



project

The In-between House 9d the Grove | N6 6JU





Charlton Brown Architecture & Interiors







Energy & Sustainability Assessment

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The In-between House, 9d The Grove

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Introduction

The Mayor is committed to making London a zero carbon city and with almost 80% of the city's emissions coming from buildings, therefore, there is a big drive to tackle emissions starting with new build and major refurbishment projects.

The Camden Local Plan sets out the local council's planning policies which set out the various energy and sustainability targets for project's requiring planning consent. The Camden Local Plan is the name given to a group of policies that together form the development plan for Camden.

This energy assessment will look at the relevant policies within the Plan and shall demonstrate how this development plans to apply the principles of each policy in both the architectural and building services design.

The relevant sections in The Camden Local Plan are:

Policy CC1: Climate change Mitigation

- 1. The Energy Hierarchy
- 2. Sustainable Patterns of Development
- 3. Resource efficiency, demolition and retrofitting existing buildings
- 4. Decentralised Energy Generation



1.1 Brief

Charlton Brown Architects have been instructed by the clients to undertake this Energy and Sustainability Assessment to establish the carbon footprint of the proposed replacement dwelling at 9D The Grove, and to compare this with that of the existing house if refurbished to modern standards.

The new dwelling aims to achieve exemplary sustainability, to maximise energy efficiency and reduce carbon emissions through passive and active energy conservation methods, whilst providing a flexible home for longevity and a modern family life.

The proposal would be designed to greatly exceed the London Borough of Camden's energy reduction target to reduce carbon dioxide emissions by at least 19% compared with Building Regulations 2013 Part L1A requirements.



Aerial view of 9d the Grove.

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1.2 The existing building

The site is located at 9D The Grove and lies within the Highgate Conservation Area within the administrative boundary of the London Borough of Camden.

The existing house was originally constructed in the post-war era of the 1950s and is in a clear need for renewal in order to better meet the needs and requirements of a liveable residential home. It has very poor energy efficiency, having no floor, wall or roof insulation, single glazing and building services that require upgrading to more energy efficient alternatives. The current Energy Performance Certificate shows a current rating of 59, which is below the average of Band D (scores between 55-68). This is lower than the average energy efficiency for a dwelling in England and Wales of 60.

The current envelope would need substantial overhauling only to raise the performance just above average, and the owner would have to rely on piecemeal measures for minimal performance gain.

The existing dwelling has been modelled using SAP 2012 to establish the current carbon emission rate both as it stands, and what could be achieved if it was refurbished within the bounds of viability, without the need to demolish and re-build.

Existing Building

Total Floor Area	Dwelling Emission Rate (DER) (CO ² kg/m ² /year	Total CO ² (kg/yr)
142.8	52.8	7541.74

The Dwelling Emission Rate (DER) of the existing house as it stands, taking into account the total regulated CO2 emissions due to heating, hot water, pumps and fans, and lighting for the house as existing has been calculated as 7541.7 kg/yr. The full SAP calculations confirming the DER can be found in Appendix 1.



Existing balcony





1.3 The existing building retrofit

Retaining the existing building envelope proves to not provide adequate liveable space for a modern family of 4: 2 adults and 2 teenage children. As such to retain the existing form and provide the necessities for modern family life, without significant loss of the existing fabric, adding an additional level to the existing building would prove to be the least intrusive measure. It is understood, and agreed upon in the pre-application feedback from Camden Council, that increasing the height of 9D is not acceptable, as it changes the hierarchy along The Grove and the existing relationship between the listed Park House and The Stables. To retain the existing without increasing the floor space results in a home not fit for a modern family.

However, regardless of the space limitations, this analysis looks at the carbon comparison of retrofitting the existing building as is, if a second level was not added to the building Whilst there is no actual requirement to undertake any work to improve the existing property, if it was to be refurbished to modern standards, the following improvement measures could reasonably be implemented.

- * The existing building would require to be stripped completely internally.
- * The ground floor slab would require insulation above the existing concrete slab, decreasing and compromising the existing head height.
- * The existing cavity walls will require blown insulation into the existing cavity, as already limited space requirements prohibit the use of internal or external insulation. There is a potential moisture risk with the implementation of insulation into the new cavity, via driving rain and rising damp if great consideration to thermal connections is not possible.
- * New steels will be required to support the first floor to

enable a new layout to the ground floor that is able to adapt to family life over time and ensure the longevity of the building.

- The roof covering will require replacement however the level is not possible to be raised to increase the thermal performance to modern standards as the parapet is low lying and as mentioned the internal floor to ceiling heights are already low for maximal light infiltration. Insulation will be introduced between the existing rafters, retaining a cold roof to minimise moisture risk.
- * The windows and doors would all require replacement for increased thermal performance and where possible, relocation, to maximise available light / considered layout for modern family life.
- * Thermal bridges will be present at wall and floor junctions with the inability to form continuous insulation layer without significant structural implications
- * The retained form will affect the quality of light significantly as rooms will become more pokey and effect the ability for the light to penetrate to the depth of the structure.
- * The low ceiling heights will affect the quality of light and space within 9D, as well as making it not possible to run services through ceiling voids.

As such it is evident that the retention of the existing fabric will see a small increase in thermal performance, barely meeting the lowest possible standard legally possible in the UK. These standards are not fit for the future and fall far short of the possible operational carbon savings available with a construction to the proposed new build.

Existing Building

Modelling Inputs	
External Wall U Value	
Ground Floor U Value	
Roof U Value	
Window U Value	
Window g Value	
Air Permeability	

Existing Building performance measured against Building Regulations Part L1A Standard Case.

Existing Building Retrofit

Modelling Inputs	SAP 2012	Value	Unit
External Wall U Value	0.18	0.55	W/m ² K
Ground Floor U Value	0.13	0.2	W/m ² K
Roof U Value	0.13	0.32	W/m ² K
Window U Value	1.4	1.4	W/m ² K
Window g Value	0.63		
Air Permeability	5	5	m ³ /h/m ² @50Pa

Existing Building Retrofit performance measured against Building Regulations Part L1A Standard Case.

SAP 2012	Value	Unit
0.18	1.4	W/m ² K
0.13	1.03-1.02	W/m ² K
0.13	1.5	W/m ² K
1.4	5.8-5.9	W/m ² K
0.63		
5	>10	m ³ /h/m ² @50Pa



1.3 The existing building retrofit

The consequential DER that could be achieved by incorporating these improvements has been calculated as below:

Existing Building - Retrofit

Total Floor Area	Dwelling Emission Rate (DER) (CO ² kg/m ² /year	Total CO ² (kg/yr)
142.8	26.5	3785.67

The Total related CO2 emissions for the existing house, following refurbishment, would be 3785.7 kg/yr. The full SAP calculations confirming the DER can be found in Appendix 1.



1.4 The proposed dwelling

The proposed development comprises the demolition of the existing dwelling on the site, and the erection of a replacement family home. It is intended that the new dwelling will:

- better utilises space and light; *
- has a strong connection between the outdoor and indoor; *
- lateral rather than cellular living; ×
- benefits from enhanced sustainability and environmental * credentials;
- × positively contributes to the existing street scene and conservation area with architectural inspiration to be drawn from the surrounding character of the area.





Proposed Basement Plan

Proposed Ground Floor Plan





Proposed First Floor Plan



Building Regulations Approved Document L1A 2013 - National Planning Policy Framework (February 2019) Conservation of fuel and power in new dwellings

The Regulations place a legal requirement for the Building CO2 Emission Rate (calculated using an approved software package) must be less than the Target Emission Rate for which there is prescribed method for calculating.

The intention of the Government is to reduce the regulated carbon emissions from buildings and in each amendment to the Regulations the requirement for CO2 reductions increases. The latest update came in 2013 and requires a c.a. 9% improvement from the previous Regulations set in 2010.

Climate Change Act 2008

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Published 26th November 2008, the Uk Government set the world's first long-term legally binding framework to mitigate against climate change. The Act sets legally binding targets to reduce greenhouse gas emissions through action in the UK and abroad with a target of 80% reduction by 2050.

As required under Section 34 of the Climate Change Act, the Fifth Annual Carbon Budget was accepted by the Government in June 2016. This sets out a budget for UK emissions for the period 2028-2032.

Following a commitment in June 2019, the Climate Change Act has been amended to target net zero emissions by 2050.

The department for communities and Local Government determines national policies on different aspects of planning and the rules that govern the operation of the system. Accordingly, the National Planning Policy Framework (NPPF), which came into force in March 2012 and was updated in February 2019, aims to strengthen local decision making.

Paragraph 10 of the NPPF confirms that at the heart of this document is a 'presumption in favour of sustainable development', and that development proposals that accord with an up-to-date development plan should be approved without delay.

Paragraph 7 states that the purpose of the planning system is to contribute to the achievement of sustainable development. At a very high level, the objective of sustainable development can be summarised as meeting the needs of the present without compromising the ability of future generations to meet their own needs.



The London Plan

The Mayor's London Plan sets targets and provides guidance to the 32 London boroughs and the Corporation of the City of London for the spatial development of London to 2036. The current version was published in March 2015. First published in 2004 with revisions being made in line with the revised energy performance targets set out in the updated Building Regulations.

Policy 5.2 Minimising Carbon Dioxide Emissions. This states that development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

- Be lean: use less energy
- Be clean: supply energy efficiently
- Be green: use renewable energy

Policy 5.3 Sustainable Design and Construction. This states that development proposals should demonstrate that sustainable design standards are integral to the proposal, including its construction and operation, and should ensure that they are considered at the beginning of the design process.



This document provides guidance on the implementation of London Plan Policy 5.3 'Sustainable Design and Construction', as well as a range of policies relating to environmental sustainability. The document contains best practice and priority targets for a range of issues related to sustainable design and construction, grouped into three categories: resource management

Sustainable Design and Construction Supplementary Planning Guidance (SPG) (April 2014)

adapting to climate change, and greening the city



CONSTRUCTION SUPPLEMENTARY PLANNING GUIDANCE

APRIL 2014 LONDON PLAN 201 INFLEMENTATION

MAYOR OF LONDON



The Camden Local Plan

The Camden Local Plan sets out the Council's planning policies to ensure that Camden continues to have robust, effective and up-to-date planning policies that respond to changing circumstances and the borough's unique characteristics and contribute to delivering the Camden Plan and other local priorities.

The overall vision of the Camden Plan, and the Local Plan, is as follows: We want to make Camden a better borough - a place where everyone has a chance to succeed and nobody gets left behind. A place that works for everyone. Policies of relevance to the proposed development include the following outlined

Policy D1 Design.

This states that, in order to secure high quality design, the Council will require that development:

- respects local context and character;
- is sustainable in design and construction, incorporating best practice in resource management and climate change mitigation and adaptation;
- is of sustainable and durable construction and adaptable to different activities and land uses;
- comprises details and materials that are of high quality and complement the local character;
- responds to natural features and preserves gardens and other open space;
- incorporates high quality landscape design and maximises opportunity for greening for example through planting of trees and soft landscaping; and
- for housing, provides a high standard of accommodation.

Policy CC1: Climate Change Mitigation

The Council aims to tackle the causes of climate change in the borough by ensuring developments use less energy and assess the feasibility of decentralised energy and renewable energy technologies

- Green Action for Change: Camden's environmental sustainability plan (2011-2020) commits Camden to a 27% borough wide Carbon Dioxide (CO2) reduction by 2017 and a 40% borough wide CO2 reduction by 2020 (London carbon reduction target). Over 90% of Camden's carbon dioxide emissions are produced by the operation of buildings.
- Camden Council commissioned two borough wide carbon reduction studies to ensure that local planning policy appropriately responds to the carbon emissions reduction challenge. The first study, 'Delivering a low carbon Camden', considered carbon reduction scenarios to 2050 to align with the long-term national 80% carbon dioxide reduction target within the Climate Change Act 2008. The 2010 study focused specifically on the challenges of achieving a carbon dioxide reduction target of 40% by 2020.

Both studies concluded that meeting borough carbon dioxide reduction targets depends on the growth of Combined Heat and Power (CHP) led decentralised energy networks; the extensive thermal improvement of existing housing stock; behaviour change; the significant deployment of appropriate renewable technologies; and the steady de-carbonisation of the national electricity grid.

Policy CC2 Adapting to climate change

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

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

- the protection of existing green spaces and promoting new appropriate а. green infrastructure:
- not increasing, and wherever possible reducing, surface water runb. off through increasing permeable surfaces and use of Sustainable Drainage Systems;
- incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and
- measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.

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

Sustainable design and construction measures

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

- ensuring development schemes demonstrate how adaptation measures e. and sustainable development principles have been incorporated into the design and proposed implementation;
- encourage new build residential development to use the Home Quality Mark and Passivhaus design standards:
- encouraging conversions and extensions of 500 sgm of residential floorspace or above or five or more dwellings to achieve "excellent" in BREEAM domestic refurbishment; and expecting non-domestic developments of 500 sgm of floorspace or
- above to achieve "excellent" in BREEAM assessments and encouraging zero carbon in new development from 2019.



Policy CC1: The Energy Hierarchy

The energy hierarchy is a sequence of steps that minimise the energy consumption of a building. Buildings designed in line with the energy hierarchy priorities lower cost passive design measures, such as improved fabric performance over higher cost active systems such as renewable energy technologies. The following diagram shows a simplified schematic of the energy hierarchy, which is explained further in supplementary planning document Camden Planning Guidance on sustainability.

Section 8.8 requires all developments involving five or more dwellings and/or more than 500 sqm of (gross internal) any floorspace will be required to submit an energy statement demonstrating how the energy hierarchy has been applied to make the fullest contribution to CO2 reduction. All new residential development will also be required to demonstrate a 19% CO2 reduction below Part L 2013 Building Regulations (in addition to any requirements for renewable energy).

The London plan references a 35% CO2 reduction below Part L 2013 Building regulations, Camden Local Authority require a 19% carbon reduction target, but for the purposes of this report a 35% reduction has been targeted.

Be Lean

Proposals should demonstrate how passive design measures including the development orientation, form, mass, and window sizes and positions have been taken into consideration to reduce energy demand, demonstrating that the minimum energy efficiency requirements required under building regulations will be met and where possible exceeded.

Be Clean

The second stage of the energy hierarchy 'be clean' should demonstrate how the development will supply energy efficiently through clean energy systems such as CHP or decentralised energy.

Be Green

The "be green" stage of the energy hierarchy requires that developments make use of renewable technologies to achieve the sites overall carbon dioxide emissions target.

Be Green renewable energy systems

Be Clean

combined heat and power, and district energy systems

Be Lean

passive design and energy efficiency of building systems



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Policy CC1: The Energy Hierarchy

Section 8.41 requires all new developments to submit a statement describing how the project has applied The London Plan's cooling hierarchy and shall demonstrate how the risk of overheating has been mitigated.

The cooling hierarchy includes:

- * Minimise internal heat gains
- * Reduce external heat gains through consideration of; orientation, shading, fenestration, insulation etc.
- * Manage internal heat through exposed thermal mass and high ceilings
- * Passive ventilation
- * Mechanical ventilation
- * Active cooling

The Energy Hierarchy in the upcoming London Plan 2019



Source: Greater London Authority



Policy 5.2: Minimising Carbon Dioxide

The policy states that all major developments are to produce and issue an energy strategy that must follow the principles of "be lean", "be clean", and "be green" and as minimum must achieve an onsite carbon emission reduction of 35% beyond the current Building Regulations (2013).

The listed requirements are:

- Carbon emissions are to be minimised in accordance with the energy hierarchy
- Domestic buildings are to achieve a 40% carbon emission improvement over the 2010 Building Regulations (35% the 2013 Building Regulations)
- Strategy for achieving carbon dioxide emission reductions to be presented in a detailed energy assessment
- Energy assessments to include calculation results, proposed reductions through energy efficient designs, proposals to use decentralised energy where feasible (including CHP), proposal to include on-site renewable technologies
- Where carbon dioxide emission targets cannot be achieved on-site shortfalls are to be made-up off-site or through a cash in lieu contribution

The intention is to achieve 35% carbon emission savings on-site through the application of the energy hierarchy. Detailed information to be provided further in this report.

POLICY 5.2 MINIMISING CARBON DIOXIDE EMISSIONS

Planning decisions

- A Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:
 - 1 Be lean: use less energy
 - 2 Be clean: supply energy efficiently
 - 3 Be green: use renewable energy
- The Mayor will work with boroughs and developers to ensure that B major developments meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019.

Residential buildings:

Year	Improvement on 2010 Building R
2010-2013	25 per cent (Code for Sustainable
2013-2016	40 per cent
2016-2031	Zero Carbon

- C Major development proposals should include a detailed energy assessment to demonstrate how the targets for carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy.
- D As a minimum, energy assessments should include the following details:
 - a calculation of the energy demand and carbon dioxide emissions covered by Building Regulations and, separately, the energy demand and carbon dioxide emissions from any other part of the development, including plant or equipment, that are not covered by the Building Regulations (see paragraph 5.22) at each stage of the energy hierarchy
 - proposals to reduce carbon dioxide emissions through the energy b efficient design of the site, buildings and services
 - proposals to further reduce carbon dioxide emissions through the use of decentralised energy where feasible, such as district heating and cooling and combined heat and power (CHP)
 - proposals to further reduce carbon dioxide emissions through the d use of on-site renewable energy technologies.
- E The carbon dioxide reduction targets should be met on-site. Where it is clearly demonstrated that the specific targets cannot be fully achieved on-site, any shortfall may be provided off-site or through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

egulatons

Homes level 4)t



Policy 5.7: Renewable Energy

The policy outlines the expectation to increase the amount of energy provided by on-site renewable technologies.

New developments will be expected to provide substantial carbon dioxide emission reductions through the use of on-site renewable energy generation.

The ambition for this project shall be to achieve a 10% carbon dioxide emission reduction through the installation of a photovoltaic system to be installed on the roof.

Details and results to be presented further in this report.

POLICY 5.7 RENEWABLE ENERGY

Strategic

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

Planning decisions

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

LDF preparation

C Within LDFs boroughs should, and other agencies may wish to, develop more detailed policies and proposals to support the development of renewable energy in London - in particular, to identify broad areas where specific renewable energy technologies, including large scale

systems and the large scale deployment of small scale systems, are appropriate. The identification of areas should be consistent with any guidelines and criteria outlined by the Mayor.

All renewable energy systems should be located and designed to D minimise any potential adverse impacts on biodiversity, the natural environment and historical assets, and to avoid any adverse impacts on air quality.



3.0 Low and Zero Carbon Technologies

Before undertaking any energy assessment it is important to review the Low and Zero Carbon (LZC) technologies available and their suitability to the project. There are a number of factors influencing the decision to pursue any LZC installation and these include; location, local environment, political drivers, financial and technical feasibility, and marketability. In the following sections various available LZC technologies will be reviewed before presenting a decision matrix that will define which technologies will be pursued and tested.

Solar Thermal Collectors

Solar water heating (SWH) using solar thermal collectors is a well proven technology and payback periods are relatively short. The two main types of collector technology are flat plate collectors and evacuated tube collectors. Evacuated tubes are more efficient by around 20% (including better operation on cloudy days), and can produce higher temperature waters up to around 150°C. Annual outputs of around 450 - 600+ kWh/yr per m2 of collector (flat plate - evacuated) could be possible for a fully optimised installation.

SWH collection panels can achieve net efficiencies of around 50%, which is much higher than that of PVs. On the negative side they are typically sized to provide around 50-60% of hot water requirements to avoid the risk of overheating during the summer. This reduces the potential for carbon reduction, and therefore if roof space is limited, compete with PV systems for size.

Photovoltaics

Solar Pv panels would provide electrical generation for use on site. They are one of the few true zero carbon energy technologies available due to little maintenance requirements. Systems can be easily integrated into almost any surface at any point in a building's life (including fit-out) without too much intervention.

The annual solar availability in London is around 1000 kWh/m2 on an unobstructed / unshaded horizontal surface. PV's convert solar energy (sunlight) into electricity. They are commonly manufactured into glazed collectors which can be ground mounted, roof mounted or building-integrated. The performance of PVs is heavily influenced by over-shadowing. 10% shading could result in 80% loss in electrical performance.

PVs of course generate most electricity during the day, when sunlight is most present. Without a storage battery, this electricity is fed back into the grid when the site demand falls below generation. Many solar PV systems are eligible for the Feed in Tariff and export Tariff, generating a small income for the clients, to offset energy use at times when demand exceeds generation on site.



Solar thermal flat plate collectors.



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Solar thermal vacuum tube collectors.

Solar PV panels

based on LG Neon R



3.0 Low and Zero Carbon Technologies

Wind turbines

Wind turbines convert kinetic energy in flowing air/wind into electrical energy using an electrical generator.

Visual impacts, noise, intermittent power production, local planning such as height restrictions, impacts on migratory paths of birds, interference with radio and/or TV signals and so on, all impact on the viability of wind production in a highly residential area.

Wind turbines are also only appropriate where the average wind velocity is in excess of 6m/s.

Heat Pumps

Properly designed and installed heat pumps offer very low carbon space heating and can also provide low carbon cooling. The pumps are powered by electricity although there are variants such as gas-fired absorption units available - albeit with lower efficiencies. Heat pumps take low temperature heat and upgrade it to a higher more useful temperature. The heat source can be from the external ambient air, a nearby water source or the ground. Ambient air and ground as the source of renewable energy have been considered in this assessment.

Combined Heat and Power

There are various types of combined heat and power generation (i.e. CHP/CCHP), typically gas turbines, gas engines and fuel cells - or a mix thereof. It is possible that in a modular system some units could run on biomass (e.g. wood pellets), biofuels, bio-methane etc.

The Energy Hierarchy identifies combined heat and power (CHP) as a method of producing heat and electricity with much lower emissions than separate heat and power. For maximum efficiency, a CHP system needs to operate for at least 5000 hours/year and requires a heat sink, a consistent base heating load requirement throughout the year where the waste heat from the electrical generation may be used constantly and efficiently while simultaneously providing electricity for the site. It is therefore more appropriate for hospitals, hotels etc. where demand is consistent. Domestic dwellings have variable occupation patterns resulting in inconsistent heating and electrical demand. For a development of this size and scale, it would not be appropriate to provide a new CHP plant.





3.0 Low and Zero Carbon Technologies

Low and Zero Carbon Technology Decision Matrix

	Technology	Lifecycle Carbon Saving Potential	Grants	Lifecycle Costs	Space Requirements	Planning Restrictions	Noise	Appropriate for the sit
	Solar Hot Water	Low	Renewable Heat Insentive	Medium	Low	Suitable	Suitable	Suitable
Solar Energy	Photovoltaics	Low-Medium	Feed-In-Tariff	High	Low	Suitable	Suitable	Suitable
Wind Energy	Wind Turbines	Low-Medium	Feed-In-Tariff	Medium	Medium-High	Not Acceptable	Noise from gears and generator	Not Suitable
	Ground Source Heat Pumps	Medium	Renewable Heat Insentive	Medium-High	Medium	Suitable	Suitable	Not Suitable
Heat Pumps	Air Source Heat Pumps	Low-Medium	Renewable Heat Insentive	Low	Medium-Low	Suitable	Fan & compressor noise	Not Suitable
	Biomass Boilers	Medium	Renewable Heat Insentive	Medium-Low	Medium	PM10 Particulate	Suitable	Not Suitable
Combined heat	Biomass CHP	High	Renewable Heat Insentive	Medium	Medium	PM10 Particulate	Suitable	Not Suitable
and power / alternative fuels	Gas Fired CHP	Medium	Feed-In-Tariff	Medium-Low	Low	Suitable	Suitable	Not Suitable
	District Heating / Cooling	Medium-High	Renewable Heat Insentive	Medium	Low	Suitable	Suitable	Suitable
	Small Scale Hydro Power	Low	Feed-In-Tariff	Low	N/A	N/A	N/A	N/A
Hydro Power	Tidal Power	Low	Feed-In-Tariff	Low	N/A	N/A	N/A	N/A
	Wave Power	Low	Feed-In-Tariff	Low	N/A	N/A	N/A	N/A

Reasons for exclusion
Tested and shown to provide substantial CO ² savings.
Tested and shown to provide substantial CO ² savings.
Noisy and not suitable in urban areas (due to turbulence coming from surrounding buildings)
Limited ground space due to small garden and tree root protection areas
Limited site / garden space and close proximity to neighbouring buildings finds space and noise an issue
Discounted due to concerns over emissions, air quality, noise from deliveries and fuel supply.
Discounted due to concerns over noise and required demand being too low to be cost effective.
No networks or future networks planned for the area.
Not applicable due to

geographical restrictions



4.0 Cooling Hierarchy

The design of the proposal has been developed in line with the GLA's recommended 'Cooling Hierarchy' approach detailed in London Plan Policy 5.9.

With ever increasing temperatures, the earth is currently facing the effects of global warming and an ever changing climate. In order to protect the development against overheating in the future, a number of key design features have been proposed to ensure the new dwelling is resilient to increased temperatures. A summary of the measures included to reduce the risk of overheating is provided below.

Passive design measures to prevent solar gains entering the building:

- Glazing ratio to surface area considered to prevent excessive internal gains, but maintain a good level of daylight penetration.
- Good form factor to minimise thermal transmission to reduce both heat loss in winter and heat gain in summer.
- Glazing location to suit site orientation / location.
- Glazing with very low u values and g values
- Retention of existing trees to provide natural shading in the summer months *

Passive design measures that have been implemented to mitigate heat gain within the building:

- Internal heat gains reduced via specification of low heat emitting LED light fittings and equipment.
- Naturally ventilated living guarters with mechanical ventilation
- * Green roof to reduce urban heat island effect and aid in rainwater harvesting.
- High ceilings to increase air movement and stratification, where warmer air rises aiding to mitigate overheating.
- Openable windows on multiple aspects across all floors will provide a passive ventilation strategy that utilises cross flow and stack ventilation. This will maximise the potential for natural ventilation within the proposed dwelling.

Mechanical and active cooling

Mechanical ventilation with heat recovery will be implemented using the Nilan Compact P system. This unit allows for a summer bypass, whereby the heat recovered from internal air is expelled from the building with the stale air. This would be used when the air outside is cooler than the air inside. The Nilan Compact P system also includes an option for reversible cooling unit. This unit is capable of cooling the ventilation systems supply air by up to 10°C during warmer periods.



Midday shading from the harsh southerly sun keeps the building cool in the middle of the day.





8am morning light from the East.

4pm afternoon/evening light from the West.



5.0 Annual CO2 Emission Calculations - Standard case energy demand assessment

The dwelling has been modelled using SAP 2012 to establish both the Standard Case TER (Target Emission Rate) required to meet Building Regulations compliance for CO2 emissions and the Actual case DER (Dwelling Emission Rate) of the dwelling as proposed.

The standard Case TER has been calculated as below.

SAP 2012 - Standard Case

Total Floor Area	Standard Case (TER) (CO ² kg/m ² /year)	Total CO ² (kg/yr)
380.0	14.0	5313.4

The total regulated CO2 emissions due to heating, hot water, pumps and fans and lighting for the development if built to Building Regulations Part L1A standard would be 8,222.53 kg/yr. The full SAP calculations confirming the TER can be found in Appendix B.

This figure has been used to calculate the 19% carbon off-set required and therefore the maximum CO2 emissions to be achieved to satisfy the London Borough of Camden's planning requirement.

The figures calculated are illustrated in the summary below.

SAP 2012 - Target 19% CO2 Savings

	Total CO ² (kg/yr)
Building Regulations Compliant Case	5313.4
Minimum 19% Target Reduction Standard Case Emissions	1009.5
Maximum CO ² emissions to be achieved	4303.9

SAP BASELINE PART L1A:2013

Modelling Inputs	Value	Unit
External Wall U Value	0.18	W/m ² K
Basement Wall U value	0.18	W/m ² K
Ground Floor U Value	0.13	W/m ² K
Basement Slab U Value	0.13	W/m ² K
Roof U Value	0.13	W/m ² K
Window U Value	1.4	W/m ² K
Window g Value	0.63	
Air Permeability	5	m ³ /h/m ² @50Pa
Lighting efficacies	100% low energy	lm/cW
Lighting occupancy controls	No	
Lighting daylight controls	No	
Ventilation SFP	0.76	W/l/s
Heating system efficiency	89%	
Heating boiler efficiency	90%	
Controls		
DHW efficiency	0.85 x (0.2 + 0.051 V2/3) kWh/day	

The Building Regulations Compliant case has been calculated at 5313.4 kg CO2/yr. The calculated minimum 19% reduction in CO2 required = $5313.4 \times 0.19 = 1009.5 \text{ kg CO2/yr}$. The overall maximum CO2 emissions to be achieved for the development is 5313.4 - 1009.5 = 4303.9 kg CO2/yr.

Notes
- Mains Gas
- Radiators
- Fan Flue
- Sedbuk 2009 89% efficient
- Heated by boiler 150L Cylinder
- Time & Temp zone controls



5.0 Annual CO2 Emission Calculations - Be Lean

SAP Modelling Inputs

Be Lean

Modelling Inputs	Value	Unit	Notes
External Wall U Value	0.15	W/m ² K	 Wall ties assumed to be stainless steel at 2.5 per m2 with a cross-sectional area assumed to be 60mm2.
Basement Wall U value	0.15	W/m ² K	 FoamGlass / Perinsul blocks at basement wall floor junctions
Ground Floor U Value	0.10	W/m ² K	- Where in contact with ground (no basement below)
Basement Slab U Value	0.10	W/m ² K	
Roof U Value	0.12	W/m ² K	- Extensive Green Roof of sedums herbs and grasses
Window U Value	0.8	W/m ² K	- Triple Glazing
Window g Value	0.6-0.5		
Air Permeability	<3	m ³ /h/m ² @50Pa	
Thermal Bridging	0.05	W/m ² K	
Electricity power factor			
Lighting efficacies	90-100	lm/cW	
Lighting occupancy controls	Yes		
Lighting daylight controls	Yes		
Ventilation SFP	0.76	W/l/s	- MVHR
Heat exchanger efficiency	90%		 MVHR Nilan Compact P system, which includes supply air electrical heating coil, summer bypass and a reversible cooling unit
Heating boiler efficiency	90%		- Gas fired boiler for back up space heating
DHW efficiency	90%		- Nilan Compact P system to provide sanitary hot water

The 'Be Lean' scenario is used to identify the building's demand reduction measures. High levels of passive and energy efficient design have been incorporated to reduce the development's energy consumption and associated CO² emissions. It is an expectation of the Greater London Authority (GLA) that new dwellings achieve at least a 10% reduction by the 'Be Lean' stage.

* Fabric First and glazing specification

The U-values indicated in the modelling inputs (shown left) have been improved from the minimum standards set out under Part L, as a means of limiting heat loss through the dwellings fabric. To maximise the passive energy savings, form, orientation, window location, high levels of insulation and window specification require considered attention. Whilst providing an initial uplift in initial capital costs, these are outweighed by the benefits and operational savings gained throughout the life of the building.

The glazing will be triple glazed, argon filled with a low emissivity coating. Although this has yet to be formally specified, it is expected that window U-values will be $0.8 \text{ W/m}^2\text{K}$, with a g value between 0.6-0.5 and light transmission of around 70% to improve natural daylight penetration.

* Airtightness

A high level of airtightness is proposed, where a level equal to or below $3m^3/h/m^2$ shall be targeted, meaning that air infiltration between the internal and external environment will be largely controlled, and space heating / cooling demand further reduced.

* Thermal Bridges

Details of building junctions are an aspect of considerable importance when looking to reduce significant sources of heat loss from the building due to thermal (cold) bridging. This is typically a construction detail which has higher thermal conductivity than the surrounding materials, creating a path of least resistance for heat transfer. Thermal bridges result in an overall reduction of the thermal performance of a building and should therefore be designed out where possible. As this aspect of the building has not been detailed as yet, an assumed accredited construction detail of 0.05 (y value) has been use.

* High efficiency equipment

High efficiency plant equipment and controls are proposed to limit the auxiliary energy consumed.
Low energy LED lighting will be installed throughout.

In order to assess the CO2 emissions reductions achieved through the 'Be Lean' stage, space and water heating demand is served by an individual gas-fired combustion boiler with an efficiency of 90%.
The house will be provided with opening windows to mitigate overheating, however, outside air will be provided via mechanical ventilation with heat recovery (MVHR), with a specific fan power of 0.76 W/l/s.

- A heat exchanger with an efficiency of >90% has also been specified. These efficiencies are higher than set out in the Compliance Guide.

- Timed, sensored and temperature zones will be used to control heating and lighting consumption within the dwelling.



5.0 Annual CO2 Emission Calculations - Be Lean

The 'Be Lean' inputs described for the proposed building have been captured in energy modelling using the Standard Assessment Procedure (SAP).

The CO2 emissions for the proposed under the 'Be Lean' tier of the Energy Hierarchy are shown below. DER and TER worksheets showing the 'Be Lean' performance of the dwelling are provided in Appendix 2.

This analysis demonstrates that the proposed will achieve a carbon dioxide emission saving of 12.9% through energy efficiency means alone, under the 'Be Lean' Scenario.

Be Lean Co2 Savings

Standard Case TER (Part L1A) (CO ² kg/m ² /year)	Proposed 'Be Lean' (DER) (CO² kg/m²/year)	Emissions Savings (CO ² kg/m ² /year)	Emissions Savings %		
14.0	12.2	1.8	12.9		

21



5.0 Annual CO2 Emission Calculations - Be Clean



The potential for the proposed dwelling to incorporate a low carbon heating/cooling system has been reviewed, in line with the hierarchy presented in London Plan Policy 5.6:

- Site-wide CHP network; and
- Communal heating and cooling. ×

The London Heat Map is a tool provided by the Mayor of London to identify opportunities for decentralised energy projects in London. It builds on the 2005 London Community Heating Development Study.

The image displayed (left) is an extract from the London Heat Map, showing the area in the vicinity of the site. It illustrates;

The extract displayed (left) indicates that the site of the proposed dwelling is located within an area of low heat demand, with no planned or existing heat networks within the vicinity. It is also located outside local heat network priority areas.

Given the scale and density of the proposed development, the establishment of a new heat network is infeasible. Furthermore, the use of combined heat and power (CHP) is also considered to be unviable for the proposed site, based on the most up-to-date GLA energy guidance, which looks to move away from the use of natural gas to meet space and water heating demands.

× Extract from London Heat Map

Connection to existing heating or cooling networks;

Heat demand (areas of higher heat demand are shown in red); Existing heat networks (shown as red lines); Proposed heat networks (shown as orange lines); and Heat network priority areas (white with black borders).



5.0 Annual CO2 Emission Calculations - Be Clean

The 'Be Clean' carbon dioxide emissions are therefore identical to those set out in the 'Be Lean' scenario.

The CO2 emissions for the proposed under the 'Be Clean' tier of the Energy Hierarchy are shown below. DER and TER worksheets showing the 'Be Clean' performance of the dwelling are provided in Appendix 2.

This analysis demonstrates that the proposed will achieve a carbon dioxide emission saving of 12.9% through energy efficiency means alone, under the 'Be Clean' Scenario.

Be Clean Co2 Savings

Standard Case TER (Part L1A) (CO ² kg/m ² /year)	Proposed 'Be Clean' (DER) (CO ² kg/m ² /year)	Emissions Savings (CO ² kg/m ² /year)	Emissions Savings %		
14.0	12.2	1.8	12.9		

Be Clean

Modelling Inputs	Value	Unit	Notes
External Wall U Value	0.15	W/m ² K	- Wall ties assumed to be stainless steel at 2.5 per m2 with a cross-sectional area assumed to be 60mm2.
Basement Wall U value	0.15	W/m ² K	- FoamGlass / Perinsul blocks at basement wall floor junctions
Ground Floor U Value	0.10	W/m ² K	- Where in contact with ground (no basement below)
Basement Slab U Value	0.10	W/m ² K	
Roof U Value	0.12	W/m ² K	- Extensive Green Roof of sedums herbs and grasses
Window U Value	0.8	W/m ² K	- Triple Glazing
Window g Value	0.6-0.5		
Air Permeability	<3	m ³ /h/m ² @50Pa	
Thermal Bridging	0.05	W/m ² K	
Electricity power factor			
Lighting efficacies	90-100	lm/cW	
Lighting occupancy controls	Yes		
Lighting daylight controls	Yes		
Ventilation SFP	0.76	W/l/s	- MVHR
Heat exchanger efficiency	90%		 MVHR Nilan Compact P system, which includes supply air electrical heating coil, summer bypass and a reversible cooling unit
Heating boiler efficiency	90%		- Gas fired boiler for back up space heating
DHW efficiency	90%		- Nilan Compact P system to provide sanitary hot water

SAP Modelling Inputs



5.0 Annual CO2 Emission Calculations - Be Green

SAP Modelling Inputs

Be Green

Modelling Inputs	Value	Unit	Notes
External Wall U Value	0.15	W/m ² K	 Wall ties assumed to be stainless steel at 2.5 per m² with a cross-sectional area assumed to be 60mm².
Basement Wall U value	0.15	W/m ² K	 FoamGlass / Perinsul blocks at basement wall floor junctions
Ground Floor U Value	0.10	W/m ² K	- Where in contact with ground (no basement below)
Basement Slab U Value	0.10	W/m ² K	
Roof U Value	0.12	W/m ² K	- Extensive Green Roof of sedums herbs and grasses
Window U Value	0.8	W/m^2K	- Triple Glazing
Window g Value	0.6-0.5		
Air Permeability	<3	m ³ /h/m ² @50Pa	
Electricity power factor			
Lighting efficacies	90-100	lm/cW	
Lighting occupancy controls	Yes		
Lighting daylight controls	Yes		
Ventilation SFP	0.76	W/l/s	
Heat exchanger efficiency	90%		 MVHR Nilan Compact P system, which includes supply air electrical heating coil, summer bypass and a reversible cooling unit
Heating boiler efficiency	90%		- Gas fired condensing boiler for back up space heating
DHW efficiency	90%		- Nilan Compact P system to provide sanitary hot water
PV efficiency	20.8%		 360W PV panel = 1.6kWh per panel per day, this equates to 10 panels. LG NeON® R LG360Q1C-A5 installed to be south facing at 30°
Solar thermal collector efficiency	81%		 Lochinvar LSP20H+ flat plate installed to be south facing at 30° Collector active area 1.79m² Total 3no. Panels providing total area of 5.37m² For additional space heating demand

The 'Be Green" stage of the energy hierarchy requires that developments make use of renewable technologies to achieve the sites overall carbon dioxide emissions target.

In this instance and within the context of the buildings form and location the most suitable renewable technology has been found to be photovoltaics and solar thermal panels (as seen in the LZC decision matrix) producing zero carbon electricity and hot water.

The overall carbon dioxide emissions reduction of 61.4% exceeds The London Plan's target of 35%.

The photovoltaics are to be installed on the flat the roof of the building. The panels are the be south facing and installed to an angle of 30°. The panels produce 1.6kWh per panel per day (relative to avg London sunshine hours), this equates to 10no. LG360Q1C - A5 panels.

Similarly, the solar thermal panel design has been based on the flat plate Lochinvar LSP20+ (Horizontal) solar collector with an active area of 1.79m² with 3no. panels providing a total area of 5.37m². The solar thermal panels will also be south facing, installed to an angle of 30°.

The panel layout ensures that overshading is minimised by placing the panels closest to the northern end of 9D, furthest from 9B Park House's shadow.

The roof will be freely accessible to allow easy maintenance and cleaning of the panels to ensure continued performance of the panels. The green roof will also reduce ambient heat, which will aid in maintaining increased efficiency of the solar therm and photovoltaic panels.



5.0 Annual CO2 Emission Calculations - Be Green

The 'Be Green' inputs described for the proposed building have been captured in energy modelling using the Standard Assessment Procedure (SAP).

The CO2 emissions for the proposed under the 'Be Green' tier of the Energy Hierarchy are shown below. DER and TER worksheets showing the 'Be Green' performance of the dwelling are provided in Appendix 2.

This analysis demonstrates that the proposed will achieve a carbon dioxide emission saving of 61.4% through energy efficiency means alone, under the 'Be Green' Scenario, exceeding The London Borough of Camden's 19% target requirement.

Comparison of Existing Retrofit vs New Build

The analysis has shown that by incorporating energy efficient construction and installations, there is a significant reduction in the development CO2 emissions based on the SAP calculation method.

The potential on-site low and zero carbon technologies have also been assessed taking into account the scale of this particular development and constraints such as location, visual impact, preventing additional vehicle movements and local pollution concerns.

The scheme therefore demonstrates a significant reduction in carbon emissions compared with both the existing house if it was to be refurbished and the London Borough of Camden Planning requirements for new build dwellings.

Be Green Co2 Savings

Standard Case TER (Part L1A) (CO ² kg/m ² /year)	Proposed 'Be Green' (DER) (CO ² kg/m ² /year)	Emissions Savings (CO ² kg/m ² /year)	Emissions Savings %	
14.0	5.4	8.6	61.4	

Existing Retrofit vs Proposed Co2 Savings

Existing Retrofit	Proposed New Build	Total Savings	Total Savings
Total CO ² (kg/yr)	Total CO ² (kg/yr)	CO ² (kg/yr)	CO ² (%)
3785.7	2046.8	1738.9	45.9



6.0 Sustainability Statement

Proposed Sustainability Measures

The sustainability strategy for the proposed development has been assessed using the Greater London Authority (GLA) supplementary planning guidance (SPG) 'Sustainable Design and Construction'. This enables a holistic sustainability approach for the proposed development. The principle of sustainable design and construction is referenced within the London Borough of Camden's Local Plan, and therefore the GLA's 'Sustainable Design and Construction' SPG represents best practice guidance to meet high standards of sustainable design and construction.

The proposals incorporate a range of passive and active design measures that will reduce the energy demand for space conditioning, hot water and lighting. Sustainability measures will include reduction in water use, waste and pollution as well as improvements in occupant health & wellbeing and ecology.

The following subsections detail the sustainability measures that will be incorporated into the design of the proposed dwellings.



Land

The site, as shown in the image below (left), is currently occupied by a detached 2 storey, modest residential dwelling with a private rear garden. It is currently in use as a single family residential dwelling (Use Class C3).

The continued utilisation of this site will ensure that the proposed dwelling is constructed on a previously used (brownfield) site, thus reducing development on greenfield and Green Belt sites. The proposed dwelling retains the location of the existing dwelling, retaining the extent of the rear garden to ensure sufficient green space is retained.

The proposed dwelling has been designed to respect the scale and massing of the neighbouring properties. This will ensure that the form of the proposed scheme will fit within the street scene, whilst also respecting the neighbouring buildings.



Extract from the TFL PTAL map

Location and Transport

The site is located on the corner where The Grove meets Fitzroy Park. The surrounding uses are purely residential with the nearest local shops located along Highgate High Street, approximately a 5 minute walk away.

The site has good public transport links. It is located within PTAL 2 and is a 15 minute walk from Highgate Underground Station which is on the Northern Line and in addition, there are various bus stops within an 8-10 minute walk.

Water Efficiency

The city often consumes more water than is available during dry weather. As the population of London grows, this situation will be further exacerbated, with increased pressure on the supply of potable water.

In order to actively mitigate against this, water saving fittings and appliances shall be installed to target a water consumption rate of 105 litres or less per person per day, based on the DCLG water efficiency calculator for residential dwellings. Full details of the water calculation are provided in Appendix 3.

Subject to changes at later detailed design stages, it is proposed that the following measures will be incorporated:

- setting.

It is intended that, to further reduce the consumption of water postdevelopment, storage tanks to facilitate the recycling of grey- and/or rainwater will be provided. This will contribute to a reduction in the use of potable water.

Low volume, dual flush toilets of 6/3 litres.

Water consumption levels no higher than 5 litres/minute in hand-wash basins, and 8 litres/minute in kitchen sinks.

Bath with a capacity to overflow no higher than 170 litres.

Showers with a flow rate of 12 litres/minute using a flow restrictor.

Washing machine with water consumption no more than 5 litres/kg.

Dishwasher with water consumption of no more than 1 litres per place



6.0 Sustainability Statement

Materials and Waste

The selection of materials is determined by a variety of factors, such as the architectural context, design rationale, embodied carbon and maintenance requirements. For the proposed dwelling, consideration will be given to the lifecycle environmental performance, with materials selected in consideration of the BRE's Green Guide to Specification, aiming for A or B rated materials wherever possible.

During the detailed design of the building fabric, consideration will be given to minimising the environmental impact of materials, by selecting non-toxic and robust materials to ensure longevity and a minimal impact on the health Park, which are to be retained. of the occupants.

Timber will be selected and purchased in consideration of sustainability certification. It is intended that all structural timber elements, along with any timber used for temporary uses such as scaffolding, will be sustainably sourced. This may include FSC and/or PEFC sources.

Where possible, it is intended that locally sourced materials will be employed during the construction of the proposed dwelling. This will aid in ensuring materials that are is in keeping with local vernacular are employed, whilst also contributing to the minimisation of the embodied carbon associated with these materials.

Furthermore, applying the principles of a circular economy, whereby the use of recycled and reused materials is prioritised, where feasible will also aid in minimising the embodied carbon associated with the dwelling.

During operation, a dedicated storage area will be incorporated for the storage of recycling and general waste, in line with the requirements of the London Borough of Camden policy.

Nature Conservation and Biodiversity

The site in its current state comprises an existing dwelling with a private rear garden. The rear garden currently comprises a small proportion of hard-standing, as well as a network of retaining walls, including an outbuilding, all with concrete foundations.

An arboricultural survey has been undertaken and advice sought in relation to the existing trees, in particular the trees screening along Fitzroy Park. The proposals have been carefully considered around the trees along Fitzroy

In addition to this, soft landscaping will be incorporated within the rear garden, additional planting to the front garden and a green roof to improve the extent of permeable surface area.

Tackling Increased Temperatures and Drought

In order to protect the development against overheating in the future, a number of key design features have been proposed to ensure the new dwelling is resilient to increased temperatures which may be experienced as a result of climate change and the urban heat island effect. A summary of the measures included to reduce the risk of overheating is provided below.

The design of the proposed dwelling has been developed in line within the GLA's recommended 'Cooling Hierarchy' approach, detailed in London Plan Policy 5.9. This applies a similar principle to the thorough decision-making process of the Energy Hierarchy, with the aim of reducing CO2 emissions from cooling, and minimising the risk of overheating where no cooling is present:

Minimisation of internal heat generation through energy efficient design

- Heat gain from lighting is kept to a minimum as a result of an energyefficient lighting design solution.
- The availability of natural light is maximised by optimising the light transmittance of the glass elements of the façade.
- Heat gains from equipment will be minimised through the specification of low energy systems.

Reduction of the amount of heat entering the building in the summer

from solar gain.

Management of the heat within the building

mitigate overheating.

Passive ventilation

dwelling.

Mechanical and active cooling

Strategy section of this report.

The building's façades have a balanced amount of glazing to optimise daylight penetration, without increasing the risk of overheating arising

The proposed dwelling will have high ceilings, promoting increased air movement and stratification, whereby warmer air rises, thus aiding to

Openable windows on multiple aspects across all floors will provide a passive ventilation strategy that utilises cross-flow and stack ventilation to maximise the potential for natural ventilation within the proposed

Cooling may potentially be provided by the proposed Nilan Compact P system, which includes a reversible cooling unit capable of cooling air used for ventilation only. Whilst this cooling will not be the equivalent of air conditioning, whereby the air within a space is cooled to a specified temperature, the use of a reversible cooling unit allows the specified system to cool incoming air by up to 10°C. In this way, supply air can be cooled during warm periods, without affecting the efficiency with which hot water is produced. The inclusion of this technology has been accounted for within the energy modelling detailed within the Energy



6.0 Sustainability Statement

Flooding

The image below confirms that the proposed site is located in Flood Zone 1, and is not at risk of flooding from rivers or the sea, reservoirs or surface water.

The proposed green roof has been included to promote species biodiversity, local wildlife and improve air quality. The green roof will also provide rainwater attenuation, reducing the volume of surface water runoff on-site and impact on local sewers. Furthermore, the incorporation of soft landscaping will positively contribute to the management of the 5mm storm event, therefore limiting runoff for the typical everyday rainfall event.

The management of surface water in this way will reduce the burden on the existing Thames Water sewer network, as well as reducing the risk of flooding on-site and within the immediate surroundings.

Pollution

Air Pollution

The Environment Act 1995 requires all Local Authorities to review air quality within their districts. If it appears that any air quality 'Objective' prescribed in the regulations and in the National Air Quality Strategy is not likely to be Road (A1) to the east of the site. However, the below map (bottom) shows achieved, then the Local Authority must designate the affected area as an Air that noise from these roads will have no impact on the new dwelling. Quality Management Area (AQMA).

The site location, and the whole of the London Borough of Camden, is specified as an AQMA, due to excessive levels of nitrogen dioxide (NO²) and particulate matter (PM₁₀) arising from road transport.

The images below shows the levels of NO² and PM₁₀ measured at the site in 2020. These images indicate that the levels of NO² and PM₁₀ present at the site in 2020 would have been below the annual mean objectives for both pollutants.

It is anticipated that transport emissions may be mitigated by encouraging the occupants to cycle through the provision of bicycle storage within the new dwelling.

Noise Pollution

The development is not located within close proximity to transport noise sources. The closest road noise sources are Highgate Hill (B519) and Holloway

The site is also not located within close enough proximity to any rail lines for noise from this source to impact on the occupants in the future, as demonstrated on the map below (top).







Extract from the Environment Agency's online flood map

Extract from London Air Online pollution map. Left indicating annual levels of NO² and right PM₁₀ exposure

Low (1-3)

Extract from England Noise and Air Quality Viewer. Top indicating rail sources and bottom road sources.



7.0 Conclusion

Conclusion

Every effort has been made to prioritise energy savings and carbon dioxide emission reductions through early engagement with the design team during concept development and extensive energy modelling.

Ambitious levels of thermal performance have been set for the building fabric with triple glazing specified for all new windows and the target u-values for all external elements have been set well * below the limits set by The Building Regulations.

With this strategy the thermal modelling exercise demonstrating the three levels of The Energy Hierarchy show the following progressing reductions in annual carbon dioxide emissions:

- Be Lean -12.9%
- Be Clean 12.9%
- Be Green 61.4%

This demonstrates that the building will achieve the 35% carbon dioxide reductions targets as set by The Camden Local Plan and The London Plan.

the proposals support relevant policy relating to sustainable development. This shows that the proposed development:

- will provide a new family home to replace the existing dwelling on-site;
- give consideration to the lifecycle environmental will performance of the new dwelling when selecting materials to reduce embodied carbon:

will minimise internal water consumption to 105 litres per person per day;

will retain the screening trees along Fitzroy Park, and provide a new green roof to maintain and enhance the biodiversity of the site:

will manage surface water runoff through the incorporation of soft landscaping;

will minimise energy demand through the specification of low u-values, low air permeability and low thermal bridging to reduce heat loss; and

will utilise a highly efficient renewable systems to reduce the need for on-site fossil fuel combustion to provide space and water heating, mechanical ventilation with heat recovery, and a degree of comfort cooling.

Overall, the proposals for the scheme are in line with the principles of sustainable development, as well as the policy requirements of the NPPF and the London Borough of Camden, and will provide a This document demonstrate that the siting and design of new dwelling that seeks to promote these principles in operation.

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Appendix

Appendix 1 : SAP 2012 Calculations for the Dwelling as Existing and Refurbished

Charlton Brown Architecture & Interiors

Assessor Name: Software Name:Stroma FSAP 2012Stroma Number: Software Version:Version: 1.0.4.26Property Address: 9D The Grove_Existing BuildingAddress :Image: Secondary floorArea(m ²) 60.92 Av. Height(m) 2.42 Volume(m ³) 149.86 Ground floorSecondary floorSecondary floorImage: Secondary floor $3a)+(3b)+(3c)+(3d)+(3e)+(3n) = 348.11$ Secondary floorOwelling volumeSecondary floorSecondary floorSecondary floorSecondary floorSecondary floorOwelling volumeSecondary floorSecondary floor
Property Address: 9D The Grove_Existing BuildingAddress :1. Overall dwelling dimensions:Ground floorArea(m²)Av. Height(m)Volume(m³)Ground floor 60.92 (1a) x 2.46 (2a) = 149.86 (3a)First floor 81.92 (1b) x 2.42 (2b) = 198.26 (3b)Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+(1n) 142.84 (4)Uwelling volume(3a)+(3b)+(3c)+(3d)+(3e)+(3n) = 348.11 (5)2. Ventilation rate:
Address :1. Overall dwelling dimensions:Ground floor $Area(m^2)$ $Av. Height(m)$ $Volume(m^3)$ Ground floor 60.92 $(1a) \times$ 2.46 $(2a) =$ 149.86 $(3a)$ First floor 81.92 $(1b) \times$ 2.42 $(2b) =$ 198.26 $(3b)$ Total floor area TFA = $(1a)+(1b)+(1c)+(1d)+(1e)+(1n)$ 142.84 (4) Dwelling volume(3a)+(3b)+(3c)+(3d)+(3e)+(3n) =348.11colspan="2">total floor area TFA = $(1a)+(1b)+(1c)+(1d)+(1e)+(1n)$ 142.84 (4) Dwelling volume(3a)+(3b)+(3c)+(3d)+(3e)+(3n) = 348.11 (5) 2. Ventilation rate:main heatingsecondary heatingothertotalm³ per hour
Area(m²)Av. Height(m)Volume(m³)Ground floor 60.92 $(1a) \times 2.46$ $(2a) = 149.86$ $(3a)$ First floor 81.92 $(1b) \times 2.42$ $(2b) = 198.26$ $(3b)$ Total floor area TFA = $(1a)+(1b)+(1c)+(1d)+(1e)+(1n)$ 142.84 (4) Dwelling volume $(3a)+(3c)+(3d)+(3e)+(3n) = 348.11$ (5) 2. Ventilation rate:main heatingsecondary heatingother totaltotalm³ per hour
Ground floor 60.92 (1a) x 2.46 (2a) = 149.86 (3a)First floor 81.92 (1b) x 2.42 (2b) = 198.26 (3b)Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+(1n) 142.84 (4)Dwelling volume $(3a)+(3b)+(3c)+(3d)+(3e)+(3n) =$ 348.11 (5)2. Ventilation rate: m^3 per hourMain heatingsecondary heatingothertotal m^3 per hour
First floor First floor Total floor area TFA = $(1a)+(1b)+(1c)+(1d)+(1e)+(1n)$ Dwelling volume (3a)+(3b)+(3c)+(3d)+(3e)+(3n) = 348.11 (5) 2. Ventilation rate: Main secondary heating the data of the model of t
Total floor area TFA = $(1a)+(1b)+(1c)+(1d)+(1e)+(1n)$ Dwelling volume (3a)+(3b)+(3c)+(3d)+(3e)+(3n) = 348.11 (5) 2. Ventilation rate: main heating secondary other total m ³ per hour
Dwelling volume (3a)+(3b)+(3c)+(3d)+(3e)+(3n) = 348.11 2. Ventilation rate: main heating the ating secondary heating the ating total
2. Ventilation rate: main secondary other total m ³ per hour heating heating to be a second and the second an
2. Ventilation rate: main secondary other total m ³ per hour heating heating contained to the secondary other total m ³ per hour
heating heating [
Number of chimneys $0 + 0 + 0 = 0$ + $0 + 0$ = 0 (6a)
Number of open flues $0 + 0 + 0 = 0 $
Number of intermittent fans
Number of passive vents2x 10 =20(7b)
Number of flueless gas fires 0 (7c)
Air changes per hour
Infiltration due to chimneys, flues and fans = $(6a)+(6b)+(7a)+(7b)+(7c) = 30$ \div (5) = 0.09 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)
Number of storeys in the dwelling (ns)
Additional infiltration $[(9)-1]\times 0.1 = 0$ (10) Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonny construction
if both types of wall are present, use the value corresponding to the greater wall area (after
deducting areas of openings); if equal user 0.35
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0
If no draught lobby, enter 0.05, else enter 0 0 (13)
Windows and doors draught supped $0.25 - [0.2 \times (14) \div 100] = 0.15$
Infiltration rate $(8) + (10) + (11) + (12) + (13) + (15) = 0$ (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area
If based on air permeability value, then $(18) = [(17) \div 20] + (8)$, otherwise $(18) = (16)$ 0.84 (18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used
Number of sides sheltered 2 (19) Chalter factor (20) = 1 [0.075 × (10)] =
Shelter factor $(20) = 1 - [0.073 \times (19)] = 0.85$ (20)
Infiltration rate modified for monthly wind speed $(21) = (10) \times (20) = 0.71$ (21)
lan Feb Mar Anr May lun lul Aug Sen Oct Nov Dec
Monthly average wind speed from Table 7
(22)m= 5.1 5 4.9 4.4 4.3 3.8 3.8 3.7 4 4.3 4.5 4.7

Wind I	Factor (2	22a)m =	(22)m ÷	4										
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18		
Adjust	ed infiltr	ation rat	e (allowi	ng for sł	nelter an	d wind s	speed) =	(21a) x	(22a)m					
	0.91	0.89	0.87	0.78	0.76	0.68	0.68	0.66	0.71	0.76	0.8	0.84		
Calcul	late effe	ctive air	change .	rate for t	he appli	cable ca	ise			•				
	echanica		using App	andix N (2	23h) - (23a	a) x Emv (a	acuation (I	N5)) othe	nuiso (23)	(23a)			0	(23a)
lf bal	anced with	heat reco	overv: effic	iencv in %	allowing f	for in-use f	actor (fron	n Table 4h) –	5) – (200)			0	(23D)
a) If	halance	nd mach	anical ve	ntilation	with he	at recov			-) 	2b)m + (23h) v [1 _ (23c)	0 · 1001	(230)
(24a)m=				0					0			1 - (200)	÷ 100]	(24a)
b) If	halance	d mech:	I anical ve	ntilation	without	heat rec	covery (I	1 MV) (24h	$1 = \frac{1}{2}$	2b)m + (23b)			· · · ·
(24b)m=	0			0	0	0			0		0	0		(24b)
c) If	whole h	use ex	r tract ver	tilation o	ı or positiv	ı ve input v	ı ventilatio	n from (utside		<u> </u>	1		
-,	if (22b)n	n < 0.5 ×	< (23b), t	hen (24	c) = (23b	o); other	wise (24	c) = (22	b) m + 0	.5 × (23b))			
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) If	natural if (22b)r	ventilation n = 1, the	on or wh en (24d)	ole hous m = (221	se positiv b)m othe	ve input erwise (2	ventilatio 24d)m =	on from 0.5 + [(2	loft 2b)m² x	0.5]				
(24d) <mark>m=</mark>	0.91	0.89	0.88	0.81	0.79	0.73	0.73	0.72	0.75	0.79	0.82	0.85		(24d)
Effe	ctive air	change	rate - er	nter (24a) or (24	o) or (24	c) or (24	d) in bo	x (25)					
(25)m=	0.91	0.89	0.88	0.81	0.79	0.73	0.73	0.72	0.75	0.79	0.82	0.85		(25)
3 He	at losse	s and he	at loss i	naramet	er.									
		Gros	ss	Openin	as	Net Ar	ea	U-val	ue	AXU		k-value	<u>,</u>	AXk
		area	(m²)	n	η ²	A ,r	m²	W/m2	2K	(W/	K)	kJ/m²·ł	<	kJ/K
Doo <mark>rs</mark>	Type 1					2.14	x	1	=	2. <mark>1356</mark> 9	8			(26)
Doors	Type 2					1.84	x	1	=	1.83594	6			(26)
Doors	Туре 3					3.92	x	1	=	3.91756	7			(26)
Windo	ws Type	e 1				6.936	1 x1	/[1/(5.9)+	0.04] =	33.11				(27)
Windo	ws Type	2				8.2483	23 <mark>x</mark> 1	/[1/(5.9)+	0.04] =	39.37				(27)
Windo	ws Type	e 3				16.921	03 <mark>x</mark> 1	/[1/(5.9)+	0.04] =	80.77				(27)
Floor						60.91	7 X	1.03	=	62.7445	1			(28)
Walls	Type1	182.	37	39.9	9	142.3	7 X	1.4	=	199.32	2		- -	(29)
Walls	Type2	23.8	37	0		23.87	7 X	0.72	=	17.12			- -	(29)
Roof		81.9	92	0		81.92	2 X	1.5		122.89) 		- -	(30)
Total a	area of e	lements	, m²			349.0	8				((31)
* for wir ** includ	ndows and de the area	l roof wind as on both	ows, use e sides of ir	effective wi nternal wal	indow U-va Ils and par	alue calcul titions	lated using	g formula 1	1/[(1/U-val	ue)+0.04] a	as given in	n paragraph	3.2	
Fabric	heat los	ss, W/K :	= S (A x	U)				(26)(30) + (32) =				563.2	22 (33)
Heat c	apacity	Cm = S((Axk)						((28).	(30) + (32	2) + (32a)	(32e) =	0	(34)

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

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

Indicative Value: Medium

(35)

250

Therm	al bridg	es : S (L	x Y) cal	culated u	using Ap	pendix I	К						52.36	(36)
if details	of therma	al bridging	are not kn	own (36) =	= 0.05 x (3	1)			(00)	(00)				-
Vontile	abric ne	at loss		monthl					(33) +	(30) =	(25)m x (5)		615.58	(37)
Ventile		Feb	Mar	Anr	y Mav	lun	6	Διια	(30)m Sen			Dec	1	
(38)m=	104.61	102.78	100.98	92.55	90.97	83.63	83.63	82.27	86.45	90.97	94.16	97.5	-	(38)
Heat t			L			I			(39)m	- (37) + (38)m]	
(39)m=	720.19	718.36	716.56	708.13	706.55	699.21	699.21	697.85	702.04	706.55	709.74	713.08	1	
						I				Average =	Sum(39)₁.	₁₂ /12=	708.12	(39)
Heat lo	oss para	meter (H	HLP), W/	m²K	i	i	1	1	(40)m	= (39)m ÷	- (4)	1		
(40)m=	5.04	5.03	5.02	4.96	4.95	4.9	4.9	4.89	4.91	4.95	4.97	4.99		
Numb	er of day	/s in moi	nth (Tab	le 1a)					,	Average =	: Sum(40)₁.	12 /12=	4.96	(40)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec]	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)
4. Wa	ater hea	ting enei	gy requi	rement:								kWh/y	ear:	
Assum	ned occu	ipancy, I	N								2	92	1	(42)
if TF	A > 13.	9, N = 1	+ 1.76 x	[1 - exp	(-0.0003	849 x (TF	FA -13.9)2)] + 0.0	0013 x (TFA -13	.9)		1	
	A £ 13.	9, N = 1 le hot wa	aterusa	ne in litre	es per da	v Vd av	erage -	(25 x N)	+ 36		10	2.6	1	(43)
Reduce	the annua	al average	hot water	usage by a	5% if the a	lwelling is	designed i	to achieve	a water us	se ta <mark>rget</mark> o	10	3.0		(43)
not mor	e that 125	litres pe <mark>r</mark>	person per	∙day (all w	rater use, l	hot and co	ld)						,	
List worth	Jan	Feb	Mar	Apr	May	Jun	Jul Tabla 1 a v	Aug	Sep	Oct	Nov	Dec		
Hot wat	er usage i	n litres per	day for ea		va,m = ra			(43)					,	
(44)m=	113.97	109.82	105.68	101.53	97.39	93.24	93.24	97.39	101.53	105.68	109.82	113.97	1040.00	
Energy	content of	hot water	used - cal	culated mo	onthly $= 4$.	190 x Vd,r	m x nm x D	0Tm / 3600) kWh/mor	total = Su oth (see Ta	ables 1b, 1	c, 1d)	1243.20	(44)
(45)m=	169.01	147.81	152.53	132.98	127.6	110.11	102.03	117.08	118.48	138.08	150.72	163.67		
lf incton	tanaayaya	votor booti		of upo (po	hatwata	r otorogo)	ontor 0 in	haven (16	· to (61)	Total = Su	m(45) ₁₁₂ =	=	1630.11	(45)
						siorage),		17 50	10 (01)	00.74		04.55	1	(46)
(46)m= Water	25.35 storage	22.17 loss:	22.88	19.95	19.14	16.52	15.3	17.56	17.77	20.71	22.61	24.55		(46)
Storag	je volum	e (litres)	includir	ig any so	olar or W	/WHRS	storage	within sa	ame ves	sel		150	1	(47)
If com	munity h	eating a	nd no ta	nk in dw	velling, e	nter 110) litres in	(47)					-	
Otherv	vise if no	o stored	hot wate	er (this in	ncludes i	nstantar	neous co	ombi boil	ers) ente	er '0' in ((47)			
Water	storage	loss: uror's de	olarad I	occ fact	or ie kno	wp (k\\/k	a/dav/).					~-	1	(40)
a) II II Tompo	anulaci	actor fro	m Table	255 18010 25		WII (KVVI	i/uay).				1.	.95]	(48)
Energy	v lost fro	actor no		ZU kWb/ya	aar			(18) v (10)	_		0.	.54]	(49)
b) If m	nanufact	urer's de	eclared of	ylinder l	oss fact	or is not	known:	(40) × (43)	_		1.	.05		(50)
Hot wa	ater stor	age loss	factor fr	om Tabl	e 2 (kW	h/litre/da	ay)					0]	(51)
If com	munity h	eating s	ee secti	on 4.3									1	
Volum	e ractor	Irom Tal	ule 2a m Tahla	2h								0	4	(52) (53)
i empe				20								U	J	(00)

Energy Enter	/ lost fro (50) or	om water (54) in (5	• storage 55)	, kWh/ye	ear			(47) x (51) x (52) x (53) =				0		(54) (55)
Water	storage	loss cal	culated	for each	month			((56)m = (55) × (41)ı	m	L			
(56)m=	32.64	29.48	32.64	31.59	32.64	31.59	32.64	32.64	31.59	32.64	31.59	32.64		(56)
If cylinde	er contain	s dedicate	d solar sto	rage, (57)	m = (56)m	x [(50) – (H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Append	ix H	
(57)m=	32.64	29.48	32.64	31.59	32.64	31.59	32.64	32.64	31.59	32.64	31.59	32.64		(57)
Primar	v circuit	loss (ar	nual) fro	om Table	e 3							0		(58)
Primar	y circuit	loss cal	culated	for each	month (59)m = ((58) ÷ 36	65 × (41)	m					
(mo	dified by	factor f	rom Tab	le H5 if t	here is s	solar wat	ter heatir	ng and a	cylinde	r thermo	stat)		I	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
Combi	loss ca	lculated	for each	month	(61)m =	(60) ÷ 30	65 × (41))m	-		-	-		
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)
Total h	neat req	uired for	water h	eating ca	alculated	for eac	h month	(62)m =	0.85 × ((45)m +	(46)m +	(57)m +	(59)m + (61)	m
(62)m=	224.91	198.31	208.44	187.08	183.5	164.21	157.94	172.99	172.58	193.98	204.82	219.58		(62)
Solar DI	HW input	calculated	using App	endix G o	r Appendix	: H (negati	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)		
(add a	dditiona	l lines if	FGHRS	and/or \	NWHRS	applies	, see Ap	pendix (G)			r	I	
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output from water heater														
(64)m=	224.91	198.31	208.44	187.08	183.5	164.21	157.94	172.99	172.58	193.98	204.82	219.58		
Output from water heater (annual) 112 2288.35 (64)														
Heat g	ains fro	m water	heating.	, kWh/m	onth 0.2	5 ´ [0.85	× (45)m	+ (61)m	1] + 0.8 x	(46)m	+ (57)m	+ (59)m]	
(65)m=	100.92	89.54	95.44	87.5	87.15	79.89	78.65	83.65	82.68	90.64	93.4	99.15		(65)
inclu	ide (57)	m in calo	culation	of (65)m	only if c	ylinder i	s in the o	dwelling	or hot w	ater is fr	om com	munity h	eating	
5. Int	ternal ga	ains (see	e Table 5	5 and 5a):									
Metab	olic gair	is (Table	<u>5), Wat</u>	ts	-			i			-	i		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		()
(66)m=	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12		(66)
Lightin	g gains	(calcula	ted in Ap	opendix	L, equat	ion L9 o	r L9a), a	lso see	Table 5			i	I	()
(67)m=	41.8	37.13	30.19	22.86	17.09	14.43	15.59	20.26	27.19	34.53	40.3	42.96		(67)
Applia	nces ga	ins (calc	ulated ir	n Append	dix L, eq	uation L	13 or L1	3a), also	see Ta	ble 5	1		I	()
(68)m=	312.62	315.86	307.69	290.29	268.32	247.67	233.88	230.63	238.81	256.21	278.18	298.83		(68)
Cookir	ng gains	(calcula	ted in A	ppendix I	L, equat	tion L15	or L15a)), also se	e Table	5			I	()
(69)m=	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61		(69)
Pumps	s and fa	ns gains I	(Table \$	5a)				i				i	I	()
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3		(70)
Losses	s e.g. ev	aporatic	on (nega	tive valu	es) (Tab	ole 5)	i	·	· · · · ·		i	·	l	
(71)m=	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89		(71)
Water	heating	gains (T	able 5)	r	r	r							l	
(72)m=	135.64	133.25	128.28	121.52	117.14	110.96	105.71	112.44	114.83	121.82	129.72	133.26		(72)
Total i	internal	gains =	-			(66)	m + (67)m	n + (68)m -	⊦ (69)m + ((70)m + (7	1)m + (72)	m	l	
(73)m=	559.9	556.08	536	504.5	472.38	442.89	425.01	433.17	450.66	482.4	518.03	544.88		(73)
6. So	lar gains	S:												

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

Orientation:		Access Factor Table 6d		Area m²	Flux Table 6a			g_ Table 6b		FF Table 6c	Gains (W)		
East	0.9x	0.77	x	6.94	×	19.64) ×	0.63	x	0.7] =	41.63	(76)
East	0.9x	0.77	x	6.94	×	38.42	x	0.63	x	0.7] =	81.44	(76)
East	0.9x	0.77	x	6.94	×	63.27	x	0.63	x	0.7] =	134.12	(76)
East	0.9x	0.77	x	6.94	×	92.28	x	0.63	x	0.7	=	195.61	(76)
East	0.9x	0.77	x	6.94	×	113.09	x	0.63	x	0.7] =	239.73	(76)
East	0.9x	0.77	x	6.94	×	115.77	x	0.63	x	0.7] =	245.41	(76)
East	0.9x	0.77	x	6.94	×	110.22	x	0.63	x	0.7	=	233.64	(76)
East	0.9x	0.77	x	6.94	×	94.68	x	0.63	x	0.7] =	200.69	(76)
East	0.9x	0.77	x	6.94	×	73.59	x	0.63	x	0.7	=	155.99	(76)
East	0.9x	0.77	x	6.94	×	45.59	x	0.63	x	0.7	=	96.64	(76)
East	0.9x	0.77	x	6.94	×	24.49	x	0.63	x	0.7] =	51.91	(76)
East	0.9x	0.77	x	6.94	×	16.15	x	0.63	x	0.7] =	34.24	(76)
South	0.9x	0.77	x	8.25	×	46.75	×	0.63	x	0.7] =	117.85	(78)
South	0.9x	0.77	x	8.25	x	76.57	x	0.63	x	0.7] =	193.01	(78)
South	0.9x	0.77	x	8.25	x	97.53	x	0.63	x	0.7	i =	245.86	– (78)
South	0.9x	0.77	x	8.25	×	110.23	x	0.63	Х	0.7	1 =	277.88	(78)
Sout <mark>h</mark>	0.9x	0.77	x	8.25	x	114.87	x	0.63	x	0.7	i -	289.57	(78)
Sout <mark>h</mark>	0.9x	0.77	x	8.25	x	110.55	İ 🖈	0.63	x	0.7] =	278.67	(78)
Sout <mark>h</mark>	0.9x	0.7 <mark>7</mark>	x	8.25	x	108.01	x	0.63	x	0.7] =	272.28	(78)
Sout <mark>h</mark>	0.9x	0.77	x	8.25	x	104.89	x	0.63	x	0.7] =	264.42	(78)
Sout <mark>h</mark>	0.9x	0.77	x	8.25	x	101.89	×	0.63	x	0.7] =	256.83	(78)
Sout <mark>h</mark>	0.9x	0.77	x	8.25	х	82.59	x	0.63	x	0.7] =	2 <mark>08.18</mark>	(78)
South	0.9x	0.77	x	8.25	×	55.42	x	0.63	x	0.7] =	139.7	(78)
South	0.9x	0.77	x	8.25	×	40.4	x	0.63	x	0.7	=	101.84	(78)
West	0.9x	0.77	x	16.92	x	19.64	x	0.63	x	0.7] =	101.57	(80)
West	0.9x	0.77	x	16.92	×	38.42	x	0.63	x	0.7] =	198.68	(80)
West	0.9x	0.77	x	16.92	×	63.27	x	0.63	x	0.7	=	327.2	(80)
West	0.9x	0.77	x	16.92	x	92.28	x	0.63	x	0.7] =	477.21	(80)
West	0.9x	0.77	x	16.92	×	113.09	x	0.63	x	0.7] =	584.83	(80)
West	0.9x	0.77	x	16.92	x	115.77	x	0.63	x	0.7	1 =	598.68	(80)
West	0.9x	0.77	x	16.92	×	110.22	×	0.63	x	0.7	1 =	569.97	(80)
West	0.9x	0.77	x	16.92	x	94.68	x	0.63	x	0.7] =	489.6	(80)
West	0.9x	0.77	x	16.92	×	73.59	×	0.63	x	0.7] =	380.55	(80)
West	0.9x	0.77	x	16.92	×	45.59	×	0.63	×	0.7] =	235.75	(80)
West	0.9x	0.77	x	16.92	×	24.49	x	0.63	x	0.7	j =	126.64	- (80)
West	0.9x	0.77	x	16.92	×	16.15	x	0.63	x	0.7	i =	83.52	– (80)

Solar g	olar gains in watts, calculated for each month $(83)m = Sum(74)m \dots (82)m$												
(83)m=	261.05	473.14	707.19	950.7	1114.13	1122.76	1075.88	954.7	793.38	540.57	318.25	219.59	(83)
Total gains – internal and solar (84)m = (73)m + (83)m , watts													
(84)m=	820.95	1029.21	1243.19	1455.2	1586.51	1565.65	1500.89	1387.87	1244.04	1022.97	836.28	764.48	(84)

7. Mean internal temperature (heating season)														
Temperature during heating periods in the living area from Table 9. Th1 (°C)												21	(85)	
Utilisation factor for gains for living area, h1,m (see Table 9a)														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(86)m=	0.99	0.99	0.99	0.97	0.95	0.91	0.86	0.88	0.95	0.98	0.99	1	l	(86)
Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)														
(87)m=	16.7	16.95	17.47	18.23	19.04	19.81	20.3	20.22	19.57	18.54	17.51	16.67	I	(87)
Temp	erature	durina h	eating r	L Deriods in	n rest of	dwelling	from Ta	hle 9 Ti	h2 (°C)					
(88)m=	18.08	18.08	18.08	18.09	18.09	18.1	18.1	18.1	18.1	18.09	18.09	18.08		(88)
Litilion	tion for	l torfor a	l oine for	l		L	L							
Utilisa						n_{2} , m (se		9a)	0.87	0.97	0.00	0.00	l	(89)
(00)11-	0.00	0.00	0.00	0.00	0.01	0.75	0.04	0.01	0.07	0.07	0.00	0.00		(00)
Mean	interna	l temper	ature in	the rest	of dwelli	ng T2 (fo	ollow ste	eps 3 to 7	7 in Tabl	e 9c)			I	(00)
(90)m=	13.04	13.4	14.15	15.23	16.37	17.42	17.97	17.91	17.13	15.68	14.2	13		(90)
	$fLA = Living area \div (4) =$												0.33	(91)
Mean	interna	l temper	ature (fo	r the wh	ole dwe	lling) = fl	LA × T1	+ (1 – fL	A) × T2					
(92)m=	14.24	14.56	15.24	16.21	17.24	18.2	18.73	18.67	17.93	16.62	15.28	14.2		(92)
Ap <mark>ply</mark>	adjustn	nent to t	he mear	n interna	temper	ature fro	m Table	4e, whe	ere appro	opri <mark>ate</mark>				
(93)m=	14.09	14.41	15.09	16.06	17.09	18.05	18.58	18.52	17.78	16.47	15.13	14.05		(93)
8. Spa	ace hea	ting requ	uirement	:										
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate														
the ut	lisation		or gains	using Ta	able 9a					0.1				
Litilioc	Jan	Feb	iviar	Apr	Iviay	Jun	Jui	Aug	Sep	Oct	INOV	Dec		
(94)m-		0.98		. 0.93	0.88	0.79	0.63	0.68	0.86	0.95	0.98	0.99		(94)
(94)III-		0.90 hmGm	W = (0)	$\frac{0.93}{100 \times (8)}$	()m	0.75	0.05	0.00	0.00	0.95	0.90	0.99		(01)
(95)m=	809.2	1006.06	, 1196.96	1359.97	1402.73	1236.99	950.62	945.08	1067.41	970,79	818.7	754.98	I	(95)
Month	ly aver		rnal tem		from T	able 8	000.02	0 10.00	1001.11	010.10	01017	101.00		()
(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	I	(96)
Heat	loss rate	e for mea	I an intern	al tempe	erature.	Lm . W =	[=[(39)m_	I x [(93)m·	– (96)m	1				
(97)m=	7048.72	6831.11	6153.89	5071.36	3811.01	2414.63	1383.72	1476.38	2583.31	4145.24	5698.31	7023.39	I	(97)
Space	e heatin	g require	ement fo	r each n	nonth, k	Nh/mont	h = 0.02	24 x [(97)m – (95)m] x (4 ⁻	1)m			
(98)m=	4642.2	3914.43	3687.96	2672.2	1791.76	0	0	0	0	2361.8	, 3513.32	4663.7	I	
l								Tota	l per year	(kWh/year	-) = Sum(9	8)15,912 =	27247.36	(98)
Snace	- heatin	a require	ement in	k\//h/m²	2/vear								190 75	 (99)
8c. Space cooling requirement														
Calcu	lated to	r June, J	uly and	August.	See Tal		lul	Διια	Son	Oct	Nov	Dee		
Haat	Jall lose rate		lculated	Usina 24	5°C inter	nal tem	l Jul Derature	and evt	ornal tan					
(100)m=	0		0	0		6572.55	5174.13	5303.64		0				(100)
Utilisa	tion fac	tor for lo	l ss.hm	Ĺ							Ĺ			× /
(101)m=	0	0	0	0	0	0.28	0.33	0.3	0	0	0	0		(101)
	ıl loss, h	nmLm (V	/atts) =	(100)m x	(101)m								_	
---	--	---	--	---	---	---	--	--	--	--	---	--	-------------------------	--
(102)m=	0	0	0	0	0	1811.51	1692.83	1599.11	0	0	0	0		(102)
Gains	s (solar	gains ca	lculated	for appli	cable we	eather re	egion, se	e Table	10)					
(103)m=	0	0	0	0	0	1942.9	1865.18	1737.11	0	0	0	0		(103)
Space set (1	e <i>coolin</i> 04)m to	<i>g require</i> zero if (e <i>ment fo</i> 104)m <	r month, : 3 × (98	<i>whole a</i>)m	lwelling,	continu	ous (kW	(h) = 0.0	24 x [(10	03)m – (102)m]:	x (41)m	
(104)m=	0	0	0	0	0	0	0	0	0	0	0	0		
									Total	= Sum(104)	=	0	(104)
Coolec	d fractio	n 							f C =	cooled	area ÷ (4	4) =	4.17	(105)
Intermi	ittency f	actor (Ta	able 10b)										
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0		
Snace	cooling	roquiror	nent for	month -	· (104)m	× (105)	✓ (106)r	n	l otal	I = Sum(104)	=	0	(106)
(107)m=					0	0		0	0	0	0	0		
(,			-	-			-		Total	= Sum(107)	=	0	(107)
Snace	cooling	requirer	nent in k	⟨\//h/m²/\	/ear				(107)	$$ $(4) -$	-090-7		0	
	orgung	requirer		ividual b		(otomo i	naludina	mioro ((+) -				
9a. En	ergy rec o hootii	quiremer	its – ina	ividual n	eating sy	ystems i	nciuaing	micro-C	nP)					
Fracti	on of st	n g. Dace hea	at from s	econdar	v/supple	mentarv	svstem						0	(201)
Fracti	on of sr	ace hea	at from n	nain syst	em(s)	,	- ,	(202) = 1 -	- (201) =				1	(202)
Fracti	ion of to	tal heati	no from	main eye	stom 1			(204) - (204)	02) x [1 -)	(203)] -			4	
THOI				ing quat				(204) - (20	52) ~ [1	(200)] –				
EIIICIE	ency of	main spa		ing syste				/ 1					89.9	(206)
Efficie	ency of	seconda	ry/suppl	ementar	y heating	g system	ו, %						0	(208)
Coolii	na Svste	em Ener	av Effici	ency Rat	tio								4.05	(209)
			37											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ar
Space	Jan e heatin	Feb g require	Mar ement (c	Apr alculate	May d above)	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ar
Space	Jan e heatin 4642.2	Feb g require 3914.43	Mar ement (c 3687.96	Apr alculate 2672.2	May d above) 1791.76	Jun 0	Jul 0	Aug 0	Sep 0	Oct 2361.8	Nov 3513.32	Dec 4663.7	kWh/ye	ar
Space (211)m	Jan e heatin 4642.2 n = {[(98	Feb g require 3914.43)m x (20	Mar ement (c 3687.96 4)] } x 1	Apr alculated 2672.2 00 ÷ (20	May d above) 1791.76 06)	Jun 0	Jul 0	Aug 0	Sep 0	Oct 2361.8	Nov 3513.32	Dec 4663.7	kWh/ye	ar (211)
Space (211)m	Jan e heatin 4642.2 n = {[(98 5163.74	Feb g require 3914.43)m x (20 4354.21	Mar ement (c 3687.96 4)] } x 1 4102.29	Apr alculated 2672.2 00 ÷ (20 2972.41	May d above) 1791.76 06) 1993.06	Jun 0	0 0	Aug 0 0	Sep 0 0	Oct 2361.8 2627.14	Nov 3513.32 3908.03	Dec 4663.7 5187.65	kWh/ye	ar (211)
Space (211)m	Jan e heatin 4642.2 n = {[(98 5163.74	Feb g require 3914.43 m x (20 4354.21	Mar ement (d 3687.96 4)] } x 1 4102.29	Apr alculate 2672.2 00 ÷ (20 2972.41	May d above) 1791.76 06) 1993.06	J un 0	0 0	Aug 0 0 Tota	0 0 I (kWh/yea	Oct 2361.8 2627.14 ar) =Sum(2	Nov 3513.32 3908.03 211) _{15,1012}	Dec 4663.7 5187.65	kWh/ye 30308.52	(211) (211)
Space (211)m Space	Jan e heatin 4642.2 n = {[(98 5163.74	Feb g require 3914.43 c)m x (20 4354.21 g fuel (s	Mar ement (c 3687.96 4)] } x 1 4102.29 econdar	Apr alculate 2672.2 00 ÷ (20 2972.41 y), kWh/	May d above) 1791.76 06) 1993.06	Jun 0	Jul 0 0	Aug 0 Tota	0 0 I (kWh/yea	Oct 2361.8 2627.14 ar) =Sum(2	Nov 3513.32 3908.03 211) _{15,1012}	Dec 4663.7 5187.65	kWh/ye 30308.52	(211) (211)
Space (211)m Space = {[(98	Jan e heatin 4642.2 n = {[(98 5163.74 e heatin)m x (20	Feb g require 3914.43)m x (20 4354.21 g fuel (s 01)] } x 1	Mar ement (c 3687.96 (4)] } x 1 4102.29 econdar 00 ÷ (20	Apr alculate 2672.2 00 ÷ (20 2972.41 y), kWh/ 8)	May d above) 1791.76 06) 1993.06	Jun 0	0 0	Aug 0 Tota	0 0 I (kWh/yea	Oct 2361.8 2627.14 ar) =Sum(2	Nov 3513.32 3908.03 211) _{15,1012}	Dec 4663.7 5187.65	kWh/ye 30308.52	(211) (211)
Space (211)m Space = {[(98 (215)m=	Jan e heatin 4642.2 n = {[(98 5163.74 e heatin)m x (20 0	Feb g require 3914.43)m x (20 4354.21 g fuel (s 01)] } x 1 0	Mar ement (c 3687.96 4)] } x 1 4102.29 econdar 00 ÷ (20 0	Apr alculate 2672.2 00 ÷ (20 2972.41 y), kWh/ 8) 0	May d above) 1791.76 06) 1993.06 month	J un 0 0	0 0 0	Aug 0 Tota	O O I (kWh/yea O	Oct 2361.8 2627.14 ar) =Sum(2 0	Nov 3513.32 3908.03 211) _{15,1012} 0	Dec 4663.7 5187.65	kWh/ye 30308.52	ar (211) (211)
Space (211)m Space = {[(98 (215)m=	Jan e heatin 4642.2 n = {[(98 5163.74 e heatin)m x (20 0	Feb g require 3914.43 c)m x (20 4354.21 g fuel (s 01)] } x 1 0	Mar ement (c 3687.96 (4)] } x 1 4102.29 econdar 00 ÷ (20 0	Apr alculate 2672.2 00 ÷ (20 2972.41 y), kWh/ 8) 0	May d above) 1791.76 06) 1993.06 month	Jun 0	0 0	Aug 0 Tota 0 Tota	0 0 I (kWh/yea 0 I (kWh/yea	Oct 2361.8 2627.14 ar) =Sum(2 0 ar) =Sum(2	Nov 3513.32 3908.03 211) _{15,1012} 0 215) _{15,1012}	Dec 4663.7 5187.65	kWh/ye 30308.52	(211) (211) (211)
Space (211)m Space = {[(98 (215)m= Water	Jan e heatin 4642.2 n = {[(98 5163.74 e heatin)m x (20 0 heating	Feb g require 3914.43 b)m x (20 4354.21 g fuel (s 01)] } x 1 0	Mar ement (c 3687.96 4)] } x 1 4102.29 econdar 00 ÷ (20 0	Apr alculate 2672.2 00 ÷ (20 2972.41 y), kWh/ 8) 0	May d above) 1791.76 06) 1993.06 month 0	0 0	0 0	Aug 0 Tota 0 Tota	0 0 I (kWh/yea 0 I (kWh/yea	Oct 2361.8 2627.14 ar) =Sum(2 0 ar) =Sum(2	Nov 3513.32 3908.03 211) _{15,1012} 0 215) _{15,1012}	Dec 4663.7 5187.65	kWh/ye 30308.52 0	(211) (211) (211)
Space (211)m Space = {[(98 (215)m= Water Output	Jan e heatin 4642.2 n = {[(98 5163.74 e heatin)m x (20 0 heating	Feb g require 3914.43 c)m x (20 4354.21 g fuel (s 01)] } x 1 0 ater hea	Mar ement (c 3687.96 (4)] } x 1 4102.29 econdar 00 ÷ (20 0 ter (calc 208.44	Apr alculated 2672.2 00 ÷ (20 2972.41 y), kWh/ 8) 0 ulated al	May d above) 1791.76 06) 1993.06 month 0	Jun 0 0	0 0 0	Aug 0 Tota 0 Tota	0 0 1 (kWh/yea 0 1 (kWh/yea	Oct 2361.8 2627.14 ar) =Sum(2 0 ar) =Sum(2	Nov 3513.32 3908.03 211) _{15,1012} 0 215) _{15,1012}	Dec 4663.7 5187.65 7 0 7 219.58	kWh/ye	(211) (211) (211)
Space (211)m Space = {[(98 (215)m= Water Output	Jan a heatin 4642.2 a = {[(98 5163.74 b heatin)m x (20 0 heating from w 224.91	Feb g require 3914.43 ()m x (20 4354.21 g fuel (s (s) (1)] } x 1 0 ater hea 198.31 reter hea	Mar ement (c 3687.96 (4)] } x 1 4102.29 econdar 00 ÷ (20 0 0 ter (calc 208.44	Apr alculated 2672.2 00 ÷ (20 2972.41 y), kWh/ 8) 0 ulated al 187.08	May d above) 1791.76 06) 1993.06 month 0 0 bove) 183.5	Jun 0 0	0 0 0 157.94	Aug 0 Tota 0 Tota 172.99	Sep 0 0 I (kWh/yea 0 I (kWh/yea 1 (kWh/yea	Oct 2361.8 2627.14 ar) =Sum(2 0 ar) =Sum(2 193.98	Nov 3513.32 3908.03 211) _{15,1012} 0 215) _{15,1012} 204.82	Dec 4663.7 5187.65 7 7 0 7 219.58	kWh/ye	(211) (211) (211) (215)
Space (211)m Space = {[(98 (215)m= Water Output Efficier (217)m=	Jan e heatin 4642.2 n = {[(98 5163.74 e heatin)m x (20 0 heating from w 224.91 ncy of w	Feb g require 3914.43 b)m x (20 4354.21 g fuel (s 01)] } x 1 0 ater hea 198.31 vater hea 89.35	Mar ement (c 3687.96 (4)] } x 1 4102.29 econdar 00 ÷ (20 0 ter (calc 208.44 ter	Apr alculated 2672.2 00 ÷ (20 2972.41 y), kWh/ 8) 0 ulated al 187.08	May d above) 1791.76 06) 1993.06 month 0 5 5 5 5 5 5 88.86	Jun 0 0	Jul 0 0 0 157.94	Aug 0 Tota 0 Tota 172.99	Sep 0 0 1 (kWh/yea 0 1 (kWh/yea 172.58	Oct 2361.8 2627.14 ar) =Sum(2 0 ar) =Sum(2 193.98	Nov 3513.32 3908.03 211) _{15,1012} 0 215) _{15,1012} 204.82	Dec 4663.7 5187.65 = 0 = 219.58	kWh/ye	(211) (211) (215) (216) (217)
Space (211)m Space = {[(98 (215)m= Water Output Efficier (217)m=	Jan a heatin 4642.2 a = {[(98 5163.74 b heatin)m x (20 b heatin 20 beating 224.91 hcy of w 89.38	Feb g require 3914.43 ()m x (20 4354.21 g fuel (s (s) (s) (s) (s) (s) (s) (s) (Mar ament (c 3687.96 (4)] } x 1 4102.29 econdar 00 ÷ (20 0 ter (calc 208.44 ter 89.3 W/b/m	Apr alculated 2672.2 00 ÷ (20 2972.41 y), kWh/ 8) 0 ulated al 187.08 89.16	May d above) 1791.76 06) 1993.06 month 0 183.5 88.86	Jun 0 0	Jul 0 0 0 157.94 79.8	Aug 0 Tota 0 Tota 172.99	Sep 0 0 1 (kWh/yea 0 1 (kWh/yea 172.58 79.8	Oct 2361.8 2627.14 ar) =Sum(2 0 ar) =Sum(2 193.98 89.04	Nov 3513.32 3908.03 211) _{15,1012} 0 215) _{15,1012} 204.82 89.28	Dec 4663.7 5187.65 = 0 219.58 89.39	kWh/ye	(211) (211) (211) (215) (216) (217)
Space (211)m Space = {[(98 (215)m= Water Output Efficier (217)m= Fuel fo (219)m	Jan e heatin 4642.2 n = {[(98 5163.74 e heatin)m x (20 0 heating from w 224.91 ncy of w 89.38 or water n = (64)	Feb g require 3914.43 b)m x (20 4354.21 g fuel (s 0)] } x 1 0 ater hea 198.31 rater hea 89.35 heating, m x 100	Mar ement (c 3687.96 (4)] } x 1 4102.29 econdar 00 ÷ (20 0 ter (calc 208.44 tter 89.3 kWh/mc 0 ÷ (217)	Apr alculated 2672.2 00 ÷ (20 2972.41 y), kWh/ 8) 0 ulated al 187.08 89.16 onth	May d above) 1791.76 06) 1993.06 month 0 bove) 183.5 88.86	Jun 0 0 164.21 79.8	Jul 0 0 0 157.94 79.8	Aug 0 Tota 0 Tota 172.99 79.8	Sep 0 0 1 (kWh/yea 0 1 (kWh/yea 172.58 79.8	Oct 2361.8 2627.14 ar) =Sum(2 0 ar) =Sum(2 193.98 89.04	Nov 3513.32 3908.03 211) _{15,1012} 0 215) _{15,1012} 204.82 89.28	Dec 4663.7 5187.65 = 0 = 219.58 89.39	kWh/ye	(211) (211) (215) (216) (217)
Space (211)m Space = {[(98 (215)m= Water Output Efficier (217)m= Fuel fo (219)m (219)m=	Jan e heatin 4642.2 n = {[(98 5163.74 e heatin)m x (20 0 heating 224.91 ncy of w 89.38 or water n = (64) 251.64	Feb g require 3914.43 ()m x (20 4354.21 g fuel (s (s) (1)] } x 1 0 ater hea 198.31 vater hea 89.35 heating, m x 100 221.94	Mar ement (c 3687.96 (4)] } x 1 4102.29 econdar 00 ÷ (20 0 (208.44 tter 89.3 kWh/mc 0 ÷ (217) 233.42	Apr alculated 2672.2 00 ÷ (20 2972.41 y), kWh/ 8) 0 ulated al 187.08 89.16 onth m 209.82	May d above) 1791.76 06) 1993.06 month 0 183.5 88.86 206.52	Jun 0 0 164.21 79.8 205.78	Jul 0 0 0 157.94 79.8 197.92	Aug 0 Tota 0 Tota 172.99 79.8	Sep 0 0 0 1 (kWh/yea 0 172.58 79.8 216.27	Oct 2361.8 2627.14 ar) =Sum(2 0 ar) =Sum(2 193.98 89.04 217.85	Nov 3513.32 3908.03 211) _{15,1012} 0 215) _{15,1012} 204.82 89.28 229.42	Dec 4663.7 5187.65 = 0 = 219.58 89.39 245.64	kWh/ye	(211) (211) (211) (215) (216) (217)
Space (211)m Space = {[(98 (215)m= Water Output Efficier (217)m= Fuel fo (219)m=	Jan e heatin 4642.2 a = {[(98 5163.74 e heatin)m x (20 0 heating from w 224.91 ncy of w 89.38 or water a = (64) 251.64	Feb g require 3914.43 (m x (20) 4354.21 g fuel (s (s) (1)] } x 1 0 ater hea 198.31 rater hea 89.35 heating, m x 100 221.94	Mar ament (c 3687.96 4)] } x 1 4102.29 econdar 00 ÷ (20 0 ter (calc 208.44 tter 89.3 kWh/ma 0 ÷ (217) 233.42	Apr alculated 2672.2 00 ÷ (20 2972.41 y), kWh/ 8) 0 ulated al 187.08 89.16 onth m 209.82	May d above) 1791.76 06) 1993.06 month 0 bove) 183.5 88.86 206.52	Jun 0 0 164.21 79.8 205.78	Jul 0 0 0 157.94 79.8 197.92	Aug 0 0 Tota 0 Tota 172.99 79.8 216.78 Tota	Sep 0 0 1 (kWh/yea 0 1 (kWh/yea 172.58 79.8 216.27 I = Sum(2*)	Oct 2361.8 2627.14 ar) =Sum(2 0 ar) =Sum(2 193.98 89.04 217.85 19a) ₁₁₂ =	Nov 3513.32 3908.03 211) _{15,1012} 0 215) _{15,1012} 204.82 89.28 229.42	Dec 4663.7 5187.65 7 219.58 89.39 245.64	kWh/ye	(211)] (211)] (215)] (216) (217)] (219)
Space (211)m Space = {[(98 (215)m= Water Output Efficier (217)m= Fuel fo (219)m (219)m= Annua	Jan e heatin 4642.2 n = {[(98 5163.74 e heatin)m x (20 0 heating 224.91 ncy of w 89.38 or water n = (64) 251.64	Feb g require 3914.43 b)m x (20 4354.21 g fuel (s 0 1)] } x 1 0 ater hea 198.31 vater hea 89.35 heating, m x 100 221.94	Mar ement (c 3687.96 (4)] } x 1 4102.29 econdar 00 ÷ (20 0 ter (calc 208.44 ter 89.3 kWh/me 0 ÷ (217) 233.42	Apr alculated 2672.2 00 ÷ (20 2972.41 y), kWh/ 8) 0 ulated al 187.08 89.16 onth m 209.82	May d above) 1791.76 06) 1993.06 month 0 183.5 88.86 206.52	Jun 0 0 164.21 79.8 205.78	Jul 0 0 0 157.94 79.8 197.92	Aug 0 Tota 0 Tota 172.99 79.8 216.78 Tota	Sep 0 0 1 (kWh/yea 0 1 (kWh/yea 172.58 79.8 216.27 I = Sum(2*)	Oct 2361.8 2627.14 ar) =Sum(2 0 ar) =Sum(2 193.98 89.04 217.85 19a) ₁₁₂ = k	Nov 3513.32 3908.03 211) _{15,1012} 0 215) _{15,1012} 204.82 89.28 229.42 Wh/year	Dec 4663.7 5187.65 7 219.58 89.39 245.64	kWh/ye	(211) (211) (215) (216) (217) (219)

Water heating fuel used			Г	2653]
Electricity for pumps, fans and electric keep-hot			-		•
central heating pump:		Γ	30		(230c)
boiler with a fan-assisted flue		Ē	45		(230e)
Total electricity for the above, kWh/year	S	um of (230a)(230g) =	[75	(231)
Electricity for lighting				738.2	(232)
12a. CO2 emissions – Individual heating systems	including micro-C	HP			-
	Energy kWh/year	Emission factor kg CO2/kWh)r	Emissions kg CO2/yea	r
Space heating (main system 1)	(211) x	0.216	= [6546.64	(261)
Space heating (secondary)	(215) x	0.519	= [0	(263)
Water heating	(219) x	0.216	= [573.05	(264)
Space and water heating	(261) + (262) + (263)	+ (264) =	[7119.69	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= [38.93	(267)
Electricity for lighting	(232) x	0.519	- [383.13	(268)
Total CO2, kg/year		sum of (265)(271) =	_ [7541.74	(272 <mark>)</mark>
Dwelling CO2 Emission Rate		(272) ÷ (4) =	[52.8	(273)
El rating (section 14)				48	(274)

				User D	etails:								
Assessor Name: Software Name:	Stroma FS	AP 2012			Strom Softwa	a Num are Ver	ber: sion:		Versio	on: 1.0.4.26			
			Pı	operty /	Address:	9D The	Grove_	Existing	Building]			
Address :													
1. Overall dwelling dime	nsions:			A	(Av. 114	ark (ma)					
Ground floor				Area	a(m²)	(1a) x	Av. неі	46	(2a) =	149.86	(3a)		
First floor					1.02	(1b) x	2	42	(2b) =	108.26](3b)		
Total floor area TFA – (1a	a)+(1b)+(1c)+(1d)+(1e)+	(1n		10.04	(12) 1	2.	.72	(_~)	130.20](0.2)		
	()+(10)+(10)+(10)+(10)+	(111	/ 12	+2.84	(4) (3a)±(3b)	+(3c)+(3d)+(30)+	(3n) -		1		
Dweiling volume						(38)+(30)	+(3C)+(3U)+(36)+	.(01) =	348.11	(5)		
2. Ventilation rate:	main	6000	ndar		other		total			m ³ per bour			
main heatingsecondary heatingothertotal $m^3 p$ Number of chimneys0+0=0 $x 40 =$ Number of open flues0+0=0 $x 20 =$													
Number of chimneys	0	+	0	+	0	=	0	x 4	= 0	0	(6a)		
Number of open flues	0	+	0] + [0] = [0	x 2	20 =	0	(6b)		
Number of intermittent far	าร						4	x 1	0 =	40	(7a)		
Number of passive vents							0	x 1	0 =	0	(7b)		
Number of flueless gas fir	es						0	x 4	40 =	0	(7c)		
									Air ch	anges per hou	ır		
Infiltration due to chimney	rs, flu <mark>es an</mark> d fa	ans = (6a)+(6b)+(7	<mark>a)</mark> +(7b)+(7	7c) =		40		÷ (5) =	0.11	(8)		
If a pressurisation test has be	een ca <mark>rried out</mark> or	is intended, p	roceed	to (17), c	otherwise o	continue fro	om (9) to (16)					
Additional infiltration	le uw <mark>eiling</mark> (na)						[(9)-	11x0.1 =	0	(9)		
Structural infiltration: 0.	25 for steel or	timber fran	ne or	0.35 for	masonr	y constr	uction			0	(11)		
if both types of wall are pro	esent, use the val	lue correspond	ding to	the greate	er wall are	a (after].		
If suspended wooden fl	gs); if equal user oor. enter 0.2	(unsealed)	or 0.	1 (seale	d). else	enter 0				0](12)		
If no draught lobby, ent	er 0.05, else e	enter 0		(-,,					0	(13)		
Percentage of windows	and doors dra	aught stripp	bed							0	(14)		
Window infiltration					0.25 - [0.2	x (14) ÷ 1	= [00			0	(15)		
Infiltration rate					(8) + (10)	+ (11) + (1	2) + (13) +	+ (15) =		0	(16)		
Air permeability value, o	q50, expresse	d in cubic n	netre	s per ho	ur per so	quare m	etre of e	nvelope	area	5	(17)		
If based on air permeabili	ty value, then	(18) = [(17) ÷	20]+(8	s), otherwi	se (18) = (16)	. , .			0.36	(18)		
Air permeability value applies	s if a pressurisation H	on test has bee	en don	e or a deg	ree air pei	rmeability i	s being us	sed		0	1(10)		
Shelter factor	u				(20) = 1 -	[0.075 x (1	9)] =			0.85	(19)		
Infiltration rate incorporati	ng shelter fac	tor			(21) = (18)) x (20) =				0.31	(21)		
Infiltration rate modified for	or monthly win	d speed									-		
Jan Feb	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec				
Monthly average wind spe	eed from Tabl	e 7	_										
(22)m= 5.1 5	4.9 4.4	4.3 3	3.8	3.8	3.7	4	4.3	4.5	4.7				

Wind F	Factor (2	22a)m =	(22)m ÷	4										
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18		
Adjust	ed infiltr	ation rat	e (allowi	ing for sl	nelter an	d wind s	speed) =	(21a) x	(22a)m	-	-	-	-	
	0.4	0.39	0.38	0.34	0.33	0.29	0.29	0.29	0.31	0.33	0.35	0.36		
Calcul	ate effe	<i>ctive air</i>	change	rate for t	the appli	cable ca	se	•	-	-	-			(22.0)
lf exh	aust air h	eat numn	using App	endix N (2	23b) = (23a	a) x Emv (e	equation (I	N5)) othe	rwise (23h	(23a) = (23a)				(238)
lf bal	anced with	n heat reco	overv: effic	iencv in %	allowing f	or in-use f	actor (fron	n Table 4h) =	<i>()</i>				(230)
a) If	halance	n mech	anical ve	ntilation	with he	at recov	erv (MV/	HR) (24:	″ a)m – (2	2h)m + (23h) 🗙 [1 – (23c)	⊥	(230)
(24a)m=				0	0	0]	(24a)
b) If	balance	ed mech	I anical ve	entilation	u without	L heat rec	L Coverv (N	L MV) (24t	(2) m = (2)	1 2b)m + (1 23b)		1	
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If	whole h	iouse ex	tract ver	ntilation of	r positiv	/e input v	ventilatio	on from o	outside	1	1	!	1	
,	if (22b)r	n < 0.5 >	< (23b), t	then (24	c) = (23b); other	wise (24	c) = (22	o) m + 0	.5 × (23b))			
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) If	natural if (22b)r	ventilation = 1, th	on or wh en (24d)	ole hous m = (22	se positiv b)m othe	ve input erwise (2	ventilatio 24d)m =	on from 0.5 + [(2	loft 2b)m² x	0.5]				
(24d) <mark>m=</mark>	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57		(24d)
Effe	ctive air	change	rate - er	nter (24a) or (24	o) or (24	c) or (24	d) in bo	(25)					
(25)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57		(25)
3 He	at losse	s and he	eat loss i	oaramet	er.									
		Gros	ss	Openir	as	Net Ar	ea	U-val	ue	AXU		k-value)	AXk
		area	(m²)	n	ι <u>9</u> - 1 ²	A ,r	m²	W/m2	2K	(W/	K)	kJ/m²-I	K	kJ/K
Doo <mark>rs</mark>	Type 1					2.14	x	1	=	2. <mark>13569</mark>	8			(26)
Doors	Type 2					1.84	x	1	=	1.83594	6			(26)
Doors	Туре 3					3.92	x	1	=	3.91756	67			(26)
Windo	ws Type	e 1				6.01	x1	/[1/(1.4)+	0.04] =	7.97				(27)
Windo	ws Type	e 2				7.15	x1	/[1/(1.4)+	0.04] =	9.48				(27)
Windo	ws Type	e 3				14.66	3 x1	/[1/(1.4)+	0.04] =	19.44				(27)
Floor						60.91	7 X	0.13	=	7.91920	9			(28)
Walls ⁻	Type1	182.	37	35.7	1	146.6	6 X	0.18	=	26.4	T i		ΞĒ	(29)
Walls ⁻	Type2	23.8	37	0		23.87	7 X	0.18		4.3	= i		Ξ F	(29)
Roof		81.9	92	0		81.92	2 X	0.13	=	10.65	= i		Ξ F	(30)
Total a	area of e	elements	s, m²			349.0	8				'			(31)
* for win ** includ	idows and le the area	l roof wind as on both	lows, use e sides of ir	effective wi	indow U-va Ils and par	alue calcul titions	lated using	g formula 1	/[(1/U-valu	ue)+0.04] a	as given in	n paragraph	1 3.2	. ,
Fabric	heat los	ss, W/K	= S (A x	U)				(26)(30) + (32) =				94.	04 (33)
Heat c	apacity	Cm = S	(A x k)	-					((28).	(30) + (32	2) + (32a)	(32e) =	0	(34)

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

Indicative Value: Medium

(35)

250

Therma	al bridge	es : S (L	x Y) cal	culated u	using Ap	pendix I	<						17.45	(36)
if details	of therma	al bridging	are not kn	own (36) =	= 0.05 x (3	:1)			(22)	(26) -				
Ventila	tion her	at loss ca	alculated	monthly	v				(33) + (38)m	= 0.33 × (25)m x (5)		111.49	(37)
	Jan	Feb	Mar	Apr	, May	Jun	Jul	Aug	Sep	Oct	Nov	Dec]	
(38)m=	66.42	66.07	65.73	64.12	63.82	62.43	62.43	62.17	62.96	63.82	64.43	65.07		(38)
Heat tr	ansfer o	coefficier	nt, W/K						(39)m	= (37) + (3	38)m		•	
(39)m=	177.91	177.56	177.22	175.62	175.32	173.92	173.92	173.66	174.46	175.32	175.92	176.56		
Heat lo	oss para	meter (H	ILP), W∕	/m²K					(40)m	Average = = (39)m ÷	Sum(39)₁. · (4)	12 /12=	175.61	(39)
(40)m=	1.25	1.24	1.24	1.23	1.23	1.22	1.22	1.22	1.22	1.23	1.23	1.24		
Numbe	er of day	rs in mor	nth (Tab	le 1a)		•	•	•	,	Average =	Sum(40)1.	12 /12=	1.23	(40)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec]	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)
					-							-	-	
4. Wa	ter heat	ing ener	gy requi	irement:								kWh/y	ear:	
4. Water heating energy requirement: kWh/year: Assumed occupancy, N 2.92 if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9) if TFA £ 13.9, N = 1														
	A £ 13.9	P, N = 1	ater usar	ne in litre	es per da	v Vd av	erage –	(25 x N)	+ 36		10	2.6		(43)
Reduce	the annua	al average	hot water	usage by a	5% if the c	welling is	design <mark>ed</mark> i	to achieve	a water us	se ta <mark>rget o</mark>	r IU	3.0	J	(43)
not more	e that 125	litres per p	person per	r day (all w	rater use, l	hot and co	ld)						,	
Hot wate	Jan	Feb	Mar day for or	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(11)	112 07		105 CR	404 52				07.20	101 52	105.69	100.00	112.07	1	
(44)II <mark>I</mark> =	113.97	109.02	105.00	101.55	97.39	93.24	93.24	97.39	101.55	Total = Su	m(44)1 12 =	113.97	1243.26	(44)
Energy o	content of	hot water	used - cal	culated mo	onthly = 4.	190 x Vd,r	m x nm x D	0Tm / 3600) kWh/mor	nth (see Ta	ables 1b, 1	c, 1d)	1	
(45)m=	169.01	147.81	152.53	132.98	127.6	110.11	102.03	117.08	118.48	138.08	150.72	163.67		
lf instant	aneous w	ater heatir	ng at point	of use (no	hot wate	r storage),	enter 0 in	boxes (46,) to (61)	Total = Su	m(45) ₁₁₂ =	=	1630.11	(45)
(46)m=	25.35	22.17	22.88	19.95	19.14	16.52	15.3	17.56	17.77	20.71	22.61	24.55]	(46)
vvater Storag	storage e volum	ioss: e (litres)	includir	ng any so	olar or W	WHRS	storage	within sa	ame ves	sel		150	1	(47)
If comr	nunity h	eating a	nd no ta	ink in dw	velling, e	enter 110) litres in	(47)					1	()
Otherw	vise if no	stored	hot wate	er (this in	ncludes i	nstantar	neous co	ombi boil	ers) ente	er '0' in (47)			
Water	storage	loss: uror's de	olarad l	occ fact	or ie kno	wp (k\//k	v/dov/):						1	(40)
Tempe	rature f	actor fro	m Tahla	2h			i/uay).				1.	54]	(40)
Energy	lost fro	m water	storage	 . kWh/ve	ear			(48) x (49)) =		0.	75]	(49)
b) If m	anufact	urer's de	eclared of	ylinder l	oss fact	or is not	known:	()			0.	75]	(00)
Hot wa	ter stor	age loss	factor fr	om Tabl	e 2 (kW	h/litre/da	ay)					0		(51)
	полих П		~~ ~~ ~+ ·	n 1 2									-	
volum	e factor	from Tal	ee secti ble 2a	on 4.3								0]	(52)

Energy Enter	y lost fro (50) or	om water (54) in (5	• storage 55)	e, kWh/ye	ear			(47) x (51)) x (52) x (53) =	0.	0		(54) (55)
Water	storage	loss cal	culated	for each	month			((56)m = (55) × (41)ı	m	L			
(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(56)
If cylinde	er contain	s dedicate	d solar sto	rage, (57)	m = (56)m	x [(50) – (H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Append	ix H	
(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(57)
Primar	y circuit	loss (ar	nual) fro	om Table	e 3	-						0		(58)
Primar	y circuit	loss cal	culated	for each	month (59)m = ((58) ÷ 36	65 × (41)	m					
(mo	dified by	factor f	rom Tab	le H5 if t	here is s	solar wat	ter heatir	ng and a	cylinde	r thermo	stat)			
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
Combi	loss ca	lculated	for each	month	(61)m =	(60) ÷ 30	65 × (41))m						
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)
Total h	neat req	uired for	water h	eating ca	alculated	l for eac	h month	(62)m =	0.85 × ((45)m +	(46)m +	(57)m +	(59)m + (61)r	n
(62)m=	215.6	189.9	199.13	178.07	174.19	155.2	148.63	163.68	163.57	184.67	195.81	210.27		(62)
Solar Dł	-IW input	calculated	using App	endix G o	Appendix	H (negati	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)		
(add a	dditiona	l lines if	FGHRS	and/or \	NWHRS	applies	, see Ap	pendix (G)					
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output	t from w	ater hea	ter	-					-					
(64)m=	215.6	189.9	199.13	178.07	174.19	155.2	148.63	163.68	163.57	184.67	195.81	210.27		
								Outp	out from wa	ater heate	r <mark>(annual)</mark> ₁	12	2178.72	(64)
Hea <mark>t g</mark>	ains fro	m water	heating.	, kWh/m	onth 0.2	5 ′ [0.85	× (45)m	ı + (61)m	n] + 0.8 x	(<mark>46)m</mark> (+ (57)m	+ (<mark>59</mark>)m]	
(65)m=	93.47	82.82	<mark>87</mark> .99	80.29	79.7	72.68	71.2	76.21	75.47	83.19	86.19	91.7		(65)
inclu	<mark>ide</mark> (57)	m in calo	culation	of (65)m	only if c	ylinder i	s in the o	dwelling	or hot w	ate <mark>r is f</mark> r	om com	munity h	eating	
5. Int	ternal ga	ains (see	e Table 5	5 and 5a):									
Metab	<u>olic gair</u>	s (Table	e 5), Wat	ts										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m=	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12		(66)
Lightin	g gains	(calcula	ted in Ap	opendix	L, equat	ion L9 o	r L9a), a	lso see	Table 5		-			
(67)m=	28.15	25	20.33	15.39	11.51	9.71	10.5	13.64	18.31	23.25	27.14	28.93		(67)
Applia	nces ga	ins (calc	ulated ir	n Append	dix L, eq	uation L	13 or L1	3a), also	see Ta	ble 5	-	-		
(68)m=	312.62	315.86	307.69	290.29	268.32	247.67	233.88	230.63	238.81	256.21	278.18	298.83		(68)
Cookir	ng gains	(calcula	ted in A	ppendix	L, equat	ion L15	or L15a)), also se	e Table	5		-		
(69)m=	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61		(69)
Pumps	and fa	ns gains	(Table \$	5a)										
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3		(70)
Losses	s e.g. ev	vaporatic	on (nega	tive valu	es) (Tab	le 5)								
(71)m=	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89		(71)
Water	heating	gains (T	able 5)											
(72)m=	125.63	123.24	118.27	111.51	107.13	100.95	95.7	102.43	104.82	111.81	119.71	123.25		(72)
Total i	nternal	gains =				(66))m + (67)m	n + (68)m -	+ (69)m + ((70)m + (7	1)m + (72)	m		
(73)m=	536.24	533.94	516.13	487.03	456.79	428.17	409.91	416.54	431.77	461.11	494.86	520.84		(73)
6. So	lar gains	S:												

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

Orienta	ition:	Access Factor Table 6d	r	Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.01	×	19.64	×	0.63	×	0.7] =	36.07	(76)
East	0.9×	0.77	x	6.01	x	38.42	x	0.63	x	0.7] =	70.57	(76)
East	0.9×	0.77	x	6.01	x	63.27	x	0.63	x	0.7] =	116.22	(76)
East	0.9x	0.77	x	6.01	×	92.28	×	0.63	×	0.7] =	169.49	(76)
East	0.9x	0.77	x	6.01	×	113.09	×	0.63	×	0.7] =	207.72	(76)
East	0.9x	0.77	x	6.01	x	115.77	x	0.63	x	0.7] =	212.64	(76)
East	0.9x	0.77	x	6.01	×	110.22	×	0.63	×	0.7] =	202.44	(76)
East	0.9x	0.77	x	6.01	x	94.68	x	0.63	x	0.7] =	173.89	(76)
East	0.9x	0.77	x	6.01	x	73.59	×	0.63	×	0.7	1 =	135.16	(76)
East	0.9x	0.77	x	6.01	x	45.59	×	0.63	x	0.7	1 =	83.74	(76)
East	0.9x	0.77	x	6.01	x	24.49	x	0.63	x	0.7] =	44.98	(76)
East	0.9x	0.77	x	6.01	x	16.15	x	0.63	×	0.7	1 =	29.67	(76)
South	0.9x	0.77	x	7.15	x	46.75	×	0.63	x	0.7] =	102.16	(78)
South	0.9x	0.77	x	7.15	x	76.57	x	0.63	x	0.7] =	167.31	(78)
South	0.9x	0.77	x	7.15	x	97.53	x	0.63	x	0.7	1 =	213.12	(78)
South	0.9x	0.77	x	7.15	×	110.23	x	0.63	х	0.7	1	240.88	(78)
Sout <mark>h</mark>	0.9x	0.77	x	7.15	x	114.87	x	0.63	x	0.7	i -	251.01	- (78)
Sout <mark>h</mark>	0.9x	0.77	x	7.15	x	110.55	×	0.63	x	0.7] =	2 <mark>41.56</mark>	(78)
Sout <mark>h</mark>	0.9x	0.77	x	7.15	x	108.01	x	0.63	x	0.7] =	236.02	(78)
South	0.9x	0.77	x	7.15	x	104.89	x	0.63	x	0.7] =	229.21	(78)
South	0.9x	0.77	x	7.15	x	101.89	×	0.63	x	0.7] =	222.63	(78)
Sout <mark>h</mark>	0.9×	0.77	x	7.15	x	82.59	x	0.63	x	0.7] =	180.46	(78)
South	0.9×	0.77	x	7.15	×	55.42	×	0.63	×	0.7] =	121.09	(78)
South	0.9x	0.77	x	7.15	×	40.4	×	0.63	×	0.7] =	88.28	(78)
West	0.9×	0.77	x	14.66	x	19.64	x	0.63	x	0.7] =	87.99	(80)
West	0.9×	0.77	x	14.66	x	38.42	x	0.63	x	0.7] =	172.13	(80)
West	0.9x	0.77	x	14.66	×	63.27	×	0.63	×	0.7] =	283.48	(80)
West	0.9×	0.77	x	14.66	x	92.28	x	0.63	x	0.7] =	413.44	(80)
West	0.9x	0.77	x	14.66	×	113.09	×	0.63	×	0.7] =	506.69	(80)
West	0.9x	0.77	x	14.66	×	115.77	×	0.63	×	0.7] =	518.69	(80)
West	0.9x	0.77	x	14.66	x	110.22	x	0.63	x	0.7] =	493.81	(80)
West	0.9x	0.77	x	14.66	×	94.68	×	0.63	×	0.7] =	424.17	(80)
West	0.9x	0.77	x	14.66	×	73.59	x	0.63	x	0.7	=	329.7	(80)
West	0.9x	0.77	x	14.66	x	45.59	x	0.63	x	0.7] =	204.25	(80)
West	0.9x	0.77	x	14.66	×	24.49	×	0.63	×	0.7] =	109.72	(80)
West	0.9x	0.77	x	14.66	x	16.15	x	0.63	x	0.7] =	72.36	(80)

Solar g	ains in	watts, ca	alculated	for eac	h month			(83)m = S	um(74)m.	(82)m			
(83)m=	226.23	410.01	612.82	823.81	965.42	972.89	932.27	827.28	687.5	468.45	275.79	190.3	(83)
Total g	ains – ir	nternal a	ind solar	⁻ (84)m =	= (73)m -	+ (83)m	, watts						-
(84)m=	762.47	943.96	1128.95	1310.84	1422.2	1401.06	1342.18	1243.82	1119.27	929.56	770.65	711.15	(84)

7. Me	an inter	nal temp	perature	(heating	season)								
Temp	erature	during h	neating p	eriods ir	n the livir	ng area f	from Tab	ole 9, Th	1 (°C)				21	(85)
Utilisa	ation fac	tor for g	ains for	living are	ea, h1,m	(see Ta	ble 9a)					I		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(86)m=	1	1	0.99	0.96	0.88	0.72	0.55	0.61	0.86	0.98	1	1		(86)
Mean	internal	l tompor	ature in	living ar	22 T1 /fc	llow sto	ns 3 to 7	r in Tabl	- 9c)					
(87)m=	19.57	19.76	20.06	20.44	20.75	20.93	20.99	20.98	20.84	20.41	19.91	19.54		(87)
-							· -			-				
I emp	erature	during h	leating p	eriods ir	n rest of	dwelling	trom 1a	able 9, 11	n2 (°C)	10.0	40.00	40.00		(00)
(88)m=	19.88	19.89	19.89	19.9	19.9	19.91	19.91	19.91	19.9	19.9	19.89	19.89		(00)
Utilisa	tion fac	tor for g	ains for	rest of d	welling,	n2,m (se	e Table	9a)						
(89)m=	1	1	0.98	0.94	0.83	0.63	0.42	0.48	0.78	0.97	1	1		(89)
Mean	internal	l temper	ature in	the rest	of dwelli	ng T2 (fe	ollow ste	eps 3 to 7	7 in Tabl	e 9c)				
(90)m=	17.98	18.26	18.69	19.24	19.66	19.86	19.9	19.9	19.77	19.21	18.49	17.94		(90)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 17.98 18.69 19.24 19.66 19.9 19.9 19.77 19.21 18.49 17.94 $fLA = Living area ÷ (4) = 0.33 Mean internal temperature (for the whole dwelling) = fLA \times T1 + (1 - fLA) \times T2 (92)m= 18.5 18.75 19.14 19.63 20.01 20.26 20.25 20.12 19.6 18.95 18.46 $														(91)
Mean	internal	l temper	ature (fo	r the wh	ole dwel	ling) = fl	A 🗙 T1	+ (1 – fl	A) x T2			•		
(92)m=	18.5	18.75	19.14	19.63	20.01	20.21	20.26	20.25	20.12	19.6	18.95	18.46		(92)
	adiustr	nent to t	he mear	internal	temper	ature fro	m Table	4e, whe	ere appro	opriate				
(93)m=	18.5	18.75	19.14	19.63	20.01	20.21	20.26	20.25	20.12	19.6	18.95	18.46		(93)
8. Spa	ace hea	ting requ	uirement											
Set Ti	to the r	mean int	ernal ter	nperatur	e obtain	ed at ste	ep 11 of	Table 9	o, so tha	t Ti,m=(76)m an	d re-calc	ulate	
the ut	<mark>ilis</mark> ation	factor fo	or g <mark>ains</mark>	using Ta	ble 9a						,			
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisa	ation fac	tor for g	ains, hm	1:										
(94)m=	1	0.99	0.98	0.94	0.84	0.65	0.47	0.52	0.8	0.97	0.99	1		(94)
Usefu	l gains,	hmGm	, W = (94	4)m x (84	4)m									
(95)m=	760.59	937.61	1106.62	1230.1	1190.04	916.54	626.32	652.55	895.59	897.45	766.38	709.88		(95)
Month	nly avera	age exte	ernal tem	perature	e from Ta	able 8								
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat	oss rate	e for mea	an intern	al tempe	erature,	_m , W =	=[(39)m : L	x [(93)m· L	– (96)m	4.577.00	0005.00	0540.00		(07)
(97)m=	2526.44	2458.77	2239.99	1884.27	1457.62	976.02	635.68	668.62	1050.69	1577.66	2085.32	2518.02		(97)
Space	e neating	g require		r each m		/vn/moni	$\ln = 0.02$	24 X [(97))m – (95)mj x (4	1)m	1245.25		
(90)11=	1313.79	1022.22	043.22	471	199.00	0	0	U Tota	0	300.00	949.03	1343.23	0050.07	
								Tota	i per year	(kvvn/year	') = Sum(9	8)15,912 =	6650.27	(96)
Space	e heating	g require	ement in	kWh/m ²	/year								46.56	(99)
9a. En	ergy req	luiremer	nts – Indi	ividual h	eating sy	/stems i	ncluding	micro-C	HP)					
Space	e heatir	ng:												
Fracti	on of sp	ace hea	at from s	econdar	y/supple	mentary	system						0	(201)
Fracti	on of sp	ace hea	at from m	nain syst	em(s)			(202) = 1 -	- (201) =				1	(202)
Fracti	on of to	tal heati	ng from	main sys	stem 1			(204) = (20	02) × [1 –	(203)] =			1	(204)
Efficie	ency of r	main spa	ace heat	ing syste	em 1								93.5	(206)
Efficie	ency of s	seconda	ry/suppl	ementar	y heating	g system	n, %						0	(208)
			, n.,				-					l	-	` ´

												_	l	
Snoo	Jan	Feb	Mar Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ır
Space	1313 79	g require			199.08	0	0	0	0	506.08	949 63	1345 25		
(211)m		$m \times (20)$			100.00	•	•	•	•	000.00	0 10.00	1010.20		(211)
(211)11	1405.12	1093.28	901.84	503.75	212.92	0	0	0	0	541.26	1015.65	1438.78		(211)
								Tota	l (kWh/yea	L ar) =Sum(2	L 211) _{15,1012}	=	7112.59	(211)
Space	e heatin	g fuel (s	econdar	y), kWh/	month									J
= {[(98)m x (20)1)]}x1	00 ÷ (20	8)						-				
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		-
								Tota	l (kWh/yea	ar) =Sum(2	215) _{15,1012}	-	0	(215)
Water	heating	J												
Output	from wa	ater hea	ter (calc	ulated a	bove) 174 19	155.2	148 63	163 68	163 57	184 67	195 81	210 27		
Efficie	ncv of w	ater hea	iter	110.01		100.2	110.00	100.00	100.01	101.07	100.01	210.21	79.8	(216)
(217)m=	88.82	88.64	88.24	87.29	85.17	79.8	79.8	79.8	79.8	87.37	88.47	88.89		」、 (217)
Fuel fo	r water	heating,	kWh/mo	onth										
(219)m	n = (64)	<u>m x 100</u>) ÷ (217)	m						i	i		l	
(219)m=	242.74	214.24	225.67	204	204.52	194.49	186.25	205.11	204.98	211.37	221.33	236.55		7
A 10 10 10 10								Tota	1 = Sum(2	19a) ₁₁₂ =	Alleluce		2551.25	(219)
Space	heating	fuel use	ed. main	svstem	1					K	wn/year		7112.59	1
Water	heating	fueluse	d	- J - · · -									2551.25] T
The	ineating	Tuer use	iu .	a ha a taƙa t									2551.25]
Electri	city for p	oumps, ta	ans and	electric	keep-no	[
centra	al heatin	ig pump										30		(230c)
boi <mark>ler</mark>	with a f	an-assis	sted flue									45		(230e)
Total e	electricity	/ for the	above, l	kWh/yea	r			sum	of (230a).	(230g) =			75	(231)
Electri	city for li	ghting											497.15	(232)
12a. (CO2 em	issions -	– Individ	ual heati	ing syste	ems inclu	uding mi	cro-CHF)					-
						_	Ŭ				. ,		_ · ·	
						En kW	ergy /h/year			kg CO	2/kWh	tor	kg CO2/yea	r
Space	heating	(main s	ystem 1)		(211	l) x			0.2	16	=	1536.32	(261)
Space	heating	(second	dary)			(218	5) x			0.5	19	=	0	(263)
Water	heating					(219	9) x			0.2	16	=	551.07	(264)
Space	and wa	ter heati	ng			(261	I) + (262) ·	+ (263) + (264) =				2087.39	(265)
Electri	city for p	oumps, fa	ans and	electric	keep-ho	t (231	I) x			0.5	19	=	38.93] (267)
Electri	city for li	ghting			-	(232	2) x			0.5	19	=	258.02	(268)
Total C	CO2, kg/	'year							sum o	f (265)(2	271) =		2384.33	(272)
														-

TER =

16.69

(273)

				User D	etails:						
Assessor Name: Software Name:	Stroma F	SAP 201	2 P	ropertv	Strom Softwa	a Num are Ver 9D The	ber: sion: Grove	Retrofit	Versio	on: 1.0.4.26	
Address :											
1. Overall dwelling dime	ensions:										
				Area	a(m²)		Av. Hei	ight(m)	_	Volume(m ³)	_
Ground floor				6	60.92	(1a) x	2.	.46	(2a) =	149.86	(3a)
First floor				8	31.92	(1b) x	2.	.42	(2b) =	198.26	(3b)
Total floor area TFA = (1	a)+(1b)+(1c)+	-(1d)+(1e	e)+(1r	ı) <u> </u>	42.84	(4)			-		-
Dwelling volume						(3a)+(3b))+(3c)+(3d	l)+(3e)+	.(3n) =	348.11](5)
2 Ventilation rate:], ,
	main	S	econdar	у	other		total			m ³ per hour	
Number of chimneys	heating	⊢ h □+□		┐ + ┌	0] = [0	x 4	40 =	0	(6a)
Number of open flues		╡╻┝	0	」 L ヿ + ୮		」	0	x2	20 =	0	
Number of intermittent fo			0		0	JĽ	0		10 -	0	
	115					Ļ	1		10 -	10	(7a)
Number of passive vents	6						2	X	10 =	20	(7b)
Number of flueless gas f	ires					L	0	x 2	⁴⁰ = Air ch	0 nanges per hou](7c) Ir
Infiltration due to chimne	ys, flues and	fans = (6	a)+(6b)+(7	<mark>a)+</mark> (7b)+(7c) =		30	· ·	÷ (5) =	0.09	(8)
If a pressurisation test has b	been carried out o	or is intende	ed, procee	d to (17), d	otherwise o	continue fr	om (9) to ((16)			
Additional infiltration	ne dw <mark>eining</mark> (i	15)						[(9)-	-11x0.1 =	0	(9)
Structural infiltration: 0	.25 for steel of	or timber t	frame or	0.35 for	r masoni	v constr	uction	[(0)	110.1 -	0	(11)
if both types of wall are p	present, use the v	alue corres	ponding to	the great	er wall are	a (after				-], ,
deducting areas of openi	ngs); if equal use floor_enter 0	er 0.35 2 (unseal	ed) or 0	1 (seale	ad) alsa	enter ()				0	1(12)
If no draught lobby en	iter 0.05 else	enter 0		i (Seale	<i>u)</i> , eise	enter o				0	(12)
Percentage of window	s and doors c	raught st	ripped							0	(14)
Window infiltration		0			0.25 - [0.2	x (14) ÷ 1	00] =			0	(15)
Infiltration rate					(8) + (10)	+ (11) + (1	2) + (13) +	+ (15) =		0	(16)
Air permeability value,	q50, express	ed in cub	oic metre	s per ho	our per s	quare m	etre of e	nvelope	area	5	(17)
If based on air permeabi	lity value, the	ן (18) = [(1	7) ÷ 20]+(8	3), otherwi	ise (18) = ((16)				0.34	(18)
Air permeability value applie	es if a pressurisa	tion test has	s been don	e or a deg	gree air pe	rmeability	is being us	sed			
Shelter factor	eu				(20) = 1 -	[0.075 x (1	9)] =			2	(19)
Infiltration rate incorporation	ting shelter fa	ctor			(21) = (18) x (20) =				0.00](21)
Infiltration rate modified f	for monthly wi	nd speed	ł							0.20	J, ,
Jan Feb	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	beed from Tab	ole 7	-		-		-	-			
(22)m= 5.1 5	4.9 4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7		

Wind F	Factor (2	22a)m =	(22)m ÷	4										
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18		
Adjust	ed infiltr	ation rat	e (allowi	ing for sl	nelter an	d wind s	speed) =	(21a) x	(22a)m					
	0.36	0.36	0.35	0.31	0.31	0.27	0.27	0.26	0.29	0.31	0.32	0.34		
Calcul	ate effe	ctive air	change	rate for a	he appli	cable ca	ise					 Г		(00-)
ll III If exh	aust air h		using Ann	endix N (2	23h) - (23a	a) x Emv (e	equation (N5)) othe	rwise (23h	n) – (23a)				(238)
lf bal	anced with	n heat reco	overv: effic	ciency in %	allowing f	or in-use f	actor (fron	n Table 4h) =) = (20u)				(230)
a) If	balance	d mech	anical ve	entilation	with he	at recov	erv (MV	HR) (24a	′′ a)m = (2'	2h)m + (23h) x [L 1 – (23c) -	 1001	(230)
(24a)m=	0	0		0	0	0			0	0	0		. 100]	(24a)
b) If	balance	d mech	ı anical ve	entilation	without	heat red	ı covery (l	u MV) (24t	m = (2)	1 2b)m + (23b)			
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If	whole h	ouse ex	tract ver	ntilation (r positiv	/e input v	ventilatio	on from o	utside		<u>.</u>	<u>. </u>		
	if (22b)n	n < 0.5 >	< (23b), t	then (24	c) = (23k	o); other	wise (24	c) = (22t	o) m + 0	.5 × (23t	o)			
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) If	natural if (22b)n	ventilation = 1, th	on or wh en (24d)	ole hous m = (22	se positiv b)m othe	ve input erwise (2	ventilatie 24d)m =	on from l 0.5 + [(2	loft 2b)m² x	0.5]				
(24d) <mark>m=</mark>	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	0.55	0.56		(24d)
Effe	ctive air	change	rate - er	nter (24a) or (24	o) or (24	c) or (24	d) in bo	(25)			<u> </u>		
(25)m=	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	0.55	0.56		(25)
3 He	at losse	s and he	at loss	naramet	er.									
		Gros	ss	Openir	as	Net Ar	ea	U-val	ue	AXU		k-value		AXk
		area	(m²)	'n	1 ²	A ,r	m²	W/m2	2K	(VV/	K)	kJ/m²∙K		kJ/K
Doo <mark>rs</mark>	Type 1					2.14	x	1	=	2. <mark>1356</mark> 9	8			(26)
Doors	Type 2					1.84	x	1	=	1.83594	6			(26)
Doors	Туре 3					3.92	x	1	=	3.91756	57			(26)
Windo	ws Type	e 1				6.936	1 x1	/[1/(1.4)+	0.04] =	9.2				(27)
Windo	ws Type	2				8.2483	23 <mark>x</mark> 1	/[1/(1.4)+	0.04] =	10.94				(27)
Windo	ws Type	93				16.921	03 <mark>x</mark> 1	/[1/(1.4)+	0.04] =	22.43				(27)
Floor						60.91	7 X	0.2	=	12.183	4			(28)
Walls	Type1	182.	37	39.9	9	142.3	7 X	0.55	=	78.31			<u> </u>	(29)
Walls	Type2	23.8	37	0		23.87	7 X	0.4	=	9.56			ĪĒ	(29)
Roof		81.9	92	0		81.92	<u>2</u> X	0.32	=	26.22	i F		ī 🗖	(30)
Total a	area of e	lements	s, m²			349.0	8							(31)
* for win	dows and	roof wind	ows, use e	effective w	indow U-va	alue calcul	lated using	g formula 1	/[(1/U-valu	ue)+0.04] a	as given in	paragraph	3.2	
Fabric	ne the area	as on both	sides of ii $-S(\Delta v)$	nternal wai	is and par	titions		(26)(30)) + (32) =			Г	470 7	(22)
Heat	apacity	Cm = Si	– C (A x (A x k)	0)				((00)	((28)	(30) + (3	2) + (32a)	(32e) = 「	0	(34)
		••	(,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,						· · · · ·	() (-	/ (/	N /	0	

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

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

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

(35)

250

Therm	al bridg	es : S (L	x Y) cal	culated u	using Ap	pendix I	<						52.36	(36)
if details	of therma	al bridging	are not kn	own (36) =	= 0.05 x (3	1)			(22)	(20)			r	
Vontile	abric ne	at loss		1 monthly					(33) +	(30) =	(25)m x (5)		229.08	(37)
Ventile		Feb	Mar		y Mav	lun	lul	Δυσ	Sen			Dec	1	
(38)m=	65.06	64.77	64.48	63.11	62.86	61.67	61.67	61.45	62.13	62.86	63.37	63.91		(38)
Heat ti	ransfer (roefficier	nt W/K						(39)m	= (37) + (38)m]	
(39)m=	294.14	293.84	293.55	292.19	291.94	290.75	290.75	290.53	291.21	291.94	292.45	292.99	1	
									<u>ا</u>	Average =	Sum(39)1	12 /12=	292.19	(39)
Heat lo	oss para	meter (H	HLP), W/	/m²K			· · · · · ·		(40)m	= (39)m ÷	- (4)		1	
(40)m=	2.06	2.06	2.06	2.05	2.04	2.04	2.04	2.03	2.04	2.04	2.05	2.05		
Numbe	er of day	/s in moi	nth (Tab	le 1a)					,	Average =	sum(40)₁	12 /12=	2.05	(40)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec]	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)
4. Wa	4. Water heating energy requirement: kWh/ye													
4. Water heating energy requirement: kWh/ye Assumed occupancy, N 2.92														(42)
Assumed occupancy, N if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)														(12)
if TF	A £ 13.	9, N = 1	tor uso	no in litro	no nor de	w V/d ov	orago	(25 x NI)	1.26				1	(42)
Reduce	the annua	al average	hot water	usage by	5% if the a	lwelling is	design <mark>ed</mark>	(25 X N) to achieve	a water us	se target o	10	3.6	J	(43)
not mor	e that 125	litres pe <mark>r</mark> l	person pel	r day (all w	rater use, l	hot and co	ld)			_			_	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot wat	er usage i	n litres per	day for ea	ach month	Vd,m = fa	ctor from T	able 1c x	(43)				r	,	
(44)m=	113.97	109.82	105.68	101.53	97.39	93.24	93. <mark>2</mark> 4	97.39	101.53	10 <u>5.68</u>	109.82	113.97		
Energy	content of	hot water	used - cal	culated mo	onthly $= 4$.	190 x Vd,r	n x nm x D	0Tm / 3600) kWh/mor	total = Su hth (see Ta	m(44) ₁₁₂ = ables 1b, 1	= c, 1d)	1243.26	(44)
(45)m=	169.01	147.81	152.53	132.98	127.6	110.11	102.03	117.08	118.48	138.08	150.72	163.67]	
										Total = Su	m(45) ₁₁₂ =	=	1630.11	(45)
lf instan	taneous w	ater heatıı	ng at point	of use (no	hot water	r storage), I	enter 0 in	boxes (46)) to (61)	· · · · · ·	i	·	7	
(46)m= Water	25.35 storage	22.17	22.88	19.95	19.14	16.52	15.3	17.56	17.77	20.71	22.61	24.55		(46)
Storag	e volum	e (litres)	includir	ng any so	olar or W	/WHRS	storage	within sa	ame ves	sel		150	1	(47)
If com	munity h	eating a	nd no ta	ınk in dw	velling, e	nter 110	litres in	(47)					1	
Otherv	vise if no	o stored	hot wate	er (this in	ncludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in ((47)			
Water	storage	loss:			'- I		· (-) ·						1	(12)
a) If m		urer's de	eciared i	OSS TACK	or is kno	wn (kvvr	n/day):				1.	95]	(48)
Tempe	erature f	actor fro	m Table	ZD				$(40) \times (40)$			0.	54]	(49)
b) If m	anufact	urer's de	eclared of	e, kvvn/ye cvlinder l	ear loss fact	or is not	known:	(48) X (49)) =		1.	05		(50)
Hot wa	ater stor	age loss	factor fr	om Tabl	e 2 (kW	h/litre/da	ıy)					0]	(51)
If com	munity h	eating s	ee secti	on 4.3									-	
Volum	e factor	trom Tal	ble 2a	2h								0	4	(52)
rempe	erature f	acior Iro		20								U	J	(53)

Energy Enter	y lost fro (50) or	om water (54) in (5	storage 55)	, kWh/ye	ear			(47) x (51)) x (52) x (53) =	1.	0		(54) (55)
Water	storage	loss cal	culated	for each	month			((56)m = (55) × (41)	m				
(56)m=	32.64	29.48	32.64	31.59	32.64	31.59	32.64	32.64	31.59	32.64	31.59	32.64		(56)
If cylinde	er contain	s dedicate	d solar sto	rage, (57)	m = (56)m	x [(50) – (H11)] ÷ (50	0), else (5	7)m = (56)	m where (H11) is fro	m Append	l lix H	
(57)m=	32.64	29.48	32.64	31.59	32.64	31.59	32.64	32.64	31.59	32.64	31.59	32.64		(57)
Primar	v circuit	loss (ar	nual) fro	om Table	e 3							0		(58)
Primar	y circuit	loss cal	culated	for each	month (59)m = ((58) ÷ 36	65 × (41)	m					
(mo	dified by	factor f	rom Tab	le H5 if t	here is s	solar wat	ter heatir	ng and a	cylinde	r thermo	stat)			
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
Combi	loss ca	lculated	for each	month	(61)m =	(60) ÷ 30	65 × (41))m	-		-	-		
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)
Total h	neat req	uired for	water h	eating ca	alculated	for eac	h month	(62)m =	0.85 × ((45)m +	(46)m +	(57)m +	(59)m + (61)	m
(62)m=	224.91	198.31	208.44	187.08	183.5	164.21	157.94	172.99	172.58	193.98	204.82	219.58		(62)
Solar DI	HW input	calculated	using App	endix G o	r Appendix	: H (negati	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)		
(add a	dditiona	l lines if	FGHRS	and/or \	NWHRS	applies	, see Ap	pendix (G)			r	I	
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output	t from w	ater hea	ter										I	
(64)m=	224.91	198.31	208.44	187.08	183.5	164.21	157.94	172.99	172.58	193.98	204.82	219.58		
								Outp	out from wa	ater heate	r (annual)₁	12	2288.35	(64)
Heat g	ains fro	m water	heating.	, kWh/m	onth 0.2	5 ´ [0.85	× (45)m	+ (61)m	1] + 0.8 >	(46)m	+ (57)m	+ (59)m]	
(65)m=	100.92	89.54	95.44	87.5	87.15	79.89	78.65	83.65	82.68	90.64	93.4	99.15		(65)
inclu	ude (57)	m in calo	culation	of (65)m	only if c	ylinder i	s in the c	dwelling	or hot w	ater is fr	om com	munity h	eating	
5. Int	ternal ga	ains (see	e Table 5	5 and 5a):									
Metab	olic gair	is (Table	5), Wat	ts	-			i			-	i		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m=	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12		(66)
Lightin	ig gains	(calcula	ted in Ap	opendix I	L, equat	ion L9 o I	r L9a), a	lso see	Table 5		1	i	I	
(67)m=	27.87	24.75	20.13	15.24	11.39	9.62	10.39	13.51	18.13	23.02	26.87	28.64		(67)
Applia	nces ga	ins (calc	ulated ir	n Append	dix L, eq	uation L	13 or L1	3a), also	see Ta	ble 5	1		I	
(68)m=	312.62	315.86	307.69	290.29	268.32	247.67	233.88	230.63	238.81	256.21	278.18	298.83		(68)
Cookir	ng gains	(calcula	ited in A	ppendix I	L, equat	tion L15	or L15a)), also se	e Table	5			I	
(69)m=	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61		(69)
Pumps	s and fa	ns gains I	(Table \$	5a)				i				i	1	<i>(</i>)
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3		(70)
Losses	s e.g. e\	aporatic	n (nega	tive valu	es) (Tab	ole 5)		·	i		i	·	I	
(71)m=	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89		(71)
Water	heating	gains (T	able 5)	r	r	r							I	
(72)m=	135.64	133.25	128.28	121.52	117.14	110.96	105.71	112.44	114.83	121.82	129.72	133.26		(72)
Total i	internal	gains =				(66)	m + (67)m	n + (68)m -	+ (69)m + ((70)m + (7	1)m + (72)	m	I	
(73)m=	545.97	543.7	525.93	496.88	466.68	438.08	419.81	426.41	441.6	470.89	504.6	530.56		(73)
6. So	lar gains	S:												

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

Orienta	tion:	Access Facto Table 6d	r	Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.94	×	19.64) ×	0.63	x	0.7] =	41.63	(76)
East	0.9x	0.77	x	6.94	×	38.42	x	0.63	x	0.7] =	81.44	(76)
East	0.9x	0.77	x	6.94	×	63.27	x	0.63	x	0.7] =	134.12	(76)
East	0.9x	0.77	x	6.94	×	92.28	x	0.63	x	0.7] =	195.61	(76)
East	0.9x	0.77	x	6.94	×	113.09	x	0.63	x	0.7] =	239.73	(76)
East	0.9x	0.77	x	6.94	×	115.77	x	0.63	x	0.7] =	245.41	(76)
East	0.9x	0.77	x	6.94	×	110.22	x	0.63	x	0.7] =	233.64	(76)
East	0.9x	0.77	x	6.94	×	94.68	x	0.63	x	0.7] =	200.69	(76)
East	0.9x	0.77	x	6.94	×	73.59	x	0.63	x	0.7] =	155.99	(76)
East	0.9x	0.77	x	6.94	×	45.59	x	0.63	x	0.7	j =	96.64	(76)
East	0.9x	0.77	x	6.94	x	24.49	x	0.63	x	0.7	=	51.91	(76)
East	0.9x	0.77	x	6.94	×	16.15	x	0.63	x	0.7	j =	34.24	(76)
South	0.9x	0.77	x	8.25	x	46.75	x	0.63	x	0.7	i =	117.85	(78)
South	0.9x	0.77	x	8.25	x	76.57	x	0.63	x	0.7	i =	193.01	(78)
South	0.9x	0.77	x	8.25	x	97.53	x	0.63	x	0.7	j =	245.86	– (78)
South	0.9x	0.77	x	8.25	×	110.23	x	0.63	Х	0.7	1	277.88	(78)
Sout <mark>h</mark>	0.9x	0.77	x	8.25	x	114.87	x	0.63	x	0.7	i -	289.57	– (78)
Sout <mark>h</mark>	0.9x	0.77	x	8.25	x	110.55	i 🖈	0.63	x	0.7	i =	278.67	– (78)
Sout <mark>h</mark>	0.9x	0.7 <mark>7</mark>	x	8.25	x	108.01	x	0.63	x	0.7	j =	272.28	(78)
Sout <mark>h</mark>	0.9x	0.77	x	8.25	x	104.89	x	0.63	x	0.7	j =	264.42	(78)
Sout <mark>h</mark>	0.9x	0.77	x	8.25	x	101.89	×	0.63	x	0.7	j =	256.83	(78)
Sout <mark>h</mark>	0.9x	0.77	x	8.25	x	82.59	x	0.63	x	0.7	j =	208.18	(78)
South	0.9x	0.77	x	8.25	×	55.42	x	0.63	x	0.7] =	139.7	(78)
South	0.9x	0.77	x	8.25	×	40.4	x	0.63	x	0.7] =	101.84	(78)
West	0.9x	0.77	x	16.92	×	19.64	x	0.63	x	0.7] =	101.57	(80)
West	0.9x	0.77	x	16.92	×	38.42	x	0.63	x	0.7] =	198.68	(80)
West	0.9x	0.77	x	16.92	×	63.27	x	0.63	x	0.7] =	327.2	(80)
West	0.9x	0.77	x	16.92	x	92.28	x	0.63	x	0.7] =	477.21	(80)
West	0.9x	0.77	x	16.92	×	113.09	x	0.63	x	0.7] =	584.83	(80)
West	0.9x	0.77	x	16.92	×	115.77	x	0.63	x	0.7	j =	598.68	(80)
West	0.9x	0.77	x	16.92	x	110.22	x	0.63	x	0.7	j =	569.97	(80)
West	0.9x	0.77	x	16.92	×	94.68	x	0.63	x	0.7] =	489.6	(80)
West	0.9x	0.77	x	16.92	×	73.59	x	0.63	x	0.7] =	380.55	(80)
West	0.9x	0.77	x	16.92	×	45.59	×	0.63	x	0.7] =	235.75	(80)
West	0.9x	0.77	x	16.92	×	24.49	×	0.63	×	0.7] =	126.64	(80)
West	0.9x	0.77	x	16.92	x	16.15	x	0.63	x	0.7	i =	83.52	(80)

Solar g	ains in	watts, ca	alculated	for eac	h month			(83)m = S	um(74)m.	(82)m			
(83)m=	261.05	473.14	707.19	950.7	1114.13	1122.76	1075.88	954.7	793.38	540.57	318.25	219.59	(83)
Total g	ains – ii	nternal a	nd solar	(84)m =	= (73)m -	+ (83)m	, watts						
(84)m=	807.02	1016.84	1233.12	1447.58	1580.81	1560.84	1495.7	1381.12	1234.97	1011.46	822.84	750.16	(84)

7. Me	an inter	nal temp	perature	(heating	season)								
Temp	erature	during h	neating p	eriods ir	n the livii	ng area i	from Tab	ole 9, Th	1 (°C)				21	(85)
Utilisa	ation fac	tor for g	ains for	living are	ea, h1,m	(see Ta	ble 9a)					I		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(86)m=	1	0.99	0.99	0.97	0.92	0.83	0.7	0.75	0.91	0.98	1	1		(86)
Mean	interna	l temper	ature in	living ar	ea T1 (fo	u bllow ste	ns 3 to 7	7 in Tabl	e 9c)					
(87)m=	18.68	18.9	19.28	19.79	20.29	20.68	20.87	20.83	20.5	19.84	19.17	18.64		(87)
Temp	erature	durina h	neating p	eriods ir	n rest of	u dwelling	from Ta	u able 9 Tl	h2 (°C)					
(88)m=	19.29	19.3	19.3	19.3	19.3	19.31	19.31	19.31	19.31	19.3	19.3	19.3		(88)
Litilion	tion for	tor for a	oine for	root of d	L Wolling	h2 m (oc	L Toblo							
Utilisa						n_{2} , m (se		9a)	0.84	0.97	0.00	1		(89)
(03)11-	I	0.55	0.90	0.95	0.00	0.71	0.43	0.50	0.04	0.97	0.99	I		(00)
Mean	interna	l temper	ature in	the rest	of dwelli	ng T2 (f	ollow ste	eps 3 to 7	7 in Tabl	e 9c)	1			
(90)m=	16.31	16.63	17.19	17.93	18.61	19.1	19.27	19.25	18.91	18.01	17.02	16.26		(90)
									t	LA = Livin	g area ÷ (4	4) =	0.33	(91)
Mean	interna	l temper	ature (fo	r the wh	ole dwe	lling) = fl	LA × T1	+ (1 – fL	A) × T2					
(92)m=	17.09	17.38	17.88	18.54	19.16	19.61	19.79	19.77	19.43	18.61	17.72	17.04		(92)
Ap <mark>ply</mark>	adjustn	nent to t	he mear	interna	l temper	ature fro	m Table	4e, whe	ere appro	opri <mark>ate</mark>				
(93)m=	16.94	17.23	17.73	18. <mark>3</mark> 9	19.01	19.46	19.64	19.62	19.28	18.46	17.57	16.89		(93)
8. Spa	ace hea	ting reવા	uirement											
Set T	i to the r	nean i <mark>nt</mark>	ernal ter	nperatu	re obtain	ed at ste	ep 11 of	Table 9	<mark>o, s</mark> o tha	t Ti <mark>,m=(</mark>	76)m an	d re-calc	ulate	
the ut	ilisation	factor fo	or gains	using Ta	able 9a					_				
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisa	ation fac	tor for g	ains, hm		0.07	0.70	0.54		0.01		0.00			(04)
(94)m=	0.99	0.99	0.97	0.94	0.87	0.73	0.54	0.6	0.84	0.96	0.99	1		(94)
Usefu	Il gains,	hmGm	, VV = (94)	4)m x (84	4)m	4404 75	040.00	000.05	4000.00	074.07	044.54	740.00		(05)
(90)m=	602.59	1005.01	1201.1	1359.01	1307.73	1134.75	012.20	830.95	1032.23	971.27	614.54	740.69		(93)
	ily avera						16.6	16.4	14.1	10.6	7.1	4.2		(96)
	4.3	4.9				14.0	[(20)m	10.4	(06)m	10.0	7.1	4.2		(50)
	2717 69	2621 62	an intern			LIII , VV =			- (90)III	2204.04	2062.26	2717 51		(97)
(97)iii=	bootin	3021.03	- 3295.51	r ooob n	2134.07	1414.39	$\frac{004.72}{1000}$	934.43	1307.93	2294.94	1)m	5717.51		(01)
(98)m-	2168 83	1758 37	1558 24	1017 31	570 15		11 = 0.02		0)111] X (4	1619 15	2210 14		
(00)11-	2100.00	1730.07	1000.24	1017.01	070.10	0	0	Toto				2210.14	44007	(08)
								Tota	i per year	(kvvn/year) = Sum(9	o) _{15,912} =	11007	
Space	e heatin	g require	ement in	kWh/m²	²/year								83.22	(99)
8c. S	bace co	oling rec	quiremer	nt										
Calcu	lated fo	r June, J	July and	August.	See Tal	ple 10b		,				,		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Heat	loss rate	e Lm (ca	lculated	using 2	5°C inter	nal temp	perature	and exte	ernal ten	nperatur	e from T	able 10)		
(100)m=	0	0	0	0	0	2733.03	2151.53	2208.01	0	0	0	0		(100)
Utilisa	ation fac	tor for lo	oss hm	r	1	r	r					· · · · · ·		
(101)m=	0	0	0	0	0	0.62	0.71	0.66	0	0	0	0		(101)

Usefu	Il loss, h	mLm (V	vatts) =	(100)m x	(101)m									
(102)m=	0	0	0	0	0	1696.02	1518.54	1464.58	0	0	0	0		(102)
Gains	(solar	gains ca	lculated	for appli	cable w	eather re	egion, se	e Table	10)					
(103)m=	0	0	0	0	0	1930.88	1852.19	1720.22	0	0	0	0		(103)
Space	e <i>coolin</i> 04)m to	g require	e <i>ment fo</i> 104)m <	r month, $3 \times (98)$	whole o	dwelling,	continue	ous (kW	(h) = 0.0	24 x [(10)3)m – (102)m]>	x (41)m	
(104)m=	0	0	0	0	0	0	248.23	190.2	0	0	0	0		
									Total	I = Sum(104)	=	438 43	(104)
Cooled	fractio	n							f C =	cooled	area ÷ (4	4) =	4.17	(105)
Intermi	ittency f	actor (Ta	able 10b)								í I		
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0		
									Tota	l = Sum((104)	=	0	(106)
Space	cooling	requirer	ment for	month =	(104)m	× (105)	× (106)r	n						
(107)m=	0	0	0	0	0	0	259.07	198.5	0	0	0	0		
									Total	= Sum(107)	=	457.56	(107)
Space	cooling	requirer	ment in k	د/Wh/m²	/ear				(107)) ÷ (4) =			3.2	(108)
9a En	erav rea	nuiremer	nts – Ind	ividual h	eating s	vstems i	ncluding	micro-C	HP)					
Space	e heatii	ומי.				,)					
Fracti	on of sp	bace hea	at from s	econdar	y/supple	mentary	system					[0	(201)
Fracti	on of sr	ace hea	at from n	nain syst	em(s)		-	(202) = 1 -	- (201) =				1	(202)
Fracti	on of to	tal heati	no from	main sve	stom 1			(204) - (204))) x [1 -	(203)] -				(204)
				· · · ·				(204) - (20	, ~ ['	(200)] -			1	(204)
Efficie	ency of	main spa	ace heat	ing syste	em 1								89.9	(206)
Efficie	ency of a	seconda	ry/suppl	ementar	y heatin	g system	ח, %						0	(208)
Co <mark>olir</mark>	n <mark>g</mark> Syste	em En <mark>er</mark>	gy Effici	ency Ra	tio								4.05	(209)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ear
Space	e heatin	g require	ement (c	alculate	d above)								
	2168.83	1758.37	1558.24	1017.31	570.15	0	0	0	0	984.81	1619.15	2210.14		
(211)m	n = {[(98)m x (20	(4)] } x 1	00 ÷ (20)6)		-	-						(211)
. ,	2412.49	1955.92	1733.31	1131.6	, 634.21	0	0	0	0	1095.45	1801.06	2458.44		
			1	1		1	1	Tota	l (kWh/yea	ar) =Sum(2	211) _{15,1012}	=	13222.47	(211)
Space	e heatin	a fuel (s	econdar	v), kWh/	month							I		
= {[(98])m x (2()1)]}x1	00 ÷ (20)),	monur									
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
		1	1			1	1	Tota	l (kWh/yea	ar) =Sum(2	1 215) _{15.10} 12	=	0	(215)
Water	heating	r										l		
Output	from w	ater hea	ter (calc	ulated a	bove)									
e anp ar	224.91	198.31	208.44	187.08	183.5	164.21	157.94	172.99	172.58	193.98	204.82	219.58		
Efficier	ncy of w	ater hea	iter	1		1	1						79.8	(216)
(217)m=	88.84	88.76	88.58	88.17	87.21	79.8	79.8	79.8	79.8	88.07	88.64	88.88		(217)
Fuel fo	r water	i heating	ı kWh/m	onth	I	1	1	11		I				
(219)m	1 = (64)	<u>m x 100</u>) ÷ (217)	<u>m</u>										
(219)m=	253.16	223.42	235.32	212.19	210.41	205.78	197.92	216.78	216.27	220.27	231.07	247.04		
								Tota	I = Sum(2	19a) ₁₁₂ =			2669.62	(219)
Space	coolin	g fuel, k	Wh/moi	nth.								I		
(221)m	n = (107)m÷ (209	9)	1									1	
(221)m=	0	0	0	0	0	0	63.97	49.01	0	0	0	0		
								Tota	I = Sum(22	21) ₆₈ =			112.98	(221)

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			13222.47	
Water heating fuel used			2669.62	
Space cooling fuel used			112.98	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30	(2)	30c)
boiler with a fan-assisted flue		45	(2	30e)
Total electricity for the above, kWh/year	sum of (230a))(230g) =	75 (2	31)
Electricity for lighting			492.13 (2	32)
12a. CO2 emissions – Individual heating systems	including micro-CHP			
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating (main system 1)	(5.1.1)			
opaco noaling (main by cloin 1)	(211) x	0.216 =	2856.05 (2	61)
Space heating (secondary)	(211) x (215) x	0.216 =	2856.05 (2) 0 (2)	:61) :63)
Space heating (secondary) Water heating	(211) x (215) x (219) x	0.216 = 0.519 = 0.216 =	2856.05 (2) 0 (2) 576.64 (2)	:61) :63) :64)
Space heating (main cyclem ty) Space heating Water heating Space and water heating	(211) x (215) x (219) x (261) + (262) + (263) + (264) =	0.216 = 0.519 = 0.216 =	2856.05 (2) 0 (2) 576.64 (2) 3432.69 (2)	261) 263) 264) 265)
Space heating (main cyclem ty) Space heating Water heating Space and water heating Space cooling	(211) x (215) x (219) x (261) + (262) + (263) + (264) = (221) x	$\begin{array}{c} 0.216 \\ = \\ 0.519 \\ = \\ 0.216 \\ = \\ 0.519 \\ = \\ \end{array}$	2856.05 (2) 0 (2) 576.64 (2) 3432.69 (2) 58.64 (2)	261) 263) 264) 265) 266)
Space heating (main cyclem ty) Space heating Water heating Space and water heating Space cooling Electricity for pumps, fans and electric keep-hot	(211) x $(215) x$ $(219) x$ $(261) + (262) + (263) + (264) =$ $(221) x$ $(231) x$	$\begin{array}{c} 0.216 \\ = \\ \hline 0.519 \\ = \\ \hline 0.216 \\ = \\ \hline 0.519 \\ = \\ \hline 0.519 \\ = \\ \hline 0.519 \\ = \\ \hline \end{array}$	2856.05 (2) 0 (2) 576.64 (2) 3432.69 (2) 58.64 (2) 38.93 (2)	261) 263) 264) 265) 266)
Space heating (main cyclenii ty) Space heating Space and water heating Space cooling Electricity for pumps, fans and electric keep-hot Electricity for lighting	(211) x $(215) x$ $(219) x$ $(261) + (262) + (263) + (264) =$ $(221) x$ $(231) x$ $(232) x$	$\begin{array}{c} 0.216 \\ = \\ \hline 0.519 \\ = \\ \hline 0.216 \\ = \\ \hline 0.519 \\ = \\ \hline \end{array}$	2856.05 (2) 0 (2) 576.64 (2) 3432.69 (2) 58.64 (2) 38.93 (2) 255.42 (2)	261) 263) 264) 265) 266) 267)
Space heating (main cyclent ty) Space heating Space and water heating Space cooling Electricity for pumps, fans and electric keep-hot Electricity for lighting Total CO2, kg/year	(211) x $(215) x$ $(219) x$ $(261) + (262) + (263) + (264) =$ $(221) x$ $(231) x$ $(232) x$ sum	$\begin{array}{c} 0.216 \\ = \\ 0.519 \\ = \\ 0.216 \\ = \\ 0.519 \\ = \\$	2856.05 (2) 0 (2) 576.64 (2) 3432.69 (2) 58.64 (2) 38.93 (2) 255.42 (2) 3785.67 (2)	61) 63) 64) 65) 66) 66) 68) 72)
Space heating (main cyclenii ty) Space heating Space and water heating Space cooling Electricity for pumps, fans and electric keep-hot Electricity for lighting Total CO2, kg/year Dwelling CO2 Emission Rate	(211) x $(215) x$ $(219) x$ $(261) + (262) + (263) + (264) =$ $(221) x$ $(231) x$ $(232) x$ sum (272)	$\begin{array}{c} 0.216 \\ \hline \\ 0.519 \\ \hline \\ 0.216 \\ \hline \\ \\ 0.519 \\ \hline \\ 0.519 \\ \hline \\ 0.519 \\ \hline 0.519$	2856.05 (2) 0 (2) 576.64 (2) 3432.69 (2) 58.64 (2) 38.93 (2) 255.42 (2) 3785.67 (2) 26.5 (2)	 61) 63) 64) 65) 66) 67) 68) 72) 73)

			User D	Details:						
Assessor Name: Software Name:	on: 1.0.4.26									
			Property	Address	: 9D The	Grove_	Retrofit			
Address :										
1. Overall dwelling dime	nsions:		_	()						
Ground floor			Are	a(m²)	(1a) x	Av. Hei	ight(m)	(2a) =	Volume(m ³)] (3a)
Eirst floor				0.92	(10) X		.40	(2a) =	149.00	
				31.92	(ID) X	2.	.42	(20) =	198.26	
Total floor area TFA = (1a	a)+(1b)+(1c)+((1d)+(1e)+(1	n) 1	42.84	(4)					_
Dwelling volume					(3a)+(3b))+(3c)+(3d)+(3e)+	.(3n) =	348.11	(5)
2. Ventilation rate:										
	main heating	seconda heating	ary	other		total			m ³ per hour	
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	ns	_			- Ē	4	x 1	0 =	40	(7a)
Number of passive vents					Ē	0	x 1	0 =	0	(7b)
Number of flueless gas fi	res					0	x 4	40 =	0	(7c)
								Air ch	anges per hou	ır L
Infiltration due to chimney	s, flu <mark>es an</mark> d fa	ans = (6a) + (6b) +	<mark>(7a)+</mark> (7b)+((7c) =		40		÷ (5) =	0.11	(8)
If a pressurisation test has b	een ca <mark>rried o</mark> ut or	is intended, proce	ed to (17),	otherwise o	continue fr	om (9) to (16)			-
Additional infiltration	ne dw <mark>elling</mark> (ne	5)					[(0)	11×0.1 -	0	(9)
Structural infiltration: 0.	.25 for steel or	timber frame o	or 0.35 fo	r masoni	v constr	uction	[(3)-	11×0.1 =	0	1(10) 1(11)
if both types of wall are pr	resent, use the va	lue corresponding	to the great	ter wall are	a (after]()
deducting areas of openin	ngs); if equal user	0.35 (upscaled) or (ad) also	optor 0					
If no draught lobby ent	ter 0.05 else ϵ	enter 0	J. 1 (Seale	eu), eise					0	(12)
Percentage of windows	s and doors dr	aught stripped							0	(10)
Window infiltration		5 1		0.25 - [0.2	2 x (14) ÷ 1	= [00			0	(15)
Infiltration rate				(8) + (10)	+ (11) + (1	2) + (13) +	+ (15) =		0	(16)
Air permeability value,	q50, expresse	ed in cubic metr	es per ho	our per s	quare m	etre of e	nvelope	area	5	(17)
If based on air permeabil	ity value, then	(18) = [(17) ÷ 20]+	(8), otherw	ise (18) = ((16)				0.36	(18)
Air permeability value applie	s if a pressurisatio	on test has been do	one or a de	gree air pe	rmeability	is being us	sed			
Number of sides sheltere	d			(20) = 1 -	[0.075 x (1	9)] =			2	(19)
Infiltration rate incorporat	ing shelter fac	tor		(21) = (18) x (20) =	/			0.85	(20)
Infiltration rate modified for	or monthly win	ld speed							0.01	,,
Jan Feb	Mar Apr	May Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	eed from Tabl	e 7								
(22)m= 5.1 5	4.9 4.4	4.3 3.8	3.8	3.7	4	4.3	4.5	4.7		

Wind F	Factor (2	22a)m =	(22)m ÷	4										
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18		
Adjust	ed infiltr	ation rat	e (allowi	ing for sl	nelter an	d wind s	speed) =	(21a) x	(22a)m	-	-	-	-	
	0.4	0.39	0.38	0.34	0.33	0.29	0.29	0.29	0.31	0.33	0.35	0.36		
Calcul	ate effe	<i>ctive air</i>	change	rate for t	the appli	cable ca	se	-	-	-	-			(22.0)
lf exh	aust air h	eat numn	using App	endix N (2	23b) = (23a	a) x Emv (e	equation (I	N5)) othe	rwise (23h	(23a) = (23a)				(238)
lf bal	anced with	n heat reco	overv: effic	iencv in %	allowing f	or in-use f	actor (fron	n Table 4h) =	<i>()</i>				(230)
a) If	halance	n mech	anical ve	ntilation	with he	at recov	erv (MV/	HR) (24:	″ a)m – (2	2h)m + (23h) 🗙 [1 – (23c)	⊥	(230)
(24a)m=				0	0	0						0]	(24a)
b) If	balance	ed mech	I anical ve	entilation	u without	L heat rec	L Coverv (N	L MV) (24t	(2) m = (2)	1 2b)m + (1 23b)		1	
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If	whole h	iouse ex	tract ver	ntilation of	r positiv	/e input v	ventilatio	on from o	outside	1	1	!	1	
,	if (22b)r	n < 0.5 >	< (23b), t	then (24	c) = (23b); other	wise (24	c) = (22	o) m + 0	.5 × (23b)			
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) If	natural if (22b)r	ventilation = 1, th	on or wh en (24d)	ole hous m = (22	se positiv b)m othe	ve input erwise (2	ventilatio 24d)m =	on from 0.5 + [(2	loft 2b)m² x	0.5]				
(24d) <mark>m=</mark>	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57		(24d)
Effe	ctive air	change	rate - er	nter (24a) or (24	o) or (24	c) or (24	d) in bo	(25)					
(25)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57		(25)
3 He	at losse	s and he	eat loss i	oaramet	er.									
		Gros	ss	Openir	as	Net Ar	ea	U-val	ue	AXU		k-value)	AXk
		area	(m²)	n	ι <u>9</u> - 1 ²	A ,r	m²	W/m2	2K	(W/	K)	kJ/m²-I	K	kJ/K
Doo <mark>rs</mark>	Type 1					2.14	x	1	=	2. <mark>13569</mark>	8			(26)
Doors	Type 2					1.84	x	1	=	1.83594	6			(26)
Doors	Туре 3					3.92	x	1	=	3.91756	67			(26)
Windo	ws Type	e 1				6.01	x1	/[1/(1.4)+	0.04] =	7.97				(27)
Windo	ws Type	e 2				7.15	x1	/[1/(1.4)+	0.04] =	9.48				(27)
Windo	ws Type	e 3				14.66	3 x1	/[1/(1.4)+	0.04] =	19.44				(27)
Floor						60.91	7 X	0.13	=	7.91920	9			(28)
Walls ⁻	Type1	182.	37	35.7	1	146.6	6 X	0.18	=	26.4	T i		ΞĒ	(29)
Walls ⁻	Type2	23.8	37	0		23.87	7 X	0.18		4.3	= i		Ξ F	(29)
Roof		81.9	92	0		81.92	2 X	0.13	=	10.65	= i		Ξ F	(30)
Total a	area of e	elements	s, m²			349.0	8				'			(31)
* for win ** includ	idows and le the area	l roof wind as on both	lows, use e sides of ir	effective wi	indow U-va Ils and par	alue calcul titions	lated using	g formula 1	/[(1/U-valu	ue)+0.04] a	as given in	n paragraph	1 3.2	. ,
Fabric	heat los	ss, W/K	= S (A x	U)				(26)(30) + (32) =				94.	04 (33)
Heat c	apacity	Cm = S	(A x k)	-					((28).	(30) + (32	2) + (32a)	(32e) =	0	(34)

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

Indicative Value: Medium

(35)

250

Therma	al bridge	es : S (L	x Y) cal	culated u	using Ap	pendix I	<						17.45	(36)
if details	of therma	al bridging	are not kn	own (36) =	= 0.05 x (3	:1)			(22)	(26) -				
Ventila	tion her	at loss ca	alculated	monthly	v				(33) + (38)m	= 0.33 × (25)m x (5)		111.49	(37)
	Jan	Feb	Mar	Apr	, May	Jun	Jul	Aug	Sep	Oct	Nov	Dec]	
(38)m=	66.42	66.07	65.73	64.12	63.82	62.43	62.43	62.17	62.96	63.82	64.43	65.07		(38)
Heat tr	ansfer o	coefficier	nt, W/K						(39)m	= (37) + (3	38)m		•	
(39)m=	177.91	177.56	177.22	175.62	175.32	173.92	173.92	173.66	174.46	175.32	175.92	176.56		
Heat lo	oss para	meter (H	ILP), W∕	/m²K					(40)m	Average = = (39)m ÷	Sum(39)₁. · (4)	12 /12=	175.61	(39)
(40)m=	1.25	1.24	1.24	1.23	1.23	1.22	1.22	1.22	1.22	1.23	1.23	1.24		
Numbe	er of day	rs in mor	nth (Tab	le 1a)		•	•	•	,	Average =	Sum(40)1.	12 /12=	1.23	(40)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec]	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)
					-							-	-	
4. Water heating energy requirement: kWh/ye														
4. Water heating energy requirement: kWh/ye Assumed occupancy, N 2.92 if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9) if TFA £ 13.9, N = 1]	(42)
	A £ 13.9	P, N = 1	ater usar	ne in litre	es per da	v Vd av	erage –	(25 x N)	+ 36		10	2.6		(43)
Reduce	the annua	al avera <mark>ge</mark>	hot water	usage by a	5% if the c	welling is	design <mark>ed</mark> i	to achieve	a water us	se ta <mark>rget o</mark>	r IU	3.0	J	(43)
not more	e that 125	litres per p	person per	r day (all w	rater use, l	hot and co	ld)						,	
Hot wate	Jan	Feb	Mar day for or	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(11)	112 07		105 CR					07.20	101 52	105.69	100.00	112.07	1	
(44)II <mark>I</mark> =	113.97	109.02	105.00	101.55	97.39	93.24	93.24	97.39	101.55	Total = Su	m(44)1 12 =	113.97	1243.26	(44)
Energy o	content of	hot water	used - cal	culated mo	onthly = 4.	190 x Vd,r	m x nm x D	0Tm / 3600) kWh/mor	nth (see Ta	ables 1b, 1	c, 1d)	1	
(45)m=	169.01	147.81	152.53	132.98	127.6	110.11	102.03	117.08	118.48	138.08	150.72	163.67		
lf instant	aneous w	ater heatir	ng at point	of use (no	hot wate	r storage),	enter 0 in	boxes (46,) to (61)	Total = Su	m(45) ₁₁₂ =	=	1630.11	(45)
(46)m=	25.35	22.17	22.88	19.95	19.14	16.52	15.3	17.56	17.77	20.71	22.61	24.55]	(46)
vvater Storag	storage e volum	ioss: e (litres)	includir	ng any so	olar or W	WHRS	storage	within sa	ame ves	sel		150	1	(47)
If comr	nunity h	eating a	nd no ta	ink in dw	velling, e	enter 110) litres in	(47)					1	()
Otherw	vise if no	stored	hot wate	er (this in	ncludes i	nstantar	neous co	ombi boil	ers) ente	er '0' in (47)			
Water	storage	loss: uror's de	olarad l	occ fact	or ie kno	wp (k\//k	v/dov/):						1	(40)
Tempe	rature f	actor fro	m Tahla	2h			i/uay).				1.	54]	(40)
Energy	lost fro	m water	storage	 . kWh/ve	ear			(48) x (49)) =		0.	75]	(49)
b) If m	anufact	urer's de	eclared of	ylinder l	oss fact	or is not	known:	()			0.	75]	(00)
Hot wa	ter stor	age loss	factor fr	om Tabl	e 2 (kW	h/litre/da	ay)					0		(51)
	полих П		~~ ~~ ~+ ·	n 1 2									-	
volum	e factor	from Tal	ee secti ble 2a	on 4.3								0]	(52)

Energy Enter	y lost fro (50) or	om water (54) in (5	• storage 55)	e, kWh/ye	ear			(47) x (51)) x (52) x (53) =	0.	0		(54) (55)
Water	storage	loss cal	culated	for each	month			((56)m = (55) × (41)ı	m	L			
(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(56)
If cylinde	er contain	s dedicate	d solar sto	rage, (57)	m = (56)m	x [(50) – (H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Append	ix H	
(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(57)
Primar	y circuit	loss (ar	nual) fro	om Table	e 3	-						0		(58)
Primar	y circuit	loss cal	culated	for each	month (59)m = ((58) ÷ 36	65 × (41)	m					
(mo	dified by	factor f	rom Tab	le H5 if t	here is s	solar wat	ter heatir	ng and a	cylinde	r thermo	stat)			
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
Combi	loss ca	lculated	for each	month	(61)m =	(60) ÷ 30	65 × (41))m						
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)
Total h	neat req	uired for	water h	eating ca	alculated	l for eac	h month	(62)m =	0.85 × ((45)m +	(46)m +	(57)m +	(59)m + (61)r	n
(62)m=	215.6	189.9	199.13	178.07	174.19	155.2	148.63	163.68	163.57	184.67	195.81	210.27		(62)
Solar Dł	-IW input	calculated	using App	endix G o	r Appendix	H (negati	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)		
(add a	dditiona	l lines if	FGHRS	and/or \	NWHRS	applies	, see Ap	pendix (G)					
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output	t from w	ater hea	ter	-					-					
(64)m=	215.6	189.9	199.13	178.07	174.19	155.2	148.63	163.68	163.57	184.67	195.81	210.27		
								Outp	out from wa	ater heate	r <mark>(annual)</mark> ₁	12	2178.72	(64)
Hea <mark>t g</mark>	ains fro	m water	heating.	, kWh/m	onth 0.2	5 ′ [0.85	× (45)m	ı + (61)m	n] + 0.8 x	(<mark>46)m</mark> (+ (57)m	+ (<mark>59</mark>)m]	
(65)m=	93.47	82.82	<mark>87</mark> .99	80.29	79.7	72.68	71.2	76.21	75.47	83.19	86.19	91.7		(65)
inclu	<mark>ide</mark> (57)	m in calo	culation	of (65)m	only if c	ylinder i	s in the o	dwelling	or hot w	ate <mark>r is f</mark> r	om com	munity h	eating	
5. Int	ternal ga	ains (see	e Table 5	5 and 5a):									
Metab	<u>olic gair</u>	s (Table	e 5), Wat	ts										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m=	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12		(66)
Lightin	g gains	(calcula	ted in Ap	opendix	L, equat	ion L9 o	r L9a), a	lso see	Table 5		-			
(67)m=	28.15	25	20.33	15.39	11.51	9.71	10.5	13.64	18.31	23.25	27.14	28.93		(67)
Applia	nces ga	ins (calc	ulated ir	n Append	dix L, eq	uation L	13 or L1	3a), also	see Ta	ble 5	-	-		
(68)m=	312.62	315.86	307.69	290.29	268.32	247.67	233.88	230.63	238.81	256.21	278.18	298.83		(68)
Cookir	ng gains	(calcula	ted in A	ppendix	L, equat	ion L15	or L15a)), also se	e Table	5		-		
(69)m=	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61		(69)
Pumps	and fa	ns gains	(Table \$	5a)										
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3		(70)
Losses	s e.g. ev	vaporatic	on (nega	tive valu	es) (Tab	le 5)								
(71)m=	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89		(71)
Water	heating	gains (T	able 5)											
(72)m=	125.63	123.24	118.27	111.51	107.13	100.95	95.7	102.43	104.82	111.81	119.71	123.25		(72)
Total i	nternal	gains =				(66))m + (67)m	n + (68)m -	+ (69)m + ((70)m + (7	1)m + (72)	m		
(73)m=	536.24	533.94	516.13	487.03	456.79	428.17	409.91	416.54	431.77	461.11	494.86	520.84		(73)
6. So	lar gains	S:												

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

Orienta	ition:	Access Factor Table 6d	r	Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.01	×	19.64	×	0.63	×	0.7] =	36.07	(76)
East	0.9×	0.77	x	6.01	x	38.42	x	0.63	x	0.7] =	70.57	(76)
East	0.9×	0.77	x	6.01	x	63.27	x	0.63	x	0.7] =	116.22	(76)
East	0.9x	0.77	x	6.01	×	92.28	×	0.63	×	0.7] =	169.49	(76)
East	0.9x	0.77	x	6.01	×	113.09	×	0.63	×	0.7] =	207.72	(76)
East	0.9x	0.77	x	6.01	x	115.77	x	0.63	x	0.7] =	212.64	(76)
East	0.9x	0.77	x	6.01	×	110.22	×	0.63	×	0.7] =	202.44	(76)
East	0.9x	0.77	x	6.01	x	94.68	x	0.63	x	0.7] =	173.89	(76)
East	0.9x	0.77	x	6.01	x	73.59	×	0.63	×	0.7	1 =	135.16	(76)
East	0.9x	0.77	x	6.01	x	45.59	×	0.63	x	0.7	1 =	83.74	(76)
East	0.9x	0.77	x	6.01	x	24.49	x	0.63	x	0.7] =	44.98	(76)
East	0.9x	0.77	x	6.01	x	16.15	x	0.63	×	0.7	1 =	29.67	(76)
South	0.9x	0.77	x	7.15	x	46.75	×	0.63	x	0.7] =	102.16	(78)
South	0.9x	0.77	x	7.15	x	76.57	x	0.63	x	0.7] =	167.31	(78)
South	0.9x	0.77	x	7.15	x	97.53	x	0.63	x	0.7	1 =	213.12	(78)
South	0.9x	0.77	x	7.15	×	110.23	x	0.63	х	0.7	1	240.88	(78)
Sout <mark>h</mark>	0.9x	0.77	x	7.15	x	114.87	x	0.63	x	0.7	i -	251.01	- (78)
Sout <mark>h</mark>	0.9x	0.77	x	7.15	x	110.55	×	0.63	x	0.7] =	2 <mark>41.56</mark>	(78)
Sout <mark>h</mark>	0.9x	0.77	x	7.15	x	108.01	x	0.63	x	0.7] =	236.02	(78)
South	0.9x	0.77	x	7.15	x	104.89	x	0.63	x	0.7] =	229.21	(78)
South	0.9x	0.77	x	7.15	x	101.89	×	0.63	x	0.7] =	222.63	(78)
Sout <mark>h</mark>	0.9×	0.77	x	7.15	x	82.59	x	0.63	x	0.7] =	180.46	(78)
South	0.9×	0.77	x	7.15	×	55.42	×	0.63	×	0.7] =	121.09	(78)
South	0.9x	0.77	x	7.15	×	40.4	×	0.63	×	0.7] =	88.28	(78)
West	0.9×	0.77	x	14.66	x	19.64	x	0.63	x	0.7] =	87.99	(80)
West	0.9×	0.77	x	14.66	x	38.42	x	0.63	x	0.7] =	172.13	(80)
West	0.9x	0.77	x	14.66	×	63.27	×	0.63	×	0.7] =	283.48	(80)
West	0.9×	0.77	x	14.66	x	92.28	x	0.63	x	0.7] =	413.44	(80)
West	0.9x	0.77	x	14.66	×	113.09	×	0.63	×	0.7] =	506.69	(80)
West	0.9x	0.77	x	14.66	×	115.77	×	0.63	×	0.7] =	518.69	(80)
West	0.9x	0.77	x	14.66	x	110.22	x	0.63	x	0.7] =	493.81	(80)
West	0.9x	0.77	x	14.66	×	94.68	×	0.63	×	0.7] =	424.17	(80)
West	0.9x	0.77	x	14.66	×	73.59	x	0.63	x	0.7	=	329.7	(80)
West	0.9x	0.77	x	14.66	x	45.59	x	0.63	x	0.7] =	204.25	(80)
West	0.9x	0.77	x	14.66	×	24.49	×	0.63	×	0.7] =	109.72	(80)
West	0.9x	0.77	x	14.66	x	16.15	x	0.63	x	0.7] =	72.36	(80)

Solar g	ains in	watts, ca	alculated	for eac	h month			(83)m = S	um(74)m.	(82)m			
(83)m=	226.23	410.01	612.82	823.81	965.42	972.89	932.27	827.28	687.5	468.45	275.79	190.3	(83)
Total g	ains – ir	nternal a	ind solar	⁻ (84)m =	= (73)m -	+ (83)m	, watts						-
(84)m=	762.47	943.96	1128.95	1310.84	1422.2	1401.06	1342.18	1243.82	1119.27	929.56	770.65	711.15	(84)

7. Me	7. Mean internal temperature (heating season) 21 (45) Temperature during heating periods in the living area from Table 9, Th1 (*C) 21 (45) Utilisation factor for gains for living area, h1,m (see Table 9a) 1 0.99 0.96 0.88 0.72 0.55 0.61 0.86 0.98 1 1 0.69 1 0.66 0.98 1 1 0.66 0.98 1 1 0.66 0.98 1 1 0.66 0.98 1 1 0.66 0.98 1 1 0.66 0.98 1 1 0.66 0.98 1 1 0.66 0.98 1 1 0.66 0.98 1 1 0.66 0.98 1 1 0.66 0.98 1 1 0.66 0.98 0.99 1.9.9 <td< th=""></td<>														
Temp	erature	during h	neating p	eriods ir	n the livir	ng area f	from Tab	ole 9, Th	1 (°C)				21	(85)	
Utilisa	ation fac	tor for g	ains for	living are	ea, h1,m	(see Ta	ble 9a)					I			
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
(86)m=	1	1	0.99	0.96	0.88	0.72	0.55	0.61	0.86	0.98	1	1		(86)	
Mean	internal	l tompor	ature in	living ar	22 T1 /fc	llow sto	ns 3 to 7	r in Tabl	- 9c)						
(87)m=	19.57	19.76	20.06	20.44	20.75	20.93	20.99	20.98	20.84	20.41	19.91	19.54		(87)	
-							· -			-					
I emp	erature	during h	leating p	eriods ir	n rest of	dwelling	trom 1a	able 9, 11	n2 (°C)	10.0	40.00	40.00		(00)	
(88)m=	19.88	19.89	19.89	19.9	19.9	19.91	19.91	19.91	19.9	19.9	19.89	19.89		(00)	
Utilisa	tion fac	tor for g	ains for	rest of d	welling,	n2,m (se	e Table	9a)							
(89)m=	1	1	0.98	0.94	0.83	0.63	0.42	0.48	0.78	0.97	1	1		(89)	
Mean	internal	l temper	ature in	the rest	of dwelli	ng T2 (fe	ollow ste	eps 3 to 7	7 in Tabl	e 9c)					
(90)m = 17.98 18.26 18.69 19.24 19.66 19.86 19.9 19.9 19.77 19.21 18.49 17.94 (9) $ fLA = Living area \div (4) = 0.33 $ (9)															
$fLA = Living area \div (4) = 0.33$ (9) Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$														(91)	
Mean	internal	l temper	ature (fo	r the wh	ole dwel	ling) = fl	A 🗙 T1	+ (1 – fl	A) x T2			•			
$fLA = \text{Living area} \div (4) = 0.33 (9)$ Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$ $(92)m = 18.5 18.75 19.14 19.63 20.01 20.21 20.26 20.25 20.12 19.6 18.95 18.46 (9)$ Apply adjustment to the mean internal temperature from Table 4e, where appropriate															
	adiustr	nent to t	he mear	internal	temper	ature fro	m Table	4e, whe	ere appro	opriate					
(93)m=	Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$ 92)m = 18.5 18.75 19.14 19.63 20.01 20.21 20.25 20.12 19.6 18.95 18.46 (92) Apply adjustment to the mean internal temperature from Table 4e, where appropriate 93)m = 18.5 18.75 19.14 19.63 20.01 20.21 20.25 20.12 19.6 18.95 18.46 (92)														
8. Spa	ace hea	ting requ	uirement												
Set Ti	to the r	mean int	ernal ter	nperatur	e obtain	ed at ste	ep 11 of	Table 9	o, so tha	t Ti,m=(76)m an	d re-calc	ulate		
the ut	<mark>ilis</mark> ation	factor fo	or g <mark>ains</mark>	using Ta	ble 9a						,				
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Utilisa	ation fac	tor for g	ains, hm	1:											
(94)m=	1	0.99	0.98	0.94	0.84	0.65	0.47	0.52	0.8	0.97	0.99	1		(94)	
Usefu	l gains,	hmGm	, W = (94	4)m x (84	4)m										
(95)m=	760.59	937.61	1106.62	1230.1	1190.04	916.54	626.32	652.55	895.59	897.45	766.38	709.88		(95)	
Month	nly avera	age exte	ernal tem	perature	e from Ta	able 8									
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)	
Heat	oss rate	e for mea	an intern	al tempe	erature,	_m , W =	=[(39)m : L	x [(93)m· L	– (96)m	4.577.00	0005.00	0540.00		(07)	
(97)m=	2526.44	2458.77	2239.99	1884.27	1457.62	976.02	635.68	668.62	1050.69	1577.66	2085.32	2518.02		(97)	
Space	e neating	g require		r each m		/vn/moni	$\ln = 0.02$	24 X [(97))m – (95)mj x (4	1)m	1245.25			
(90)11=	1313.79	1022.22	043.22	471	199.00	0	0	U Tota	0	300.00	949.03	1343.23	0050.07		
								Tota	i per year	(kvvn/year	') = Sum(9	8)15,912 =	6650.27	(96)	
Space	e heating	g require	ement in	kWh/m ²	/year								46.56	(99)	
9a. En	ergy req	luiremer	nts – Indi	ividual h	eating sy	/stems i	ncluding	micro-C	HP)						
Space	e heatir	ng:													
Fracti	on of sp	ace hea	at from s	econdar	y/supple	mentary	system						0	(201)	
Fracti	on of sp	ace hea	at from m	nain syst	em(s)			(202) = 1 -	- (201) =				1	(202)	
Fracti	on of to	tal heati	ng from	main sys	stem 1			(204) = (20	02) × [1 –	(203)] =			1	(204)	
Efficie	ency of r	main spa	ace heat	ing syste	em 1								93.5	(206)	
Efficie	ency of s	seconda	ry/suppl	ementar	y heating	g system	n, %						0	(208)	
			, n.,				-					l	-	` ´	

												_	l	
Snoo	Jan	Feb	Mar Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ır
Space	1313 79	g require			199.08	0	0	0	0	506.08	949 63	1345 25		
(211)m		$m \times (20)$			100.00	•	•	•	•	000.00	0 10.00	1010.20		(211)
(211)11	1405.12	1093.28	901.84	503.75	212.92	0	0	0	0	541.26	1015.65	1438.78		(211)
								Tota	l (kWh/yea	L ar) =Sum(2	L 211) _{15,1012}	=	7112.59	(211)
Space	e heatin	g fuel (s	econdar	y), kWh/	month									J
= {[(98)m x (20)1)]}x1	00 ÷ (20	8)						-				
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		-
								Tota	l (kWh/yea	ar) =Sum(2	215) _{15,1012}	-	0	(215)
Water	heating	J												
Output	from wa	ater hea	ter (calc	ulated a	bove) 174 19	155.2	148 63	163 68	163 57	184 67	195 81	210 27		
Efficie	ncv of w	ater hea	iter	110.01		100.2	110.00	100.00	100.01	101.07	100.01	210.21	79.8	(216)
(217)m=	88.82	88.64	88.24	87.29	85.17	79.8	79.8	79.8	79.8	87.37	88.47	88.89		」、 (217)
Fuel fo	r water	heating,	kWh/mo	onth										
(219)m	n = (64)	<u>m x 100</u>) ÷ (217)	m						i	i		l	
(219)m=	242.74	214.24	225.67	204	204.52	194.49	186.25	205.11	204.98	211.37	221.33	236.55		7
A 19 19 19 19								Tota	1 = Sum(2	19a) ₁₁₂ =	Alleluce		2551.25	(219)
Space	heating	fuel use	ed. main	svstem	1					K	wn/year		7112.59	1
Water	heating	fueluse	d	- J - · · -									2551.25] T
The	ineating	Tuer use	iu .	a ha a taƙa t									2551.25]
Electri	city for p	oumps, ta	ans and	electric	keep-no	[
centra	al heatin	ig pump										30		(230c)
boi <mark>ler</mark>	with a f	an-assis	sted flue									45		(230e)
Total e	electricity	/ for the	above, l	kWh/yea	r			sum	of (230a).	(230g) =			75	(231)
Electri	city for li	ghting											497.15	(232)
12a. (CO2 em	issions -	– Individ	ual heati	ing syste	ems inclu	uding mi	cro-CHF)					-
						_	Ŭ				. ,		- · ·	
						En kW	ergy /h/year			kg CO	2/kWh	tor	kg CO2/yea	r
Space	heating	(main s	ystem 1)		(211	l) x			0.2	16	=	1536.32	(261)
Space	heating	(second	dary)			(218	5) x			0.5	19	=	0	(263)
Water	heating					(219	9) x			0.2	16	=	551.07	(264)
Space	and wa	ter heati	ng			(261	I) + (262) ·	+ (263) + (264) =				2087.39	(265)
Electri	city for p	oumps, fa	ans and	electric	keep-ho	t (231	I) x			0.5	19	=	38.93] (267)
Electri	city for li	ghting			-	(232	2) x			0.5	19	=	258.02	(268)
Total C	CO2, kg/	'year							sum o	f (265)(2	271) =		2384.33	(272)
														-

TER =

16.69

(273)

Appendix

Appendix 2 : SAP 2012 Calculations for the Proposed New Dwelling - Be Clean, Be Lean and Be Green Scenarios

			User [Details:						
Assessor Name: Software Name:	Stroma FSAF	P 2012		Strom Softwa	a Num are Ve	ber: rsion:		Versic	on: 1.0.4.26	
		F	Property	Address	: 9D The	e Grove_	Propose	ed_Be Le	ean	
Address :										
1. Overall dwelling dimen	sions:		_							
			Are	a(m²)	I	Av. Hei	ight(m)	-	Volume(m ³)	1
Basement			1	26.23	(1a) x		3	(2a) =	378.69	(3a)
Ground floor			1	29.92	(1b) x		3	(2b) =	389.76	(3b)
First floor			1	23.86	(1c) x	2	2.7	(2c) =	334.42	(3c)
Total floor area TFA = (1a))+(1b)+(1c)+(1d)+(1e)+(1	n) 3	80.01	(4)					
Dwelling volume					(3a)+(3b)+(3c)+(3d	l)+(3e)+	.(3n) =	1102.87	(5)
2. Ventilation rate:										-
	m ³ per hour									
Number of chimneys		+ 0] + [0] = [0	x	40 =	0	(6a)
Number of open flues	0	+ 0	= + F	0	_ _ = _	0	x	20 =	0	(6b)
Number of intermittent fan	s				Ī	0	x	10 =	0	(7a)
Number of passive vents					Ē	0	x	10 =	0	(7b)
Number of flueless gas fire	es					0	X	40 =	0	(7c)
								Air ch	nanges per hou	ır
Infiltration due to chimneys	s, flu <mark>es an</mark> d fans	6 = (6a) + (6b) + (6b)	7a)+(7b)+	(7c) =		0		÷ (5) =	0	(8)
If a pressurisation test has be	en ca <mark>rried o</mark> ut or is i	intended, procee	ed to (17),	otherwise of	continue fr	rom (9) to (16)			7
Number of storeys in the	e dwelling (ns)								0	(9)
Additional inflitration	E for staal or tin	nhar frama a	r 0 25 fo	* ***	n / oonotr	uction	[(9)	-1]x0.1 =	0	(10)
if both types of wall are pre	sent, use the value	corresponding t	o the grea	ter wall are	a (after	uction			0](11)
deducting areas of opening	s); if equal user 0.3	5	J							_
If suspended wooden flo	oor, enter 0.2 (u	nsealed) or ().1 (seale	ed), else	enter 0				0	(12)
If no draught lobby, ente	er 0.05, else ent	er 0							0	(13)
Percentage of windows	and doors drau	ght stripped							0	(14)
Window infiltration				0.25 - [0.2	2 x (14) ÷ 1	= [00]			0	(15)
Infiltration rate				(8) + (10)	+ (11) + (1	12) + (13) +	+ (15) =		0	(16)
Air permeability value, q	50, expressed i	n cubic metre	es per ho	our per s	quare m	etre of e	nvelope	area	3	(17)
If based on air permeabilit	y value, then (18	3) = [(17) ÷ 20]+	(8), otherw	rise (18) = ((16)				0.15	(18)
Air permeability value applies	if a pressurisation to	est has been do	ne or a de	gree air pe	rmeability	is being us	sed		[1
Shelter factor				(20) = 1 -	[0.075 x (1	19)] =			2	(19)
Infiltration rate incorporatir	ng shelter factor			(21) = (18) x (20) =	/-			0.33	(20)
Infiltration rate modified for	r monthly wind s	speed			/				0.13](-')
Jan Feb M	/lar Apr	May Jun	Jul	Aug	Sep	Oct	Nov	Dec]	
Monthly average wind spe	ed from Table 7	,								
(22)m= 5.1 5 4	.9 4.4	4.3 3.8	3.8	3.7	4	4.3	4.5	4.7		
	· ·		•	•	•	•	•	•	•	

wind i	Factor (22	2a)m =	(22)m ÷	4										
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18		
Adjuste	ed infiltra	ition rat	e (allowi	ng for sł	nelter an	d wind s	speed) =	(21a) x	(22a)m					
	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15		
Calcula	ate effect	<i>tive air</i> Lventila	change i tion:	rate for t	he appli	cable ca	ise						- 	(220)
lf exh	aust air he	at pump	using Appe	endix N. (2	3b) = (23a) × Fmv (e	equation (I	N5)), othe	wise (23b) = (23a)			0.5	(234)
lf bala	anced with	heat reco	overv: effic	iencv in %	allowing f	or in-use f	actor (fron	n Table 4h) =) (200)			0.5	(230)
a) If	halancer	d mech	anical ve	ntilation	with he	at recov	erv (MVI	HR) (24a)m – (2:	2h)m + (23h) x [[,]	1 – (23c)		(230)
(24a)m=	0.3	0.29	0.29	0.27	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28		(24a)
b) If	balanced	d mech	ı anical ve	ntilation	without	heat red	L Covery (N	и VV) (24b)m = (22	1 2b)m + (1	23b)		1	
, (24b)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If	whole ho	ouse ex	tract ver	ntilation of	or positiv	e input	ventilatio	on from c	outside			<u> </u>	1	
i	if (22b)m	< 0.5 >	(23b), t	hen (240	c) = (23b); other	wise (24	c) = (22b	o) m + 0.	.5 × (23b) 	<u> </u>	1	(0.4-)
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) lf i	natural v if (22b)m	entilation = 1, th	on or wh en (24d)	ole hous $m = (22b)$	se positiv o)m othe	/e input rwise (2	ventilatio 24d)m =	on from I 0.5 + [(2	oft 2b)m² x	0.5]				
(24d) <mark>m=</mark>	0	0	0	0	0	0	0	0	0	0	0	0		(24d)
Effe	ctive air o	change	rate - er	nter (24a) or (24t) or (24	c) or (24	d) in boy	(25)					
(25)m=	0.3	0.29	0.29	0.27	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28		(25)
3. He	at losses	and he	eat loss r	paramete	er:									
ELEN	/IENT	Gros	SS	Openin	gs	Net Ar	ea	U-valu	le K	AXU	0	k-value		A X k
Doors	Tvpe 1	alea	(11-)			A ,I			<u> </u>	(• • • •	<u>)</u>	KJ/111-•1		KJ/ K
Doors	Type 2					2 69		1 1	=	2 88772	7			(26)
Windo						2.89			=	2. <mark>88772</mark> 2.81540	7			(26)
	ws Type	1				2.89	x x 68 x1	1 1 /[1/(0.8)+	0.04] =	2. <mark>88772</mark> 2.81540	7			(26) (26) (27)
Windov	ws Type ws Type	1 2				2.89 2.82 3.4447 19.872	x x 68 x ¹ 23 x ¹	1 [1/(0.8)+ /[1/(0.8)+	= 0.04] = 0.04] =	2.88772 2.81540 2.67 15.4	7			(26) (26) (27) (27)
Window	ws Type ws Type ws Type	1 2 3				2.89 2.82 3.4447 19.872	x 68 x1 23 x1 49 x1	1 [1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+	= 0.04] = 0.04] = 0.04] =	2.88772 2.81540 2.67 15.4 0.68	7		1	(26) (26) (27) (27) (27)
Windov Windov Windov	ws Type ws Type ws Type ws Type	1 2 3 4				2.89 2.82 3.4447 19.872 0.8717 31.800	x x 68 x1 23 x1 49 x1 67 x1	1 /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+	0.04] = [0.04] = [0.04] = [0.04] = [0.04] = [2.88772 2.81540 2.67 15.4 0.68 24.66	7		1	(26) (26) (27) (27) (27) (27)
Windov Windov Windov Floor T	ws Type ws Type ws Type ws Type Гуре 1	1 2 3 4				2.89 2.82 3.4447 19.872 0.8717 31.800	x 68 x1 23 x1 49 x1 67 x1 3 x	1 /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ 0.1	= 0.04] = [0.04] = [0.04] = [0.04] = [= =	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623				(26) (26) (27) (27) (27) (27) (27) (28)
Windov Windov Windov Floor T Floor T	ws Type ws Type ws Type ws Type Type 1 Type 2	1 2 3 4				2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690	x x 68 x1 23 x1 49 x1 67 x1 67 x1 3 x 5 x	1 /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ 0.1 0.1	= [0.04] = [0.04] = [0.04] = [0.04] = [= = [= =]	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909				(26) (26) (27) (27) (27) (27) (27) (28) (28)
Windov Windov Windov Floor T Floor T Walls	ws Type ws Type ws Type ws Type fype 1 fype 2 Type1	1 2 3 4 278.	86	61.7		2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1	x 68 x1 23 x1 49 x1 67 x1 3 x 5 x 7 x	1 /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ 0.1 0.1 0.15	= 0.04] = [0.04] = [0.04] = [0.04] = [= [= [= [= [= [2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57				(26) (27) (27) (27) (27) (27) (28) (28) (28) (29)
Windov Windov Windov Floor T Floor T Walls ⁻ Walls ⁻	ws Type ws Type ws Type ws Type fype 1 fype 2 Type1 Type1	1 2 3 4 <u>278.</u> 148.	86	61.7		2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690 217.1 148.4	x 68 x1 23 x1 49 x1 67 x1 3 x 5 x 7 x 3 x	$ \begin{array}{c c} 1 \\ \hline 1 \\ /[1/(0.8)+ \\ /[1/(0.8)+ \\ /[1/(0.8)+ \\ \hline 0.1 \\ \hline 0.1 \\ \hline 0.15 \\ 0.15 \\ \hline $	= $0.04] = [0.04] = [0.04] = [0.04] = [0.04] = [0.04] = [= [= [] = [] = [] = [= [] =$	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57 22.26				(26) (27) (27) (27) (27) (27) (28) (28) (28) (29)
Windov Windov Floor T Floor T Walls ⁻ Walls ⁻ Roof T	ws Type ws Type ws Type ws Type fype 1 fype 2 Type1 Type2 fype1	1 2 3 4 <u>278.</u> 148. 123.	86 43 86	61.7 0		2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8	x x 68 x1 23 x1 49 x1 67 x1 3 x 5 x 7 x 3 x 66 x	$ \begin{array}{c} 1\\ 1\\ (1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ 0.1\\ 0.1\\ 0.15\\ 0.15\\ 0.12\\ 0.12 \end{array} $	$\begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57 22.26 14.86				(26) (27) (27) (27) (27) (27) (28) (28) (28) (29) (29) (29) (30)
Windov Windov Floor T Floor T Walls ⁻ Roof T Roof T	ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type1	1 2 3 4 278. 148. 123. 6.4	86 43 86	61.7 0 0		2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690 217.1 148.4 123.8 6.46	x x 68 x1 23 x1 49 x1 67 x1 3 x 55 x 7 x 3 x 6 x x 6 x	$ \begin{array}{c c} 1 \\ \hline 1 \\ /[1/(0.8)+ \\ /[1/(0.8)+ \\ /[1/(0.8)+ \\ \hline 0.1 \\ 0.1 \\ \hline 0.15 \\ 0.15 \\ \hline 0.12 \\ 0.12 \\ \hline 0.12$	$\begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57 22.26 14.86 0.77				(26) (27) (27) (27) (27) (27) (28) (28) (28) (29) (29) (29) (30)
Windov Windov Floor T Floor T Walls ⁻ Walls ⁻ Roof T Roof T Total a	ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type2 area of el-	1 2 3 4 <u>278.</u> 148. <u>123.</u> 6.4 ements	86 43 86 6 , m ²	61.7 0 0 0		2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8 6.46 687.5	x x 68 x1 23 x1 49 x1 67 x1 3 x 5 x 7 x 3 x 6 x 3 x 3	1 1 /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ 0.1 0.1 0.15 0.15 0.12 0.12	$\begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57 22.26 14.86 0.77				(26) (27) (27) (27) (27) (27) (28) (28) (28) (29) (29) (29) (30) (30) (31)
Windov Windov Floor T Floor T Walls ⁻ Walls ⁻ Roof T Roof T Total a * for win	ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type2 area of el-	1 2 3 4 278. 148. 123. 6.4 ements roof wind	86 43 86 6 , m ² ows, use e	61.7 0 0 0	ndow U-va	2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8 6.46 687.5 alue calcul	x x x x x x x x x x x x x x	$ \begin{array}{c} 1\\ 1\\ (1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ 0.1\\ 0.1\\ 0.15\\ 0.15\\ 0.15\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12 \end{array} $	$\begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57 22.26 14.86 0.77 4(e)+0.04] a	7 7 5 5 1 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1	paragraph		(26) (27) (27) (27) (27) (28) (28) (28) (29) (29) (29) (30) (30) (31)
Windov Windov Floor T Floor T Walls ⁻ Roof T Roof T Total a * for win ** includ Fabric	ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type2 area of el- dows and r le the areas heat loss	1 2 3 4 <u>278.</u> 148. <u>123.</u> 6.4 ements roof wind s on both s, W/K =	86 43 86 6 , m ² ows, use e sides of ir = S (A x	61.7 0 0 0 effective wi internal walk	ndow U-va	2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690 217.1 148.4 123.8 6.46 687.5 alue calcul itions	x x 68 x1 23 x1 49 x1 67 x1 37 x 55 x 7 x 3 x 55 x 7 x 3 x 49 x1 67 x1 37 x 1 37 x 1 57 x 1 37 x 27 x 1 37 x 1 37 x 1 37 x 1 37 x 1 37 x 1 37 x 1 37 x 1 37 x 1 37 x 1 2 2 x 1 2 2 x 1 2 x 1 2 2 x 1 2 x 2 2 x 1 2 x 2 x	$ \begin{array}{c} 1\\ 1\\ (1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ (1/(0.8)+\\ 0.1\\ 0.1\\ 0.15\\ 0.15\\ 0.15\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12 \end{array} $	$\begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57 22.26 14.86 0.77	7 7 5 5 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	paragraph]	(26) (27) (27) (27) (27) (27) (28) (28) (29) (29) (29) (29) (30) (30) (31)
Windov Windov Floor T Floor T Floor T Walls ⁻ Walls ⁻ Roof T Roof T Roof T Total a * for win ** includ Fabric Heat c	ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type2 area of eli- dows and i le the areas heat loss apacity C	1 2 3 4 278. 148. 123. 6.4 ements roof wind s on both s, W/K =	86 43 86 6 , m ² ows, use e sides of ir = S (A x (A x k)	61.7 0 0 0 effective wi internal walk	ndow U-ve	2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8 6.46 687.5 blue calcul itions	x x 68 x1 23 x1 49 x1 67 x1 3 x 5 x 7 x 3 x 6 x 3 x 49 x1 67 x1 3 x 49 x1 67 x1 3 x 49 x1 67 x1 3 x 49 x1 5 x 7 x 3 x 4 5 x 4 x 1 5 x 7 x 3 x 4 5 x 7 x 4 3 x 4 5 x 7 x 4 5 x 7 x 4 5 x 7 x 4 5 x 7 x 4 5 x 7 x 4 5 x 7 x 1 5 x 7 x 1 5 x 7 x 1 3 x 4 5 x 7 x 1 3 x 4 5 x 7 x 1 3 x 4 5 x 7 x 1 3 x 4 5 x 7 x 1 3 x 4 x 1 5 x 7 x 3 x 1 5 x 7 x 3 x 4 5 x 7 x 1 3 x 4 5 x 7 x 1 3 x 4 x 1 5 x 7 x 3 x 4 x 1 x x 1 x 1 x x 1 x x x 1 x x x x x x x x x x x x x	$ \begin{array}{c} 1\\ 1\\ (1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ 0.1\\ 0.1\\ 0.15\\ 0.15\\ 0.15\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12 \end{array} $	$\begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57 22.26 14.86 0.77 (22.26) 14.86 0.77	7 7 5 5 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	paragraph (32e) =		(26) (27) (27) (27) (27) (28) (28) (28) (29) (29) (30) (30) (31) (31)
Windov Windov Floor T Floor T Valls ⁻ Walls ⁻ Roof T Roof T Total a * for win ** includ Fabric Heat c Therm	ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type2 area of el- dows and r de the areas heat loss apacity C al mass	1 2 3 4 278. 148. 123. 123. 6.4 ements s on both s, W/K = Cm = S(parame	86 43 86 6 , m ² ows, use e sides of ir = S (A x (A x k) tter (TMF	$\begin{bmatrix} 61.7\\ 0\\ 0\\ 0\\ \end{bmatrix}$	ndow U-va s and part	2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8 6.46 687.5 alue calcul itions	x x 68 x1 23 x1 49 x1 67 x1 3 x 5 x 7 x 3 x 6 x 3 2 4 6 x 3 2 1 4 9 x1 67 x1 3 x 5 x 7 x 3 x 1 6 x 1 3 x 1 23 x1 23 x1 23 x1 23 x1 23 x1 23 x1 23 x1 23 x1 23 x1 23 x1 24 x1 25 x1 26 x1 27 x1 26 x1 27 x1 27 x1 27 x1 28 x1 29 x1 20 x1 2	$ \begin{array}{c} 1\\ 1\\ (1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ 0.1\\ 0.1\\ 0.15\\ 0.15\\ 0.15\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12 \end{array} $	$ \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57 22.26 14.86 0.77 22.26 14.86 0.77	7 7 5 5 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	paragraph (32e) =	132.58 0 250	(26) (27) (27) (27) (27) (27) (28) (28) (29) (29) (29) (29) (30) (30) (31) (31)

can be ι	be used of a dealled calculation. rmal bridges : S (L x Y) calculated using Appendix K 34.35 (36) tails of thermal bridging are not known (36) = 0.05 x (31) all fabric heat loss $(3) + (36) = 1$ (37) + (38) m $(38) = 0.33 \times (25)m \times (5)$ (30) $(31) + (32) = 1$ (30) $(32) + (32) + (32)m $														
Therm	al bridg	es : S (L	x Y) cal	culated u	using Ap	pendix ł	<						34.35	(36)	
if details	stails of thermal bridging are not known $(36) = 0.05 \times (31)$ tal fabric heat loss $(33) + (36) =$ 166.93 (37) ntilation heat loss calculated monthly $(38)m = 0.33 \times (25)m \times (5)$ (38)m = 0.33 \times (25)m \times (5) (38)m = 0.33 \times (25)m \times (5) Image: 108.12 106.96 105.8 99.99 98.83 93.03 91.87 95.35 98.83 101.15 103.47 (38) at transfer coefficient, W/K (39)m = (37) + (38)m (37) (38) (37) (38) m= 275.04 273.88 272.72 266.92 265.76 259.96 258.8 262.28 265.76 268.08 270.4 Average = Sum(39) ₁₁₂ /12= 266.63 (39) at loss parameter (HLP), W/m ² K (40)m = (39)m ÷ (4) (m= 0.72 0.72 0.7 0.7 0.68 0.68 0.69 0.7 0.71 0.71 0.71														
Total fa	abric he	at loss							(33) +	(36) =			166.93	(37)	
Ventila	tion hea	at loss ca	alculated	I monthly	/				(38)m	= 0.33 × (25)m x (5)				
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
(38)m=	108.12	106.96	105.8	99.99	98.83	93.03	93.03	91.87	95.35	98.83	101.15	103.47		(38)	
Heat tr	ansfer o	coefficier	nt, W/K						(39)m	= (37) + (3	38)m				
(39)m=	275.04	273.88	272.72	266.92	265.76	259.96	259.96	258.8	262.28	265.76	268.08	270.4			
				I						Average =	Sum(39)1.	.12 /12=	266.63	(39)	
Heat lo	oss para	imeter (F	HLP), W/	′m²K					(40)m	= (39)m ÷	· (4)		I		
(40)m=	0.72	0.72	0.72	0.7	0.7	0.68	0.68	0.68	0.69	0.7	0.71	0.71		_	
Numbe	er of day	/s in moi	nth (Tab	le 1a)					,	Average =	Sum(40)1	.12 /12=	0.7	(40)	
(41)m= 31 28 31 30 31 30 31 31 30 31 31 30 31 30 31														(41)	
4 \M/2	4. Water heating energy requirement: kWh/year:														
4. Water heating energy requirement: kWh/year:															
Assum	ed occu	upancy, I	N								3.	24		(42)	
if TE	A > 13.	9, $N = 1$	+ 1.76 x	[1 - exp	(-0.0003	49 x (TF	-A -13.9)2)] + 0.0)013 x (IFA -13.	.9)				
Annua	averac	le hot wa	ater usad	ae in litre	s per da	v Vd.av	erage =	(25 x N)	+ 36		111	05		(43)	
Redu <mark>ce</mark>	the annua	al average	hot water	usage by a	5% if the d	welling is	designed t	o achieve	a water us	se target o	f			()	
not more	e that 125	litres per p	person pei	day (all w	ater use, h	not and co	ld)								
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Hot wate	er usage i	n litres per	day for ea	ach month	Vd,m = fa	ctor from T	Table 1c x	(43)							
(44)m=	122.16	117.72	113.27	108.83	104.39	99.95	99.95	104.39	108.83	113.27	117.72	122.16			
									-	Total = Su	m(44) ₁₁₂ =		1332.64	(44)	
Energy of	content of	hot water	used - cal	culated mo	onthly $= 4$.	190 x Vd,n	m x nm x D	0Tm / 3600	kWh/mor	oth (see Ta	ables 1b, 1	c, 1d)			
(45)m=	181.16	158.44	163.5	142.54	136.77	118.02	109.37	125.5	127	148	161.56	175.44			
									-	Total = Su	m(45) ₁₁₂ =		1747.31	(45)	
lf instan	taneous v	ater heatii	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46)) to (61)						
(46)m=	27.17	23.77	24.52	21.38	20.52	17.7	16.4	18.82	19.05	22.2	24.23	26.32		(46)	
Water	storage	loss:											I		
Storag	e volum	ie (litres)	incluair	ig any so	biar or v	WHR5	storage	within sa	ime ves	sei		150		(47)	
If com	nunity h	eating a	ind no ta	nk in dw	elling, e	nter 110) litres in	(47)		or (0) in (47)				
Water	rise II no		not wate	er (unis in	iciudes i	nstantar	ieous co		ers) ente	er o m (47)				
a) If m	anufact	urer's de	eclared l	oss facto	or is kno	wn (kWł	n/dav).				1	95		(48)	
Tempe	arature f	actor fro	m Table	2h			"aay):				1.	55		(40)	
Enorm	loot fro				or			$(49) \times (40)$			0.	54		(49)	
b) If m	anufact	m water urer's de	slorage	, Kvvn/ye svlinder l	ear oss facti	or is not	known.	(40) X (49)	=		1.	05		(50)	
Hot wa	iter stor	age loss	factor fr	om Tabl	e 2 (kWl	h/litre/da	ay))		(51)	
If com	munity ł	eating s	ee secti	on 4.3	,		- /						I	. /	
Volum	e factor	from Ta	ble 2a								(0		(52)	
Tempe	erature f	actor fro	m Table	2b							(0		(53)	

Energy Enter	/ lost fro (50) or	om water (54) in (5	• storage 55)	e, kWh/ye	ear			(47) x (51)) x (52) x (53) =	1.	0		(54) (55)
Water	storage	loss cal	culated	for each	month			((56)m = (55) × (41)	m				
(56)m=	32.64	29.48	32.64	31.59	32.64	31.59	32.64	32.64	31.59	32.64	31.59	32.64		(56)
If cylinde	er contain	s dedicate	d solar sto	orage, (57)	m = (56)m	x [(50) – (H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Append	lix H	
(57)m=	32.64	29.48	32.64	31.59	32.64	31.59	32.64	32.64	31.59	32.64	31.59	32.64		(57)
Primar	y circuit	loss (ar	nual) fro	om Table	e 3	-		-	-	-		0		(58)
Primar	y circuit	loss cal	culated	for each	month (59)m = ((58) ÷ 36	65 × (41)	m					
(moo	dified by	factor f	rom Tab	le H5 if t	here is s	olar wat	ter heatii	ng and a	cylinde	r thermo	ostat)	1		
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
Combi	loss ca	lculated	for each	month	(61)m =	(60) ÷ 30	65 × (41))m	-	-		-		
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)
Total h	neat req	uired for	water h	eating ca	alculated	for eac	h month	(62)m =	0.85 × ((45)m +	(46)m +	(57)m +	(59)m + (61)	m
(62)m=	237.06	208.94	219.4	196.64	192.68	172.13	165.27	181.41	181.1	203.91	215.66	231.35		(62)
Solar DH	HW input	calculated	using App	endix G o	r Appendix	H (negati	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)		
(add a	dditiona	l lines if	FGHRS	and/or \	NWHRS	applies	, see Ap	pendix (G)				1	
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output	t from w	ater hea	ter										I	
(64)m=	237.06	208.94	219.4	196.64	192.68	172.13	165.27	181.41	181.1	203.91	215.66	231.35		_
								Outp	out from wa	ater heate	r (annual)₁	12	2405.55	(64)
Heat g	ains fro	m water	heating.	, kWh/m	onth 0.2	5 / [0.85	× (45)m	i + (61)m	1] + 0.8 >	(<mark>(46)m</mark>	+ (57)m	+ (59)m]	
(65)m=	104.96	93.08	99.09	90.68	90.2	82.52	81.09	86.45	85.51	93.94	97	103.06		(65)
inclu	ide (57)	m in calo	culation	of (65)m	only if c	ylinder i	s in the o	dwelling	or hot w	ater is fr	om com	munity h	eating	
5. Int	ternal ga	ains (see	e Table 5	5 and 5a):									
Metab	olic gair	is (Table	<u>e 5), Wat</u>	ts									I	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		(2.2)
(66)m=	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8		(66)
Lightin	g gains	(calcula	ted in A _l	ppendix	L, equat	ion L9 o	r L9a), a I	lso see	Table 5				I	(07)
(67)m=	50.67	45	36.6	27.71	20.71	17.49	18.89	24.56	32.96	41.85	48.85	52.08		(67)
Applia	nces ga	ins (calc I	ulated ir	n Appeno	dix L, eq	uation L	13 or L1	3a), also I	see Ta	ble 5	1		I	(00)
(68)m=	520.24	525.64	512.04	483.07	446.52	412.16	389.2	383.8	397.41	426.37	462.93	497.29		(68)
Cookir	ng gains	(calcula	ted in A	ppendix I	L, equat	ion L15	or L15a)), also se	ee Table	5			I	(22)
(69)m=	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18		(69)
Pumps	s and fa	ns gains I	(Table :	5a)	1		1				1		I	(70)
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3		(70)
Losses	s e.g. ev	aporatic	on (nega I	tive valu	es) (Tab I	le 5)	1				1		I	
(71)m=	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44		(71)
Water	heating	gains (T	able 5)	1							1		I	
(72)m=	141.07	138.51	133.18	125.94	121.24	114.62	108.99	116.2	118.76	126.26	134.72	138.52		(72)
Total i	Internal	gains =		_		(66))m + (67)m	n + (68)m -	+ (69)m + ((70)m + (7	1)m + (72)	m	I	
(73)m=	786.52	783.69	756.36	711.26	663	618.8	591.63	599.1	623.67	669.02	721.04	762.42		(73)
6. So	lar gains	S:												

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

Orienta	tion:	Access Factor Table 6d	r	Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.44	×	10.63) x	0.6	x	0.7] =	10.66	(74)
North	0.9x	0.77	x	3.44	×	20.32	x	0.6	x	0.7] =	20.37	(74)
North	0.9x	0.77	x	3.44	x	34.53	x	0.6	x	0.7] =	34.62	(74)
North	0.9x	0.77	x	3.44	×	55.46	x	0.6	x	0.7] =	55.61	(74)
North	0.9x	0.77	x	3.44	×	74.72	x	0.6	x	0.7] =	74.91	(74)
North	0.9x	0.77	x	3.44	x	79.99	x	0.6	x	0.7	=	80.2	(74)
North	0.9x	0.77	x	3.44	x	74.68	x	0.6	x	0.7] =	74.87	(74)
North	0.9x	0.77	x	3.44	x	59.25	x	0.6	x	0.7] =	59.4	(74)
North	0.9x	0.77	x	3.44	×	41.52	x	0.6	x	0.7] =	41.63	(74)
North	0.9x	0.77	x	3.44	x	24.19	x	0.6	x	0.7] =	24.25	(74)
North	0.9x	0.77	x	3.44	×	13.12	x	0.6	x	0.7] =	13.15	(74)
North	0.9x	0.77	x	3.44	×	8.86	x	0.6	x	0.7] =	8.89	(74)
East	0.9x	0.77	x	19.87	×	19.64	x	0.6	x	0.7	=	113.6	(76)
East	0.9x	0.77	x	19.87	×	38.42	x	0.6	x	0.7] =	222.22	(76)
East	0.9x	0.77	x	19.87	×	63.27	x	0.6	x	0.7	=	365.97	(76)
East	0.9x	0.77	x	19.87	×	92.28	x	0.6	х	0.7		533.75	(76)
East	0.9x	0.77	x	19.87	x	113.09	x	0.6	x	0.7] =	654.13	(76)
East	0.9x	0.77	x	19.87	x	115.77	İ 🖈	0.6	x	0.7] =	669.62	(76)
East	0.9x	0.77	x	19.87	x	110.22	x	0.6	x	0.7	=	637.5	(76)
East	0.9x	0.77	x	19.87	x	94.68	x	0.6	x	0.7] =	547.61	(76)
East	0.9x	0.77	x	19.87	x	73.59	×	0.6	x	0.7] =	425.64	(76)
East	0.9x	0.77	x	19.87	х	45.59	x	0.6	x	0.7	=	2 <mark>63.69</mark>	(76)
East	0.9x	0.77	x	19.87	×	24.49	x	0.6	x	0.7] =	141.65	(76)
East	0.9x	0.77	x	19.87	×	16.15	x	0.6	x	0.7] =	93.42	(76)
South	0.9x	0.77	x	0.87	×	46.75	x	0.6	x	0.7] =	11.86	(78)
South	0.9x	0.77	x	0.87	×	76.57	x	0.6	x	0.7] =	19.43	(78)
South	0.9x	0.77	x	0.87	x	97.53	x	0.6	x	0.7] =	24.75	(78)
South	0.9x	0.77	x	0.87	x	110.23	x	0.6	x	0.7	=	27.97	(78)
South	0.9x	0.77	x	0.87	x	114.87	x	0.6	x	0.7	=	29.15	(78)
South	0.9x	0.77	x	0.87	x	110.55	x	0.6	x	0.7] =	28.05	(78)
South	0.9x	0.77	x	0.87	x	108.01	x	0.6	x	0.7] =	27.41	(78)
South	0.9x	0.77	x	0.87	x	104.89	x	0.6	x	0.7	=	26.62	(78)
South	0.9x	0.77	x	0.87	x	101.89	x	0.6	x	0.7	=	25.85	(78)
South	0.9x	0.77	x	0.87	x	82.59	x	0.6	x	0.7	=	20.95	(78)
South	0.9x	0.77	x	0.87	x	55.42	x	0.6	x	0.7] =	14.06	(78)
South	0.9x	0.77	x	0.87	×	40.4	x	0.6	x	0.7] =	10.25	(78)
West	0.9x	0.77	x	31.81	×	19.64	x	0.6	x	0.7] =	181.82	(80)
West	0.9x	0.77	x	31.81	×	38.42	x	0.6	x	0.7] =	355.68	(80)
West	0.9x	0.77	x	31.81	x	63.27	x	0.6	x	0.7	=	585.76	(80)

West	0.9x	0.77	x	31.	81	×	9	2.28	x		0.6] x [0.7	=	854.3	(80)
West	0.9x	0.77	×	31.	81	×「	1	13.09	x		0.6	Ξ́×Γ	0.7	=	1046.97	(80)
West	0.9x	0.77	x	31.	81	×	1′	15.77	x		0.6	=	0.7	=	1071.76	(80)
West	0.9x	0.77	x	31.	81	×	11	10.22	x		0.6	_ × [0.7	=	1020.36	(80)
West	0.9x	0.77	x	31.	81	×	9	4.68	x		0.6		0.7	=	876.48	(80)
West	0.9x	0.77	x	31.	81	×	7	3.59	x		0.6	Ī × Ī	0.7	=	681.26	(80)
West	0.9x	0.77	x	31.	81	×	4	5.59	x		0.6	_ × [0.7	=	422.05	(80)
West	0.9x	0.77	x	31.	81	×	2	4.49	x		0.6] × [0.7	=	226.71	(80)
West	0.9x	0.77	x	31.	81	×	1	6.15	x		0.6	x [0.7	=	149.52	(80)
Solar g	gains in	watts, ca	alculated	for eac	h month	<u> </u>			(83)m	ı = Su	m(74)m	.(82)m			1	
(83)m=	317.95	617.71	1011.1	1471.63	1805.16	184	49.63	1760.15	1510	0.1	1174.38	730.95	395.57	262.08		(83)
Total g	gains – i	nternal a	and sola	r (84)m = T	= (73)m I	+ (8	33)m	, watts			I		1		l	(0.1)
(84)m=	1104.47	1401.4	1767.46	2182.89	2468.17	240	68.43	2351.77	2109	9.2	1798.05	1399.96	5 1116.61	1024.5	1	(84)
7. Me	ean inter	nal temp	berature	(heating	seasor	า)										
Temp	perature	during h	neating p	eriods i	n the livi	ng a	area f	rom Tab	ole 9,	, Th1	(°C)				21	(85)
Utilis	ation fac	tor for g	ains for	living are	ea, h1,m	n (se	e Ta	ble 9a)							1	
	Jan	Feb	Mar	Apr	May	<u> </u>	Jun	Jul	Αι	ug	Sep	Oct	Nov	Dec		
(86)m=	1	1	1	0.98	0.88	0	0.66	0.49	0.5	56	0.89	1	1	1		(86)
Me <mark>ar</mark>	n interna	l temper	ature in	living ar	ea T1 (f	olloy	w ste	ps 3 t <mark>o 7</mark>	' in T	able	9c)					
(87)m=	20.66	20.69	20.74	20.82	20.87	20	0.89	20.89	20.8	89	20.88	20.8	20.72	20.65		(87)
Temp	oerature	during h	neating p	periods in	n rest of	dwe	elling	from Ta	ble 9	9, Th	2 (°C)					
(88)m=	20.32	20.32	20.33	20.34	20.34	20	0.35	20.35	20.3	36	20.35	20.34	20.34	20.33		(88)
Utilis	ation fac	tor for a	ains for	rest of d	welling,	h2,i	m (se	e Table	9a)							
(89)m=	1	1	1	0.98	0.85		0.6	0.41	0.4	8	0.84	1	1	1		(89)
Mear	interna	l temper	ature in	the rest	of dwell	ling	T2 (fr	allow ste	ns 3	to 7	in Table	2 9c)	1			
(90)m=	19.83	19.88	19.97	20.09	20.16	2	20.2	20.2	20.	.2	20.18	20.07	19.94	19.84		(90)
						1					fl	A = Livi	ng area ÷ (4	4) =	0.07	(91)
Moor	intorno	ltompor	oturo (fr	r tho wh	olo dur	lling		Δ Τ1	. (1	۴I۸	<u>у у то</u>				L	
(92)m-	19.89		20.02	20 14	20 22) = IL 0.25	_A X I I	+ (1 -	- ILA	20.23	20.12	20	19.9		(92)
	/ adjustr	nent to t	he mear	interna		ratu	re fro	m Table	4e 1	wher		priate	20	10.0		
(93)m=	19.74	19.79	19.87	19.99	20.07	2	20.1	20.1	20.	.1	20.08	19.97	19.85	19.75		(93)
8. Sp	ace hea	ting requ	uiremen	l		1										
Set T	i to the	mean int	ernal te	mperatu	re obtaiı	ned	at ste	ep 11 of	Tabl	e 9b,	so that	: Ti,m=	(76)m an	d re-calc	ulate	
the u	tilisation	factor fo	or gains	using Ta	able 9a	-									1	
	Jan	Feb	Mar	Apr	May	<u> </u>	Jun	Jul	Aı	ug	Sep	Oct	Nov	Dec		
Utilis	ation fac	tor for g	ains, hrr I): 											1	(0.1)
(94)m=	1	1		0.97	0.83	0).58	0.39	0.4	5	0.82	0.99	1	1	l	(94)
USET	JI gains,	nmGm	, VV = (9)	4)m x (8	4)m	14	21 17	000.02	057	62	1 160 15	1202.2	1116 45	1024 49		(05)
Mont	hly aver				$\frac{2000.00}{100}$		۲۰۰۱/ ۵ 8	909.90	337.	.05	1400.40	1392.3		1024.40		(33)
(96)m=	4.3	4.9	6.5	8.9	11.7	1	4.6	16.6	16	.4	14.1	10.6	7.1	4.2		(96)
Heat	loss rate	e for mea	an interr	al temp	erature	Lm.	, W =	=[(39)m :	x [(9:	 3)m–	(96)m		I .		I	
(97)m=	4247.9	4079.01	3647.53	2961.16	2223.54	14	, 29.9	910.28	958.	.74	1569.16	2490.29	3416.82	4205.46		(97)
	-															

Spac	e heatin	g require	ement fo	or each n	nonth, k	Wh/mon	th = 0.02	24 x [(97))m – (95	5)m] x (4	1)m			
(98)m=	2338.74	1799.58	1401.85	604.37	124.76	0	0	0	0	816.91	1656.27	2366.65		
							-	Tota	l per year	(kWh/yeai	r) = Sum(9	8)15,912 =	11109.11	(98)
Spac	e heatin	g require	ement in	∙kWh/m²	²/year								29.23	(99)
80 S	nace co	olina rea	nuiremer	ht	-									
Calci	lated fo	r.lune .	July and	August	See Tal	ble 10b								
Calot	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Heat	loss rate	e Lm (ca	lculated	using 2	5°C inter	rnal tem	perature	and exte	ernal ten	nperatur	e from T	able 10)	1	
(100)m=	0	0	0	0	0	2443.66	1923.73	1966.91	0	0	0	0		(100)
Utilisa	ation fac	tor for lo	oss hm										-	
(101)m=	0	0	0	0	0	0.96	0.99	0.97	0	0	0	0		(101)
Usefu	ul loss, h	mLm (V	Vatts) =	(100)m >	k (101)m								•	
(102)m=	0	0	0	0	0	2343.62	1897.21	1912.03	0	0	0	0		(102)
Gains	s (solar	gains ca	lculated	for appli	icable w	eather re	egion, se	e Table	10)				1	
(103)m=	0	0	0	0	0	3057.76	2916.81	2637.86	0	0	0	0		(103)
Spac	e coolin	g require	ement fo	r month,	, whole c	dwelling,	continu	ous (kW	(h) = 0.0	24 x [(10	03)m – (*	102)m]:	x (41)m	
(104)m-						514 18	758 58	540.02	0	0		0	1	
(104)			L ů			014.10	100.00	040.02	 Total	– Sum(1.04)	_	1812 78	T (104)
Cooled	d fractio	n							f C =	cooled	area ÷ (4	l) =	1.57	(105)
Interm	<mark>itte</mark> ncy f	actor (Ta	able 10b)							· ·	,	L	
(106) <mark>m=</mark>	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0		
									Tota	I = Sum((104)	=	0	(106)
Space	cooling	require	ment for	month =	= (104)m	× (105)	× (106)r	n						
(107)m=	0	0	0	0	0	201.71	297.59	211.85	0	0	0	0		_
									Total	l = Sum(107)	=	711.14	(107)
Space	cooling	require	ment in l	«Wh/m²/	year				(107)) ÷ (4) =			1.87	(108)
9a. En	ergy red	quiremer	nts – Ind	ividual h	eating s	ystems i	ncluding	micro-C	CHP)					
Spac	e heatii	ng:												_
Fract	ion of sp	bace hea	at from s	econdar	y/supple	mentary	system						0	(201)
Fract	ion of sp	bace hea	at from n	nain syst	tem(s)			(202) = 1 -	- (201) =				1	(202)
Fract	ion of to	tal heati	ng from	main sy	stem 1			(204) = (2	02) × [1 –	(203)] =			1	(204)
Efficie	ency of	main spa	ace heat	ing syste	em 1								89.9	(206)
Efficie	ency of	seconda	ry/suppl	ementar	y heating	g systen	ז, %						0	(208)
Cooli	ng Syste	em Ener	gy Effici	ency Ra	tio								4.05	(209)
		Eeb	Mar		May	lun	lul	Δυσ	Son	Oct	Nov	Dec	k)//b/v/o	_l ⊃r
Snac	e heatin		ement (c	<u>alculate</u>	d above)	Jui	Aug	Seb			Dec	Kvvi//ye	ai
Opac	2338.74	1799.58	1401.85	604.37	124.76	/ 0	0	0	0	816.91	1656.27	2366.65	1	
(011))m v (20					-	-					l	(014)
(211)11	$I = \{[(90) \\ 2601 \\ 49 \end{bmatrix}$	2001 75	[1559 34	$100 \div (20)$	138 77	0	0	0	0	908 68	1842 34	2632 53	1	(211)
	2001.43	2001.70	1000.04	072.27	100.77	0	0	Tota	l (kWh/vea	ar) = Sum(2)	211)	2002.00	12257 10	7(211)
Snor	o hootin	a fuel /s	ooondar	ν.) [J\Λ/]-	manth			. 014		, Santa	- * * / 15,1012		12007.19	
Shac	$m \times (20)$	y iuei (S)1)] \ v 1	econdar	у), күүп/ 181	month									
(215)m=		0	0 - 120	0	0	0	0	0	0	0	0	0		
、 · - /····-							I	Tota	l I (kWh/yea	ar) =Sum(2	215), ₅₄₀ 42	=	0	(215)
									· · · · ·		- 1		Ľ	· · · /

Water heating

from wa	ater hea	ter (calc	ulated a	bove)			-							
237.06	208.94	219.4	196.64	192.68	172.13	165.27	181.41	181.1	203.91	215.66	231.35		-	
cy of w	ater hea	iter		· · · · ·	1				1	ı —		79.8	(216)	
88.86	88.73	88.39	87.19	83.49	79.8	79.8	79.8	79.8	87.68	88.61	88.9		(217)	
water = (64)	heating, m x 100	kWh/mo (217) ∸ (217)	onth											
266.77	235.47	248.23	225.53	230.79	215.7	207.11	227.32	226.94	232.55	243.39	260.24			
							Tota	al = Sum(2	19a) ₁₁₂ =	_		2820.05	(219)	
	g fuel, k	Wh/mor	nth.										_	
= (107) 0)m÷ (20:	9) 0	0	0	49.8	73.48	52.31	0	0	0	0			
-							Tota	al = Sum(2)	21) ₆₈ =			175.59	(221)	
totals									k	Wh/veai	r	kWh/vear	1	
neating	fuel use	ed, main	system	1								12357.19]	
neating	fuel use	d										2820.05]	
cooling	fuel use	ed										175.59]	
ity for p	oumps, fa	ans and	electric	keep-ho	t								-	
anical v	entilatio	n - balar	nced, ext	ract or p	ositive i	nput fro	m outsid	е			1480.05		(230a)	
l heatin	g pump	:									30		(230c)	
ectricity	/ for the	above, l	kWh/yea	r			sum	of (230a).	<mark>(2</mark> 30g) =			1510.05	(231)	
ity for li	ghting											894.79] (232)	
O2 em	issions -	– Individ	ual heat	ing syste	ems inclu	udina m	nicro-CHF	2			l			
		I			En k\/	ergy /b/vear			Emiss	ion fac 2/k\//h	tor	Emissions	r	
neatina	(main s	vstem 1)		(21	1) x				16	=	2669 15	T(261)	
o neating	` (second	darv)	,		(21	5) x			0.5	10	=	0		
	(000011	uury)			(21)				0.5	19	- I	0		
leating					(26)	1) . (262)	\	(264) -	0.2	16	-	609.13] ⁽²⁰⁴⁾	
and war	ter neati	ng			(20	1) + (202)) + (203) +	(204) =			l	3278.28	(265)	
cooling					(22)	1) x			0.5	19	=	91.13	(266)	
ity for p	oumps, f	ans and	electric	keep-ho	t (23 ⁻	1) x			0.5	19	=	783.72	(267)	
ity for li	ghting				(232	2) x			0.5	19	=	464.4	(268)	
02, kg/	year							sum o	of (265)(271) =	[4617.53	(272)	
ng CO2	Emissi	on Rate	•					(272)	÷ (4) =		[12.15	(273)	
g (secti	on 14)										[85	(274)	
	from wa 237.06 cy of w 88.86 water = (64) 266.77 cooling = (107 0 totals heating heating heating cooling ity for p nical w 1 heating hea	from water hea237.06208.94cy of water hea88.8688.73water heating,= (64) m x 100266.77235.47cooling fuel, k= (107) m÷ (20900totalsheating fuel usecooling (secondand water heatingcoolingity for lightingO2, kg/yearag CO2 Emissig (section 14)	from water heater (calc 237.06 208.94 219.4 cy of water heater 88.86 88.73 88.39 water heating, kWh/mod = (64)m x 100 ÷ (217) 266.77 235.47 248.23 cooling fuel, kWh/mod = (107)m÷ (209) 0 0 0 0 0 0 totals heating fuel used icooling fuel used ity for pumps, fans and anical ventilation - balar I heating pump: ectricity for the above, I ity for lighting ity for lighting 02 emissions – Individ heating (main system 1 heating (secondary)) heating and water heating cooling ity for lighting 02, kg/year and and ity for lighting 02, kg/year and 02, kg/year and and ig (co2 Emission Rate g (section 14) ity	from water heater (calculated a 237.06 208.94 219.4 196.64 cy of water heater 88.86 88.73 88.39 87.19 water heating, kWh/month = (64)m x 100 \div (217)m 266.77 235.47 248.23 225.53 cooling fuel, kWh/month. = (107)m \div (209) 0 0 0 0 totals heating fuel used, main system heating fuel used cooling fuel used cooling fuel used ity for pumps, fans and electric anical ventilation - balanced, ext I heating pump: ectricity for the above, kWh/yea ity for lighting C2 emissions – Individual heat heating (main system 1) heating (secondary) heating and water heating cooling ity for pumps, fans and electric ity for pumps, fans and electric fuely for lighting C2 emissions – Individual heat pag CO2 Emission Rate g (section 14)	from water heater (calculated above)237.06208.94219.4196.64192.68cy of water heater88.8688.7388.3987.1983.49water heating, kWh/month= (64)m x 100 ÷ (217)m266.77235.47248.23225.53230.79cooling fuel, kWh/month.= (107)m÷ (209)00000000totalsheating fuel used, main system 1heating fuel usedcooling 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			User D	etails:						
Assessor Name: Software Name:	Stroma FSAP 20	12		Strom Softwa	a Num are Vei	ber: rsion:		Versic	on: 1.0.4.26	
		Р	roperty	Address	: 9D The	e Grove_	Propose	ed_Be Le	ean	
Address :										
1. Overall dwelling dimens	Sions:		A	n (ma 2)		A.v. 11a	arla t (ma)			
Basement			Area	a(m²)	(1a) x	AV. Hel		(2a) =		1 (3-3)
				26.23	(1a) X		3](2a) =	378.69	
Ground floor			1	29.92	(1b) x		3	(2b) =	389.76	(3b)
First floor			1	23.86	(1c) x	2	2.7	(2c) =	334.42	(3c)
Total floor area $TFA = (1a)$	+(1b)+(1c)+(1d)+(1	e)+(1r	n) 3	80.01	(4)					
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+	.(3n) =	1102.87	(5)
2. Ventilation rate:										
	m ³ per hour									
Number of chimneys	0 +	0	+	0	=	0	X	40 =	0	(6a)
Number of open flues	0 +	0	<u> </u> + [0	_ _ = _	0	x	20 =	0	(6b)
Number of intermittent fans					- Ē	4	x -	10 =	40	(7a)
Number of passive vents					Ē	0	x	10 =	0	(7b)
Number of flueless gas fire	s					0	X	40 =	0	(7c)
								Air ch	nange <mark>s per</mark> hou	ır
Infiltration due to chimneys	, flues and fans =	(6a)+(6b)+(7	a)+(7b)+(7c) =	Ţ	40		÷ (5) =	0.04	(8)
It a pressurisation test has bee	n carried out or is inten	ded, procee	d to (17), i	otherwise (continue fr	om (9) to (16)			
Additional infiltration	dwelling (IIS)						[(9)]	-11x0 1 =	0	(9)
Structural infiltration: 0.2	5 for steel or timbe	r frame or	0.35 fo	r masoni	ry constr	uction			0	(11)
if both types of wall are pres deducting areas of openings	ent, use the value corre s); if equal user 0.35	esponding to	the great	ter wall are	a (after]
If suspended wooden flo	or, enter 0.2 (unse	aled) or 0	1 (seale	ed), else	enter 0				0	(12)
If no draught lobby, enter	r 0.05, else enter 0								0	(13)
Percentage of windows a	and doors draught	stripped							0	(14)
Window infiltration				0.25 - [0.2	2 x (14) ÷ 1	= [00			0	(15)
Infiltration rate				(8) + (10)	+ (11) + (1	12) + (13) +	+ (15) =		0	(16)
Air permeability value, q	50, expressed in cu	ibic metre	s per ho	our per s	quare m	etre of e	nvelope	area	5	(17)
If based on air permeability	value, then (18) = [(17) ÷ 20]+(B), otherw	ise (18) = ((16)				0.29	(18)
Air permeability value applies in	f a pressurisation test h	as been dor	ne or a de	gree air pe	rmeability	is being us	sed		r	-
Number of sides sheltered				(20) = 1 -	[0 075 x (1	19)] =			2	(19)
Infiltration rate incorporation	a shelter factor			(20) = 1 (21) = (18)	(20) = (20) =	[0]] =			0.85	$\int_{(21)}^{(20)}$
Infiltration rate modified for	monthly wind snew	be		<u>,-</u> ., = (10	, (=0) =				0.24	J ⁽²¹⁾
Jan Feb M	ar Apr Ma	/ Jun	Jul	Aua	Sep	Oct	Nov	Dec]	
Monthly average wind spee	ed from Table 7	1		<u> </u>	- 7				1	
(22)m= 5.1 5 4.	9 4.4 4.3	3.8	3.8	3.7	4	4.3	4.5	4.7		
		1	I	I	I	1	I	I	1	

Wind F	Factor (22	2a)m =	(22)m ÷	4											
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18]		
Adjust	ed infiltra	tion rate	e (allowi	ing for sl	nelter ar	nd wind s	speed) =	= (21a) x	(22a)m						
	0.31	0.3	0.3	0.27	0.26	0.23	0.23	0.23	0.24	0.26	0.27	0.29]		
Calcul	l ate effect	tive air (change	rate for t	he appl	cable ca	ise	-		-		-	-		
If mechanical ventilation:							aquation (rwise (23h	(23a)				0	(23a)
If bal	anced with	heat reco	overv: effic	viency in %		for in-use f	actor (fror	m Table 4h) –) = (20a)				0	(230)
a) If	balanced	d mecha	anical ve	entilation	with he	at recove	ery (MV	HR) (24a	a)m = (2	2b)m + (23b) × [′	1 – (23c)	L) ÷ 100]	0	(230)
(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0]		(24a)
b) If	balanced	d mecha	anical ve	entilation	without	heat red	covery (MV) (24b)m = (2	2b)m + (23b)		-		
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0			(24b)
c) If	whole ho if (22b)m	ouse ex < 0.5 ×	tract ver (23b), 1	ntilation of then (24)	or positiv c) = (23I	ve input v o); otherv	ventilati wise (24	on from c lc) = (22t	outside b) m + 0	.5 × (23b)		-		
(24c)m=		0	0	0	0	0	0	0	0	0	0	0]		(24c)
d) If	natural v if (22b)m	entilation $= 1, the$	on or wh en (24d)	iole hous m = (22	se positi b)m othe	ve input erwise (2	ventilati 24d)m =	on from I 0.5 + [(2	oft 2b)m² x	0.5]	1		1		
(24d) <mark>m=</mark>	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.54	0.54			(24d)
Effe	ctive air c	change	rate - er	nter (24a) or (24	o) or (24	c) or (2	4d) in boy	(25)						
(25)m=	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.54	0.54	1		(25)
3 Ho	at losses	and he	atloss	naramet	or.								-		
							_								V L
ELEN		Gros	3S (m²)	Openin	igs 1 ²	Net Ar	rea m²	U-valu W/m2	le K	A X U	\sim	k-valu k.l/m²-	e K	A . kJ	х к /К
Doors	Type 1	area	ss (m²)	Openin rr	igs 1 ²	Net Ar A ,r 2.89	rea m²	U-valu W/m2	ue K =	A X U (W/I 2.88772	K) 7	k-valu kJ/m²⊷	e K	A kJ	х к /К (26)
Doors Doors	Type 1 Type 2	area	(m²)	Openin r	igs 1 ²	Net Ar A ,r 2.89	rea m² x	U-valu W/m2	Je K = =	A X U (W/I 2.88772 2.81540	K) 7 7	k-valu kJ/m²•	e K	A kJ	X K /K (26) (26)
Doors Doors Windo	Type 1 Type 2 ws Type	area	(m²)	Openin rr	igs 1 ²	Net Ar A ,r 2.89 2.82 3.4447	rea m ² x x 68 x ¹	U-valu W/m2	ue K = 0.04] =	A X U (W/ 2.88772 2.81540 4.57	K) 7 7	k-valu₀ kJ/m²∙	e K	A kJ	(26) (26) (27)
Doors Doors Windo Windo	Type 1 Type 2 ws Type ws Type	area	(m²)	Openin m	IGS 1 ²	Net Ar A ,r 2.89 2.82 3.4447 19.872	rea m ² x x 68 x ¹ 23 x ¹	U-valu W/m2 1 1/[1/(1.4)+	LE K = 0.04] = 0.04] =	A X U (W/I 2.88772 2.81540 4.57 26.35	K) 7 7	k-valu kJ/m²-	e K	A kJ	(26) (26) (27) (27)
Doors Doors Windo Windo Windo	Type 1 Type 2 ws Type ws Type ws Type	area 1 2 3	(m²)	Openin r	IGS 1 ²	Net Ar A ,r 2.89 2.82 3.4447 19.872 0.8717	rea m ² x 68 x1 23 x1 49 x1	U-valu W/m2	LE K = 0.04] = 0.04] = 0.04] =	A X U (W/ 2.88772 2.81540 4.57 26.35 1.16	K) 7	k-valu kJ/m²•	e K	A kJ	X K (26) (26) (27) (27) (27)
Doors Doors Windo Windo Windo Windo	Type 1 Type 2 ws Type ws Type ws Type ws Type ws Type	area 1 2 3 4	55 (m²)	Openin r	IGS 1 ²	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.806	rea m ² x 68 x1 23 x1 49 x1 67 x1	U-valu W/m2 1 1/[1/(1.4)+ 1/[1/(1.4)+ 1/[1/(1.4)+	LE K = 0.04] = 0.04] = 0.04] = 0.04] =	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17	K) 7	k-valu kJ/m²•	e K	A kJ	X K (26) (26) (27) (27) (27) (27) (27)
Doors Doors Windo Windo Windo Windo Floor	Type 1 Type 2 ws Type ws Type ws Type ws Type ws Type Type 1	area 1 2 3 4	(m²)	Openin r	Igs 1 ²	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.800 126.2	rea m ² x 68 x ¹ 23 x ¹ 49 x ¹ 67 x ¹ 3 x	U-valu W/m2 1 1/[1/(1.4)+ 1/[1/(1.4)+ 1/[1/(1.4)+ 1/[1/(1.4)+ 0.13	LE K = 0.04] = 0.04] = 0.04] = 0.04] = = =	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.409	K) 7 7	k-valu kJ/m²•	e K	A kJ	X K (26) (26) (27) (27) (27) (27) (27) (28)
Doors Doors Windo Windo Windo Windo Floor	Type 1 Type 2 ws Type ws Type ws Type ws Type ws Type Type 1 Type 2	area 1 2 3 4	(m²)	Openin r	Igs 1 ²	Net Ar A,r 2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690	rea m ² x 68 x1 23 x1 49 x1 67 x1 67 x1 33 x 5 x	U-valu W/m2 1 1/[1/(1.4)+ 1/[1/(1.4)+ 1/[1/(1.4)+ 1/[1/(1.4)+ 0.13 0.13	LE K = 0.04] = 0.04] = 0.04] = 0.04] = = = =	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976	<) 7 7 	k-valu kJ/m²·	e K	A kJ	X K (26) (26) (27) (27) (27) (27) (27) (27) (28) (28)
Doors Doors Windo Windo Windo Floor Floor	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type1	area 1 2 3 4	ss (m²) 86	61.7	, ,	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1	rea m ² x 68 x1 23 x1 67 x1 67 x1 3 x 55 x 7 x	U-valu W/m2 1 1/[1/(1.4)+ 1/[1/(1.4)+ 1/[1/(1.4)+ 1/[1/(1.4)+ 0.13 0.13 0.18	LE K = 0.04] = 0.04] = 0.04] = 0.04] = = = = =	A X U (W// 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09	<) 7 7 	k-valu kJ/m²·	e K	A kJ	X K (26) (26) (27) (27) (27) (27) (27) (27) (28) (28) (28) (29)
Doors Doors Windo Windo Windo Windo Floor Floor Walls	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2	278.3 278.4	86 43	61.7 0	, ,	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690 217.1 148.4	rea m ² x 68 x ¹ 23 x ¹ 67 x ¹ 67 x ¹ 3 x 7 x 3 x	U-valu W/m2 1 1/[1/(1.4)+ 1/[1/(1.4)+ 1/[1/(1.4)+ 1/[1/(1.4)+ 0.13 0.13 0.18 0.18	LE K = 0.04] = 0.04] = 0.04] = 0.04] = = = = = = = =	A X U (W// 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09 26.72	<) 7 7 3 5 5 5	k-valu kJ/m²-	e K	A kJ	<pre>X K /K (26) (26) (27) (27) (27) (27) (27) (28) (28) (29) (29)</pre>
Doors Doors Windo Windo Windo Windo Floor Floor Walls Walls Roof	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1	area 1 2 3 4 278.3 148.4 123.3	86 86	61.7 0	/gs /²	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8	rea m ² x x 68 x1 23 x1 49 x1 67 x1 3 x 5 x 7 x 3 x 66 x	$\begin{array}{c} U-valu \\ W/m2 \\ \hline \\ 1 \\ \hline \\ 1 \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 0.13 \\ \hline \\ 0.13 \\ \hline \\ 0.18 \\ \hline \\ 0.13 \\ \hline \end{array}$	LE K = 0.04] = 0.04] = 0.04] = 0.04] = = = = = = = = = =	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09 26.72 16.1	<) 7 7 3 5 5 1 1 1 5	k-value kJ/m²•	е К	A kJ	<pre>X K /K (26) (26) (27) (27) (27) (27) (27) (28) (28) (29) (29) (30)</pre>
Doors Doors Windo Windo Windo Windo Floor Floor Valls Walls Roof	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type1 Type1 Type2	area 1 2 3 4 278.1 148.4 123.1 6.40	86 43 6	61.7 0 0	/gs /²	Net Ar A,r 2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690 217.1 148.4 123.8 6.46	rea m ² x 68 x1 23 x1 67 x1 67 x1 67 x1 67 x1 5 x 7 x 3 x 66 x	U-valu W/m2 1 1 1/[1/(1.4)+ 1/[1/(1.4)+ 1/[1/(1.4)+ 1/[1/(1.4)+ 0.13 0.13 0.18 0.13 0.13	LE K = 0.04] = 0.04] = 0.04] = 0.04] = = = = = = = = = = = = =	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09 26.72 16.1 0.84	<) 7 7 1 1 1 3 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	k-value kJ/m²-	eκ	A kJ	<pre>X K</pre>
Doors Doors Windo Windo Windo Windo Floor Floor Kools Roof Total a	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type2 Type1 Type2 area of ele	area 1 2 3 4 278.4 148.4 123.4 6.46 ements	86 43 6 , m ²	0 61.7 0 0	, , 	Net Ar A,r 2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690 217.1 148.4 123.8 6.46 687.5	rea m ² x 68 x1 23 x1 68 x1 23 x1 67 x1 3 x 55 x 7 x 3 x 66 x 3	$\begin{array}{c} U-valu \\ W/m2 \\ \hline \\ 1 \\ \hline \\ 1 \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 0.13 \\ \hline 0.13 \\ \hline 0.18 \\ \hline 0.13 \\ \hline 0.13 \\ \hline 0.13 \\ \hline 0.13 \\ \hline 0.13 \\ \hline 0.13 \\ \hline 0.13 \\ \hline \end{array}$	LE K = 0.04] = 0.04] = 0.04] = 0.04] = = = = = = = = = = = = = =	A X U (W// 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09 26.72 16.1 0.84	<) 7 7 1 1 1 2 1 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1	k-valu kJ/m²·	e K	A kJ	X K (26) (26) (27) (27) (27) (27) (27) (27) (28) (28) (28) (29) (29) (29) (30) (30) (31)
Doors Doors Windo Windo Windo Windo Floor Floor Floor Kalls Roof Roof Total a * for win ** inclus	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type2 Type1 Type2 area of ele	Gross area 1 2 3 4 278.8 148.4 123.8 6.40 ements roof winders on both	86 (m ²) 86 43 86 6 5 , m ² ows, use e sides of ii	61.7 0 0 0 0 0 0 0 0 0 0 0 0 0	indow U-v	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8 6.46 687.5 alue calcul titions	rea m ² x 68 x1 23 x1 49 x1 67 x1 3 x 7 x 3 x 7 x 3 x 66 x 3 16 x 3 16 x 3 10 16 x	U-valu W/m2 1 1 1/[1/(1.4)+ 1/[1/(1.4)+ 1/[1/(1.4)+ 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	LE K = 0.04] = 0.04] = 0.04] = 0.04] = = = = = = = = () = () (1/U-value)	A X U (W// 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09 26.72 16.1 0.84	<) 7 7 7 9 5 [] 5 [] 6 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	k-valu kJ/m²-	e K		<pre>X K /K (26) (26) (27) (27) (27) (27) (27) (28) (28) (29) (29) (29) (30) (30) (31)</pre>
Doors Doors Windo Windo Windo Windo Windo Floor Floor Roof Roof Total a * for win ** incluc Fabric	Type 1 Type 2 ws Type ws Type ws Type ws Type type 1 Type 2 Type 1 Type 2 Type1 Type2 area of ele adows and r de the areas theat loss	Gross area 1 2 3 4 278.3 148.4 123.3 6.40 ements roof winder s on both s, W/K =	86 (m ²) 86 43 86 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	61.7 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	indow U-v	Net Ar A,r 2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690 217.1 148.4 123.8 6.46 687.5 alue calcul titions	rea m ² x 68 x1 23 x1 67 x1 67 x1 67 x1 67 x1 67 x1 7 x 3 x 66 x 3 66 x 3 10 10 10 10 10 10 10 10 10 10 10 10 10	U-valu W/m2 1 1 1/[1/(1.4)+ 1/[1/(1.4)+ 1/[1/(1.4)+ 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	$\begin{bmatrix} 1 \\ K \\ - \\ - \\ - \\ - \\ - \\ - \\ - \\ - \\ -$	A X U (W// 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09 26.72 16.1 0.84	<) 7 7 7 9 9 5 [] 9 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	k-value kJ/m²-	e K	A kJ	X K (26) (26) (27) (27) (27) (27) (27) (28) (28) (29) (29) (29) (30) (30) (31) (33)
Doors Doors Windo Windo Windo Windo Floor Floor Floor Walls Roof Total a * for win ** incluc Fabric Heat o	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type2 area of ele adows and r de the areas heat loss capacity C	area 1 2 3 4 278.i 123.i 148.i 123.i 6.40 ements roof window s on both s, W/K = Cm = S(86 (m ²) 86 43 86 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	61.7 0 0 0 effective winternal wal	indow U-v	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8 6.46 687.5 alue calcul titions	rea m ² x 68 x1 23 x1 67 x1 67 x1 67 x1 67 x1 55 x 7 x 3 x 66 x 3 66 x 3 1 ated using	U-valu W/m2 1 1 1/[1/(1.4)+ 1/[1/(1.4)+ 1/[1/(1.4)+ 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	$\begin{bmatrix} JE \\ K \\ = \\ 0.04 \end{bmatrix} = \\ 0.04 \end{bmatrix} = \\ 0.04 \end{bmatrix} = \\ 0.04 \end{bmatrix} = \\ = \\ = \\ = \\ = \\ = \\ = \\ = \\ = \\ =$	A X U (W// 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09 26.72 16.1 0.84 (30) + (32	<) 7 7 7 9 5 [] 9 5 [] 9 8 5 [] 9 8 5 [] 9 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	k-value kJ/m²-	e K	A kJ 9.58 0	X K (26) (26) (27) (27) (27) (27) (27) (28) (28) (29) (29) (29) (30) (30) (30) (31) (33) (34)
Doors Doors Windo Windo Windo Windo Floor Floor Floor Walls Roof Roof Total a * for win ** incluc Fabric Heat o Therm	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type2 area of ele adows and r de the areas heat loss capacity C hal mass p	area 1 2 3 4 278.3 148.4 123.3 148.4 123.4 6.40 ements roof window s on both s, W/K = Cm = S(parameters	86 (m ²) 86 43 86 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	Openin m 61.7 0 0 0 0 0 0 0 0	indow U-v Is and par	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8 6.46 687.5 alue calcul titions	rea m ² x 68 x1 23 x1 49 x1 67 x1 3 x 55 x 7 x 3 x 66 x 3 66 x 3 16 x 3 16 x	U-valu W/m2 1 1 1/(1/(1.4)+ 1/(1/(1.4)+ 1/(1/(1.4)+ 1/(1/(1.4)+ 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	$\begin{bmatrix} JE \\ K \\ = \\ 0.04 \end{bmatrix} = \\ 0.04 \end{bmatrix} = \\ 0.04 \end{bmatrix} = \\ 0.04 \end{bmatrix} = \\ = \\ = \\ = \\ = \\ = \\ = \\ = \\ = \\ =$	A X U (W// 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09 26.72 16.1 0.84 <i>Je)+0.04] e</i> (30) + (32	<pre> </pre> 7 7 7 7 9 9 5 1 9 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1	k-value kJ/m²-	e K	9.58 0	X K (26) (27) (27) (27) (27) (27) (28) (28) (29) (29) (29) (30) (30) (31) (31) (33) (34) (35)
can be ι	In be used instead of a detailed calculation. hermal bridges : S (L x Y) calculated using Appendix K 34.35 (36)														
------------	--	-------------	-------------	-------------	----------------	------------	------------	-------------------	--------------	----------------------------	---------------------------------------	----------	---------	----------	
Therm	al bridge	es : S (L	x Y) cal	culated u	using Ap	pendix ł	<						34.35	(36)	
if details	of therma	al bridging	are not kn	own (36) =	= 0.05 x (3	1)								_	
Total fa	abric he	at loss							(33) +	(36) =			213.93	(37)	
Ventila	tion hea	at loss ca	alculated	monthly	/				(38)m	= 0.33 × (25)m x (5)				
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
(38)m=	199.49	198.81	198.14	195.01	194.43	191.7	191.7	191.19	192.75	194.43	195.61	196.85		(38)	
Heat tr	ansfer c	coefficier	nt, W/K						(39)m	= (37) + (3	38)m				
(39)m=	413.42	412.74	412.07	408.94	408.35	405.62	405.62	405.12	406.68	408.35	409.54	410.78			
Heatla		motor (l	אע (ס וו						(40)m	Average =	Sum(39)1.	.12 /12=	408.94	(39)	
Heat IC	oss para		1LP), VV/	102K	4.07	4.07	4.07	4.07	(40)m	= (39)m ÷	(4)	1.00	l		
(40)m=	1.09	1.09	1.08	1.08	1.07	1.07	1.07	1.07	1.07	1.07	1.08	1.08	4.00		
Numbe	er of day	vs in mor	nth (Tab	le 1a)					,	<pre>Average =</pre>	Sum(40)1	.12/12=	1.08	(40)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)	
4. Wa	ter heat	ina ener	av reau	rement:								kWh/ve	ear:		
			<u> </u>												
	Assumed occupancy, N if TEA > 13.9 N = 1 + 1.76 x [1 - exp(-0.000349 x (TEA -13.9)2)] + 0.0013 x (TEA -13.9) (42)														
if TF	A £ 13.9	9, N = 1	T 1.70 X	[i - exp	(-0.0003	49 X (11	A - 13.9)z)] + 0.0	013 x (1	II A -13.	3)				
Annua	l averag	e hot wa	ater usag	ge in litre	s per da	y Vd,av	erage =	(25 x N)	+ 36		111	.05		(43)	
Reduce	the annua	al average	hot water	usage by {	5% if the d	welling is	designed t	o achieve	a water us	se target o	f				
normore		nines per p		uay (all W											
List water	Jan	Feb	Mar	Apr	May	Jun		Aug	Sep	Oct	Nov	Dec			
HOL WAL	er usage il	Tillies per	day lor ea		vu,m = 1a			(43)							
(44)m=	122.16	117.72	113.27	108.83	104.39	99.95	99.95	104.39	108.83	113.27	117.72	122.16		-	
Energy o	content of	hot water	used - cal	culated mo	onthly $= 4$.	190 x Vd,r	n x nm x D)Tm / 3600	r kWh/mon	Fotal = Sui hth (see Ta	m(44) ₁₁₂ = ables 1b, 1	c, 1d)	1332.64	(44)	
(45)m=	181.16	158.44	163.5	142.54	136.77	118.02	109.37	125.5	127	148	161.56	175.44			
										Fotal = Su	m(45) ₁₁₂ =	:	1747.31	(45)	
lf instant	taneous w	ater heatii	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46)) to (61)						
(46)m=	27.17	23.77	24.52	21.38	20.52	17.7	16.4	18.82	19.05	22.2	24.23	26.32		(46)	
Water	storage	loss:	·		1			·u ·		1	-		l		
Storag	e volum	e (litres)	includir	ig any so	biar or w	WHRS	storage	within sa	ime vess	sei		150		(47)	
If comr	nunity h	eating a	nd no ta	nk in dw	elling, e	nter 110	litres in	(47) mbi baili	oro) onto	n (0) in (47)				
Water	storade		not wate	er (unis in	ciudes i	istantai	ieous co		ers) ente		47)				
a) If m	anufact	urer's de	eclared I	oss facto	or is kno	wn (kWł	n/day):				1.	39		(48)	
Tempe	erature fa	actor fro	m Table	2b		,	, , , ,					54		(49)	
Energy	/ lost fro	m water	storage	kWh/ve	ar			(48) x (49)	_			75		(50)	
b) If m	anufact	urer's de	eclared of	ylinder l	oss facto	or is not	known:	(10) x (10)	_		0.	15		(00)	
Hot wa	ater stora	age loss	factor fr	om Tabl	e 2 (kWl	h/litre/da	ıy)				()		(51)	
If comr	munity h	eating s	ee secti	on 4.3											
Volum	e factor	from Tal	ble 2a								()		(52)	
Tempe	erature fa	actor fro	m Table	2b)		(53)	

Energy Enter	y lost fro (50) or	om water (54) in (5	⁻ storage 55)	e, kWh/ye	ear			(47) x (51)) x (52) x (53) =	0.	0 75		(54) (55)
Water	storage	loss cal	culated	for each	month			((56)m = (55) × (41)ı	m				. ,
(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(56)
If cylinde	er contain	s dedicate	l d solar sto	nage, (57)	I m = (56)m	x [(50) – (L H11)] ÷ (50	0), else (5	1 7)m = (56)	n where (H11) is fro	m Append	ix H	
(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(57)
Primar	y circuit	loss (ar	nnual) fro	om Table	e 3							0		(58)
Primar	y circuit	loss cal	culated	for each	month (59)m = ((58) ÷ 36	65 × (41)	m					
(mo	dified by	factor f	rom Tab	le H5 if t	here is s	solar wat	ter heatir	ng and a	cylinde	r thermo	stat)		I	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
Combi	loss ca	lculated	for each	month	(61)m =	(60) ÷ 30	65 × (41))m						
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)
Total h	neat req	uired for	water h	eating ca	alculated	l for eac	h month	(62)m =	0.85 × ((45)m +	(46)m +	(57)m +	(59)m + (61)	m
(62)m=	227.75	200.53	210.09	187.63	183.37	163.12	155.96	172.09	172.09	194.6	206.65	222.04		(62)
Solar DI	HW input	calculated	using App	endix G o	r Appendix	H (negati	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)		
(add a	dditiona	l lines if	FGHRS	and/or \	NWHRS	applies	, see Ap	pendix (G)					
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output	t from w	ater hea	ter	-			-				-			
(64)m=	227.75	200.53	210.09	187.63	183.37	163.12	155.96	172.09	172.09	194.6	206.65	222.04		
								Outp	out from wa	ater heate	r (annual)₁	12	2295.92	(64)
Hea <mark>t g</mark>	l <mark>ain</mark> s fro	m water	heating	, kWh/m	onth 0.2	5 [′] [0.85	× (45)m	+ (61)m	n] + 0.8 x	(<mark>46)m</mark> (+ (57)m	+ (<mark>59)</mark> m]	
(65)m=	97.51	86.35	91.64	83.47	82.75	75.32	73.64	79	78.3	86.49	89.79	9 <mark>5.61</mark>		(65)
inclu	ude (57)	m in calo	culation	of (65)m	only if c	ylinder i	s in the o	dwelling	<mark>or ho</mark> t w	ate <mark>r is f</mark> r	om com	munity h	eating	
5. Int	ternal ga	ains (see	e Table {	5 and 5a):									
Metab	olic gair	is (Table	e 5), Wat	ts										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m=	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8		(66)
Lightin	g gains	(calcula	ted in Ap	opendix	L, equat	ion L9 o	r L9a), a	lso see	Table 5					
(67)m=	49.21	43.71	35.55	26.91	20.12	16.98	18.35	23.85	32.02	40.65	47.45	50.58		(67)
Applia	nces ga	ins (calc	ulated ir	n Append	dix L, eq	uation L	13 or L1	3a), also	see Ta	ble 5				
(68)m=	520.24	525.64	512.04	483.07	446.52	412.16	389.2	383.8	397.41	426.37	462.93	497.29		(68)
Cookir	ng gains	(calcula	ated in A	ppendix	L, equat	tion L15	or L15a)), also se	e Table	5	-			
(69)m=	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18		(69)
Pumps	s and fa	ns gains	(Table	5a)										
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3		(70)
Losses	s e.g. ev	aporatic	n (nega	tive valu	es) (Tab	le 5)								
(71)m=	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44		(71)
Water	heating	gains (T	able 5)											
(72)m=	131.06	128.5	123.17	115.93	111.23	104.61	98.98	106.19	108.75	116.25	124.71	128.51		(72)
Total i	internal	gains =			•	(66)	m + (67)m	n + (68)m -	+ (69)m + ((70)m + (7	1)m + (72)	Im		
(73)m=	775.06	772.39	745.29	700.45	652.4	608.29	581.07	588.39	612.71	657.81	709.62	750.92		(73)
6. So	lar gains	5:	•	•				•						

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

Orienta	tion:	Access Facto Table 6d	r	Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.44	x	10.63	×	0.63	x	0.7] =	11.19	(74)
North	0.9x	0.77	x	3.44	x	20.32	×	0.63	x	0.7	1 =	21.39	(74)
North	0.9x	0.77	x	3.44	x	34.53	x	0.63	x	0.7] =	36.35	(74)
North	0.9x	0.77	x	3.44	x	55.46	×	0.63	x	0.7] =	58.39	(74)
North	0.9x	0.77	x	3.44	x	74.72	×	0.63	x	0.7] =	78.66	(74)
North	0.9x	0.77	x	3.44	x	79.99	×	0.63	x	0.7] =	84.21	(74)
North	0.9x	0.77	x	3.44	x	74.68	x	0.63	x	0.7] =	78.62	(74)
North	0.9x	0.77	x	3.44	x	59.25	×	0.63	x	0.7] =	62.37	(74)
North	0.9x	0.77	x	3.44	x	41.52	x	0.63	x	0.7] =	43.71	(74)
North	0.9x	0.77	x	3.44	x	24.19	×	0.63	x	0.7] =	25.47	(74)
North	0.9x	0.77	x	3.44	x	13.12	×	0.63	x	0.7] =	13.81	(74)
North	0.9x	0.77	x	3.44	x	8.86	×	0.63	x	0.7] =	9.33	(74)
East	0.9x	0.77	x	19.87	x	19.64	×	0.63	x	0.7] =	119.28	(76)
East	0.9x	0.77	x	19.87	x	38.42	×	0.63	x	0.7] =	233.34	(76)
East	0.9x	0.77	x	19.87	x	63.27	×	0.63	x	0.7	=	384.27	(76)
East	0.9x	0.77	x	19.87	×	92.28	x	0.63	х	0.7		560.44	(76)
East	0.9x	0.77	x	19.87	x	113.09	х	0.63	x	0.7] =	6 86.84	(76)
East	0.9x	0.77	x	19.87	х	115.77	×	0.63	x	0.7	=	703.1	(76)
East	0.9x	0.77	x	19.87	x	110.22	x	0.63	x	0.7] =	6 <mark>69.38</mark>	(76)
East	0.9x	0.77	x	19.87	x	94.68	x	0.63	x	0.7] =	574.99	(76)
East	0.9x	0.77	x	19.87	x	73.59	×	0.63	x	0.7] =	446.92	(76)
East	0.9x	0.77	x	19.87	х	45.59	×	0.63	x	0.7] =	276.87	(76)
East	0.9×	0.77	x	19.87	×	24.49	×	0.63	x	0.7] =	148.73	(76)
East	0.9x	0.77	x	19.87	x	16.15	x	0.63	x	0.7] =	98.09	(76)
South	0.9x	0.77	x	0.87	x	46.75	x	0.63	x	0.7] =	12.46	(78)
South	0.9×	0.77	x	0.87	x	76.57	x	0.63	x	0.7	=	20.4	(78)
South	0.9×	0.77	x	0.87	x	97.53	x	0.63	x	0.7] =	25.98	(78)
South	0.9x	0.77	x	0.87	x	110.23	x	0.63	x	0.7	=	29.37	(78)
South	0.9x	0.77	x	0.87	x	114.87	x	0.63	x	0.7] =	30.6	(78)
South	0.9x	0.77	x	0.87	x	110.55	x	0.63	x	0.7	=	29.45	(78)
South	0.9x	0.77	x	0.87	x	108.01	x	0.63	x	0.7	=	28.78	(78)
South	0.9x	0.77	x	0.87	x	104.89	x	0.63	x	0.7] =	27.95	(78)
South	0.9x	0.77	x	0.87	x	101.89	x	0.63	x	0.7	=	27.14	(78)
South	0.9x	0.77	x	0.87	x	82.59	x	0.63	x	0.7	=	22	(78)
South	0.9x	0.77	x	0.87	x	55.42	x	0.63	x	0.7	=	14.76	(78)
South	0.9x	0.77	x	0.87	x	40.4	x	0.63	x	0.7	=	10.76	(78)
West	0.9x	0.77	x	31.81	x	19.64	x	0.63	x	0.7	=	190.91	(80)
West	0.9x	0.77	x	31.81	×	38.42	×	0.63	x	0.7	=	373.47	(80)
West	0.9x	0.77	x	31.81	x	63.27	x	0.63	x	0.7] =	615.05	(80)

West	0.9x	0.77	x	31.	81	x	9	2.28	×		0.63	×	0.7	=	897.01	(80)
West	0.9x	0.77	x	31.	81	x	1	13.09	x		0.63		0.7	=	1099.32	(80)
West	0.9x	0.77	x	31.	81	x	1	15.77	x		0.63		0.7	=	1125.35	(80)
West	0.9x	0.77	x	31.	81	x	1	10.22	x		0.63		0.7	=	1071.38	(80)
West	0.9x	0.77	x	31.	81	x	9	4.68	x		0.63	_ × [0.7	=	920.3	(80)
West	0.9x	0.77	x	31.	81	x	7	3.59] x		0.63	× [0.7	=	715.33	(80)
West	0.9x	0.77	x	31.	81	x	4	5.59	x		0.63	_ × [0.7	=	443.15	(80)
West	0.9x	0.77	x	31.	81	x	2	4.49	x		0.63	×	0.7	=	238.05	(80)
West	0.9x	0.77	x	31.	81	x	1	6.15	x		0.63	×	0.7	=	157	(80)
	_								-							
Solar	gains in	watts, ca	alculated	d for eac	h month	<u> </u>			(83)m	า = Sเ	um(74)m .	(82)m	_		•	
(83)m=	333.84	648.6	1061.66	1545.21	1895.42	19	942.11	1848.15	158	5.61	1233.1	767.49	415.35	275.18		(83)
Total	gains – i	nternal a	and sola	r (84)m =	= (73)m	+ (83)m	, watts	. – –						7	
(84)m=	1108.9	1420.98	1806.95	2245.66	2547.82	2	550.39	2429.22	217:	3.99	1845.82	1425.3	1124.97	1026.1		(84)
7. Me	ean inter	nal temp	perature	(heating	seasor	า)										
Tem	perature	during h	neating p	periods i	n the livi	ng	area	from Tab	ole 9	, Th1	1 (°C)				21	(85)
Utilis	ation fac	tor for g	ains for	living are	ea, h1,m	<u>ו (s</u>	see Ta	ble 9a)							-	
	Jan	Feb	Mar	Apr	May		Jun	Jul	A	ug	Sep	Oct	Nov	Dec		
(86)m=	1	1	1	0.99	0.96		0.85	0.69	0.7	77	0.96	1	1	1		(86)
Me <mark>a</mark>	n interna	l temper	ature in	living ar	ea T1 <mark>(</mark> f	ollo	ow ste	ps 3 t <mark>o 7</mark>	7 in T	able	9c)					
(87)m=	1 <mark>9.55</mark>	19.69	19.96	20.32	20.66		20.89	20. <mark>97</mark>	20.	95	20.74	20.29	19.86	1 <mark>9.53</mark>]	(87)
Tem	oerature	during h	neating r	periods i	n rest of	dv	vellina	from Ta	able 9	9. Th)2 (°C)				-	
(88)m=	20.01	20.01	20.01	20.02	20.02		20.03	20.03	20.	03	20.03	20.02	20.02	20.02	1	(88)
Litilie	ation for	tor for a	aine for	roct of d	wolling	<u>г</u> h2			00)						1	
(89)m=		1		0.99	0.94		, III (Se	0.56	9 <u>a</u>)	35	0.93	1	1	1	1	(89)
	. :		L !	41 4			. TO //					- 0>			1	
		1 temper	ature in		of dwell	ing T) I Z (TO 10.04	20.02	eps 3	$\frac{5 \text{ to } 7}{01}$	10 77	e 9C)	18.40	18.01	1	(90)
(50)11-	10.04	10.20	10.00	10.17	10.00		10.04	20.02	20.		10.77	LA = Liv	ing area ÷ (4	10.01	0.07	(00)
													3	,	0.07	
Mea	n interna	l temper	ature (fo	or the wh	ole dwe	ellin	ng) = fl	_A × T1	+ (1	- fL	A) × T2				1	(00)
(92)m=	18.15	18.35	18.73	19.25	19.72		20.01	20.09	20.	07	19.84	19.22	18.59	18.12	J	(92)
	y adjustr	19.25	ne mear	1 interna	1 temper		Jre fro	m Table	e 4e,	wne	re appro	priate	19.50	19.12	1	(03)
(35)III-		ting regi	uiremen	19.25	19.72	1 4	20.01	20.03	20.	<u> </u>	19.04	19.22	10.59	10.12		(00)
Set 1	Ti to the i	mean int	ternal te	mperatu	re obtai	ner	t at ste	on 11 of	Tab	le 9h	so tha	t Ti m-	(76)m an	d re-cal	rulate	
the u	tilisation	factor fo	or gains	using Ta	able 9a		1 01 01		Tub		, 50 114		.(70)11 an		Julate	
	Jan	Feb	Mar	Apr	May	Γ	Jun	Jul	A	ug	Sep	Oct	Nov	Dec]	
Utilis	ation fac	tor for g	ains, hr	ו:											_	
(94)m=	1	1	1	0.98	0.93		0.77	0.57	0.6	65	0.92	1	1	1		(94)
Usef	ul gains,	hmGm	, W = (9	4)m x (8	4)m								_		•	
(95)m=	1108.74	1420.17	1801.74	2208.38	2360.36	19	971.83	1380.15	1420	0.44	1703.03	1418.2	8 1124.54	1026		(95)
Mont	hly aver	age exte	ernal tem	nperature	e from T	abl	le 8	1	·		i				1	
(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	J	(96)
Heat	loss rate	e for mea	an interr	nal temp	erature,	Lm	n , W =	=[(39)m :	x [(9	3)m-	- (96)m				1	
(97)m=	5725.75	5553.07	5040.23	4232.69	3276.29	2	196.02	1414.17	1488	8.68	2335.26	3518.4	9 4706.08	5718.99		(97)

		En	ergy			Emiss	ion fac	tor	Emission	5
12a. CO2 emissions – Individual he	eating syste	ems inclu	uding mi	cro-CHP)					
Electricity for lighting									869.11	(232)
Total electricity for the above, kWh/y	/ear			sum	of (230a).	(230g) =		ļ	75	(231)
polier with a fan-assisted flue								45		(230e)
central neating pump:								30		(230C)
Electricity for pumps, rans and electric	пс кеер-пс	π								(000 -)
Flastricity for pumps for and clast	via kaana ha							l	2000.10	
Water beating fuel used								l ſ		╡
Annual totals Space heating fuel used main syste	em 1					k	Wh/year	[19672 31	Ĺ Ĺ
				lota	I = Sum(2)	19a) ₁₁₂ =			2658.16	(219)
	5 208.38	204.41	195.44	215.66	215.65	218.22	230.61	247.31		_
Fuel for water heating, kWh/month $(210)m = (64)m \times 100 \div (217)m$										
(217)m= 89.75 89.69 89.54 89.1	4 88	79.8	79.8	79.8	79.8	89.18	89.61	89.78		(217)
Efficiency of water heater									79.8	(216)
227.75 200.53 210.09 187.0	63 183.37	163.12	155.96	172.09	172.09	194.6	206.65	222.04		
Water heating Output from water heater (calculated	d above)						/ 15,1012	² [
(215)m= 0 0 0 0	0	0		U Tota	U L (kWh/vea	= 0 ar) = Sum(2)	(15)	0	0	 (215)
Space heating fuel (secondary), kV = {[(98)m x (201)] } x 100 ÷ (208)	Vh/month									
				Tota	l (kWh/yea	ar) =Sum(2	2 11) _{15,1012}		19672.31	(211)
3673.86 2970.38 2576.94 1558.	.82 728.83	0	0	0	0	1671.19	2757.98	3734.32		(=)
$(211)m = \{[(98)m \times (204)]\} \times 100 \div$	(206)	I						L]		(211)
3435.06 2777.3 2409.44 1457	.5 681.45	0	0	0	0	1562.56	2578.71	3491.59		
Jan Feb Mar Ap	or May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ar
Elliciency of secondary/supplemen	tary neatin	g system	1, %						0	(208)
Efficiency of main space neating sy	/stem 1		- 0/						93.5	(206)
Fraction of total heating from main	system 1			(204) = (2	02) x [1 –	(203)] =			1	(204)
Fraction of space heat from main s	ystem(s)			(202) = 1 -	-(201) =	(000)]			1	(202)
Fraction of space heat from second	ary/supple	ementary	v system		(22.1)			Į	0	(201)
9a. Energy requirements – Individua	I heating s	ystems i	ncluding	micro-C	CHP)					
Space heating requirement in kWh	/m²/year								48.4	(99)
				Tota	l per year	(kWh/year) = Sum(9	8)15,912 =	18393.61	(98)
(98)m= 3435.06 2777.3 2409.44 1457	.5 681.45	0	0	0	0	1562.56	2578.71	3491.59		
opace nearing requirement for cac			11 - 0.02	<u> </u>)11 - (33	<u>////] ^ (4</u>	1,111			

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

kWh/year

Emission factor kg CO2/kWh

Emissions kg CO2/year

(211) x	0.216	=	4249.22	(261)
(215) x	0.519	=	0](263)
(219) x	0.216	=	574.16	(264)
(261) + (262) + (263) + (264) =			4823.38	(265)
(231) x	0.519	=	38.93	(267)
(232) x	0.519	=	451.07	(268)
sum	of (265)(271) =		5313.37	(272)
	(211) x (215) x (219) x (261) + (262) + (263) + (264) = (231) x (232) x sum	(211) x 0.216 (215) x 0.519 (219) x 0.216 (261) + (262) + (263) + (264) =(231) x 0.519 (232) x 0.519 sum of (265)(271) =	$(211) \times$ 0.216 = $(215) \times$ 0.519 = $(219) \times$ 0.216 = $(261) + (262) + (263) + (264) =$ (231) \times 0.519 = $(232) \times$ 0.519 = $sum of (265)(271) =$	(211) x 0.216 = 4249.22 (215) x 0.519 = 0 (219) x 0.216 = 574.16 (261) + (262) + (263) + (264) = 4823.38 (231) x 0.519 =(232) x 0.519 =sum of (265)(271) = 5313.37

TER =

13.98 (273)



			User D	etails:										
Assessor Name: Software Name:	Stroma FSAP 20	12		Strom Softwa	a Num are Ve	ber: rsion:		Versic	on: 1.0.4.26					
		P	roperty.	Address	: 9D The	e Grove_	Propose	ed_Be C	lean					
Address :														
1. Overall dwelling dimens	ions:		•	()										
Racomont			Area	a(m²)	(10) ×	AV. He			Volume(m ³)					
Dasement			1	26.23	(ia) x		3	(2a) =	378.69	(3a)				
Ground floor			1	29.92	(1b) x		3	(2b) =	389.76	(3b)				
First floor			1:	23.86	(1c) x	2	2.7	(2c) =	334.42	(3c)				
Total floor area TFA = (1a)-	-(1b)+(1c)+(1d)+(1	e)+(1r	n)3	80.01	(4)									
Dwelling volume					(3a)+(3b)+(3c)+(3d	l)+(3e)+	.(3n) =	1102.87	(5)				
2. Ventilation rate:														
main heatingsecondary heatingothertotalnNumber of chimneys0+0+0=0 $x \ 40 \ =$ 1														
Number of chimneys		0] + [0] = [0	x	40 =	0	(6a)				
Number of open flues	0 +	0	<u> </u> + [0	- =	0	x	20 =	0	(6b)				
Number of intermittent fans					, r	0	x	10 =	0	(7a)				
Number of passive vents					Ē	0	x	10 =	0	(7b)				
Number of flueless gas fires	3				Ē	0	X ·	40 =	0	(7c)				
								Air ch	nange <mark>s per</mark> hou	ır				
Infiltration due to chimneys,	flues and fans = (6a)+(6b)+(7	a)+(7b)+(7c) =		0		÷ (5) =	0	(8)				
If a pressurisation test has been	n carried out or is intend	led, procee	d to (17), (otherwise o	continue fr	rom (9) to (16)			1				
Additional infiltration	dwelling (ns)						[(0)	1100 1	0	(9)				
Structural infiltration: 0.25	for steel or timber	frame or	0 35 fo	r masoni	v constr	uction	[(9)	-1]XU.1 =	0	(10)				
if both types of wall are prese	ent, use the value corre	sponding to	the great	ter wall are	a (after	dottori			0]()				
deducting areas of openings,); if equal user 0.35		1 (000)	a) alaa	onton O					1				
If suspended wooden floo	or, enter 0.2 (unsea	aled) or U	.1 (seale	ea), eise	enter U				0	(12)				
Percentage of windows a	nd doors draught s	strinned							0	$\begin{bmatrix} (13) \\ (14) \end{bmatrix}$				
Window infiltration		siippeu		0.25 - [0.2	x (14) ÷ 1	001 =			0	(14)				
Infiltration rate				(8) + (10)	、 <i>′</i> + (11) + (1	- 2) + (13) -	+ (15) =		0	(10)				
Air permeability value, q5	0, expressed in cu	bic metre	s per ho	our per s	quare m	etre of e	nvelope	area	3	(17)				
If based on air permeability	value, then (18) = [(17) ÷ 20]+(B), otherw	ise (18) = ((16)				0.15](18)				
Air permeability value applies if	a pressurisation test ha	as been dor	ne or a deg	gree air pe	rmeability	is being us	sed], ,				
Number of sides sheltered									2	(19)				
Shelter factor				(20) = 1 -	[0.075 x (1	[9)] =			0.85	(20)				
Infiltration rate incorporating	shelter factor			(21) = (18) x (20) =				0.13	(21)				
Infiltration rate modified for	monthly wind spee	d	-	-	-	-		_	1					
Jan Feb M	ar Apr May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	J					
Monthly average wind spee	d from Table 7	-				1	1		1					
(22)m= 5.1 5 4.9	4.4 4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	J					

wind i	Factor (22	2a)m =	(22)m ÷	4										
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18		
Adjuste	ed infiltra	ition rat	e (allowi	ng for sł	nelter an	d wind s	speed) =	(21a) x	(22a)m					
	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15		
Calcula	ate effect	<i>tive air</i> Lventila	change i tion:	rate for t	he appli	cable ca	ise						- 	(220)
lf exh	aust air he	at pump	using Appe	endix N. (2	3b) = (23a) × Fmv (e	equation (I	N5)), othe	wise (23b) = (23a)			0.5	(234)
lf bala	anced with	heat reco	overv: effic	iencv in %	allowing f	or in-use f	actor (fron	n Table 4h) =) (200)			0.5	(230)
a) If	halancer	d mech	anical ve	ntilation	with he	at recov	erv (MVI	HR) (24a)m – (2:	2h)m + (23h) x [[,]	1 – (23c)		(230)
(24a)m=	0.3	0.29	0.29	0.27	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28		(24a)
b) If	balanced	d mech	ı anical ve	ntilation	without	heat red	L Covery (N	и VV) (24b)m = (22	1 2b)m + (1	23b)		1	
, (24b)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If	whole ho	ouse ex	tract ver	ntilation of	or positiv	e input	ventilatio	on from c	outside			<u> </u>	1	
i	if (22b)m	< 0.5 >	(23b), t	hen (240	c) = (23b); other	wise (24	c) = (22b	o) m + 0.	.5 × (23b) 	<u> </u>	1	(0.4-)
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) lf i	natural v if (22b)m	entilation = 1, th	on or wh en (24d)	ole hous $m = (22b)$	se positiv o)m othe	/e input rwise (2	ventilatio 24d)m =	on from I 0.5 + [(2	oft 2b)m² x	0.5]				
(24d) <mark>m=</mark>	0	0	0	0	0	0	0	0	0	0	0	0		(24d)
Effe	ctive air o	change	rate - er	nter (24a) or (24t) or (24	c) or (24	d) in boy	(25)					
(25)m=	0.3	0.29	0.29	0.27	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28		(25)
3. He	at losses	and he	eat loss r	paramete	er:									
ELEN	/IENT	Gros	SS	Openin	gs	Net Ar	ea	U-valu	le K	AXU	0	k-value		A X k
Doors	Tvpe 1	alea	(11-)			A ,I			<u> </u>	(• • • •	<u>)</u>	KJ/111-•1		KJ/ K
Doors	Type 2					2 69		1 1	=	2 88772	7			(26)
Windo						2.89			=	2. <mark>88772</mark> 2.81540	7			(26)
	ws Type	1				2.89	x x 68 x1	1 1 /[1/(0.8)+	0.04] =	2. <mark>88772</mark> 2.81540	7			(26) (26) (27)
Windov	ws Type ws Type	1 2				2.89 2.82 3.4447 19.872	x x 68 x ¹ 23 x ¹	1 [1/(0.8)+ /[1/(0.8)+	= 0.04] = 0.04] =	2.88772 2.81540 2.67 15.4	7			(26) (26) (27) (27)
Windo	ws Type ws Type ws Type	1 2 3				2.89 2.82 3.4447 19.872	x 68 x1 23 x1 49 x1	1 [1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+	= 0.04] = 0.04] = 0.04] =	2.88772 2.81540 2.67 15.4 0.68	7		1	(26) (26) (27) (27) (27)
Windov Windov Windov	ws Type ws Type ws Type ws Type	1 2 3 4				2.89 2.82 3.4447 19.872 0.8717 31.800	x x 68 x1 23 x1 49 x1 67 x1	1 /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+	0.04] = [0.04] = [0.04] = [0.04] = [0.04] = [2.88772 2.81540 2.67 15.4 0.68 24.66	7		1	(26) (26) (27) (27) (27) (27)
Windov Windov Windov Floor T	ws Type ws Type ws Type ws Type Гуре 1	1 2 3 4				2.89 2.82 3.4447 19.872 0.8717 31.800	x 68 x1 23 x1 49 x1 67 x1 3 x	1 /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ 0.1	= = = = = = = = = = = = = = = = = = =	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623				(26) (26) (27) (27) (27) (27) (27) (28)
Windov Windov Windov Floor T Floor T	ws Type ws Type ws Type ws Type Type 1 Type 2	1 2 3 4				2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690	x x 68 x1 23 x1 49 x1 67 x1 67 x1 3 x 5 x	1 /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ 0.1 0.1	= 0.04] = [0.04] = [0.04] = [0.04] = [= [= = [2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909				(26) (26) (27) (27) (27) (27) (27) (28) (28)
Windov Windov Windov Floor T Floor T Walls	ws Type ws Type ws Type ws Type fype 1 fype 2 Type1	1 2 3 4 278.	86	61.7		2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1	x 68 x1 23 x1 49 x1 67 x1 3 x 5 x 7 x	1 /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ 0.1 0.1 0.15	= 0.04] = [0.04] = [0.04] = [0.04] = [= [= [= [= [= [2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57				(26) (27) (27) (27) (27) (27) (28) (28) (28) (29)
Windov Windov Windov Floor T Floor T Walls ⁻ Walls ⁻	ws Type ws Type ws Type ws Type fype 1 fype 2 Type1 Type1 Type2	1 2 3 4 <u>278.</u> 148.	86	61.7		2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690 217.1 148.4	x 68 x1 23 x1 49 x1 67 x1 3 x 5 x 7 x 3 x	$ \begin{array}{c c} 1 \\ \hline 1 \\ /[1/(0.8)+ \\ /[1/(0.8)+ \\ /[1/(0.8)+ \\ \hline 0.1 \\ \hline 0.1 \\ \hline 0.15 \\ 0.15 \\ \hline $	= $0.04] = [0.04] = [0.04] = [0.04] = [0.04] = [0.04] = [= [= [] = [] = [] = [= [] =$	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57 22.26				(26) (27) (27) (27) (27) (27) (28) (28) (28) (29)
Windov Windov Floor T Floor T Walls ⁻ Walls ⁻ Roof T	ws Type ws Type ws Type ws Type fype 1 fype 2 Type1 Type2 fype1	1 2 3 4 <u>278.</u> 148. 123.	86 43 86	61.7 0		2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8	x x 68 x1 23 x1 49 x1 67 x1 3 x 5 x 7 x 3 x 66 x	$ \begin{array}{c} 1\\ 1\\ (1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ 0.1\\ 0.1\\ 0.15\\ 0.15\\ 0.12\\ \end{array} $	$\begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57 22.26 14.86				(26) (27) (27) (27) (27) (27) (28) (28) (28) (29) (29) (29) (30)
Windov Windov Floor T Floor T Walls ⁻ Roof T Roof T	ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type1	1 2 3 4 278. 148. 123. 6.4	86 43 86	61.7 0 0		2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690 217.1 148.4 123.8 6.46	x x 68 x1 23 x1 49 x1 67 x1 3 x 55 x 7 x 3 x 6 x x 6 x	$ \begin{array}{c c} 1 \\ \hline 1 \\ /[1/(0.8)+ \\ /[1/(0.8)+ \\ /[1/(0.8)+ \\ \hline 0.1 \\ 0.1 \\ \hline 0.15 \\ 0.15 \\ \hline 0.12 \\ 0.12 \\ \hline 0.12$	$\begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57 22.26 14.86 0.77				(26) (27) (27) (27) (27) (27) (28) (28) (28) (29) (29) (29) (30)
Windov Windov Floor T Floor T Walls ⁻ Walls ⁻ Roof T Roof T Total a	ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type2 area of el-	1 2 3 4 <u>278.</u> 148. <u>123.</u> 6.4 ements	86 43 86 6 , m ²	61.7 0 0 0		2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8 6.46 687.5	x x 68 x1 23 x1 49 x1 67 x1 3 x 5 x 7 x 3 x 6 x 3 x 3	1 1 /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ 0.1 0.1 0.15 0.15 0.12 0.12	$\begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57 22.26 14.86 0.77				(26) (27) (27) (27) (27) (27) (28) (28) (28) (29) (29) (29) (30) (30) (31)
Windov Windov Floor T Floor T Walls ⁻ Walls ⁻ Roof T Roof T Total a * for win	ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type2 area of el-	1 2 3 4 278. 148. 123. 6.4 ements roof wind	86 43 86 6 , m ² ows, use e	61.7 0 0 0	ndow U-va	2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8 6.46 687.5 alue calcul	x x x x x x x x x x x x x x	$ \begin{array}{c} 1\\ 1\\ (1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ 0.1\\ 0.1\\ 0.15\\ 0.15\\ 0.15\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12 \end{array} $	$\begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57 22.26 14.86 0.77 4(e)+0.04] a	7 7 5 5 1 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1	paragraph		(26) (27) (27) (27) (27) (28) (28) (28) (29) (29) (29) (30) (30) (31)
Windov Windov Floor T Floor T Walls ⁻ Roof T Roof T Total a * for win ** includ Fabric	ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type2 area of el- dows and r le the areas heat loss	1 2 3 4 <u>278.</u> 148. <u>123.</u> 6.4 ements roof wind s on both s, W/K =	86 43 86 6 , m ² ows, use e sides of ir = S (A x	61.7 0 0 0 effective wi internal walk	ndow U-va	2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690 217.1 148.4 123.8 6.46 687.5 alue calcul itions	x x x x x x x x x x x x x x	$ \begin{array}{c} 1\\ 1\\ (1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ (1/(0.8)+\\ 0.1\\ 0.1\\ 0.15\\ 0.15\\ 0.15\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12 \end{array} $	$\begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57 22.26 14.86 0.77	7 7 5 5 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	paragraph]	(26) (27) (27) (27) (27) (27) (28) (28) (29) (29) (29) (29) (30) (30) (31)
Windov Windov Floor T Floor T Floor T Walls ⁻ Walls ⁻ Roof T Roof T Roof T Total a * for win ** includ Fabric Heat c	ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type2 area of eli- dows and i le the areas heat loss apacity C	1 2 3 4 278. 148. 123. 6.4 ements roof wind s on both s, W/K =	86 43 86 6 , m ² ows, use e sides of ir = S (A x (A x k)	61.7 0 0 0 effective wi internal walk	ndow U-ve	2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8 6.46 687.5 blue calcul itions	x x 68 x1 23 x1 49 x1 67 x1 3 x 5 x 7 x 3 x 6 x 3 x 49 x1 67 x1 3 x 49 x1 67 x1 3 x 49 x1 67 x1 3 x 49 x1 5 x 7 x 3 x 4 5 x 4 x 1 5 x 7 x 3 x 4 5 x 7 x 4 3 x 4 5 x 7 x 4 5 x 7 x 4 5 x 7 x 4 5 x 7 x 4 5 x 7 x 4 5 x 7 x 1 5 x 7 x 1 5 x 7 x 1 3 x 4 5 x 7 x 1 3 x 4 5 x 7 x 1 3 x 4 5 x 7 x 1 3 x 4 5 x 7 x 1 3 x 4 x 1 5 x 7 x 3 x 1 5 x 7 x 3 x 4 5 x 7 x 1 3 x 4 5 x 7 x 1 3 x 4 x 1 5 x 7 x 3 x 4 x 1 x x 1 x 1 x x 1 x x x 1 x x x x x x x x x x x x x	$ \begin{array}{c} 1\\ 1\\ (1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ 0.1\\ 0.1\\ 0.15\\ 0.15\\ 0.15\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12 \end{array} $	$\begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57 22.26 14.86 0.77 22.26	7 7 5 5 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	paragraph (32e) =		(26) (27) (27) (27) (27) (28) (28) (28) (29) (29) (30) (30) (31) (31)
Windov Windov Floor T Floor T Valls ⁻ Walls ⁻ Roof T Roof T Total a * for win ** includ Fabric Heat c Therm	ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type2 area of el- dows and r de the areas heat loss apacity C al mass	1 2 3 4 278. 148. 123. 123. 6.4 ements roof wind s on both s, W/K = Cm = S(parame	86 43 86 6 , m ² ows, use e sides of ir = S (A x (A x k) tter (TMF	$\begin{bmatrix} 61.7\\ 0\\ 0\\ 0\\ \end{bmatrix}$	ndow U-va s and part	2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8 6.46 687.5 alue calcul itions	x x 68 x1 23 x1 49 x1 67 x1 3 x 5 x 7 x 3 x 6 x 3 2 4 6 x 3 2 1 4 9 x1 67 x1 3 x 5 x 7 x 3 x 1 6 x 1 3 x 1 23 x1 23 x1 23 x1 23 x1 23 x1 23 x1 23 x1 23 x1 23 x1 23 x1 24 x1 25 x1 26 x1 27 x1 26 x1 27 x1 27 x1 27 x1 28 x1 29 x1 20 x1 2	$ \begin{array}{c} 1\\ 1\\ (1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ 0.1\\ 0.1\\ 0.15\\ 0.15\\ 0.15\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12 \end{array} $	$ \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57 22.26 14.86 0.77 22.26 14.86 0.77	7 7 5 5 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	paragraph (32e) =	132.58 0 250	(26) (27) (27) (27) (27) (27) (28) (28) (29) (29) (29) (29) (30) (30) (31) (31)

can be ι	ised inste	ad of a dei	tailed calc	ulation.										
Therm	al bridg	es : S (L	x Y) cal	culated u	using Ap	pendix ł	<						34.35	(36)
if details	of therma	al bridging	are not kn	own (36) =	= 0.05 x (3	1)								
Total fa	abric he	at loss							(33) +	(36) =			166.93	(37)
Ventila	tion hea	at loss ca	alculated	I monthly	/				(38)m	= 0.33 × (25)m x (5)			
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(38)m=	108.12	106.96	105.8	99.99	98.83	93.03	93.03	91.87	95.35	98.83	101.15	103.47		(38)
Heat tr	ansfer o	coefficier	nt, W/K						(39)m	= (37) + (3	38)m			
(39)m=	275.04	273.88	272.72	266.92	265.76	259.96	259.96	258.8	262.28	265.76	268.08	270.4		
				I						Average =	Sum(39)1.	.12 /12=	266.63	(39)
Heat lo	oss para	imeter (F	HLP), W/	′m²K					(40)m	= (39)m ÷	· (4)		I	
(40)m=	0.72	0.72	0.72	0.7	0.7	0.68	0.68	0.68	0.69	0.7	0.71	0.71		_
Numbe	er of day	/s in moi	nth (Tab	le 1a)					,	Average =	Sum(40)1	.12 /12=	0.7	(40)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)
4 \M/2	iter hea	ting ener	rav reau	rement.								k\//h/\/e	ear.	
vvc	ssumed occupancy N (42)													
Assum	Assumed occupancy, N 3.24 (42)													
	A > 13.	9, $N = 1$	+ 1.76 x	[1 - exp	(-0.0003	49 x (TF	-A -13.9)2)] + 0.0)013 x (IFA -13.	.9)			
Annua	averac	le hot wa	ater usad	ae in litre	s per da	v Vd.av	erage =	(25 x N)	+ 36		111	05		(43)
Redu <mark>ce</mark>	the annua	al average	hot water	usage by a	5% if the d	welling is	designed t	o achieve	a water us	se target o	f			()
not more	e that 125	litres per p	person pei	day (all w	ater use, h	not and co	ld)							
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot wate	er usage i	n litres per	day for ea	ach month	Vd,m = fa	ctor from T	Table 1c x	(43)						
(44)m=	122.16	117.72	113.27	108.83	104.39	99.95	99.95	104.39	108.83	113.27	117.72	122.16		
									-	Total = Su	m(44) ₁₁₂ =		1332.64	(44)
Energy of	content of	hot water	used - cal	culated mo	onthly $= 4$.	190 x Vd,n	m x nm x D	0Tm / 3600	kWh/mor	oth (see Ta	ables 1b, 1	c, 1d)		
(45)m=	181.16	158.44	163.5	142.54	136.77	118.02	109.37	125.5	127	148	161.56	175.44		
									-	Total = Su	m(45) ₁₁₂ =		1747.31	(45)
lf instan	taneous v	ater heatii	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46)) to (61)					
(46)m=	27.17	23.77	24.52	21.38	20.52	17.7	16.4	18.82	19.05	22.2	24.23	26.32		(46)
Water	storage	loss:						· · · · · · · · · · · · · · · · · · ·					I	
Storag	e volum	ie (litres)	incluair	ig any so	biar or v	WHR5	storage	within sa	ime ves	sei		150		(47)
If com	nunity h	eating a	ind no ta	nk in dw	elling, e	nter 110) litres in	(47)		or (0) in (47)			
Water	rise II no		not wate	er (unis in	iciudes i	nstantar	ieous co		ers) ente	er o m (47)			
a) If m	anufact	urer's de	eclared l	oss facto	or is kno	wn (kWł	n/dav).				1	95		(48)
Tempe	arature f	actor fro	m Table	2h			"aay):				1.	55		(40)
Enorm	loot fro				or			$(49) \times (40)$			0.	54		(49)
b) If m	anufact	m water urer's de	storage	, Kvvn/ye svlinder l	ear oss facti	or is not	known.	(40) X (49)	=		1.	05		(50)
Hot wa	iter stor	age loss	factor fr	om Tabl	e 2 (kWl	h/litre/da	ay)				()		(51)
If com	munity ł	eating s	ee secti	on 4.3	,		- /						I	. /
Volum	e factor	from Ta	ble 2a								(0		(52)
Tempe	erature f	actor fro	m Table	2b							(0		(53)

Energy Enter	/ lost fro (50) or	om water (54) in (5	• storage 55)	e, kWh/ye	ear			(47) x (51)) x (52) x (53) =	1.	0		(54) (55)
Water	storage	loss cal	culated	for each	month			((56)m = (55) × (41)	m				
(56)m=	32.64	29.48	32.64	31.59	32.64	31.59	32.64	32.64	31.59	32.64	31.59	32.64		(56)
If cylinde	er contain	s dedicate	d solar sto	orage, (57)	m = (56)m	x [(50) – (H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Append	lix H	
(57)m=	32.64	29.48	32.64	31.59	32.64	31.59	32.64	32.64	31.59	32.64	31.59	32.64		(57)
Primar	y circuit	loss (ar	nual) fro	om Table	e 3	-		-	-	-		0		(58)
Primar	y circuit	loss cal	culated	for each	month (59)m = ((58) ÷ 36	65 × (41)	m					
(moo	dified by	factor f	rom Tab	le H5 if t	here is s	olar wat	ter heatii	ng and a	cylinde	r thermo	ostat)	1		
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
Combi	loss ca	lculated	for each	month	(61)m =	(60) ÷ 30	65 × (41))m	-	-		-		
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)
Total h	neat req	uired for	water h	eating ca	alculated	for eac	h month	(62)m =	0.85 × ((45)m +	(46)m +	(57)m +	(59)m + (61)	m
(62)m=	237.06	208.94	219.4	196.64	192.68	172.13	165.27	181.41	181.1	203.91	215.66	231.35		(62)
Solar DH	HW input	calculated	using App	endix G o	r Appendix	H (negati	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)		
(add a	dditiona	l lines if	FGHRS	and/or \	NWHRS	applies	, see Ap	pendix (G)				1	
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output	t from w	ater hea	ter										I	
(64)m=	237.06	208.94	219.4	196.64	192.68	172.13	165.27	181.41	181.1	203.91	215.66	231.35		_
								Outp	out from wa	ater heate	r (annual)₁	12	2405.55	(64)
Heat g	ains fro	m water	heating.	, kWh/m	onth 0.2	5 / [0.85	× (45)m	i + (61)m	1] + 0.8 >	(<mark>(46)m</mark>	+ (57)m	+ (59)m]	
(65)m=	104.96	93.08	99.09	90.68	90.2	82.52	81.09	86.45	85.51	93.94	97	103.06		(65)
inclu	ide (57)	m in calo	culation	of (65)m	only if c	ylinder i	s in the o	dwelling	or hot w	ater is fr	om com	munity h	eating	
5. Int	ternal ga	ains (see	e Table 5	5 and 5a):									
Metab	olic gair	is (Table	<u>e 5), Wat</u>	ts									I	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		(2.2)
(66)m=	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8		(66)
Lightin	g gains	(calcula	ted in A _l	ppendix	L, equat	ion L9 o	r L9a), a I	lso see	Table 5				I	(07)
(67)m=	50.67	45	36.6	27.71	20.71	17.49	18.89	24.56	32.96	41.85	48.85	52.08		(67)
Applia	nces ga	ins (calc I	ulated ir	n Appeno	dix L, eq	uation L	13 or L1	3a), also I	see Ta	ble 5	1		I	(00)
(68)m=	520.24	525.64	512.04	483.07	446.52	412.16	389.2	383.8	397.41	426.37	462.93	497.29		(68)
Cookir	ng gains	(calcula	ted in A	ppendix I	L, equat	ion L15	or L15a)), also se	ee Table	5			I	(22)
(69)m=	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18		(69)
Pumps	s and fa	ns gains I	(Table :	5a)	1		1				1		I	(70)
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3		(70)
Losses	s e.g. ev	aporatic	on (nega I	tive valu	es) (Tab I	le 5)	1				1		I	
(71)m=	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44		(71)
Water	heating	gains (T	able 5)	1							1		I	
(72)m=	141.07	138.51	133.18	125.94	121.24	114.62	108.99	116.2	118.76	126.26	134.72	138.52		(72)
Total i	Internal	gains =		_		(66))m + (67)m	n + (68)m -	+ (69)m + ((70)m + (7	1)m + (72)	m	I	
(73)m=	786.52	783.69	756.36	711.26	663	618.8	591.63	599.1	623.67	669.02	721.04	762.42		(73)
6. So	lar gains	S:												

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

Orienta	tion:	Access Factor Table 6d	r	Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.44	×	10.63) x	0.6	x	0.7] =	10.66	(74)
North	0.9x	0.77	x	3.44	×	20.32	x	0.6	x	0.7] =	20.37	(74)
North	0.9x	0.77	x	3.44	x	34.53	x	0.6	x	0.7] =	34.62	(74)
North	0.9x	0.77	x	3.44	×	55.46	x	0.6	x	0.7] =	55.61	(74)
North	0.9x	0.77	x	3.44	×	74.72	x	0.6	x	0.7] =	74.91	(74)
North	0.9x	0.77	x	3.44	x	79.99	x	0.6	x	0.7	=	80.2	(74)
North	0.9x	0.77	x	3.44	x	74.68	x	0.6	x	0.7] =	74.87	(74)
North	0.9x	0.77	x	3.44	x	59.25	x	0.6	x	0.7] =	59.4	(74)
North	0.9x	0.77	x	3.44	×	41.52	x	0.6	x	0.7] =	41.63	(74)
North	0.9x	0.77	x	3.44	x	24.19	x	0.6	x	0.7] =	24.25	(74)
North	0.9x	0.77	x	3.44	×	13.12	x	0.6	x	0.7] =	13.15	(74)
North	0.9x	0.77	x	3.44	×	8.86	x	0.6	x	0.7] =	8.89	(74)
East	0.9x	0.77	x	19.87	×	19.64	x	0.6	x	0.7	=	113.6	(76)
East	0.9x	0.77	x	19.87	×	38.42	x	0.6	x	0.7] =	222.22	(76)
East	0.9x	0.77	x	19.87	×	63.27	x	0.6	x	0.7	=	365.97	(76)
East	0.9x	0.77	x	19.87	×	92.28	x	0.6	х	0.7		533.75	(76)
East	0.9x	0.77	x	19.87	x	113.09	x	0.6	x	0.7] =	654.13	(76)
East	0.9x	0.77	x	19.87	x	115.77	İ 🖈	0.6	x	0.7] =	669.62	(76)
East	0.9x	0.77	x	19.87	x	110.22	x	0.6	x	0.7	=	637.5	(76)
East	0.9x	0.77	x	19.87	x	94.68	x	0.6	x	0.7] =	547.61	(76)
East	0.9x	0.77	x	19.87	x	73.59	×	0.6	x	0.7] =	425.64	(76)
East	0.9x	0.77	x	19.87	х	45.59	x	0.6	x	0.7	=	2 <mark>63.69</mark>	(76)
East	0.9x	0.77	x	19.87	×	24.49	x	0.6	x	0.7] =	141.65	(76)
East	0.9x	0.77	x	19.87	×	16.15	x	0.6	x	0.7] =	93.42	(76)
South	0.9x	0.77	x	0.87	×	46.75	x	0.6	x	0.7] =	11.86	(78)
South	0.9x	0.77	x	0.87	×	76.57	x	0.6	x	0.7] =	19.43	(78)
South	0.9x	0.77	x	0.87	x	97.53	x	0.6	x	0.7] =	24.75	(78)
South	0.9x	0.77	x	0.87	x	110.23	x	0.6	x	0.7	=	27.97	(78)
South	0.9x	0.77	x	0.87	x	114.87	x	0.6	x	0.7	=	29.15	(78)
South	0.9x	0.77	x	0.87	x	110.55	x	0.6	x	0.7] =	28.05	(78)
South	0.9x	0.77	x	0.87	x	108.01	x	0.6	x	0.7] =	27.41	(78)
South	0.9x	0.77	x	0.87	x	104.89	x	0.6	x	0.7	=	26.62	(78)
South	0.9x	0.77	x	0.87	x	101.89	x	0.6	x	0.7] =	25.85	(78)
South	0.9x	0.77	x	0.87	x	82.59	x	0.6	x	0.7	=	20.95	(78)
South	0.9x	0.77	x	0.87	x	55.42	x	0.6	x	0.7] =	14.06	(78)
South	0.9x	0.77	x	0.87	×	40.4	x	0.6	x	0.7] =	10.25	(78)
West	0.9x	0.77	x	31.81	×	19.64	x	0.6	x	0.7] =	181.82	(80)
West	0.9x	0.77	x	31.81	×	38.42	x	0.6	x	0.7] =	355.68	(80)
West	0.9x	0.77	x	31.81	x	63.27	x	0.6	x	0.7	=	585.76	(80)

West	0.9x	0.77	x	31.	81	×	9	2.28	x		0.6] x [0.7	=	854.3	(80)
West	0.9x	0.77	×	31.	81	×「	1	13.09	x		0.6	Ξ́×Γ	0.7	=	1046.97	(80)
West	0.9x	0.77	x	31.	81	×	1′	15.77	x		0.6	=	0.7	=	1071.76	(80)
West	0.9x	0.77	x	31.	81	×	11	10.22	x		0.6	_ × [0.7	=	1020.36	(80)
West	0.9x	0.77	x	31.	81	×	9	4.68	x		0.6	آ × آ	0.7	=	876.48	(80)
West	0.9x	0.77	x	31.	81	×	7	3.59	x		0.6	Ī × Ī	0.7	=	681.26	(80)
West	0.9x	0.77	x	31.	81	×	4	5.59	x		0.6	_ × [0.7	=	422.05	(80)
West	0.9x	0.77	x	31.	81	×	2	4.49	x		0.6] × [0.7	=	226.71	(80)
West	0.9x	0.77	x	31.	81	×	1	6.15	x		0.6	x [0.7	=	149.52	(80)
Solar g	gains in	watts, ca	alculated	for eac	h month	<u> </u>			(83)m	ı = Su	m(74)m	.(82)m			1	
(83)m=	317.95	617.71	1011.1	1471.63	1805.16	184	49.63	1760.15	1510	0.1	1174.38	730.95	395.57	262.08		(83)
Total g	gains – i	nternal a	and sola	r (84)m = T	= (73)m I	+ (8	33)m	, watts			I		1		l	(0.1)
(84)m=	1104.47	1401.4	1767.46	2182.89	2468.17	240	68.43	2351.77	2109	9.2	1798.05	1399.96	5 1116.61	1024.5	1	(84)
7. Me	ean inter	nal temp	berature	(heating	seasor	า)										
Temp	perature	during h	neating p	eriods i	n the livi	ng a	area f	rom Tab	ole 9,	, Th1	(°C)				21	(85)
Utilis	ation fac	tor for g	ains for	living are	ea, h1,m	n (se	e Ta	ble 9a)							1	
	Jan	Feb	Mar	Apr	May	<u> </u>	Jun	Jul	Αι	ug	Sep	Oct	Nov	Dec		
(86)m=	1	1	1	0.98	0.88	0	0.66	0.49	0.5	56	0.89	1	1	1		(86)
Me <mark>ar</mark>	n interna	l temper	ature in	living ar	ea T1 (f	olloy	w ste	ps 3 t <mark>o 7</mark>	' in T	able	9c)					
(87)m=	20.66	20.69	20.74	20.82	20.87	20	0.89	20.89	20.8	89	20.88	20.8	20.72	20.65		(87)
Temp	oerature	during h	neating p	periods in	n rest of	dwe	elling	from Ta	ble 9	9, Th	2 (°C)					
(88)m=	20.32	20.32	20.33	20.34	20.34	20	0.35	20.35	20.3	36	20.35	20.34	20.34	20.33		(88)
Utilis	ation fac	tor for a	ains for	rest of d	welling,	h2,i	m (se	e Table	9a)							
(89)m=	1	1	1	0.98	0.85		0.6	0.41	0.4	8	0.84	1	1	1		(89)
Mear	interna	l temper	ature in	the rest	of dwell	ling	T2 (fr	allow ste	ns 3	to 7	in Table	2 9c)	1			
(90)m=	19.83	19.88	19.97	20.09	20.16	2	20.2	20.2	20.	.2	20.18	20.07	19.94	19.84		(90)
						1					fl	A = Livi	ng area ÷ (4	4) =	0.07	(91)
Moor	intorno	ltompor	oturo (fr	r tho wh	olo dur	lling		Δ Τ1	. (1	۴I۸	<u>у у то</u>				L	
(92)m-	19.89		20.02	20 14	20 22) = IL 0.25	_A X I I	+ (1 -	- ILA	20.23	20.12	20	19.9		(92)
	/ adjustr	nent to t	he mear	interna		ratu	re fro	m Table	4e 1	wher		priate	20	10.0		
(93)m=	19.74	19.79	19.87	19.99	20.07	2	20.1	20.1	20.	.1	20.08	19.97	19.85	19.75		(93)
8. Sp	ace hea	ting requ	uiremen	l		1										
Set T	i to the	mean int	ernal te	mperatu	re obtaiı	ned	at ste	ep 11 of	Tabl	e 9b,	so that	: Ti,m=	(76)m an	d re-calc	ulate	
the u	tilisation	factor fo	or gains	using Ta	able 9a	-									1	
	Jan	Feb	Mar	Apr	May	<u> </u>	Jun	Jul	Aı	ug	Sep	Oct	Nov	Dec		
Utilis	ation fac	tor for g	ains, hrr I): 											1	(0.1)
(94)m=	1	1		0.97	0.83	0).58	0.39	0.4	5	0.82	0.99	1	1	l	(94)
USET	JI gains,	nmGm	, VV = (9)	4)m x (8	4)m	14	21 17	000.02	057	62	1 160 15	1202.2	1116 45	1024 49		(05)
Mont	hly aver				$\frac{2000.00}{100}$		۲۰۰۱/ ۵ 8	909.90	337.	.05	1400.40	1392.3		1024.40		(33)
(96)m=	4.3	4.9	6.5	8.9	11.7	1	4.6	16.6	16	.4	14.1	10.6	7.1	4.2		(96)
Heat	loss rate	e for mea	an interr	al temp	erature	Lm.	, W =	=[(39)m :	x [(9:	 3)m–	(96)m		I .		I	
(97)m=	4247.9	4079.01	3647.53	2961.16	2223.54	14	, 129.9	910.28	958.	.74	1569.16	2490.29	3416.82	4205.46		(97)
	-															

Spac	e heatin	g require	ement fo	or each n	nonth, k	Wh/mon	th = 0.02	24 x [(97))m – (95	5)m] x (4	1)m			
(98)m=	2338.74	1799.58	1401.85	604.37	124.76	0	0	0	0	816.91	1656.27	2366.65		
							-	Tota	l per year	(kWh/yeai	r) = Sum(9	8)15,912 =	11109.11	(98)
Spac	e heatin	g require	ement in	∙kWh/m²	²/year								29.23	(99)
80 S	nace co	olina rea	nuiremer	ht.	-									
Calci	lated fo	r.lune .	July and	August	See Tal	ble 10b								
Calot	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Heat	loss rate	e Lm (ca	lculated	using 2	5°C inter	rnal tem	perature	and exte	ernal ten	nperatur	e from T	able 10)	1	
(100)m=	0	0	0	0	0	2443.66	1923.73	1966.91	0	0	0	0		(100)
Utilisa	ation fac	tor for lo	oss hm										-	
(101)m=	0	0	0	0	0	0.96	0.99	0.97	0	0	0	0		(101)
Usefu	ul loss, h	mLm (V	Vatts) =	(100)m >	k (101)m								•	
(102)m=	0	0	0	0	0	2343.62	1897.21	1912.03	0	0	0	0		(102)
Gains	s (solar	gains ca	lculated	for appli	icable w	eather re	egion, se	e Table	10)				1	
(103)m=	0	0	0	0	0	3057.76	2916.81	2637.86	0	0	0	0		(103)
Spac	e coolin	g require	ement fo	r month,	, whole c	dwelling,	continu	ous (kW	(h) = 0.0	24 x [(10	03)m – (*	102)m]:	x (41)m	
(104)m-						514 18	758 58	540.02	0	0		0	1	
(104)						014.10	100.00	040.02	 Total	– Sum(1.04)	_	1812 78	T (104)
Cooled	d fractio	n							f C =	cooled	area ÷ (4	l) =	1.57	(105)
Interm	<mark>itte</mark> ncy f	actor (Ta	able 10b)							· ·	,	L	
(106) <mark>m=</mark>	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0		
									Tota	l = Sum((104)	=	0	(106)
Space	cooling	require	ment for	month =	= (104)m	× (105)	× (106)r	n						
(107)m=	0	0	0	0	0	201.71	297.59	211.85	0	0	0	0		_
									Total	l = Sum(107)	=	711.14	(107)
Space	cooling	require	ment in l	«Wh/m²/	year				(107)) ÷ (4) =			1.87	(108)
9a. En	ergy red	quiremer	nts – Ind	ividual h	eating s	ystems i	ncluding	micro-C	CHP)					
Spac	e heatii	ng:												_
Fract	ion of sp	bace hea	at from s	econdar	y/supple	mentary	system						0	(201)
Fract	ion of sp	bace hea	at from n	nain syst	tem(s)			(202) = 1 -	- (201) =				1	(202)
Fract	ion of to	tal heati	ng from	main sy	stem 1			(204) = (2	02) × [1 –	(203)] =			1	(204)
Efficie	ency of	main spa	ace heat	ing syste	em 1								89.9	(206)
Efficie	ency of	seconda	ry/suppl	ementar	y heating	g systen	ז, %						0	(208)
Cooli	ng Syste	em Ener	gy Effici	ency Ra	tio								4.05	(209)
		Eeb	Mar		May	lun	lul	Δυσ	Son	Oct	Nov	Dec	k)//b/v/o	_l ⊃r
Snac	e heatin		ement (c	<u>alculate</u>	d above)	Jui	Aug	Seb			Dec	Kvvi//ye	ai
Opac	2338.74	1799.58	1401.85	604.37	124.76	/ 0	0	0	0	816.91	1656.27	2366.65	1	
(011))m v (20					-	-					l	(014)
(211)[]	$I = \{[(90) \\ 2601 \\ 49 \end{bmatrix}$	2001 75	[1559 34	$100 \div (20)$	138 77	0	0	0	0	908 68	1842 34	2632 53	1	(211)
	2001.43	2001.70	1000.04	072.27	100.77	0	0	Tota	l (kWh/vea	ar) = Sum(2)	211)	2002.00	12257 10	7(211)
Snor	o hootin	a fuel /s	ooondar	ν.) [J\Λ/]-	manth			. 014		, Santa	- * * / 15,1012		12307.19	
Shac	$m \times (20)$	y iuei (S)1)] \ v 1	econdar	у), күүп/ 181	month									
(215)m=		0	0 - 120	0	0	0	0	0	0	0	0	0		
、 · - /····-							I	Tota	l I (kWh/yea	ar) =Sum(2	215), ₅₄₀ 42	=	0	(215)
									· · · · ·		- 1		Ľ	· · · /

Water heating

from wa	ater hea	ter (calc	ulated a	bove)			-							
237.06	208.94	219.4	196.64	192.68	172.13	165.27	181.41	181.1	203.91	215.66	231.35		-	
cy of w	ater hea	iter		· · · · ·	1				1	ı —		79.8	(216)	
88.86	88.73	88.39	87.19	83.49	79.8	79.8	79.8	79.8	87.68	88.61	88.9		(217)	
water $= (64)$	heating, m x 100	kWh/mo (217) ∸ (217)	onth											
266.77	235.47	248.23	225.53	230.79	215.7	207.11	227.32	226.94	232.55	243.39	260.24			
							Tota	al = Sum(2	19a) ₁₁₂ =	_		2820.05	(219)	
	g fuel, k	Wh/mor	nth.										_	
= (107) 0)m÷ (20:	9) 0	0	0	49.8	73.48	52.31	0	0	0	0			
-							Tota	al = Sum(2)	21) ₆₈ =			175.59	(221)	
totals									k	Wh/veai	r	kWh/vear	1	
neating	fuel use	ed, main	system	1								12357.19]	
eating	fuel use	d										2820.05]	
cooling	fuel use	ed										175.59]	
ity for p	oumps, fa	ans and	electric	keep-ho	t									
anical v	entilatio	n - balar	nced, ext	ract or p	ositive i	nput fro	m outsid	е			1480.05		(230a)	
l heatin	g pump	:									30		(230c)	
ectricity	/ for the	above, l	kWh/yea	r			sum	of (230a).	<mark>(2</mark> 30g) =			1510.05	(231)	
ity for li	ghting											894.79] (232)	
02 em	issions -	– Individ	ual heat	ing syste	ems inclu	udina m	nicro-CHF	2			l			
		I			En k\/	ergy /b/vear			Emiss	ion fac 2/k\//h	tor	Emissions	r	
neatina	(main s	vstem 1)		(21	1) x				16	=	2669 15	T(261)	
o neating	` (second	darv)	,		(21	5) x			0.5	10	=	0		
	(000011	uury)			(21)				0.5	19	- I	0		
leating					(26)	1) . (262)	\	(264) -	0.2	16	-	609.13] ⁽²⁰⁴⁾	
and war	ter neati	ng			(20	1) + (202)) + (203) +	(204) =			l	3278.28	(265)	
cooling					(22)	1) x			0.5	19	=	91.13	(266)	
ity for p	oumps, f	ans and	electric	keep-ho	t (23 ⁻	1) x			0.5	19	=	783.72	(267)	
ity for li	ghting				(232	2) x			0.5	19	=	464.4	(268)	
02, kg/	year							sum o	of (265)(271) =	[4617.53	(272)	
ng CO2	Emissi	on Rate	•					(272)	÷ (4) =		[12.15	(273)	
g (secti	on 14)										[85	(274)	
	from wa 237.06 cy of w 88.86 water = (64) 266.77 cooling = (107 0 totals heating heating heating cooling ity for p nical w 1 heating hea	from water hea237.06208.94cy of water hea88.8688.73water heating,= (64) m x 100266.77235.47cooling fuel, k= (107) m÷ (20900totalsheating fuel usecooling (secondand water heatingcoolingity for lightingO2, kg/yearag CO2 Emissig (section 14)	from water heater (calc 237.06 208.94 219.4 cy of water heater 88.86 88.73 88.39 water heating, kWh/mod = (64)m x 100 ÷ (217) 266.77 235.47 248.23 cooling fuel, kWh/mod = (107)m÷ (209) 0 0 0 0 0 0 totals heating fuel used cooling fuel used ity for pumps, fans and anical ventilation - balar I heating pump: ectricity for the above, I ity for lighting O2 emissions - Individ heating (main system 1 heating (secondary) heating and water heating cooling ity for pumps, fans and ity for lighting O2, kg/year ag CO2 Emission Rate g (section 14)	from water heater (calculated a 237.06 208.94 219.4 196.64 cy of water heater 88.86 88.73 88.39 87.19 water heating, kWh/month = (64)m x 100 \div (217)m 266.77 235.47 248.23 225.53 cooling fuel, kWh/month. = (107)m \div (209) 0 0 0 0 totals heating fuel used, main system heating fuel used cooling fuel used cooling fuel used ity for pumps, fans and electric anical ventilation - balanced, ext I heating pump: ectricity for the above, kWh/yea ity for lighting C2 emissions – Individual heat heating (main system 1) heating (secondary) heating and water heating cooling ity for pumps, fans and electric ity for pumps, fans and electric fuely for lighting C2 emissions – Individual heat pag CO2 Emission Rate g (section 14)	from water heater (calculated above)237.06208.94219.4196.64192.68cy of water heater88.8688.7388.3987.1983.49water heating, kWh/month= (64)m x 100 ÷ (217)m266.77235.47248.23225.53230.79cooling fuel, kWh/month.= (107)m÷ (209)00000000totalsheating fuel used, main system 1heating fuel usedcooling fuel used <td colspa<="" td=""><td>from water heater (calculated 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225.53 230.79 215.7 207.11 227.32 226.94 232.55 cooling fuel, kWh/month. = (107)m÷ (209) 0 0 0 49.8 73.48 52.31 0 0 Total = Sum(219a)</td><td>trom water heater (calculated above) 237.06 208.94 219.4 198.64 192.68 172.13 165.27 181.41 181.1 203.91 215.66 cy of water heater 88.88 88.73 88.73 87.79 87.68 88.61 water heating, kWh/month = (64)m x 100 ÷ (217)m 227.92 226.94 232.55 243.39 266.77 235.47 248.23 225.53 230.79 215.7 207.11 227.32 226.94 232.55 243.39 Total = Sum(2199)</td><td>from water heater (calculated above). 237.06 208.94 219.4 196.64 192.68 172.13 185.27 181.1 181.1 203.91 216.66 231.35 cy of water heater 88.86 87.3 98.39 97.19 83.49 79.8 79.8 79.8 79.8 79.8 87.68 88.61 88.9 water heating, kWh/month = (64,m) x 100 + (217)m 225.53 230.79 215.7 207.11 227.32 226.94 232.55 243.39 260.24 Total = Sum(219a),, a = cooling fuel, kWh/month. = (107)m+ (209) 0 0 0 49.8 73.48 52.31 0 0 0 0 Total = Sum(219a,, a = kWh/month. = 1007/m+ (209) Total = Sum(219a,, a = 0</td><td>troom water heater (calculated above) 237.06 208.94 219.4 196.64 192.88 172.13 165.27 181.41 181.1 203.91 215.66 231.35 288.08 88.73 88.39 87.19 83.49 79.8 79.8 79.8 79.8 87.68 88.61 88.9 (Water heating, KWh/month. colspan="2">(107)m (209) 0<</td></td></td></td></td>	<td>from water heater (calculated above)237.06208.94219.4196.64192.68172.13cy of water heater88.8688.7388.3987.1983.4979.8water heating, kWh/month= (64)m x 100 ÷ (217)m266.77235.47248.23225.53230.79215.7cooling fuel, kWh/month.= (107)m÷ (209)00049.8totalsheating fuel used, main system 1heating fuel usedcooling pumps, fans and electric keep-hotheating pump:ectricity for the above, kWh/yearty for lightingC2 emissions – Individual heating systems includeheating (main system 1)(21)and water heating(22)cooling(22)cooling(22)(21)(21)(22)(22)(22)(22)(22)(22)(22)(22)(21)<td>from water heater (calculated above) 237.06 208.94 219.4 196.64 192.68 172.13 165.27 cy of water heater 88.86 88.73 88.39 87.19 83.49 79.8 79.8 water heating, kWh/month = 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			User D	Details:						
Assessor Name: Software Name:	Stroma FSAP 20)12		Strom Softwa	a Num are Vei	ber: rsion:		Versic	on: 1.0.4.26	
		P	roperty	Address	: 9D The	e Grove_	Propose	ed_Be C	lean	
Address :	ional									
T. Overall dwelling dimens	10115.		Aro	o(m ²)			iaht(m)		Volumo(m ³)	
Basement				26.23	(1a) x	Av. nei	ישוועווו) ג	(2a) =	378.69	(3a)
Ground floor				29.92	(1b) x		3](2b) =	389.76](3b)
First floor				23.86	(1c) x		.7	(2c) =	334.42	(3c)
Total floor area TFA = $(1a)$ +	·(1b)+(1c)+(1d)+(1	1e)+(1r	י <u>י</u> ר) [3	80.01	(4)](=0)	004.42](00)
Dwelling volume	(-/ (-/ (-/ (- / (/	00.01	(3a)+(3b)+(3c)+(3d)+(3e)+	.(3n) =	1102.87	l(5)
						, , , , ,	, , ,		1102.07](0)
2. Ventilation rate:	main	seconda	ry	other		total			m ³ per hour	
Number of chimneys	heating	heating 0] + [0] = [0	X 4	40 =	0	(6a)
Number of open flues	0 +	0		0	」] = [0	x	20 =	0	(6b)
Number of intermittent fans					ц Ц	4	x ′	10 =	40	(7a)
Number of passive vents						0	×	10 =	0	(7b)
Number of flueless gas fires					Γ	0	X 4	40 =	0	(7c)
								Air ch	anges per hou	ı r
Infiltration due to chimneys	flues and fans =	(6a)+(6b)+(7	7a)+(7b)+((7c) =	Г	40	-	÷ (5) −		"](8)
If a pressurisation test has beer	carried out or is inter	ded, procee	d to (17),	otherwise o	continue fr	rom (9) to (16)	. (0) –	0.04](0)
Number of storeys in the	dwelling (ns)								0	(9)
Additional infiltration							[(9)	-1]x0.1 =	0	(10)
Structural infiltration: 0.25	for steel or timbe	er frame or	⁻ 0.35 fo	r masoni	ry constr	uction			0	(11)
if both types of wall are prese deducting areas of openings	ent, use the value corr : if equal user 0.35	esponding to	o the great	ter wall are	a (after					_
If suspended wooden floo	or, enter 0.2 (unse	aled) or 0	.1 (seale	ed), else	enter 0				0	(12)
If no draught lobby, enter	0.05, else enter ()							0	(13)
Percentage of windows a	nd doors draught	stripped							0	(14)
Window infiltration				0.25 - [0.2	2 x (14) ÷ 1	= [00			0	(15)
Infiltration rate				(8) + (10)	+ (11) + (1	12) + (13) +	⊦ (15) =		0	(16)
Air permeability value, q5	0, expressed in c	ubic metre	es per ho	our per s	quare m	etre of e	nvelope	area	5	(17)
If based on air permeability	value, then (18) =	[(17) ÷ 20]+(8), otherw	ise (18) = ((16)				0.29	(18)
Air permeability value applies if	a pressurisation test l	nas been dor	ne or a de	gree air pe	rmeability	is being us	sed		-	_
Number of sides sheltered									2	(19)
Shelter factor				(20) = 1 -	[0.075 x (1	[9)] =			0.85	(20)
Infiltration rate incorporating	shelter factor			(21) = (18) x (20) =				0.24	(21)
Infiltration rate modified for	monthly wind spe	ed I.	<u> </u>	1					1	
Jan Feb Ma	ar Apr Ma	y Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind spee	d from Table 7	-i						1	1	
(22)m= 5.1 5 4.9	4.4 4.3	3.8	3.8	3.7	4	4.3	4.5	4.7		

Wind F	Factor (22	2a)m =	(22)m ÷	4											
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18]		
Adjust	ed infiltra	tion rate	e (allowi	ing for sl	nelter ar	nd wind s	speed) =	= (21a) x	(22a)m						
	0.31	0.3	0.3	0.27	0.26	0.23	0.23	0.23	0.24	0.26	0.27	0.29]		
Calcul	l ate effect	tive air (change	rate for t	he appli	icable ca	ise	-		-		-	-		
	echanicai		using Ann	endix N (2	(23) – (23)	a) v Emv (d	aquation (rwise (23t	(23a)				0	(23a)
If bal	anced with	heat reco	overv: effic	viency in %	allowing t	for in-use f	actor (fror	m Table 4h) –) = (20a)				0	
a) If	balanced	d mecha	anical ve	entilation	with he	at recove	ery (MV	HR) (24a	, – a)m = (2	2b)m + (23b) × [′	1 – (23c)	L) ÷ 100]	0	(230)
(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0]		(24a)
b) If	balanced	d mecha	anical ve	entilation	without	heat red	covery (MV) (24b)m = (2	2b)m + (23b)		-		
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0]		(24b)
c) If	whole ho if (22b)m	ouse ex < 0.5 ×	tract ver (23b), 1	ntilation of then (24)	or positiv c) = (23ł	ve input v o); otherv	ventilati wise (24	on from c lc) = (22t	outside b) m + 0	.5 × (23b)		-		
(24c)m=		0	0	0	0	0	0	0	0	0	0	0]		(24c)
d) If	natural v if (22b)m	entilation $= 1, the$	on or wh en (24d)	iole hous m = (22	se positi o)m othe	ve input erwise (2	ventilati 24d)m =	on from I 0.5 + [(2	oft 2b)m² x	0.5]	1		J		
(24d) <mark>m=</mark>	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.54	0.54			(24d)
Effe	ctive air c	change	rate - er	nter (24a) or (24	b) or (24	c) or (2	4d) in boy	(25)				· · · · ·		
(25)m=	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.54	0.54	1		(25)
3 Ho	atlosses	and he	atloss	naramet	or.										
		Croc		Oponin										A .	V k
ELEN		area	(m^2)	openin		Net Ar	rea m²	U-valı W/m2	ue K	A X U	K)	k-value	e K	k.J/	лк /К
Doors	Type 1	area	(m²)	r	lgs 1 ²	Net Ar A ,r 2.89	rea m ² x	U-valu W/m2	ue K =	A X U (W/I 2.88772	K) 7	k-valu kJ/m²⊷	e K	A . kJ	/K (26)
Doors Doors	Type 1 Type 2	area	(m²)	r	195 1 ²	Net Ar A ,r 2.89	rea m ² x	U-valu W/m2	ue :K = =	A X U (W/I 2.88772 2.81540	K) 7 7	k-value kJ/m²•	e K	kJ,	/K (26) (26)
Doors Doors Windo	Type 1 Type 2 ws Type	area	(m²)	m	IGS 1 ²	Net Ar A ,r 2.89 2.82 3.4447	rea m ² x x 68 x ¹	U-valu W/m2	2K = 0.04] =	A X U (W/I 2.88772 2.81540 4.57	K) 7 7	k-value kJ/m²⊷	e K	kJ,	(26) (26) (27)
Doors Doors Windo Windo	Type 1 Type 2 ws Type ws Type	area	(m²)	openin m	gs 1 ²	Net Ar A ,r 2.89 2.82 3.4447 19.872	rea m ² x x 68 x ¹ 23 x ¹	U-valu W/m2	2K = 0.04] = 0.04] =	A X U (W/ 2.88772 2.81540 4.57 26.35	K) 7 7	k-valu kJ/m²•	e K	kJ,	(26) (26) (27)
Doors Doors Windo Windo Windo	Type 1 Type 2 ws Type ws Type ws Type	area 1 2 3	(m²)	r	gs 1 ²	Net Ar A ,r 2.89 2.82 3.4447 19.872 0.8717	rea m ² x x 68 x1 23 x1 49 x1	U-valu W/m2	ue = 0.04] = 0.04] =	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16	<) 7 7	k-value kJ/m²•	e K	kJ,	<pre>/K (26) (26) (27) (27) (27) (27)</pre>
Doors Doors Windo Windo Windo Windo	Type 1 Type 2 ws Type ws Type ws Type ws Type ws Type	area 1 2 3 4	(m²)	r	gs 1 ²	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.806	rea m ² x 68 x1 23 x1 49 x1 67 x1	U-valu W/m2 1 1/[1/(1.4)+ 1/[1/(1.4)+ 1/[1/(1.4)+ 1/[1/(1.4)+	ue = 0.04] = 0.04] = 0.04] = 0.04] =	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17	<) 7 7	k-value kJ/m²-	e K	Α. kJ	(26) (26) (27) (27) (27) (27)
Doors Doors Windo Windo Windo Windo Floor	Type 1 Type 2 ws Type ws Type ws Type ws Type ws Type Type 1	1 2 3 4	(m²)	r	gs 1 ²	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.800 126.2	rea m ² x 68 x ¹ 23 x ¹ 49 x ¹ 67 x ¹ 3 x	U-valu W/m2 1 1/[1/(1.4)+ 1/[1/(1.4)+ 1/[1/(1.4)+ 1/[1/(1.4)+ 0.13	ue = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] =	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4095	<) 7 7	k-value kJ/m²-	eκ	А., kJ,	/K (26) (26) (27) (27) (27) (27) (27) (28)
Doors Doors Windo Windo Windo Windo Floor	Type 1 Type 2 ws Type ws Type ws Type ws Type ws Type Type 1 Type 2	1 2 3 4	(m²)	r	gs ₁ 2	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690	rea m ² x 68 x1 23 x1 49 x1 67 x1 33 x 5 x	$\begin{array}{c} U-valu \\ W/m2 \\ \hline \\ 1 \\ \hline \\ 1 \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 0.13 \\ \hline \\ 0.13 \end{array}$	ue = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] =	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976	<) 7 7 9 5	k-value kJ/m²•	e K	KJ,	/K (26) (27) (27) (27) (27) (27) (28) (28)
Doors Doors Windo Windo Windo Floor Floor	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type1	area 1 2 3 4	86	61.7	gs ,²	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1	rea m ² x 68 x1 23 x1 67 x1 67 x1 3 x 55 x 7 x	$\begin{array}{c} U-valu \\ W/m2 \\ \hline \\ 1 \\ \hline \\ 1 \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 0.13 \\ \hline \\ 0.13 \\ \hline \\ 0.18 \\ \hline \end{array}$	ue = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] =	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09	<) 7 7 3 3 5 5	k-value kJ/m²•	е К	KJ,	<pre>/K (26) (26) (27) (27) (27) (27) (27) (27) (28) (28) (28) (29)</pre>
Doors Doors Windo Windo Windo Windo Floor Floor Walls	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2	1 2 3 4 278.1 148.4	86 43	61.7 0	, ,	Net Ar A,r 2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690 217.1 148.4	rea m ² x 68 x ¹ 23 x ¹ 67 x ¹ 67 x ¹ 3 x 7 x 3 x	$\begin{array}{c} U-valu \\ W/m2 \\ \hline \\ 1 \\ \hline \\ 1 \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 0.13 \\ \hline \\ 0.13 \\ \hline \\ 0.18 \\ \hline \\ 0.18 \\ \hline \end{array}$	ue = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = = = = = = = = = = = = = = = = =	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09 26.72	<) 7 7 3 5 5 5	k-value kJ/m²-	е К	KJ,	<pre>/K (26) (26) (27) (27) (27) (27) (27) (28) (28) (29) (29)</pre>
Doors Doors Windo Windo Windo Windo Floor Floor Walls Roof	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1	1 2 3 4 278.4 148.4 123.4	86 86	61.7 0	,	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8	ea m² x 68 23 49 57 x1 33 7 x 33 x 34 x x1 x1 x23 x1 x3 x49 x1 x5 x x3 x6 x	$\begin{array}{c} U-valu \\ W/m2 \\ \hline \\ 1 \\ \hline \\ 1 \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 0.13 \\ \hline \\ 0.13 \\ \hline \\ 0.18 \\ \hline \\ 0.13 \\ \hline \\ 0.13 \\ \hline \end{array}$	ue = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = = = = = = = = = = = = = = =	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09 26.72 16.1	<) 7 7 9 5 1 1	k-value kJ/m²-	е К		<pre>/K (26) (26) (27) (27) (27) (27) (27) (28) (28) (29) (29) (30)</pre>
ELEN Doors Doors Windo Windo Windo Floor Floor Floor Walls Walls Roof	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type1 Type1 Type2	1 2 3 4 278.1 148.4 123.1 6.40	86 43 6	61.7 0 0	, , , , , , , , , , , , , , , , , , ,	Net Ar A,r 2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690 217.1 148.4 123.8 6.46	rea m ² x 68 x1 23 x1 67 x1 67 x1 67 x1 67 x1 5 x 7 x 3 x 66 x	$\begin{array}{c} U-valu \\ W/m2 \\ \hline \\ 1 \\ \hline \\ 1 \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 0.13 \\ \hline 0.13 \\ \hline 0.18 \\ \hline 0.13 \\ \hline 0.13 \\ \hline 0.13 \\ \hline \end{array}$	ue ue K = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 1<	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09 26.72 16.1		k-value kJ/m²-	е К	KJ, kJ,	/K (26) (27) (27) (27) (27) (27) (28) (28) (29) (29) (30) (30)
Doors Doors Windo Windo Windo Windo Floor Floor Kool Roof Total a	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type2 Type1 Type2 area of ele	1 2 3 4 278.1 148.4 123.1 6.40 ements	86 (m ²) 86 43 86 6 5 , m ²	61.7 0 0	gs ,²	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8 6.46 687.5	rea m ² x x 68 x1 23 x1 68 x1 23 x1 67 x1 3 x 55 x 7 x 3 x 66 x 3	$\begin{array}{c} U-valu \\ W/m2 \\ \hline \\ 1 \\ \hline \\ 1 \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 0.13 \\ \hline 0.13 \\ \hline 0.18 \\ \hline 0.13 \\ \hline 0.13 \\ \hline 0.13 \\ \hline 0.13 \\ \hline 0.13 \\ \hline 0.13 \\ \hline \end{array}$	ue = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 1 =	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09 26.72 16.1 0.84	<) 7 7 1 1 2 3 5 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	k-value kJ/m²•	е К		/K (26) (27) (27) (27) (27) (27) (27) (28) (28) (29) (29) (30) (30) (31)
Doors Doors Windo Windo Windo Windo Floor Floor Floor Roof Roof Total a * for win ** inclus	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type2 Type1 Type2 area of ele	1 2 3 4 278.4 148.4 123.4 6.40 ements roof windows on both	86 (m²) 86 43 86 6 5 , m² 50ws, use e sides of ii	61.7 0 0 0 effective winternal wal	, , , , , , , , , , , , , , , , , , ,	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8 6.46 687.5 alue calcul titions	rea m² x 68 23 49 57 x1 67 x1 67 x1 55 7 3 x .66 x .3 .46 .3 .41	$\begin{array}{c} U-value \\ W/m2 \\ \hline \\ 1 \\ \hline \\ 1 \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 0.13 \\ \hline 0.13 \\$	ue K 0.04] 0.04] 0.04] 0.04] 0.04] = 0.04] =	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09 26.72 16.1 0.84	<) 7 7 3 5 5 5 5 5 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7	k-value kJ/m²-	е К		<pre>/K (26) (26) (27) (27) (27) (27) (27) (28) (28) (29) (29) (30) (30) (31)</pre>
ELEN Doors Doors Windo Windo Windo Windo Floor Floor Floor Walls Roof Roof Total a * for win ** incluc Fabric	Type 1 Type 2 ws Type ws Type ws Type ws Type type 1 Type 2 Type 1 Type 2 Type1 Type2 area of ele adows and r de the areas theat loss	area 1 2 3 4 278.i 148.i 123.i 6.46 ements roof window s on both s, W/K =	86 (m ²) 86 43 86 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	61.7 0 0 0 effective whether ternal wale U)	indow U-v.	Net Ar A,r 2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690 217.1 148.4 123.8 6.46 687.5 alue calcul titions	rea m ² x 68 x1 23 x1 49 x1 67 x1 67 x1 67 x1 7 x 3 x 7 x 3 x 66 x 3 166 x 3 166 x	$\begin{array}{c} U-valu \\ W/m2 \\ \hline \\ 1 \\ \hline \\ 1 \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 0.13 \\ \hline 0.13 \\ $	$\begin{bmatrix} ue \\ K \\ = \\ 0.04 \end{bmatrix} = \\ 0.04 \end{bmatrix} = \\ 0.04 \end{bmatrix} = \\ 0.04 \end{bmatrix} = \\ = \\ = \\ = \\ = \\ = \\ = \\ (1/U-value) + (32) = \\ = \\ = \\ = \\ = \\ = \\ = \\ = \\ = \\ = $	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09 26.72 16.1 0.84	<) 7 7 7 9 9 1 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	k-value kJ/m²•	е К	9.58	/K (26) (27) (27) (27) (27) (28) (28) (29) (29) (30) (30) (31) (33)
ELEN Doors Doors Windo Windo Windo Windo Floor Floor Floor Walls Roof Total a * for win ** incluc Fabric Heat o	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type2 area of ele adows and r de the areas heat loss capacity C	area 1 2 3 4 278.1 148.4 123.1 6.46 ements roof windown s, W/K = Cm = S(86 (m ²) 86 43 86 5 5 6 5 5 6 5 5 6 5 5 6 5 5 6 5 5 6 5 5 6 5 5 6 5 5 6 5 5 5 6 5 5 5 5 6 5	61.7 0 0 0 0 0 0 0 0 0 0 0 0 0	indow U-v	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8 6.46 687.5 alue calcul titions	rea m ² x 68 x1 23 x1 67 x1 67 x1 67 x1 67 x1 5 x 7 x 3 x 66 x 3 66 x 3 1 ated using	$\begin{array}{c} U-valu \\ W/m2 \\ \hline \\ 1 \\ \hline \\ 1 \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 0.13 \\ \hline 0.13 \\ $	$\begin{bmatrix} 1 \\ - \\ - \\ - \\ - \\ - \\ - \\ - \\ - \\ - \\$	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09 26.72 16.1 0.84 (30) + (32	<) 7 7 7 9 9 5 [] 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	k-value kJ/m²•	e K	9.58 0	/K (26) (27) (27) (27) (27) (27) (27) (28) (29) (29) (30) (30) (31) (33) (34)
ELEN Doors Doors Windo Windo Windo Windo Floor Floor Floor Walls Walls Roof Total a * for win ** incluc Fabric Heat o Therm	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type2 area of ele adows and r de the areas cheat loss capacity C hal mass p	area 1 2 3 4 278.3 148.4 123.4 148.4 123.4 6.40 ements roof window s on both s, W/K = Cm = S(parameters	86 (m ²) 86 43 86 6 5 5 6 5 5 6 5 5 6 5 5 6 5 5 6 5 5 6 7 8 6 7 8 6 7 8 6 7 8 7 8 7 8 7 8 7 8	$\begin{bmatrix} 61.7\\ 0\\ 0\\ 0\\ 0\\ 0\\ 0\\ 0\\ 0\\ 0\\ 0\\ 0\\ 0\\ 0\\$	indow U-v. Is and par	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8 6.46 687.5 alue calcul titions	rea m ² x 68 x1 68 x1 49 x1 67 x1 3 x 7 x 3 x 7 x 3 x 6 x 3 x 6 x 3 x 16 x 3 x 16 x	$\begin{array}{c} U-valu \\ W/m2 \\ \hline \\ 1 \\ \hline \\ 1 \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 0.13 \\ \hline 0.13 \\ $	$\begin{bmatrix} ue \\ K \\ = \\ 0.04 \end{bmatrix} = \\ 0.04 \end{bmatrix} = \\ 0.04 \end{bmatrix} = \\ 0.04 \end{bmatrix} = \\ = \\ 0.04 \end{bmatrix} = \\ = \\ = \\ = \\ = \\ = \\ = \\ = \\ (1/U-value) + (32) = \\ ((28)). \\ Indical$	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09 26.72 16.1 0.84 Ue)+0.04] a (30) + (32 ative Value	<pre> </pre> </td <td>k-value kJ/m²-</td> <td>e K</td> <td>9.58 0</td> <td>/K (26) (27) (27) (27) (27) (27) (28) (29) (29) (30) (30) (31) (33) (34) (35)</td>	k-value kJ/m²-	e K	9.58 0	/K (26) (27) (27) (27) (27) (27) (28) (29) (29) (30) (30) (31) (33) (34) (35)

can be ι	ised instea	ad of a dei	tailed calc	ulation.										
Therm	al bridge	es : S (L	x Y) cal	culated u	using Ap	pendix ł	<						34.35	(36)
if details	of therma	al bridging	are not kn	own (36) =	= 0.05 x (3	1)								_
Total fa	abric he	at loss							(33) +	(36) =			213.93	(37)
Ventila	tion hea	at loss ca	alculated	monthly	/				(38)m	= 0.33 × (25)m x (5)			
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(38)m=	199.49	198.81	198.14	195.01	194.43	191.7	191.7	191.19	192.75	194.43	195.61	196.85		(38)
Heat tr	ansfer c	coefficier	nt, W/K						(39)m	= (37) + (3	38)m			
(39)m=	413.42	412.74	412.07	408.94	408.35	405.62	405.62	405.12	406.68	408.35	409.54	410.78		
Heatla		motor (l	אע (ס וו						(40)m	Average =	Sum(39)1.	.12 /12=	408.94	(39)
	oss para		1LP), VV/	102K	4.07	4.07	4.07	4.07	(40)m	= (39)m ÷	(4)	1.00	l	
(40)m=	1.09	1.09	1.08	1.08	1.07	1.07	1.07	1.07	1.07	1.07	1.08	1.08	4.00	
Numbe	er of day	vs in mor	nth (Tab	le 1a)					,	<pre>Average =</pre>	Sum(40)1	.12/12=	1.08	(40)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)
4. Wa	ter heat	ina ener	av reau	rement:								kWh/ve	ear:	
			<u> </u>											
	ied occu	ipancy, l	N 1 76 y	[1 - ovo	(_0_0003		-A -13 0	$(2)1 \pm 0.0$)013 v (T		3.:	24		(42)
if TF	A £ 13.9	9, N = 1	T 1.70 X	[i - exp	(-0.0003	49 X (11	A - 13.9)z)] + 0.0	013 x (1	II A -13.	5)			
Annua	l averag	e hot wa	ater usag	ge in litre	s per da	y Vd,av	erage =	(25 x N)	+ 36		111	.05		(43)
Reduce	the annua	al average	hot water	usage by {	5% if the d	welling is	designed t	o achieve	a water us	se target o	f			
normore		nines per p		uay (all W										
List water	Jan	Feb	Mar	Apr	May	Jun		Aug	Sep	Oct	Nov	Dec		
HOL WAL	er usage il	Tillies per	uay ior ea		vu,iii = iai			(43)						
(44)m=	122.16	117.72	113.27	108.83	104.39	99.95	99.95	104.39	108.83	113.27	117.72	122.16		-
Energy o	content of	hot water	used - cal	culated mo	onthly $= 4$.	190 x Vd,r	n x nm x D)Tm / 3600	r kWh/mon	Fotal = Sui hth (see Ta	m(44) ₁₁₂ = ables 1b, 1	c, 1d)	1332.64	(44)
(45)m=	181.16	158.44	163.5	142.54	136.77	118.02	109.37	125.5	127	148	161.56	175.44		
										Fotal = Su	m(45) ₁₁₂ =	:	1747.31	(45)
lf instant	taneous w	ater heatii	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46)) to (61)					
(46)m=	27.17	23.77	24.52	21.38	20.52	17.7	16.4	18.82	19.05	22.2	24.23	26.32		(46)
Water	storage	loss:	·		1			·u ·		1	-		l	
Storag	e volum	e (litres)	includir	ig any so	biar or w	WHRS	storage	within sa	ime vess	sei		150		(47)
If comr	nunity h	eating a	nd no ta	nk in dw	elling, e	nter 110	litres in	(47) mbi baili	oro) onto	n (0) in (47)			
Water	storade		not wate	er (unis in	ciudes i	istantai	ieous co		ers) ente		47)			
a) If m	anufact	urer's de	eclared I	oss facto	or is kno	wn (kWł	n/day):				1.	39		(48)
Tempe	erature fa	actor fro	m Table	2b		,	, , , , ,					54		(49)
Energy	/ lost fro	m water	storage	kWh/ve	ar			(48) x (49)	_			75		(50)
b) If m	anufact	urer's de	eclared of	ylinder l	oss facto	or is not	known:	(10) x (10)	_		0.	15		(00)
Hot wa	ater stora	age loss	factor fr	om Tabl	e 2 (kWl	h/litre/da	ıy)				()		(51)
If comr	munity h	eating s	ee secti	on 4.3										
Volum	e factor	from Tal	ble 2a								()		(52)
Tempe	erature fa	actor fro	m Table	2b)		(53)

Energy Enter	y lost fro (50) or	om water (54) in (5	⁻ storage 55)	e, kWh/ye	ear			(47) x (51)) x (52) x (53) =	0.	0 75		(54) (55)
Water	storage	loss cal	culated	for each	month			((56)m = (55) × (41)ı	m				. ,
(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(56)
If cylinde	er contain	s dedicate	l d solar sto	nage, (57)	I m = (56)m	x [(50) – (L H11)] ÷ (50	0), else (5	1 7)m = (56)	n where (H11) is fro	m Append	ix H	
(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(57)
Primar	y circuit	loss (ar	nnual) fro	om Table	e 3							0		(58)
Primar	y circuit	loss cal	culated	for each	month (59)m = ((58) ÷ 36	65 × (41)	m					
(mo	dified by	factor f	rom Tab	le H5 if t	here is s	solar wat	ter heatir	ng and a	cylinde	r thermo	stat)		I	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
Combi	loss ca	lculated	for each	month	(61)m =	(60) ÷ 30	65 × (41))m						
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)
Total h	neat req	uired for	water h	eating ca	alculated	l for eac	h month	(62)m =	0.85 × ((45)m +	(46)m +	(57)m +	(59)m + (61)	m
(62)m=	227.75	200.53	210.09	187.63	183.37	163.12	155.96	172.09	172.09	194.6	206.65	222.04		(62)
Solar DI	HW input	calculated	using App	endix G o	r Appendix	H (negati	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)		
(add a	dditiona	l lines if	FGHRS	and/or \	NWHRS	applies	, see Ap	pendix (G)					
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output	t from w	ater hea	ter	-			-				-			
(64)m=	227.75	200.53	210.09	187.63	183.37	163.12	155.96	172.09	172.09	194.6	206.65	222.04		
								Outp	out from wa	ater heate	r (annual)₁	12	2295.92	(64)
Hea <mark>t g</mark>	l <mark>ain</mark> s fro	m water	heating	, kWh/m	onth 0.2	5 ′ [0.85	× (45)m	+ (61)m	n] + 0.8 x	(<mark>46)m</mark> (+ (57)m	+ (<mark>59)</mark> m]	
(65)m=	97.51	86.35	91.64	83.47	82.75	75.32	73.64	79	78.3	86.49	89.79	9 <mark>5.61</mark>		(65)
inclu	ude (57)	m in calo	culation	of (65)m	only if c	ylinder i	s in the o	dwelling	<mark>or ho</mark> t w	ate <mark>r is f</mark> r	om com	munity h	eating	
5. Int	ternal ga	ains (see	e Table {	5 and 5a):									
Metab	olic gair	is (Table	e 5), Wat	ts										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m=	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8		(66)
Lightin	g gains	(calcula	ted in Ap	opendix	L, equat	ion L9 o	r L9a), a	lso see	Table 5					
(67)m=	49.21	43.71	35.55	26.91	20.12	16.98	18.35	23.85	32.02	40.65	47.45	50.58		(67)
Applia	nces ga	ins (calc	ulated ir	n Append	dix L, eq	uation L	13 or L1	3a), also	see Ta	ble 5				
(68)m=	520.24	525.64	512.04	483.07	446.52	412.16	389.2	383.8	397.41	426.37	462.93	497.29		(68)
Cookir	ng gains	(calcula	ated in A	ppendix	L, equat	tion L15	or L15a)), also se	e Table	5	-			
(69)m=	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18		(69)
Pumps	s and fa	ns gains	(Table	5a)										
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3		(70)
Losses	s e.g. ev	aporatic	n (nega	tive valu	es) (Tab	le 5)								
(71)m=	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44		(71)
Water	heating	gains (T	able 5)											
(72)m=	131.06	128.5	123.17	115.93	111.23	104.61	98.98	106.19	108.75	116.25	124.71	128.51		(72)
Total i	internal	gains =			•	(66)	m + (67)m	n + (68)m -	+ (69)m + ((70)m + (7	1)m + (72)	Im		
(73)m=	775.06	772.39	745.29	700.45	652.4	608.29	581.07	588.39	612.71	657.81	709.62	750.92		(73)
6. So	lar gains	5:	•	•				•						

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

Orienta	tion:	Access Facto Table 6d	r	Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.44	x	10.63	×	0.63	x	0.7] =	11.19	(74)
North	0.9×	0.77	x	3.44	x	20.32	×	0.63	x	0.7	1 =	21.39	(74)
North	0.9x	0.77	x	3.44	x	34.53	x	0.63	x	0.7] =	36.35	(74)
North	0.9x	0.77	x	3.44	x	55.46	×	0.63	x	0.7] =	58.39	(74)
North	0.9x	0.77	x	3.44	x	74.72	×	0.63	x	0.7] =	78.66	(74)
North	0.9x	0.77	x	3.44	x	79.99	×	0.63	x	0.7] =	84.21	(74)
North	0.9x	0.77	x	3.44	x	74.68	x	0.63	x	0.7] =	78.62	(74)
North	0.9x	0.77	x	3.44	x	59.25	×	0.63	x	0.7] =	62.37	(74)
North	0.9x	0.77	x	3.44	x	41.52	x	0.63	x	0.7] =	43.71	(74)
North	0.9x	0.77	x	3.44	x	24.19	×	0.63	x	0.7] =	25.47	(74)
North	0.9x	0.77	x	3.44	x	13.12	×	0.63	x	0.7] =	13.81	(74)
North	0.9x	0.77	x	3.44	x	8.86	×	0.63	x	0.7] =	9.33	(74)
East	0.9x	0.77	x	19.87	x	19.64	×	0.63	x	0.7] =	119.28	(76)
East	0.9x	0.77	x	19.87	x	38.42	×	0.63	x	0.7] =	233.34	(76)
East	0.9x	0.77	x	19.87	x	63.27	×	0.63	x	0.7	=	384.27	(76)
East	0.9x	0.77	x	19.87	×	92.28	x	0.63	х	0.7		560.44	(76)
East	0.9x	0.77	x	19.87	x	113.09	х	0.63	x	0.7] =	6 86.84	(76)
East	0.9x	0.77	x	19.87	х	115.77	×	0.63	x	0.7	=	703.1	(76)
East	0.9x	0.77	x	19.87	x	110.22	x	0.63	x	0.7] =	6 <mark>69.38</mark>	(76)
East	0.9x	0.77	x	19.87	x	94.68	x	0.63	x	0.7] =	574.99	(76)
East	0.9x	0.77	x	19.87	x	73.59	×	0.63	x	0.7] =	446.92	(76)
East	0.9x	0.77	x	19.87	х	45.59	×	0.63	x	0.7] =	276.87	(76)
East	0.9×	0.77	x	19.87	×	24.49	×	0.63	x	0.7] =	148.73	(76)
East	0.9x	0.77	x	19.87	x	16.15	x	0.63	x	0.7] =	98.09	(76)
South	0.9x	0.77	x	0.87	x	46.75	x	0.63	x	0.7] =	12.46	(78)
South	0.9×	0.77	x	0.87	x	76.57	x	0.63	x	0.7	=	20.4	(78)
South	0.9×	0.77	x	0.87	x	97.53	x	0.63	x	0.7] =	25.98	(78)
South	0.9x	0.77	x	0.87	x	110.23	x	0.63	x	0.7	=	29.37	(78)
South	0.9x	0.77	x	0.87	x	114.87	x	0.63	x	0.7] =	30.6	(78)
South	0.9x	0.77	x	0.87	x	110.55	x	0.63	x	0.7	=	29.45	(78)
South	0.9x	0.77	x	0.87	x	108.01	x	0.63	x	0.7	=	28.78	(78)
South	0.9x	0.77	x	0.87	x	104.89	x	0.63	x	0.7] =	27.95	(78)
South	0.9x	0.77	x	0.87	x	101.89	x	0.63	x	0.7	=	27.14	(78)
South	0.9x	0.77	x	0.87	x	82.59	x	0.63	x	0.7	=	22	(78)
South	0.9x	0.77	x	0.87	x	55.42	x	0.63	x	0.7	=	14.76	(78)
South	0.9x	0.77	x	0.87	x	40.4	x	0.63	x	0.7	=	10.76	(78)
West	0.9x	0.77	x	31.81	x	19.64	x	0.63	x	0.7	=	190.91	(80)
West	0.9x	0.77	x	31.81	×	38.42	×	0.63	x	0.7	=	373.47	(80)
West	0.9x	0.77	x	31.81	x	63.27	x	0.63	x	0.7] =	615.05	(80)

West	0.9x	0.77	x	31.	81	x	9	2.28	×		0.63	×	0.7	=	897.01	(80)
West	0.9x	0.77	x	31.	81	x	1	13.09	x		0.63		0.7	=	1099.32	(80)
West	0.9x	0.77	x	31.	81	x	1	15.77	x		0.63		0.7	=	1125.35	(80)
West	0.9x	0.77	x	31.	81	x	1	10.22	x		0.63		0.7	=	1071.38	(80)
West	0.9x	0.77	x	31.	81	x	9	4.68	x		0.63	_ × [0.7	=	920.3	(80)
West	0.9x	0.77	x	31.	81	x	7	3.59] x		0.63	× [0.7	=	715.33	(80)
West	0.9x	0.77	x	31.	81	x	4	5.59	x		0.63	_ × [0.7	=	443.15	(80)
West	0.9x	0.77	x	31.	81	x	2	4.49	x		0.63	×	0.7	=	238.05	(80)
West	0.9x	0.77	x	31.	81	x	1	6.15	x		0.63	×	0.7	=	157	(80)
	_								-							
Solar	gains in	watts, ca	alculated	d for eac	h month	<u> </u>			(83)m	า = Sเ	um(74)m .	(82)m	_		•	
(83)m=	333.84	648.6	1061.66	1545.21	1895.42	19	942.11	1848.15	158	5.61	1233.1	767.49	415.35	275.18		(83)
Total	gains – i	nternal a	and sola	r (84)m =	= (73)m	+ (83)m	, watts	. – –						7	
(84)m=	1108.9	1420.98	1806.95	2245.66	2547.82	2	550.39	2429.22	217:	3.99	1845.82	1425.3	1124.97	1026.1		(84)
7. Me	ean inter	nal temp	perature	(heating	seasor	า)										
Tem	perature	during h	neating p	periods i	n the livi	ng	area	from Tab	ole 9	, Th1	1 (°C)				21	(85)
Utilis	ation fac	tor for g	ains for	living are	ea, h1,m	<u>ו (s</u>	see Ta	ble 9a)							-	
	Jan	Feb	Mar	Apr	May		Jun	Jul	A	ug	Sep	Oct	Nov	Dec		
(86)m=	1	1	1	0.99	0.96		0.85	0.69	0.7	77	0.96	1	1	1		(86)
Me <mark>a</mark>	n interna	l temper	ature in	living ar	ea T1 <mark>(</mark> f	ollo	ow ste	ps 3 t <mark>o 7</mark>	7 in T	able	9c)					
(87)m=	1 <mark>9.55</mark>	19.69	19.96	20.32	20.66		20.89	20. <mark>97</mark>	20.	95	20.74	20.29	19.86	1 <mark>9.53</mark>]	(87)
Tem	oerature	during h	neating r	periods i	n rest of	dv	vellina	from Ta	able 9	9. Th)2 (°C)				-	
(88)m=	20.01	20.01	20.01	20.02	20.02		20.03	20.03	20.	03	20.03	20.02	20.02	20.02	1	(88)
Litilie	ation for	tor for a	aine for	roct of d	wolling	<u>г</u> h2			00)						1	
(89)m=		1		0.99	0.94		, III (Se	0.56	9 <u>a</u>)	35	0.93	1	1	1	1	(89)
	. :		L !	41 4			. TO //					- 0>			1	
		1 temper	ature in		of dwell	ing T) I∠ (10 10.04	20.02	eps 3	$\frac{5 \text{ to } 7}{01}$	10 77	e 9C)	18.40	18.01	1	(90)
(50)11-	10.04	10.20	10.00	10.17	10.00		10.04	20.02	20.		10.77	LA = Liv	ing area ÷ (4	10.01	0.07	(00)
													3	,	0.07	
Mea	n interna	l temper	ature (fo	or the wh	ole dwe	ellin	ng) = fl	_A × T1	+ (1	- fL	A) × T2				1	(00)
(92)m=	18.15	18.35	18.73	19.25	19.72		20.01	20.09	20.	07	19.84	19.22	18.59	18.12	J	(92)
	y adjustr	19.25	ne mear	1 interna	1 temper		Jre fro	m Table	e 4e,	wne	re appro	priate	19.50	19.12	1	(03)
(35)III-		ting regi	uiremen	19.25	19.72	1 4	20.01	20.03	20.	<u> </u>	19.04	19.22	10.59	10.12		(00)
Set 1	Ti to the i	mean int	ternal te	mperatu	re obtai	ner	t at ste	on 11 of	Tab	le 9h	so tha	t Ti m-	(76)m an	d re-cal	rulate	
the u	tilisation	factor fo	or gains	using Ta	able 9a		1 01 01		Tub		, 50 114		.(70)11 an		Julate	
	Jan	Feb	Mar	Apr	May	Γ	Jun	Jul	A	ug	Sep	Oct	Nov	Dec]	
Utilis	ation fac	tor for g	ains, hr	ו:											_	
(94)m=	1	1	1	0.98	0.93		0.77	0.57	0.6	65	0.92	1	1	1		(94)
Usef	ul gains,	hmGm	, W = (9	4)m x (8	4)m								_		•	
(95)m=	1108.74	1420.17	1801.74	2208.38	2360.36	19	971.83	1380.15	1420	0.44	1703.03	1418.2	8 1124.54	1026		(95)
Mont	hly aver	age exte	ernal tem	nperature	e from T	abl	le 8	1	·		i				1	
(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	J	(96)
Heat	loss rate	e for mea	an interr	nal temp	erature,	Lm	n , W =	=[(39)m :	x [(9	3)m-	- (96)m				1	
(97)m=	5725.75	5553.07	5040.23	4232.69	3276.29	2	196.02	1414.17	1488	8.68	2335.26	3518.4	9 4706.08	5718.99		(97)

		En	ergy			Emiss	ion fac	tor	Emission	5
12a. CO2 emissions – Individual he	eating syste	ems inclu	uding mi	cro-CHP)					
Electricity for lighting									869.11	(232)
Total electricity for the above, kWh/y	/ear			sum	of (230a).	(230g) =		ļ	75	(231)
polier with a fan-assisted flue								45		(230e)
central neating pump:								30		(230C)
Electricity for pumps, rans and electric	пс кеер-пс	π								(000 -)
Flastricity for pumps for and clast	via kaana ha							l	2000.10	
Water beating fuel used								l ſ		╡
Annual totals Space heating fuel used main syste	em 1					k	Wh/year	[19672 31	Ĺ Ĺ
				lota	I = Sum(2)	19a) ₁₁₂ =			2658.16	(219)
	5 208.38	204.41	195.44	215.66	215.65	218.22	230.61	247.31		_
Fuel for water heating, kWh/month $(210)m = (64)m \times 100 \div (217)m$										
(217)m= 89.75 89.69 89.54 89.1	4 88	79.8	79.8	79.8	79.8	89.18	89.61	89.78		(217)
Efficiency of water heater									79.8	(216)
227.75 200.53 210.09 187.0	63 183.37	163.12	155.96	172.09	172.09	194.6	206.65	222.04		
Water heating Output from water heater (calculated	d above)						/ 15,1012	² [
(215)m= 0 0 0 0	0	0		U Tota	U L (kWh/vea	= 0 ar) = Sum(2)	(15)	0	0	 (215)
Space heating fuel (secondary), kV = {[(98)m x (201)] } x 100 ÷ (208)	Vh/month									
				Tota	l (kWh/yea	ar) =Sum(2	2 11) _{15,1012}		19672.31	(211)
3673.86 2970.38 2576.94 1558.	.82 728.83	0	0	0	0	1671.19	2757.98	3734.32		(=)
$(211)m = \{[(98)m \times (204)]\} \times 100 \div$	(206)	I						L]		(211)
3435.06 2777.3 2409.44 1457	.5 681.45	0	0	0	0	1562.56	2578.71	3491.59		
Jan Feb Mar Ap	or May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ar
Elliciency of secondary/supplemen	tary neatin	g system	1, %						0	(208)
Efficiency of main space neating sy	/stem 1		- 0/						93.5	(206)
Fraction of total heating from main	system 1			(204) = (2	02) x [1 –	(203)] =			1	(204)
Fraction of space heat from main s	ystem(s)			(202) = 1 -	-(201) =	(000)]			1	(202)
Fraction of space heat from second	ary/supple	ementary	v system					Į	0	(201)
9a. Energy requirements – Individua	I heating s	ystems i	ncluding	micro-C	CHP)					
Space heating requirement in kWh	/m²/year								48.4	(99)
				Tota	l per year	(kWh/year) = Sum(9	8)15,912 =	18393.61	(98)
(98)m= 3435.06 2777.3 2409.44 1457	.5 681.45	0	0	0	0	1562.56	2578.71	3491.59		
opace nearing requirement for cac			11 - 0.02	<u> </u>)11 - (33	<u>////] ^ (4</u>	1,111			

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

kWh/year

Emission factor kg CO2/kWh

Emissions kg CO2/year

(211) x	0.216	=	4249.22	(261)
(215) x	0.519	=	0](263)
(219) x	0.216	=	574.16	(264)
(261) + (262) + (263) + (264) =			4823.38	(265)
(231) x	0.519	=	38.93	(267)
(232) x	0.519	=	451.07	(268)
sum	of (265)(271) =		5313.37	(272)
	(211) x (215) x (219) x (261) + (262) + (263) + (264) = (231) x (232) x sum	(211) x 0.216 (215) x 0.519 (219) x 0.216 (261) + (262) + (263) + (264) =(231) x 0.519 (232) x 0.519 sum of (265)(271) =	$(211) \times$ 0.216 = $(215) \times$ 0.519 = $(219) \times$ 0.216 = $(261) + (262) + (263) + (264) =$ (231) \times 0.519 = $(232) \times$ 0.519 = $sum of (265)(271) =$	(211) x 0.216 = 4249.22 (215) x 0.519 = 0 (219) x 0.216 = 574.16 (261) + (262) + (263) + (264) = 4823.38 (231) x 0.519 =(232) x 0.519 =sum of (265)(271) = 5313.37

TER =

13.98 (273)



			User D	Details:						
Assessor Name: Software Name:	Stroma FSAI	P 2012		Strom Softwa	a Num are Vei	ber: rsion:		Versic	on: 1.0.4.26	
			Property	Address	: 9D The	e Grove_	Propose	ed_Be G	reen	
Address :										
1. Overall dwelling dimens	ions:									
			Are	a(m²)		Av. Hei	ight(m)	-	Volume(m ³)	-
Basement			1	26.23	(1a) x		3	(2a) =	378.69	(3a)
Ground floor			1	29.92	(1b) x		3	(2b) =	389.76	(3b)
First floor			1	23.86	(1c) x	2	2.7	(2c) =	334.42	(3c)
Total floor area TFA = (1a)-	-(1b)+(1c)+(1c	d)+(1e)+(1	n) 3	80.01	(4)			-		-
Dwelling volume					(3a)+(3b)+(3c)+(3d	l)+(3e)+	.(3n) =	1102.87	(5)
2. Ventilation rate:										7
	main beating	seconda beating	ary	other		total			m ³ per hour	
Number of chimneys		+ 0	+	0] = [0	×	40 =	0	(6a)
Number of open flues	0	+ 0	=	0	- -	0	x	20 =	0	(6b)
Number of intermittent fans					- Ē	0	x -	10 =	0	(7a)
Number of passive vents					Ē	0	×	10 =	0	(7b)
Number of flueless gas fires	6				Ē	0	X	40 =	0	(7c)
								Air ch	nange <mark>s per</mark> hou	ır
Infiltration due to chimneys,	flues and fan	s = (6a)+(6b)+	(7a)+(7b)+((7c) =		0		÷ (5) =	0	(8)
It a pressurisation test has been	carried out or is	intended, proce	ed to (17),	otherwise (continue fr	om (9) to (16)			1
Additional infiltration	dweiling (ns)						[(0)	11-0.4	0	(9)
Structural infiltration: 0.2	for steel or ti	mher frame c	or 0 35 fo	r masoni	rv constr	ruction	[(9)	- 1]XU. 1 =	0	(10)
if both types of wall are pres	ent, use the value	corresponding	to the grea	ter wall are	a (after	dottori			0]()
deducting areas of openings	; if equal user 0.3	35 uppeoled) or (ad) alaa	ontor O				_	1
If suspended wooden not	or, enter 0.2 (0.05 alog and	insealed) or (J.1 (Seale	ea), eise	enter U				0	(12)
Dereentage of windows a	0.05, eise ein								0	(13)
Window infiltration		igin sinpped		0 25 - [0 2	$P \ge (14) \div 1$	001 =			0	(14) (45)
Infiltration rate				(8) + (10)	+ (11) + (1	2) + (13) +	+ (15) =		0	(10)
	0 expressed	in cubic metr	es ner ha		auare m	etre of e	nvelone	area	0	(10)
If based on air permeability	value then (1	8) = [(17) ÷ 20]+	(8), otherw	ise (18) = ((16)		involopo	aroa	0.15	(18)
Air permeability value applies if	a pressurisation	test has been do	one or a de	gree air pe	rmeability	is being us	sed		0.15	
Number of sides sheltered	,		·		,	0			2	(19)
Shelter factor				(20) = 1 -	[0.075 x (1	9)] =			0.85	(20)
Infiltration rate incorporating	shelter facto	r		(21) = (18) x (20) =				0.13	(21)
Infiltration rate modified for	monthly wind	speed								-
Jan Feb M	ar Apr	May Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind spee	d from Table	7	_							
(22)m= 5.1 5 4.9	4.4	4.3 3.8	3.8	3.7	4	4.3	4.5	4.7]	

wind i	Factor (22	2a)m =	(22)m ÷	4										
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18		
Adjuste	ed infiltra	ition rat	e (allowi	ng for sł	nelter an	d wind s	speed) =	(21a) x	(22a)m					
	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15		
Calcula	ate effect	<i>tive air</i> Lventila	change i tion:	rate for t	he appli	cable ca	ise						- 	(220)
lf exh	aust air he	at pump	using Appe	endix N. (2	3b) = (23a) × Fmv (e	equation (I	N5)), othe	wise (23b) = (23a)			0.5	(234)
lf bala	anced with	heat reco	overv: effic	iencv in %	allowing f	or in-use f	actor (fron	n Table 4h) =) (200)			0.5	(230)
a) If	halancer	d mech	anical ve	ntilation	with he	at recov	erv (MVI	HR) (24a)m – (2:	2h)m + (23h) x [[,]	1 – (23c)		(230)
(24a)m=	0.3	0.29	0.29	0.27	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28		(24a)
b) If	balanced	d mech	ı anical ve	ntilation	without	heat red	L Covery (N	и VV) (24b)m = (22	1 2b)m + (1	23b)		1	
, (24b)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If	whole ho	ouse ex	tract ver	ntilation of	or positiv	e input	ventilatio	on from c	outside			<u> </u>	1	
i	if (22b)m	< 0.5 >	(23b), t	hen (240	c) = (23b); other	wise (24	c) = (22b	o) m + 0.	.5 × (23b) 	<u> </u>	1	(0.4-)
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) lf i	natural v if (22b)m	entilation = 1, th	on or wh en (24d)	ole hous $m = (22b)$	se positiv o)m othe	/e input rwise (2	ventilatio 24d)m =	on from I 0.5 + [(2	oft 2b)m² x	0.5]				
(24d) <mark>m=</mark>	0	0	0	0	0	0	0	0	0	0	0	0		(24d)
Effe	ctive air o	change	rate - er	nter (24a) or (24t) or (24	c) or (24	d) in boy	(25)					
(25)m=	0.3	0.29	0.29	0.27	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28		(25)
3. He	at losses	and he	eat loss r	paramete	er:									
ELEN	/IENT	Gros	SS	Openin	gs	Net Ar	ea	U-valu	le K	AXU	0	k-value		A X k
Doors	Tvpe 1	alea	(11-)			A ,I			<u> </u>	(• • • •	<u>)</u>	KJ/111-•1		KJ/ K
Doors	Type 2					2 69		1 1	=	2 88772	7			(26)
Windo						2.89			=	2. <mark>88772</mark> 2.81540	7			(26)
	ws Type	1				2.89	x x 68 x1	1 1 /[1/(0.8)+	0.04] =	2. <mark>88772</mark> 2.81540	7			(26) (26) (27)
Windov	ws Type ws Type	1 2				2.89 2.82 3.4447 19.872	x x 68 x ¹ 23 x ¹	1 [1/(0.8)+ /[1/(0.8)+	= 0.04] = 0.04] =	2.88772 2.81540 2.67 15.4	7			(26) (26) (27) (27)
Window	ws Type ws Type ws Type	1 2 3				2.89 2.82 3.4447 19.872	x 68 x1 23 x1 49 x1	1 [1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+	= 0.04] = 0.04] = 0.04] =	2.88772 2.81540 2.67 15.4 0.68	7		1	(26) (26) (27) (27) (27)
Windov Windov Windov	ws Type ws Type ws Type ws Type	1 2 3 4				2.89 2.82 3.4447 19.872 0.8717 31.800	x x 68 x1 23 x1 49 x1 67 x1	1 /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+	0.04] = [0.04] = [0.04] = [0.04] = [0.04] = [2.88772 2.81540 2.67 15.4 0.68 24.66	7		1	(26) (26) (27) (27) (27) (27)
Windov Windov Windov Floor T	ws Type ws Type ws Type ws Type Гуре 1	1 2 3 4				2.89 2.82 3.4447 19.872 0.8717 31.800	x 68 x1 23 x1 49 x1 67 x1 3 x	1 /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ 0.1	= 0.04] = [0.04] = [0.04] = [0.04] = [= =	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623				(26) (26) (27) (27) (27) (27) (27) (28)
Windov Windov Windov Floor T Floor T	ws Type ws Type ws Type ws Type Type 1 Type 2	1 2 3 4				2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690	x x 68 x1 23 x1 49 x1 67 x1 67 x1 3 x 5 x	1 /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ 0.1 0.1	= [0.04] = [0.04] = [0.04] = [0.04] = [= = [= = [2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909				(26) (26) (27) (27) (27) (27) (27) (28) (28)
Windov Windov Windov Floor T Floor T Walls	ws Type ws Type ws Type ws Type fype 1 fype 2 Type1	1 2 3 4 278.	86	61.7		2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1	x 68 x1 23 x1 49 x1 67 x1 3 x 5 x 7 x	1 /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ /[1/(0.8)+ 0.1 0.1 0.15	= 0.04] = [0.04] = [0.04] = [0.04] = [= [= [= [= [= [2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57				(26) (27) (27) (27) (27) (27) (28) (28) (28) (29)
Windov Windov Windov Floor T Floor T Walls ⁻ Walls ⁻	ws Type ws Type ws Type ws Type fype 1 fype 2 Type1 Type1 Type2	1 2 3 4 <u>278.</u> 148.	86	61.7		2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690 217.1 148.4	x x 68 x1 23 x1 49 x1 67 x1 3 x 5 x 7 x 3 x	$ \begin{array}{c c} 1 \\ \hline 1 \\ /[1/(0.8)+ \\ /[1/(0.8)+ \\ /[1/(0.8)+ \\ \hline 0.1 \\ \hline 0.1 \\ \hline 0.15 \\ 0.15 \\ \hline $	= $0.04] = [0.04] = [0.04] = [0.04] = [0.04] = [0.04] = [= [= [] = [] = [] = [= [] =$	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57 22.26				(26) (27) (27) (27) (27) (27) (28) (28) (28) (29)
Windov Windov Floor T Floor T Walls ⁻ Walls ⁻ Roof T	ws Type ws Type ws Type ws Type fype 1 fype 2 Type1 Type2 fype1	1 2 3 4 <u>278.</u> 148. 123.	86 43 86	61.7 0		2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8	x x 68 x1 23 x1 49 x1 67 x1 3 x 5 x 7 x 3 x 66 x	$ \begin{array}{c} 1\\ 1\\ (1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ 0.1\\ 0.1\\ 0.15\\ 0.15\\ 0.12\\ 0.12 \end{array} $	$\begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57 22.26 14.86				(26) (27) (27) (27) (27) (27) (28) (28) (28) (29) (29) (29) (30)
Windov Windov Floor T Floor T Walls ⁻ Roof T Roof T	ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type1	1 2 3 4 278. 148. 123. 6.4	86 43 86	61.7 0 0		2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690 217.1 148.4 123.8 6.46	x x 68 x1 23 x1 49 x1 67 x1 3 x 55 x 7 x 3 x 6 x x 6 x	$ \begin{array}{c c} 1 \\ \hline 1 \\ /[1/(0.8)+ \\ /[1/(0.8)+ \\ /[1/(0.8)+ \\ \hline 0.1 \\ 0.1 \\ \hline 0.15 \\ 0.15 \\ \hline 0.12 \\ 0.12 \\ \hline 0.12$	$\begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57 22.26 14.86 0.77				(26) (27) (27) (27) (27) (27) (28) (28) (28) (29) (29) (29) (30)
Windov Windov Floor T Floor T Walls ⁻ Walls ⁻ Roof T Roof T Total a	ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type2 area of el	1 2 3 4 <u>278.</u> 148. <u>123.</u> 6.4 ements	86 43 86 6 , m ²	61.7 0 0 0		2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8 6.46 687.5	x x 68 x1 23 x1 49 x1 67 x1 3 x 5 x 7 x 3 x 6 x 3 x 3	$ \begin{array}{c c} 1 \\ \hline 1 \\ \hline 1 \\ \hline 1 \\ \hline 1 \\ \hline 0.8 \\ \hline 1 \\ \hline 1 \\ \hline 0.8 \\ \hline 0.1 \\ \hline 0.$	$\begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57 22.26 14.86 0.77				(26) (27) (27) (27) (27) (27) (28) (28) (28) (29) (29) (29) (30) (30) (31)
Windov Windov Floor T Floor T Walls ⁻ Walls ⁻ Roof T Roof T Total a * for win	ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type2 area of el-	1 2 3 4 278. 148. 123. 6.4 ements roof wind	86 43 86 6 , m ² ows, use e	61.7 0 0 0	ndow U-va	2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8 6.46 687.5 alue calcul	x x x x x x x x x x x x x x	$ \begin{array}{c} 1\\ 1\\ (1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ 0.1\\ 0.1\\ 0.15\\ 0.15\\ 0.15\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12 \end{array} $	$\begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57 22.26 14.86 0.77 4(e)+0.04] a	7 7 5 5 1 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1	paragraph		(26) (27) (27) (27) (27) (28) (28) (28) (29) (29) (29) (30) (30) (31)
Windov Windov Floor T Floor T Walls ⁻ Roof T Roof T Total a * for win ** includ Fabric	ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type2 area of el- dows and r le the areas heat loss	1 2 3 4 <u>278.</u> 148. <u>123.</u> 6.4 ements roof wind s on both s, W/K =	86 43 86 6 , m ² ows, use e sides of ir = S (A x	61.7 0 0 0 effective wi internal walk	ndow U-va	2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690 217.1 148.4 123.8 6.46 687.5 alue calcul itions	x x 68 x1 23 x1 49 x1 67 x1 37 x 55 x 7 x 3 x 55 x 7 x 3 x 49 x1 67 x1 37 x 1 37 x 1 57 x 1 37 x 27 x 1 37 x 1 37 x 1 37 x 1 37 x 1 37 x 1 37 x 1 37 x 1 37 x 1 37 x 1 2 2 x 1 2 2 x 1 2 x 1 2 x 1 2 x 1 2 x 1 2 x 1 2 x 1 2 x 1 2 x 2 x	$ \begin{array}{c} 1\\ 1\\ (1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ (1/(0.8)+\\ 0.1\\ 0.1\\ 0.15\\ 0.15\\ 0.15\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12 \end{array} $	$\begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57 22.26 14.86 0.77	7 7 5 5 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	paragraph]	(26) (27) (27) (27) (27) (27) (28) (28) (29) (29) (29) (29) (30) (30) (31)
Windov Windov Floor T Floor T Floor T Walls ⁻ Walls ⁻ Roof T Roof T Roof T Total a * for win ** includ Fabric Heat c	ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type2 area of eli- dows and i le the areas heat loss apacity C	1 2 3 4 278. 148. 123. 6.4 ements roof wind s on both s, W/K =	86 43 86 6 , m ² ows, use e sides of ir = S (A x (A x k)	61.7 0 0 0 effective wi internal walk	ndow U-ve	2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8 6.46 687.5 blue calcul itions	x x 68 x1 23 x1 49 x1 67 x1 3 x 5 x 7 x 3 x 6 x 3 x 49 x1 67 x1 3 x 49 x1 67 x1 3 x 49 x1 67 x1 3 x 49 x1 5 x 7 x 3 x 4 5 x 4 x 1 5 x 7 x 3 x 4 5 x 7 x 4 3 x 4 5 x 7 x 4 5 x 7 x 4 5 x 7 x 4 5 x 7 x 4 5 x 7 x 4 5 x 7 x 1 5 x 7 x 1 5 x 7 x 1 3 x 4 5 x 7 x 1 3 x 4 5 x 7 x 1 3 x 4 5 x 7 x 1 3 x 4 5 x 7 x 1 3 x 4 x 1 5 x 7 x 3 x 1 5 x 7 x 3 x 4 5 x 7 x 1 3 x 4 5 x 7 x 1 3 x 4 x 1 5 x 7 x 3 x 4 x 1 x x 1 x 1 x x 1 x x x 1 x x x x x x x x x x x x x	$ \begin{array}{c} 1\\ 1\\ (1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ 0.1\\ 0.1\\ 0.15\\ 0.15\\ 0.15\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12 \end{array} $	$\begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57 22.26 14.86 0.77 (22.26) 14.86 0.77	7 7 5 5 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	paragraph (32e) =		(26) (27) (27) (27) (27) (28) (28) (28) (29) (29) (30) (30) (31) (31)
Windov Windov Floor T Floor T Valls ⁻ Walls ⁻ Roof T Roof T Total a * for win ** includ Fabric Heat c Therm	ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type2 area of el- dows and r de the areas heat loss apacity C al mass	1 2 3 4 278. 148. 123. 123. 6.4 ements s on both s, W/K = Cm = S(parame	86 43 86 6 , m ² ows, use e sides of ir = S (A x (A x k) tter (TMF	$\begin{bmatrix} 61.7\\ 0\\ 0\\ 0\\ \end{bmatrix}$	ndow U-va s and part	2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8 6.46 687.5 alue calcul itions	x x 68 x1 23 x1 49 x1 67 x1 3 x 5 x 7 x 3 x 6 x 3 2 4 6 x 3 2 1 4 9 x1 67 x1 3 x 5 x 7 x 3 x 1 6 x 1 3 x 1 23 x1 23 x1 23 x1 23 x1 23 x1 23 x1 23 x1 23 x1 23 x1 23 x1 24 x1 25 x1 26 x1 27 x1 26 x1 27 x1 27 x1 27 x1 28 x1 29 x1 20 x1 2	$ \begin{array}{c} 1\\ 1\\ (1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ /[1/(0.8)+\\ 0.1\\ 0.1\\ 0.15\\ 0.15\\ 0.15\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12\\ 0.12 \end{array} $	$ \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $	2.88772 2.81540 2.67 15.4 0.68 24.66 12.623 0.36909 32.57 22.26 14.86 0.77 22.26 14.86 0.77	7 7 5 5 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	paragraph (32e) =	132.58 0 250	(26) (27) (27) (27) (27) (27) (28) (28) (29) (29) (29) (29) (30) (30) (31) (31)

can be ι	ised inste	ad of a dei	tailed calc	ulation.										
Therm	al bridge	es : S (L	x Y) cal	culated u	using Ap	pendix ł	<						34.35	(36)
if details	of therma	al bridging	are not kn	own (36) =	= 0.05 x (3	1)								_
Total fa	abric he	at loss							(33) +	(36) =			166.93	(37)
Ventila	tion hea	at loss ca	alculated	monthl	/				(38)m	= 0.33 × (25)m x (5)			
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(38)m=	108.12	106.96	105.8	99.99	98.83	93.03	93.03	91.87	95.35	98.83	101.15	103.47		(38)
Heat tr	ansfer o	coefficier	nt, W/K						(39)m	= (37) + (3	38)m			
(39)m=	275.04	273.88	272.72	266.92	265.76	259.96	259.96	258.8	262.28	265.76	268.08	270.4		
									/	Average =	Sum(39)1.	12 /12=	266.63	(39)
Heat lo	oss para	meter (F	HLP), W/	/m²K					(40)m	= (39)m ÷	· (4)		I	
(40)m=	0.72	0.72	0.72	0.7	0.7	0.68	0.68	0.68	0.69	0.7	0.71	0.71		_
Numbe	er of day	vs in moi	nth (Tab	le 1a)					,	Average =	Sum(40) ₁ .	12 /12=	0.7	(40)
	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)
			-	-						-	-			
4. Wa	ter heat	ting ener	rgy requ	irement:								kWh/ye	ear:	
A											-		l	(10)
if TF	A > 13.9	ipancy, i 9. N = 1	N + 1.76 x	[1 - exp	(-0.0003	49 x (TF	- A -13.9)2)] + 0.0)013 x (⁻	TFA -13.	<u>3.</u> 9)	24		(42)
if TF	A £ 13.9	9, N = 1			```)				、		- /			
Annua	l averag	e hot wa	ater usag	ge in <mark>litre</mark>	s per da	y Vd,av	erage =	(25 x N)	+ 36		11'	1.05		(43)
not more	the annua e that 125	litres per l	hot water person pe	usage by : r dav (all w	5% it the a ater use. I	welling is hot and co	designed (ld)	o achieve	a water us	se target o	Ť			
	law		Max		Maria	l		0	0.00	Ort	New	Dee		
Hot wate	Jan er usage i	n litres per	iviar dav for e	Apr	Iviay Vd.m = fa	ctor from T	Jul Jul	Aug (43)	Sep	Oct	NOV	Dec		
(44)	400.40	447.70	440.07	400.02	404.00	00.05	00.05	()	100.00	440.07	447 70	400.40		
(44)m=	122.16	117.72	113.27	108.83	104.39	99.95	99.95	104.39	108.83	113.27	117.72	122.16	1000.64	(44)
Energy o	content of	hot water	used - cal	culated mo	onthly $= 4$.	190 x Vd,r	n x nm x D)Tm / 3600) kWh/mor	total = Su oth (see Ta	m(44) ₁₁₂ = ables 1b, 1	= c, 1d)	1332.64	(44)
(45)m=	181.16	158.44	163.5	142.54	136.77	118.02	109.37	125.5	127	148	161.56	175.44		
									-	Total = Su	m(45) ₁₁₂ =	-	1747.31	(45)
lf instan	taneous w	ater heatii	ng at point	of use (no	hot water	· storage),	enter 0 in	boxes (46,) to (61)				L	
(46)m=	27.17	23.77	24.52	21.38	20.52	17.7	16.4	18.82	19.05	22.2	24.23	26.32		(46)
Storag		1055. a (litrae)	includir	na anv so	lar or M		storada	within sa	mavas	ما		454.0	l	(47)
If com	e volum			ng any su		ntor 110		(47)		501		151.6		(47)
Otherv	vise if no	o stored	hot wate	er (this in	icludes i	nstantar		(47) mbi boil	ers) ente	er '0' in (47)			
Water	storage	loss:	not nat			lotantai					,			
a) If m	anufact	urer's de	eclared I	oss facto	or is kno	wn (kWł	n/day):				1.	95		(48)
Tempe	erature f	actor fro	m Table	2b							0.	54		(49)
Energy	/ lost fro	m water	· storage	, kWh/ye	ear			(48) x (49)	=		1.	05		(50)
b) If manufacturer's declared cylinder loss factor is not known:														
Hot wa	ter stor	age loss	factor fr	om Tabl	e 2 (kW	h/litre/da	ıy)					0		(51)
	nunity h	from Tel	ee secti	on 4.3								-	l	
Tempe	e lactor arature f	nom ra actor fro	ule 28 m Tahla	2h								0		(52)
rompe	auro			20								0		(33)

Energy Enter	/ lost fro (50) or (om water (54) in (5	⁻ storage 55)	e, kWh/ye	ear			(47) x (51)) x (52) x (53) =	1.	0		(54) (55)
Water	storage	loss cal	culated	for each	month			((56)m = (55) × (41)ı	m	L			
(56)m=	32.64	29.48	32.64	31.59	32.64	31.59	32.64	32.64	31.59	32.64	31.59	32.64		(56)
If cylinde	er contain	s dedicate	l d solar sto	l orage, (57)	I m = (56)m	x [(50) – (I H11)] ÷ (5	0), else (5	1 7)m = (56)	m where (I H11) is fro	m Append	l lix H	
(57)m=	32.29	29.17	32.29	31.25	32.29	31.25	32.29	32.29	31.25	32.29	31.25	32.29		(57)
Primar	y circuit	loss (ar	nnual) fro	om Table	e 3							0		(58)
Primar	y circuit	loss cal	culated	for each	month (59)m = ((58) ÷ 36	65 × (41)	m					
(moo	dified by	factor fi	rom Tab	le H5 if t	here is s	solar wat	ter heatir	ng and a	cylinde	r thermo	stat)		1	()
(59)m=	23.26	21.01	21.87	15.76	10.47	9.91	10.24	11.17	17.11	21.87	22.51	23.26		(59)
Combi	loss ca	lculated	for each	month	(61)m =	(60) ÷ 30	65 × (41))m						
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)
Total h	eat req	uired for	water h	eating ca	alculated	for eac	h month	(62)m =	0.85 × ((45)m +	(46)m +	(57)m +	(59)m + (61)	m
(62)m=	236.72	208.62	217.66	189.55	179.53	159.18	151.9	168.96	175.36	202.17	215.32	231		(62)
Solar DH	HW input	calculated	using App	endix G o	r Appendix	: H (negati	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)		
(add a	dditiona	l lines if	FGHRS	and/or \	NWHRS	applies	, see Ap	pendix (G)			1	I	
(63)m=	-17.34	-28.94	-49.29	-66.06	-81.62	-80.24	-79.18	-69.18	-54.18	-37	-20.57	-14.51		(63)
Output	from w	ater hea	ter										I	
(64)m=	219.37	179.68	168.37	123.49	97.92	78.94	72.72	99.78	121.18	165.17	194.75	216.48		
								Outp	out from wa	ater heate	r (annual)₁	12	1737.84	(64)
Heat g	ains fro	m water	heating	, kWh/m	onth 0.2	5 <i>[</i> 0.85	× (45)m	+ (61)m	1] + 0.8 x	(<mark>46)</mark> m	+ (57)m	+ (59)m]	
(65)m=	104.68	92.83	97.69	85	79.69	72.17	70.39	76.5	80.92	92.54	96.73	102.78		(65)
inclu	ide (57)	m in calo	culation	of (65)m	only if c	ylinder i	s in the c	dwelling	or hot w	ater is fr	om com	munity h	eating	
5. Int	ternal ga	ains (see	e Table &	5 and 5a):									
Metab	olic gair	s (Table	e 5), Wat	ts				·	·		- I	i		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m=	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8		(66)
Lightin	g gains	(calcula	ted in Ap	opendix	L, equat	ion L9 o	r L9a), a	lso see	Table 5		i	i	I	
(67)m=	50.67	45	36.6	27.71	20.71	17.49	18.89	24.56	32.96	41.85	48.85	52.08		(67)
Applia	nces ga	ins (calc	ulated ir	n Append	dix L, eq	uation L	13 or L1	3a), also	see Ta	ble 5		1	I	
(68)m=	520.24	525.64	512.04	483.07	446.52	412.16	389.2	383.8	397.41	426.37	462.93	497.29		(68)
Cookir	ng gains	(calcula	ated in A	ppendix	L, equa	tion L15	or L15a)), also se	e Table	5			1	
(69)m=	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18		(69)
Pumps	and fai	ns gains	(Table (5a)										
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0		(70)
Losses	s e.g. ev	aporatio	on (nega	tive valu	es) (Tab	ole 5)			I		1	1	1	
(71)m=	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44		(71)
Water	heating	gains (T	able 5)											
(72)m=	140.7	138.13	131.31	118.06	107.11	100.24	94.61	102.82	112.38	124.38	134.35	138.15		(72)
Total i	nternal	gains =				(66)	m + (67)m	n + (68)m +	+ (69)m + ((70)m + (7	1)m + (72)	m		
(73)m=	783.15	780.32	751.48	700.38	645.87	601.42	574.24	582.72	614.29	664.14	717.66	759.05		(73)
6. So	lar gains	S:												

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

Orienta	ition:	Access Factor Table 6d	r	Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.44	x	10.63	x	0.6	×	0.7] =	10.66	(74)
North	0.9x	0.77	x	3.44	x	20.32	x	0.6	x	0.7] =	20.37	(74)
North	0.9x	0.77	x	3.44	x	34.53	x	0.6	x	0.7] =	34.62	(74)
North	0.9x	0.77	x	3.44	x	55.46	x	0.6	x	0.7] =	55.61	(74)
North	0.9x	0.77	x	3.44	x	74.72	x	0.6	×	0.7] =	74.91	(74)
North	0.9x	0.77	x	3.44	x	79.99	x	0.6	x	0.7	=	80.2	(74)
North	0.9x	0.77	x	3.44	x	74.68	x	0.6	x	0.7] =	74.87	(74)
North	0.9x	0.77	x	3.44	x	59.25	×	0.6	x	0.7] =	59.4	(74)
North	0.9x	0.77	x	3.44	x	41.52	×	0.6	×	0.7] =	41.63	(74)
North	0.9x	0.77	x	3.44	x	24.19	x	0.6	x	0.7] =	24.25	(74)
North	0.9x	0.77	x	3.44	x	13.12	×	0.6	x	0.7] =	13.15	(74)
North	0.9x	0.77	x	3.44	x	8.86	×	0.6	×	0.7] =	8.89	(74)
East	0.9x	0.77	x	19.87	x	19.64	×	0.6	×	0.7] =	113.6	(76)
East	0.9x	0.77	x	19.87	x	38.42	x	0.6	×	0.7] =	222.22	(76)
East	0.9x	0.77	x	19.87	x	63.27	x	0.6	×	0.7	=	365.97	(76)
East	0.9x	0.77	x	19.87	×	92.28	x	0.6	x	0.7		533.75	(76)
East	0.9x	0.77	x	19.87	x	113.09	x	0.6	x	0.7] =	654.13	(76)
East	0.9x	0.77	x	19.87	x	115.77	×	0.6	x	0.7	=	669.62	(76)
East	0.9x	0.77	x	19.87	x	110.22	x	0.6	x	0.7	=	637.5	(76)
East	0.9x	0.77	x	19.87	x	94.68	x	0.6	x	0.7] =	547.61	(76)
East	0.9x	0.77	x	19.87	x	73.59	×	0.6	x	0.7] =	425.64	(76)
East	0.9x	0.77	x	19.87	x	45.59	×	0.6	x	0.7	=	2 <mark>63.69</mark>	(76)
East	0.9x	0.77	x	19.87	x	24.49	x	0.6	x	0.7] =	141.65	(76)
East	0.9x	0.77	x	19.87	x	16.15	×	0.6	×	0.7] =	93.42	(76)
South	0.9x	0.77	x	0.87	x	46.75	x	0.6	×	0.7] =	11.86	(78)
South	0.9x	0.77	x	0.87	x	76.57	×	0.6	x	0.7] =	19.43	(78)
South	0.9x	0.77	x	0.87	x	97.53	x	0.6	x	0.7] =	24.75	(78)
South	0.9x	0.77	x	0.87	x	110.23	x	0.6	x	0.7	=	27.97	(78)
South	0.9x	0.77	x	0.87	x	114.87	x	0.6	x	0.7	=	29.15	(78)
South	0.9x	0.77	x	0.87	x	110.55	x	0.6	x	0.7] =	28.05	(78)
South	0.9x	0.77	x	0.87	x	108.01	x	0.6	x	0.7	=	27.41	(78)
South	0.9x	0.77	x	0.87	x	104.89	x	0.6	x	0.7	=	26.62	(78)
South	0.9x	0.77	x	0.87	x	101.89	x	0.6	x	0.7	=	25.85	(78)
South	0.9x	0.77	x	0.87	x	82.59	x	0.6	x	0.7	=	20.95	(78)
South	0.9x	0.77	x	0.87	x	55.42	x	0.6	×	0.7] =	14.06	(78)
South	0.9x	0.77	x	0.87	×	40.4	×	0.6	×	0.7] =	10.25	(78)
West	0.9x	0.77	x	31.81	x	19.64	x	0.6	×	0.7	=	181.82	(80)
West	0.9x	0.77	x	31.81	x	38.42	×	0.6	×	0.7] =	355.68	(80)
West	0.9x	0.77	x	31.81	×	63.27	×	0.6	×	0.7	=	585.76	(80)

West	0.9x	0.77	x	31	.81	x	9	2.28	x		0.6	×	0.7	=	854.3	(80)
West	0.9x	0.77	x	31	.81	x	1	13.09	x		0.6		0.7	=	1046.97	(80)
West	0.9x	0.77	x	31	.81	x	1	15.77	x		0.6		0.7	=	1071.76	(80)
West	0.9x	0.77	x	31	.81	x	1	10.22	x		0.6	= × [0.7		1020.36	(80)
West	0.9x	0.77	x	31	.81	x	9	4.68	x		0.6	Ξ×Γ	0.7		876.48	(80)
West	0.9x	0.77	x	31	.81	x	7	3.59	x		0.6	= × [0.7	=	681.26	(80)
West	0.9x	0.77	x	31	.81	x	4	5.59	x		0.6		0.7	=	422.05	(80)
West	0.9x	0.77	x	31	.81	x	2	4.49	x		0.6		0.7	=	226.71	(80)
West	0.9x	0.77	x	31	.81	x	1	6.15	x		0.6	=	0.7	=	149.52	(80)
	-															
Solar	gains in	watts, ca	alculated	d for eac	h month	١			(83)m	n = Su	um(74)m .	(82)m		-		
(83)m=	317.95	617.71	1011.1	1471.63	1805.16	18	349.63	1760.15	151	0.1	1174.38	730.95	395.57	262.08		(83)
Total of	gains – i	nternal a	nd sola	r (84)m	= (73)m	+ (83)m	, watts					-			
(84)m=	1101.09	1398.03	1762.58	2172.01	2451.04	24	451.04	2334.39	2092	2.82	1788.68	1395.09	1113.23	1021.13		(84)
7. Me	ean inter	nal temp	erature	(heating	g seasor	ר)										
Tem	oerature	during h	eating p	periods i	n the liv	ing	area f	rom Tab	ole 9,	, Th1	1 (°C)				21	(85)
Utilis	ation fac	tor for g	ains for	living ar	ea, h1,n	n (s	ее Та	ble 9a)	_							
	Jan	Feb	Mar	Apr	May		Jun	Jul	A	ug	Sep	Oct	Nov	Dec		
(86)m=	1	1	1	0.98	0.89		0.67	0.49	0.5	57	0.89	1	1	1		(86)
Mear	n interna	l temper	ature in	living ar	ea T1 (f	ollo	w ste	ps 3 to 7	7 in T	able	9c)					
(87)m=	21	21	21	21	21	\overline{V}	21	21	2.	1	21	21	21	21		(87)
Tem		during h	eating r	periods i	n rest of	dw	vellina	from Ta	able 9	э Th)2 (°C)					
(88)m=	20.32	20.32	20.33	20.34	20.34		20.35	20.35	20.	36	20.35	20.34	20.34	20.33		(88)
Litilio	otion for	tor for a	ning for	root of a	L Wolling	<u>ь</u>	m (oc		<u> </u>							
(89)m=				0.98	0.85		, III (Se	0.42	9a)	19	0.84	1	1	1		(89)
()																
Mear	n interna	l temper	ature in	the rest	of dwel	ling	12 (fo	ollow ste	eps 3	$\frac{10}{26}$	in labl	e 9c)	20.24	20.22		(00)
(90)11=	20.32	20.32	20.33	20.34	20.34		20.35	20.35	20.	30	20.35 f	20.34	20.34	20.33	0.07	(00)
														.,	0.07	
Mear	n interna	l temper	ature (fo	or the wh	nole dwe	ellin T	g) = fl	_A × T1	+ (1	– fL/	A) × T2					(00)
(92)m=	20.37	20.37	20.37	20.39	20.39		20.4	20.4	20.	.4	20.4	20.39	20.38	20.38	I	(92)
	y adjustr		1e meai			T	re ro	m I able	4e,	wne	re appro	opriate	20.28	20.28		(03)
(93)III=		ting regu	uiremen	20.39	20.39		20.4	20.4	20.	.4	20.4	20.39	20.38	20.30		(00)
Set T	i to the	mean int	ernal te	mneratu	re obtai	ned	l at ste	on 11 of	Tabl	e 9h	so tha	t Ti m–	(76)m an	d re-calc	ulate	
the u	tilisation	factor fo	or gains	using Ta	able 9a	neu		50 11 01	Tubi		, 50 110		(70)11 an		ulate	
	Jan	Feb	Mar	Apr	May		Jun	Jul	A	ug	Sep	Oct	Nov	Dec		
Utilis	ation fac	tor for g	ains, hn	ו:												
(94)m=	1	1	1	0.98	0.86		0.61	0.42	0.4	19	0.85	1	1	1		(94)
Usef	ul gains,	hmGm ,	W = (9	4)m x (8	4)m				·						1	
(95)m=	1101.07	1397.78	1759.4	2123.25	2098.15	14	194.83	987.74	1034	4.27	1514.87	1389.46	1113.12	1021.11	I	(95)
Mont	hly aver	age exte	rnal ten	nperatur	e from T	abl	e 8	40.0		, 1	<u>,,,</u> 1	40.5				
(96)m=	4.3	4.9	6.5	8.9	11.7		14.6	16.6	16.	.4	14.1	10.6	(.1	4.2	1	(96)
	1055 rate						I, VV =	=[(39)M2	x [(9)	3)m- 3⊿⊑ I	- (96)m	2601 77	3561 44	1375 00		(07)
(37)11=	1 19.92	1 7237.03	5/04	1 0000.23	1 2009.40	1 10	.00.00	300.40	1 1030	J.40	1031.07	2001.77	0001.44	+5/5.00	1	(37)

Spac	e heatin	ig requir	ement fo	or each n	nonth, k	Wh/mon	th = 0.02	24 x [(97))m – (95	5)m] x (4	1)m			
(98)m=	2469.23	1908.38	1506.3	678.94	157.19	0	0	0	0	901.96	1762.79	2495.35		
							-	Tota	l per year	(kWh/year) = Sum(9	8)15,912 =	11880.14	(98)
Spac	e heatin	g requir	ement in	ı kWh/m [;]	²/year								31.26	(99)
8c. S	pace co	oling rea	quiremer	nt										
Calcu	lated fo	or June, .	July and	August.	See Ta	ble 10b								
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Heat	loss rat	e Lm (ca	lculated	using 2	5°C inter	rnal tem	perature	and exte	ernal ten	nperatur	e from T	able 10)		
(100)m=	0	0	0	0	0	2443.66	1923.73	1966.91	0	0	0	0		(100)
Utilisa	ation fac	tor for lo	oss hm										1	
(101)m=	0	0	0	0	0	0.96	0.99	0.97	0	0	0	0		(101)
Usefu	ul loss, ł	nmLm (V	Vatts) =	(100)m > I	(101)m I	1							1	(100)
(102)m=	0	0	0	0	0	2341.14	1896.4	1910.45	0	0	0	0		(102)
Gains	s (solar	gains ca	lculated	for appli	icable w	eather re	egion, se	e Table	10)				1	(100)
(103)m=	0	0	0	0	0	3043.38	2902.43	2624.48			0	0	(11)	(103)
Spac set (1	<i>e cooiin</i> 04)m to	g require zero if (e <i>ment to</i> (104)m <	or montn, < 3 × (98	, <i>wnole c</i>)m	aweiling,	continu	ous (KVV	(n) = 0.0	24 X [(10)3)m – (102)m] :	∢(41)m	
(104)m=	0	0	0	0	0	505.62	748.48	531.24	0	0	0	0		
			<u> </u>						Total	l = Sum(104)	=	1785.33	(104)
Cooled	d fractio	n							fC=	cooled	area ÷ (4	4) =	1.57	(105)
Interm	<mark>itte</mark> ncy f	actor (T	able 10b)										
(106)m=	0	0	0	0	0	0.25	0. <mark>25</mark>	0.25	0	0	0	0		_
									Tota	l = Sum((104)	=	0	(106)
Space	cooling	require	ment for	month =	= (104)m	× (105)	× (106)r	n L				-	1	
(107)m=	0	0	0	0	0	198.35	293.62	208.4		0	0	0		
_									Iotal	I = Sum(107)	=	700.37	(107)
Space	cooling	require	ment in l	‹Wh/m²/	year				(107)) ÷ (4) =			1.84	(108)
9a. En	ergy reo	quiremer	nts – Ind	ividual h	eating s	ystems i	ncluding	micro-C	CHP)					
Spac	e heati	ng:			/l-									
Fract	ion of sp	bace nea	at from s	econdar	y/supple	ementary	system		(22.1)				0	(201)
Fract	ion of sp	bace hea	at from n	nain syst	em(s)			(202) = 1 -	- (201) =				1	(202)
Fract	ion of to	tal heati	ng from	main sy	stem 1			(204) = (2	02) × [1 –	(203)] =			1	(204)
Efficie	ency of	main spa	ace heat	ing syste	em 1								396.16	(206)
Efficie	ency of	seconda	ry/suppl	ementar	y heatin	g systen	n, %						65	(208)
Cooli	ng Syst	em Ener	gy Effici	ency Ra	tio								4.05	(209)
	Jan	Feb	Mar	Apr	Mav	Jun	Jul	Aua	Sep	Oct	Nov	Dec	kWh/ve	⊐ ar
Spac	e heatin	g requir	ement (c	alculate	d above)	• •						,	
•	2469.23	1908.38	1506.3	678.94	157.19	0	0	0	0	901.96	1762.79	2495.35		
(211)n	L 1 = {[(98)m x (20	1)4)] } x 1	1 100 ÷ (20)6)								i	(211)
()	623.29	481.72	380.22	171.38	39.68	0	0	0	0	227.68	444.97	629.89		()
								Tota	l I (kWh/yea	I ar) =Sum(2	211) _{1 510 12}	=	2998.82	(211)
Snac	e heatin	a fuel (s	econdar	·v) k\//h/	month				-					` ´
= {[(98)m x (20) 1)] } x 1	00 ÷ (20)8)										
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
	L				!	•		Tota	l (kWh/yea	ar) =Sum(2	215) _{15,1012}	=	0	(215)

Water heating

Output from water heater (calculated above)								
219.37 179.68 168.37 123.49 97.92	78.94 72.72	99.78	121.18	165.17	194.75	216.48		
Efficiency of water heater							119.34	(216)
(217)m= 119.34 119.34 119.34 119.34 119.34 1	19.34 119.34	119.34	119.34	119.34	119.34	119.34		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 \div (217)m								
(219)m= 183.82 150.56 141.08 103.48 82.05 (66.15 60.93	83.61	101.54	138.4	163.19	181.4		
	ł	Total	= Sum(2*	19a) ₁₁₂ =		•	1456.21	(219)
Space cooling fuel, kWh/month. $(221)m = (107)m \div (209)$								-
(221)m= 0 0 0 0 0 4	48.98 72.5	51.46	0	0	0	0		_
		Total	= Sum(22	21) ₆₈ =			172.93	(221)
Annual totals				k	Wh/yea	r I	kWh/year	- г
Space heating fuel used, main system 1							2998.82	ļ
Water heating fuel used							1456.21	
Space cooling fuel used							172.93	
Electricity for pumps, fans and electric keep-hot								
mechanical ventilation - balanced, extract or pos	itive input fror	n outside				1480.05		(230a)
pump for solar water heating						50		(230g)
Total electricity for the above, kWh/year		sum o	of (230a).	<mark>(2</mark> 30g) =			1530.05	(231)
Electricity for lighting						ĺ	894.79	(232)
Electricity generated by PVs						[-3109.03	(233)
12a. CO2 emissions – Individual heating system	s including mi	cro-CHP						1
	Enormy			Emico	ion foo	tor	Emissiana	
	kWh/year			kg CO	2/kWh		kg CO2/yea	r
Space heating (main system 1)	(211) x			0.5	19	= [1556.39	(261)
Space heating (secondary)	(215) x			0.0	19	=	0	(263)
Water heating	(219) x			0.5	19	=	755.77	(264)
Space and water heating	(261) + (262)	+ (263) + (2	264) =			[2312.16	(265)
Space cooling	(221) x			0.5	19	=	89.75	(266)
Electricity for pumps, fans and electric keep-hot	(231) x			0.5	19	=	794.1	(267)
Electricity for lighting	(232) x			0.5	19	=	464.4	(268)
Energy saving/generation technologies Item 1				0.5	19	= [-1613.59	(269)
Total CO2, kg/year			sum o	f (265)(2	271) =	ו [2046.82](272)
Dwelling CO2 Emission Rate			(272) -	÷ (4) =		ו [5.39](273)
El rating (section 14)						[94	(274)

			User [Details:								
Assessor Name: Software Name:	Stroma FSAP 2	2012		Strom Softwa	a Num are Ve	ber: rsion:		Versic	on: 1.0.4.26			
		P	roperty	Address	: 9D The	e Grove_	Propose	ed_Be G	reen			
Address :												
1. Overall dwelling dimens	sions:		A	a (ma 2)								
Basement			Are		(1a) x	AV. He		(22) =		1 (3a)		
				20.23			3](2a) =	378.69			
Ground floor			1	29.92	(1b) x		3	(2b) =	389.76	(3b)		
First floor			1	23.86	(1c) x	2	2.7	(2c) =	334.42	(3c)		
Total floor area TFA = (1a)	+(1b)+(1c)+(1d)+	·(1e)+(1ı	n) 3	80.01	(4)							
Dwelling volume					(3a)+(3b)+(3c)+(3d	l)+(3e)+	.(3n) =	1102.87	(5)		
2. Ventilation rate:	_			_		_						
	main heating	seconda heating	ry	other		total			m ³ per hour			
Number of chimneys	0 +	0	+	0] = [0	X	40 =	0	(6a)		
Number of open flues	0 +	0	_ + _	0	_ _ = [0	x	20 =	0	(6b)		
Number of intermittent fans	;				Ī	4	x -	10 =	40	(7a)		
Number of passive vents					Ē	0	x	10 =	0	(7b)		
Number of flueless gas fire	s					0	X	40 =	0	(7c)		
								Air ch	nange <mark>s per</mark> hou	ır		
Infiltration due to chimneys	, flues and fans =	(6a)+(6b)+(7	7a)+(7b)+	(7c) =	ļ	40		÷ (5) =	0.04	(8)		
It a pressurisation test has bee	n carried out or is inte	ended, procee	d to (17),	otherwise	continue fr	om (9) to (16)					
Additional infiltration	dweining (ris)						[(9)]	-11x0 1 =	0	(9)		
Structural infiltration: 0.2	5 for steel or timk	per frame or	r 0.35 fo	r mason	ry constr	ruction			0	(11)		
if both types of wall are pres deducting areas of openings	ent, use the value co s); if equal user 0.35	orresponding to	o the grea	ter wall are	ea (after]		
If suspended wooden flo	or, enter 0.2 (uns	ealed) or 0	.1 (seal	ed), else	enter 0				0	(12)		
If no draught lobby, ente	r 0.05, else enter	0							0	(13)		
Percentage of windows a	and doors draugh	nt stripped							0	(14)		
Window infiltration				0.25 - [0.2	2 x (14) ÷ 1	= [00			0	(15)		
Infiltration rate				(8) + (10)	+ (11) + (1	12) + (13) -	+ (15) =		0	(16)		
Air permeability value, q	50, expressed in	cubic metre	es per h	our per s	quare m	etre of e	nvelope	area	5	(17)		
If based on air permeability	value, then (18) =	= [(17) ÷ 20]+(8), otherw	vise (18) = ((16)				0.29	(18)		
Air permeability value applies i	f a pressurisation test	t has been doi	ne or a de	gree air pe	rmeability	is being us	sed		-			
Shelter factor				(20) = 1 -	[0.075 x (1	19)] =			2	(19)		
Infiltration rate incorporatin	a shelter factor			(21) = (18) x (20) =				0.00	(21)		
Infiltration rate modified for	monthly wind sp	eed							0.27	J (<u> </u>		
Jan Feb M	lar Apr M	ay Jun	Jul	Aug	Sep	Oct	Nov	Dec				
Monthly average wind spee	onthly average wind speed from Table 7											
(22)m= 5.1 5 4.	9 4.4 4.3	3 3.8	3.8	3.7	4	4.3	4.5	4.7]			
									-			

Wind F	Factor (22	2a)m =	(22)m ÷	4											
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18]		
Adjust	ed infiltra	tion rate	e (allowi	ing for sl	nelter ar	nd wind s	speed) =	= (21a) x	(22a)m						
	0.31	0.3	0.3	0.27	0.26	0.23	0.23	0.23	0.24	0.26	0.27	0.29			
Calcul	l ate effect	tive air (change	rate for t	he appl	cable ca	se	-		-		-	-		
	echanicai		llion. Ising App	endix N (2	23h) - (23)	a) v Emv (d	acuation (rwise (23t	(23a)				0	(23a)
If bal	anced with	heat reco	werv: effic	viency in %		for in-use f	actor (fror	m Table 4h) –) = (20a)				0	(230)
a) If	balanced	d mecha	anical ve	entilation	with he	at recove	ery (MV	HR) (24a	, – a)m = (2	2b)m + (23b) × [′	1 – (23c)) ÷ 100]	(230)
(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0]		(24a)
b) If	balanced	d mecha	anical ve	entilation	without	heat red	covery (MV) (24b)m = (2	2b)m + (23b)		-		
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0			(24b)
c) If	whole ho if (22b)m	ouse ex < 0.5 ×	tract ver : (23b), 1	ntilation of then (24)	or positiv c) = (23I	ve input v o); otherv	ventilati wise (24	on from c lc) = (22t	outside b) m + 0	.5 × (23b)		-		
(24c)m=		0	0	0	0	0	0	0	0	0	0	0]		(24c)
d) If	natural v if (22b)m	entilatio	on or wh en (24d)	iole hous m = (22	se positi b)m othe	ve input erwise (2	ventilati 24d)m =	on from I 0.5 + [(2	oft 2b)m² x	0.5]	1		J		
(24d) <mark>m=</mark>	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.54	0.54			(24d)
Effe	ctive air c	hange	rate - er	nter (24a) or (24	o) or (24	c) or (2	4d) in boy	(25)				1		
(25)m=	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.54	0.54]		(25)
3 Ho	atlosses	and he	atloss	naramet	or.								-		
		Croc		Oponin											V L
ELEN		area	(m^2)	openin	igs 1 ²	Net Ar	rea m²	U-valı W/m2	ue K	A X U	K)	k-valu k.l/m².	e K	A k.	лк I/K
Doors	Type 1	area	(m²)	r	igs 1 ²	Net Ar A ,r 2.89	rea m²	U-valu W/m2	ue K =	A X U (W/I 2.88772	K) 7	k-valu kJ/m²⊷	e K	A K.	лк J/K (26)
Doors Doors	Type 1 Type 2	area	(m²)	r	igs 1 ²	Net Ar A ,r 2.89 2.82	rea m ² x x	U-valu W/m2	ue K = =	A X U (W/I 2.88772 2.81540	K) 7 7	k-valu kJ/m²•	e K	A k.	/K (26) (26)
Doors Doors Windo	Type 1 Type 2 ws Type	area	(m²)	m	195 1 ²	Net Ar A ,r 2.89 2.82 3.4447	rea m² x x 68 x ¹	U-valu W/m2 1 1/[1/(1.4)+	2K = 0.04] =	A X U (W/I 2.88772 2.81540 4.57	K) 7 7	k-valu kJ/m²∙	e K	A k.	хк J/K (26) (26) (27)
Doors Doors Windo Windo	Type 1 Type 2 ws Type ws Type	area	(m²)	openin m	IGS 1 ²	Net Ar A ,r 2.89 2.82 3.4447 19.872	rea m ² x x 68 x ¹ 23 x ¹	U-valu W/m2 1 1 1/[1/(1.4)+	2K = 0.04] = 0.04] =	A X U (W/I 2.88772 2.81540 4.57 26.35	K) 7 7	k-valu kJ/m²•	e K	A k.	(26) (26) (27) (27)
Doors Doors Windo Windo Windo	Type 1 Type 2 ws Type ws Type ws Type	area 1 2 3	(m²)	r	Igs 1 ²	Net Ar A ,r 2.89 2.82 3.4447 19.872 0.8717	rea m ² × 68 ×1 23 ×1 49 ×1	U-valu W/m2	ue = 0.04] = 0.04] =	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16	K) 7 7	k-valu kJ/m²•	e K	A k.	(26) (26) (27) (27) (27)
Doors Doors Windo Windo Windo Windo	Type 1 Type 2 ws Type ws Type ws Type ws Type ws Type	area 1 2 3 4	(m²)	r	Igs 1 ²	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.806	rea m ² x 68 x ¹ 23 x ¹ 49 x ¹ 67 x ¹	U-valu W/m2 1 1/[1/(1.4)+ 1/[1/(1.4)+ 1/[1/(1.4)+	ue = 0.04] = 0.04] = 0.04] = 0.04] =	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17	<) 7 7	k-valu kJ/m²•	e K	A k.	(26) (26) (27) (27) (27) (27) (27)
Doors Doors Windo Windo Windo Windo Floor	Type 1 Type 2 ws Type ws Type ws Type ws Type ws Type Type 1	1 2 3 4	(m²)	r	Igs 1 ²	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.800 126.2	rea m ² x 68 x ¹ 23 x ¹ 49 x ¹ 57 x ¹ 3 x	U-valu W/m2 1 1/[1/(1.4)+ 1/[1/(1.4)+ 1/[1/(1.4)+ 1/[1/(1.4)+ 0.13	ue = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] =	A X U (W// 2.88772 2.81540 4.57 26.35 1.16 42.17 16.409	<) 7 7	k-valu kJ/m²•	e K	A k.	(26) (26) (27) (27) (27) (27) (27) (28)
Doors Doors Windo Windo Windo Windo Floor	Type 1 Type 2 ws Type ws Type ws Type ws Type ws Type Type 1 Type 2	area 1 2 3 4	(m²)	r	igs 1 ²	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690	rea m ² x 68 x1 23 x1 49 x1 67 x1 3 x 5 x	$\begin{array}{c} U-valu \\ W/m2 \\ \hline \\ 1 \\ \hline \\ 1 \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 0.13 \\ \hline \\ 0.13 \end{array}$	ue = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] =	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976	<) 7 7 9 5	k-valu kJ/m²-	e K	A k.	(26) (26) (27) (27) (27) (27) (27) (27) (28) (28)
Doors Doors Windo Windo Windo Floor Floor	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type1	area 1 2 3 4	6 (m ²)	61.7	, ,	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1	rea m ² x 68 x1 23 x1 67 x1 67 x1 3 x 5 x 7 x	$\begin{array}{c} U-valu \\ W/m2 \\ \hline \\ 1 \\ \hline \\ 1 \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 0.13 \\ \hline \\ 0.13 \\ \hline \\ 0.18 \\ \hline \end{array}$	ue = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] =	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09	<) 7 7 3 3 5 5	k-valu kJ/m²·	e K	A k.	 k (26) (26) (27) (28) (28) (28) (29)
Doors Doors Windo Windo Windo Windo Floor Floor Walls	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2	area 1 2 3 4 278.1 148	86 43	61.7 0	, ,	Net Ar A,r 2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690 217.1 148.4	rea m ² x 68 x ¹ 23 x ¹ 49 x ¹ 57 x ¹ 3 x 5 x 7 x 3 x	$\begin{array}{c} U-valu \\ W/m2 \\ \hline \\ 1 \\ \hline \\ 1 \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 0.13 \\ \hline \\ 0.13 \\ \hline \\ 0.18 \\ \hline \\ 0.18 \end{array}$	ue = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = = = = = = = = = = = = = = = = =	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09 26.72	<) 7 7 3 5 5 5	k-valu kJ/m²·	e K		(26) (26) (27) (27) (27) (27) (27) (28) (28) (28) (29) (29)
Doors Doors Windo Windo Windo Windo Floor Floor Walls Walls Roof	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1	area 1 2 3 4 278.4 148.4	86 (m ²)	61.7 0	, , , ,	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8	ea m ² x 68 x1 23 x1 49 x1 57 x1 3 x 7 x 3 x 6 x	$\begin{array}{c} U-valu \\ W/m2 \\ \hline \\ 1 \\ \hline \\ 1 \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 0.13 \\ \hline \\ 0.13 \\ \hline \\ 0.18 \\ \hline \\ 0.13 \\ \hline \end{array}$	ue = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = = = = = = = = = = = = = = =	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09 26.72 16.1	<) 7 7 3 5 5 1 1	k-value kJ/m²-	е К		(26) (26) (27) (27) (27) (27) (27) (28) (28) (28) (29) (29) (29) (30)
Doors Doors Windo Windo Windo Windo Floor Floor Kalls Roof Roof	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type2 Type1 Type2	area 1 2 3 4 278.1 148.1 123.1 6.44	86 (m ²) 86 43 86 6	61.7 0 0	, , , , , , , , , , , , , , , , , , ,	Net Ar A,r 2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690 217.1 148.4 123.8 6.46	rea m ² x 68 x1 23 x1 67 x1 67 x1 67 x1 5 x 7 x 3 x 6 x x	$\begin{array}{c} U-valu \\ W/m2 \\ \hline \\ 1 \\ \hline \\ 1 \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 0.13 \\ \hline 0.13 \\ \hline 0.18 \\ \hline 0.13 \\ \hline 0.13 \\ \hline 0.13 \\ \hline 0.13 \end{array}$	ue = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 1	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09 26.72 16.1	<) 7 7 1 1 3 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	k-value kJ/m²-	е К		 K (26) (27) (27) (27) (27) (27) (27) (27) (28) (28) (29) (29) (30) (30)
Doors Doors Windo Windo Windo Windo Floor Floor Kool Roof Total a	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type2 Type1 Type2 area of ele	area 1 2 3 4 148.4 123.4 123.4 6.44 ements	86 (m ²) 86 43 86 5 , m ²	61.7 0 0	, , 	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690 217.1 148.4 123.8 6.46 687.5	rea m ² x x 68 x1 23 x1 49 x1 57 x1 3 x 5 x 7 x 3 x 6 x 3	$\begin{array}{c} U-valu \\ W/m2 \\ \hline \\ 1 \\ \hline \\ 1 \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 1/[1/(1.4)+ \\ 0.13 \\ \hline 0.13 \\ \hline 0.18 \\ \hline 0.13 \\ \hline 0.13 \\ \hline 0.13 \\ \hline 0.13 \\ \hline 0.13 \\ \hline 0.13 \\ \hline 0.13 \\ \hline \end{array}$	ue = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = = = = = = = = = = = = = = = = = = =	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09 26.72 16.1 0.84	<) 7 7 1 1 1 2 1 3 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	k-valu kJ/m²·	e K		X K (26) (26) (27) (27) (27) (27) (27) (28) (28) (28) (28) (29) (29) (29) (30) (30) (30) (31)
Doors Doors Windo Windo Windo Windo Floor Floor Floor Kalls Roof Roof Total a * for win ** inclus	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type2 Type1 Type2 area of ele	area 1 2 3 4 123.4 148.4 123.4 6.40 ements coof winde	86 (m ²) 86 43 86 3 3 5 , m ² 5 ows, use e sides of ir	61.7 0 0 0 effective winternal wal	indow U-v Is and par	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8 6.46 687.5 alue calcul titions	rea m ² x 68 x1 23 x1 49 x1 57 x1 3 x 5 x 7 x 3 x 6 x 3 x 6 x 3 x 6 x	U-value W/m2 1 1 1/[1/(1.4)+ 1/[1/(1.4)+ 1/[1/(1.4)+ 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	ue ue No4] = 0.04] = 0.04] = 0.04] = 0.04] = 1 =	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09 26.72 16.1 0.84	<) 7 7 3 5 5 5 5 5 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7	k-value kJ/m²-	e K		(26) (27) (27) (27) (27) (28) (28) (29) (30) (30) (31)
Doors Doors Windo Windo Windo Windo Windo Floor Floor Roof Roof Total a * for win ** incluc Fabric	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type 1 Type2 Type1 Type2 area of ele adows and r de the areas theat loss	area 1 2 3 4 123.1 148.4 123.1 123.1 6.44 ements coof winded con both s, W/K =	86 (m ²) 86 43 86 5 , m ² 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	61.7 0 0 0 effective whether ternal wale U)	indow U-v ls and par	Net Ar A,r 2.89 2.82 3.4447 19.872 0.8717 31.806 126.2 3.690 217.1 148.4 123.8 6.46 687.5 alue calcul titions	rea m ² x 68 x1 23 x1 49 x1 67 x1 3 x 5 x 7 x 3 x 6 x 3 2 49 x1 67 x1 3 x 5 x 7 x 3 x 6 x 3 2 2 3 x 1 2 3 x 1 3 x 1 3 x 1 2 3 x 1 2 3 x 1 2 3 x 1 2 3 x 1 3 x 2 3 x 1 3 x 2 3 x 1 3 x 2 3 x 1 3 x 2 3 x 1 3 x 2 3 x 1 3 x 2 3 x 1 3 x 2 x 1 3 x 2 x 1 3 x 2 x 1 3 x 2 x 1 3 x 2 x 1 3 x 2 x 1 3 x 2 x 1 3 x 2 x 1 3 x 2 x 1 3 x 2 x 1 3 x 2 x 1 3 x 2 x 1 3 x 2 x 1 3 x 2 x 1 3 x 2 x 1 3 x 1 x 1 3 x 1 x 1 3 x 1 x 1 3 x 1 x 1 3 x 1 x 1 3 x 1 x 1 3 x 1 x 1 3 x 1 x 1 x 1 x 1 x 1 x 1 x 1 x 1 x 1 x 1	U-value W/m2 1 1 1/[1/(1.4)+ 1/[1/(1.4)+ 1/[1/(1.4)+ 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	$\begin{array}{c} ue \\ K \\ = \\ 0.04] = \\ 0.04] = \\ 0.04] = \\ 0.04] = \\ = \\ = \\ = \\ = \\ = \\ = \\ (1/U-value) \\ + (32) = \\ \end{array}$	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09 26.72 16.1 0.84	<) 7 7 9 5 5 1 1 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1	k-value kJ/m²-	e K	A k.	 k (26) (27) (27) (27) (27) (27) (28) (28) (29) (29) (29) (30) (30) (31)
Doors Doors Windo Windo Windo Windo Floor Floor Floor Walls Roof Total a * for win ** incluc Fabric Heat o	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type2 area of ele adows and r de the areas heat loss capacity C	area 1 2 3 4 148.4 123.3 6.44 ements oof winder s on both s, W/K = Cm = S(86 (m ²) 86 43 86 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	61.7 0 0 0 0 0 0 0 0 0 0 0 0 0	indow U-v Is and par	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8 6.46 687.5 alue calcul titions	rea m ² x 68 x1 23 x1 68 x1 49 x1 67 x1 37 x1 37 x 5 x 7 x 3 x 6 x 3 6 x 3 23 x 1 23 x1 23 x1 37 x1 37 x1 37 x 37 x 37 x 37 x 37 x 37 x 37 x 37 x	U-value W/m2 1 1 1/[1/(1.4)+ 1/[1/(1.4)+ 1/[1/(1.4)+ 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	$ \begin{array}{c} \text{ue}\\ \text{K}\\ = \\ 0.04] = \\ 0.04] = \\ 0.04] = \\ 0.04] = \\ = \\ = \\ = \\ = \\ = \\ (1/U-value) + (32) = \\ ((28). \end{array} $	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09 26.72 16.1 0.84 (30) + (32	<) 7 7 7 9 5 [] 9 8 5 [] 9 8 5 [] 9 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	k-value kJ/m²-	e K	A k. 	X K (26) (26) (27) (27) (27) (27) (28) (28) (28) (29) (29) (29) (29) (30) (30) (30) (31)
Doors Doors Windo Windo Windo Windo Floor Floor Floor Walls Roof Roof Total a * for win ** incluc Fabric Heat o Therm	Type 1 Type 2 ws Type ws Type ws Type ws Type Type 1 Type 2 Type1 Type2 Type1 Type2 area of ele adows and r de the areas cheat loss capacity C hal mass p	area 1 2 3 4 278.i 123.i 123.i 6.4i ements soof winder so of winder so of winder so wind	86 43 86 3 43 86 3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	$\begin{array}{c} 61.7\\ \hline 0\\ \hline $	indow U-v Is and par	Net Ar A, r 2.89 2.82 3.4447 19.872 0.8717 31.800 126.2 3.690 217.1 148.4 123.8 6.46 687.5 alue calcul titions	rea m ² x 68 x1 68 x1 49 x1 57 x1 3 x 5 x 7 x 3 x 6 x 3 x 6 x 3 x 6 x	U-value W/m2 1 1 1/(1/(1.4)+ 1/(1/(1.4)+ 1/(1/(1.4)+ 1/(1/(1.4)+ 1/(1/(1.4)+ 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13	$\begin{bmatrix} 1 \\ - \\ - \\ - \\ - \\ - \\ - \\ - \\ - \\ - \\$	A X U (W/I 2.88772 2.81540 4.57 26.35 1.16 42.17 16.4099 0.47976 39.09 26.72 16.1 0.84 ue)+0.04] a (30) + (32 ative Value	<pre> </pre> </td <td>k-value kJ/m²-</td> <td>e K</td> <td>A k. 79.58 0 250</td> <td> K (26) (27) (27) (27) (27) (27) (28) (28) (29) (29) (29) (30) (30) (31) (33) (34) (35) </td>	k-value kJ/m²-	e K	A k. 79.58 0 250	 K (26) (27) (27) (27) (27) (27) (28) (28) (29) (29) (29) (30) (30) (31) (33) (34) (35)

can be ι	ised instea	ad of a dei	tailed calc	ulation.										
Thermal bridges : S (L x Y) calculated using Appendix K 34.35 (36) if details of thermal bridging are not known (36) = 0.05 x (31)													(36)	
if details	of therma	al bridging	are not kn	own (36) =	= 0.05 x (3	1)								_
Total fa	abric he	at loss							(33) +	(36) =			213.93	(37)
Ventila	tion hea	at loss ca	alculated	monthly	/				(38)m	= 0.33 × (25)m x (5)			
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(38)m=	199.49	198.81	198.14	195.01	194.43	191.7	191.7	191.19	192.75	194.43	195.61	196.85		(38)
Heat tr	ansfer c	coefficier	nt, W/K						(39)m	= (37) + (3	38)m			
(39)m=	413.42	412.74	412.07	408.94	408.35	405.62	405.62	405.12	406.68	408.35	409.54	410.78		
Heatla		motor (l							(40)m	Average =	Sum(39)1.	.12 /12=	408.94	(39)
Heat IC	oss para		1LP), VV/	102K	4.07	4.07	4.07	4.07	(40)m	= (39)m ÷	(4)	1.00	l	
(40)m=	1.09	1.09	1.08	1.08	1.07	1.07	1.07	1.07	1.07	1.07	1.08	1.08	4.00	
Numbe	er of day	vs in mor	nth (Tab	le 1a)					,	<pre>Average =</pre>	Sum(40)1	.12/12=	1.08	(40)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)
4. Wa	ter heat	ina ener	av reau	rement:								kWh/ve	ear:	
			<u> </u>											
Assumed occupancy, N 3.24 (42)														
if TF	A £ 13.9	9, N = 1	T 1.70 X	[i - exp	(-0.0003	49 X (11	A - 13.9)z)] + 0.0	013 x (1	II A -13.	5)			
Annua	l averag	e hot wa	ater usag	ge in litre	s per da	y Vd,av	erage =	(25 x N)	+ 36		111	.05		(43)
Reduce	the annua	al average	hot water	usage by {	5% if the d	welling is	designed t	o achieve	a water us	se target o	f			
normore		nines per p		uay (all W										
List water	Jan	Feb	Mar	Apr	May	Jun		Aug	Sep	Oct	Nov	Dec		
HOL WAL	er usage il	Tillies per	uay ior ea		vu,iii = iai			(43)						
(44)m=	122.16	117.72	113.27	108.83	104.39	99.95	99.95	104.39	108.83	113.27	117.72	122.16		-
Energy o	content of	hot water	used - cal	culated mo	onthly $= 4$.	190 x Vd,r	n x nm x D)Tm / 3600	r kWh/mon	Fotal = Sui hth (see Ta	m(44) ₁₁₂ = ables 1b, 1	c, 1d)	1332.64	(44)
(45)m=	181.16	158.44	163.5	142.54	136.77	118.02	109.37	125.5	127	148	161.56	175.44		
									1	Fotal = Su	m(45) ₁₁₂ =		1747.31	(45)
lf instant	taneous w	ater heatii	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46)) to (61)					
(46)m=	27.17	23.77	24.52	21.38	20.52	17.7	16.4	18.82	19.05	22.2	24.23	26.32		(46)
Water	storage	loss:	·		1			·u ·		1	-		l	
Storag	e volum	e (litres)	includir	ig any so	biar or w	WHRS	storage	within sa	ime vess	sei		150		(47)
If comr	nunity h	eating a	nd no ta	nk in dw	elling, e	nter 110	litres in	(47) mbi baili	oro) onto	n (0) in (47)			
Water	storade		not wate	er (unis in	ciudes i	istantai	ieous co		ers) ente		47)			
a) If m	anufact	urer's de	eclared I	oss facto	or is kno	wn (kWł	n/day):				1.	39		(48)
Tempe	erature fa	actor fro	m Table	2b		,	, , , , ,					54		(49)
Energy	/ lost fro	m water	storage	kWh/ve	ar			(48) x (49)	_			75		(50)
b) If m	anufact	urer's de	eclared of	ylinder l	oss facto	or is not	known:	(10) x (10)	_		0.	15		(00)
Hot wa	ater stora	age loss	factor fr	om Tabl	e 2 (kWl	h/litre/da	ıy)				()		(51)
If comr	munity h	eating s	ee secti	on 4.3										
Volum	e factor	from Tal	ble 2a								()		(52)
Tempe	erature fa	actor fro	m Table	2b)		(53)

Energy Enter	y lost fro (50) or	om water (54) in (5	⁻ storage 55)	e, kWh/ye	ear		(47) x (51) x (52) x (53) =					0 75		(54) (55)
Water	storage	loss cal	culated	for each	month			((56)m = (55) × (41)ı	m				. ,
(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(56)
If cylinde	er contain	s dedicate	l d solar sto	nage, (57)	I m = (56)m	x [(50) – (L H11)] ÷ (50	0), else (5	1 7)m = (56)	n where (H11) is fro	m Append	ix H	
(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(57)
Primar	y circuit	loss (ar	nnual) fro	om Table	e 3							0		(58)
Primar	y circuit	loss cal	culated	for each	month (59)m = ((58) ÷ 36	65 × (41)	m					
(mo	dified by	factor f	rom Tab	le H5 if t	here is s	solar wat	ter heatir	ng and a	cylinde	r thermo	stat)		I	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
Combi	loss ca	lculated	for each	month	(61)m =	(60) ÷ 30	65 × (41))m						
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)
Total h	neat req	uired for	water h	eating ca	alculated	l for eac	h month	(62)m =	0.85 × ((45)m +	(46)m +	(57)m +	(59)m + (61)	m
(62)m=	227.75	200.53	210.09	187.63	183.37	163.12	155.96	172.09	172.09	194.6	206.65	222.04		(62)
Solar DI	HW input	calculated	using App	endix G o	r Appendix	H (negati	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)		
(add a	dditiona	l lines if	FGHRS	and/or \	NWHRS	applies	, see Ap	pendix (G)					
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output	t from w	ater hea	ter	-			-				-			
(64)m=	227.75	200.53	210.09	187.63	183.37	163.12	155.96	172.09	172.09	194.6	206.65	222.04		
								Outp	out from wa	ater heate	r (annual)₁	12	2295.92	(64)
Hea <mark>t g</mark>	l <mark>ain</mark> s fro	m water	heating	, kWh/m	onth 0.2	5 ′ [0.85	× (45)m	+ (61)m	n] + 0.8 x	(<mark>46)m</mark> (+ (57)m	+ (<mark>59)</mark> m]	
(65)m=	97.51	86.35	91.64	83.47	82.75	75.32	73.64	79	78.3	86.49	89.79	9 <mark>5.61</mark>		(65)
inclu	ude (57)	m in calo	culation	of (65)m	only if c	ylinder i	s in the o	dwelling	<mark>or ho</mark> t w	ate <mark>r is f</mark> r	om com	munity h	eating	
5. Int	ternal ga	ains (see	e Table {	5 and 5a):									
Metab	olic gair	is (Table	e 5), Wat	ts										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m=	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8		(66)
Lightin	g gains	(calcula	ted in Ap	opendix	L, equat	ion L9 o	r L9a), a	lso see	Table 5					
(67)m=	49.21	43.71	35.55	26.91	20.12	16.98	18.35	23.85	32.02	40.65	47.45	50.58		(67)
Applia	nces ga	ins (calc	ulated ir	n Append	dix L, eq	uation L	13 or L1	3a), also	see Ta	ble 5				
(68)m=	520.24	525.64	512.04	483.07	446.52	412.16	389.2	383.8	397.41	426.37	462.93	497.29		(68)
Cookir	ng gains	(calcula	ated in A	ppendix	L, equat	tion L15	or L15a)), also se	e Table	5	-			
(69)m=	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18		(69)
Pumps	s and fa	ns gains	(Table	5a)										
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3		(70)
Losses	s e.g. ev	aporatic	n (nega	tive valu	es) (Tab	le 5)								
(71)m=	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44		(71)
Water	heating	gains (T	able 5)											
(72)m=	131.06	128.5	123.17	115.93	111.23	104.61	98.98	106.19	108.75	116.25	124.71	128.51		(72)
Total i	internal	gains =	:			(66)	m + (67)m	• n + (68)m -	• + (69)m + (• (70)m + (7	1)m + (72)	m	I	
(73)m=	775.06	772.39	745.29	700.45	652.4	608.29	581.07	588.39	612.71	657.81	709.62	750.92		(73)
6. So	lar gains	S:	•	•				•						

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.
Orienta	tion:	Access Facto Table 6d	r	Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.44	x	10.63	×	0.63	x	0.7] =	11.19	(74)
North	0.9×	0.77	x	3.44	x	20.32	×	0.63	x	0.7	1 =	21.39	(74)
North	0.9x	0.77	x	3.44	x	34.53	x	0.63	x	0.7] =	36.35	(74)
North	0.9×	0.77	x	3.44	x	55.46	×	0.63	x	0.7] =	58.39	(74)
North	0.9x	0.77	x	3.44	x	74.72	×	0.63	x	0.7] =	78.66	(74)
North	0.9x	0.77	x	3.44	x	79.99	×	0.63	x	0.7] =	84.21	(74)
North	0.9x	0.77	x	3.44	x	74.68	×	0.63	x	0.7	=	78.62	(74)
North	0.9x	0.77	x	3.44	x	59.25	×	0.63	x	0.7] =	62.37	(74)
North	0.9x	0.77	x	3.44	x	41.52	×	0.63	x	0.7	=	43.71	(74)
North	0.9x	0.77	x	3.44	x	24.19	×	0.63	x	0.7] =	25.47	(74)
North	0.9x	0.77	x	3.44	x	13.12	x	0.63	x	0.7] =	13.81	(74)
North	0.9x	0.77	x	3.44	x	8.86	×	0.63	x	0.7] =	9.33	(74)
East	0.9x	0.77	x	19.87	x	19.64	×	0.63	x	0.7] =	119.28	(76)
East	0.9x	0.77	x	19.87	x	38.42	×	0.63	x	0.7	1 =	233.34	(76)
East	0.9x	0.77	x	19.87	x	63.27	×	0.63	x	0.7	1 =	384.27	- (76)
East	0.9x	0.77	x	19.87	×	92.28	×	0.63	х	0.7	1 =	560.44	(76)
East	0.9x	0.77	x	19.87	x	113.09	x	0.63	x	0.7	i -	686.84	(76)
East	0.9x	0.77	x	19.87	x	115.77	×	0.63	x	0.7	i =	703.1	_ (76)
East	0.9x	0.77	x	19.87	x	110.22	x	0.63	x	0.7	i =	669.38	– (76)
East	0.9x	0.77	x	19.87	x	94.68	x	0.63	x	0.7	i =	574.99	(76)
East	0.9x	0.77	x	19.87	x	73.59	×	0.63	x	0.7] =	446.92	(76)
East	0.9x	0.77	x	19.87	х	45.59	×	0.63	x	0.7	1 =	276.87	(76)
East	0.9×	0.77	x	19.87	×	24.49	×	0.63	x	0.7	1 =	148.73	(76)
East	0.9x	0.77	x	19.87	x	16.15	×	0.63	x	0.7	i =	98.09	(76)
South	0.9x	0.77	x	0.87	x	46.75	x	0.63	x	0.7] =	12.46	(78)
South	0.9x	0.77	x	0.87	x	76.57	x	0.63	x	0.7] =	20.4	(78)
South	0.9x	0.77	x	0.87	x	97.53	×	0.63	x	0.7] =	25.98	(78)
South	0.9x	0.77	x	0.87	x	110.23	x	0.63	x	0.7] =	29.37	(78)
South	0.9x	0.77	x	0.87	x	114.87	×	0.63	x	0.7] =	30.6	(78)
South	0.9x	0.77	x	0.87	x	110.55	×	0.63	x	0.7] =	29.45	(78)
South	0.9x	0.77	x	0.87	x	108.01	x	0.63	x	0.7] =	28.78	(78)
South	0.9x	0.77	x	0.87	x	104.89	x	0.63	x	0.7] =	27.95	(78)
South	0.9x	0.77	x	0.87	x	101.89	×	0.63	x	0.7] =	27.14	(78)
South	0.9x	0.77	x	0.87	x	82.59	×	0.63	x	0.7] =	22	(78)
South	0.9x	0.77	x	0.87	x	55.42	×	0.63	x	0.7	=	14.76	(78)
South	0.9x	0.77	x	0.87	×	40.4	x	0.63	x	0.7] =	10.76	(78)
West	0.9x	0.77	x	31.81	×	19.64	×	0.63	x	0.7	=	190.91	(80)
West	0.9x	0.77	x	31.81	×	38.42	×	0.63	x	0.7] =	373.47	(80)
West	0.9x	0.77	x	31.81	×	63.27	×	0.63	x	0.7] =	615.05	(80)

West	0.9x	0.77	x	31.	81	x	9	2.28	x		0.63	×	0.7	=	897.01	(80)
West	0.9x	0.77	×	31.	81	x	1 [,]	13.09	x		0.63		0.7	=	1099.32	(80)
West	0.9x	0.77	×	31.	81	x	1.	15.77	x		0.63	_ × [0.7	=	1125.35	(80)
West	0.9x	0.77	×	31.	81	x	1	10.22	x		0.63	_ × [0.7	=	1071.38	(80)
West	0.9x	0.77	×	31.	81	x	9	4.68	x		0.63] × [0.7	=	920.3	(80)
West	0.9x	0.77	x	31.	81	x	7	3.59	x		0.63	x	0.7	=	715.33	(80)
West	0.9x	0.77	x	31.	81	x	4	5.59	x		0.63	x	0.7	=	443.15	(80)
West	0.9x	0.77	x	31.	81	x	2	4.49	x		0.63	x	0.7	=	238.05	(80)
West	0.9x	0.77	x	31.	81	x	1	6.15	x		0.63	x	0.7	=	157	(80)
Solar	gains in	watts, ca	alculate	d for eac	h month	<u>۱</u>			(83)m	n = Sur	m(74)m .	(82)m			-	
(83)m=	333.84	648.6	1061.66	1545.21	1895.42	2 19	942.11	1848.15	1585	5.61	1233.1	767.49	415.35	275.18		(83)
Total	gains – i	nternal a	and sola r	r (84)m = T	= (73)m 1	+ (8	83)m	, watts					1		7	
(84)m=	1108.9	1420.98	1806.95	2245.66	2547.82	2 25	550.39	2429.22	2173	3.99	1845.82	1425.3	1124.97	1026.1]	(84)
7. M	ean inter	nal temp	perature	(heating	l seasor	า)										
Tem	perature	during h	neating	periods i	n the liv	ing	area f	rom Tab	ole 9,	, Th1	(°C)				21	(85)
Utilis	ation fac	tor for g	ains for	living are	ea, h1,n	n (s	ee Ta	ble 9a)							-	
	Jan	Feb	Mar	Apr	May		Jun	Jul	A	ug	Sep	Oct	Nov	Dec		
(86)m=	1	1	1	0.99	0.96		0.85	0.69	0.7	77	0.96	1	1	1		(86)
Mea	n interna	l temper	ature in	living ar	ea T1 (f	ollo	w ste	ps 3 t <mark>o 7</mark>	7 in T	able	9c)					
(87)m=	19.55	19.69	19.96	20.32	20.66	2	20.89	20. <mark>97</mark>	20.	95	20.74	20.29	19.86	1 <mark>9.53</mark>]	(87)
Tem	perature	during h	eating i	periods i	n rest of	í dw	/ellina	from Ta	able 9	9. Th	2 (°C)				-	
(88)m=	20.01	20.01	20.01	20.02	20.02		20.03	20.03	20.	03	20.03	20.02	20.02	20.02	1	(88)
Litilio		tor for a	oine for	root of d	walling	<u>ь</u>	m (oc		<u>()</u>						-	
(89)m=				0.99	0.94		0.77	0.56	9a)	55	0.93	1	1	1	1	(89)
(00)]	()
Mea		l temper	ature in	the rest	of dwel	ling T_₁	12 (fo	ollow ste	eps 3	$\frac{1}{01}$ to 7	In Tabl	e 9c)	19.40	19.01	1	(00)
(90)m=	18.04	16.20	16.63	19.17	19.05		9.94	20.02	20.	01	19.77	19.13	10.49	10.01		(90)
															0.07	(91)
Mea	n interna	l temper	ature (fo	or the wh	ole dwe	ellin	g) = fl	_A × T1	+ (1	– fLA	() × T2		1		7	()
(92)m=	18.15	18.35	18.73	19.25	19.72	2	20.01	20.09	20.	07	19.84	19.22	18.59	18.12	l	(92)
Appl	y adjustr	nent to t	he mea	n interna	I tempe	ratu	ire fro	m Table	4e,	where	e appro	opriate	40.50	40.40	1	(02)
(93)m=	18.15	18.35	18.73	19.25	19.72		20.01	20.09	20.	07	19.84	19.22	18.59	18.12]	(93)
8. Sp	Dace nea	tting requ	uiremen	(ro obtoi	n		on 11 of	Tabl		an the	Tim	(76)	d ra aal	ouloto	
the u	itilisation	factor fo	or dains	using Ta	re obtai able 9a	nea	l at ste	эрттог	Tabi	ie 90,	so tha	(11,m=	(76)m an	u re-cai	culate	
	Jan	Feb	Mar	Apr	Mav		Jun	Jul	A	ua	Sep	Oct	Nov	Dec	1	
Utilis	ation fac	tor for g	ains, hn	<u>י</u> ר:	<u> </u>	-			I		1		_		7	
(94)m=	1	1	1	0.98	0.93		0.77	0.57	0.6	65	0.92	1	1	1	1	(94)
Usef	ul gains,	hmGm	, W = (9	4)m x (8	4)m	-			•				•		-	
(95)m=	1108.74	1420.17	1801.74	2208.38	2360.36	5 19	971.83	1380.15	1420).44 [^]	1703.03	1418.28	1124.54	1026]	(95)
Mon	thly aver	age exte	rnal ten	nperature	e from T	abl	e 8								_	
(96)m=	4.3	4.9	6.5	8.9	11.7		14.6	16.6	16	.4	14.1	10.6	7.1	4.2		(96)
Heat	loss rat	e for me	an interi	nal temp	erature,	Lm	n, W =	=[(39)m :	x [(93	3)m–	(96)m				-	
(97)m=	5725.75	5553.07	5040.23	4232.69	3276.29	21	96.02	1414.17	1488	3.68 2	2335.26	3518.49	4706.08	5718.99		(97)

			En	ergy			Emiss	ion fac	tor	Emission	5
12a. CO2 emissions – Individ	lual heat	ting syste	ems inclu	uding mi	cro-CHP)					
Electricity for lighting										869.11	(232)
Total electricity for the above, kWh/year sum of (230a)(230g) =								75	(231)		
boiler with a fan-assisted flue	;						(000)		45		(230e)
central nearing pump:									30		(230C)
Electricity for pumps, rans and	electric	кеер-по	λ								(000 -)
Electricity for summer fore and	lolootric	koon b-	.+						l	2000.10	
Water heating fuel used	-,	-							l I	2659.16	4
Annual totals Space heating fuel used main) system	1					k	Wh/year	r I	kWh/yea	r T
					Tota	I = Sum(2	19a) ₁₁₂ =			2658.16	(219)
$(219)m = (64)m \times 100 \div (217)$ (219)m = 253.76 223.58 234.64)m 210.5	208.38	204.41	195.44	215.66	215.65	218.22	230.61	247.31		_
Fuel for water heating, kWh/m (210) m = (64) m × 100 ; (217)	onth										
(217)m= 89.75 89.69 89.54	89.14	88	79.8	79.8	79.8	79.8	89.18	89.61	89.78		(217)
Efficiency of water heater	•	•	•							79.8	(216)
227.75 200.53 210.09	187.63	183.37	163.12	155.96	172.09	172.09	194.6	206.65	222.04		
Water heating Output from water heater (calo	culated a	bove)						- 10715,1012	² [0	
(215)m= 0 0 0	0	0	0		U Tota	0 L (k\Wh/vea	= 0 ar) = Sum(2)	215)	0	0	(215)
Space heating fuel (seconda = {[(98)m x (201)] } x 100 ÷ (20	ry), kWh/ 08)	/month									
	1		1	ļ	Tota	l (kWh/yea	i ar) =Sum(2	1 211) _{15,1012}	2=	19672.31	(211)
3673.86 2970.38 2576.94	1558.82	728.83	0	0	0	0	1671.19	2757.98	3734.32		(211)
$(211)m = \{[(98)m \times (204)]\} \times$	100 ÷ (20	1									(211)
3435.06 2777.3 2409.44	1457.5	681.45		0	0	0	1562.56	2578.71	3491.59		
Jan Feb Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ear
Efficiency of secondary/supp	lementar	ry neatin	g systen	1, %						0	(208)
Efficiency of main space nea	ting syste			0/						93.5	(206)
Fraction of total heating from main system 1 $(204) = (202) \times [1 - (203)] =$									1	(204)	
Fraction of space neat from main system(s) $(202) = 1 - (201) =$							1	(202)			
Space heating: Fraction of space heat from s	secondar	y/supple	ementary	system		()			ļ	0	(201)
9a. Energy requirements – Inc	lividual h	eating s	ystems i	ncluding	i micro-C	CHP)					
Space heating requirement in	ו kWh/m²	²/year								48.4	(99)
					Tota	l per year	(kWh/yeai	r) = Sum(9	8)15,912 =	18393.61	(98)
(98)m= 3435.06 2777.3 2409.44	1457.5	681.45	0	0	0	0	1562.56	2578.71	3491.59		_
Opube neuting requirement is			VVII/IIIOII	11 = 0.02	<u> </u>)iii – (33	<u>) </u>	1,111			

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

kWh/year

Emission factor kg CO2/kWh

Emissions kg CO2/year

Space heating (main system 1)	(211) x	0.216	=	4249.22	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	574.16	(264)
Space and water heating	(261) + (262) + (263) + (264) =			4823.38	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	451.07	(268)
Total CO2, kg/year	sum	of (265)(271) =		5313.37	(272)

TER =

20.96 (273)

Appendix

Appendix 3 : Water Calculations

Charlton Brown Architecture & Interiors

Installation Type	Unit of Measure	Capacity/Flow rate (1)	Use Factor (2)	Fixed use (litres/person/day) (3)	Litres/person/day = [(1)x(2)] + (3) (4)		
WC (single flush)	Flush Volume (litres)	(-)	4.42	0.00	0		
WC (dual flush)	Full flush Volume (litres)		1.46	0.00	0		
	Part flush Volume (litres)		2.96	0.00	0		
WC (multiple fittings)	Average effective flushing Volume (litres)	3.99	4.42	0.00	17.64		
Taps (excluding kitchen/utility room taps)	Flow rate (litres/min)	5.00	1.58	1.58	9.48		
Bath (where shower also present)	Capacity to overflow(litres)	170.00	0.11	0.00	18.70		
Shower (where bath also present)	Flow Rate(litres / minute)	12.00	4.37	0.00	52.44		
Bath Only	Capacity to overflow(litres)		0.50	0.00	0		
Shower Only	Flow Rate (litres/minute)		5.60	0.00	0		
Kitchen/Utility room sink taps	Flow rate (litres/minute)	7.50	0.44	10.36	13.66		
Washing Machine	(Litres/kg dry load)	5.00	2.1	0.00	10.50		
Dishwasher	(Litres/place setting)	1.00	3.6	0.00	3.60		
Waste disposal unit	(Litres/use)	Present	3.08	0.00	0		
Water Softener	(Litres/person/day)		1.00	0.00	0		
	(5)	Total Calculated =SUM(column 4)	otal Calculated use (litres/person/day) -SUM(column 4)				
	(6)	Contribution fror (litres/person/da	0				
	(7)	Contribution from rainwater (litres/person/day)			15.96		
	(8)	Normalisation fa	0.91				
	(9)	Total internal water consumption = [(5)-(6)-(7)]x(8) (litres/person/day)			100.15		
	(10)	External water u	se		5.0		
	(11)	Total water cons =(9)+(10)(litres	umption /person/o	(Building Regulation 17.K) day)	105.2		

Installation Type	Make/Model (mandatory)	Litres/Person/Day
WC (multiple fittings)	All WCs	17.64
Taps	All basin taps	9.48
Baths (shower(s) present)	Master Bathroom, Family Bathroom	18.70
Showers (bath(s) present)	All showers	52.44
Kitchen Taps	Kitchen Tap	13.66
Washing Machines		10.50
Dishwasher		3.60
Contribution from rainwater (litres/person/day)	Flat Roof	17.64





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