rate Air permeability value,               | a50 eynress     | ad in cubi | ic metre   | s ner ho     |                  |              |                        |          | area      | 0                     | (16)     |
| If based on air permeabi                                |                 |            |            | •            | •                | •            | ictic oi c             | листорс  | arca      | 0.05                  | (17)     |
| Air permeability value applie                           | -               |            |            |              |                  |              | is being u             | sed      |           | 0.00                  |          |
| Number of sides sheltered                               | ed              |            |            |              | (00) 4           | IO 075 · · / | 40)1                   |          |           | 2                     | (19)     |
| Shelter factor  | tina abaltar fa | .4         |            |              | (20) = 1 -       |              | 19)] =                 |          |           | 0.85                  | (20)     |
| Infiltration rate incorpora                             | -               |            |            |              | (21) = (18       | ) X (20) =   |                        |          |           | 0.04                  | (21)     |
| Infiltration rate modified to                           | Mar Apr         | May        | Jun        | Jul          | Aug              | Sep          | Oct                    | Nov      | Dec       | 1                     |          |
| Monthly average wind sp                                 |                 |            | Juli       | Jui          | <sub>I</sub> Aug | Г оер        | 1 001                  | 1 1404   | l Dec     | ]                     |          |
| (22)m= 5.1 5  | 4.9 4.4         | 4.3        | 3.8        | 3.8          | 3.7              | 4            | 4.3                    | 4.5      | 4.7       | 1                     |          |
| · · · <u>L </u>   |                 |            |            | 1            | 1                | <u> </u>     |                        | <u> </u> | 1         | 1                     |          |
| Wind Factor (22a)m = (2                                 | <del></del>     | 1 4 25 1   | 0.05       | 0.0-         | I 6.05           |              | 400                    |          |           | 1                     |          |
| (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      | ]                     |          |

|  | 0.05   | 0.05   | 0.05   | 0.05   | 0.04                  | 0.04         | 0.04             | 0.04  | 0.05   | 0.05   | 0.05              | ]             |               |
|--|--|--|--|--|-----------------------|--------------|------------------|---|--|--|-------------------|---------------|---------------|
| Calculate effe   |  | _  | rate for t   | he appli                                     | cable ca              | se           | ļ                |   |  | <u>I</u>   | !                 |               |               |
| If mechanic  |  |  | andis N. (O  | 2h) (22a                                     | .) Fm. (a             | auatian (N   | VIEVV othor      | muiaa (22h  | \ (225\  |  |                   | 0.5           | (23           |
| If exhaust air h   |  | 0  |  | , ,  | ,                     | . `          | ,, .             | •   | ) = (23a)  |  |                   | 0.5           | (23           |
| If balanced with   |  | -  | -  | _  |                       |              |                  |   | SI.) (   | 001) [   | 4 (00.)           | 76.5          | (23           |
| a) If balance  | ed mech  | anical ve  | ntilation<br>0.16  | 0.16   | o.16                  | 0.16         | TR) (24a<br>0.16 | 0.16 0.16   | 2b)m + ()<br>0.16  | 23b) × [<br>0.17   | <del>1 ` '</del>  | ) ÷ 100]<br>] | (24           |
| , L  |  |  |  |  |                       |              |                  |   |  | <u> </u>   | 0.17              | J             | (2)           |
| b) If balance  | 1  |  |  |  |                       |              | <u> </u>         | í `   | <u> </u>   | <del></del>  | Ι ,               | 1             | (2            |
| 24b)m= 0   | 0  | 0  | 0  | 0  | 0                     | 0            | 0                | 0   | 0  | 0  | 0                 | J             | (2            |
| c) If whole h  |  | tract ven<br>‹ (23b), t  |  | •  | •                     |              |                  |   | 5 v (23h   | ,)   |                   |               |               |
| $\frac{11(225)1}{24c)m=0}$   | 0.5 7  | 0  | 0  | 0  | 0                     | 0            | 0                | 0   | 0  | 0  | 0                 | 1             | (2            |
| d) If natural  |  |  | ole hous   |  |                       |              |                  |   |  |  |                   | J             | `             |
| ,  |  | en (24d)   |  | •  | •                     |              |                  |   | 0.5]   |  |                   |               |               |
| 24d)m= 0   | 0  | 0  | 0  | 0  | 0                     | 0            | 0                | 0   | 0  | 0  | 0                 | ]             | (2            |
| Effective air  | change   | rate - er  | iter (24a  | or (24b                                      | o) or (24             | c) or (24    | d) in box        | (25)  |  | •  | •                 |               |               |
| 25)m= 0.17   | 0.17   | 0.17   | 0.16   | 0.16   | 0.16                  | 0.16         | 0.16             | 0.16  | 0.16   | 0.17   | 0.17              |               | (2            |
| 2  |  | VII COO  |  |  |                       |              |                  |   |  |  |                   |               | -             |
| 3. Heat losse  |  |  |  |  | Not Ar                | 00           | LI voli          |   | A V I I  |  | برامد با          |               | 1 V I         |
| LEMENT   | Gros<br>area   |  | Openin<br>m  |  | Net Ar<br>A ,r        |              | U-valı<br>W/m2   |   | A X U<br>(W/I  | <)   | k-value<br>kJ/m²- |               | A X k<br>kJ/K |
| Vin <mark>dows</mark> Type   |  |  |  |  | 17.6                  |              | [1/( 0.85 )+     | _   | 14.47  |  |                   |               | (2            |
| Vin <mark>dows</mark> Type   |  |  |  |  | 7.9                   | _            | [1/( 0.85 )+     | <u> </u>  | 6.49   | Ħ  |                   |               | (2            |
| Valls Type1  | 41   |  | 17.6   | $\neg \setminus$                             | 23.4                  | X            | 0.2              | <b>—</b>  | 4.68   | Ħ,   |                   |               | (2            |
| Valls Type2  | 18.9   |  | 7.9  | ╡╹   |                       | ×            | 0.2              |   | 2.2  | 븍 ¦  |                   | ╡             | (2            |
| otal area of e   | L  |  | 7.9  |  | 11                    | <b>=</b>   ^ | 0.2              |   |  |  |                   |               |               |
| for windows and  |  |  | ffective wi  | ndow H-vs                                    | 59.9                  | ated using   | r formula 1      | /[(1/  L.v.alu                                    | D) L() (A)   | e aiven in   | naragrani         | 1 2 2         | (3            |
| * include the are  |  |  |  |  |                       | aleu using   | i Torritula 1    | /[( 1/O-valu                                      | <del>0</del> )+0.0+j a   | is giveri iii  | paragrapi         | 1 3.2         |               |
| abric heat lo  | ss, W/K :  | = S (A x   | U)   |  |                       |              | (26)(30)         | + (32) =  |  |  |                   | 27.84         | (3            |
| leat capacity  | Cm = S(  | (Axk)  |  |  |                       |              |                  | ((28)   | .(30) + (32  | 2) + (32a).  | (32e) =           | 584.8         | (3            |
|  | parame   | ter (TMF   | P = Cm ÷   | - TFA) ir                                    | kJ/m²K                |              |                  | Indica  | tive Value   | Low  |                   | 100           | (3            |
| hermal mass  | sments wh  | ere the de   | taila af tha   | 00004=104                                    | ion are not           | known nr     |                  |   | values of  | TMD in T   | able 1f           |               |               |
|  |  |  | ians or trie   | CONSTRUCT                                    | on are not            | KIIOWII PI   | ecisely the      | indicative  | values of  | TIVIT III I  |                   |               |               |
| or design asses<br>an be used inste  | ead of a de  | tailed calcu   | ulation.   |  |                       | ·            | ecisely the      | indicative  | values of  | TIVIP III I  |                   |               |               |
| or design asses<br>an be used inste<br>hermal bridg  | ead of a de<br>es : S (L   | tailed calcu<br>x Y) calc  | <i>ulation.</i><br>culated ι   | using Ap                                     | pendix ł              | ·            | ecisely the      | e indicative                                      | values or  | TIVIP III T  |                   | 8.99          | (3            |
| for design asses<br>an be used inste<br>Thermal bridg<br>details of therm  | ead of a de<br>es : S (L<br>al bridging                              | tailed calcu<br>x Y) calc  | <i>ulation.</i><br>culated ι   | using Ap                                     | pendix ł              | ·            | ecisely the      |   |  | TIVIF III 1  |                   |               |               |
| for design asses<br>an be used inste<br>Thermal bridg<br>details of therma<br>Total fabric he  | ead of a dea<br>es:S(L<br>al bridging<br>eat loss                    | tailed calcu<br>x Y) calc<br>are not kn                            | ulation.<br>culated (<br>own (36) =  | using Ap<br>= 0.05 x (3                      | pendix ł              | ·            | ecisely the      | (33) +  | (36) =   |  |                   | 8.99<br>36.83 |               |
| for design assessan be used instead in the following in t | ead of a decest : S (Leal bridging eat loss can                      | tailed calcu<br>x Y) calculare not known                           | ulation. culated to  | using Ap<br>= 0.05 x (3                      | pendix ł              | · (          |                  | (33) +<br>(38)m                                   | (36) =<br>= 0.33 × (   | 25)m x (5  | 1                 |               |               |
| for design assessan be used inste<br>Thermal bridg<br>details of thermation her<br>Total fabric her<br>dentilation her   | es : S (L<br>al bridging<br>eat loss<br>at loss ca                   | x Y) calc<br>x Y) calc<br>are not known<br>alculated               | ulation. culated to own (36) = I monthly   | using Ap<br>- 0.05 x (3<br>/<br>May          | pendix ł<br>1)<br>Jun | Jul          | Aug              | (33) +<br>(38)m<br>Sep                            | (36) =<br>= 0.33 × (   | 25)m x (5<br>Nov   | Dec               |               | (3            |
| for design assessan be used instead in the integral bridge details of thermal fotal fabric here. The integral of the integral  | es : S (L<br>al bridging<br>eat loss<br>at loss ca<br>Feb            | x Y) calc<br>x Y) calc<br>are not known<br>alculated<br>Mar        | ulation. culated to  | using Ap<br>= 0.05 x (3                      | pendix ł              | · (          |                  | (33) +<br>(38)m<br>Sep<br>11.99                   | (36) =<br>= 0.33 × (<br>Oct<br>12.23                                     | 25)m x (5<br>Nov<br>12.39  | 1                 |               | (3            |
| for design assessan be used instead in hermal bridge details of thermal fotal fabric hermal design and the desi | es : S (L al bridging eat loss at loss ca Feb 12.79 coefficier       | x Y) calc<br>x Y) calc<br>are not kn<br>alculated<br>Mar<br>12.71  | ulation. culated to own (36) = I monthly Apr 12.31                                   | using Ap<br>= 0.05 x (3<br>/<br>May<br>12.23 | Jun                   | Jul<br>11.83 | Aug<br>11.75     | (33) +<br>(38)m<br>Sep<br>11.99<br>(39)m          | (36) =<br>= 0.33 × (<br>Oct<br>12.23<br>= (37) + (3                      | 25)m x (5)<br>Nov<br>12.39<br>38)m                                 | Dec 12.55         |               | (3            |
| for design assessan be used instead in hermal bridge details of thermal fotal fabric hermal design and the desi | es : S (L<br>al bridging<br>eat loss<br>at loss ca<br>Feb            | x Y) calc<br>x Y) calc<br>are not known<br>alculated<br>Mar        | ulation. culated to own (36) = I monthly   | using Ap<br>- 0.05 x (3<br>/<br>May          | pendix ł<br>1)<br>Jun | Jul          | Aug              | (33) +<br>(38)m<br>Sep<br>11.99<br>(39)m<br>48.82 | $(36) =$ $= 0.33 \times ($ Oct $12.23$ $= (37) + (34)$ $49.06$           | 25)m x (5<br>Nov<br>12.39<br>38)m<br>49.22                         | Dec 12.55         | 36.83         | (3            |
| For design assessan be used instead in the used instead in the integral of the | es : S (L al bridging eat loss at loss ca Feb 12.79 coefficier 49.62 | x Y) calc<br>are not known<br>alculated<br>Mar<br>12.71<br>nt, W/K | ulation.<br>  culated to<br>  own (36) =<br>  monthly<br>  Apr<br>  12.31<br>  49.14 | using Ap<br>= 0.05 x (3<br>/<br>May<br>12.23 | Jun                   | Jul<br>11.83 | Aug<br>11.75     | (33) +<br>(38)m<br>Sep<br>11.99<br>(39)m<br>48.82 | $(36) =$ $= 0.33 \times ($ Oct $12.23$ $= (37) + (34)$ $49.06$ Average = | 25)m x (5<br>Nov<br>12.39<br>38)m<br>49.22<br>Sum(39) <sub>1</sub> | Dec 12.55         |               | (3            |
| 38)m= 12.87<br>Heat transfer   | es : S (L al bridging eat loss at loss ca Feb 12.79 coefficier 49.62 | x Y) calc<br>are not known<br>alculated<br>Mar<br>12.71<br>nt, W/K | ulation.<br>  culated to<br>  own (36) =<br>  monthly<br>  Apr<br>  12.31<br>  49.14 | using Ap<br>= 0.05 x (3<br>/<br>May<br>12.23 | Jun                   | Jul<br>11.83 | Aug<br>11.75     | (33) +<br>(38)m<br>Sep<br>11.99<br>(39)m<br>48.82 | $(36) =$ $= 0.33 \times ($ Oct $12.23$ $= (37) + (34)$ $49.06$           | 25)m x (5<br>Nov<br>12.39<br>38)m<br>49.22<br>Sum(39) <sub>1</sub> | Dec 12.55         | 36.83         | (3            |

Number of days in month (Table 1a)

|   |                    | 5 111 11101 | · `                     | <del></del>      |  | Ι.           | Ι                 | Γ.               | Γ.           | I a .                     | ١                      |          |         |               |
|---|--------------------|-------------|-------------------------|------------------|--|--------------|-------------------|------------------|--------------|---------------------------|------------------------|----------|---------|---------------|
| (44)                                    | Jan                | Feb         | Mar                     | Apr              | May  | Jun          | Jul               | Aug              | Sep          | Oct                       | Nov                    | Dec      |         | (44)          |
| (41)m=                                  | 31                 | 28          | 31                      | 30               | 31   | 30           | 31                | 31               | 30           | 31                        | 30                     | 31       |         | (41)          |
|   |                    |             |                         |                  |  |              |                   |                  |              |                           |                        |          |         |               |
| 4. Wa                                   | ter heat           | ing ener    | rgy requi               | irement:         |  |              |                   |                  |              |                           |                        | kWh/ye   | ear:    |               |
| Assum                                   | ad occi            | pancy, I    | N                       |                  |  |              |                   |                  |              |                           |                        | 0        | 1       | (42)          |
|   |                    |             |                         | [1 - exp         | (-0.0003   | 349 x (TF    | A -13.9           | )2)] + 0.0       | 0013 x (     | TFA -13.                  |                        | .3       |         | (42)          |
|   | A £ 13.9           |             |                         |                  | `  | `            |                   | , ,,             | `            |                           | ,                      |          |         |               |
|   |                    |             |                         |                  |  |              |                   | (25 x N)         |              |                           |                        | .73      |         | (43)          |
|   |                    | -           | not water<br>person per |                  |  | -            | -                 | io acriieve      | a water us   | se largel o               | ı                      |          |         |               |
| [                                       |                    |             | · ·                     |                  | i  | <del> </del> |                   |                  | 0            | 0.4                       | NI                     | Des      |         |               |
| Hot wate                                | Jan<br>er usage ii | Feb         | Mar<br>day for ea       | Apr<br>ach month | May<br>  Vd m = fa                               | Jun          | Jul<br>Table 1c x | (43)             | Sep          | Oct                       | Nov                    | Dec      |         |               |
| г                                       |                    | -           |                         |                  |  |              |                   | · ·              |              |                           |                        |          | 1       |               |
| (44)m=                                  | 97.6               | 94.05       | 90.5                    | 86.96            | 83.41  | 79.86        | 79.86             | 83.41            | 86.96        | 90.5                      | 94.05                  | 97.6     |         | <b>—</b> ,,,, |
| Eneray a                                | content of         | hot water   | used - cal              | culated me       | onthly = $4$ .                                   | 190 x Vd.r   | m x nm x E        | OTm / 3600       | ) kWh/mor    | Total = Su<br>oth (see Ta | . ,                    |          | 1064.76 | (44)          |
| σ,                                      |                    |             | i                       | i                |  |              |                   |                  |              |                           |                        | ,        |         |               |
| (45)m=                                  | 144.74             | 126.59      | 130.63                  | 113.89           | 109.28   | 94.3         | 87.38             | 100.27           | 101.47       | 118.25                    | 129.08                 | 140.18   |         | (45)          |
| If instant                              | aneous w           | ater heatii | na at point             | of use (no       | hot wate   | storage).    | enter 0 in        | boxes (46        |              | Total = Su                | m(45) <sub>112</sub> = |          | 1396.07 | (45)          |
| г                                       |                    |             | ,                       |                  |  |              |                   |                  | . , ,        | 47.74                     | 40.00                  | 04.00    |         | (46)          |
| (46)m=  <br>Water s                     | 21.71<br>storage   | 18.99       | 19.59                   | 17.08            | 16.39  | 14.14        | 13.11             | 15.04            | 15.22        | 17.74                     | 19.36                  | 21.03    |         | (40)          |
|   | _                  |             | includir                | ng anv se        | olar or W  | WHRS         | storage           | within sa        | ame ves      | sel                       |                        | 0        |         | (47)          |
|   |                    | · ·         | ınd no ta               |                  |  |              |                   |                  |              |                           |                        |          |         | ( ,           |
|   | -                  | 7           |                         |                  |  |              |                   | ` '              | ers) ente    | er '0' in (               | 47)                    |          |         |               |
|   | storage            |             |                         |                  |  |              |                   |                  |              |                           | <b>'</b>               |          |         |               |
|   |                    |             | eclared l               | oss facto        | or is kno  | wn (kWł      | n/day):           |                  |              |                           |                        | 0        |         | (48)          |
| Tempe                                   | rature fa          | actor fro   | m Table                 | 2b               |  |              |                   |                  |              |                           |                        | 0        |         | (49)          |
| •                                       |                    |             | storage                 |                  | ear  |              |                   | (48) x (49)      | ) =          |                           |                        | 10       |         | (50)          |
| • |                    |             | eclared of              | -                |  | or is not    | known:            |                  |              |                           | <u> </u>               | 10       |         | ()            |
| Hot wa                                  | ter stora          | age loss    | factor fr               | om Tab           | e 2 (kW  | h/litre/da   | ay)               |                  |              |                           | 0.                     | 02       |         | (51)          |
|   | •                  | •           | ee secti                | on 4.3           |  |              |                   |                  |              |                           |                        |          |         |               |
|   |                    | from Tal    |                         |                  |  |              |                   |                  |              |                           | 1.                     | 03       |         | (52)          |
| Tempe                                   | rature f           | actor fro   | m Table                 | 2b               |  |              |                   |                  |              |                           | 0                      | .6       |         | (53)          |
| •                                       |                    |             | storage                 | , kWh/y          | ear  |              |                   | (47) x (51)      | ) x (52) x ( | 53) =                     | 1.                     | 03       |         | (54)          |
| Enter (                                 | (50) or (          | 54) in (5   | 55)                     |                  |  |              |                   |                  |              |                           | 1.                     | 03       |         | (55)          |
| Water                                   | storage            | loss cal    | culated f               | for each         | month  |              |                   | ((56)m = (       | 55) × (41)   | m                         |                        |          |         |               |
| (56)m=                                  | 32.01              | 28.92       | 32.01                   | 30.98            | 32.01  | 30.98        | 32.01             | 32.01            | 30.98        | 32.01                     | 30.98                  | 32.01    |         | (56)          |
| If cylinde                              | r contains         | dedicate    | d solar sto             | rage, (57)       | m = (56)m  | x [(50) – (  | H11)] ÷ (5        | 0), else (5      | 7)m = (56)   | m where (                 | H11) is fro            | m Append | ix H    |               |
| (57)m=                                  | 32.01              | 28.92       | 32.01                   | 30.98            | 32.01  | 30.98        | 32.01             | 32.01            | 30.98        | 32.01                     | 30.98                  | 32.01    |         | (57)          |
| ` ′ [                                   |                    |             | <u> </u>                |                  | <u> </u>   | I            | I                 |                  | l            | l                         |                        | 0        |         | (58)          |
| -                                       |                    |             | nual) fro               |                  |  | F0\          | (50) . 20         | SE (44)          |              |                           |                        | 0        |         | (30)          |
| -                                       | •                  |             |                         |                  |  | •            | . ,               | $65 \times (41)$ | ı cylinde    | r thermo                  | ctat)                  |          |         |               |
| (59)m=                                  | 23.26              | 21.01       | 23.26                   | 22.51            | 23.26  | 22.51        | 23.26             | 23.26            | 22.51        | 23.26                     | 22.51                  | 23.26    |         | (59)          |
|   |                    |             |                         |                  |  | l .          | <u> </u>          |                  |              | 1 20.20                   |                        | 20.20    |         | (/            |
| г                                       |                    |             | for each                |                  | <del>`                                    </del> | <del>`</del> | <del>- ` `</del>  | <u></u>          | <del></del>  | <del></del>               | i                      | i        | ı       |               |
| (61)m=                                  | 0                  | 0           | 0                       | 0                | 0  | 0            | 0                 | 0                | 0            | 0                         | 0                      | 0        |         | (61)          |

| Total heat                                       | equired for                | water he    | eating ca  | alculated  | l for ea | ch month       | (62)     | m =     | 0.85 × (      | 45)m +          | · (46)m +  | (57)m +     | (59)m + (61)m |                            |
|--|----------------------------|-------------|------------|------------|----------|----------------|----------|---------|---------------|-----------------|--|-------------|---------------|----------------------------|
| (62)m= 200                                       | <del>-i</del>              | 185.91      | 167.38     | 164.56     | 147.7    |                | 155.     |         | 154.96        | 173.53          | <del>`                                    </del> | 195.45      |               | (62)                       |
| Solar DHW in                                     | put calculated             | using App   | endix G oı | · Appendix | H (neg   | ative quantit  | y) (ent  | er '0'  | if no solar   | contribu        | ition to wate                                    | er heating) | 1             |                            |
| (add addition                                    | onal lines if              | FGHRS       | and/or \   | vwhrs      | applie   | es, see Ap     | pend     | lix G   | S)            |                 |  |             |               |                            |
| (63)m= 0   | 0                          | 0           | 0          | 0          | 0        | 0              | 0        |         | 0             | 0               | 0  | 0           |               | (63)                       |
| Output from                                      | n water hea                | ter         |            |            | •        |                | •        | •       |               |                 | •  |             | •             |                            |
| (64)m= 200                                       | .02 176.52                 | 185.91      | 167.38     | 164.56     | 147.7    | 9 142.66       | 155      | .55     | 154.96        | 173.53          | 182.58   | 195.45      |               |                            |
| Output from water heater (annual) <sub>112</sub> |                            |             |            |            |          |                |          | 2046.91 | (64)          |                 |  |             |               |                            |
| Heat gains                                       | from water                 | heating,    | kWh/m      | onth 0.2   | 5 ′ [0.8 | 85 × (45)m     | า + (6   | 1)m     | ] + 0.8 x     | [(46)m          | n + (57)m  | + (59)m     | ]             |                            |
| (65)m= 92.                                       | 35 82.03                   | 87.66       | 80.66      | 80.56      | 74.15    | 73.28          | 77.      | 56      | 76.53         | 83.54           | 85.72  | 90.83       |               | (65)                       |
| include (  | 57)m in cal                | culation of | of (65)m   | only if c  | ylinde   | r is in the    | dwell    | ing (   | or hot w      | ater is         | from com   | munity h    | eating        |                            |
| 5. Interna                                       | l gains (see               | e Table 5   | and 5a     | ):         |          |                |          |         |               |                 |  |             |               |                            |
| Metabolic o                                      | gains (Table               | e 5), Wat   | ts         |            |          |                |          |         |               |                 |  |             |               |                            |
| Ja   |                            | Mar         | Apr        | May        | Jur      | Jul            | Aı       | ug      | Sep           | Oct             | Nov  | Dec         |               |                            |
| (66)m= 137                                       | .76 137.76                 | 137.76      | 137.76     | 137.76     | 137.7    | 6 137.76       | 137.     | .76     | 137.76        | 137.76          | 137.76   | 137.76      |               | (66)                       |
| Lighting ga                                      | ins (calcula               | ted in Ap   | pendix     | L, equat   | ion L9   | or L9a), a     | ılso s   | ee T    | Table 5       |                 | -  | -           |               |                            |
| (67)m= 45.                                       | 05 40.02                   | 32.54       | 24.64      | 18.42      | 15.55    | 16.8           | 21.8     | 84      | 29.31         | 37.22           | 43.44  | 46.31       |               | (67)                       |
| Appliances                                       | gains (calc                | ulated ir   | Append     | dix L, eq  | uation   | L13 or L1      | 3a), a   | also    | see Tal       | ole 5           |  |             |               |                            |
| (68)m= 301                                       | .71 304.84                 | 296.95      | 280.16     | 258.96     | 239.0    | 3 225.72       | 222      | .59     | 230.48        | 247.27          | 268.47   | 288.4       |               | (68)                       |
| Cooking ga                                       | ins (calcu <mark>la</mark> | ated in A   | ppendix    | L, equa    | tion L1  | 5 or L15a      | ), als   | o se    | e Table       | 5               |  |             | '             |                            |
| (69)m= 51.                                       | 07 51.07                   | 51.07       | 51.07      | 51.07      | 51.07    | 51.07          | 51.0     | 07      | 51.07         | 51.07           | 51.07  | 51.07       |               | (69)                       |
| Pumps and  | l fans gains               | (Table 5    | ōa)        |            |          |                |          |         |               |                 |  | -           |               |                            |
| (70)m = 0  | 0                          | 0           | 0          | 0          | 0        | 0              | 0        |         | 0             | 0               | 0  | 0           |               | (70)                       |
| Losses e.g                                       | . evaporatio               | n (nega     | tive valu  | es) (Tab   | le 5)    |                |          |         |               |                 |  |             |               |                            |
| (71)m= -91                                       | 84 -91.84                  | -91.84      | -91.84     | -91.84     | -91.8    | 91.84          | -91.     | .84     | -91.84        | -91.84          | -91.84   | -91.84      |               | (71)                       |
| Water heat                                       | ing gains (1               | Table 5)    |            |            |          |                |          |         |               |                 |  | -           |               |                            |
| (72)m= 124                                       | .12 122.07                 | 117.82      | 112.03     | 108.28     | 102.9    | 98.49          | 104      | .25     | 106.3         | 112.29          | 119.05   | 122.08      |               | (72)                       |
| Total inter                                      | nal gains =                | •           |            |            | (6       | 66)m + (67)n   | n + (68  | 3)m +   | (69)m + (     | 70)m + (        | 71)m + (72)                                      | m           | -             |                            |
| (73)m= 567                                       | .88 563.93                 | 544.31      | 513.82     | 482.64     | 454.5    | 6 438          | 445      | .67     | 463.08        | 493.77          | 527.95   | 553.78      |               | (73)                       |
| 6. Solar g                                       |                            |             |            |            |          |                |          |         |               |                 |  |             |               |                            |
| ŭ  | are calculated             | Ü           |            |            |          |                | ations 1 | to co   | nvert to the  | e applica       |  | ion.        |               |                            |
| Orientation                                      | : Access F<br>Table 6d     |             | Area<br>m² |            |          | lux<br>able 6a |          | T       | g_<br>able 6b | -               | FF<br>Fable 6c                                   |             | Gains<br>(W)  |                            |
| North 0.   |                            |             |            |            | _        |                | 1 1      |         |               |                 |  | $\neg$      |               | 7(74)                      |
|  | 9x 0.77<br>9x 0.77         |             | 17         |            | ×        | 10.63          | ]        |         | 0.5           | × [<br>, [      | 0.8  | =           | 51.88         | (74)                       |
|  |                            | <del></del> |            |            | ×        | 20.32          | ]        |         | 0.5           | ×               | 0.8  | =           | 99.14         | ](74)<br>] <sub>(74)</sub> |
|  |                            | X           | 17         |            | ×        | 34.53          | ]        |         | 0.5           | ×               | 0.8  | _ =         | 168.46        | ╡                          |
|  | 9x 0.77<br>9x 0.77         |             | 17         |            | ×        | 55.46          | ]        |         | 0.5           |                 | 0.8  | _ =         | 270.6         |                            |
|  |                            |             |            |            | ×        | 74.72          | ]        |         | 0.5           | ×               | 0.8  | ╡ -         | 364.52        | ](74)<br>] <sub>(74)</sub> |
|  |                            | ×           | 17         |            | ×        | 79.99          | 】        |         | 0.5           | _  × [<br>¬ , [ | 0.8  | ╡ -         | 390.23        | ╡                          |
|  | 9x 0.77                    | X           | 17         | .0         | X        | 74.68          | X        |         | 0.5           | x               | 0.8  | =           | 364.33        | (74)                       |
| [3](3)(1)  | 9x 0.77                    | X           | 17         | _          | x        | 59.25          | x        |         | 0.5           | x               | 0.8  |             | 289.05        | (74)                       |

| North  | 0.9x  | 0.77   | X  | 17.   | 6   | x  | 41.52  | X   | 0.5  | x   | 0.8  | =   | 202.55 | (74)   |
|--|---|--|--|---|---|--|--|---|--|---|--|---|--------|--|
| North  | 0.9x  | 0.77   | X  | 17.   | 6   | x  | 24.19  | X   | 0.5  | x   | 0.8  | =   | 118.01 | (74)   |
| North  | 0.9x  | 0.77   | X  | 17.   | 6   | x  | 13.12  | X   | 0.5  | x   | 0.8  | =   | 64     | (74)   |
| North  | 0.9x  | 0.77   | X  | 17.   | 6   | x  | 8.86   | X   | 0.5  | x   | 0.8  | =   | 43.25  | (74)   |
| East   | 0.9x  | 0.77   | x  | 7.9   | )   | x  | 19.64  | x   | 0.5  | ×   | 0.8  | _ =   | 43.01  | (76)   |
| East   | 0.9x  | 0.77   | x  | 7.9   | )   | x  | 38.42  | x   | 0.5  | x   | 0.8  | =   | 84.14  | (76)   |
| East   | 0.9x  | 0.77   | x  | 7.9   | )   | x  | 63.27  | x   | 0.5  | x   | 0.8  |   | 138.56 | (76)   |
| East   | 0.9x  | 0.77   | x  | 7.9   | )   | x  | 92.28  | x   | 0.5  | ×   | 0.8  | _ =   | 202.08 | (76)   |
| East   | 0.9x  | 0.77   | X  | 7.9   | 9   | x  | 113.09   | X   | 0.5  | x   | 0.8  | =   | 247.66 | (76)   |
| East   | 0.9x  | 0.77   | X  | 7.9   | 9   | x  | 115.77   | X   | 0.5  | x   | 0.8  | =   | 253.52 | (76)   |
| East   | 0.9x  | 0.77   | X  | 7.9   | 9   | x  | 110.22   | x   | 0.5  | ×   | 0.8  | =   | 241.36 | (76)   |
| East   | 0.9x  | 0.77   | X  | 7.9   | 9   | x  | 94.68  | X   | 0.5  | x   | 0.8  | =   | 207.33 | (76)   |
| East   | 0.9x  | 0.77   | X  | 7.9   | 9   | x  | 73.59  | x   | 0.5  | x   | 0.8  | =   | 161.15 | (76)   |
| East   | 0.9x  | 0.77   | X  | 7.9   | 9   | x  | 45.59  | X   | 0.5  | x   | 0.8  | =   | 99.83  | (76)   |
| East   | 0.9x  | 0.77   | X  | 7.9   | 9   | x  | 24.49  | X   | 0.5  | x   | 0.8  | =   | 53.63  | (76)   |
| East   | 0.9x  | 0.77   | x  | 7.9   | )   | x  | 16.15  | x   | 0.5  | x   | 0.8  | =   | 35.37  | (76)   |
|  |   |  |  |   |   |  |  |   |  |   |  |   |        |  |
| Solar g  | ains in   | watts, calc  | culated  | for each  | n mont  | h  |  | (83)r   | n = Sum(74)m .   | (82)m   |  |   |        |  |
| (83)m=   | 94.89   |  | 307.02   | 472.68  | 612.18  |  | 43.75 605.   | 69 496  | 363.7  | 217.8   | 5 117.63                                       | 78.62   |        | (83)   |
| Total g  | ains – i  | nternal and  | d solar  | (84)m =   | : (73)m   | + (  | 33)m , watt  | ts  |  |   |  | •   |        |  |
| (84)m=   | 662.77  | 747.2  | 351.33   | 986.5   | 1094.82   | 2 10   | 98.31 1043   | .69 942   | .04 826.78   | 711.6   | 2 645.58                                       | 632.4   |        | (84)   |
| 7. Mean internal temperature (heating season)  |   |  |  |   |   |  |  |   |  |   |  |   |        |  |
| 7. IVIE  | an Inter  | nal tempe  | rature (   | heating   | seaso   | n) -   |  |   |  |   |  |   |        |  |
|  |   |  |  |   |   |  | area from  | Table 9   | . Th1 (°C)   | ٠.  |  |   | 21     | (85)   |
| Temp   | erature   | during he  | ating po   | eriods in   | the liv   | ving   | area from <sup>·</sup><br>ee Table 9   |   | , Th1 (°C)   | ī   | П  |   | 21     | (85)   |
| Temp   | erature<br>ation fac  | during hea   | ating pons   | eriods in   | the live<br>a, h1,r   | ving<br>m (s   | ee Table 9   | a)  |  | Oct   | Nov  | Dec   | 21     | (85)   |
| Temp   | erature   | during he  | ating po   | eriods in   | the liv   | ving<br>m (s   | ee Table 9   | a)<br>I A   | , Th1 (°C) ug Sep  | Oct   | Nov<br>0.81                                    | Dec<br>0.88                                     | 21     | (85)   |
| Temp<br>Utilisa<br>(86)m=  | erature<br>ation fac<br>Jan<br>0.87   | during heater for gain   | ating points for line Mar  | eriods in<br>iving are<br>Apr<br>0.56   | the live<br>ea, h1,r<br>May   | ving<br>m (s   | ee Table 9<br>Jun Ju<br>0.28 0.2   | a) 1 A 2 0.   | ug Sep<br>24 0.4   |   | +  |   | 21     |  |
| Temp<br>Utilisa<br>(86)m=<br>Mean  | erature<br>ation fac<br>Jan<br>0.87<br>interna  | during heater for gain<br>Feb 0.81   | ating points for line Mar 0.72 ure in I  | eriods in iving are Apr 0.56  | n the livea, h1,r<br>May<br>0.41  | m (s   | Jun Jun Jun Jun Jun Jun Jun Jun Jun Jun  | a) 2 0. to 7 in   | ug Sep<br>24 0.4<br>Table 9c)  | 0.64  | 0.81   | 0.88  | 21     | (86)   |
| Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=  | erature Ition fac Jan 0.87 Interna  | during heater for gain Feb 0.81 I temperat 20.43   | ns for li<br>Mar<br>0.72<br>ure in l   | eriods in iving are Apr 0.56 iving are 20.88  | n the live<br>ea, h1,r<br>May<br>0.41<br>ea T1 (<br>20.97   | ring<br>m (s<br>follo  | Dun Jun Jun Jun Jun Jun Jun Jun Jun Jun J  | a) 2 0. to 7 in 2   | ug Sep<br>24 0.4<br>Table 9c)<br>1 20.98   |   | 0.81   |   | 21     |  |
| Temp Utilisa (86)m= Mean (87)m= Temp   | erature Jan 0.87 interna 20.24 erature  | during heater for gain Feb 0.81 I temperat 20.43 during heater for gain for | ns for li<br>Mar<br>0.72<br>ure in l<br>20.68  | eriods in iving are 0.56 iving are 20.88 eriods in  | n the lives, h1,r<br>May<br>0.41<br>ea T1 (<br>20.97  | follo  | Jun Ju<br>Jun Ju<br>Jun Ju<br>Jun Ju<br>Jun Jun<br>Jun Jun Jun<br>Jun Jun Jun<br>Jun Jun Jun<br>Jun Jun Jun Jun<br>Jun Jun Jun Jun<br>Jun Jun Jun Jun Jun<br>Jun Jun Jun Jun Jun Jun<br>Jun Jun Jun Jun Jun Jun Jun Jun Jun<br>Jun Jun Jun Jun Jun Jun Jun Jun Jun Jun  | a) 2 0. to 7 in 2 Table   | ug Sep 24 0.4  Table 9c) 1 20.98  9, Th2 (°C)  | 20.84   | 0.81   | 20.19   | 21     | (86)   |
| Temp<br>Utilisa<br>(86)m=<br>Mean<br>(87)m=  | erature Ition fac Jan 0.87 Interna  | during heater for gain Feb 0.81 I temperat 20.43 during heater for gain for | ns for li<br>Mar<br>0.72<br>ure in l   | eriods in iving are Apr 0.56 iving are 20.88  | n the live<br>ea, h1,r<br>May<br>0.41<br>ea T1 (<br>20.97   | follo  | Dun Jun Jun Jun Jun Jun Jun Jun Jun Jun J  | a) 2 0. to 7 in 2 Table   | ug Sep<br>24 0.4<br>Table 9c)<br>1 20.98   | 0.64  | 0.81   | 0.88  | 21     | (86)   |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m=  | ution factors Jan 0.87 interna 20.24 erature 20.35  | tor for gain Feb 0.81 I temperat 20.43 during hea 20.35  | ns for li<br>Mar<br>0.72<br>ure in l<br>20.68<br>ating po  | eriods in iving are 0.56 iving are 20.88 eriods in 20.36  | n the lives, h1,r<br>May<br>0.41<br>ea T1 (<br>20.97<br>n rest o<br>20.36   | follo  | Jun Ju<br>Jun Ju<br>Jun Ju<br>Jun Ju<br>Jun Jun<br>Jun Jun Jun<br>Jun Jun Jun<br>Jun Jun Jun<br>Jun Jun Jun Jun<br>Jun Jun Jun Jun<br>Jun Jun Jun Jun Jun<br>Jun Jun Jun Jun Jun Jun<br>Jun Jun Jun Jun Jun Jun Jun Jun<br>Jun Jun Jun Jun Jun Jun Jun Jun Jun Jun  | a)  A  O  Table  10  A  A  A  A  A  A  A  A  A  A  A  A  A  | ug Sep 24 0.4  Table 9c) 1 20.98  9, Th2 (°C)  | 20.84   | 0.81   | 20.19   | 21     | (86)   |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m=  | ution factors Jan 0.87 interna 20.24 erature 20.35  | tor for gain Feb 0.81 I temperat 20.43 during hea 20.35  | ns for li<br>Mar<br>0.72<br>ure in l<br>20.68<br>ating po  | eriods in iving are 0.56 iving are 20.88 eriods in 20.36  | n the lives, h1,r<br>May<br>0.41<br>ea T1 (<br>20.97<br>n rest o<br>20.36   | ring (s following) (s followin | Dun Jun Jun Jun Jun Jun Jun Jun Jun Jun J  | a)  1   | ug Sep<br>24 0.4<br>Table 9c)<br>1 20.98<br>9, Th2 (°C)<br>36 20.36  | 20.84   | 0.81   | 20.19   | 21     | (86)   |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m=   | erature Jan 0.87 interna 20.24 erature 20.35 ation fac  | tor for gain Feb 0.81 I temperat 20.43 during hea 20.35 ctor for gain 0.8  | ns for ling por ns for ling por ns for room ns for roo | eriods in iving are 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54   | n the livea, h1,1<br>May<br>0.41<br>ea T1 (<br>20.97<br>n rest o<br>20.36<br>welling<br>0.38  | follo  | Dun Jun Jun Jun Jun Jun Jun Jun Jun Jun J  | a)  1   | ug Sep<br>24 0.4<br>Table 9c)<br>1 20.98<br>9, Th2 (°C)<br>36 20.36  | 20.84<br>20.36  | 20.52  | 0.88<br>20.19<br>20.35                          | 21     | (86)<br>(87)<br>(88)                                 |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m=   | erature Jan 0.87 interna 20.24 erature 20.35 ation fac  | during heater for gain Feb 0.81  I temperat 20.43  during heater for gain 0.8  I temperat 1.8  | ns for ling por ns for ling por ns for room ns for roo | eriods in iving are 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54   | n the livea, h1,1<br>May<br>0.41<br>ea T1 (<br>20.97<br>n rest o<br>20.36<br>welling<br>0.38  | ring (sm (sfollo   | Dun Jun Jun Jun Jun Jun Jun Jun Jun Jun J  | a)  A  O  To 7 in  Table  Table  98  0  steps 3   | ug Sep<br>24 0.4<br>Table 9c)<br>1 20.98<br>9, Th2 (°C)<br>36 20.36  | 20.84<br>20.36  | 0.81<br>20.52<br>20.36<br>0.79                 | 0.88<br>20.19<br>20.35                          |        | (86)<br>(87)<br>(88)                                 |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean  | erature Jan 0.87 interna 20.24 erature 20.35 ation factors 0.85 interna   | during heater for gain Feb 0.81  I temperat 20.43  during heater for gain 0.8  I temperat 1.8  | ns for li Mar 0.72 ure in l 20.68 ating per 20.35 ns for r 0.7 ure in t  | Apr 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54 the rest of   | ea, h1,r<br>May<br>0.41<br>ea T1 (<br>20.97<br>erest o<br>20.36<br>welling<br>0.38  | ring (sm (sfollo   | Dun Jun Jun Jun Jun Jun Jun Jun Jun Jun J  | a)  A  O  To 7 in  Table  Table  98  0  steps 3   | ug Sep 24 0.4  Table 9c) 1 20.98  9, Th2 (°C) 36 20.36  2 0.36  3 to 7 in Table 36 20.34                                   | 0.64<br>20.84<br>20.36<br>0.61<br>e 9c)<br>20.17                        | 0.81<br>20.52<br>20.36<br>0.79                 | 0.88<br>20.19<br>20.35<br>0.87                  | 21     | (86)<br>(87)<br>(88)<br>(89)                         |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m=   | erature Jan 0.87 interna 20.24 erature 20.35 ation fact 0.85 interna 19.35  | during heater tor for gain leading heater to the leading heater to the leading heater to the leading heater tor for gain leading heater to the leading hea | ns for ling por ns for roure in the second s | eriods in iving are 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54 the rest of 20.22                                     | ea, h1,1<br>May<br>0.41<br>ea T1 (<br>20.97<br>n rest o<br>20.36<br>welling<br>0.38<br>of dwel<br>20.32                             | ring m (s  | y steps 3 to 20.39 21 20.36 20.26 20.26 20.26 20.26 20.26 20.26 20.26 20.26 20.26 20 | a)  A  O  To 7 in  Table  B  B  B  B  C  Steps 3  C  C  C  C  C  C  C  C  C  C  C  C  C           | ug Sep 24 0.4  Table 9c) 1 20.98 9, Th2 (°C) 36 20.36 2 0.36 3 to 7 in Table 36 20.34                                      | 0.64<br>20.84<br>20.36<br>0.61<br>e 9c)<br>20.17                        | 0.81<br>20.52<br>20.36<br>0.79                 | 0.88<br>20.19<br>20.35<br>0.87                  |        | (86)<br>(87)<br>(88)<br>(89)                         |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m=   | erature Jan 0.87 interna 20.24 erature 20.35 ation fac 0.85 interna 19.35   | during heater tor for gain leading heater to the leading heater to | ns for li Mar 0.72 ure in l 20.68 ating po 20.35 ns for r 0.7 ure in t 19.95   | eriods in iving are Apr 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54 the rest of 20.22 er the who                      | ea, h1,r<br>May<br>0.41<br>ea T1 (<br>20.97<br>n rest o<br>20.36<br>welling<br>0.38<br>of dwel<br>20.32                             | ring (sm (s / l) (s /  | ee Table 9  Jun Ju  0.28 0.2  w steps 3 to 10.99 21  relling from 10.36 20.3  m (see Tac 10.25 0.16  T2 (follow 10.36 20.3  g) = fLA × 1   | a)  II  | ug Sep 24 0.4  Table 9c) 1 20.98  9, Th2 (°C) 36 20.36  2 0.36  3 to 7 in Table 36 20.34                                   | 0.64<br>20.84<br>20.36<br>0.61<br>(e 9c)<br>20.17<br>(LA = Liv          | 0.81 20.52 20.36 0.79 19.74 ving area ÷ (-     | 0.88<br>20.19<br>20.35<br>0.87<br>19.28<br>4) = |        | (86)<br>(87)<br>(88)<br>(89)<br>(90)                 |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m=   | erature Jan 0.87 interna 20.24 erature 20.35 ation fac 0.85 interna 19.35 interna 19.71   | during heater tor for gain leading heater to see the second secon | ns for li Mar 0.72 ure in l 20.68 ating pe 20.35 ns for r 0.7 ure in t 19.95 ure (for  | eriods in iving are Apr 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54 the rest of 20.22 r the who 20.48                 | n the lives, h1,1 May 0.41 ea T1 (20.97 n rest of 20.36 welling 0.38 of dwelling 20.32 ole dwelling 20.58                           | ring m (s follows) follows fol | ee Table 9  Jun Ju  0.28 0.2  w steps 3 1  0.99 21  relling from 0.36 20.3  m (see Ta  0.25 0.16  T2 (follow 0.36 20.3   | a)  A  O  O  To 7 in  Table  B  B  O  Steps 3  C  T1 + (1)  C  C  C  C  C  C  C  C  C  C  C  C  C | ug Sep 24 0.4  Table 9c) 1 20.98 9, Th2 (°C) 36 20.36 2 0.36 3 to 7 in Table 36 20.34  fLA) × T2 62 20.6                   | 0.64<br>20.84<br>20.36<br>0.61<br>e 9c)<br>20.17<br>LA = Liv            | 0.81  20.52  20.36  0.79  19.74  ving area ÷ ( | 0.88<br>20.19<br>20.35<br>0.87                  |        | (86)<br>(87)<br>(88)<br>(89)                         |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m=   | erature Jan 0.87 interna 20.24 erature 20.35 ation fac 0.85 interna 19.35 interna 19.71 adjustr   | during heater for gain Feb 0.81 I temperat 20.43 during heater 20.35 eter for gain 0.8 I temperat 19.61 I temperat 19.94 ment to the   | ating points for line Mar 0.72 ure in l 20.68 ating points for r 0.7 ure in t 19.95 ure (for 20.24 at mean   | eriods in iving are Apr 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54 the rest of 20.22 r the who 20.48                 | the lives, h1,r May 0.41  ea T1 (20.97  rest of 20.36  welling 0.38  of dwelling 20.32  ole dwelling 20.58  tempe                   | ring (s) (s) (s) (s) (s) (s) (s) (s) (s) (s)   | ee Table 9  Jun Ju  0.28 0.2  w steps 3 to 10.99 21  relling from 10.36 20.3  m (see Taction T2 (follow 10.36 20.3  g) = fLA × 10.61 20.6  tree from Taction T | a)  II  | ug Sep 24 0.4  Table 9c) 1 20.98  9, Th2 (°C) 36 20.36  2 0.36  3 to 7 in Table 36 20.34  - fLA) × T2 62 20.6  where appre | 0.64  20.84  20.36  0.61  e 9c)  20.17  fLA = Liv                       | 0.81 20.52 20.36 0.79 19.74 ving area ÷ (      | 0.88<br>20.19<br>20.35<br>0.87<br>19.28<br>4) = |        | (86)<br>(87)<br>(88)<br>(89)<br>(90)                 |
| Temp Utilisa (86)m= Mean (87)m= Temp (88)m= Utilisa (89)m= Mean (90)m= Mean (92)m= Apply (93)m=                | erature Jan 0.87 interna 20.24 erature 20.35 ation fac 0.85 interna 19.35 interna 19.71 adjustr 19.71                                       | during heat tor for gain learning heat 20.43 during heat 20.35 ctor for gain learning heat 19.61 ltemperat 19.94 ment to the 19.94   | ating pons for line ating pons for roure in the second sec | eriods in iving are Apr 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54 the rest of 20.22 r the who 20.48 internal        | n the lives, h1,1 May 0.41 ea T1 (20.97 n rest of 20.36 welling 0.38 of dwelling 20.32 ole dwelling 20.58                           | ring (s) (s) (s) (s) (s) (s) (s) (s) (s) (s)   | ee Table 9  Jun Ju  0.28 0.2  w steps 3 1  0.99 21  relling from 0.36 20.3  m (see Ta  0.25 0.16  T2 (follow 0.36 20.3   | a)  II  | ug Sep 24 0.4  Table 9c) 1 20.98  9, Th2 (°C) 36 20.36  2 0.36  3 to 7 in Table 36 20.34  - fLA) × T2 62 20.6  where appre | 0.64<br>20.84<br>20.36<br>0.61<br>e 9c)<br>20.17<br>LA = Liv            | 0.81 20.52 20.36 0.79 19.74 ving area ÷ (      | 0.88<br>20.19<br>20.35<br>0.87<br>19.28<br>4) = |        | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91)<br>(92) |
| Temp Utilisa (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean (90)m=  Mean (92)m=  Apply (93)m=  8. Spa  | erature Jan 0.87 interna 20.24 erature 20.35 etion fac 0.85 interna 19.35 interna 19.71 adjustr 19.71 acc hea                               | during heater tor for gain sector for gain sec | ns for ling por line in line i | eriods in iving are Apr 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54 che rest of 20.22 er the who 20.48 internal 20.48 | n the lives, h1,1 May 0.41 ea T1 (20.97 n rest o 20.36 welling 0.38 of dwel 20.32 ole dwel 20.58 tempe 20.58                        | ring (s) (s) (s) (s) (s) (s) (s) (s) (s) (s)   | y steps 3 to 10.28 0.28 0.29 21 yelling from 10.36 20.3 yelling from 10.36 20.3 yelling from 10.36 20.3 yelling from 12.061 20.6 yelling from 12.061 20.061 yelling from 12.061 20.061 yelling from 12.061 20.061 yelling from 12.061 20.061 yelling from 12.061 20.061 yelling from 12.061 20.061 yelling from 12.061 yelling from 12 | a)  I   | ug Sep 24 0.4  Table 9c) 1 20.98  9, Th2 (°C) 36 20.36  2 0.36  3 to 7 in Table 36 20.34  - fLA) × T2 62 20.6  where appre | 0.64  20.84  20.36  0.61  e 9c)  20.17  fLA = Livitation private  20.44 | 0.81  20.52  20.36  0.79  19.74  ving area ÷ ( | 0.88  20.19  20.35  0.87  19.28  4) =  19.65    | 0.4    | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91)<br>(92) |
| Temp Utilisa  (86)m=  Mean (87)m=  Temp (88)m=  Utilisa (89)m=  Mean (90)m=  Mean (92)m=  Apply (93)m=  8. Spa | erature  Ition factor  Jan  0.87  interna  20.24  erature  20.35  Interna  19.35  interna  19.71  adjustr  19.71  ace head  to the internal | during heater tor for gain sector for gain sec | ating points for line of the content | eriods in iving are Apr 0.56 iving are 20.88 eriods in 20.36 est of dv 0.54 the rest of 20.22 r the who 20.48 internal 20.48  | n the lives, h1,1 May 0.41 ea T1 (20.97 n rest of 20.36 welling 0.38 of dwelling 20.32 ole dwelling 20.58 temper 20.58 temper 20.58 | ring (s) (s) (s) (s) (s) (s) (s) (s) (s) (s)   | y steps 3 to 10.28 0.28 0.29 21 yelling from 10.36 20.3 yelling from 10.36 20.3 yelling from 10.36 20.3 yelling from 12.061 20.6 yelling from 12.061 20.061 yelling from 12.061 20.061 yelling from 12.061 20.061 yelling from 12.061 20.061 yelling from 12.061 20.061 yelling from 12.061 20.061 yelling from 12.061 yelling from 12 | a)  I   | ug Sep 24 0.4  Table 9c) 1 20.98  9, Th2 (°C) 36 20.36  2 0.36  3 to 7 in Table 36 20.34  - fLA) × T2 62 20.6  where appre | 0.64  20.84  20.36  0.61  e 9c)  20.17  fLA = Livitation private  20.44 | 0.81  20.52  20.36  0.79  19.74  ving area ÷ ( | 0.88  20.19  20.35  0.87  19.28  4) =  19.65    | 0.4    | (86)<br>(87)<br>(88)<br>(89)<br>(90)<br>(91)<br>(92) |

Mar

Apr

May

Jun

Jul

Aug

Sep

Oct

Nov

Dec

Jan

Feb

| Litiliaa   | tion for  | tor for a | aina hm                     |           |           |             |           |           |             |             |              |             |                   |               |
|--|-----------|-----------|-----------------------------|-----------|-----------|-------------|-----------|-----------|-------------|-------------|--------------|-------------|-------------------|---------------|
| (94)m=   | 0.84      | 0.79      | ains, hm<br><sub>0.69</sub> | 0.54      | 0.39      | 0.27        | 0.19      | 0.22      | 0.38        | 0.62        | 0.78         | 0.85        |                   | (94)          |
| ` ′ L  |           |           | , W = (9 <sup>2</sup>       |           |           | V           | 00        | V         | 0.00        | 0.02        | 00           |             |                   | ,             |
| (95)m=   | 556.34    | 587.58    | 588.84                      | 535.55    | 427.2     | 291.1       | 195.22    | 204.38    | 311.68      | 439.25      | 505.48       | 540.24      |                   | (95)          |
| Month  | ly aver   | age exte  | rnal tem                    | perature  | from Ta   | able 8      |           |           |             |             |              |             |                   |               |
| (96)m=   | 4.3       | 4.9       | 6.5                         | 8.9       | 11.7      | 14.6        | 16.6      | 16.4      | 14.1        | 10.6        | 7.1          | 4.2         |                   | (96)          |
| г  |           |           | an intern                   |           |           | Lm , W =    | =[(39)m : | x [(93)m  | – (96)m     | ]           |              |             |                   |               |
| (97)m=   | 765.67    | 746.33    | 680.62                      | 569.25    | 435.82    | 292.62      | 195.52    | 204.9     | 317.2       | 482.91      | 637.76       | 762.66      |                   | (97)          |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m  |           |           |                             |           |           |             |           |           |             |             |              |             |                   |               |
| (98)m=   | 155.74    | 106.68    | 68.28                       | 24.27     | 6.42      | 0           | 0         | 0<br>     | 0           | 32.49       | 95.24        | 165.48      | 054.0             | 7(00)         |
| _  |           |           |                             |           |           |             |           | rota      | ıı per year | (kwn/year   | r) = Sum(9   | 8)15,912 =  | 654.6             | <u> </u> (98) |
| Space  | heatin    | g require | ement in                    | kWh/m²    | /year     |             |           |           |             |             |              |             | 9.08              | (99)          |
|  |           |           | nts – Cor                   |           | Ĭ         |             |           |           |             |             |              |             |                   |               |
|  |           |           | ace hea<br>from se          |           |           |             |           |           |             |             | unity sch    | neme.       | 0                 | (301)         |
|  | •         |           |                             | ,         | • •       | •           |           | (Table I  | 1) 0 11 11  | one         |              | [           | 0                 |               |
| Fraction   | n of spa  | ace heat  | from co                     | mmunity   | system    | 1 – (30     | 1) =      |           |             |             |              |             | 1                 | (302)         |
|  |           |           | y obtain he<br>s, geotherr  |           |           |             |           |           |             | up to four  | other heat   | sources; th | ne latter         |               |
|  |           |           | commun                      |           |           | iom power   | diatrono. | 00071000  | idix o.     |             |              |             | 1                 | (303a)        |
| Fraction   | of tota   | al space  | heat fro                    | m Comn    | nunity he | eat pumr    |           |           |             | (3          | 02) x (303   | a) = [      | 1                 | ]<br>(304a)   |
|  |           |           |                             |           |           |             |           | unity hes | ating eve   |             | 7 (333       |             | 1                 | (305)         |
| Factor for control and charging method (Table 4c(3)) for community heating system  Distribution loss factor (Table 12c) for community heating system |           |           |                             |           |           |             |           |           | 1.05        | (306)       |              |             |                   |               |
|  |           |           | Table                       | 20) 101 0 | Johnnan   | ity ricatii | ig syste  | '''       |             |             |              |             |                   |               |
| <b>Space</b><br>Annual   | `         |           | requiren                    | nent      |           |             |           |           |             |             |              | [           | kWh/year<br>654.6 |               |
| Space  | heat fro  | m Comr    | munity h                    | eat pum   | р         |             |           |           | (98) x (30  | 04a) x (30  | 5) x (306)   | =           | 687.33            | (307a)        |
| Efficien   | cy of se  | econdar   | y/supple                    | mentary   | heating   | system      | in % (fro | m Table   | 4a or A     | ppendix     | E)           | Ī           | 0                 | (308          |
| Space  | heating   | require   | ment froi                   | m secon   | dary/sup  | plemen      | tary syst | tem       | (98) x (30  | 01) x 100 - | ÷ (308) =    | Ī           | 0                 | (309)         |
| Water I  | hoatine   |           |                             |           |           |             |           |           |             |             |              | •           |                   | _             |
|  |           |           | equirem                     | ent       |           |             |           |           |             |             |              |             | 2046.91           | 7             |
|  |           |           | ty schem                    |           |           |             |           |           |             |             |              |             |                   | <b>_</b>      |
| Water h  | neat fro  | m Comn    | nunity he                   | eat pump  | )         |             |           |           | (64) x (30  | 03a) x (30  | 5) x (306) : | = [         | 2149.26           | (310a)        |
| Electric   | ity used  | d for hea | ıt distribu                 | ution     |           |             |           | 0.01      | × [(307a)   | (307e) +    | · (310a)(    | (310e)] =   | 28.37             | (313)         |
| Cooling  | j Systei  | m Energ   | y Efficiei                  | ncy Ratio | 0         |             |           |           |             |             |              |             | 0                 | (314)         |
| Space  | cooling   | (if there | is a fixe                   | d cooling | g systen  | n, if not e | enter 0)  |           | = (107) ÷   | - (314) =   |              |             | 0                 | (315)         |
|  |           |           | nd fans v<br>- baland       |           |           |             |           | outside   |             |             |              | ·<br>[      | 240.51            | (330a)        |
| warm a   | ir heati  | ng syste  | m fans                      |           |           |             |           |           |             |             |              | j           | 0                 | (330b)        |
| pump fo  | or solar  | water h   | eating                      |           |           |             |           |           |             |             |              | [           | 0                 | (330g)        |
| Total el   | ectricity | y for the | above, k                    | «Wh/yea   | r         |             |           |           | =(330a) ·   | + (330b) +  | (330g) =     | [           | 240.51            |               |
|  | •         | •         | •                           | -         |           |             |           |           |             |             | *            | Ĺ           |                   |               |

| Energy for lighting (calculated in App   | pendix L)  |   | 318.27   | 332)  |
|--|--|---|--|---|
| Electricity generated by PVs (Appen  | ndix M) (negative quantity)  |   | -331.63  | 333)  |
| Electricity generated by wind turbine  | e (Appendix M) (negative quantity)   |   | 0 (3   | 334)  |
| 10b. Fuel costs – Community heati  | ing scheme   |   |  |   |
|  | <b>Fuel</b><br>kWh/year  | Fuel Price<br>(Table 12)  | Fuel Cost<br>£/year  |   |
| Space heating from CHP   | (307a) x   | 4.24 × 0.0  | 1 = 29.14  | 340a)   |
| Water heating from CHP   | (310a) x   | 4.24 x 0.0  | 1 = 91.13  | 342a)   |
|  | 777.1  | Fuel Price  |  |   |
| Pumps and fans   | (331)  | 13.19 × 0.0   | 01.112   | 349)  |
| Energy for lighting  | (332)  | 13.19 × 0.0   | 41.30  | 350)  |
| Additional standing charges (Table '   | 12)  |   | 120  | 351)  |
| Energy saving/generation technolog Item 1  | gies   | 13.19 × 0.0   | 1 = -43.74 (3  | 352)  |
| Total energy cost  | = (340a)(342e) + (345)(354) =  |   | 270.23   | 355)  |
| 11b. SAP rating - Community heati  | ing scheme   |   |  |   |
| Energy cost deflator (Table 12)  |  |   | 0.42   | 356)  |
| Energy cost factor (ECF)   | [(355) x (356)] ÷ [(4) + 45.0] =   |   |  | 357)  |
|  |  |   |  |   |
| SAP rating (section12)   |  |   | 86.48  | 358)  |
| SAP rating (section12)  12b. CO2 Emissions – Community h   | En   |   | tor Emissions  | 358)  |
|  | En kW and water heating (not CHP)  | tergy Emission fact kg CO2/kWh  | tor Emissions<br>kg CO2/year   | 358)<br>367a)   |
| 12b. CO2 Emissions – Community h   | En kW and water heating (not CHP)  | kg CO2/kWh  Is repeat (363) to (366) for the second   | tor Emissions<br>kg CO2/year   |   |
| CO2 from other sources of space ar Efficiency of heat source 1 (%)   | En<br>kW<br>and water heating (not CHP)<br>If there is CHP using two fuel<br>[(307b)+(310b)] x   | kg CO2/kWh  Is repeat (363) to (366) for the second   | tor Emissions<br>kg CO2/year   | 367a)   |
| CO2 from other sources of space ar Efficiency of heat source 1 (%) CO2 associated with heat source 1   | EnkW  and water heating (not CHP)  If there is CHP using two fuel  [(307b)+(310b)] x  In [(313) x  | kg CO2/kWh  Is repeat (363) to (366) for the second  100 ÷ (367b) x 0.52  | tor Emissions<br>kg CO2/year  d fuel 219 (3 = 672.23 (3 = 14.72 (3   | 367a)<br>367)   |
| CO2 from other sources of space ar Efficiency of heat source 1 (%) CO2 associated with heat source 1 Electrical energy for heat distribution   | EnkW  and water heating (not CHP)  If there is CHP using two fuel  [(307b)+(310b)] x  In [(313) x  ity systems (363)(3   | kg CO2/kWh  Is repeat (363) to (366) for the second  100 ÷ (367b) x  0.52   | tor Emissions<br>kg CO2/year  d fuel 219 (3) = 672.23 (3) = 14.72 (3) = 686.95 (3)   | 367a)<br>367)<br>372)   |
| CO2 from other sources of space ar Efficiency of heat source 1 (%) CO2 associated with heat source 1 Electrical energy for heat distribution Total CO2 associated with communication   | EnkW  and water heating (not CHP)  If there is CHP using two fuel  [(307b)+(310b)] x  In [(313) x  ity systems (363)(3  (secondary) (309) x  | kg CO2/kWh  Is repeat (363) to (366) for the second  100 ÷ (367b) x   | tor Emissions<br>kg CO2/year  1 fuel 219 (3) = 672.23 (3) = 14.72 (3) = 686.95 (3) = 0   | 367a)<br>367)<br>372)<br>373)   |
| CO2 from other sources of space ar Efficiency of heat source 1 (%) CO2 associated with heat source 1 Electrical energy for heat distribution Total CO2 associated with communic  | EnkW  and water heating (not CHP)  If there is CHP using two fuel  [(307b)+(310b)] x  In [(313) x  ity systems (363)(3  (secondary) (309) x  mersion heater or instantaneous heater or instantaneous heater  | kg CO2/kWh  Is repeat (363) to (366) for the second  100 ÷ (367b) x   | tor Emissions<br>kg CO2/year  1 fuel 219 (3) = 672.23 (3) = 14.72 (3) = 686.95 (3) = 0 (3)   | 367a)<br>367)<br>372)<br>373)<br>374)                                 |
| CO2 from other sources of space are Efficiency of heat source 1 (%) CO2 associated with heat source 1 Electrical energy for heat distribution Total CO2 associated with communic CO2 associated with space heating CO2 associated with water from imm  | EnkW  and water heating (not CHP)  If there is CHP using two fuel  [(307b)+(310b)] x  In [(313) x  ity systems (363)(3  (secondary) (309) x  mersion heater or instantaneous head water heating (373) + (3   | kg CO2/kWh  Is repeat (363) to (366) for the second  100 ÷ (367b) x  0.52  0.52  366) + (368)(372)  eater (312) x  0.22  374) + (375) =           | tor Emissions<br>kg CO2/year  d fuel 219 (3) = 672.23 (3) = 14.72 (3) = 686.95 (3) = 0 (3) = 0 (3)   | 367a)<br>367)<br>372)<br>373)<br>374)<br>375)                         |
| CO2 from other sources of space are Efficiency of heat source 1 (%) CO2 associated with heat source 1 Electrical energy for heat distribution Total CO2 associated with communic CO2 associated with space heating CO2 associated with water from immortal CO2 associated with space and   | EnkW  and water heating (not CHP)  If there is CHP using two fuel  [(307b)+(310b)] x  In [(313) x  ity systems (363)(3  (secondary) (309) x  mersion heater or instantaneous head water heating (373) + (3  pumps and fans within dwelling (33   | kg CO2/kWh  Is repeat (363) to (366) for the second  100 ÷ (367b) × 0.52  0.52  366) + (368)(372)  eater (312) × 0.22  374) + (375) =  1)) × 0.52 | tor Emissions<br>kg CO2/year  d fuel 219 (3) = 672.23 (3) = 14.72 (3) = 686.95 (3) = 0 (3) = 0 (4) = 124.82 (3)                              | 367a)<br>367)<br>372)<br>373)<br>374)<br>375)                         |
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| 13b. Primary Energy – Community heating scheme  |                          |                      |                                  |
|---|--------------------------|----------------------|----------------------------------|
|   | Energy<br>kWh/year       | Primary factor       | P.Energy<br>kWh/year             |
| Energy from other sources of space and water heating (not CHP)  Efficiency of heat source 1 (%)  If there is CHP using to | wo fuels repeat (363) to | (366) for the second | fuel 219 (367a)                  |
| Energy associated with heat source 1 [(307b)+(3   | 10b)] x 100 ÷ (367b) x   | 3.07                 | = 3976.41 (367)                  |
| Electrical energy for heat distribution [(3   | 313) x                   |                      | = 87.08 (372)                    |
| Total Energy associated with community systems (36)   | 63)(366) + (368)(372     | 2)                   | = 4063.49 (373)                  |
| if it is negative set (373) to zero (unless specified otherwise, se   | e C7 in Appendix C       | )                    | 4063.49 (373)                    |
| Energy associated with space heating (secondary) (30  | 09) x                    | 0                    | = 0 (374)                        |
| Energy associated with water from immersion heater or instantant  | eous heater(312) x       | 1.22                 | = 0 (375)                        |
| Total Energy associated with space and water heating (3)  | 73) + (374) + (375) =    |                      | 4063.49 (376)                    |
| Energy associated with space cooling (3   | 15) x                    | 3.07                 | = 0 (377)                        |
| Energy associated with electricity for pumps and fans within dwell  | ling (331)) x            | 3.07                 | = 738.35 (378)                   |
| Energy associated with electricity for lighting (33   | 32))) x                  | 3.07                 | = 977.08 (379)                   |
| Energy saving/generation technologies Item 1  Total Primary Energy, kWh/year  sum of (376)(3                              | 382) =                   | 3.07 × 0.01          | = -1018.1 (380)<br>4760.82 (383) |
|   |                          |                      |                                  |

Agar Grove Estate Redevelopment

Summer Comfort & TM59 Assessment

Report

16<sup>th</sup> July 2019



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#### **1** Executive Summary

Summer comfort is important in all occupied buildings, and with climate catastrophe leading to increasing temperatures, is critical to the long-term success of buildings. As a reference for Agar, a recent study found London's predicted 2050 climate is comparable to Barcelona's current climate (Bastin, 2019). As with any design that depends on human operation, and is influenced by behaviour outside the client and design team's control, there are risks, and ways to mitigate these risks. This report details design work carried out, with actions for the client and design team.

The design standards for residential summer comfort have advanced since the original design of Agar for planning, including the publication of CIBSE TM59 "Design methodology for the assessment of overheating risk in homes" in 2017 (referred to as TM59 from this point on). This has two criteria – daytime comfort for all rooms, and night-time comfort for bedrooms.

The summer comfort strategy for both buildings uses a combination of natural ventilation from opening windows and mechanical ventilation. This depends on assumptions, including how open windows are, how often they are opened, and how much heat is generated inside the building (from cooking, appliances etc.). It is particularly sensitive to window operation as a way of rejecting heat from the building, and providing passive cooling. This operation depends on the building occupants, but is also influenced by the design of the windows: how easy they are to operate, internal space planning etc.

TM59 Modelling has been carried out based on 10 apartments, which have been selected to represent the most onerous examples, including apartments higher up the buildings with more exposure to solar gains, and ground floor apartments with limited openings for security. This modelling has been carried out for current weather data (2020), and future weather data (2050). TM59 uses relatively high internal gains but also assumes windows are open a lot of the time when people are in, which is potentially optimistic. For example, windows are assumed to be open whenever a room is warmer than 22°C, and bedrooms are assumed occupied 24/7.

To achieve summer comfort for 2020 weather data the following are required – without them, there is a significant risk of overheating:

#### **Block I summer comfort requirements**

Windows able to open wide day or night, 100% area of typical window to be openable:

Ground floor: 15° wide.

First floor and above: windows: 45° wide
 First floor and above: balconies: 45° wide

#### Block JKL summer comfort requirements

Windows able to open wide day or night, 60% area of typical window to be openable:

Ground floor: 15° wide.

• First floor and above: 45° wide

External solar shading to 5<sup>th</sup> floor apartments



#### **ACTION 1**

Design team and client to review and comment on Summer Comfort Requirements (tables above)

Assuming these requirements are met, the same tests have been run with predicted 2050 weather, and in this case both buildings fail both TM59 criteria. Solar heating is a significant contributor to overheating. Certain glazing, such as on Block JKL, goes to floor level with the lowest panes non-openable. These lowest panes add solar gains but relatively little to overall daylighting and do not aid natural ventilation, so we suggest omitting these. Please see section 8.2.1 for more detail.

#### **ACTION 2**

Architects to review options to omit fixed low level glazing

There are other aspects of the design that can help mitigate the risk of overheating, including:

## Potential changes and design development for the current designs

Add blinds / shades / louvres

Ensure the internal space planning allows for opening of windows

Design windows so that they can be securely held open

Ensure windows are usable i.e. detailed so they are not too heavy to operate

#### **Potential retrofit options**

Providing solar control film to reduce solar gains

Including underfloor cooling: could be accommodated/retrofitted with some changes to the Dimplex Zeroth system

Adding cooling to the mechanical ventilation system: could be accommodated with some changes to the Dimplex Zeroth system and in-apartment ductwork

Fitting external shading / louvres to limit solar gains: window reveals could be designed to incorporate this

**Ceiling fans** 

#### **ACTION 3**

Design team to review and comment on feasibility of incorporating above options in current design

## 2 Introduction

This report details the process and results of a CIBSE TM59 overheating study for Blocks I and JKL of the Agar Grove Development, Phase 1C. Agar Grove is a major development of circa 500 homes for the London Borough of Camden. Current and future weather data was used to understand the current level of overheating risk as well as potential future risks due to a changing climate. The process was iterative, testing various options to find the most suitable as well as to understand what measures may need to be taken to future proof the building against potential future climate scenarios.

It is important to note, although final results indicate rooms passing with the 2020 weather file, this is predicated on assumptions and values adjusted during iterations. Therefore it is important to read these assumptions to understand their feasibility or to consider some alternative measures which could be adopted.

|           | Assumptions                             | Value      | Comments  |
|-----------|---|------------|---|
|           | Year 2050 - Mechanical Cooling required | 50W/m2     | Cooling is applied. Hence, in this case there would need to be a retrofit of a mechanical cooling system in the future. Previous iterations tried lower cooling values (20, 30 and 40W/m2). Although some rooms passed at these lower values, 50W/m2 was required for all rooms to pass |
|           | Ground floor glazing opening fraction   | 15%        | Due to security – have contacted Camden Council for clarification on this and still awaiting a response   |
|           | U-Value - Glazing                       | 0.85W/m2.K | Total, including frames   |
|           | U-Value - External Walls                | 0.2W/m2.K  |   |
|           | U-Value - External Floors               | 0.2W/m2.K  |   |
|           | U-Value - Roof                          | 0.1W/m2.K  |   |
|           | Infiltration                            | 0.5ach     | air changes per hour  |
|           | Stage D drawing Plans                   |            |   |
| DIl. I    | Typical glazing opening fraction        | 50%        | # excludes ground floor   |
| Block I   | Metal rail ballustrades                 |            | # as opposed to glass etc which would limit air flow  |
| Block JKL | Typical glazing opening fraction        | 35%        | # excludes ground floor   |
|           | Balcony glazing opening fraction        | 50%        |   |
|           | 5th floor shading                       |            | # 5th floor only passes with addition of shading  |

Figure 1: Table of Assumptions

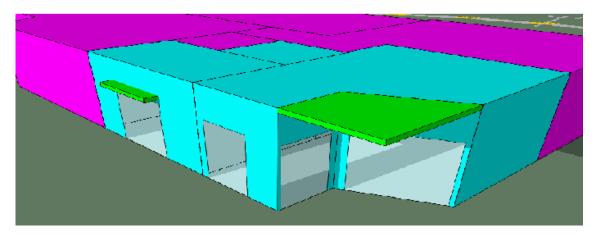


Figure 2: Block JKL 5th Floor Shading. 400mm deep shade required for bedroom, and shade to cover balcony on living/kitchen room corner

## 3 Legislation and Guidance

According to the Camden Borough's Energy Efficiency and Adaptation, "Natural light makes buildings more attractive, pleasant and energy efficient. Building layouts should be designed to maximise sunlight and daylight while taking into account other factors such as overheating and privacy." Hence the design process needs to strike the balance between beneficial solar gains (such as in colder seasons) and good daylighting versus the risk of overheating in summer.

## 3.1 Part L1A: limiting the effects of heat gains in summer.

It must be demonstrated by calculation that a minimum standard is met in terms of limiting overheating.

#### 3.2 The London Plan

The Mayor of London has a legal duty to set out policies and proposals in this strategy for adapting to climate change and a duty to take action on climate change. The London Plan sets out risks associated with climate change as well as practical steps to mitigate this.

#### 3.2.1 Chapter 5 – London's Response to Climate Change, Section 5.8 (2016)

"For development proposals the **early design stage is the most cost effective time** to incorporate relevant design and technological measures, enabling proposals to realise their full potential to reduce carbon dioxide emissions and adapt to climate change. Responding to climate change has to be an integral and essential part of the development process and not a set of 'bolt-ons' ".

#### 3.2.2 Policy 8.4.3 Minimise the risk of new development overheating

"Developers will be required to **follow the cooling hierarchy** (see below) to reduce the risk of developments **overheating** and reduce the impact on the UHI effect through avoiding mechanical cooling where possible and promoting passive cooling measures. Where mechanical cooling is proposed, developers will need to consider the use of low global warming potential refrigerants to reduce harmful emissions."

## 3.2.3 Policy 5.9 Overheating and Cooling

Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following **cooling hierarchy**:

- 1. Minimise internal heat generation through energy efficient design
- 2. Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls
- 3. Manage the heat within the building through exposed internal thermal mass and high ceilings
- 4. Passive ventilation
- 5. Mechanical ventilation
- 6. Active cooling systems (ensuring they are the lowest carbon options)

#### 3.2.4 Climate Change Adaptation Section 5.47

The GLA is developing with the Chartered Institute of Building Services Engineers (CIBSE) guidance for developers to address the risk of overheating in buildings......The Mayor encourages the use of this guidance in the preparation of development proposals. Refer to Section 3.3.1.

## 3.3 New draft London Plan (2018)

#### 3.3.1 9.2.10

As a minimum, energy strategies should contain the following information:

f. The results of dynamic overheating modelling which should be undertaken in line with relevant Chartered Institution of Building Services Engineers (CIBSE) guidance, along with any mitigating actions (see Policy SI4 Managing heat risk).

## 3.3.2 Policy SI4 Managing heat risk

9.4.3 Many aspects of building design can lead to increases in overheating risk, including high proportions of glazing and an increase in the air tightness of buildings. Single aspect dwellings are more difficult to ventilate naturally and are more likely to overheat, and should normally be avoided in line with Policy D4 Housing quality and standards. There are a number of low-energy-intensive measures that can mitigate overheating risk. These include solar shading, building orientation and solar-controlled glazing.

9.45 The Chartered Institution of Building Services Engineers (CIBSE) has produced guidance on assessing and mitigating overheating risk in new developments...**TM 59 should be used for domestic developments** and TM 52 should be used for non-domestic developments. In addition, TM 49 guidance and datasets should also be used to ensure that all new development is designed for **the climate it will experience over its design life**.

#### 3.4 The Camden Local Plan 2017

#### 3.4.1 Policy CC2 Adapting to Climate Change

This requires developments to be resilient to climate change. All development should adopt appropriate climate change adaptation measures such as:

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

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

## 4 About the buildings

#### 4.1 General

- Mae are the architects for Block I
- Hawkins Brown Associates are the architects for Block JKL

Both buildings follow a general north south axis and hence a large proportion of the glazing is on the east and west facades. This is generally difficult to shade effectively against summer sun. Block I has stepped in windows with columns and balconies whereas JKL has a mixture of balconies and 'winter gardens' which are within the thermal envelope.

## 4.2 Cooling Strategy

Both buildings are being designed to *Passivhaus* standards. The strategy is for high levels of insulation to avoid heat loss or gain via the external façade. In addition a mechanical ventilation system with heat recovery is proposed (MVHR). This will rely on relatively low flow rates of air which helps bring down energy usage associated with fans as well as a high heat recovery rate. The MVHR will have a summer bypass for the heat exchanger, allowing fresh air to be brought in not tempered when it will help cool the building in summer. During peak summertime temperatures, the system will operate as 'mixed mode' allowing the occupant to open windows as well as receive fresh air from the mechanical ventilation system.

In the modelling we accounted for both the fresh air from openable windows in addition to the mechanical ventilation rates assigned to each space. No mechanical cooling is proposed, instead relying on passive cooling aligning with the London Plan Cooling Hierarchy.

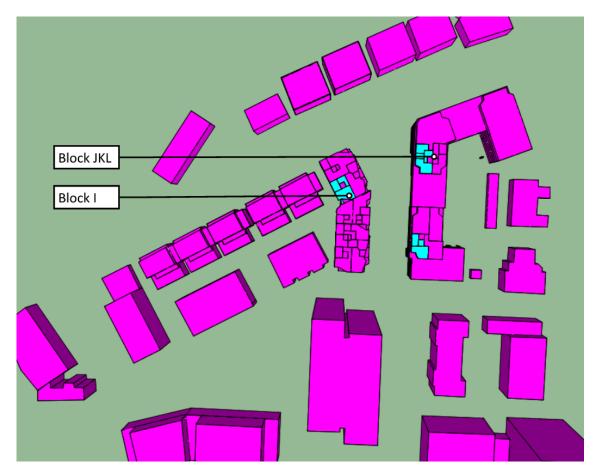


Figure 3: 3D Model from above

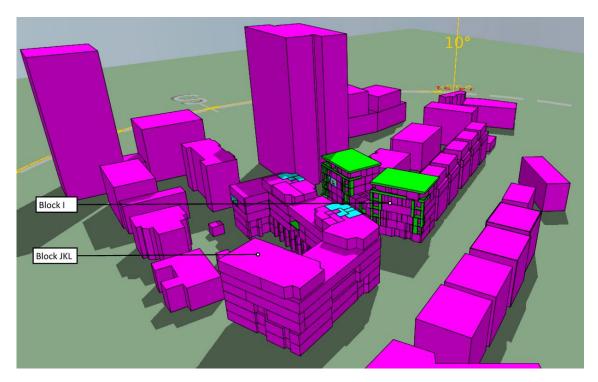


Figure 4: 3D Model showing adjacent buildings

## 5 Methodology

## **5.1** Selecting Sample Rooms:

Block I: 12 rooms modelled plus 5 integral corridors.

Block JKL: 13 rooms modelled plus 5 integral corridors.

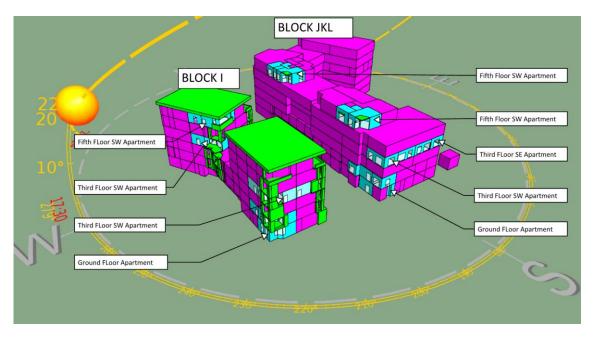


Figure 5: 3D IES Model

Refer to Modelled Spaces in the Appendix for plan drawings showing all selected rooms.

## 5.2 Why were these rooms chosen?

- Solar Gains The relative position of the sun is a major factor in the heat gain of buildings. The rooms chosen were typically those deemed to have high solar gains. In particular, those with south and west glazing which will experience long afternoon exposure to the sun's rays in combination with the heat already gained throughout the day from both solar and internal gains. As the buildings are surrounded by other high rise blocks, the top floors were expected to get the least overshadow from these adjacent buildings. Hence South-Westerly apartments on the top floors were modelled.
- Security As the strategy includes natural ventilation via openable windows, the lower floors
  were assumed to need security measures which will restrict how much the windows can be
  opened. Hence ground floor apartments were modelled.
- Asymmetry As the top floor levels were not the exact layout as lower floors, some typical mid-level (3<sup>rd</sup> floor) apartments were modelled.
- Single sided ventilation Where there was no possibility for cross flow from openings on adjacent facades there was a greater risk of insufficient fresh air flow rates to expel heat gains

## 5.3 TM59 Design Methodology



CIBSE TM59 Design Methodology for the assessment of overheating risk in homes is a standard approach using dynamic thermal analysis and the guiding framework of the calculations and this report.

TM59 gives two criteria, both of which must be met for the space to have passed. In addition corridors should be analysed if there is a deemed risk. Refer to TM59 for full definitions but a basic summary is:

#### 5.3.1 Criteria (a) – living rooms, kitchens and bedrooms.

Primarily focused on the need to ensure the internal temperature does not exceed the adaptive temperature for more than 3% of occupied hours. The adaptive temperature is dependent on the external temperature as it is deemed that occupant's subjective feeling of comfort inside a building is based on external temperatures and humidity levels. For example, if the external temperature is high, say 28°C, then occupants will be satisfied with a higher internal temperature than if the external temperature was 21.°C.

#### 5.3.2 Criteria (B) – bedrooms only.

People tend to prefer cooler temperatures for sleeping, and so there is an additional standard for bedrooms during the typical sleeping hours (10pm to 7am) by ensuring the temperature does not exceed 26C for more than 1% of annual hours.

# 5.3.3 Corridors – Temperature should not exceed 28C for more than 3% of the total annual hours.

Unlike (a) and (b) this is not mandatory, but should be highlighted as a risk if a corridor does fail.

## 5.4 Weather Data

Two weather files were used. Both are design summer year (DSY1) datasets. The DSY1 data used represents a moderately warm summer year. It is used to evaluate overheating risk within buildings with a set of years which better describe overheating events, their relative severity and their expected frequency. It should be noted there is DSY 2 (short intense warm spells) and DSY 3 (long, less intense warm spell) weather data which were not used in this modelling.

- For current analysis: London\_LWC\_DSY1\_2020High50.epw
- For adaptation for future climate, a year 2050 dataset was used: London\_LWC\_DSY1\_2050High50.epw

## 5.5 Modelling Software

IES VE 2018 modelling software was used to build a 3D model, applying all data such as internal gains (as dictated by TM59) and applying the correct weather files, fabric values, glazing opening fractions, solar 'g' values and dimensions.

## 6 Results

### 6.1 Block I

#### 6.1.1 2020 Weather File

All rooms pass both Criteria (a) and (b).

All integral corridors pass.

| BLOCK I                   |           | CRITERIA (a)        |                 | CRITERIA (b) |                    | Overall<br>RESULTS |
|---------------------------|-----------|---------------------|-----------------|--------------|--------------------|--------------------|
|                           | Threshold | Top-<br>Tadap>= 1°C | May-Sept<br>24h | Top>26°C     | Year<br>22pm - 7am |                    |
|                           |           | >3%                 |                 | >1%          | ò                  |                    |
| Room Name                 | Ţ         | %                   | FAIL/PASS       | %            | FAIL/PASS/NA       | FAIL/PASS          |
| I.5.Apt.MW.Living/Kitchen |           | 1.8%                | PASS            | -            | N/A                | PASS               |
| 5 Apt MW Corridor         |           | -                   | -               | -            | -                  | -                  |
| I.5.Apt.MW.Bedroom        |           | 1.0%                | PASS            | 0.7%         | PASS               | PASS               |
| I.3.Apt.Living.SW         |           | 2.0%                | PASS            | -            | N/A                | PASS               |
| I.3.Apt.Bedroom.SW        |           | 0.9%                | PASS            | 0.8%         | PASS               | PASS               |
| I.3.Apt.Corridor.SW       |           | -                   | -               | -            | -                  | -                  |
| I.3.Apt.Living.SE         |           | 1.8%                | PASS            | -            | N/A                | PASS               |
| I.1.Bedroom1.SW           |           | 0.8%                | PASS            | 0.4%         | PASS               | PASS               |
| I.1.Corridor.SW           |           | -                   | -               | -            | -                  | -                  |
| I.1.Bedroom2.SW           |           | 0.7%                | PASS            | 0.7%         | PASS               | PASS               |
| I.GF.Living/Kitchen.SW    |           | 1.6%                | PASS            | -            | N/A                | PASS               |
| I.3.Apt.Bedroom.MW        |           | 0.8%                | PASS            | 0.9%         | PASS               | PASS               |
| I.3.Apt.Corridor.MW       |           | -                   | -               | -            | -                  | -                  |
| I.3.Apt.Corridor.SE       |           | -                   | -               | -            | -                  | -                  |
| I.3.Apt.Bedroom1.SE       |           | 0.8%                | PASS            | 0.8%         | PASS               | PASS               |
| I.3.Apt.Living.MW         |           | 2.0%                | PASS            | -            | N/A                | PASS               |
| I.GF.Living/Kitchen.SW    |           | 1.6%                | PASS            | -            | N/A                | PASS               |

| Integral corridors/Halls |              |  |  |  |  |  |
|--------------------------|--------------|--|--|--|--|--|
| Top>28C                  |              |  |  |  |  |  |
| >3%                      |              |  |  |  |  |  |
|                          | PASS/CAUTION |  |  |  |  |  |
| -                        | -            |  |  |  |  |  |
| 1.2%                     | PASS         |  |  |  |  |  |
| -                        | -            |  |  |  |  |  |
| -                        | -            |  |  |  |  |  |
| -                        | -            |  |  |  |  |  |
| 1.1%                     | PASS         |  |  |  |  |  |
| -                        | -            |  |  |  |  |  |
| -                        | -            |  |  |  |  |  |
| 0.7%                     | PASS         |  |  |  |  |  |
| -                        | -            |  |  |  |  |  |
| -                        | -            |  |  |  |  |  |
| -                        | -            |  |  |  |  |  |
| 1.3%                     | PASS         |  |  |  |  |  |
| 1.0%                     | PASS         |  |  |  |  |  |
| -                        | -            |  |  |  |  |  |
| -                        | -            |  |  |  |  |  |
| -                        | -            |  |  |  |  |  |
|                          |              |  |  |  |  |  |

Figure 6: Block I Table of Results

#### 6.1.2 2050 Weather File

All rooms fail both criteria with the 2050 future weather file for passive cooling.

Next, active cooling was applied at 50W/m2 of floor area. All rooms then passed both Criteria (a) and Criteria (b).

The need for active (mechanical) cooling is not unsurprising for a future climate scenario of 2050. Once the external temperatures reach a certain threshold and maintain these high levels over longer periods of time, it is difficult to maintain a lower internal temperature. Options for this are discussed in section 8

#### 6.2 Block JKL

#### 6.2.1 2020 Weather File

All rooms pass both Criteria (a) and (b).

One integral corridor failed. As the corridors are not a mandatory part of passing, this report simply highlights this as a risk to consider. The model reflects the layouts of the time which included heat losses from a Dimplex Xeroth space heating and DHW unit along with associated pipework losses. To mitigate overheating risks where these are located, options include adding extract vents from the cupboard and/or insulating the cupboard.

| BLOCK JKL                                    | CRITERIA (a)  |                 | CRITERIA (b) |                    | Overall<br>RESULTS |
|--|---------------|-----------------|--------------|--------------------|--------------------|
| Threshold                                    | op-Tadap>= 1° | May-Sept<br>24h | Top>26°C     | Year<br>22pm - 7am |                    |
|  | >3%           |                 | >1%          |                    |                    |
| Room Name                                    | %             | FAIL/PASS       | %            | FAIL/PASS/NA       | FAIL/PASS          |
| JKL.5.Core C. West Bedroom                   | 2.4%          | PASS            | 0.4%         | PASS               | PASS               |
| JKL.5.Core C. West Corridor                  | -             | -               | -            | -                  | -                  |
| JKL.GF.Core A.Corridor.SW                    | -             | -               | -            | -                  | -                  |
| JKL.GF.Core A.Living.SW                      | 2.4%          | PASS            | -            | N/A                | PASS               |
| JKL.1.Core A.Double Bed 1.SW                 | 0.8%          | PASS            | 0.4%         | PASS               | PASS               |
| JKL.1.Core A.Corridor.SW                     | -             | -               | -            | -                  | -                  |
| JKL.1.Core A.Single Bed.SW                   | 0.8%          | PASS            | 0.7%         | PASS               | PASS               |
| JKL.1.Core A.Double Bed 2.SW                 | 0.8%          | PASS            | 0.6%         | PASS               | PASS               |
| JKL.3.SW Living/Kitchen                      | 2.3%          | PASS            | -            | N/A                | PASS               |
| JKL.3.Core C. SW Corridor                    | -             | -               | -            | -                  | -                  |
| JKL.3.Core C. SE Corridor                    | -             | -               | -            | -                  | -                  |
| JKL.3.Core C. SW Bedroom                     | 1.0%          | PASS            | 0.4%         | PASS               | PASS               |
| JKL.3.Core C. SE Bedroom                     | 1.1%          | PASS            | 0.4%         | PASS               | PASS               |
| JKL.3.Core C. SE Living/Kitchen              | 2.2%          | PASS            | -            | N/A                | PASS               |
| JKL.5.Core C. West Living/Kitchen            | 2.5%          | PASS            | -            | N/A                | PASS               |
| JKL.5.Core B. Main block West 2nd Bedroom    | 1.5%          | PASS            | 0.6%         | PASS               | PASS               |
| JKL.5.Core B. Main block West1st Bedroom     | 2.0%          | PASS            | 0.7%         | PASS               | PASS               |
| JKL.5.Core B. Main block West Corridor       | -             | -               | -            | -                  | -                  |
| JKL.5.Core B. Main block West Living/Kitchen | 2.9%          | PASS            | -            | N/A                | PASS               |

| Integral corridors/Halls |              |  |  |  |
|--------------------------|--------------|--|--|--|
| Top>28C                  |              |  |  |  |
| >3%                      |              |  |  |  |
|                          | PASS/CAUTION |  |  |  |
| -                        | -            |  |  |  |
| 4.5%                     | CAUTION      |  |  |  |
| 1.2%                     | PASS         |  |  |  |
| -                        | -            |  |  |  |
| -                        | -            |  |  |  |
| 0.9%                     | PASS         |  |  |  |
| -                        | -            |  |  |  |
| -                        | -            |  |  |  |
| -                        | -            |  |  |  |
| 1.1%                     | PASS         |  |  |  |
| 1.0%                     | PASS         |  |  |  |
| -                        | -            |  |  |  |
| -                        | -            |  |  |  |
| -                        | -            |  |  |  |
| -                        | -            |  |  |  |
| -                        | -            |  |  |  |
| -                        | -            |  |  |  |
| 1.6%                     | PASS         |  |  |  |
| _                        | _            |  |  |  |

Figure 7: Block JKL Table of Results

#### **6.2.2 2050** Weather File

All rooms fail both criteria with the 2050 future weather file for passive cooling. Refer to 6.1 for more details.

## 6.3 Absent neighbour

Where a neighbour is away and therefore not opening their windows, there is a chance the overheating neighbouring apartment could cause overheating in the occupied apartment.

For both Block I and Block JKL modelling was carried out where 3<sup>rd</sup> floor south-east apartments were set as unoccupied to determine the added overheating risk to the 3<sup>rd</sup> floor south-west apartments.

|                          | Criteria (a)        |                        |                 | Criteria (b)        |                        |                 |  |
|--------------------------|---------------------|------------------------|-----------------|---------------------|------------------------|-----------------|--|
| Room                     | Standard<br>Results | w/ absent<br>neighbour | Difference<br>% | Standard<br>Results | w/ absent<br>neighbour | Difference<br>% |  |
| I.3.Apt.Living.SW        | 2.0%                | 2.0%                   | 0.0%            |                     | -                      |                 |  |
| I.3.Apt.Bedroom.SW       | 0.9%                | 0.9%                   | 0.0%            | 0.8%                | 0.7%                   | -0.1%           |  |
| JKL.3.SW Living/Kitchen  | 2.3%                | 2.5%                   | 0.2%            |                     | -                      |                 |  |
| JKL.3.Core C. SW Bedroom | 1.0%                | 1.1%                   | 0.1%            | 0.4%                | 0.5%                   | 0.1%            |  |

Figure 8: Absent Neighbour, Table of Results

The results show that an absent neighbour does add to the overheating risk. However in this scenario the increase was relatively small. It should be noted there are other scenarios where the affect may be larger, such as if a neighbour on the floor below is absent - larger ceiling/floor area between apartments means more heat transfer, typically two to three times as much, or if two neighbours are absent at the same time – summer holidays.

## 7 How we reached compliance

## 7.1 Variables tried

- 'g' values (decreasing limits the amount of solar radiation that can pass through glazing)
- Sill height
- Opening Fraction
- Shading
- Assuming occupant will close window if external temperature greater than 28C
- Redesign of rooms

#### 7.2 Block I

In previous iterations, Block I was passing criteria (a) but some rooms failing (b) for the 2020 weather data.

#### Steps taken:

- 1. Changed 'g' value from 0.5 to 0.4 (keeping 30% free area glazing) Bedrooms still fail.
- 2. Changed the assumed typical free area from 30 to 50% (after discussion with the architects, Mae) All bedrooms in Block I then pass.



Figure 9: Block I Previous failing rooms

#### 7.3 Block JKL

In previous iterations Block JKL had issues with the following:

 Ground floor: The small kitchen had high internal gains and limited openings due to the security issue.

Steps taken: Architect's updated layouts and relocated kitchen from the ground floor to the first. This resolved the issue of limited openings and the rooms then passed both criteria.

• Single sided bedrooms failing criteria (b) – night time.

Steps taken: Increased opening fraction of glazing from 30% to 35%. Rooms then passed.

• 5<sup>th</sup> floor living/kitchen failing due to being highly glazed and south west facing.

#### Steps taken:

- 1. Changed typical glazing free area from 35 to 50%:- still failing criteria (a) day-time comfort.
- 2. Reduced 'g' value from 0.5 to 0.35 still failing. Did not try reducing further than 0.35 due to the negative effects of lower annual solar gains and daylighting levels.
- 3. Raised sill height and in doing so decreased window area Results: Still failing, minimal improvement (probable the reduced solar gains are offset by reduced fresh air rates). It is important to note this is different from removing the bottom pane when the bottom pane is non-opening anyway. In that case, the opening fraction will stay the same but reduce the solar gain, which is desirable.
- 4. Added shading. For the living/kitchen spaces achieved by adding a shade over the 'cut corner' area. For the bedroom, a 400mm deep shade directly over the windows.
   Results: Rooms now pass. See Figure 10 below.

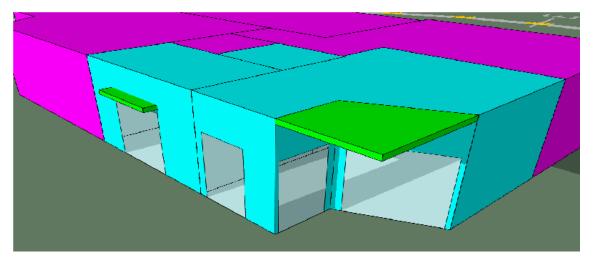


Figure 10: JKL Required Shading, 5th Floor

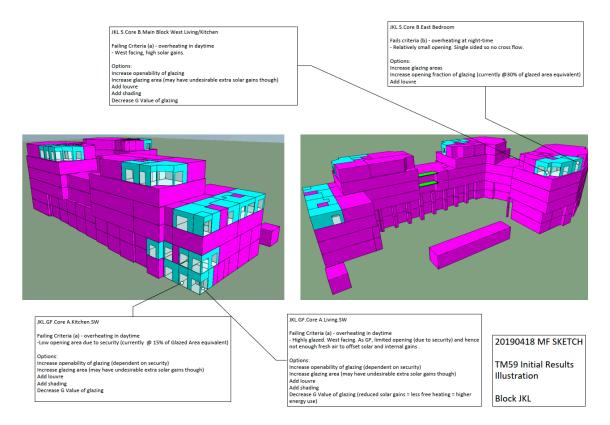


Figure 11: Block JKL Previous failing rooms

#### 8 Recommendations

#### 8.1 General

Camden Borough's planning guidance gives some examples to limit internal gains, which will in turn reduce overheating:

- Energy Efficient lighting
- Use smaller windows on the south elevations and larger on the north.
- Include high performance glazing

## 8.2 Limiting Gains

#### 8.2.1 Solar

The lower pane is generally non-opening, meaning it contributes to solar gains but does not add to fresh air rates. In addition this lowest pane, being at floor level, only has a marginal effect on daylighting. We recommend removing this pane.

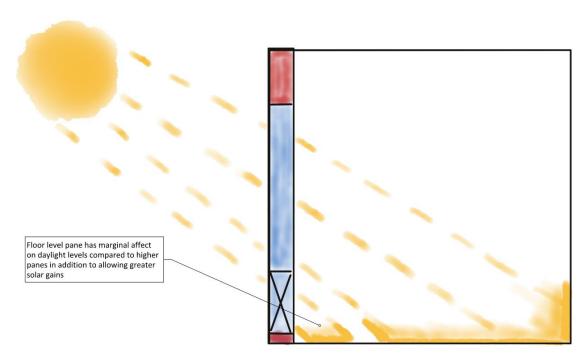
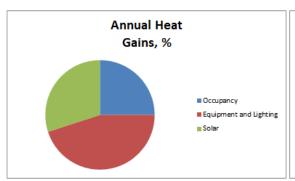


Figure 12: Illustration showing how lower pane allows little useful daylight while contributing to solar gains

#### 8.2.2 Other gains

In this study we have focused on limiting solar gains and increasing fresh air rates to reduce the risk of overheating. Another option is to reduce internal gains. For the analysis this will not have an effect because the values used are dictated by TM59. However in reality we have the option of reducing these by good design.

Annually, solar gains only account for 30% of all gains, occupancy for 25% and 45% from equipment and lighting. The solar gains increase to 70% of all gains on a typical hot summer midday.



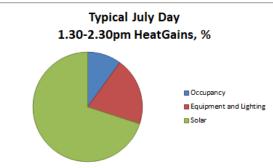


Figure 13: Annual and typical peak Heat Gains

Figure 13 above indicates it is worthwhile limiting equipment and lighting gains. For the analysis this will not have an effect because the values used are dictated by TM59. However in reality we have the option of reducing these by good design.

Generally speaking the more efficient a product the less energy is required to run it. Typically that energy is released as excess heat, contributing to heat gains. Hence by selecting energy efficient equipment, such as A++ rated fridges, induction hobs, high efficacy lighting and applying good insulation on mechanical pipework we can reduce these heat gains. Figure 14 below breaks down internal gains, showing lighting, audio-visual and cooking to be some of the biggest contributors.

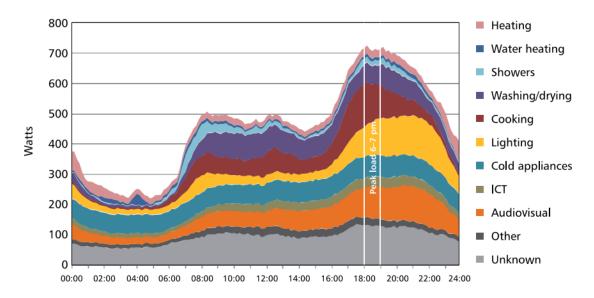
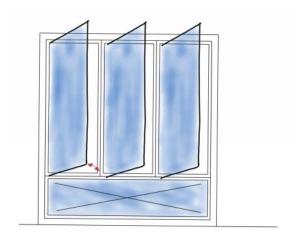


Figure 14: Average 24-hour profile for 250 homes (source: DECC, 2013)

#### 8.3 Increasing Fresh Air

Iterations have shown that reducing solar gains helps reduce the overheating risk, but in general is not always enough, due primarily to the fact that solar gains only account for a proportion of all the gains. Reducing glazing dimensions was shown to limit solar gains but also limited the fresh air rate available which was a net negative.

The variable that drove the largest improvement was increasing the openable fraction of the glazing. This is due to rooms requiring large fresh air rates, and this is not only driven by solar gains but also by internal gains.



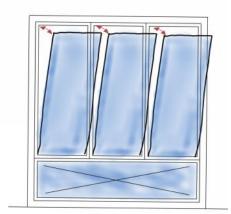


Figure 15: Side hung VS bottom hung windows — Side hung generally allow a greater opening fraction but are a greater security risk. This can be mitigated by including limiting locks which can be overridden by the occupants when security risk is low and overheating risk is high, such as a summer day when occupants are home. The best option is generally tilt and turn, allowing both options.

## 8.4 Glazing and Blinds

If adopting internal blinds that move with the glazing, outward opening glazing allows more heat to escape while still blocking the sun.

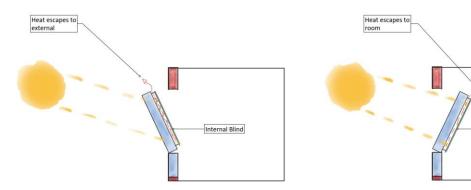
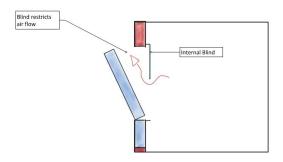
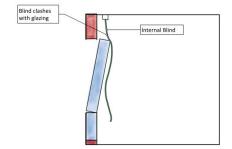


Figure 16: Integral blinds

If blinds are not integral they can restrict air flow:





Internal Blind

Figure 17: Blinds vs glazing

## 8.5 Future Climate Change adaptation

Both buildings current passive cooling design is insufficient in keeping the overheating level to within an acceptable level given the 2050 DSY future climate scenario and assumptions in the TM59 protocol. In the modelling we demonstrated that applying 50W/m2 cooling was required. There are also passive measures which, when applied in combination, may be enough to mitigate the overheating risk. Failing that, these passive measures may reduce the mechanical cooling load to below 50W/m2.

Below is a list of design features which could either be implemented now or adopted later on.

### 8.5.1 Current design options:

- Include external blinds
- Include internal blinds integral to glazing
- Add more external shading
- Remove lower glazing panes which are unopenable
- Make glazing 'tilt and turn' type
- Limit internal gains by using better than industry standard insulation on pipework and limiting heat losses from HIUs
- Add louvres this will increase fresh air rates to help mitigate heat gains. In addition louvres are secure and can be left open while windows need to be closed due to security risks
- Underfloor Cooling (UFC) At present underfloor heating (UFH) is proposed. Ensuring this type of system is adopted as opposed to, say, a radiator ensures the possibility of adapting the UFH to also provide cooling (UFC). This would not be possible with a radiator system because of the larger surface areas required for UFC. It should be noted UFC is unlikely to be able to provide 50W/m2 of cooling (more typically 7W/m2). However this should still be considered as, in combination with other passive measures listed, could be effective.

#### 8.5.2 Future design measures:

- Retrofit mechanical cooling see 'current design options' above
- Retrofit blinds internal or external, see 'current design options' above
- Retrofit glazing with screen with lower 'g' value

## 9 Conclusions

The results have shown that if we adopt the assumptions laid out in this report ('g' values, shading on JKL 5<sup>th</sup> floor and high opening fractions of glazing) then the risk of overheating is limited to within an acceptable level according to TM59.

The results for the future climate adaptation show the need for further discussion on the best approach to mitigate this, whether that is by installing underfloor heating for the ability to adapt this to underfloor cooling later on; to enhancing passive design features now or ensuring the possibility of retrofitting these should the predicted climate become reality.

## 10 Appendix

## 10.1 Modelled Spaces





## 10.2 TM59 Standard Internal Gains and Occupancy Profiles

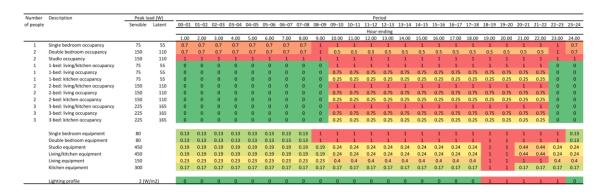


Figure 18: Heat Gain Profile, taken from TM59

## 10.3 Bibliography

Bastin, J.-F. (2019). Understanding climate change from a global analysis of city analogues. PLOS.