

Sustainability & Energy Statement

205-219 Henley Road, Caversham, Reading

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Table of Contents

Executive Summary	3
1.0 Introduction	5
2.0 Planning policies	6
3.0 Assessment methodology	9
4.0 Proposal	10
5.0 Energy Efficiency	11
5.1 Demand Reduction (Be Lean)	11
• Passive design measures	
• Active design measures	
5.2 Establishing Energy Demand and Carbon Dioxide Emissions (Be Lean)	14
• SAP calculations	
5.3 Low-Carbon and Renewable Technologies (Be Clean and Be Green)	18
5.4 Establishing Energy Demand and Carbon Dioxide Emissions (Be Green - ASHPs)	21
• SAP calculations	
5.5 Summary of Calculations and Proposals for Low-carbon and Renewable Technologies	23
6.0 Climate Change Adaption and Water Resources	24
• Sustainable drainage systems (SuDs)	
• Water efficiency measures	
7.0 Materials and Waste	26
 Appendix 1: TER & DER Worksheets for Modelled Units using Baseline Gas	
Appendix 2: 'Be Lean' SAP 10 Spreadsheet	
Appendix 3: DER Worksheets for Modelled Units using Communal ASHPs	
Appendix 4: 'Be Green (ASHPs)' SAP 10 Spreadsheet	
Appendix 5: Roof Layout showing the Indicative Location of Photovoltaic Panels	

Executive Summary

This Sustainability and Energy Statement considers the sustainability issues relating to the proposed development on land at 205-219 Henley Road, Caversham, Reading and sets out the commitments of the applicant to the site and the targets that will be applied to the development.

The Statement is provided in support of a detailed planning application for the *“Demolition of nos. 205-213 Henley Road and rear gardens of nos. 205-219 Henley Road and the erection of 2 retirement living apartment blocks (C3 use-age restricted) comprising 59 apartments including communal spaces with supporting car parking, open space, landscaping and associated infrastructure. Access into the site from the adjacent development on Henley Road.”*

The site is located in a sustainable location close to existing facilities and infrastructure and will provide homes to meet local need.

Throughout the design process, the applicant and design team members have given careful consideration to the sustainability issues relating to the site, and how these can be enhanced in a marketable and feasible manner. As a result, this Statement demonstrates that the development meets relevant sustainability criteria and in a number of areas exceeds them.

The fabric standards of the buildings exceed the requirements of the Building Regulations.

The Local Plan proposes that the benefit of a decentralised system to be the ability to use combined heat and power systems (CHP). But with the carbon emissions factors proposed within the new Part L (June 2022) the benefit of CHP is negated because the carbon factor for electricity will become significantly less than its current value. Therefore, using gas to generate electricity through a CHP system will lead to increased emissions.

However, it is proposed to install a communal air source heat system within the buildings. Each block will have its own common chiller unit, which will serve a medium temperature loop and each apartment will have its own internal unit. At the detailed working drawing design stage there may be merits in linked the system. But regardless of whether the two blocks have individual or linked systems the emissions reduction will be broadly similar.

In order to demonstrate the energy efficiency of the apartments a set of representative SAP calculations have been prepared for the ‘Be Lean’ scenario based on the use of gas boilers to each apartment and before the installation of any low-carbon and/or renewable technologies. This is not the proposed strategy but purely demonstrates the reduction from the ‘Be Lean’ condition and the energy efficiency of the buildings.

The Regulations Compliance Reports for this option are attached as Appendix 1. The results have been input into the SAP 10 spreadsheet attached as Appendix 2 to provide the ‘Be Lean’ emissions.

The carbon factors used within the report have been based on SAP 10 and the methodology is as established by the Mayor of London in the GLA Energy Assessment Guidance.

It is appreciated that the site does not come under the remit of the GLA but this Guidance presents the most up to date methodology for accurately estimating carbon emissions. This advocates the use of the SAP methodology (SAP 2012) but with the SAP 10 carbon factors.

A further set of SAP calculations have been prepared based on the use of communal air source heat pumps. The DER Worksheets for this option are attached as Appendix 3 and the results have been input into the SAP 10 spreadsheet attached as Appendix 4 to provide the 'Be Green' emissions for the site from heat pumps.

In addition to the reductions from heat pumps it is also proposed to install a total of 81 x 400W photovoltaic panels on the roofs of the two blocks. A total of 54 panels will be installed on the flat roof well to Block A. These will be gently inclined at circa 20 degrees and orientated toward due south. A total of 27 panels will be installed on the internal pitched roof to Block B. The locations will not detrimentally impact on the aesthetics of the proposal.

The panels will reduce emissions by a further **6,897 kg CO₂ per year**.

The reductions in emissions can be summarised as follows:

	Total Emissions	% Reduction
	T CO ₂ per year	
Be Lean		
Baseline (Building Regulations TER) – based on gas	62.675	
Be Lean - after energy efficiency (DER) – based on gas	55.457	11.52%
Be Green		
Emissions – after ASHPs (Be Green – ASHPs)	23.289	62.41%
Emissions – after 81 x 400W Photovoltaic Panels	16.392	73.85%

The residual emissions are 16.392 tonnes and therefore, using the carbon offset charge the payment should be **£29,506** (16.392 x £1,800).

1.0 Introduction

This report has been commissioned by Knowles Construction Limited and provides a Sustainability and Energy Statement for;

“Demolition of nos. 205-213 Henley Road and rear gardens of nos. 205-219 Henley Road and the erection of 2 retirement living apartment blocks (C3 use-age restricted) comprising 59 apartments including communal spaces with supporting car parking, open space, landscaping and associated infrastructure. Access into the site from the adjacent development on Henley Road.”

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

The buildings have been designed and will be constructed to reduce energy demand and carbon dioxide emissions.

The objective is to reduce the energy demand to an economic minimum by making investments in the parts of the buildings that have the greatest impact on energy demand and are the most difficult and costly to change in the future, namely the building fabric.

Once cost-effective structures have been designed, low-carbon and renewable technologies have been considered for installation to provide heat and/or electricity.

The following hierarchy has been followed:

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

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

2.0 Planning Policy Context

National Policy

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

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

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

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

- National Planning Policy Framework - 2021

Paragraph 152 states;

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

Local Policies

The local planning policies are set out in the **Reading Borough Local Plan**, which was adopted in November 2019. Of particular relevance to the subject area of this Statement are the following policies;

CC2: Sustainable Design and Construction

Proposals for new development, including the construction of new buildings and the redevelopment and refurbishment of existing building stock, will be acceptable where the design of buildings and site layouts use energy, water, minerals, materials and other natural resources appropriately, efficiently and with care and take account of the effects of climate change.

To meet these requirements:

- *All major non-residential developments or conversions to residential are required to meet the most up-to-date BREEAM 'Excellent' standards, where possible;*
- *All minor non-residential developments or conversions to residential are required to meet the most up-to-date BREEAM 'Very Good' standard as a minimum;*
- *All non-residential development or conversions to residential should incorporate water conservation measures so that predicted per capita consumption does not exceed the appropriate levels set out in the applicable BREEAM standard. Both residential and non-residential development should include recycling greywater and rainwater harvesting where systems are energy and cost effective.*

CC3: Adaptation to Climate Change

All developments will demonstrate how they have been designed to incorporate measures to adapt to climate change. The following measures shall be incorporated into development:

- *Wherever possible, new buildings shall be orientated to maximise the opportunities for both natural heating and ventilation and reducing exposure to wind and other elements;*
- *Proposals involving both new and existing buildings shall demonstrate how they have been designed to maximise resistance and resilience to climate change for example by including measures such as solar shading, thermal mass, heating and ventilation of the building and appropriately coloured materials in areas exposed to direct sunlight, green and brown roofs, green walls, etc;*
- *Use of trees and other planting, where appropriate as part of a landscape scheme, to provide shading of amenity areas, buildings and streets and to help to connect habitat, designed with native plants that are carefully selected, managed and adaptable to meet the predicted changed climatic conditions; and*
- *All development shall minimise the impact of surface water runoff from the development in the design of the drainage system, and where possible incorporate mitigation and resilience measures for any increases in river flooding levels as a result of climate change.*

CC4: Decentralised Energy

- *In meeting the sustainability requirements of this plan, developments of the sizes set out below shall demonstrate how consideration has been given to securing energy for the development from a decentralised energy source.*
- *Any development of more than 20 dwellings and/ or non-residential development of over 1,000 sq m shall consider the inclusion of decentralised energy provision, within the site, unless it can be demonstrated that the scheme is not suitable, feasible or viable for this form of energy provision.*
- *Where there is existing decentralised energy provision present within the vicinity of an application site, further developments of 10 dwellings or more or non-residential development of 1,000 sq m or more will be expected to link into the existing decentralised energy network or demonstrate why this is not feasible.*

CC5: Waste Minimisation and Storage

Development should demonstrate measures to minimise the generation of waste in the construction, use and life of buildings and promote more sustainable approaches to waste management, including the reuse and recycling of construction waste and the promotion of layouts and designs that provide adequate, well-designed space to facilitate waste storage, reuse, recycling and composting.

In addition to the Local Plan the Council have published further guidance within the **Sustainable Design and Construction Supplementary Planning Document**, which was adopted in December 2019.

The SPD sets out the Councils requirement that all residential developments of 10 units or more should achieve 'zero carbon' with a preference for the reduction to be achieved on site but if it is not feasible then at least 35% should be achieved on site with the balance offset using a carbon offset payment system.

3.0 Assessment Methodology

The baseline carbon dioxide emissions from the buildings have been established using agreed building specifications and detailed planning drawings and SAP calculations have been prepared for a representative range of apartments, which provide an assessment of the total emissions from the site.

A BRUKL calculation prepared for similar accommodation has been used to estimate the emissions from the communal areas and the circulation spaces.

Emission Factors

The CO₂ emission factors, where applicable, used throughout this report have been taken from the emerging Building Regulation Approved Document L – 2022 (known colloquially as SAP 10).

	kg CO ₂ /kWh
Mains gas	0.210
Grid supplied and displaced electricity	0.233

4.0 Proposal

The proposal is for the construction of 59 apartments in two buildings comprising 37 and 22 units in Block A and Block B respectively.

The accommodation schedule in detail is;

Unit Type	Number	Area	Total Area
		m ²	m ²
1-Bedroom apartment	12	51.0	612.0
1-Bedroom apartment	1	56.0	56.0
1-Bedroom apartment	3	61.0	183.0
1-Bedroom apartment	2	63.0	126.0
2-Bedroom apartment	3	66.0	198.0
2-Bedroom apartment	1	67.0	67.0
2-Bedroom apartment	1	68.0	68.0
1-Bedroom apartment	1	69.0	69.0
2-Bedroom apartment	3	69.0	207.0
2-Bedroom apartment	1	70.0	70.0
2-Bedroom apartment	8	72.0	576.0
2-Bedroom apartment	11	73.0	803.0
2-Bedroom apartment	2	76.0	152.0
2-Bedroom apartment	1	78.0	78.0
2-Bedroom apartment	1	79.0	79.0
2-Bedroom apartment	2	80.0	160.0
2-Bedroom apartment	1	83.0	83.0
2-Bedroom apartment	2	84.0	168.0
2-Bedroom apartment	1	89.0	89.0
2-Bedroom apartment	1	90.0	90.0
2-Bedroom apartment	1	99.0	99.0
Total	59		4,033.0

5.0 Energy Efficiency

5.1 Demand Reduction (Be Lean)

Design

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

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

Passive Design Measures

The passive design measures proposed include;

Passive Solar Gain

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

The position of the buildings within the site are in context with surrounding development and the shape of the site.

Natural Daylighting

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

Efficient Building Fabric

Building Envelope

U-values of the building envelope must meet Building Regulations Part L1 standards and further improvements to U-values will reduce the apartments heating requirements.

Ground and exposed floors will be insulated with 150mm 'Kingspan' PIR insulation or similar.

The building is suited to traditional load bearing construction and it is assumed the external walls are built in cavity wall construction with fully filled cavities. Horizontal roofs (cold roofs) will be insulated with 400mm of mineral wool and sloping ceilings (mansards) and flat roofs with 120mm between rafters and 50mm below.

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

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

Element	Part L Limiting U-values	Proposed U-values	Proposed Improvement
	W/m ² K	W/m ² K	
Floor	0.20	0.11	45%
External Walls	0.30	0.19	43%
Horizontal Roofs (cold roofs)	0.20	0.10	50%
Sloping, Mansard and Flat Roofs (warm roof)	0.20	0.15	30%
Windows	2.00	1.20	40%
Entrance Doors		1.00	

Air Leakage

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

The Building Regulations set a minimum standard for air permeability of 10 m³ of air per hour per m² of envelope area, at 50Pa.

It is proposed to achieve a 60% improvement over Building Regulations and the buildings will target a permeability of 4.0 m³/hr/m².

Thermal Bridging

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

The buildings will use the ACDs applicable to masonry construction and will enable the buildings to achieve the higher energy efficiency requirements of the Building Regulations.

The bridging losses have been based upon the use of the ACDs and calculated using SAP Appendix K Table 1.

Ventilation

As a result of increasing thermal efficiency and air tightness, Building Regulations Approved Document F was also revised in 2006 to address the possibility of overheating and poor air quality.

Active Design Measures will include;

Efficient Lighting and Controls

Throughout the scheme natural lighting will be optimised.

Approved Document L1 requires three in four light fittings (75%) to be dedicated low energy fittings. The homes will exceed this and all light fittings will be of a dedicated energy efficient type.

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

Space Heating and Hot Water

The baseline SAP modelling has been based upon the use of a gas combination boiler installed to each apartment but the assessment considers other options for providing space heating and hot water.

5.2 Establishing Energy Demand and Carbon Dioxide Emissions (Be Lean)

In order to assess the energy efficiency of the building (Be Lean) a set of SAP calculations have been prepared using a gas heating system as a baseline. These are not necessarily the proposed final option but are used to test the 'Be Lean' reductions only.

SAP calculations have been prepared for a 1-bedroom apartment and a 2-bedroom apartment modelled as an exposed-floor, mid-floor and top-floor unit. Calculations have been prepared for units located on the north and south sides of the buildings.

Baseline

The Regulations Compliance Reports are attached as Appendix 1 but the energy demand for the modelled apartments can be summarised as follows;

1-Bedroom apartment – 52.0 m ² Ground-floor – north orientation	Energy Demand TER	Energy Demand DER
	kWh/yr	kWh/yr
Space heating	1,778	1,681
Water heating	1,958	1,557
Electricity for pumps, fans & lighting	352	352
Total	4,088	3,590

1-Bedroom apartment – 52.0 m ² Mid-floor – north orientation	Energy Demand TER	Energy Demand DER
	kWh/yr	kWh/yr
Space heating	958	927
Water heating	1,984	1,563
Electricity for pumps, fans & lighting	352	352
Total	3,294	2,842

1-Bedroom apartment – 52.0 m ² Top-floor – north orientation	Energy Demand TER	Energy Demand DER
	kWh/yr	kWh/yr
Space heating	1,629	1,846
Water heating	1,961	1,556
Electricity for pumps, fans & lighting	352	352
Total	3,942	3,754

1-Bedroom apartment – 53.0 m ² Ground-floor – south orientation	Energy Demand TER	Energy Demand DER
	kWh/yr	kWh/yr
Space heating	1,442	1,344
Water heating	1,986	1,572
Electricity for pumps, fans & lighting	358	358
Total	3,786	3,274

1-Bedroom apartment – 53.0 m ² Mid-floor – south orientation	Energy Demand TER	Energy Demand DER
	kWh/yr	kWh/yr
Space heating	667	635
Water heating	2,018	1,579
Electricity for pumps, fans & lighting	358	358
Total	3,043	2,572

1-Bedroom apartment – 53.0 m ² Top-floor – south orientation	Energy Demand TER	Energy Demand DER
	kWh/yr	kWh/yr
Space heating	1,298	1,509
Water heating	1,991	1,570
Electricity for pumps, fans & lighting	358	358
Total	3,647	3,437

2-Bedroom apartment – 74.0 m ² Ground-floor – north orientation	Energy Demand TER	Energy Demand DER
	kWh/yr	kWh/yr
Space heating	2,617	2,504
Water heating	2,310	1,804
Electricity for pumps, fans & lighting	459	459
Total	5,386	4,767

2-Bedroom apartment – 74.0 m ² Mid-floor – north orientation	Energy Demand TER	Energy Demand DER
	kWh/yr	kWh/yr
Space heating	1,534	1,514
Water heating	2,337	1,810
Electricity for pumps, fans & lighting	459	459
Total	4,330	3,783

2-Bedroom apartment – 74.0 m ² Top-floor – north orientation	Energy Demand TER	Energy Demand DER
	kWh/yr	kWh/yr
Space heating	2,416	2,670
Water heating	2,314	1,804
Electricity for pumps, fans & lighting	459	459
Total	5,189	4,933

2-Bedroom apartment – 74.0 m ² Ground-floor – south orientation	Energy Demand TER	Energy Demand DER
	kWh/yr	kWh/yr
Space heating	2,054	1,936
Water heating	2,323	1,808
Electricity for pumps, fans & lighting	459	459
Total	4,836	4,203

2-Bedroom apartment – 74.0 m ² Mid-floor – south orientation	Energy Demand TER	Energy Demand DER
	kWh/yr	kWh/yr
Space heating	1,036	1,008
Water heating	2,358	1,816
Electricity for pumps, fans & lighting	459	459
Total	3,853	3,283

2-Bedroom apartment – 74.0 m ² Top-floor – south orientation	Energy Demand TER	Energy Demand DER
	kWh/yr	kWh/yr
Space heating	1,878	2,138
Water heating	2,328	1,806
Electricity for pumps, fans & lighting	459	459
Total	4,665	4,403

Communal Accommodation and Circulation

A BRUKL calculation for similar accommodation built to a similar specification has been used to estimate the energy demand from the communal accommodation, which can be summarised as follows:

Communal Accommodation	Notional Energy Demand	Actual Energy Demand
	kWh/m ²	kWh/m ²
Heating	25.78	12.10
Cooling	0.00	0.00
Auxiliary and Lighting	55.58	55.51
Hot Water	1.96	1.96
Totals	83.32	69.57

Summary

The energy demand figures calculated above have been inputted into the SAP 10 spreadsheet, which is attached as Appendix 2 and provides the total site TER and DER/BER emissions using the emerging carbon emissions factors.

The maximum allowable carbon dioxide emissions from the site (TER) are assessed as **62,675 kg CO₂ per year**, with the actual carbon dioxide emissions (DER) assessed as **55,457 kg CO₂ per year**.

The reduction in emissions using from energy efficiency for the 'Be Lean' scenario and using the SAP 10 carbon factors is **7,218 kg CO₂ per year**, which equates to;

- **11.52%**

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

The carbon dioxide emissions established above have been used to test the viability of various renewable and low carbon technologies as follows.

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

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

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

Wind

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

The Government wind speed database predicts local wind speeds at Henley Road to be 4.7 m/s at 10m above ground level and 5.4 m/s at 25m above ground level. This is below the level generally required for commercial investment in large wind turbines. In addition the land take, potential for noise and signal interference make a large wind turbine unsuitable for this development.

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

Combined Heat and Power and Community Heating

Combined heat and power (CHP) also called co-generation is a de-centralised method of producing electricity from a fuel and 'capturing' the heat generated for use in buildings. The plant is essentially a small-scale electrical power station. The production and transportation of electricity via the National Grid is very inefficient with over 65% of the energy produced at the power station being lost.

Consequently, CHP can demonstrate significant CO₂ savings and although not necessarily classed as renewable energy (depending on the fuel used) the technology is low carbon.

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

There is insufficient baseload to justify a CHP unit. In addition, with the emerging change in the carbon factors the emissions from Grid electricity are due to drop to below those for mains gas. Therefore, using main gas to generate electricity on site will increase emissions comparing with the use of main electricity.

CHP is not proposed.

Ground Source Heat Pumps

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

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

There is insufficient external area to install a shallow, horizontal collection system and a borehole system would be required. There are limited opportunities to place the bore holes away from the building and in addition they would be prohibitively expensive.

The installation of ground source heat pumps into this site is therefore not appropriate.

Solar

(i) Solar Water Heating

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

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

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

In apartment buildings servicing apartments below the top-floor can be problematic for solar thermal panels. The total hot water demand of the top-floor units is 28,907 kWh per year (based on the gas system) and assuming panels would reduce demand by 50% the reduction in CO₂ emissions would be 3,035 kg CO₂ per year. When combined with the energy efficiency measures incorporated into the scheme this equates to a total reduction of 16.36%.

Solar hot water panels could be used to reduce emissions but additional technologies would be required to achieve the policy target and the use of solar hot water heating panels would require the use of conventional gas boilers.

Solar hot water heating panels are not proposed.

(ii) Photovoltaics

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

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

The design of the buildings includes large flat roof areas, which may be able to accommodate some photovoltaic panels without detrimentally impacting on the appearance and urban design of the site.

It is therefore proposed to install 54 x 400 photovoltaic panels on the flat roof area of Block A and to install 27 x 400 photovoltaic panels on the internal roof pitch of Block B (a total of 32.4W kW).

These arrays will generate 29,601 kWh of energy and will reduce emissions by a further **6,897 kg CO₂ per year**.

Air Source Heat Pumps (ASHP)

Air sourced heat pumps operate using the same reverse refrigeration cycle as ground source heat pumps; however, the initial heat energy is extracted from the external air rather than the ground.

It is proposed to install a communal air heat pump system into each block. Each block will have its own common chiller unit, which will serve a medium temperature loop within the block in question. Each apartment will have its own internal unit.

5.4 Establishing Energy Demand and Carbon Dioxide Emissions (Be Green - ASHPs)

The carbon emissions have been calculated using the SAP 10 carbon but using the SAP methodology (2012).

The apartments modelled above under the 'Be Lean' scenario have been remodelled using a Daikin Altherma Geo air source heat pump in lieu of a gas system.

The TER and DER Worksheets are attached as Appendix 3 but the energy demand for the modelled apartments can be summarised as follows;

1-Bedroom apartment – 53.0 m ² Ground-floor	Energy Demand DER
	kWh/yr
Space heating and hot water	727
Heat distribution	29
Electricity for lighting	282
Total	1,038

1-Bedroom apartment – 53.0 m ² Mid-floor	Energy Demand DER
	kWh/yr
Space heating and hot water	566
Heat distribution	23
Electricity for lighting	282
Total	871

1-Bedroom apartment – 53.0 m ² Top-floor	Energy Demand DER
	kWh/yr
Space heating and hot water	766
Heat distribution	31
Electricity for lighting	282
Total	1,079

2-Bedroom apartment – 74.0 m ² Ground-floor	Energy Demand DER
	kWh/yr
Space heating and hot water	920
Heat distribution	37
Electricity for lighting	383
Total	1,340

2-Bedroom apartment – 74.0 m ² Mid-floor	Energy Demand DER
	kWh/yr
Space heating and hot water	702
Heat distribution	28
Electricity for lighting	383
Total	1,113

2-Bedroom apartment – 74.0 m ² Top-floor	Energy Demand DER
	kWh/yr
Space heating and hot water	962
Heat distribution	39
Electricity for lighting	383
Total	1,384

Summary

The energy demand figures calculated above have been inputted into the SAP 10 spreadsheet, which is attached as Appendix 4 and provides the total site DER/BER emissions using the SAP 10 carbon emissions factors.

The actual carbon dioxide emissions (DER/BER) assessed as **23,289 kg CO₂ per year**.

The reduction in emissions (compared to the Be Lean TER) from energy efficiency and using communal air source heat pump systems and using the SAP 10 carbon factors is **39,386 kg CO₂ per year**, which equates to;

- **62.84%**

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

Be Lean

A baseline calculation has been prepared using 2013 Building Regulations and the SAP 10 carbon factors. Using the current Regulations and based upon a gas heating system for the apartments the total site CO₂ emissions are calculated as **62,675 kg CO₂ per year** (TER) and **55,457 kg CO₂ per year** (DER/BER).

This equates to a reduction of **7,218 kg CO₂ per year** or **11.52%** of the total TER emissions.

The Regulation Compliance Reports are attached as Appendix 1 and the SAP 10 'Be Lean' spreadsheet is attached as Appendix 2.

Be Green - ASHPs

A further set of calculations has been prepared for the proposed energy strategy.

This proposes the installation of a communal air source heat pump system into each block. These calculations have been converted to SAP 10 emissions and the 'Be Green' spreadsheet is attached as Appendix 4.

The Regulation Compliance Reports for the proposed energy strategy (based on Part L – 2013) are attached as Appendix 3.

The actual carbon dioxide emissions (DER/BER) assessed as **23,289 kg CO₂ per year**.

The reduction in emissions using from energy efficiency and communal air source heat pumps and using the SAP 10 carbon factors is **39,386 kg CO₂ per year**, which equates to **62.84%**.

Be Green – Photovoltaic Panels

It is therefore proposed to install 54 x 400 photovoltaic panels on the flat roof area of Block A and to install 27 x 400 photovoltaic panels on the internal roof pitch of Block B (a total of 32.4W kW). These arrays will generate 29,601 kWh of energy and will reduce emissions by a further **6,897 kg CO₂ per year**.

Summary

The total reduction in emissions from energy efficiency, low-carbon and renewable technologies are calculated as; 46,283 kg CO₂ per year, which equates to a reduction of 73.85% (% of TER).

The residual emissions are **16.392 tonnes**, which requires a carbon offset payment of **£29,506** (based on the carbon offset payment of £1,800 per tonne).

6.0 Climate change adaption and Water resources

Sustainable Drainage Systems (SUDS)

The site lies within Flood Zone 1, 2 & 3. The existing site includes some buildings and hard surfacing, which are impermeable. The proposal does not detrimentally impact on the volume or rate of surface water run-off and it is understood that surface water will be disposed using infiltration methods.

A Flood Risk Assessment has been prepared for the site and accompanies the application.

Surface Water Management

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

Water efficiency measures

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

The water efficiency measures included will ensure that the water use target of 105 litres per person per day is achieved (excluding 5 l/p/d for external water use).

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

The following devices will be incorporated within the apartments:

- water efficient taps
- water efficient toilets
- low output showers
- flow restrictors to manage water pressures to achieve optimum levels and
- water meters

Water consumption calculations have been carried out using the Water Efficiency Calculator provided by the BRE. Although not perfect this calculator gives a good indication of the probable water use in a dwelling, although this is largely dependent on the way on which occupants use their homes.

Below is a typical specification, which would achieve the 105 Litres per person per year target (excluding five litres per person per day allowance for external water use).

Schedule of Appliance Water Consumption		
Appliance	Flow rate or capacity	Total Litres
WC	6/3 litres dual flush	17.64
Basin	2.0 litres/min.	4.74
Shower	9.0 litres/min	39.33
Bath	175 litres	19.25
Sink	5.0 litres/min	12.56
Washing Machine	6.75 litres/kg	14.18
Dishwasher	1.25 litres/places	4.50
		112.20
	Normalisation Factor	0.91
		102.10

7.0 Materials and Waste

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

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

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

All insulation materials to will have a zero ozone depleting potential

Construction waste

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

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

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

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

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

Appendix 1 – TER & DER Worksheets for Modelled Units using Baseline Gas

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Caversham 1BF EXP 52 North

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	52 (1a)	2.4 (2a)	124.8 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	52 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	124.8 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				1	10 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10 ÷ (5) = 0.08 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 4 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.28 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.24 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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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
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

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

0.3	0.3	0.29	0.26	0.26	0.23	0.23	0.22	0.24	0.26	0.27	0.28
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.55 0.54 0.54 0.53 0.53 0.53 0.53 0.52 0.53 0.53 0.54 0.54 (24d)

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

(25)m= 0.55 0.54 0.54 0.53 0.53 0.53 0.53 0.52 0.53 0.53 0.54 0.54 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Floor			52	$\times$ 0.11	5.72		(28)
Walls	19.13	5.22	13.91	$\times$ 0.19	2.64		(29)
Total area of elements, m²			71.13				(31)
Party wall			53.21	$\times$ 0	0		(32)
Party ceiling			52				(32b)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 15.28 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 6838.64 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 7.95 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 23.23 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	22.49	22.42	22.34	22	21.94	21.65	21.65	21.59	21.76	21.94	22.07	22.2

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

(39)m=	45.72	45.65	45.58	45.24	45.18	44.88	44.88	44.83	44.99	45.18	45.3	45.44
Average = Sum(39) _{1...12} /12=												45.24 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.88	0.88	0.88	0.87	0.87	0.86	0.86	0.86	0.87	0.87	0.87	0.87		
Average = Sum(40) _{1...12} / 12 =													0.87	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.75

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

75.74

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
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Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	83.31	80.28	77.26	74.23	71.2	68.17	68.17	71.2	74.23	77.26	80.28	83.31		
Total = Sum(44) _{1...12} =													908.89	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	123.55	108.06	111.51	97.22	93.28	80.49	74.59	85.59	86.62	100.94	110.19	119.65		
Total = Sum(45) _{1...12} =													1191.69	(45)

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

(46)m=	18.53	16.21	16.73	14.58	13.99	12.07	11.19	12.84	12.99	15.14	16.53	17.95		(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
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If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
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Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
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DER WorkSheet: New dwelling design stage

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

(61)m=	16.06	14.48	15.98	15.42	15.9	15.35	15.84	15.88	15.39	15.95	15.49	16.04	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	139.61	122.54	127.49	112.64	109.18	95.84	90.43	101.47	102	116.89	125.68	135.7	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
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Output from water heater

(64)m=	139.61	122.54	127.49	112.64	109.18	95.84	90.43	101.47	102	116.89	125.68	135.7	(64)
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Output from water heater (annual)_{1...12} 1379.47 (64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	45.1	39.55	41.07	36.18	34.99	30.6	28.76	32.43	32.65	37.55	40.51	43.8	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	(66)

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

(67)m=	15.68	13.93	11.33	8.57	6.41	5.41	5.85	7.6	10.2	12.95	15.12	16.11	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	152.43	154.01	150.02	141.54	130.83	120.76	114.03	112.45	116.44	124.92	135.63	145.7	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	(69)
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Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	(71)
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Water heating gains (Table 5)

(72)m=	60.61	58.85	55.21	50.25	47.03	42.5	38.66	43.59	45.34	50.47	56.26	58.86	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	280.95	279.02	268.79	252.6	236.5	220.91	210.77	215.87	224.22	240.58	259.25	272.92	(73)
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6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.78	x	10.63	x	0.63	x	0.7	=	12.28	(74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.63	x	0.7	=	4.68	(74)
North	0.9x	0.77	x	3.78	x	20.32	x	0.63	x	0.7	=	23.48	(74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.63	x	0.7	=	8.94	(74)
North	0.9x	0.77	x	3.78	x	34.53	x	0.63	x	0.7	=	39.89	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.44	x	34.53	x	0.63	x	0.7	=	15.2	(74)
North	0.9x	0.77	x	3.78	x	55.46	x	0.63	x	0.7	=	64.07	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.63	x	0.7	=	24.41	(74)
North	0.9x	0.77	x	3.78	x	74.72	x	0.63	x	0.7	=	86.31	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.63	x	0.7	=	32.88	(74)
North	0.9x	0.77	x	3.78	x	79.99	x	0.63	x	0.7	=	92.4	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.63	x	0.7	=	35.2	(74)
North	0.9x	0.77	x	3.78	x	74.68	x	0.63	x	0.7	=	86.27	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.63	x	0.7	=	32.86	(74)
North	0.9x	0.77	x	3.78	x	59.25	x	0.63	x	0.7	=	68.44	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.63	x	0.7	=	26.07	(74)
North	0.9x	0.77	x	3.78	x	41.52	x	0.63	x	0.7	=	47.96	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.63	x	0.7	=	18.27	(74)
North	0.9x	0.77	x	3.78	x	24.19	x	0.63	x	0.7	=	27.94	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.63	x	0.7	=	10.65	(74)
North	0.9x	0.77	x	3.78	x	13.12	x	0.63	x	0.7	=	15.15	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.63	x	0.7	=	5.77	(74)
North	0.9x	0.77	x	3.78	x	8.86	x	0.63	x	0.7	=	10.24	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.63	x	0.7	=	3.9	(74)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	16.96	32.42	55.09	88.48	119.19	127.6	119.13	94.52	66.23	38.59	20.93	14.14	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	297.92	311.44	323.87	341.08	355.7	348.51	329.9	310.39	290.45	279.17	280.18	287.06	(84)
--------	--------	--------	--------	--------	-------	--------	-------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.92	0.77	0.59	0.65	0.89	0.98	1	1	(86)

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

(87)m=	20.11	20.19	20.36	20.59	20.83	20.96	20.99	20.99	20.9	20.63	20.33	20.09	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

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

(88)m=	20.19	20.19	20.19	20.19	20.19	20.2	20.2	20.2	20.2	20.19	20.19	20.19	(88)
--------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	------

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

(89)m=	1	1	0.99	0.97	0.89	0.69	0.49	0.54	0.84	0.98	1	1	(89)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

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

(90)m=	18.99	19.11	19.35	19.69	20.01	20.17	20.2	20.2	20.11	19.75	19.32	18.96	(90)
--------	-------	-------	-------	-------	-------	-------	------	------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.48 (91)

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

(92)m=	19.53	19.63	19.83	20.13	20.4	20.55	20.58	20.58	20.49	20.17	19.81	19.51	(92)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

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

DER WorkSheet: New dwelling design stage

(93)m=	19.53	19.63	19.83	20.13	20.4	20.55	20.58	20.58	20.49	20.17	19.81	19.51	(93)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, h_m :

(94)m=	1	1	0.99	0.97	0.9	0.73	0.54	0.59	0.86	0.98	0.99	1	(94)
--------	---	---	------	------	-----	------	------	------	------	------	------	---	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	297.08	310.1	320.94	331.52	321.11	253.77	176.95	184.2	249.67	272.7	278.64	286.42	(95)
--------	--------	-------	--------	--------	--------	--------	--------	-------	--------	-------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	696.44	672.43	607.61	507.9	393.15	267.14	178.62	187.24	287.56	432.36	575.6	695.53	(97)
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	-------	--------	------

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

(98)m=	297.12	243.49	213.28	126.99	53.6	0	0	0	0	118.79	213.81	304.38	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1571.46	(98)

Space heating requirement in $kWh/m^2/year$

30.22	(99)
-------	------

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

1	(202)
---	-------

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

1	(204)
---	-------

Efficiency of main space heating system 1

93.5	(206)
------	-------

Efficiency of secondary/supplementary heating system, %

0	(208)
---	-------

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

297.12	243.49	213.28	126.99	53.6	0	0	0	0	118.79	213.81	304.38
--------	--------	--------	--------	------	---	---	---	---	--------	--------	--------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$

317.78	260.41	228.11	135.82	57.33	0	0	0	0	127.04	228.67	325.54
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

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

1680.71	(211)
---------	-------

Space heating fuel (secondary), $kWh/month$

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	
---------	---	---	---	---	---	---	---	---	---	---	---	--

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1...5,10...12} =$$

0	(215)
---	-------

Water heating

Output from water heater (calculated above)

139.61	122.54	127.49	112.64	109.18	95.84	90.43	101.47	102	116.89	125.68	135.7
--------	--------	--------	--------	--------	-------	-------	--------	-----	--------	--------	-------

Efficiency of water heater

87.3	(216)
------	-------

(217)m=	89.45	89.4	89.28	88.97	88.33	87.3	87.3	87.3	87.3	88.88	89.29	89.49	(217)
---------	-------	------	-------	-------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

$$(219)m = (64)m \times 100 \div (217)m$$

(219)m=	156.07	137.06	142.81	126.61	123.61	109.79	103.58	116.23	116.84	131.51	140.75	151.64
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

1556.5	(219)
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Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year	1680.71
----------	---------

DER WorkSheet: New dwelling design stage

Water heating fuel used		1556.5	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75 (231)
Electricity for lighting		276.89	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	363.03	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	336.2	(264)
Space and water heating	(261) + (262) + (263) + (264) =			699.24	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	143.71	(268)
Total CO2, kg/year	sum of (265)...(271) =			881.87	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			16.96	(273)
EI rating (section 14)				88	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Caversham 1BF EXP 52 North

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	52 (1a) x	2.4 (2a) =	124.8 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	52 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	124.8 (5)

2. Ventilation rate:

	main heating	secondary heating	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				2 x 10 =	20 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20 ÷ (5) = 0.16 (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]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.41 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.35 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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TER WorkSheet: New dwelling design stage

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

0.44	0.44	0.43	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.6 0.6 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.58 0.58 (24d)

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

(25)m= 0.6 0.6 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.58 0.58 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Floor			52	$\times$	0.13		(28)
Walls	19.13	5.22	13.91	$\times$	0.18		(29)
Total area of elements, m²			71.13				(31)
Party wall			53.21	$\times$	0		(32)
Party ceiling			52				(32b)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 16.18 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 6838.64 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 7.23 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 23.42 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	24.66	24.5	24.35	23.62	23.49	22.85	22.85	22.73	23.1	23.49	23.76	24.05

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

(39)m= 48.08 47.92 47.77 47.04 46.9 46.27 46.27 46.15 46.51 46.9 47.18 47.46
Average = Sum(39)_{1...12} /12= 47.04 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.92	0.92	0.92	0.9	0.9	0.89	0.89	0.89	0.89	0.9	0.91	0.91		
Average = Sum(40) _{1...12} / 12 =													0.9	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.75

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

75.74

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	83.31	80.28	77.26	74.23	71.2	68.17	68.17	71.2	74.23	77.26	80.28	83.31		
Total = Sum(44) _{1...12} =													908.89	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	123.55	108.06	111.51	97.22	93.28	80.49	74.59	85.59	86.62	100.94	110.19	119.65		
Total = Sum(45) _{1...12} =													1191.69	(45)

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

(46)m=	18.53	16.21	16.73	14.58	13.99	12.07	11.19	12.84	12.99	15.14	16.53	17.95		(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

TER WorkSheet: New dwelling design stage

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

(61)m=	42.46	36.95	39.37	36.6	36.28	33.62	34.74	36.28	36.6	39.37	39.59	42.46	(61)
--------	-------	-------	-------	------	-------	-------	-------	-------	------	-------	-------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	166.01	145.01	150.88	133.82	129.56	114.11	109.33	121.87	123.22	140.31	149.78	162.11	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	166.01	145.01	150.88	133.82	129.56	114.11	109.33	121.87	123.22	140.31	149.78	162.11	
Output from water heater (annual) _{1...12}												1646.01	(64)

Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m=	51.7	45.17	46.92	41.48	40.09	35.17	33.49	37.53	37.95	43.41	46.53	50.4	(65)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	(66)

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

(67)m=	15.68	13.93	11.33	8.57	6.41	5.41	5.85	7.6	10.2	12.95	15.12	16.11	(67)
--------	-------	-------	-------	------	------	------	------	-----	------	-------	-------	-------	------

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

(68)m=	152.43	154.01	150.02	141.54	130.83	120.76	114.03	112.45	116.44	124.92	135.63	145.7	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

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

(69)m=	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	69.48	67.21	63.06	57.6	53.88	48.85	45.01	50.44	52.71	58.34	64.63	67.74	(72)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	289.82	287.38	276.65	259.95	243.35	227.25	217.12	222.73	231.58	248.45	267.62	281.79	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.78	x	10.63	x	0.63	x	0.7	=	12.28	(74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.63	x	0.7	=	4.68	(74)
North	0.9x	0.77	x	3.78	x	20.32	x	0.63	x	0.7	=	23.48	(74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.63	x	0.7	=	8.94	(74)
North	0.9x	0.77	x	3.78	x	34.53	x	0.63	x	0.7	=	39.89	(74)

TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.44	x	34.53	x	0.63	x	0.7	=	15.2	(74)
North	0.9x	0.77	x	3.78	x	55.46	x	0.63	x	0.7	=	64.07	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.63	x	0.7	=	24.41	(74)
North	0.9x	0.77	x	3.78	x	74.72	x	0.63	x	0.7	=	86.31	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.63	x	0.7	=	32.88	(74)
North	0.9x	0.77	x	3.78	x	79.99	x	0.63	x	0.7	=	92.4	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.63	x	0.7	=	35.2	(74)
North	0.9x	0.77	x	3.78	x	74.68	x	0.63	x	0.7	=	86.27	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.63	x	0.7	=	32.86	(74)
North	0.9x	0.77	x	3.78	x	59.25	x	0.63	x	0.7	=	68.44	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.63	x	0.7	=	26.07	(74)
North	0.9x	0.77	x	3.78	x	41.52	x	0.63	x	0.7	=	47.96	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.63	x	0.7	=	18.27	(74)
North	0.9x	0.77	x	3.78	x	24.19	x	0.63	x	0.7	=	27.94	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.63	x	0.7	=	10.65	(74)
North	0.9x	0.77	x	3.78	x	13.12	x	0.63	x	0.7	=	15.15	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.63	x	0.7	=	5.77	(74)
North	0.9x	0.77	x	3.78	x	8.86	x	0.63	x	0.7	=	10.24	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.63	x	0.7	=	3.9	(74)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	16.96	32.42	55.09	88.48	119.19	127.6	119.13	94.52	66.23	38.59	20.93	14.14	(83)
--------	-------	-------	-------	-------	--------	-------	--------	-------	-------	-------	-------	-------	------

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

(84)m=	306.79	319.8	331.73	348.43	362.54	354.85	336.25	317.25	297.81	287.04	288.54	295.93	(84)
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.93	0.77	0.59	0.65	0.89	0.98	1	1	(86)

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

(87)m=	20.06	20.15	20.32	20.57	20.81	20.96	20.99	20.99	20.89	20.61	20.3	20.05	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

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

(88)m=	20.15	20.15	20.15	20.16	20.17	20.18	20.18	20.18	20.17	20.17	20.16	20.16	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	1	0.99	0.97	0.9	0.7	0.49	0.54	0.84	0.98	0.99	1	(89)
--------	---	---	------	------	-----	-----	------	------	------	------	------	---	------

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

(90)m=	18.89	19.01	19.26	19.63	19.97	20.15	20.17	20.17	20.08	19.7	19.25	18.88	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

fLA = Living area ÷ (4) =

0.48 (91)

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

(92)m=	19.45	19.56	19.77	20.08	20.37	20.54	20.57	20.56	20.47	20.14	19.76	19.44	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

TER WorkSheet: New dwelling design stage

(93)m=	19.45	19.56	19.77	20.08	20.37	20.54	20.57	20.56	20.47	20.14	19.76	19.44	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, h_m :

(94)m=	1	1	0.99	0.97	0.9	0.73	0.54	0.59	0.86	0.98	0.99	1	(94)
--------	---	---	------	------	-----	------	------	------	------	------	------	---	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	305.8	318.27	328.53	338.44	327.78	259.62	181.59	188.76	255.68	279.97	286.77	295.16	(95)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	728.59	702.39	633.71	526.07	406.7	274.67	183.56	192.21	296.35	447.32	597.11	723.52	(97)
--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	314.55	258.12	227.06	135.1	58.72	0	0	0	0	124.51	223.45	318.7	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1660.2	(98)

Space heating requirement in $kWh/m^2/year$

31.93	(99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

1	(202)
---	-------

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

1	(204)
---	-------

Efficiency of main space heating system 1

93.4	(206)
------	-------

Efficiency of secondary/supplementary heating system, %

0	(208)
---	-------

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

314.55	258.12	227.06	135.1	58.72	0	0	0	0	124.51	223.45	318.7
--------	--------	--------	-------	-------	---	---	---	---	--------	--------	-------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206)$$

336.78	276.36	243.1	144.64	62.87	0	0	0	0	133.31	239.24	341.22
--------	--------	-------	--------	-------	---	---	---	---	--------	--------	--------

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

1777.52	(211)
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Space heating fuel (secondary), $kWh/month$

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	
---------	---	---	---	---	---	---	---	---	---	---	---	--

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1...5,10...12} =$$

0	(215)
---	-------

Water heating

Output from water heater (calculated above)

166.01	145.01	150.88	133.82	129.56	114.11	109.33	121.87	123.22	140.31	149.78	162.11
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

80.3	(216)
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(217)m=	86.64	86.49	86.08	85.08	83.2	80.3	80.3	80.3	80.3	84.75	86.06	86.72	(217)
---------	-------	-------	-------	-------	------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

$$(219)m = (64)m \times 100 \div (217)m$$

(219)m=	191.62	167.67	175.28	157.3	155.72	142.11	136.15	151.77	153.45	165.55	174.05	186.93
---------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------

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

1957.6	(219)
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Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

1777.52

TER WorkSheet: New dwelling design stage

Water heating fuel used		1957.6	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75 (231)
Electricity for lighting		276.89	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	383.94	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	422.84	(264)
Space and water heating	(261) + (262) + (263) + (264) =			806.78	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	143.71	(268)
Total CO2, kg/year	sum of (265)...(271) =			989.42	(272)
TER =				19.03	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Caversham 1BF EXP 53 South

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	53 (1a) x	2.4 (2a) =	127.2 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	127.2 (5)

2. Ventilation rate:

	main heating	secondary heating	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				1 x 10 =	10 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10 ÷ (5) = 0.08 (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]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry 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

Percentage of windows and doors draught stripped

Window infiltration

0.25 - [0.2 x (14) ÷ 100] =

Infiltration rate

(8) + (10) + (11) + (12) + (13) + (15) =

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) ÷ 20] + (8), otherwise (18) = (16)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered

Shelter factor

(20) = 1 - [0.075 x (19)] =

Infiltration rate incorporating shelter factor

(21) = (18) x (20) =

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

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

0.3	0.3	0.29	0.26	0.25	0.22	0.22	0.22	0.24	0.25	0.27	0.28
-----	-----	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.55 0.54 0.54 0.53 0.53 0.53 0.53 0.52 0.53 0.53 0.54 0.54 (24d)

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

(25)m= 0.55 0.54 0.54 0.53 0.53 0.53 0.53 0.52 0.53 0.53 0.54 0.54 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Floor			53	$\times$	0.11		(28)
Walls	19.1	5.22	13.88	$\times$	0.19		(29)
Total area of elements, m²			72.1				(31)
Party wall			53.68	$\times$	0		(32)
Party ceiling			53				(32b)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 15.39 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 6941.39 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 7.98 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 23.37 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	22.9	22.83	22.75	22.41	22.35	22.05	22.05	22	22.17	22.35	22.48	22.61

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

(39)m=	46.27	46.19	46.12	45.78	45.72	45.42	45.42	45.36	45.53	45.72	45.84	45.98
Average = Sum(39) _{1...12} /12=												45.78 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.87	0.87	0.87	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.87		
	Average = Sum(40) _{1...12} /12=												0.86	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.78

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

76.44

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	84.08	81.03	77.97	74.91	71.85	68.8	68.8	71.85	74.91	77.97	81.03	84.08		
	Total = Sum(44) _{1...12} =												917.29	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	124.7	109.06	112.54	98.11	94.14	81.24	75.28	86.38	87.42	101.88	111.2	120.76		
	Total = Sum(45) _{1...12} =												1202.71	(45)

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

(46)m=	18.7	16.36	16.88	14.72	14.12	12.19	11.29	12.96	13.11	15.28	16.68	18.11		(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

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

(61)m=	16.06	14.48	15.99	15.43	15.91	15.35	15.84	15.88	15.39	15.96	15.5	16.05	(61)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	140.76	123.54	128.53	113.54	110.05	96.59	91.12	102.27	102.81	117.83	126.7	136.81	(62)
--------	--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	-------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	140.76	123.54	128.53	113.54	110.05	96.59	91.12	102.27	102.81	117.83	126.7	136.81	
Output from water heater (annual) _{1...12}												1390.56	(64)

Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m=	45.48	39.88	41.42	36.48	35.28	30.85	28.99	32.69	32.91	37.86	40.85	44.17	(65)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	(66)

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

(67)m=	16.01	14.22	11.56	8.75	6.54	5.52	5.97	7.76	10.42	13.22	15.43	16.45	(67)
--------	-------	-------	-------	------	------	------	------	------	-------	-------	-------	-------	------

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

(68)m=	155.02	156.63	152.57	143.94	133.05	122.81	115.97	114.36	118.42	127.05	137.94	148.18	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	61.13	59.35	55.67	50.67	47.42	42.85	38.97	43.94	45.71	50.89	56.74	59.36	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	284.83	282.87	272.48	256.04	239.69	223.86	213.59	218.74	227.22	243.84	262.79	276.67	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	3.78	x	46.75	x	0.63	x	0.7	=	54.01	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57	(78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.63	x	0.7	=	88.45	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67	(78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	74.58	122.15	155.6	175.86	183.25	176.36	172.31	167.34	162.54	131.75	88.41	64.45	(83)
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

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

(84)m=	359.41	405.02	428.08	431.9	422.94	400.22	385.9	386.08	389.76	375.59	351.2	341.12	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.87	0.7	0.51	0.54	0.76	0.94	0.99	1	(86)

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

(87)m=	20.23	20.36	20.53	20.73	20.89	20.98	21	21	20.96	20.77	20.46	20.19	(87)
--------	-------	-------	-------	-------	-------	-------	----	----	-------	-------	-------	-------	------

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

(88)m=	20.19	20.19	20.19	20.2	20.2	20.2	20.2	20.21	20.2	20.2	20.2	20.2	(88)
--------	-------	-------	-------	------	------	------	------	-------	------	------	------	------	------

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

(89)m=	0.99	0.99	0.97	0.93	0.82	0.62	0.42	0.45	0.69	0.92	0.99	1	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	---	------

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

(90)m=	19.16	19.35	19.6	19.88	20.09	20.19	20.2	20.2	20.18	19.95	19.5	19.11	(90)
--------	-------	-------	------	-------	-------	-------	------	------	-------	-------	------	-------	------

fLA = Living area ÷ (4) =

0.47 (91)

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

(92)m=	19.66	19.83	20.04	20.28	20.47	20.56	20.58	20.58	20.55	20.34	19.95	19.62	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

DER WorkSheet: New dwelling design stage

(93)m=	19.66	19.83	20.04	20.28	20.47	20.56	20.58	20.58	20.55	20.34	19.95	19.62	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set $T_{i,m}$ to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, h_m :

(94)m=	0.99	0.99	0.97	0.93	0.84	0.66	0.47	0.49	0.72	0.93	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	356.98	399.09	414.87	401.96	355.27	263.18	179.91	188.49	280.04	347.71	345.77	339.4	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	710.76	689.6	624.53	520.98	400.83	270.77	180.66	189.51	293.55	445.08	589.24	709.09	(97)
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	263.21	195.22	155.99	85.7	33.9	0	0	0	0	72.45	175.3	275.05	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1256.81	(98)

Space heating requirement in $kWh/m^2/year$

23.71	(99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

1	(202)
---	-------

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

1	(204)
---	-------

Efficiency of main space heating system 1

93.5	(206)
------	-------

Efficiency of secondary/supplementary heating system, %

0	(208)
---	-------

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

263.21	195.22	155.99	85.7	33.9	0	0	0	0	72.45	175.3	275.05	
--------	--------	--------	------	------	---	---	---	---	-------	-------	--------	--

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206)$$

281.51	208.8	166.83	91.65	36.26	0	0	0	0	77.48	187.48	294.17	
--------	-------	--------	-------	-------	---	---	---	---	-------	--------	--------	--

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

1344.18	(211)
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Space heating fuel (secondary), $kWh/month$

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0	
Total (kWh/year) = Sum(215) _{1...5,10...12} =												0	(215)

Water heating

Output from water heater (calculated above)

140.76	123.54	128.53	113.54	110.05	96.59	91.12	102.27	102.81	117.83	126.7	136.81	
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Efficiency of water heater

87.3	(216)
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(217)m=	89.36	89.23	89.03	88.65	88.03	87.3	87.3	87.3	87.3	88.49	89.13	89.41	(217)
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Fuel for water heating, $kWh/month$

$$(219)m = (64)m \times 100 \div (217)m$$

(219)m=	157.52	138.45	144.38	128.08	125.01	110.64	104.38	117.15	117.77	133.16	142.16	153.01	
Total = Sum(219a) _{1...12} =												1571.7	(219)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year	
1344.18	

DER WorkSheet: New dwelling design stage

Water heating fuel used		1571.7	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	75	(231)
Electricity for lighting		282.73	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	290.34	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	339.49	(264)
Space and water heating	(261) + (262) + (263) + (264) =			629.83	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	146.74	(268)
Total CO2, kg/year		sum of (265)...(271) =		815.49	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		15.39	(273)
EI rating (section 14)				89	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Caversham 1BF EXP 53 South

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	53 (1a) x	2.4 (2a) =	127.2 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	127.2 (5)

2. Ventilation rate:

	main heating	secondary heating	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				2 x 10 =	20 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20 ÷ (5) = 0.16 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.41 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.35 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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TER WorkSheet: New dwelling design stage

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

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.6 0.59 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.58 0.58 (24d)

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

(25)m= 0.6 0.59 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.58 0.58 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Floor			53	$\times$	0.13		(28)
Walls	19.1	5.22	13.88	$\times$	0.18		(29)
Total area of elements, m²			72.1				(31)
Party wall			53.68	$\times$	0		(32)
Party ceiling			53				(32b)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 16.31 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 6941.39 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 7.26 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 23.57 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	25.08	24.92	24.76	24.03	23.89	23.26	23.26	23.14	23.5	23.89	24.17	24.46

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

(39)m=	48.64	48.49	48.33	47.6	47.46	46.83	46.83	46.71	47.07	47.46	47.74	48.03
Average = Sum(39) _{1...12} /12=												47.6

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.92	0.91	0.91	0.9	0.9	0.88	0.88	0.88	0.89	0.9	0.9	0.91		
Average = Sum(40) _{1...12} / 12 =													0.9	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.78

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

76.44

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	84.08	81.03	77.97	74.91	71.85	68.8	68.8	71.85	74.91	77.97	81.03	84.08		
Total = Sum(44) _{1...12} =													917.29	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	124.7	109.06	112.54	98.11	94.14	81.24	75.28	86.38	87.42	101.88	111.2	120.76		
Total = Sum(45) _{1...12} =													1202.71	(45)

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

(46)m=	18.7	16.36	16.88	14.72	14.12	12.19	11.29	12.96	13.11	15.28	16.68	18.11		(46)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

TER WorkSheet: New dwelling design stage

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

(61)m=	42.85	37.29	39.73	36.94	36.62	33.93	35.06	36.62	36.94	39.73	39.96	42.85	(61)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	167.54	146.35	152.27	135.06	130.76	115.17	110.34	123	124.36	141.61	151.16	163.61	(62)
--------	--------	--------	--------	--------	--------	--------	--------	-----	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	167.54	146.35	152.27	135.06	130.76	115.17	110.34	123	124.36	141.61	151.16	163.61	
Output from water heater (annual) _{1...12}												1661.23	(64)

Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m=	52.17	45.59	47.35	41.86	40.46	35.49	33.79	37.88	38.3	43.81	46.97	50.87	(65)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	(66)

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

(67)m=	16.01	14.22	11.56	8.75	6.54	5.52	5.97	7.76	10.42	13.22	15.43	16.45	(67)
--------	-------	-------	-------	------	------	------	------	------	-------	-------	-------	-------	------

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

(68)m=	155.02	156.63	152.57	143.94	133.05	122.81	115.97	114.36	118.42	127.05	137.94	148.18	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	70.13	67.84	63.65	58.14	54.38	49.3	45.42	50.91	53.2	58.88	65.23	68.37	(72)
--------	-------	-------	-------	-------	-------	------	-------	-------	------	-------	-------	-------	------

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

(73)m=	293.83	291.36	280.46	263.51	246.65	230.31	220.04	225.71	234.71	251.83	271.28	285.68	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)		
South	0.9x	0.77	x	3.78	x	46.75	x	0.63	x	0.7	=	54.01	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57	(78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.63	x	0.7	=	88.45	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67	(78)

TER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	74.58	122.15	155.6	175.86	183.25	176.36	172.31	167.34	162.54	131.75	88.41	64.45	(83)
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

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

(84)m=	368.41	413.51	436.06	439.37	429.9	406.67	392.35	393.05	397.24	383.58	359.69	350.12	(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)

(86)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(86)
	1	0.99	0.98	0.95	0.87	0.7	0.52	0.54	0.76	0.94	0.99	1	

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

(87)m=	20.18	20.31	20.49	20.7	20.88	20.98	21	21	20.96	20.76	20.43	20.15	(87)
--------	-------	-------	-------	------	-------	-------	----	----	-------	-------	-------	-------	------

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

(88)m=	20.15	20.15	20.16	20.17	20.17	20.18	20.18	20.18	20.18	20.17	20.17	20.16	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.99	0.97	0.93	0.83	0.63	0.43	0.45	0.69	0.92	0.99	1	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	---	------

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

(90)m=	19.06	19.26	19.52	19.82	20.05	20.16	20.18	20.18	20.15	19.9	19.43	19.03	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

fLA = Living area ÷ (4) =

0.47 (91)

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

(92)m=	19.58	19.75	19.98	20.24	20.44	20.55	20.57	20.57	20.53	20.3	19.9	19.56	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------	-------	------

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

TER WorkSheet: New dwelling design stage

(93)m=	19.58	19.75	19.98	20.24	20.44	20.55	20.57	20.57	20.53	20.3	19.9	19.56	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, h_m :

(94)m=	0.99	0.98	0.97	0.93	0.84	0.66	0.47	0.49	0.72	0.93	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	365.73	407.29	422.69	409.47	363.11	269.64	184.76	193.35	287.17	355.17	353.85	348.17	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	743.45	720.22	651.3	539.67	414.76	278.48	185.68	194.57	302.64	460.49	611.22	737.56	(97)
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	281.03	210.29	170.08	93.74	38.43	0	0	0	0	78.36	185.31	289.7	
--------	--------	--------	--------	-------	-------	---	---	---	---	-------	--------	-------	--

Total per year ($kWh/year$) = $Sum(98)_{1...5,9...12} =$ 1346.94 (98)

Space heating requirement in $kWh/m^2/year$

25.41 (99)

9a. Energy requirements – Individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = $1 - (201) =$

1 (202)

Fraction of total heating from main system 1

(204) = $(202) \times [1 - (203)] =$

1 (204)

Efficiency of main space heating system 1

93.4 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

281.03	210.29	170.08	93.74	38.43	0	0	0	0	78.36	185.31	289.7
--------	--------	--------	-------	-------	---	---	---	---	-------	--------	-------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$

300.89	225.15	182.1	100.37	41.14	0	0	0	0	83.9	198.4	310.18
--------	--------	-------	--------	-------	---	---	---	---	------	-------	--------

Total ($kWh/year$) = $Sum(211)_{1...5,10...12} =$ 1442.12 (211)

Space heating fuel (secondary), $kWh/month$

= $\{[(98)m \times (201)]\} \times 100 \div (208)$

(215)m=	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---

Total ($kWh/year$) = $Sum(215)_{1...5,10...12} =$ 0 (215)

Water heating

Output from water heater (calculated above)

167.54	146.35	152.27	135.06	130.76	115.17	110.34	123	124.36	141.61	151.16	163.61
--------	--------	--------	--------	--------	--------	--------	-----	--------	--------	--------	--------

Efficiency of water heater

80.3 (216)

(217)m=	86.34	85.96	85.33	84.15	82.39	80.3	80.3	80.3	80.3	83.63	85.56	86.47	(217)
---------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	194.04	170.25	178.45	160.49	158.71	143.42	137.41	153.18	154.87	169.33	176.66	189.2
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------

Total = $Sum(219a)_{1...12} =$ 1986.01 (219)

Annual totals

$kWh/year$

$kWh/year$

Space heating fuel used, main system 1

1442.12

TER WorkSheet: New dwelling design stage

Water heating fuel used		1986.01	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75 (231)
Electricity for lighting		282.73	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	311.5 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	428.98 (264)
Space and water heating	(261) + (262) + (263) + (264) =		740.48 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	146.74 (268)
Total CO2, kg/year	sum of (265)...(271) =		926.14 (272)
TER =			17.47 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Caversham 1BF MID 52 North

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	52 (1a) x	2.4 (2a) =	124.8 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	52 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	124.8 (5)

2. Ventilation rate:

	main heating	secondary heating	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				1 x 10 =	10 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10 ÷ (5) = 0.08 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 4 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.28 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.24 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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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
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

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

0.3	0.3	0.29	0.26	0.26	0.23	0.23	0.22	0.24	0.26	0.27	0.28
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.55 0.54 0.54 0.53 0.53 0.53 0.53 0.52 0.53 0.53 0.54 0.54 (24d)

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

(25)m= 0.55 0.54 0.54 0.53 0.53 0.53 0.53 0.52 0.53 0.53 0.54 0.54 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Walls	19.13	5.22	13.91	$\times 0.19 =$	2.64		(29)
Total area of elements, m²			19.13				(31)
Party wall			53.21	$\times 0 =$	0		(32)
Party floor			52				(32a)
Party ceiling			52				(32b)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 9.56 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5018.64 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 2.41 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 11.97 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	22.49	22.42	22.34	22	21.94	21.65	21.65	21.59	21.76	21.94	22.07	22.2

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

(39)m=	34.46	34.39	34.32	33.98	33.92	33.62	33.62	33.57	33.73	33.92	34.04	34.18
Average = Sum(39) _{1...12} /12=												33.98

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.66	0.66	0.66	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.66		
Average = Sum(40) _{1...12} / 12=													0.65	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.75

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

75.74

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	83.31	80.28	77.26	74.23	71.2	68.17	68.17	71.2	74.23	77.26	80.28	83.31		
Total = Sum(44) _{1...12} =													908.89	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times nm \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	123.55	108.06	111.51	97.22	93.28	80.49	74.59	85.59	86.62	100.94	110.19	119.65		
Total = Sum(45) _{1...12} =													1191.69	(45)

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

(46)m=	18.53	16.21	16.73	14.58	13.99	12.07	11.19	12.84	12.99	15.14	16.53	17.95	(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

DER WorkSheet: New dwelling design stage

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

(61)m=	16.06	14.48	15.98	15.42	15.9	15.35	15.84	15.88	15.39	15.95	15.49	16.04	(61)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	139.61	122.54	127.49	112.64	109.18	95.84	90.43	101.47	102	116.89	125.68	135.7	(62)
--------	--------	--------	--------	--------	--------	-------	-------	--------	-----	--------	--------	-------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	139.61	122.54	127.49	112.64	109.18	95.84	90.43	101.47	102	116.89	125.68	135.7	
Output from water heater (annual) _{1...12}												1379.47	(64)

Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m=	45.1	39.55	41.07	36.18	34.99	30.6	28.76	32.43	32.65	37.55	40.51	43.8	(65)
--------	------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	(66)

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

(67)m=	15.68	13.93	11.33	8.57	6.41	5.41	5.85	7.6	10.2	12.95	15.12	16.11	(67)
--------	-------	-------	-------	------	------	------	------	-----	------	-------	-------	-------	------

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

(68)m=	152.43	154.01	150.02	141.54	130.83	120.76	114.03	112.45	116.44	124.92	135.63	145.7	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

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

(69)m=	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	60.61	58.85	55.21	50.25	47.03	42.5	38.66	43.59	45.34	50.47	56.26	58.86	(72)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	280.95	279.02	268.79	252.6	236.5	220.91	210.77	215.87	224.22	240.58	259.25	272.92	(73)
--------	--------	--------	--------	-------	-------	--------	--------	--------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.78	x	10.63	x	0.63	x	0.7	=	12.28 (74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.63	x	0.7	=	4.68 (74)
North	0.9x	0.77	x	3.78	x	20.32	x	0.63	x	0.7	=	23.48 (74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.63	x	0.7	=	8.94 (74)
North	0.9x	0.77	x	3.78	x	34.53	x	0.63	x	0.7	=	39.89 (74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.44	x	34.53	x	0.63	x	0.7	=	15.2	(74)
North	0.9x	0.77	x	3.78	x	55.46	x	0.63	x	0.7	=	64.07	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.63	x	0.7	=	24.41	(74)
North	0.9x	0.77	x	3.78	x	74.72	x	0.63	x	0.7	=	86.31	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.63	x	0.7	=	32.88	(74)
North	0.9x	0.77	x	3.78	x	79.99	x	0.63	x	0.7	=	92.4	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.63	x	0.7	=	35.2	(74)
North	0.9x	0.77	x	3.78	x	74.68	x	0.63	x	0.7	=	86.27	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.63	x	0.7	=	32.86	(74)
North	0.9x	0.77	x	3.78	x	59.25	x	0.63	x	0.7	=	68.44	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.63	x	0.7	=	26.07	(74)
North	0.9x	0.77	x	3.78	x	41.52	x	0.63	x	0.7	=	47.96	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.63	x	0.7	=	18.27	(74)
North	0.9x	0.77	x	3.78	x	24.19	x	0.63	x	0.7	=	27.94	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.63	x	0.7	=	10.65	(74)
North	0.9x	0.77	x	3.78	x	13.12	x	0.63	x	0.7	=	15.15	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.63	x	0.7	=	5.77	(74)
North	0.9x	0.77	x	3.78	x	8.86	x	0.63	x	0.7	=	10.24	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.63	x	0.7	=	3.9	(74)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	16.96	32.42	55.09	88.48	119.19	127.6	119.13	94.52	66.23	38.59	20.93	14.14	(83)
--------	-------	-------	-------	-------	--------	-------	--------	-------	-------	-------	-------	-------	------

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

(84)m=	297.92	311.44	323.87	341.08	355.7	348.51	329.9	310.39	290.45	279.17	280.18	287.06	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.95	0.83	0.61	0.45	0.5	0.77	0.96	0.99	1	(86)

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

(87)m=	20.45	20.52	20.65	20.83	20.96	21	21	21	20.98	20.83	20.61	20.43	(87)
--------	-------	-------	-------	-------	-------	----	----	----	-------	-------	-------	-------	------

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

(88)m=	20.37	20.38	20.38	20.38	20.38	20.39	20.39	20.39	20.39	20.38	20.38	20.38	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	0.99	0.98	0.94	0.79	0.56	0.39	0.43	0.71	0.95	0.99	1	(89)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

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

(90)m=	19.63	19.73	19.92	20.18	20.34	20.39	20.39	20.39	20.37	20.19	19.87	19.6	(90)
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fLA = Living area ÷ (4) =

0.48 (91)

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

(92)m=	20.02	20.11	20.27	20.49	20.64	20.68	20.68	20.68	20.67	20.5	20.23	20	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

DER WorkSheet: New dwelling design stage

(93)m=	20.02	20.11	20.27	20.49	20.64	20.68	20.68	20.68	20.67	20.5	20.23	20	(93)
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8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, h_m :

(94)m=	1	0.99	0.98	0.94	0.81	0.58	0.42	0.46	0.74	0.95	0.99	1	(94)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	296.78	309.43	318.77	321.51	287.18	203.31	137.18	143.6	215.17	266.2	277.73	286.22	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	541.86	523.01	472.57	393.9	303.21	204.4	137.25	143.75	221.5	335.76	446.99	540.05	(97)
--------	--------	--------	--------	-------	--------	-------	--------	--------	-------	--------	--------	--------	------

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

(98)m=	182.34	143.53	114.42	52.12	11.93	0	0	0	0	51.75	121.87	188.85	
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Total per year ($kWh/year$) = $Sum(98)_{1...5,9...12} =$ 866.81 (98)

Space heating requirement in $kWh/m^2/year$

16.67 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = $1 - (201) =$

1 (202)

Fraction of total heating from main system 1

(204) = $(202) \times [1 - (203)] =$

1 (204)

Efficiency of main space heating system 1

93.5 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

182.34	143.53	114.42	52.12	11.93	0	0	0	0	51.75	121.87	188.85
--------	--------	--------	-------	-------	---	---	---	---	-------	--------	--------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$

195.02	153.5	122.38	55.74	12.76	0	0	0	0	55.35	130.34	201.97
--------	-------	--------	-------	-------	---	---	---	---	-------	--------	--------

Total ($kWh/year$) = $Sum(211)_{1...5,10...12} =$ 927.07 (211)

Space heating fuel (secondary), $kWh/month$

= $\{[(98)m \times (201)]\} \times 100 \div (208)$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	
---------	---	---	---	---	---	---	---	---	---	---	---	--

Total ($kWh/year$) = $Sum(215)_{1...5,10...12} =$ 0 (215)

Water heating

Output from water heater (calculated above)

139.61	122.54	127.49	112.64	109.18	95.84	90.43	101.47	102	116.89	125.68	135.7
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Efficiency of water heater

87.3 (216)

(217)m=	89.08	89	88.78	88.29	87.61	87.3	87.3	87.3	87.3	88.26	88.85	89.13	(217)
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Fuel for water heating, $kWh/month$

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	156.72	137.68	143.6	127.58	124.63	109.79	103.58	116.23	116.84	132.44	141.45	152.24	
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Total = $Sum(219a)_{1...12} =$ 1562.79 (219)

Annual totals

$kWh/year$

$kWh/year$

Space heating fuel used, main system 1

927.07

DER WorkSheet: New dwelling design stage

Water heating fuel used		1562.79	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75 (231)
Electricity for lighting		276.89	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	=	200.25 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	337.56 (264)
Space and water heating	(261) + (262) + (263) + (264) =			537.81 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93 (267)
Electricity for lighting	(232) x	0.519	=	143.71 (268)
Total CO2, kg/year	sum of (265)...(271) =			720.44 (272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			13.85 (273)
EI rating (section 14)				90 (274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Caversham 1BF MID 52 North

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	52 (1a) x	2.4 (2a) =	124.8 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	52 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	124.8 (5)

2. Ventilation rate:

	main heating	secondary heating	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				2 x 10 =	20 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20 ÷ (5) = 0.16 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.41 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.35 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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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
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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TER WorkSheet: New dwelling design stage

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

0.44	0.44	0.43	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.6 0.6 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.58 0.58 (24d)

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

(25)m= 0.6 0.6 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.58 0.58 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Walls	19.13	5.22	13.91	$\times 0.18 =$	2.5		(29)
Total area of elements, m²			19.13				(31)
Party wall			53.21	$\times 0 =$	0		(32)
Party floor			52				(32a)
Party ceiling			52				(32b)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 9.42 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5018.64 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 1.69 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 11.12 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	24.66	24.5	24.35	23.62	23.49	22.85	22.85	22.73	23.1	23.49	23.76	24.05

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

(39)m=	35.78	35.62	35.47	34.74	34.6	33.97	33.97	33.85	34.21	34.6	34.88	35.16
Average = Sum(39) _{1...12} /12=												34.74 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.69	0.69	0.68	0.67	0.67	0.65	0.65	0.65	0.66	0.67	0.67	0.68		
	Average = Sum(40) _{1...12} / 12 =												0.67	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.75

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

75.74

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	83.31	80.28	77.26	74.23	71.2	68.17	68.17	71.2	74.23	77.26	80.28	83.31		
	Total = Sum(44) _{1...12} =												908.89	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	123.55	108.06	111.51	97.22	93.28	80.49	74.59	85.59	86.62	100.94	110.19	119.65		
	Total = Sum(45) _{1...12} =												1191.69	(45)

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

(46)m=	18.53	16.21	16.73	14.58	13.99	12.07	11.19	12.84	12.99	15.14	16.53	17.95		(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

TER WorkSheet: New dwelling design stage

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

(61)m=	42.46	36.95	39.37	36.6	36.28	33.62	34.74	36.28	36.6	39.37	39.59	42.46	(61)
--------	-------	-------	-------	------	-------	-------	-------	-------	------	-------	-------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	166.01	145.01	150.88	133.82	129.56	114.11	109.33	121.87	123.22	140.31	149.78	162.11	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	166.01	145.01	150.88	133.82	129.56	114.11	109.33	121.87	123.22	140.31	149.78	162.11	
Output from water heater (annual) _{1...12}												1646.01	(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	51.7	45.17	46.92	41.48	40.09	35.17	33.49	37.53	37.95	43.41	46.53	50.4	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	(66)

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

(67)m=	15.68	13.93	11.33	8.57	6.41	5.41	5.85	7.6	10.2	12.95	15.12	16.11	(67)
--------	-------	-------	-------	------	------	------	------	-----	------	-------	-------	-------	------

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

(68)m=	152.43	154.01	150.02	141.54	130.83	120.76	114.03	112.45	116.44	124.92	135.63	145.7	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

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

(69)m=	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	69.48	67.21	63.06	57.6	53.88	48.85	45.01	50.44	52.71	58.34	64.63	67.74	(72)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	289.82	287.38	276.65	259.95	243.35	227.25	217.12	222.73	231.58	248.45	267.62	281.79	(73)
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6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.78	x	10.63	x	0.63	x	0.7	=	12.28 (74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.63	x	0.7	=	4.68 (74)
North	0.9x	0.77	x	3.78	x	20.32	x	0.63	x	0.7	=	23.48 (74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.63	x	0.7	=	8.94 (74)
North	0.9x	0.77	x	3.78	x	34.53	x	0.63	x	0.7	=	39.89 (74)

TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.44	x	34.53	x	0.63	x	0.7	=	15.2	(74)
North	0.9x	0.77	x	3.78	x	55.46	x	0.63	x	0.7	=	64.07	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.63	x	0.7	=	24.41	(74)
North	0.9x	0.77	x	3.78	x	74.72	x	0.63	x	0.7	=	86.31	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.63	x	0.7	=	32.88	(74)
North	0.9x	0.77	x	3.78	x	79.99	x	0.63	x	0.7	=	92.4	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.63	x	0.7	=	35.2	(74)
North	0.9x	0.77	x	3.78	x	74.68	x	0.63	x	0.7	=	86.27	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.63	x	0.7	=	32.86	(74)
North	0.9x	0.77	x	3.78	x	59.25	x	0.63	x	0.7	=	68.44	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.63	x	0.7	=	26.07	(74)
North	0.9x	0.77	x	3.78	x	41.52	x	0.63	x	0.7	=	47.96	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.63	x	0.7	=	18.27	(74)
North	0.9x	0.77	x	3.78	x	24.19	x	0.63	x	0.7	=	27.94	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.63	x	0.7	=	10.65	(74)
North	0.9x	0.77	x	3.78	x	13.12	x	0.63	x	0.7	=	15.15	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.63	x	0.7	=	5.77	(74)
North	0.9x	0.77	x	3.78	x	8.86	x	0.63	x	0.7	=	10.24	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.63	x	0.7	=	3.9	(74)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	16.96	32.42	55.09	88.48	119.19	127.6	119.13	94.52	66.23	38.59	20.93	14.14	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	306.79	319.8	331.73	348.43	362.54	354.85	336.25	317.25	297.81	287.04	288.54	295.93	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.95	0.83	0.61	0.44	0.49	0.76	0.96	0.99	1	(86)

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

(87)m=	20.43	20.5	20.63	20.82	20.96	21	21	21	20.98	20.83	20.61	20.42	(87)
--------	-------	------	-------	-------	-------	----	----	----	-------	-------	-------	-------	------

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

(88)m=	20.35	20.35	20.36	20.37	20.37	20.38	20.38	20.38	20.38	20.37	20.37	20.36	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.94	0.79	0.55	0.38	0.42	0.71	0.95	0.99	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.58	19.68	19.88	20.16	20.33	20.38	20.38	20.38	20.36	20.18	19.85	19.57	(90)
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fLA = Living area ÷ (4) =

0.48 (91)

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

(92)m=	19.98	20.07	20.24	20.48	20.63	20.68	20.68	20.68	20.66	20.49	20.22	19.98	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

TER WorkSheet: New dwelling design stage

(93)m=	19.98	20.07	20.24	20.48	20.63	20.68	20.68	20.68	20.66	20.49	20.22	19.98	(93)
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8. Space heating requirement

Set $T_{i,m}$ to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, h_m :

(94)m=	1	0.99	0.98	0.94	0.81	0.58	0.41	0.46	0.73	0.95	0.99	1	(94)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	305.47	317.55	326.25	327.79	292.23	205.32	138.5	144.74	218.31	272.66	285.71	294.93	(95)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times ((93)m - (96)m)]$

(97)m=	561.15	540.48	487.34	402.28	309.07	206.41	138.56	144.88	224.5	342.34	457.47	554.8	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	-------	------

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

(98)m=	190.22	149.81	119.86	53.63	12.52	0	0	0	0	51.84	123.67	193.34	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												894.89	(98)

Space heating requirement in $kWh/m^2/year$

17.21	(99)
-------	------

9a. Energy requirements – Individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

1	(202)
---	-------

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

1	(204)
---	-------

Efficiency of main space heating system 1

93.4	(206)
------	-------

Efficiency of secondary/supplementary heating system, %

0	(208)
---	-------

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

190.22	149.81	119.86	53.63	12.52	0	0	0	0	51.84	123.67	193.34
--------	--------	--------	-------	-------	---	---	---	---	-------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206)$$

203.66	160.39	128.32	57.42	13.41	0	0	0	0	55.5	132.41	207
--------	--------	--------	-------	-------	---	---	---	---	------	--------	-----

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

958.13	(211)
--------	-------

Space heating fuel (secondary), $kWh/month$

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	
---------	---	---	---	---	---	---	---	---	---	---	---	--

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1...5,10...12} =$$

0	(215)
---	-------

Water heating

Output from water heater (calculated above)

166.01	145.01	150.88	133.82	129.56	114.11	109.33	121.87	123.22	140.31	149.78	162.11
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

80.3	(216)
------	-------

(217)m=	85.39	85.13	84.48	82.95	81.1	80.3	80.3	80.3	80.3	82.8	84.57	85.5	(217)
---------	-------	-------	-------	-------	------	------	------	------	------	------	-------	------	-------

Fuel for water heating, $kWh/month$

$$(219)m = (64)m \times 100 \div (217)m$$

(219)m=	194.4	170.34	178.6	161.32	159.76	142.11	136.15	151.77	153.45	169.47	177.1	189.61
---------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	--------

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

1984.07	(219)
---------	-------

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year	958.13
----------	--------

TER WorkSheet: New dwelling design stage

Water heating fuel used		1984.07	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75 (231)
Electricity for lighting		276.89	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	206.96	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	428.56	(264)
Space and water heating	(261) + (262) + (263) + (264) =			635.51	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	143.71	(268)
Total CO2, kg/year	sum of (265)...(271) =			818.15	(272)
TER =				15.73	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Caversham 1BF MID 53 South

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	53 (1a) x	2.4 (2a) =	127.2 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	127.2 (5)

2. Ventilation rate:

	main heating	secondary heating	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				1 x 10 =	10 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10 ÷ (5) = 0.08 (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]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry 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

Percentage of windows and doors draught stripped

Window infiltration

0.25 - [0.2 x (14) ÷ 100] =

Infiltration rate

(8) + (10) + (11) + (12) + (13) + (15) =

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) ÷ 20] + (8), otherwise (18) = (16)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered

Shelter factor

(20) = 1 - [0.075 x (19)] =

Infiltration rate incorporating shelter factor

(21) = (18) x (20) =

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

DER WorkSheet: New dwelling design stage

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

0.3	0.3	0.29	0.26	0.25	0.22	0.22	0.22	0.24	0.25	0.27	0.28
-----	-----	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.55 0.54 0.54 0.53 0.53 0.53 0.53 0.52 0.53 0.53 0.54 0.54 (24d)

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

(25)m= 0.55 0.54 0.54 0.53 0.53 0.53 0.53 0.52 0.53 0.53 0.54 0.54 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Walls	19.1	5.22	13.88	$\times 0.19 =$	2.64		(29)
Total area of elements, m²			19.1				(31)
Party wall			53.68	$\times 0 =$	0		(32)
Party floor			53				(32a)
Party ceiling			53				(32b)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 9.56 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5086.39 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 2.41 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 11.97 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	22.9	22.83	22.75	22.41	22.35	22.05	22.05	22	22.17	22.35	22.48	22.61

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

(39)m=	34.87	34.8	34.72	34.38	34.32	34.02	34.02	33.96	34.13	34.32	34.45	34.58
Average = Sum(39) _{1...12} /12=												34.38

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.66	0.66	0.66	0.65	0.65	0.64	0.64	0.64	0.64	0.65	0.65	0.65		
	Average = Sum(40) _{1...12} / 12 =												0.65	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.78

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

76.44

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	84.08	81.03	77.97	74.91	71.85	68.8	68.8	71.85	74.91	77.97	81.03	84.08		
	Total = Sum(44) _{1...12} =												917.29	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	124.7	109.06	112.54	98.11	94.14	81.24	75.28	86.38	87.42	101.88	111.2	120.76		
	Total = Sum(45) _{1...12} =												1202.71	(45)

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

(46)m=	18.7	16.36	16.88	14.72	14.12	12.19	11.29	12.96	13.11	15.28	16.68	18.11		(46)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

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

(61)m=	16.06	14.48	15.99	15.43	15.91	15.35	15.84	15.88	15.39	15.96	15.5	16.05	(61)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	140.76	123.54	128.53	113.54	110.05	96.59	91.12	102.27	102.81	117.83	126.7	136.81	(62)
--------	--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	-------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	140.76	123.54	128.53	113.54	110.05	96.59	91.12	102.27	102.81	117.83	126.7	136.81	
Output from water heater (annual) _{1...12}												1390.56	(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	45.48	39.88	41.42	36.48	35.28	30.85	28.99	32.69	32.91	37.86	40.85	44.17	(65)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	(66)

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

(67)m=	16.01	14.22	11.56	8.75	6.54	5.52	5.97	7.76	10.42	13.22	15.43	16.45	(67)
--------	-------	-------	-------	------	------	------	------	------	-------	-------	-------	-------	------

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

(68)m=	155.02	156.63	152.57	143.94	133.05	122.81	115.97	114.36	118.42	127.05	137.94	148.18	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	61.13	59.35	55.67	50.67	47.42	42.85	38.97	43.94	45.71	50.89	56.74	59.36	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	284.83	282.87	272.48	256.04	239.69	223.86	213.59	218.74	227.22	243.84	262.79	276.67	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	3.78	x	46.75	x	0.63	x	0.7	=	54.01 (78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57 (78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.63	x	0.7	=	88.45 (78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7 (78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67 (78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	74.58	122.15	155.6	175.86	183.25	176.36	172.31	167.34	162.54	131.75	88.41	64.45	(83)
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

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

(84)m=	359.41	405.02	428.08	431.9	422.94	400.22	385.9	386.08	389.76	375.59	351.2	341.12	(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	0.98	0.95	0.87	0.73	0.54	0.39	0.4	0.6	0.87	0.98	0.99	(86)

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

(87)m=	20.56	20.68	20.81	20.92	20.98	21	21	21	21	20.94	20.74	20.53	(87)
--------	-------	-------	-------	-------	-------	----	----	----	----	-------	-------	-------	------

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

(88)m=	20.38	20.38	20.38	20.39	20.39	20.39	20.39	20.39	20.39	20.39	20.39	20.38	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.97	0.93	0.85	0.69	0.49	0.33	0.35	0.55	0.83	0.97	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	19.79	19.97	20.15	20.3	20.37	20.39	20.39	20.39	20.39	20.32	20.05	19.75	(90)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.47 (91)

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

(92)m=	20.16	20.3	20.46	20.6	20.66	20.68	20.68	20.68	20.68	20.61	20.37	20.12	(92)
--------	-------	------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

DER WorkSheet: New dwelling design stage

(93)m=	20.16	20.3	20.46	20.6	20.66	20.68	20.68	20.68	20.68	20.61	20.37	20.12	(93)
--------	-------	------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, h_m :

(94)m=	0.99	0.97	0.94	0.86	0.71	0.52	0.36	0.38	0.57	0.85	0.97	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	355.38	393.76	400.92	369.78	300.89	206.32	138.74	145.32	223.4	318.2	340.7	338.39	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	-------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	552.88	535.99	484.72	402.12	307.5	206.77	138.76	145.35	224.45	343.64	457.25	550.49	(97)
--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	146.94	95.58	62.35	23.28	4.91	0	0	0	0	18.93	83.91	157.81	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												593.71	(98)

Space heating requirement in $kWh/m^2/year$

11.2	(99)
------	------

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

1	(202)
---	-------

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

1	(204)
---	-------

Efficiency of main space heating system 1

93.5	(206)
------	-------

Efficiency of secondary/supplementary heating system, %

0	(208)
---	-------

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

146.94	95.58	62.35	23.28	4.91	0	0	0	0	18.93	83.91	157.81
--------	-------	-------	-------	------	---	---	---	---	-------	-------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206)$$

157.16	102.22	66.68	24.9	5.25	0	0	0	0	20.25	89.75	168.78
--------	--------	-------	------	------	---	---	---	---	-------	-------	--------

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

634.99	(211)
--------	-------

Space heating fuel (secondary), $kWh/month$

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	
---------	---	---	---	---	---	---	---	---	---	---	---	--

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1...5,10...12} =$$

0	(215)
---	-------

Water heating

Output from water heater (calculated above)

140.76	123.54	128.53	113.54	110.05	96.59	91.12	102.27	102.81	117.83	126.7	136.81
--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	-------	--------

Efficiency of water heater

87.3	(216)
------	-------

(217)m=	88.91	88.67	88.32	87.83	87.43	87.3	87.3	87.3	87.3	87.73	88.55	88.99	(217)
---------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

$$(219)m = (64)m \times 100 \div (217)m$$

(219)m=	158.32	139.33	145.53	129.28	125.87	110.64	104.38	117.15	117.77	134.31	143.09	153.74
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

1579.41	(219)
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Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

634.99

DER WorkSheet: New dwelling design stage

Water heating fuel used		1579.41	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75 (231)
Electricity for lighting		282.73	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	= 137.16 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.216	= 341.15 (264)
Space and water heating	(261) + (262) + (263) + (264) =		478.31 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 38.93 (267)
Electricity for lighting	(232) x	0.519	= 146.74 (268)
Total CO2, kg/year	sum of (265)...(271) =		663.97 (272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =		12.53 (273)
EI rating (section 14)			91 (274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Caversham 1BF MID 53 South

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	53 (1a) x	2.4 (2a) =	127.2 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	127.2 (5)

2. Ventilation rate:

	main heating	secondary heating	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				2 x 10 =	20 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20 ÷ (5) = 0.16 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.41 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.35 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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TER WorkSheet: New dwelling design stage

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

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.6 0.59 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.58 0.58 (24d)

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

(25)m= 0.6 0.59 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.58 0.58 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Walls	19.1	5.22	13.88	$\times 0.18 =$	2.5		(29)
Total area of elements, m²			19.1				(31)
Party wall			53.68	$\times 0 =$	0		(32)
Party floor			53				(32a)
Party ceiling			53				(32b)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 9.42 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5086.39 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 1.69 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 11.11 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	25.08	24.92	24.76	24.03	23.89	23.26	23.26	23.14	23.5	23.89	24.17	24.46

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

(39)m= 36.19 36.03 35.87 35.14 35 34.37 34.37 34.25 34.61 35 35.28 35.57
Average = Sum(39)_{1...12} /12= 35.14 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.68	0.68	0.68	0.66	0.66	0.65	0.65	0.65	0.65	0.66	0.67	0.67		
	Average = Sum(40) _{1...12} / 12 =												0.66	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.78

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

76.44

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	84.08	81.03	77.97	74.91	71.85	68.8	68.8	71.85	74.91	77.97	81.03	84.08		
	Total = Sum(44) _{1...12} =												917.29	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	124.7	109.06	112.54	98.11	94.14	81.24	75.28	86.38	87.42	101.88	111.2	120.76		
	Total = Sum(45) _{1...12} =												1202.71	(45)

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

(46)m=	18.7	16.36	16.88	14.72	14.12	12.19	11.29	12.96	13.11	15.28	16.68	18.11		(46)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

TER WorkSheet: New dwelling design stage

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

(61)m=	42.85	37.29	39.73	36.94	36.62	33.93	35.06	36.62	36.94	39.73	39.96	42.85	(61)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	167.54	146.35	152.27	135.06	130.76	115.17	110.34	123	124.36	141.61	151.16	163.61	(62)
--------	--------	--------	--------	--------	--------	--------	--------	-----	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	167.54	146.35	152.27	135.06	130.76	115.17	110.34	123	124.36	141.61	151.16	163.61	
Output from water heater (annual) _{1...12}												1661.23	(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	52.17	45.59	47.35	41.86	40.46	35.49	33.79	37.88	38.3	43.81	46.97	50.87	(65)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	(66)

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

(67)m=	16.01	14.22	11.56	8.75	6.54	5.52	5.97	7.76	10.42	13.22	15.43	16.45	(67)
--------	-------	-------	-------	------	------	------	------	------	-------	-------	-------	-------	------

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

(68)m=	155.02	156.63	152.57	143.94	133.05	122.81	115.97	114.36	118.42	127.05	137.94	148.18	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	70.13	67.84	63.65	58.14	54.38	49.3	45.42	50.91	53.2	58.88	65.23	68.37	(72)
--------	-------	-------	-------	-------	-------	------	-------	-------	------	-------	-------	-------	------

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

(73)m=	293.83	291.36	280.46	263.51	246.65	230.31	220.04	225.71	234.71	251.83	271.28	285.68	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)		
South	0.9x	0.77	x	3.78	x	46.75	x	0.63	x	0.7	=	54.01	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57	(78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.63	x	0.7	=	88.45	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67	(78)

TER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	74.58	122.15	155.6	175.86	183.25	176.36	172.31	167.34	162.54	131.75	88.41	64.45	(83)
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

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

(84)m=	368.41	413.51	436.06	439.37	429.9	406.67	392.35	393.05	397.24	383.58	359.69	350.12	(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	0.98	0.95	0.87	0.74	0.54	0.39	0.4	0.6	0.86	0.98	0.99	(86)

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

(87)m=	20.54	20.66	20.79	20.92	20.98	21	21	21	21	20.94	20.73	20.52	(87)
--------	-------	-------	-------	-------	-------	----	----	----	----	-------	-------	-------	------

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

(88)m=	20.36	20.36	20.36	20.37	20.38	20.39	20.39	20.39	20.38	20.38	20.37	20.37	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.97	0.94	0.85	0.69	0.49	0.33	0.35	0.55	0.83	0.97	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	19.74	19.92	20.11	20.29	20.36	20.39	20.39	20.39	20.38	20.31	20.03	19.72	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.47 (91)

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

(92)m=	20.12	20.27	20.43	20.58	20.65	20.67	20.68	20.68	20.67	20.61	20.36	20.09	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

TER WorkSheet: New dwelling design stage

(93)m=	20.12	20.27	20.43	20.58	20.65	20.67	20.68	20.68	20.67	20.61	20.36	20.09	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, h_m :

(94)m=	0.99	0.97	0.94	0.86	0.71	0.51	0.36	0.37	0.57	0.84	0.97	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	364.06	401.92	408.81	376.24	306.22	208.33	140.06	146.45	226.37	323.96	348.34	347.05	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	572.35	553.7	499.74	410.6	313.39	208.78	140.08	146.48	227.45	350.24	467.81	565.37	(97)
--------	--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	154.96	102	67.66	24.74	5.33	0	0	0	0	19.55	86.02	162.43	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												622.69	(98)

Space heating requirement in $kWh/m^2/year$

11.75	(99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

1	(202)
---	-------

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

1	(204)
---	-------

Efficiency of main space heating system 1

93.4	(206)
------	-------

Efficiency of secondary/supplementary heating system, %

0	(208)
---	-------

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

154.96	102	67.66	24.74	5.33	0	0	0	0	19.55	86.02	162.43
--------	-----	-------	-------	------	---	---	---	---	-------	-------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206)$$

165.92	109.2	72.44	26.48	5.71	0	0	0	0	20.93	92.1	173.91
--------	-------	-------	-------	------	---	---	---	---	-------	------	--------

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

666.69	(211)
--------	-------

Space heating fuel (secondary), $kWh/month$

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	
---------	---	---	---	---	---	---	---	---	---	---	---	--

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1...5,10...12} =$$

0	(215)
---	-------

Water heating

Output from water heater (calculated above)

167.54	146.35	152.27	135.06	130.76	115.17	110.34	123	124.36	141.61	151.16	163.61
--------	--------	--------	--------	--------	--------	--------	-----	--------	--------	--------	--------

Efficiency of water heater

80.3	(216)
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(217)m=	84.86	84.16	83.16	81.71	80.65	80.3	80.3	80.3	80.3	81.4	83.69	85.03	(217)
---------	-------	-------	-------	-------	-------	------	------	------	------	------	-------	-------	-------

Fuel for water heating, $kWh/month$

$$(219)m = (64)m \times 100 \div (217)m$$

(219)m=	197.45	173.9	183.11	165.28	162.13	143.42	137.41	153.18	154.87	173.96	180.62	192.41
---------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

2017.72	(219)
---------	-------

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

666.69

TER WorkSheet: New dwelling design stage

Water heating fuel used		2017.72	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75 (231)
Electricity for lighting		282.73	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x		0.216	=	144.01	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	435.83	(264)
Space and water heating	(261) + (262) + (263) + (264) =				579.83	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	146.74	(268)
Total CO2, kg/year	sum of (265)...(271) =				765.49	(272)
TER =					14.44	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Caversham 1BF TOP North

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	52 (1a) x	2.4 (2a) =	124.8 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	52 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	124.8 (5)

2. Ventilation rate:

	main heating	secondary heating	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				1 x 10 =	10 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10 ÷ (5) = 0.08 (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]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry 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

Percentage of windows and doors draught stripped

Window infiltration

0.25 - [0.2 x (14) ÷ 100] =

Infiltration rate

(8) + (10) + (11) + (12) + (13) + (15) =

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) ÷ 20] + (8), otherwise (18) = (16)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered

Shelter factor

(20) = 1 - [0.075 x (19)] =

Infiltration rate incorporating shelter factor

(21) = (18) x (20) =

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

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

0.3	0.3	0.29	0.26	0.26	0.23	0.23	0.22	0.24	0.26	0.27	0.28
-----	-----	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.55 0.54 0.54 0.53 0.53 0.53 0.53 0.52 0.53 0.53 0.54 0.54 (24d)

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

(25)m= 0.55 0.54 0.54 0.53 0.53 0.53 0.53 0.52 0.53 0.53 0.54 0.54 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Walls	19.13	5.22	13.91	$\times$ 0.19	2.64		(29)
Roof	52	0	52	$\times$ 0.15	7.8		(30)
Total area of elements, m²			71.13				(31)
Party wall			53.21	$\times$ 0	0		(32)
Party floor			52				(32a)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 17.36 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 4446.64 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 8.37 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 25.73 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	22.49	22.42	22.34	22	21.94	21.65	21.65	21.59	21.76	21.94	22.07	22.2

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

(39)m=	48.22	48.15	48.08	47.74	47.67	47.38	47.38	47.32	47.49	47.67	47.8	47.94
Average = Sum(39) _{1...12} /12=												47.74 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.93	0.93	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.92	0.92	0.92		
Average = Sum(40) _{1...12} / 12 =													0.92	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.75

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

75.74

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
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Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	83.31	80.28	77.26	74.23	71.2	68.17	68.17	71.2	74.23	77.26	80.28	83.31		
Total = Sum(44) _{1...12} =													908.89	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	123.55	108.06	111.51	97.22	93.28	80.49	74.59	85.59	86.62	100.94	110.19	119.65		
Total = Sum(45) _{1...12} =													1191.69	(45)

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

(46)m=	18.53	16.21	16.73	14.58	13.99	12.07	11.19	12.84	12.99	15.14	16.53	17.95		(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

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

(61)m=	16.06	14.48	15.98	15.42	15.9	15.35	15.84	15.88	15.39	15.95	15.49	16.04	(61)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	139.61	122.54	127.49	112.64	109.18	95.84	90.43	101.47	102	116.89	125.68	135.7	(62)
--------	--------	--------	--------	--------	--------	-------	-------	--------	-----	--------	--------	-------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	139.61	122.54	127.49	112.64	109.18	95.84	90.43	101.47	102	116.89	125.68	135.7	
Output from water heater (annual) _{1...12}												1379.47	(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	45.1	39.55	41.07	36.18	34.99	30.6	28.76	32.43	32.65	37.55	40.51	43.8	(65)
--------	------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	(66)

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

(67)m=	15.68	13.93	11.33	8.57	6.41	5.41	5.85	7.6	10.2	12.95	15.12	16.11	(67)
--------	-------	-------	-------	------	------	------	------	-----	------	-------	-------	-------	------

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

(68)m=	152.43	154.01	150.02	141.54	130.83	120.76	114.03	112.45	116.44	124.92	135.63	145.7	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

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

(69)m=	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	60.61	58.85	55.21	50.25	47.03	42.5	38.66	43.59	45.34	50.47	56.26	58.86	(72)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	280.95	279.02	268.79	252.6	236.5	220.91	210.77	215.87	224.22	240.58	259.25	272.92	(73)
--------	--------	--------	--------	-------	-------	--------	--------	--------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.78	x	10.63	x	0.63	x	0.7	=	12.28	(74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.63	x	0.7	=	4.68	(74)
North	0.9x	0.77	x	3.78	x	20.32	x	0.63	x	0.7	=	23.48	(74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.63	x	0.7	=	8.94	(74)
North	0.9x	0.77	x	3.78	x	34.53	x	0.63	x	0.7	=	39.89	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.44	x	34.53	x	0.63	x	0.7	=	15.2	(74)
North	0.9x	0.77	x	3.78	x	55.46	x	0.63	x	0.7	=	64.07	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.63	x	0.7	=	24.41	(74)
North	0.9x	0.77	x	3.78	x	74.72	x	0.63	x	0.7	=	86.31	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.63	x	0.7	=	32.88	(74)
North	0.9x	0.77	x	3.78	x	79.99	x	0.63	x	0.7	=	92.4	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.63	x	0.7	=	35.2	(74)
North	0.9x	0.77	x	3.78	x	74.68	x	0.63	x	0.7	=	86.27	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.63	x	0.7	=	32.86	(74)
North	0.9x	0.77	x	3.78	x	59.25	x	0.63	x	0.7	=	68.44	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.63	x	0.7	=	26.07	(74)
North	0.9x	0.77	x	3.78	x	41.52	x	0.63	x	0.7	=	47.96	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.63	x	0.7	=	18.27	(74)
North	0.9x	0.77	x	3.78	x	24.19	x	0.63	x	0.7	=	27.94	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.63	x	0.7	=	10.65	(74)
North	0.9x	0.77	x	3.78	x	13.12	x	0.63	x	0.7	=	15.15	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.63	x	0.7	=	5.77	(74)
North	0.9x	0.77	x	3.78	x	8.86	x	0.63	x	0.7	=	10.24	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.63	x	0.7	=	3.9	(74)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	16.96	32.42	55.09	88.48	119.19	127.6	119.13	94.52	66.23	38.59	20.93	14.14	(83)
--------	-------	-------	-------	-------	--------	-------	--------	-------	-------	-------	-------	-------	------

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

(84)m=	297.92	311.44	323.87	341.08	355.7	348.51	329.9	310.39	290.45	279.17	280.18	287.06	(84)
--------	--------	--------	--------	--------	-------	--------	-------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.93	0.79	0.62	0.68	0.9	0.99	1	1	(86)

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

(87)m=	20.04	20.13	20.29	20.54	20.79	20.95	20.99	20.98	20.88	20.58	20.27	20.02	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(88)m=	20.14	20.15	20.15	20.15	20.15	20.16	20.16	20.16	20.16	20.15	20.15	20.15	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	1	0.99	0.98	0.91	0.72	0.51	0.56	0.85	0.98	1	1	(89)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

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

(90)m=	18.86	18.98	19.22	19.59	19.93	20.12	20.15	20.15	20.05	19.65	19.2	18.83	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

fLA = Living area ÷ (4) =

0.48 (91)

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

(92)m=	19.43	19.53	19.74	20.05	20.34	20.52	20.56	20.55	20.45	20.1	19.72	19.4	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------	------

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

DER WorkSheet: New dwelling design stage

(93)m=	19.43	19.53	19.74	20.05	20.34	20.52	20.56	20.55	20.45	20.1	19.72	19.4	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, h_m :

(94)m=	1	1	0.99	0.97	0.91	0.75	0.56	0.62	0.87	0.98	0.99	1	(94)
--------	---	---	------	------	------	------	------	------	------	------	------	---	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	297.09	310.14	321.1	332.37	324.74	261.83	184.8	191.85	253.83	273.24	278.7	286.42	(95)
--------	--------	--------	-------	--------	--------	--------	-------	--------	--------	--------	-------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	729.51	704.38	636.45	532.12	412.08	280.43	187.45	196.5	301.4	452.87	603.06	728.8	(97)
--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	--------	--------	-------	------

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

(98)m=	321.72	264.93	234.62	143.83	64.98	0	0	0	0	133.65	233.54	329.13	
--------	--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------	--

Total per year ($kWh/year$) = $Sum(98)_{1...5,9...12} =$ 1726.39 (98)

Space heating requirement in $kWh/m^2/year$

33.2 (99)

9a. Energy requirements – Individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = $1 - (201) =$

1 (202)

Fraction of total heating from main system 1

(204) = $(202) \times [1 - (203)] =$

1 (204)

Efficiency of main space heating system 1

93.5 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	$kWh/year$
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	------------

Space heating requirement (calculated above)

321.72	264.93	234.62	143.83	64.98	0	0	0	0	133.65	233.54	329.13
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

344.09	283.35	250.93	153.82	69.49	0	0	0	0	142.94	249.77	352.01
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

Total ($kWh/year$) = $Sum(211)_{1...5,10...12} =$ 1846.41 (211)

Space heating fuel (secondary), $kWh/month$

= $\{[(98)m \times (201)]\} \times 100 \div (208)$

(215)m=	0	0	0	0	0	0	0	0	0	0	0		
---------	---	---	---	---	---	---	---	---	---	---	---	--	--

Total ($kWh/year$) = $Sum(215)_{1...5,10...12} =$ 0 (215)

Water heating

Output from water heater (calculated above)

139.61	122.54	127.49	112.64	109.18	95.84	90.43	101.47	102	116.89	125.68	135.7
--------	--------	--------	--------	--------	-------	-------	--------	-----	--------	--------	-------

Efficiency of water heater

87.3 (216)

(217)m=	89.51	89.46	89.35	89.07	88.47	87.3	87.3	87.3	87.3	88.98	89.35	89.54	(217)
---------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	155.97	136.97	142.69	126.47	123.42	109.79	103.58	116.23	116.84	131.37	140.65	151.55	
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--

Total = $Sum(219a)_{1...12} =$ 1555.53 (219)

Annual totals

$kWh/year$

$kWh/year$

Space heating fuel used, main system 1

1846.41

DER WorkSheet: New dwelling design stage

Water heating fuel used		1555.53	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	75	(231)
Electricity for lighting		276.89	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	398.82	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	335.99	(264)
Space and water heating	(261) + (262) + (263) + (264) =			734.82	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	143.71	(268)
Total CO2, kg/year		sum of (265)...(271) =		917.45	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		17.64	(273)
EI rating (section 14)				87	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Caversham 1BF TOP North

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	52 (1a) x	2.4 (2a) =	124.8 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	52 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	124.8 (5)

2. Ventilation rate:

	main heating	secondary heating	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				2 x 10 =	20 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20 ÷ (5) = 0.16 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.41 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.35 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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TER WorkSheet: New dwelling design stage

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

0.44	0.44	0.43	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.6 0.6 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.58 0.58 (24d)

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

(25)m= 0.6 0.6 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.58 0.58 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Walls	19.13	5.22	13.91	$\times$ 0.18	2.5		(29)
Roof	52	0	52	$\times$ 0.13	6.76		(30)
Total area of elements, m²			71.13				(31)
Party wall			53.21	$\times$ 0	0		(32)
Party floor			52				(32a)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 16.18 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 4446.64 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 4.99 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 21.17 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	24.66	24.5	24.35	23.62	23.49	22.85	22.85	22.73	23.1	23.49	23.76	24.05

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

(39)m=	45.84	45.68	45.52	44.8	44.66	44.03	44.03	43.91	44.27	44.66	44.94	45.22
Average = Sum(39) _{1...12} /12=												44.8

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.88	0.88	0.88	0.86	0.86	0.85	0.85	0.84	0.85	0.86	0.86	0.87		
	Average = Sum(40) _{1...12} / 12 =												0.86	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.75

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

75.74

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	83.31	80.28	77.26	74.23	71.2	68.17	68.17	71.2	74.23	77.26	80.28	83.31		
	Total = Sum(44) _{1...12} =												908.89	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	123.55	108.06	111.51	97.22	93.28	80.49	74.59	85.59	86.62	100.94	110.19	119.65		
	Total = Sum(45) _{1...12} =												1191.69	(45)

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

(46)m=	18.53	16.21	16.73	14.58	13.99	12.07	11.19	12.84	12.99	15.14	16.53	17.95		(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

TER WorkSheet: New dwelling design stage

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

(61)m=	42.46	36.95	39.37	36.6	36.28	33.62	34.74	36.28	36.6	39.37	39.59	42.46	(61)
--------	-------	-------	-------	------	-------	-------	-------	-------	------	-------	-------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	166.01	145.01	150.88	133.82	129.56	114.11	109.33	121.87	123.22	140.31	149.78	162.11	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	166.01	145.01	150.88	133.82	129.56	114.11	109.33	121.87	123.22	140.31	149.78	162.11	
Output from water heater (annual) _{1...12}												1646.01	(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	51.7	45.17	46.92	41.48	40.09	35.17	33.49	37.53	37.95	43.41	46.53	50.4	(65)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	(66)

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

(67)m=	15.68	13.93	11.33	8.57	6.41	5.41	5.85	7.6	10.2	12.95	15.12	16.11	(67)
--------	-------	-------	-------	------	------	------	------	-----	------	-------	-------	-------	------

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

(68)m=	152.43	154.01	150.02	141.54	130.83	120.76	114.03	112.45	116.44	124.92	135.63	145.7	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

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

(69)m=	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	31.75	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	-69.96	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	69.48	67.21	63.06	57.6	53.88	48.85	45.01	50.44	52.71	58.34	64.63	67.74	(72)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	289.82	287.38	276.65	259.95	243.35	227.25	217.12	222.73	231.58	248.45	267.62	281.79	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.78	x	10.63	x	0.63	x	0.7	=	12.28 (74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.63	x	0.7	=	4.68 (74)
North	0.9x	0.77	x	3.78	x	20.32	x	0.63	x	0.7	=	23.48 (74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.63	x	0.7	=	8.94 (74)
North	0.9x	0.77	x	3.78	x	34.53	x	0.63	x	0.7	=	39.89 (74)

TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.44	x	34.53	x	0.63	x	0.7	=	15.2	(74)
North	0.9x	0.77	x	3.78	x	55.46	x	0.63	x	0.7	=	64.07	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.63	x	0.7	=	24.41	(74)
North	0.9x	0.77	x	3.78	x	74.72	x	0.63	x	0.7	=	86.31	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.63	x	0.7	=	32.88	(74)
North	0.9x	0.77	x	3.78	x	79.99	x	0.63	x	0.7	=	92.4	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.63	x	0.7	=	35.2	(74)
North	0.9x	0.77	x	3.78	x	74.68	x	0.63	x	0.7	=	86.27	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.63	x	0.7	=	32.86	(74)
North	0.9x	0.77	x	3.78	x	59.25	x	0.63	x	0.7	=	68.44	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.63	x	0.7	=	26.07	(74)
North	0.9x	0.77	x	3.78	x	41.52	x	0.63	x	0.7	=	47.96	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.63	x	0.7	=	18.27	(74)
North	0.9x	0.77	x	3.78	x	24.19	x	0.63	x	0.7	=	27.94	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.63	x	0.7	=	10.65	(74)
North	0.9x	0.77	x	3.78	x	13.12	x	0.63	x	0.7	=	15.15	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.63	x	0.7	=	5.77	(74)
North	0.9x	0.77	x	3.78	x	8.86	x	0.63	x	0.7	=	10.24	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.63	x	0.7	=	3.9	(74)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	16.96	32.42	55.09	88.48	119.19	127.6	119.13	94.52	66.23	38.59	20.93	14.14	(83)
--------	-------	-------	-------	-------	--------	-------	--------	-------	-------	-------	-------	-------	------

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

(84)m=	306.79	319.8	331.73	348.43	362.54	354.85	336.25	317.25	297.81	287.04	288.54	295.93	(84)
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.92	0.75	0.57	0.62	0.88	0.98	1	1	(86)

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

(87)m=	20.13	20.21	20.37	20.62	20.84	20.97	21	20.99	20.92	20.65	20.36	20.12	(87)
--------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	-------	-------	------

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

(88)m=	20.18	20.19	20.19	20.2	20.2	20.21	20.21	20.22	20.21	20.2	20.2	20.19	(88)
--------	-------	-------	-------	------	------	-------	-------	-------	-------	------	------	-------	------

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

(89)m=	1	1	0.99	0.97	0.88	0.67	0.47	0.52	0.82	0.97	0.99	1	(89)
--------	---	---	------	------	------	------	------	------	------	------	------	---	------

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

(90)m=	19.01	19.13	19.37	19.73	20.04	20.19	20.21	20.21	20.14	19.79	19.36	19	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	----	------

fLA = Living area ÷ (4) = 0.48 (91)

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

(92)m=	19.55	19.65	19.85	20.16	20.42	20.57	20.59	20.59	20.51	20.2	19.84	19.54	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

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

TER WorkSheet: New dwelling design stage

(93)m=	19.55	19.65	19.85	20.16	20.42	20.57	20.59	20.59	20.51	20.2	19.84	19.54	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, h_m :

(94)m=	1	1	0.99	0.97	0.89	0.71	0.52	0.57	0.84	0.97	0.99	1	(94)
--------	---	---	------	------	------	------	------	------	------	------	------	---	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	305.78	318.22	328.35	337.51	324.01	251.74	174.32	181.55	251.3	279.34	286.69	295.15	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	698.87	673.67	607.78	504.22	389.59	262.64	175.59	183.84	283.79	428.81	572.37	693.58	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	292.46	238.86	207.9	120.03	48.79	0	0	0	0	111.2	205.69	296.43	
--------	--------	--------	-------	--------	-------	---	---	---	---	-------	--------	--------	--

Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$ 1521.36 (98)

Space heating requirement in $kWh/m^2/year$

29.26 (99)

9a. Energy requirements – Individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = $1 - (201) =$

1 (202)

Fraction of total heating from main system 1

(204) = $(202) \times [1 - (203)] =$

1 (204)

Efficiency of main space heating system 1

93.4 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

292.46	238.86	207.9	120.03	48.79	0	0	0	0	111.2	205.69	296.43
--------	--------	-------	--------	-------	---	---	---	---	-------	--------	--------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$

313.13	255.74	222.59	128.52	52.24	0	0	0	0	119.06	220.22	317.38
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

Total ($kWh/year$) = $Sum(211)_{1..5,10..12} =$ 1628.86 (211)

Space heating fuel (secondary), $kWh/month$

= $\{[(98)m \times (201)]\} \times 100 \div (208)$

(215)m=	0	0	0	0	0	0	0	0	0	0	0		
---------	---	---	---	---	---	---	---	---	---	---	---	--	--

Total ($kWh/year$) = $Sum(215)_{1..5,10..12} =$ 0 (215)

Water heating

Output from water heater (calculated above)

166.01	145.01	150.88	133.82	129.56	114.11	109.33	121.87	123.22	140.31	149.78	162.11
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

80.3 (216)

(217)m=	86.46	86.3	85.86	84.78	82.83	80.3	80.3	80.3	80.3	84.47	85.85	86.55	(217)
---------	-------	------	-------	-------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	192	168.03	175.73	157.85	156.42	142.11	136.15	151.77	153.45	166.1	174.46	187.3	
---------	-----	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	-------	--

Total = $Sum(219a)_{1..12} =$ 1961.37 (219)

Annual totals

Space heating fuel used, main system 1

$kWh/year$

$kWh/year$

1628.86

TER WorkSheet: New dwelling design stage

Water heating fuel used		1961.37	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75 (231)
Electricity for lighting		276.89	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	351.83	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	423.66	(264)
Space and water heating	(261) + (262) + (263) + (264) =			775.49	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	143.71	(268)
Total CO2, kg/year	sum of (265)...(271) =			958.12	(272)
TER =				18.43	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Caversham 1BF TOP South

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	53 (1a) x	2.4 (2a) =	127.2 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	127.2 (5)

2. Ventilation rate:

	main heating	secondary heating	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				1 x 10 =	10 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10 ÷ (5) = 0.08 (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]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 4 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.28 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.24 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

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

0.3	0.3	0.29	0.26	0.25	0.22	0.22	0.22	0.24	0.25	0.27	0.28
-----	-----	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.55 0.54 0.54 0.53 0.53 0.53 0.53 0.52 0.53 0.53 0.54 0.54 (24d)

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

(25)m= 0.55 0.54 0.54 0.53 0.53 0.53 0.53 0.52 0.53 0.53 0.54 0.54 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Walls	19.1	5.22	13.88	$\times$ 0.19	2.64		(29)
Roof	53	0	53	$\times$ 0.15	7.95		(30)
Total area of elements, m²			72.1				(31)
Party wall			53.68	$\times$ 0	0		(32)
Party floor			53				(32a)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 17.51 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 4503.39 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 8.42 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 25.92 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	22.9	22.83	22.75	22.41	22.35	22.05	22.05	22	22.17	22.35	22.48	22.61

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

(39)m=	48.82	48.75	48.68	48.34	48.27	47.97	47.97	47.92	48.09	48.27	48.4	48.54
Average = Sum(39) _{1...12} /12=												48.34

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.9	0.91	0.91	0.91	0.92		
Average = Sum(40) _{1...12} / 12 =													0.91	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.78

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

76.44

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	84.08	81.03	77.97	74.91	71.85	68.8	68.8	71.85	74.91	77.97	81.03	84.08		
Total = Sum(44) _{1...12} =													917.29	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	124.7	109.06	112.54	98.11	94.14	81.24	75.28	86.38	87.42	101.88	111.2	120.76		
Total = Sum(45) _{1...12} =													1202.71	(45)

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

(46)m=	18.7	16.36	16.88	14.72	14.12	12.19	11.29	12.96	13.11	15.28	16.68	18.11		(46)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

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

(61)m=	16.06	14.48	15.99	15.43	15.91	15.35	15.84	15.88	15.39	15.96	15.5	16.05	(61)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	140.76	123.54	128.53	113.54	110.05	96.59	91.12	102.27	102.81	117.83	126.7	136.81	(62)
--------	--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	-------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	140.76	123.54	128.53	113.54	110.05	96.59	91.12	102.27	102.81	117.83	126.7	136.81	
Output from water heater (annual) _{1...12}												1390.56	(64)

Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m=	45.48	39.88	41.42	36.48	35.28	30.85	28.99	32.69	32.91	37.86	40.85	44.17	(65)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	(66)

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

(67)m=	16.01	14.22	11.56	8.75	6.54	5.52	5.97	7.76	10.42	13.22	15.43	16.45	(67)
--------	-------	-------	-------	------	------	------	------	------	-------	-------	-------	-------	------

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

(68)m=	155.02	156.63	152.57	143.94	133.05	122.81	115.97	114.36	118.42	127.05	137.94	148.18	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	61.13	59.35	55.67	50.67	47.42	42.85	38.97	43.94	45.71	50.89	56.74	59.36	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	284.83	282.87	272.48	256.04	239.69	223.86	213.59	218.74	227.22	243.84	262.79	276.67	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	3.78	x	46.75	x	0.63	x	0.7	=	54.01 (78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57 (78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.63	x	0.7	=	88.45 (78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7 (78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67 (78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	74.58	122.15	155.6	175.86	183.25	176.36	172.31	167.34	162.54	131.75	88.41	64.45	(83)
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

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

(84)m=	359.41	405.02	428.08	431.9	422.94	400.22	385.9	386.08	389.76	375.59	351.2	341.12	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.88	0.73	0.54	0.56	0.78	0.95	0.99	1	(86)

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

(87)m=	20.15	20.29	20.47	20.68	20.86	20.97	21	20.99	20.95	20.73	20.4	20.12	(87)
--------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	------	-------	------

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

(88)m=	20.15	20.15	20.15	20.16	20.16	20.16	20.16	20.16	20.16	20.16	20.16	20.15	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.99	0.97	0.94	0.84	0.65	0.44	0.46	0.71	0.93	0.99	1	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	---	------

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

(90)m=	19.02	19.22	19.48	19.78	20.02	20.14	20.16	20.16	20.12	19.85	19.38	18.98	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.47 (91)

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

(92)m=	19.56	19.73	19.95	20.2	20.42	20.53	20.55	20.55	20.51	20.27	19.86	19.52	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

DER WorkSheet: New dwelling design stage

(93)m=	19.56	19.73	19.95	20.2	20.42	20.53	20.55	20.55	20.51	20.27	19.86	19.52	(93)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, h_m :

(94)m=	0.99	0.99	0.97	0.94	0.86	0.68	0.49	0.51	0.74	0.93	0.99	1	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	---	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	357.1	399.52	416.09	405.15	362.26	273.37	188.46	197.38	289.35	350.68	346.18	339.46	(95)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	744.87	722.75	654.6	546.37	420.71	284.58	189.73	199.07	308.38	466.7	617.68	743.37	(97)
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	-------	--------	--------	------

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

(98)m=	288.51	217.21	177.45	101.68	43.48	0	0	0	0	86.32	195.48	300.51	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1410.64	(98)

Space heating requirement in $kWh/m^2/year$

26.62	(99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
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Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

1	(202)
---	-------

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

1	(204)
---	-------

Efficiency of main space heating system 1

93.5	(206)
------	-------

Efficiency of secondary/supplementary heating system, %

0	(208)
---	-------

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

288.51	217.21	177.45	101.68	43.48	0	0	0	0	86.32	195.48	300.51
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$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206)$$

308.56	232.31	189.79	108.75	46.5	0	0	0	0	92.33	209.07	321.4
--------	--------	--------	--------	------	---	---	---	---	-------	--------	-------

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

1508.71	(211)
---------	-------

Space heating fuel (secondary), $kWh/month$

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1...5,10...12} =$$

0	(215)
---	-------

Water heating

Output from water heater (calculated above)

140.76	123.54	128.53	113.54	110.05	96.59	91.12	102.27	102.81	117.83	126.7	136.81
--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	-------	--------

Efficiency of water heater

87.3	(216)
------	-------

(217)m=	89.43	89.31	89.13	88.78	88.18	87.3	87.3	87.3	87.3	88.63	89.21	89.47	(217)
---------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

$$(219)m = (64)m \times 100 \div (217)m$$

(219)m=	157.4	138.32	144.21	127.89	124.8	110.64	104.38	117.15	117.77	132.96	142.02	152.91
---------	-------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------

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

1570.44	(219)
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Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year	1508.71
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DER WorkSheet: New dwelling design stage

Water heating fuel used		1570.44	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75 (231)
Electricity for lighting		282.73	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	325.88	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	339.21	(264)
Space and water heating	(261) + (262) + (263) + (264) =			665.1	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	146.74	(268)
Total CO2, kg/year	sum of (265)...(271) =			850.76	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			16.05	(273)
EI rating (section 14)				88	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Caversham 1BF TOP South

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	53 (1a) x	2.4 (2a) =	127.2 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	127.2 (5)

2. Ventilation rate:

	main heating	secondary heating	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				2 x 10 =	20 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20 ÷ (5) = 0.16 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.41 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.35 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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TER WorkSheet: New dwelling design stage

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

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.6 0.59 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.58 0.58 (24d)

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

(25)m= 0.6 0.59 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.58 0.58 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Walls	19.1	5.22	13.88	$\times$ 0.18	2.5		(29)
Roof	53	0	53	$\times$ 0.13	6.89		(30)
Total area of elements, m²			72.1				(31)
Party wall			53.68	$\times$ 0	0		(32)
Party floor			53				(32a)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 16.31 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 4503.39 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 5.01 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 21.32 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	25.08	24.92	24.76	24.03	23.89	23.26	23.26	23.14	23.5	23.89	24.17	24.46

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

(39)m=	46.4	46.24	46.08	45.35	45.21	44.58	44.58	44.46	44.82	45.21	45.49	45.78
Average = Sum(39) _{1...12} /12=												45.35 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.88	0.87	0.87	0.86	0.85	0.84	0.84	0.84	0.85	0.85	0.86	0.86		
Average = Sum(40) _{1...12} / 12 =													0.86	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.78

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

76.44

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	84.08	81.03	77.97	74.91	71.85	68.8	68.8	71.85	74.91	77.97	81.03	84.08		
Total = Sum(44) _{1...12} =													917.29	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	124.7	109.06	112.54	98.11	94.14	81.24	75.28	86.38	87.42	101.88	111.2	120.76		
Total = Sum(45) _{1...12} =													1202.71	(45)

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

(46)m=	18.7	16.36	16.88	14.72	14.12	12.19	11.29	12.96	13.11	15.28	16.68	18.11		(46)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

TER WorkSheet: New dwelling design stage

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

(61)m=	42.85	37.29	39.73	36.94	36.62	33.93	35.06	36.62	36.94	39.73	39.96	42.85	(61)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	167.54	146.35	152.27	135.06	130.76	115.17	110.34	123	124.36	141.61	151.16	163.61	(62)
--------	--------	--------	--------	--------	--------	--------	--------	-----	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	167.54	146.35	152.27	135.06	130.76	115.17	110.34	123	124.36	141.61	151.16	163.61	
Output from water heater (annual) _{1...12}												1661.23	(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	52.17	45.59	47.35	41.86	40.46	35.49	33.79	37.88	38.3	43.81	46.97	50.87	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	(66)

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

(67)m=	16.01	14.22	11.56	8.75	6.54	5.52	5.97	7.76	10.42	13.22	15.43	16.45	(67)
--------	-------	-------	-------	------	------	------	------	------	-------	-------	-------	-------	------

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

(68)m=	155.02	156.63	152.57	143.94	133.05	122.81	115.97	114.36	118.42	127.05	137.94	148.18	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	70.13	67.84	63.65	58.14	54.38	49.3	45.42	50.91	53.2	58.88	65.23	68.37	(72)
--------	-------	-------	-------	-------	-------	------	-------	-------	------	-------	-------	-------	------

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

(73)m=	293.83	291.36	280.46	263.51	246.65	230.31	220.04	225.71	234.71	251.83	271.28	285.68	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	3.78	x	46.75	x	0.63	x	0.7	=	54.01 (78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57 (78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.63	x	0.7	=	88.45 (78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7 (78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67 (78)

TER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	74.58	122.15	155.6	175.86	183.25	176.36	172.31	167.34	162.54	131.75	88.41	64.45	(83)
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

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

(84)m=	368.41	413.51	436.06	439.37	429.9	406.67	392.35	393.05	397.24	383.58	359.69	350.12	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)	21	(85)
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Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.94	0.86	0.68	0.5	0.52	0.74	0.94	0.99	1	(86)

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

(87)m=	20.24	20.37	20.55	20.75	20.9	20.98	21	21	20.97	20.79	20.48	20.21	(87)
--------	-------	-------	-------	-------	------	-------	----	----	-------	-------	-------	-------	------

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

(88)m=	20.19	20.19	20.19	20.21	20.21	20.22	20.22	20.22	20.21	20.21	20.2	20.2	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.92	0.81	0.61	0.41	0.43	0.67	0.91	0.98	1	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	---	------

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

(90)m=	19.17	19.37	19.62	19.91	20.11	20.21	20.22	20.22	20.19	19.98	19.54	19.15	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.47 (91)

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

(92)m=	19.68	19.84	20.06	20.3	20.48	20.57	20.59	20.59	20.56	20.36	19.98	19.65	(92)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

TER WorkSheet: New dwelling design stage

(93)m=	19.68	19.84	20.06	20.3	20.48	20.57	20.59	20.59	20.56	20.36	19.98	19.65	(93)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set $T_{i,m}$ to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, h_m :

(94)m=	0.99	0.98	0.97	0.92	0.83	0.64	0.45	0.47	0.7	0.92	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	------	-----	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	365.6	406.84	421.46	406.24	356.28	260.14	177.1	185.36	278.32	352.09	353.39	348.09	(95)
--------	-------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	713.41	691.01	624.79	517.21	397.15	266.25	177.66	186.11	289.5	441.34	586.1	707.33	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	-------	--------	------

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

(98)m=	258.77	190.97	151.28	79.9	30.41	0	0	0	0	66.4	167.55	267.27	
--------	--------	--------	--------	------	-------	---	---	---	---	------	--------	--------	--

Total per year ($kWh/year$) = $Sum(98)_{1...5,9...12} =$ 1212.55 (98)

Space heating requirement in $kWh/m^2/year$

22.88 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = $1 - (201) =$

1 (202)

Fraction of total heating from main system 1

(204) = $(202) \times [1 - (203)] =$

1 (204)

Efficiency of main space heating system 1

93.4 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

258.77	190.97	151.28	79.9	30.41	0	0	0	0	66.4	167.55	267.27
--------	--------	--------	------	-------	---	---	---	---	------	--------	--------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$

277.06	204.46	161.97	85.55	32.56	0	0	0	0	71.1	179.39	286.16
--------	--------	--------	-------	-------	---	---	---	---	------	--------	--------

Total ($kWh/year$) = $Sum(211)_{1...5,10...12} =$ 1298.24 (211)

Space heating fuel (secondary), $kWh/month$

= $\{[(98)m \times (201)]\} \times 100 \div (208)$

(215)m=	0	0	0	0	0	0	0	0	0	0	0		
---------	---	---	---	---	---	---	---	---	---	---	---	--	--

Total ($kWh/year$) = $Sum(215)_{1...5,10...12} =$ 0 (215)

Water heating

Output from water heater (calculated above)

167.54	146.35	152.27	135.06	130.76	115.17	110.34	123	124.36	141.61	151.16	163.61
--------	--------	--------	--------	--------	--------	--------	-----	--------	--------	--------	--------

Efficiency of water heater

80.3 (216)

(217)m=	86.14	85.72	85.03	83.78	82.03	80.3	80.3	80.3	80.3	83.27	85.31	86.28	(217)
---------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	194.5	170.73	179.07	161.21	159.41	143.42	137.41	153.18	154.87	170.06	177.19	189.63	
---------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--

Total = $Sum(219a)_{1...12} =$ 1990.66 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1298.24

TER WorkSheet: New dwelling design stage

Water heating fuel used		1990.66	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75 (231)
Electricity for lighting		282.73	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	280.42 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	429.98 (264)
Space and water heating	(261) + (262) + (263) + (264) =		710.4 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	146.74 (268)
Total CO2, kg/year	sum of (265)...(271) =		896.06 (272)
TER =			16.91 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Caversham 2BF EXP 74 North

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	74 (1a) x	2.4 (2a) =	177.6 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	177.6 (5)

2. Ventilation rate:

	main heating	secondary heating	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				2 x 10 =	20 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20 ÷ (5) = 0.11 (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]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 (12)

If no draught lobby, enter 0.05, else enter 0 (13)

Percentage of windows and doors draught stripped (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.27 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

DER WorkSheet: New dwelling design stage

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

0.34	0.33	0.33	0.29	0.29	0.25	0.25	0.25	0.27	0.29	0.3	0.31
------	------	------	------	------	------	------	------	------	------	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.56 0.56 0.55 0.54 0.54 0.53 0.53 0.53 0.54 0.54 0.54 0.55 (24d)

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

(25)m= 0.56 0.56 0.55 0.54 0.54 0.53 0.53 0.53 0.54 0.54 0.54 0.55 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Windows Type 3			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Floor			74	$\times$ 0.11	= 8.14		(28)
Walls	30.98	6.66	24.32	$\times$ 0.19	= 4.62		(29)
Total area of elements, m²			104.98				(31)
Party wall			53.36	$\times$ 0	= 0		(32)
Party ceiling			74				(32b)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 21.59 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 9556.72 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 10.07 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 31.66 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	32.67	32.54	32.41	31.81	31.7	31.17	31.17	31.07	31.37	31.7	31.92	32.16

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

(39)m=	64.33	64.2	64.07	63.47	63.36	62.83	62.83	62.74	63.03	63.36	63.58	63.82
Average = Sum(39) _{1...12} /12=												63.47 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.87	0.87	0.87	0.86	0.86	0.85	0.85	0.85	0.85	0.86	0.86	0.86		
Average = Sum(40) _{1...12} / 12 =													0.86	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.34

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

89.76

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
Total = Sum(44) _{1...12} =													1077.07	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8		
Total = Sum(45) _{1...12} =													1412.21	(45)

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

(46)m=	21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

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

(61)m=	16.23	14.62	16.13	15.54	16.01	15.44	15.92	15.98	15.5	16.08	15.64	16.21	(61)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	162.65	142.68	148.27	130.75	126.56	110.83	104.32	117.41	118.14	135.7	146.22	158.01	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	162.65	142.68	148.27	130.75	126.56	110.83	104.32	117.41	118.14	135.7	146.22	158.01	
Output from water heater (annual) _{1...12}												1601.53	(64)

Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m=	52.74	46.23	47.97	42.19	40.76	35.58	33.37	37.72	38	43.79	47.33	51.2	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	(66)

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

(67)m=	21.72	19.29	15.69	11.88	8.88	7.49	8.1	10.53	14.13	17.94	20.94	22.32	(67)
--------	-------	-------	-------	-------	------	------	-----	-------	-------	-------	-------	-------	------

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

(68)m=	206.45	208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34	(68)
--------	--------	--------	--------	-------	--------	--------	--------	-------	-------	-------	-------	--------	------

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

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(69)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	70.89	68.8	64.48	58.6	54.78	49.41	44.85	50.7	52.78	58.86	65.73	68.82	(72)
--------	-------	------	-------	------	-------	-------	-------	------	-------	-------	-------	-------	------

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

(73)m=	360.14	357.77	344.44	323.26	301.94	281.55	268.49	274.62	285.7	307.09	331.46	349.56	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.78	x	10.63	x	0.63	x	0.7	=	12.28 (74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.63	x	0.7	=	4.68 (74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.63	x	0.7	=	4.68 (74)
North	0.9x	0.77	x	3.78	x	20.32	x	0.63	x	0.7	=	23.48 (74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.63	x	0.7	=	8.94 (74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.44	x	20.32	x	0.63	x	0.7	=	8.94	(74)
North	0.9x	0.77	x	3.78	x	34.53	x	0.63	x	0.7	=	39.89	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.63	x	0.7	=	15.2	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.63	x	0.7	=	15.2	(74)
North	0.9x	0.77	x	3.78	x	55.46	x	0.63	x	0.7	=	64.07	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.63	x	0.7	=	24.41	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.63	x	0.7	=	24.41	(74)
North	0.9x	0.77	x	3.78	x	74.72	x	0.63	x	0.7	=	86.31	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.63	x	0.7	=	32.88	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.63	x	0.7	=	32.88	(74)
North	0.9x	0.77	x	3.78	x	79.99	x	0.63	x	0.7	=	92.4	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.63	x	0.7	=	35.2	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.63	x	0.7	=	35.2	(74)
North	0.9x	0.77	x	3.78	x	74.68	x	0.63	x	0.7	=	86.27	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.63	x	0.7	=	32.86	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.63	x	0.7	=	32.86	(74)
North	0.9x	0.77	x	3.78	x	59.25	x	0.63	x	0.7	=	68.44	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.63	x	0.7	=	26.07	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.63	x	0.7	=	26.07	(74)
North	0.9x	0.77	x	3.78	x	41.52	x	0.63	x	0.7	=	47.96	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.63	x	0.7	=	18.27	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.63	x	0.7	=	18.27	(74)
North	0.9x	0.77	x	3.78	x	24.19	x	0.63	x	0.7	=	27.94	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.63	x	0.7	=	10.65	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.63	x	0.7	=	10.65	(74)
North	0.9x	0.77	x	3.78	x	13.12	x	0.63	x	0.7	=	15.15	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.63	x	0.7	=	5.77	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.63	x	0.7	=	5.77	(74)
North	0.9x	0.77	x	3.78	x	8.86	x	0.63	x	0.7	=	10.24	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.63	x	0.7	=	3.9	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.63	x	0.7	=	3.9	(74)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 21.64 41.36 70.28 112.89 152.08 162.8 152 120.59 84.5 49.23 26.7 18.04 (83)

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

(84)m= 381.78 399.13 414.72 436.15 454.01 444.35 420.48 395.21 370.2 356.32 358.16 367.61 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	1	1	1	0.99	0.95	0.82	0.64	0.7	0.92	0.99	1	1

(86)

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

(87)m= 20.07 20.15 20.31 20.55 20.79 20.95 20.99 20.98 20.88 20.59 20.29 20.06 (87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.19	20.2	20.2	20.2	20.2	20.21	20.21	20.21	20.21	20.2	20.2	20.2	(88)
--------	-------	------	------	------	------	-------	-------	-------	-------	------	------	------	------

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

(89)m=	1	1	1	0.98	0.93	0.75	0.53	0.6	0.88	0.99	1	1	(89)
--------	---	---	---	------	------	------	------	-----	------	------	---	---	------

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

(90)m=	18.94	19.05	19.29	19.64	19.97	20.17	20.21	20.2	20.09	19.7	19.27	18.92	(90)
--------	-------	-------	-------	-------	-------	-------	-------	------	-------	------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.34 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.32	19.42	19.63	19.94	20.25	20.43	20.47	20.47	20.36	20	19.62	19.3	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	------	------

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

(93)m=	19.32	19.42	19.63	19.94	20.25	20.43	20.47	20.47	20.36	20	19.62	19.3	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	1	1	0.99	0.98	0.93	0.77	0.57	0.63	0.89	0.98	1	1	(94)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	381.13	398.07	412.35	428	421.5	342.24	240.23	249.65	329.97	350.88	356.96	367.12	(95)
--------	--------	--------	--------	-----	-------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m - (96)m]

(97)m=	966.32	932.34	841.36	701.02	541.6	366.59	243.29	255.23	394.46	595.6	795.76	963.83	(97)
--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	-------	--------	--------	------

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

(98)m=	435.38	359.03	319.18	196.58	89.36	0	0	0	0	182.07	315.94	443.96	(98)
--------	--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 2341.49 \quad (98)$$

Space heating requirement in kWh/m²/year

$$31.64 \quad (99)$$

9a. Energy requirements – Individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) = 1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] = 1 \quad (204)$$

Efficiency of main space heating system 1

$$93.5 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

kWh/year

Space heating requirement (calculated above)

435.38	359.03	319.18	196.58	89.36	0	0	0	0	182.07	315.94	443.96
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

465.64	383.99	341.37	210.24	95.57	0	0	0	0	194.73	337.9	474.82
--------	--------	--------	--------	-------	---	---	---	---	--------	-------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 2504.26 \quad (211)$$

Space heating fuel (secondary), kWh/month

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	(215)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

162.65	142.68	148.27	130.75	126.56	110.83	104.32	117.41	118.14	135.7	146.22	158.01
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------

Efficiency of water heater

87.3 (216)

(217)m= 89.61 89.57 89.46 89.19 88.6 87.3 87.3 87.3 87.3 89.11 89.46 89.64 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

181.51	159.3	165.74	146.59	142.85	126.96	119.49	134.49	135.33	152.3	163.44	176.27
--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------

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

1804.27 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

2504.26

Water heating fuel used

1804.27

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75 (231)

Electricity for lighting

383.53 (232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	540.92 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	389.72 (264)
Space and water heating	(261) + (262) + (263) + (264) =		930.64 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	199.05 (268)
Total CO2, kg/year		sum of (265)...(271) =	1168.62 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	15.79 (273)
EI rating (section 14)			87 (274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Caversham 2BF EXP 74 North

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	74 (1a) x	2.4 (2a) =	177.6 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	177.6 (5)

2. Ventilation rate:

	main heating	secondary heating	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				3 x 10 =	30 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30 ÷ (5) = 0.17 (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]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 (12)

If no draught lobby, enter 0.05, else enter 0 (13)

Percentage of windows and doors draught stripped (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.36 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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TER WorkSheet: New dwelling design stage

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

0.45	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42
------	------	------	------	------	------	------	------	------	------	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.6 0.6 0.6 0.58 0.57 0.56 0.56 0.55 0.56 0.57 0.58 0.59 (24d)

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

(25)m= 0.6 0.6 0.6 0.58 0.57 0.56 0.56 0.55 0.56 0.57 0.58 0.59 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Windows Type 3			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Floor			74	$\times$ 0.13	= 9.62		(28)
Walls	30.98	6.66	24.32	$\times$ 0.18	= 4.38		(29)
Total area of elements, m²			104.98				(31)
Party wall			53.36	$\times$ 0	= 0		(32)
Party ceiling			74				(32b)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 22.83 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 9556.72 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 9.06 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 31.89 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	35.34	35.11	34.88	33.8	33.6	32.66	32.66	32.48	33.02	33.6	34.01	34.43

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

(39)m= 67.23 67 66.77 65.69 65.49 64.55 64.55 64.37 64.91 65.49 65.9 66.32
Average = Sum(39)_{1...12} /12= 65.69 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.91	0.91	0.9	0.89	0.88	0.87	0.87	0.87	0.88	0.88	0.89	0.9		
Average = Sum(40) _{1...12} / 12 =													0.89	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.34

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

89.76

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
Total = Sum(44) _{1...12} =													1077.07	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8		
Total = Sum(45) _{1...12} =													1412.21	(45)

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

(46)m=	21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

TER WorkSheet: New dwelling design stage

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

(61)m=	50.31	43.79	46.65	43.38	42.99	39.84	41.16	42.99	43.38	46.65	46.92	50.31	(61)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	196.73	171.85	178.8	158.58	153.54	135.23	129.56	144.43	146.02	166.27	177.49	192.11	(62)
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	196.73	171.85	178.8	158.58	153.54	135.23	129.56	144.43	146.02	166.27	177.49	192.11	
Output from water heater (annual) _{1...12}												1950.6	(64)

Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m=	61.26	53.53	55.6	49.15	47.5	41.68	39.68	44.47	44.97	51.44	55.15	59.73	(65)
--------	-------	-------	------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	(66)

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

(67)m=	21.72	19.29	15.69	11.88	8.88	7.49	8.1	10.53	14.13	17.94	20.94	22.32	(67)
--------	-------	-------	-------	-------	------	------	-----	-------	-------	-------	-------	-------	------

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

(68)m=	206.45	208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34	(68)
--------	--------	--------	--------	-------	--------	--------	--------	-------	-------	-------	-------	--------	------

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

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(69)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	82.34	79.65	74.73	68.26	63.85	57.88	53.34	59.78	62.46	69.14	76.59	80.28	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	371.59	368.62	354.7	332.93	311.01	290.02	276.97	283.7	295.38	317.36	342.32	361.02	(73)
--------	--------	--------	-------	--------	--------	--------	--------	-------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.78	x	10.63	x	0.63	x	0.7	=	12.28 (74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.63	x	0.7	=	4.68 (74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.63	x	0.7	=	4.68 (74)
North	0.9x	0.77	x	3.78	x	20.32	x	0.63	x	0.7	=	23.48 (74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.63	x	0.7	=	8.94 (74)

TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.44	x	20.32	x	0.63	x	0.7	=	8.94	(74)
North	0.9x	0.77	x	3.78	x	34.53	x	0.63	x	0.7	=	39.89	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.63	x	0.7	=	15.2	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.63	x	0.7	=	15.2	(74)
North	0.9x	0.77	x	3.78	x	55.46	x	0.63	x	0.7	=	64.07	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.63	x	0.7	=	24.41	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.63	x	0.7	=	24.41	(74)
North	0.9x	0.77	x	3.78	x	74.72	x	0.63	x	0.7	=	86.31	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.63	x	0.7	=	32.88	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.63	x	0.7	=	32.88	(74)
North	0.9x	0.77	x	3.78	x	79.99	x	0.63	x	0.7	=	92.4	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.63	x	0.7	=	35.2	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.63	x	0.7	=	35.2	(74)
North	0.9x	0.77	x	3.78	x	74.68	x	0.63	x	0.7	=	86.27	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.63	x	0.7	=	32.86	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.63	x	0.7	=	32.86	(74)
North	0.9x	0.77	x	3.78	x	59.25	x	0.63	x	0.7	=	68.44	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.63	x	0.7	=	26.07	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.63	x	0.7	=	26.07	(74)
North	0.9x	0.77	x	3.78	x	41.52	x	0.63	x	0.7	=	47.96	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.63	x	0.7	=	18.27	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.63	x	0.7	=	18.27	(74)
North	0.9x	0.77	x	3.78	x	24.19	x	0.63	x	0.7	=	27.94	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.63	x	0.7	=	10.65	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.63	x	0.7	=	10.65	(74)
North	0.9x	0.77	x	3.78	x	13.12	x	0.63	x	0.7	=	15.15	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.63	x	0.7	=	5.77	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.63	x	0.7	=	5.77	(74)
North	0.9x	0.77	x	3.78	x	8.86	x	0.63	x	0.7	=	10.24	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.63	x	0.7	=	3.9	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.63	x	0.7	=	3.9	(74)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=

21.64	41.36	70.28	112.89	152.08	162.8	152	120.59	84.5	49.23	26.7	18.04
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 (83)

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

(84)m=

393.24	409.98	424.98	445.82	463.08	452.82	428.96	404.29	379.88	366.59	369.02	379.07
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (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)

(86)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1	1	0.99	0.95	0.82	0.64	0.7	0.92	0.99	1	1

 (86)

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

(87)m=

20.03	20.11	20.28	20.53	20.77	20.94	20.99	20.98	20.87	20.58	20.27	20.02
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (87)

TER WorkSheet: New dwelling design stage

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

(88)m=	20.16	20.16	20.17	20.18	20.18	20.19	20.19	20.19	20.19	20.18	20.18	20.17	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	1	1	0.98	0.93	0.75	0.54	0.59	0.88	0.99	1	1	(89)
--------	---	---	---	------	------	------	------	------	------	------	---	---	------

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

(90)m=	18.85	18.97	19.21	19.59	19.93	20.15	20.19	20.19	20.07	19.66	19.21	18.84	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.34 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.25	19.35	19.57	19.9	20.22	20.42	20.46	20.45	20.34	19.97	19.57	19.24	(92)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	19.25	19.35	19.57	19.9	20.22	20.42	20.46	20.45	20.34	19.97	19.57	19.24	(93)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	1	1	0.99	0.98	0.93	0.77	0.57	0.63	0.89	0.98	1	1	(94)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	392.45	408.74	422.32	437.08	429.74	349.11	245.59	254.96	337.54	360.49	367.59	378.46	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m - (96)m]

(97)m=	1005.1	968.48	872.81	722.9	557.81	375.51	249.04	261.03	404.94	613.6	821.72	997.65	(97)
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	-------	--------	--------	------

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

(98)m=	455.82	376.14	335.16	205.79	95.28	0	0	0	0	188.31	326.97	460.67	(98)
--------	--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 2444.16 \quad (98)$$

Space heating requirement in kWh/m²/year

$$33.03 \quad (99)$$

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) = 1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] = 1 \quad (204)$$

Efficiency of main space heating system 1

$$93.4 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

kWh/year

Space heating requirement (calculated above)

455.82	376.14	335.16	205.79	95.28	0	0	0	0	188.31	326.97	460.67
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

488.02	402.72	358.85	220.33	102.02	0	0	0	0	201.62	350.08	493.22
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 2616.87 \quad (211)$$

Space heating fuel (secondary), kWh/month

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	(215)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

TER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

196.73	171.85	178.8	158.58	153.54	135.23	129.56	144.43	146.02	166.27	177.49	192.11
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

80.3 (216)

(217)m= 87.1 86.97 86.61 85.71 83.89 80.3 80.3 80.3 80.3 85.37 86.57 87.17 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

225.87	197.59	206.44	185.03	183.02	168.4	161.34	179.86	181.84	194.78	205.03	220.38
--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------

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

2309.58 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

2616.87

Water heating fuel used

2309.58

Electricity for pumps, fans and electric keep-hot

central heating pump:

30

(230c)

boiler with a fan-assisted flue

45

(230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75 (231)

Electricity for lighting

383.53 (232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	565.24 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	498.87 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1064.11 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	199.05 (268)
Total CO2, kg/year		sum of (265)...(271) =	1302.09 (272)

TER =

17.6 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Caversham 2BF EXP 74 South

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	74 (1a) x	2.4 (2a) =	177.6 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	177.6 (5)

2. Ventilation rate:

	main heating	secondary heating	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				2 x 10 =	20 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20 ÷ (5) = 0.11 (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]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 4 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.31 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.27 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

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

0.34	0.33	0.33	0.29	0.29	0.25	0.25	0.25	0.27	0.29	0.3	0.31
------	------	------	------	------	------	------	------	------	------	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.56 0.56 0.55 0.54 0.54 0.53 0.53 0.53 0.54 0.54 0.54 0.55 (24d)

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

(25)m= 0.56 0.56 0.55 0.54 0.54 0.53 0.53 0.53 0.54 0.54 0.54 0.55 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Windows Type 3			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Floor			74	x 0.11 =	8.14		(28)
Walls	25.04	6.66	18.38	x 0.19 =	3.49		(29)
Total area of elements, m²			99.04				(31)
Party wall			59.55	x 0 =	0		(32)
Party ceiling			74				(32b)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 20.46 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 9323.75 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 9.69 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 30.15 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	32.67	32.54	32.41	31.81	31.7	31.17	31.17	31.07	31.37	31.7	31.92	32.16

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

(39)m=	62.82	62.69	62.56	61.96	61.85	61.32	61.32	61.23	61.53	61.85	62.07	62.31
Average = Sum(39) _{1...12} /12=												61.96 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.85	0.85	0.85	0.84	0.84	0.83	0.83	0.83	0.83	0.84	0.84	0.84		
Average = Sum(40) _{1...12} / 12 =													0.84	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.34

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

89.76

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
Total = Sum(44) _{1...12} =													1077.07	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8		
Total = Sum(45) _{1...12} =													1412.21	(45)

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

(46)m=	21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

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

(61)m=	16.23	14.62	16.13	15.54	16.01	15.44	15.92	15.98	15.5	16.08	15.64	16.21	(61)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	162.65	142.68	148.27	130.75	126.56	110.83	104.32	117.41	118.14	135.7	146.22	158.01	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	162.65	142.68	148.27	130.75	126.56	110.83	104.32	117.41	118.14	135.7	146.22	158.01	
Output from water heater (annual) _{1...12}												1601.53	(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	52.74	46.23	47.97	42.19	40.76	35.58	33.37	37.72	38	43.79	47.33	51.2	(65)
--------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	-------	------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	(66)

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

(67)m=	21.72	19.29	15.69	11.88	8.88	7.49	8.1	10.53	14.13	17.94	20.94	22.32	(67)
--------	-------	-------	-------	-------	------	------	-----	-------	-------	-------	-------	-------	------

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

(68)m=	206.45	208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34	(68)
--------	--------	--------	--------	-------	--------	--------	--------	-------	-------	-------	-------	--------	------

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

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(69)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	70.89	68.8	64.48	58.6	54.78	49.41	44.85	50.7	52.78	58.86	65.73	68.82	(72)
--------	-------	------	-------	------	-------	-------	-------	------	-------	-------	-------	-------	------

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

(73)m=	360.14	357.77	344.44	323.26	301.94	281.55	268.49	274.62	285.7	307.09	331.46	349.56	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	3.78	x	46.75	x	0.63	x	0.7	=	54.01	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57	(78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.63	x	0.7	=	88.45	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 95.16 155.84 198.52 224.37 233.81 225.01 219.85 213.5 207.38 168.09 112.8 82.23 (83)

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

(84)m= 455.3 513.61 542.96 547.63 535.75 506.56 488.33 488.12 493.08 475.18 444.26 431.79 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	1	0.99	0.99	0.96	0.9	0.74	0.55	0.57	0.79	0.96	0.99	1

(86)

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

(87)m=	20.2	20.33	20.5	20.7	20.87	20.97	21	21	20.96	20.75	20.43	20.17
--------	------	-------	------	------	-------	-------	----	----	-------	-------	-------	-------

(87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.21	20.21	20.21	20.22	20.22	20.23	20.23	20.23	20.23	20.22	20.22	20.22	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	0.99	0.98	0.95	0.86	0.66	0.45	0.48	0.73	0.94	0.99	1	(89)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

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

(90)m=	19.14	19.33	19.57	19.86	20.09	20.21	20.23	20.23	20.19	19.93	19.48	19.1	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

$$fLA = \text{Living area} \div (4) = 0.34 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.5	19.67	19.89	20.15	20.36	20.47	20.49	20.49	20.45	20.21	19.8	19.46	(92)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

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

(93)m=	19.5	19.67	19.89	20.15	20.36	20.47	20.49	20.49	20.45	20.21	19.8	19.46	(93)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	1	0.99	0.98	0.95	0.87	0.69	0.49	0.51	0.75	0.94	0.99	1	(94)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	453.29	508.47	530.95	518.57	464.5	348.02	237.29	248.75	369.45	448.1	439.59	430.39	(95)
--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	-------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m - (96)m]

(97)m=	954.67	925.63	837.46	696.75	535.31	359.86	238.37	250.24	390.68	594.25	788.58	951.02	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	373.03	280.32	228.04	128.3	52.69	0	0	0	0	108.73	251.28	387.35	(98)
--------	--------	--------	--------	-------	-------	---	---	---	---	--------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 1809.73 \quad (98)$$

Space heating requirement in kWh/m²/year

$$24.46 \quad (99)$$

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) = 1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] = 1 \quad (204)$$

Efficiency of main space heating system 1

$$93.5 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

kWh/year

Space heating requirement (calculated above)

373.03	280.32	228.04	128.3	52.69	0	0	0	0	108.73	251.28	387.35
--------	--------	--------	-------	-------	---	---	---	---	--------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

398.96	299.81	243.9	137.21	56.35	0	0	0	0	116.29	268.74	414.27
--------	--------	-------	--------	-------	---	---	---	---	--------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 1935.54 \quad (211)$$

Space heating fuel (secondary), kWh/month

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	(215)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

162.65	142.68	148.27	130.75	126.56	110.83	104.32	117.41	118.14	135.7	146.22	158.01
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------

Efficiency of water heater

87.3 (216)

(217)m= 89.5 89.39 89.21 88.86 88.22 87.3 87.3 87.3 87.3 88.7 89.3 89.55 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

181.72	159.61	166.2	147.15	143.46	126.96	119.49	134.49	135.33	153	163.74	176.45
--------	--------	-------	--------	--------	--------	--------	--------	--------	-----	--------	--------

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

1807.6 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1935.54

Water heating fuel used

1807.6

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75 (231)

Electricity for lighting

383.53 (232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	418.08 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	390.44 (264)
Space and water heating	(261) + (262) + (263) + (264) =		808.52 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	199.05 (268)
Total CO2, kg/year		sum of (265)...(271) =	1046.5 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	14.14 (273)
EI rating (section 14)			88 (274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Caversham 2BF EXP 74 South

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	74 (1a)	2.4 (2a)	177.6 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	177.6 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				3	30 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.17 (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

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry 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

Percentage of windows and doors draught stripped

Window infiltration

Infiltration rate

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) ÷ 20] + (8), otherwise (18) = (16)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered

Shelter factor

Infiltration rate incorporating shelter factor

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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TER WorkSheet: New dwelling design stage

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

0.45	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.6 0.6 0.6 0.58 0.57 0.56 0.56 0.55 0.56 0.57 0.58 0.59 (24d)

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

(25)m= 0.6 0.6 0.6 0.58 0.57 0.56 0.56 0.55 0.56 0.57 0.58 0.59 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Windows Type 3			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Floor			74	x 0.13 =	9.62		(28)
Walls	25.04	6.66	18.38	x 0.18 =	3.31		(29)
Total area of elements, m²			99.04				(31)
Party wall			59.55	x 0 =	0		(32)
Party ceiling			74				(32b)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 21.76 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 9323.75 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 8.68 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 30.44 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	35.34	35.11	34.88	33.8	33.6	32.66	32.66	32.48	33.02	33.6	34.01	34.43

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

(39)m= 65.78 65.55 65.32 64.24 64.04 63.1 63.1 62.92 63.46 64.04 64.45 64.87
Average = Sum(39)_{1...12} /12= 64.24 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.89	0.89	0.88	0.87	0.87	0.85	0.85	0.85	0.86	0.87	0.87	0.88		
	Average = Sum(40) _{1...12} / 12 =												0.87	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.34

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

89.76

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
	Total = Sum(44) _{1...12} =												1077.07	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8		
	Total = Sum(45) _{1...12} =												1412.21	(45)

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

(46)m=	21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
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TER WorkSheet: New dwelling design stage

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

(61)m=	50.31	43.79	46.65	43.38	42.99	39.84	41.16	42.99	43.38	46.65	46.92	50.31	(61)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	196.73	171.85	178.8	158.58	153.54	135.23	129.56	144.43	146.02	166.27	177.49	192.11	(62)
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	196.73	171.85	178.8	158.58	153.54	135.23	129.56	144.43	146.02	166.27	177.49	192.11	
Output from water heater (annual) _{1...12}												1950.6	(64)

Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m=	61.26	53.53	55.6	49.15	47.5	41.68	39.68	44.47	44.97	51.44	55.15	59.73	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	(66)

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

(67)m=	21.72	19.29	15.69	11.88	8.88	7.49	8.1	10.53	14.13	17.94	20.94	22.32	(67)
--------	-------	-------	-------	-------	------	------	-----	-------	-------	-------	-------	-------	------

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

(68)m=	206.45	208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34	(68)
--------	--------	--------	--------	-------	--------	--------	--------	-------	-------	-------	-------	--------	------

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

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(69)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	82.34	79.65	74.73	68.26	63.85	57.88	53.34	59.78	62.46	69.14	76.59	80.28	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	371.59	368.62	354.7	332.93	311.01	290.02	276.97	283.7	295.38	317.36	342.32	361.02	(73)
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6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	3.78	x	46.75	x	0.63	x	0.7	=	54.01	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57	(78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.63	x	0.7	=	88.45	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)

TER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 95.16 155.84 198.52 224.37 233.81 225.01 219.85 213.5 207.38 168.09 112.8 82.23 (83)

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

(84)m= 466.75 524.46 553.22 557.3 544.81 515.03 496.81 497.2 502.76 485.45 455.12 443.25 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	1	0.99	0.99	0.96	0.9	0.74	0.55	0.57	0.8	0.96	0.99	1

(86)

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

(87)m= 20.16 20.29 20.46 20.68 20.86 20.97 21 20.99 20.95 20.73 20.41 20.14 (87)

TER WorkSheet: New dwelling design stage

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

(88)m=	20.18	20.18	20.18	20.19	20.2	20.21	20.21	20.21	20.2	20.2	20.19	20.19	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.95	0.86	0.67	0.46	0.48	0.73	0.94	0.99	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.05	19.24	19.5	19.81	20.05	20.19	20.21	20.21	20.17	19.89	19.42	19.02	(90)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.34 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.42	19.59	19.82	20.1	20.32	20.45	20.47	20.47	20.43	20.17	19.76	19.4	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.42	19.59	19.82	20.1	20.32	20.45	20.47	20.47	20.43	20.17	19.76	19.4	(93)
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8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	1	0.99	0.98	0.95	0.87	0.69	0.49	0.51	0.75	0.94	0.99	1	(94)
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Useful gains, hmGm, W = (94)m x (84)m

(95)m=	464.48	518.97	540.85	527.88	473.87	355.8	243.08	254.58	378.01	457.47	449.99	441.63	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m - (96)m]

(97)m=	994.74	963.15	870.24	719.66	552.32	369.24	244.38	256.33	401.75	613.12	815.58	986.01	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	394.51	298.49	245.07	138.08	58.37	0	0	0	0	115.8	263.23	405.02	(98)
--------	--------	--------	--------	--------	-------	---	---	---	---	-------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 1918.55 \quad (98)$$

Space heating requirement in kWh/m²/year

$$25.93 \quad (99)$$

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) = 1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] = 1 \quad (204)$$

Efficiency of main space heating system 1

$$93.4 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

394.51	298.49	245.07	138.08	58.37	0	0	0	0	115.8	263.23	405.02
--------	--------	--------	--------	-------	---	---	---	---	-------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

422.39	319.58	262.38	147.84	62.49	0	0	0	0	123.98	281.83	433.64
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 2054.12 \quad (211)$$

Space heating fuel (secondary), kWh/month

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	(215)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

TER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

196.73	171.85	178.8	158.58	153.54	135.23	129.56	144.43	146.02	166.27	177.49	192.11
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

												80.3	(216)
--	--	--	--	--	--	--	--	--	--	--	--	------	-------

(217)m=	86.77	86.43	85.85	84.7	82.85	80.3	80.3	80.3	80.3	84.16	86.04	86.88	(217)
---------	-------	-------	-------	------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	226.73	198.83	208.28	187.22	185.32	168.4	161.34	179.86	181.84	197.57	206.29	221.11
---------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------

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

2322.78	(219)
---------	-------

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

2054.12

Water heating fuel used

2322.78

Electricity for pumps, fans and electric keep-hot

central heating pump:

30	(230c)
----	--------

boiler with a fan-assisted flue

45	(230e)
----	--------

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75	(231)
----	-------

Electricity for lighting

383.53	(232)
--------	-------

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	443.69 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	501.72 (264)
Space and water heating	(261) + (262) + (263) + (264) =		945.41 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	199.05 (268)
Total CO2, kg/year		sum of (265)...(271) =	1183.39 (272)

TER =	15.99	(273)
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DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Caversham 2BF MID 74 North

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	74 (1a) x	2.4 (2a) =	177.6 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	177.6 (5)

2. Ventilation rate:

	main heating	secondary heating	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				2 x 10 =	20 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20 ÷ (5) = 0.11 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 4 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.31 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.27 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

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

0.34	0.33	0.33	0.29	0.29	0.25	0.25	0.25	0.27	0.29	0.3	0.31
------	------	------	------	------	------	------	------	------	------	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.56 0.56 0.55 0.54 0.54 0.53 0.53 0.53 0.54 0.54 0.54 0.55 (24d)

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

(25)m= 0.56 0.56 0.55 0.54 0.54 0.53 0.53 0.53 0.54 0.54 0.54 0.55 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Windows Type 3			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Walls	30.98	6.66	24.32	x 0.19	= 4.62		(29)
Total area of elements, m²			30.98				(31)
Party wall			53.36	x 0	= 0		(32)
Party floor			74				(32a)
Party ceiling			74				(32b)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 13.45 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 7706.72 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 3.29 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 16.74 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

(38)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	32.67	32.54	32.41	31.81	31.7	31.17	31.17	31.07	31.37	31.7	31.92	32.16

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

(39)m=	49.4	49.27	49.15	48.54	48.43	47.91	47.91	47.81	48.11	48.43	48.66	48.9		
Average = Sum(39) _{1...12} /12=													48.54	(39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.67	0.67	0.66	0.66	0.65	0.65	0.65	0.65	0.65	0.65	0.66	0.66		
	Average = Sum(40) _{1...12} / 12 =												0.66	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.34

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

89.76

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
	Total = Sum(44) _{1...12} =												1077.07	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8		
	Total = Sum(45) _{1...12} =												1412.21	(45)

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

(46)m=	21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

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

(61)m=	16.23	14.62	16.13	15.54	16.01	15.44	15.92	15.98	15.5	16.08	15.64	16.21	(61)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	162.65	142.68	148.27	130.75	126.56	110.83	104.32	117.41	118.14	135.7	146.22	158.01	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	162.65	142.68	148.27	130.75	126.56	110.83	104.32	117.41	118.14	135.7	146.22	158.01	
Output from water heater (annual) _{1...12}												1601.53	(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	52.74	46.23	47.97	42.19	40.76	35.58	33.37	37.72	38	43.79	47.33	51.2	(65)
--------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	-------	------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	(66)

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

(67)m=	21.72	19.29	15.69	11.88	8.88	7.49	8.1	10.53	14.13	17.94	20.94	22.32	(67)
--------	-------	-------	-------	-------	------	------	-----	-------	-------	-------	-------	-------	------

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

(68)m=	206.45	208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34	(68)
--------	--------	--------	--------	-------	--------	--------	--------	-------	-------	-------	-------	--------	------

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

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(69)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	70.89	68.8	64.48	58.6	54.78	49.41	44.85	50.7	52.78	58.86	65.73	68.82	(72)
--------	-------	------	-------	------	-------	-------	-------	------	-------	-------	-------	-------	------

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

(73)m=	360.14	357.77	344.44	323.26	301.94	281.55	268.49	274.62	285.7	307.09	331.46	349.56	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d			Area m ²	Flux Table 6a			g_ Table 6b	FF Table 6c			Gains (W)	
North	0.9x	0.77	x	3.78	x	10.63	x	0.63	x	0.7	=	12.28	(74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.63	x	0.7	=	4.68	(74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.63	x	0.7	=	4.68	(74)
North	0.9x	0.77	x	3.78	x	20.32	x	0.63	x	0.7	=	23.48	(74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.63	x	0.7	=	8.94	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.44	x	20.32	x	0.63	x	0.7	=	8.94	(74)
North	0.9x	0.77	x	3.78	x	34.53	x	0.63	x	0.7	=	39.89	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.63	x	0.7	=	15.2	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.63	x	0.7	=	15.2	(74)
North	0.9x	0.77	x	3.78	x	55.46	x	0.63	x	0.7	=	64.07	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.63	x	0.7	=	24.41	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.63	x	0.7	=	24.41	(74)
North	0.9x	0.77	x	3.78	x	74.72	x	0.63	x	0.7	=	86.31	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.63	x	0.7	=	32.88	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.63	x	0.7	=	32.88	(74)
North	0.9x	0.77	x	3.78	x	79.99	x	0.63	x	0.7	=	92.4	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.63	x	0.7	=	35.2	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.63	x	0.7	=	35.2	(74)
North	0.9x	0.77	x	3.78	x	74.68	x	0.63	x	0.7	=	86.27	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.63	x	0.7	=	32.86	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.63	x	0.7	=	32.86	(74)
North	0.9x	0.77	x	3.78	x	59.25	x	0.63	x	0.7	=	68.44	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.63	x	0.7	=	26.07	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.63	x	0.7	=	26.07	(74)
North	0.9x	0.77	x	3.78	x	41.52	x	0.63	x	0.7	=	47.96	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.63	x	0.7	=	18.27	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.63	x	0.7	=	18.27	(74)
North	0.9x	0.77	x	3.78	x	24.19	x	0.63	x	0.7	=	27.94	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.63	x	0.7	=	10.65	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.63	x	0.7	=	10.65	(74)
North	0.9x	0.77	x	3.78	x	13.12	x	0.63	x	0.7	=	15.15	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.63	x	0.7	=	5.77	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.63	x	0.7	=	5.77	(74)
North	0.9x	0.77	x	3.78	x	8.86	x	0.63	x	0.7	=	10.24	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.63	x	0.7	=	3.9	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.63	x	0.7	=	3.9	(74)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 21.64 41.36 70.28 112.89 152.08 162.8 152 120.59 84.5 49.23 26.7 18.04 (83)

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

(84)m= 381.78 399.13 414.72 436.15 454.01 444.35 420.48 395.21 370.2 356.32 358.16 367.61 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	1	1	0.99	0.97	0.89	0.68	0.5	0.55	0.84	0.98	1	1

(86)

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

(87)m= 20.38 20.45 20.58 20.77 20.93 20.99 21 21 20.97 20.79 20.55 20.37 (87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.37	20.37	20.37	20.38	20.38	20.39	20.39	20.39	20.39	20.38	20.38	20.38	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	1	0.99	0.97	0.85	0.62	0.43	0.48	0.78	0.97	1	1	(89)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

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

(90)m=	19.53	19.63	19.82	20.1	20.31	20.38	20.39	20.39	20.36	20.12	19.79	19.51	(90)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.34 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.82	19.91	20.08	20.33	20.52	20.59	20.59	20.59	20.57	20.35	20.05	19.8	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

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

(93)m=	19.82	19.91	20.08	20.33	20.52	20.59	20.59	20.59	20.57	20.35	20.05	19.8	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	1	1	0.99	0.97	0.86	0.64	0.45	0.51	0.8	0.97	1	1	(94)
--------	---	---	------	------	------	------	------	------	-----	------	---	---	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	381.02	397.76	411.13	421.02	390.88	284	191.18	200.15	295.85	346.54	356.5	367.05	(95)
--------	--------	--------	--------	--------	--------	-----	--------	--------	--------	--------	-------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m - (96)m]

(97)m=	766.61	739.4	667.33	554.82	427.29	286.93	191.35	200.54	311.03	472.01	629.99	762.81	(97)
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	286.88	229.58	190.61	96.33	27.09	0	0	0	0	93.35	196.91	294.44	(98)
--------	--------	--------	--------	-------	-------	---	---	---	---	-------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 1415.19 \quad (98)$$

Space heating requirement in kWh/m²/year

$$19.12 \quad (99)$$

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) = 1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] = 1 \quad (204)$$

Efficiency of main space heating system 1

$$93.5 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

286.88	229.58	190.61	96.33	27.09	0	0	0	0	93.35	196.91	294.44
--------	--------	--------	-------	-------	---	---	---	---	-------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

306.82	245.55	203.86	103.03	28.97	0	0	0	0	99.84	210.6	314.91
--------	--------	--------	--------	-------	---	---	---	---	-------	-------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 1513.57 \quad (211)$$

Space heating fuel (secondary), kWh/month

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	(215)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

162.65	142.68	148.27	130.75	126.56	110.83	104.32	117.41	118.14	135.7	146.22	158.01
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------

Efficiency of water heater

87.3 (216)

(217)m= 89.32 89.25 89.07 88.63 87.85 87.3 87.3 87.3 87.3 88.58 89.11 89.36 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

182.1	159.87	166.47	147.52	144.06	126.96	119.49	134.49	135.33	153.2	164.09	176.83
-------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------

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

1810.42 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1513.57

Water heating fuel used

1810.42

Electricity for pumps, fans and electric keep-hot

central heating pump:

30

(230c)

boiler with a fan-assisted flue

45

(230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75 (231)

Electricity for lighting

383.53 (232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	326.93 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	391.05 (264)
Space and water heating	(261) + (262) + (263) + (264) =		717.98 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	199.05 (268)
Total CO2, kg/year		sum of (265)...(271) =	955.96 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	12.92 (273)
EI rating (section 14)			89 (274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Caversham 2BF MID 74 North

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	74 (1a) x	2.4 (2a) =	177.6 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	177.6 (5)

2. Ventilation rate:

	main heating	secondary heating	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				3 x 10 =	30 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30 ÷ (5) = 0.17 (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]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry 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

Percentage of windows and doors draught stripped

Window infiltration

0.25 - [0.2 x (14) ÷ 100] =

Infiltration rate

(8) + (10) + (11) + (12) + (13) + (15) =

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) ÷ 20] + (8), otherwise (18) = (16)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered

Shelter factor

(20) = 1 - [0.075 x (19)] =

Infiltration rate incorporating shelter factor

(21) = (18) x (20) =

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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TER WorkSheet: New dwelling design stage

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

0.45	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42
------	------	------	------	------	------	------	------	------	------	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59
-----	-----	-----	------	------	------	------	------	------	------	------	------

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

(25)m=

0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59
-----	-----	-----	------	------	------	------	------	------	------	------	------

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		
Windows Type 3			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		
Walls	30.98	6.66	24.32	x 0.18	4.38		
Total area of elements, m²			30.98				
Party wall			53.36	x 0	0		
Party floor			74				
Party ceiling			74				

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 13.21 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 7706.72 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 2.28 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 15.49 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	35.34	35.11	34.88	33.8	33.6	32.66	32.66	32.48	33.02	33.6	34.01	34.43

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

(39)m=	50.83	50.6	50.37	49.29	49.08	48.14	48.14	47.97	48.51	49.08	49.49	49.92
Average = Sum(39) _{1...12} /12=												49.28

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.69	0.68	0.68	0.67	0.66	0.65	0.65	0.65	0.66	0.66	0.67	0.67		
	Average = Sum(40) _{1...12} / 12 =												0.67	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.34

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

89.76

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
	Total = Sum(44) _{1...12} =												1077.07	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8		
	Total = Sum(45) _{1...12} =												1412.21	(45)

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

(46)m=	21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

TER WorkSheet: New dwelling design stage

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

(61)m=	50.31	43.79	46.65	43.38	42.99	39.84	41.16	42.99	43.38	46.65	46.92	50.31	(61)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	196.73	171.85	178.8	158.58	153.54	135.23	129.56	144.43	146.02	166.27	177.49	192.11	(62)
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	196.73	171.85	178.8	158.58	153.54	135.23	129.56	144.43	146.02	166.27	177.49	192.11	(64)
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Output from water heater (annual)_{1...12} 1950.6 (64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	61.26	53.53	55.6	49.15	47.5	41.68	39.68	44.47	44.97	51.44	55.15	59.73	(65)
--------	-------	-------	------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	(66)

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

(67)m=	21.72	19.29	15.69	11.88	8.88	7.49	8.1	10.53	14.13	17.94	20.94	22.32	(67)
--------	-------	-------	-------	-------	------	------	-----	-------	-------	-------	-------	-------	------

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

(68)m=	206.45	208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34	(68)
--------	--------	--------	--------	-------	--------	--------	--------	-------	-------	-------	-------	--------	------

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

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(69)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	82.34	79.65	74.73	68.26	63.85	57.88	53.34	59.78	62.46	69.14	76.59	80.28	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	371.59	368.62	354.7	332.93	311.01	290.02	276.97	283.7	295.38	317.36	342.32	361.02	(73)
--------	--------	--------	-------	--------	--------	--------	--------	-------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.78	x	10.63	x	0.63	x	0.7	=	12.28 (74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.63	x	0.7	=	4.68 (74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.63	x	0.7	=	4.68 (74)
North	0.9x	0.77	x	3.78	x	20.32	x	0.63	x	0.7	=	23.48 (74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.63	x	0.7	=	8.94 (74)

TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.44	x	20.32	x	0.63	x	0.7	=	8.94	(74)
North	0.9x	0.77	x	3.78	x	34.53	x	0.63	x	0.7	=	39.89	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.63	x	0.7	=	15.2	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.63	x	0.7	=	15.2	(74)
North	0.9x	0.77	x	3.78	x	55.46	x	0.63	x	0.7	=	64.07	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.63	x	0.7	=	24.41	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.63	x	0.7	=	24.41	(74)
North	0.9x	0.77	x	3.78	x	74.72	x	0.63	x	0.7	=	86.31	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.63	x	0.7	=	32.88	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.63	x	0.7	=	32.88	(74)
North	0.9x	0.77	x	3.78	x	79.99	x	0.63	x	0.7	=	92.4	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.63	x	0.7	=	35.2	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.63	x	0.7	=	35.2	(74)
North	0.9x	0.77	x	3.78	x	74.68	x	0.63	x	0.7	=	86.27	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.63	x	0.7	=	32.86	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.63	x	0.7	=	32.86	(74)
North	0.9x	0.77	x	3.78	x	59.25	x	0.63	x	0.7	=	68.44	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.63	x	0.7	=	26.07	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.63	x	0.7	=	26.07	(74)
North	0.9x	0.77	x	3.78	x	41.52	x	0.63	x	0.7	=	47.96	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.63	x	0.7	=	18.27	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.63	x	0.7	=	18.27	(74)
North	0.9x	0.77	x	3.78	x	24.19	x	0.63	x	0.7	=	27.94	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.63	x	0.7	=	10.65	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.63	x	0.7	=	10.65	(74)
North	0.9x	0.77	x	3.78	x	13.12	x	0.63	x	0.7	=	15.15	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.63	x	0.7	=	5.77	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.63	x	0.7	=	5.77	(74)
North	0.9x	0.77	x	3.78	x	8.86	x	0.63	x	0.7	=	10.24	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.63	x	0.7	=	3.9	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.63	x	0.7	=	3.9	(74)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=

21.64	41.36	70.28	112.89	152.08	162.8	152	120.59	84.5	49.23	26.7	18.04
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 (83)

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

(84)m=

393.24	409.98	424.98	445.82	463.08	452.82	428.96	404.29	379.88	366.59	369.02	379.07
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (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)

(86)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1	0.99	0.97	0.88	0.67	0.49	0.54	0.83	0.98	1	1

 (86)

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

(87)m=

20.37	20.44	20.57	20.77	20.93	20.99	21	21	20.97	20.79	20.55	20.36
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 (87)

TER WorkSheet: New dwelling design stage

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

(88)m=	20.35	20.36	20.36	20.37	20.37	20.38	20.38	20.39	20.38	20.37	20.37	20.36	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	1	0.99	0.96	0.85	0.61	0.42	0.47	0.77	0.97	1	1	(89)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

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

(90)m=	19.49	19.6	19.8	20.09	20.31	20.38	20.38	20.39	20.36	20.12	19.78	19.49	(90)
--------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.34 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.79	19.88	20.06	20.32	20.52	20.59	20.59	20.59	20.56	20.35	20.04	19.79	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	19.79	19.88	20.06	20.32	20.52	20.59	20.59	20.59	20.56	20.35	20.04	19.79	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	1	1	0.99	0.96	0.86	0.63	0.45	0.5	0.79	0.97	0.99	1	(94)
--------	---	---	------	------	------	------	------	-----	------	------	------	---	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	392.32	408.39	420.95	429.26	396.56	285.54	192.04	200.8	299.4	355.32	367.02	378.38	(95)
--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m - (96)m]

(97)m=	787.27	757.96	682.87	563.03	432.81	288.26	192.2	201.15	313.53	478.36	640.48	778.01	(97)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

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

(98)m=	293.84	234.92	194.87	96.31	26.97	0	0	0	0	91.55	196.89	297.32	(98)
--------	--------	--------	--------	-------	-------	---	---	---	---	-------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 1432.67 \quad (98)$$

Space heating requirement in kWh/m²/year

$$19.36 \quad (99)$$

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) = 1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] = 1 \quad (204)$$

Efficiency of main space heating system 1

$$93.4 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

kWh/year

Space heating requirement (calculated above)

293.84	234.92	194.87	96.31	26.97	0	0	0	0	91.55	196.89	297.32
--------	--------	--------	-------	-------	---	---	---	---	-------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

314.61	251.52	208.64	103.12	28.88	0	0	0	0	98.02	210.8	318.33
--------	--------	--------	--------	-------	---	---	---	---	-------	-------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 1533.9 \quad (211)$$

Space heating fuel (secondary), kWh/month

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	(215)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

TER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

196.73	171.85	178.8	158.58	153.54	135.23	129.56	144.43	146.02	166.27	177.49	192.11
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

80.3 (216)

(217)m= 86.06 85.84 85.27 83.84 81.66 80.3 80.3 80.3 80.3 83.62 85.31 86.15 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

228.6	200.2	209.69	189.15	188.01	168.4	161.34	179.86	181.84	198.85	208.05	223
-------	-------	--------	--------	--------	-------	--------	--------	--------	--------	--------	-----

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

2336.99 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1533.9

Water heating fuel used

2336.99

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75 (231)

Electricity for lighting

383.53 (232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	331.32 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	504.79 (264)
Space and water heating	(261) + (262) + (263) + (264) =		836.11 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	199.05 (268)
Total CO2, kg/year		sum of (265)...(271) =	1074.09 (272)

TER =

14.51 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Caversham 2BF MID 74 South

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	74 (1a)	2.4 (2a)	177.6 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	177.6 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				2	20 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.11 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 4 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.31 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.27 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

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

0.34	0.33	0.33	0.29	0.29	0.25	0.25	0.25	0.27	0.29	0.3	0.31
------	------	------	------	------	------	------	------	------	------	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.56 0.56 0.55 0.54 0.54 0.53 0.53 0.53 0.54 0.54 0.54 0.55 (24d)

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

(25)m= 0.56 0.56 0.55 0.54 0.54 0.53 0.53 0.53 0.54 0.54 0.54 0.55 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Windows Type 3			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Walls	25.04	6.66	18.38	x 0.19	= 3.49		(29)
Total area of elements, m²			25.04				(31)
Party wall			59.55	x 0	= 0		(32)
Party floor			74				(32a)
Party ceiling			74				(32b)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 12.32 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 7473.75 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 3.11 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 15.43 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	32.67	32.54	32.41	31.81	31.7	31.17	31.17	31.07	31.37	31.7	31.92	32.16

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

(39)m= 48.1 47.97 47.84 47.24 47.13 46.61 46.61 46.51 46.81 47.13 47.36 47.59
Average = Sum(39)_{1...12} /12= 47.24 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.65	0.65	0.65	0.64	0.64	0.63	0.63	0.63	0.63	0.64	0.64	0.64		
Average = Sum(40) _{1...12} / 12 =													0.64	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.34

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

89.76

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
Total = Sum(44) _{1...12} =													1077.07	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8		
Total = Sum(45) _{1...12} =													1412.21	(45)

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

(46)m=	21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

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

(61)m=	16.23	14.62	16.13	15.54	16.01	15.44	15.92	15.98	15.5	16.08	15.64	16.21	(61)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	162.65	142.68	148.27	130.75	126.56	110.83	104.32	117.41	118.14	135.7	146.22	158.01	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	162.65	142.68	148.27	130.75	126.56	110.83	104.32	117.41	118.14	135.7	146.22	158.01	
Output from water heater (annual) _{1...12}												1601.53	(64)

Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m=	52.74	46.23	47.97	42.19	40.76	35.58	33.37	37.72	38	43.79	47.33	51.2	(65)
--------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	-------	------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	(66)

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

(67)m=	21.72	19.29	15.69	11.88	8.88	7.49	8.1	10.53	14.13	17.94	20.94	22.32	(67)
--------	-------	-------	-------	-------	------	------	-----	-------	-------	-------	-------	-------	------

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

(68)m=	206.45	208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34	(68)
--------	--------	--------	--------	-------	--------	--------	--------	-------	-------	-------	-------	--------	------

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

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(69)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	70.89	68.8	64.48	58.6	54.78	49.41	44.85	50.7	52.78	58.86	65.73	68.82	(72)
--------	-------	------	-------	------	-------	-------	-------	------	-------	-------	-------	-------	------

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

(73)m=	360.14	357.77	344.44	323.26	301.94	281.55	268.49	274.62	285.7	307.09	331.46	349.56	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)		
South	0.9x	0.77	x	3.78	x	46.75	x	0.63	x	0.7	=	54.01	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57	(78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.63	x	0.7	=	88.45	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 95.16 155.84 198.52 224.37 233.81 225.01 219.85 213.5 207.38 168.09 112.8 82.23 (83)

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

(84)m= 455.3 513.61 542.96 547.63 535.75 506.56 488.33 488.12 493.08 475.18 444.26 431.79 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	1	0.99	0.97	0.91	0.78	0.59	0.42	0.44	0.65	0.91	0.99	1

(86)

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

(87)m= 20.51 20.63 20.76 20.9 20.97 21 21 21 21 20.92 20.69 20.48 (87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.39	20.39	20.39	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.39	20.39	(88)
--------	-------	-------	-------	------	------	------	------	------	------	------	-------	-------	------

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

(89)m=	0.99	0.98	0.96	0.89	0.74	0.53	0.36	0.38	0.59	0.88	0.98	1	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	---	------

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

(90)m=	19.73	19.9	20.09	20.28	20.37	20.4	20.4	20.4	20.4	20.31	20	19.69	(90)
--------	-------	------	-------	-------	-------	------	------	------	------	-------	----	-------	------

$$fLA = \text{Living area} \div (4) = 0.34 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.99	20.15	20.32	20.49	20.58	20.6	20.6	20.61	20.6	20.51	20.23	19.96	(92)
--------	-------	-------	-------	-------	-------	------	------	-------	------	-------	-------	-------	------

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

(93)m=	19.99	20.15	20.32	20.49	20.58	20.6	20.6	20.61	20.6	20.51	20.23	19.96	(93)
--------	-------	-------	-------	-------	-------	------	------	-------	------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.96	0.89	0.76	0.55	0.38	0.4	0.61	0.88	0.98	1	(94)
--------	------	------	------	------	------	------	------	-----	------	------	------	---	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	452.29	504.66	519.68	488.36	405.16	278.9	186.61	195.54	302.1	420.24	435.93	429.8	(95)
--------	--------	--------	--------	--------	--------	-------	--------	--------	-------	--------	--------	-------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m - (96)m]

(97)m=	754.86	731.42	661.19	547.44	418.35	279.78	186.64	195.59	304.22	467.16	621.93	750.13	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	225.11	152.39	105.28	42.54	9.81	0	0	0	0	34.91	133.92	238.33	(98)
--------	--------	--------	--------	-------	------	---	---	---	---	-------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 942.3 \quad (98)$$

Space heating requirement in kWh/m²/year

$$12.73 \quad (99)$$

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

$$1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

$$1 \quad (204)$$

Efficiency of main space heating system 1

$$93.5 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

kWh/year

Space heating requirement (calculated above)

225.11	152.39	105.28	42.54	9.81	0	0	0	0	34.91	133.92	238.33
--------	--------	--------	-------	------	---	---	---	---	-------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

240.76	162.98	112.6	45.5	10.49	0	0	0	0	37.34	143.23	254.9
--------	--------	-------	------	-------	---	---	---	---	-------	--------	-------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 1007.81 \quad (211)$$

Space heating fuel (secondary), kWh/month

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0	(215)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

162.65	142.68	148.27	130.75	126.56	110.83	104.32	117.41	118.14	135.7	146.22	158.01
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------

Efficiency of water heater

87.3 (216)

(217)m= 89.13 88.92 88.6 88.06 87.52 87.3 87.3 87.3 87.3 87.94 88.8 89.2 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

182.48	160.45	167.35	148.47	144.6	126.96	119.49	134.49	135.33	154.32	164.66	177.14
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------

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

1815.74 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1007.81

Water heating fuel used

1815.74

Electricity for pumps, fans and electric keep-hot

central heating pump:

30

(230c)

boiler with a fan-assisted flue

45

(230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75

(231)

Electricity for lighting

383.53

(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	217.69 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	392.2 (264)
Space and water heating	(261) + (262) + (263) + (264) =		609.89 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	199.05 (268)
Total CO2, kg/year		sum of (265)...(271) =	847.86 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	11.46 (273)
EI rating (section 14)			90 (274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Caversham 2BF MID 74 South

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	74 (1a) x	2.4 (2a) =	177.6 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	177.6 (5)

2. Ventilation rate:

	main heating	secondary heating	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				3 x 10 =	30 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30 ÷ (5) = 0.17 (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]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry 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

Percentage of windows and doors draught stripped

Window infiltration

0.25 - [0.2 x (14) ÷ 100] =

Infiltration rate

(8) + (10) + (11) + (12) + (13) + (15) =

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) ÷ 20] + (8), otherwise (18) = (16)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered

Shelter factor

(20) = 1 - [0.075 x (19)] =

Infiltration rate incorporating shelter factor

(21) = (18) x (20) =

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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TER WorkSheet: New dwelling design stage

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

0.45	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42
------	------	------	------	------	------	------	------	------	------	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.6 0.6 0.6 0.58 0.57 0.56 0.56 0.55 0.56 0.57 0.58 0.59 (24d)

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

(25)m= 0.6 0.6 0.6 0.58 0.57 0.56 0.56 0.55 0.56 0.57 0.58 0.59 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Windows Type 3			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Walls	25.04	6.66	18.38	$\times 0.18 =$	3.31		(29)
Total area of elements, m²			25.04				(31)
Party wall			59.55	$\times 0 =$	0		(32)
Party floor			74				(32a)
Party ceiling			74				(32b)

* for windows and roof windows, use effective window U-value calculated using formula $1/[1/(U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 12.14 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 7473.75 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 2.1 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 14.24 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	35.34	35.11	34.88	33.8	33.6	32.66	32.66	32.48	33.02	33.6	34.01	34.43

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

(39)m= 49.59 49.35 49.12 48.04 47.84 46.9 46.9 46.73 47.26 47.84 48.25 48.68
Average = Sum(39)_{1...12} /12= 48.04 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.67	0.67	0.66	0.65	0.65	0.63	0.63	0.63	0.64	0.65	0.65	0.66		
	Average = Sum(40) _{1...12} / 12 =												0.65	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.34

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

89.76

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
	Total = Sum(44) _{1...12} =												1077.07	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8		
	Total = Sum(45) _{1...12} =												1412.21	(45)

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

(46)m=	21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

TER WorkSheet: New dwelling design stage

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

(61)m=	50.31	43.79	46.65	43.38	42.99	39.84	41.16	42.99	43.38	46.65	46.92	50.31	(61)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	196.73	171.85	178.8	158.58	153.54	135.23	129.56	144.43	146.02	166.27	177.49	192.11	(62)
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	196.73	171.85	178.8	158.58	153.54	135.23	129.56	144.43	146.02	166.27	177.49	192.11	
Output from water heater (annual) _{1...12}												1950.6	(64)

Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m=	61.26	53.53	55.6	49.15	47.5	41.68	39.68	44.47	44.97	51.44	55.15	59.73	(65)
--------	-------	-------	------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	(66)

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

(67)m=	21.72	19.29	15.69	11.88	8.88	7.49	8.1	10.53	14.13	17.94	20.94	22.32	(67)
--------	-------	-------	-------	-------	------	------	-----	-------	-------	-------	-------	-------	------

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

(68)m=	206.45	208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34	(68)
--------	--------	--------	--------	-------	--------	--------	--------	-------	-------	-------	-------	--------	------

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

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(69)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	82.34	79.65	74.73	68.26	63.85	57.88	53.34	59.78	62.46	69.14	76.59	80.28	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	371.59	368.62	354.7	332.93	311.01	290.02	276.97	283.7	295.38	317.36	342.32	361.02	(73)
--------	--------	--------	-------	--------	--------	--------	--------	-------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)		
South	0.9x	0.77	x	3.78	x	46.75	x	0.63	x	0.7	=	54.01	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57	(78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.63	x	0.7	=	88.45	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)

TER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 95.16 155.84 198.52 224.37 233.81 225.01 219.85 213.5 207.38 168.09 112.8 82.23 (83)

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

(84)m= 466.75 524.46 553.22 557.3 544.81 515.03 496.81 497.2 502.76 485.45 455.12 443.25 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	1	0.99	0.97	0.91	0.78	0.58	0.42	0.43	0.64	0.9	0.99	1

(86)

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

(87)m= 20.49 20.61 20.75 20.9 20.97 21 21 21 21 20.92 20.69 20.48 (87)

TER WorkSheet: New dwelling design stage

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

(88)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	(88)
--------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	------

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

(89)m=	0.99	0.98	0.96	0.89	0.74	0.53	0.36	0.38	0.59	0.87	0.98	1	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	---	------

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

(90)m=	19.69	19.87	20.06	20.27	20.36	20.4	20.4	20.4	20.39	20.3	19.99	19.67	(90)
--------	-------	-------	-------	-------	-------	------	------	------	-------	------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.34 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.96	20.12	20.3	20.48	20.57	20.6	20.6	20.6	20.6	20.51	20.22	19.94	(92)
--------	-------	-------	------	-------	-------	------	------	------	------	-------	-------	-------	------

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

(93)m=	19.96	20.12	20.3	20.48	20.57	20.6	20.6	20.6	20.6	20.51	20.22	19.94	(93)
--------	-------	-------	------	-------	-------	------	------	------	------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.96	0.89	0.75	0.54	0.38	0.39	0.61	0.88	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	463.39	514.95	529.19	495.82	410.77	280.59	187.68	196.37	304.94	427.14	445.84	440.94	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m - (96)m]

(97)m=	776.59	751.06	677.71	556.29	424.35	281.44	187.71	196.42	307.01	473.96	633.21	766.31	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	233.02	158.67	110.5	43.54	10.11	0	0	0	0	34.84	134.91	242.08	(98)
--------	--------	--------	-------	-------	-------	---	---	---	---	-------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 967.66 \quad (98)$$

Space heating requirement in kWh/m²/year

$$13.08 \quad (99)$$

9a. Energy requirements – Individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) = 1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] = 1 \quad (204)$$

Efficiency of main space heating system 1

$$93.4 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

233.02	158.67	110.5	43.54	10.11	0	0	0	0	34.84	134.91	242.08
--------	--------	-------	-------	-------	---	---	---	---	-------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

249.48	169.88	118.31	46.62	10.82	0	0	0	0	37.3	144.44	259.19
--------	--------	--------	-------	-------	---	---	---	---	------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 1036.04 \quad (211)$$

Space heating fuel (secondary), kWh/month

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	(215)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

TER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

196.73	171.85	178.8	158.58	153.54	135.23	129.56	144.43	146.02	166.27	177.49	192.11
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

80.3 (216)

(217)m= 85.48 84.85 83.88 82.28 80.86 80.3 80.3 80.3 80.3 81.88 84.37 85.63 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	230.15	202.53	213.16	192.73	189.88	168.4	161.34	179.86	181.84	203.06	210.37	224.34
---------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------

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

2357.67 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1036.04

Water heating fuel used

2357.67

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75 (231)

Electricity for lighting

383.53 (232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	223.79 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	509.26 (264)
Space and water heating	(261) + (262) + (263) + (264) =		733.04 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	199.05 (268)
Total CO2, kg/year		sum of (265)...(271) =	971.02 (272)

TER =

13.12 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Caversham 2BF TOP 74 North

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	74 (1a) x	2.4 (2a) =	177.6 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	177.6 (5)

2. Ventilation rate:

	main heating	secondary heating	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				2 x 10 =	20 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20 ÷ (5) = 0.11 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 4 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.31 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.27 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

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

0.34	0.33	0.33	0.29	0.29	0.25	0.25	0.25	0.27	0.29	0.3	0.31
------	------	------	------	------	------	------	------	------	------	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.56 0.56 0.55 0.54 0.54 0.53 0.53 0.53 0.54 0.54 0.54 0.55 (24d)

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

(25)m= 0.56 0.56 0.55 0.54 0.54 0.53 0.53 0.53 0.54 0.54 0.54 0.55 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Windows Type 3			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Walls	30.98	6.66	24.32	x 0.19 =	4.62		(29)
Roof	74	0	74	x 0.15 =	11.1		(30)
Total area of elements, m²			104.98				(31)
Party wall			53.36	x 0 =	0		(32)
Party floor			74				(32a)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 24.55 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 6152.72 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 9.65 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 34.21 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	32.67	32.54	32.41	31.81	31.7	31.17	31.17	31.07	31.37	31.7	31.92	32.16

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

(39)m= 66.87 66.74 66.61 66.01 65.9 65.38 65.38 65.28 65.58 65.9 66.13 66.37
Average = Sum(39)_{1...12} /12= 66.01 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.9	0.9	0.9	0.89	0.89	0.88	0.88	0.88	0.89	0.89	0.89	0.9		
Average = Sum(40) _{1...12} / 12 =													0.89	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.34

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

89.76

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
Total = Sum(44) _{1...12} =													1077.07	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8		
Total = Sum(45) _{1...12} =													1412.21	(45)

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

(46)m=	21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

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

(61)m=	16.23	14.62	16.13	15.54	16.01	15.44	15.92	15.98	15.5	16.08	15.64	16.21	(61)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	162.65	142.68	148.27	130.75	126.56	110.83	104.32	117.41	118.14	135.7	146.22	158.01	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	162.65	142.68	148.27	130.75	126.56	110.83	104.32	117.41	118.14	135.7	146.22	158.01	
Output from water heater (annual) _{1...12}												1601.53	(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	52.74	46.23	47.97	42.19	40.76	35.58	33.37	37.72	38	43.79	47.33	51.2	(65)
--------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	-------	------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	(66)

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

(67)m=	21.72	19.29	15.69	11.88	8.88	7.49	8.1	10.53	14.13	17.94	20.94	22.32	(67)
--------	-------	-------	-------	-------	------	------	-----	-------	-------	-------	-------	-------	------

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

(68)m=	206.45	208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34	(68)
--------	--------	--------	--------	-------	--------	--------	--------	-------	-------	-------	-------	--------	------

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

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(69)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	70.89	68.8	64.48	58.6	54.78	49.41	44.85	50.7	52.78	58.86	65.73	68.82	(72)
--------	-------	------	-------	------	-------	-------	-------	------	-------	-------	-------	-------	------

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

(73)m=	360.14	357.77	344.44	323.26	301.94	281.55	268.49	274.62	285.7	307.09	331.46	349.56	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d			Area m ²	Flux Table 6a			g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.78	x	10.63	x	0.63	x	0.7	=	12.28	(74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.63	x	0.7	=	4.68	(74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.63	x	0.7	=	4.68	(74)
North	0.9x	0.77	x	3.78	x	20.32	x	0.63	x	0.7	=	23.48	(74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.63	x	0.7	=	8.94	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.44	x	20.32	x	0.63	x	0.7	=	8.94	(74)
North	0.9x	0.77	x	3.78	x	34.53	x	0.63	x	0.7	=	39.89	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.63	x	0.7	=	15.2	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.63	x	0.7	=	15.2	(74)
North	0.9x	0.77	x	3.78	x	55.46	x	0.63	x	0.7	=	64.07	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.63	x	0.7	=	24.41	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.63	x	0.7	=	24.41	(74)
North	0.9x	0.77	x	3.78	x	74.72	x	0.63	x	0.7	=	86.31	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.63	x	0.7	=	32.88	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.63	x	0.7	=	32.88	(74)
North	0.9x	0.77	x	3.78	x	79.99	x	0.63	x	0.7	=	92.4	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.63	x	0.7	=	35.2	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.63	x	0.7	=	35.2	(74)
North	0.9x	0.77	x	3.78	x	74.68	x	0.63	x	0.7	=	86.27	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.63	x	0.7	=	32.86	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.63	x	0.7	=	32.86	(74)
North	0.9x	0.77	x	3.78	x	59.25	x	0.63	x	0.7	=	68.44	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.63	x	0.7	=	26.07	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.63	x	0.7	=	26.07	(74)
North	0.9x	0.77	x	3.78	x	41.52	x	0.63	x	0.7	=	47.96	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.63	x	0.7	=	18.27	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.63	x	0.7	=	18.27	(74)
North	0.9x	0.77	x	3.78	x	24.19	x	0.63	x	0.7	=	27.94	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.63	x	0.7	=	10.65	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.63	x	0.7	=	10.65	(74)
North	0.9x	0.77	x	3.78	x	13.12	x	0.63	x	0.7	=	15.15	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.63	x	0.7	=	5.77	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.63	x	0.7	=	5.77	(74)
North	0.9x	0.77	x	3.78	x	8.86	x	0.63	x	0.7	=	10.24	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.63	x	0.7	=	3.9	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.63	x	0.7	=	3.9	(74)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 21.64 41.36 70.28 112.89 152.08 162.8 152 120.59 84.5 49.23 26.7 18.04 (83)

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

(84)m= 381.78 399.13 414.72 436.15 454.01 444.35 420.48 395.21 370.2 356.32 358.16 367.61 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	1	1	1	0.99	0.95	0.83	0.66	0.72	0.93	0.99	1	1

(86)

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

(87)m= 20.02 20.1 20.27 20.51 20.76 20.94 20.99 20.98 20.86 20.56 20.25 20.01 (87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.16	20.17	20.17	20.17	20.18	20.18	20.18	20.18	20.18	20.18	20.17	20.17	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	1	1	0.98	0.93	0.76	0.55	0.61	0.89	0.99	1	1	(89)
--------	---	---	---	------	------	------	------	------	------	------	---	---	------

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

(90)m=	18.84	18.96	19.2	19.56	19.91	20.13	20.18	20.17	20.05	19.63	19.18	18.82	(90)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.34 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.24	19.34	19.56	19.88	20.2	20.4	20.45	20.45	20.32	19.94	19.54	19.22	(92)
--------	-------	-------	-------	-------	------	------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	19.24	19.34	19.56	19.88	20.2	20.4	20.45	20.45	20.32	19.94	19.54	19.22	(93)
--------	-------	-------	-------	-------	------	------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	1	1	0.99	0.98	0.93	0.79	0.59	0.65	0.9	0.99	1	1	(94)
--------	---	---	------	------	------	------	------	------	-----	------	---	---	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	381.13	398.08	412.42	428.47	423.99	349.08	247.52	256.63	333.04	351.16	356.97	367.11	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m - (96)m]

(97)m=	999.14	964.05	869.92	724.92	560.09	379.46	251.73	264.09	407.86	615.77	822.96	996.88	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	459.8	380.33	340.38	213.44	101.26	0	0	0	0	196.87	335.51	468.55	(98)
--------	-------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 2496.13 \quad (98)$$

Space heating requirement in kWh/m²/year

$$33.73 \quad (99)$$

9a. Energy requirements – Individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) = 1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] = 1 \quad (204)$$

Efficiency of main space heating system 1

$$93.5 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

kWh/year

Space heating requirement (calculated above)

459.8	380.33	340.38	213.44	101.26	0	0	0	0	196.87	335.51	468.55
-------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

491.77	406.77	364.04	228.28	108.3	0	0	0	0	210.55	358.83	501.12
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 2669.66 \quad (211)$$

Space heating fuel (secondary), kWh/month

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	(215)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

162.65	142.68	148.27	130.75	126.56	110.83	104.32	117.41	118.14	135.7	146.22	158.01
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------

Efficiency of water heater

87.3 (216)

(217)m= 89.64 89.6 89.5 89.26 88.69 87.3 87.3 87.3 87.3 89.17 89.5 89.67 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

181.44	159.23	165.66	146.49	142.69	126.96	119.49	134.49	135.33	152.19	163.36	176.21
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

1803.54 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

2669.66

Water heating fuel used

1803.54

Electricity for pumps, fans and electric keep-hot

central heating pump:

30

(230c)

boiler with a fan-assisted flue

45

(230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75

(231)

Electricity for lighting

383.53

(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	576.65 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	389.56 (264)
Space and water heating	(261) + (262) + (263) + (264) =		966.21 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	199.05 (268)
Total CO2, kg/year		sum of (265)...(271) =	1204.19 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	16.27 (273)
EI rating (section 14)			86 (274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Caversham 2BF TOP 74 North

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	74 (1a) x	2.4 (2a) =	177.6 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	177.6 (5)

2. Ventilation rate:

	main heating	secondary heating	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				3 x 10 =	30 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30 ÷ (5) = 0.17 (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]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry 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

Percentage of windows and doors draught stripped

Window infiltration

0.25 - [0.2 x (14) ÷ 100] =

Infiltration rate

(8) + (10) + (11) + (12) + (13) + (15) =

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) ÷ 20] + (8), otherwise (18) = (16)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered

Shelter factor

(20) = 1 - [0.075 x (19)] =

Infiltration rate incorporating shelter factor

(21) = (18) x (20) =

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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TER WorkSheet: New dwelling design stage

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

0.45	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42
------	------	------	------	------	------	------	------	------	------	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.6 0.6 0.6 0.58 0.57 0.56 0.56 0.55 0.56 0.57 0.58 0.59 (24d)

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

(25)m= 0.6 0.6 0.6 0.58 0.57 0.56 0.56 0.55 0.56 0.57 0.58 0.59 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Windows Type 3			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Walls	30.98	6.66	24.32	x 0.18 =	4.38		(29)
Roof	74	0	74	x 0.13 =	9.62		(30)
Total area of elements, m²			104.98				(31)
Party wall			53.36	x 0 =	0		(32)
Party floor			74				(32a)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 22.83 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 6152.72 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 5.98 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 28.81 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	35.34	35.11	34.88	33.8	33.6	32.66	32.66	32.48	33.02	33.6	34.01	34.43

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

(39)m=	64.15	63.92	63.69	62.61	62.4	61.46	61.46	61.29	61.83	62.4	62.81	63.24
Average = Sum(39) _{1...12} /12=												62.61 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.87	0.86	0.86	0.85	0.84	0.83	0.83	0.83	0.84	0.84	0.85	0.85		
	Average = Sum(40) _{1...12} / 12 =												0.85	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.34

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

89.76

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
	Total = Sum(44) _{1...12} =												1077.07	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8		
	Total = Sum(45) _{1...12} =												1412.21	(45)

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

(46)m=	21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

TER WorkSheet: New dwelling design stage

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

(61)m=	50.31	43.79	46.65	43.38	42.99	39.84	41.16	42.99	43.38	46.65	46.92	50.31	(61)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	196.73	171.85	178.8	158.58	153.54	135.23	129.56	144.43	146.02	166.27	177.49	192.11	(62)
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	196.73	171.85	178.8	158.58	153.54	135.23	129.56	144.43	146.02	166.27	177.49	192.11	
Output from water heater (annual) _{1...12}												1950.6	(64)

Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m=	61.26	53.53	55.6	49.15	47.5	41.68	39.68	44.47	44.97	51.44	55.15	59.73	(65)
--------	-------	-------	------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	(66)

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

(67)m=	21.72	19.29	15.69	11.88	8.88	7.49	8.1	10.53	14.13	17.94	20.94	22.32	(67)
--------	-------	-------	-------	-------	------	------	-----	-------	-------	-------	-------	-------	------

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

(68)m=	206.45	208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34	(68)
--------	--------	--------	--------	-------	--------	--------	--------	-------	-------	-------	-------	--------	------

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

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(69)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	82.34	79.65	74.73	68.26	63.85	57.88	53.34	59.78	62.46	69.14	76.59	80.28	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	371.59	368.62	354.7	332.93	311.01	290.02	276.97	283.7	295.38	317.36	342.32	361.02	(73)
--------	--------	--------	-------	--------	--------	--------	--------	-------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.78	x	10.63	x	0.63	x	0.7	=	12.28 (74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.63	x	0.7	=	4.68 (74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.63	x	0.7	=	4.68 (74)
North	0.9x	0.77	x	3.78	x	20.32	x	0.63	x	0.7	=	23.48 (74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.63	x	0.7	=	8.94 (74)

TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.44	x	20.32	x	0.63	x	0.7	=	8.94	(74)
North	0.9x	0.77	x	3.78	x	34.53	x	0.63	x	0.7	=	39.89	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.63	x	0.7	=	15.2	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.63	x	0.7	=	15.2	(74)
North	0.9x	0.77	x	3.78	x	55.46	x	0.63	x	0.7	=	64.07	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.63	x	0.7	=	24.41	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.63	x	0.7	=	24.41	(74)
North	0.9x	0.77	x	3.78	x	74.72	x	0.63	x	0.7	=	86.31	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.63	x	0.7	=	32.88	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.63	x	0.7	=	32.88	(74)
North	0.9x	0.77	x	3.78	x	79.99	x	0.63	x	0.7	=	92.4	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.63	x	0.7	=	35.2	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.63	x	0.7	=	35.2	(74)
North	0.9x	0.77	x	3.78	x	74.68	x	0.63	x	0.7	=	86.27	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.63	x	0.7	=	32.86	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.63	x	0.7	=	32.86	(74)
North	0.9x	0.77	x	3.78	x	59.25	x	0.63	x	0.7	=	68.44	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.63	x	0.7	=	26.07	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.63	x	0.7	=	26.07	(74)
North	0.9x	0.77	x	3.78	x	41.52	x	0.63	x	0.7	=	47.96	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.63	x	0.7	=	18.27	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.63	x	0.7	=	18.27	(74)
North	0.9x	0.77	x	3.78	x	24.19	x	0.63	x	0.7	=	27.94	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.63	x	0.7	=	10.65	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.63	x	0.7	=	10.65	(74)
North	0.9x	0.77	x	3.78	x	13.12	x	0.63	x	0.7	=	15.15	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.63	x	0.7	=	5.77	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.63	x	0.7	=	5.77	(74)
North	0.9x	0.77	x	3.78	x	8.86	x	0.63	x	0.7	=	10.24	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.63	x	0.7	=	3.9	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.63	x	0.7	=	3.9	(74)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 21.64 41.36 70.28 112.89 152.08 162.8 152 120.59 84.5 49.23 26.7 18.04 (83)

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

(84)m= 393.24 409.98 424.98 445.82 463.08 452.82 428.96 404.29 379.88 366.59 369.02 379.07 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	1	1	1	0.99	0.94	0.8	0.62	0.68	0.91	0.99	1	1

(86)

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

(87)m= 20.09 20.17 20.33 20.57 20.81 20.96 20.99 20.99 20.89 20.62 20.32 20.08 (87)

TER WorkSheet: New dwelling design stage

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

(88)m=	20.2	20.2	20.2	20.21	20.22	20.23	20.23	20.23	20.22	20.22	20.21	20.21	(88)
--------	------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	1	0.99	0.98	0.92	0.73	0.52	0.57	0.87	0.98	1	1	(89)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

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

(90)m=	18.97	19.08	19.32	19.68	20.01	20.2	20.22	20.22	20.12	19.74	19.32	18.96	(90)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.34 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.35	19.45	19.66	19.98	20.28	20.45	20.48	20.48	20.38	20.04	19.66	19.34	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	19.35	19.45	19.66	19.98	20.28	20.45	20.48	20.48	20.38	20.04	19.66	19.34	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	1	1	0.99	0.98	0.92	0.75	0.55	0.61	0.88	0.98	1	1	(94)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	392.45	408.72	422.21	436.37	426.24	340	236.45	246.04	333.14	360.03	367.56	378.47	(95)
--------	--------	--------	--------	--------	--------	-----	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m - (96)m]

(97)m=	965.27	930	838.12	693.8	535.25	359.75	238.72	250.18	388.52	589.01	788.63	957.48	(97)
--------	--------	-----	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	426.18	350.3	309.44	185.35	81.1	0	0	0	0	170.36	303.18	430.79	(98)
--------	--------	-------	--------	--------	------	---	---	---	---	--------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 2256.69 \quad (98)$$

Space heating requirement in kWh/m²/year

$$30.5 \quad (99)$$

9a. Energy requirements – Individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) = 1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] = 1 \quad (204)$$

Efficiency of main space heating system 1

$$93.4 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

426.18	350.3	309.44	185.35	81.1	0	0	0	0	170.36	303.18	430.79
--------	-------	--------	--------	------	---	---	---	---	--------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

456.29	375.05	331.31	198.45	86.83	0	0	0	0	182.4	324.6	461.23
--------	--------	--------	--------	-------	---	---	---	---	-------	-------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 2416.16 \quad (211)$$

Space heating fuel (secondary), kWh/month

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	(215)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

TER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

196.73	171.85	178.8	158.58	153.54	135.23	129.56	144.43	146.02	166.27	177.49	192.11
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

80.3 (216)

(217)m= 86.95 86.81 86.42 85.44 83.53 80.3 80.3 80.3 80.3 85.11 86.39 87.02 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

226.26	197.97	206.89	185.6	183.82	168.4	161.34	179.86	181.84	195.36	205.46	220.75
--------	--------	--------	-------	--------	-------	--------	--------	--------	--------	--------	--------

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

2313.56 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

2416.16

Water heating fuel used

2313.56

Electricity for pumps, fans and electric keep-hot

central heating pump:

30

(230c)

boiler with a fan-assisted flue

45

(230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75 (231)

Electricity for lighting

383.53 (232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	521.89 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	499.73 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1021.62 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	199.05 (268)
Total CO2, kg/year		sum of (265)...(271) =	1259.6 (272)

TER =

17.02 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Caversham 2BF TOP 74 South

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	74 (1a) x	2.4 (2a) =	177.6 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	177.6 (5)

2. Ventilation rate:

	main heating	secondary heating	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				2 x 10 =	20 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20 ÷ (5) = 0.11 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 4 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.31 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.27 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

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

0.34	0.33	0.33	0.29	0.29	0.25	0.25	0.25	0.27	0.29	0.3	0.31
------	------	------	------	------	------	------	------	------	------	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.56 0.56 0.55 0.54 0.54 0.53 0.53 0.53 0.54 0.54 0.54 0.55 (24d)

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

(25)m= 0.56 0.56 0.55 0.54 0.54 0.53 0.53 0.53 0.54 0.54 0.54 0.55 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Windows Type 3			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Walls	25.04	6.66	18.38	x 0.19 =	3.49		(29)
Roof	74	0	74	x 0.15 =	11.1		(30)
Total area of elements, m²			99.04				(31)
Party wall			59.55	x 0 =	0		(32)
Party floor			74				(32a)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 23.42 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5919.75 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 9.9 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 33.32 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	32.67	32.54	32.41	31.81	31.7	31.17	31.17	31.07	31.37	31.7	31.92	32.16

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

(39)m= 65.99 65.86 65.73 65.13 65.02 64.5 64.5 64.4 64.7 65.02 65.25 65.48
Average = Sum(39)_{1...12} /12= 65.13 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.89	0.89	0.89	0.88	0.88	0.87	0.87	0.87	0.87	0.88	0.88	0.88		
Average = Sum(40) _{1...12} /12=													0.88	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.34

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

89.76

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
Total = Sum(44) _{1...12} =													1077.07	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8		
Total = Sum(45) _{1...12} =													1412.21	(45)

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

(46)m=	21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

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

(61)m=

16.23	14.62	16.13	15.54	16.01	15.44	15.92	15.98	15.5	16.08	15.64	16.21
-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------

 (61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=

162.65	142.68	148.27	130.75	126.56	110.83	104.32	117.41	118.14	135.7	146.22	158.01
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------

 (62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (63)

Output from water heater

(64)m=

162.65	142.68	148.27	130.75	126.56	110.83	104.32	117.41	118.14	135.7	146.22	158.01
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------

Output from water heater (annual)_{1...12}

1601.53

 (64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=

52.74	46.23	47.97	42.19	40.76	35.58	33.37	37.72	38	43.79	47.33	51.2
-------	-------	-------	-------	-------	-------	-------	-------	----	-------	-------	------

 (65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96

 (66)

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

(67)m=

21.72	19.29	15.69	11.88	8.88	7.49	8.1	10.53	14.13	17.94	20.94	22.32
-------	-------	-------	-------	------	------	-----	-------	-------	-------	-------	-------

 (67)

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

(68)m=

206.45	208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34
--------	--------	--------	-------	--------	--------	--------	-------	-------	-------	-------	--------

 (68)

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

(69)m=

34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7
------	------	------	------	------	------	------	------	------	------	------	------

 (69)

Pumps and fans gains (Table 5a)

(70)m=

3	3	3	3	3	3	3	3	3	3	3	3
---	---	---	---	---	---	---	---	---	---	---	---

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=

-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m=

70.89	68.8	64.48	58.6	54.78	49.41	44.85	50.7	52.78	58.86	65.73	68.82
-------	------	-------	------	-------	-------	-------	------	-------	-------	-------	-------

 (72)

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

(73)m=

360.14	357.77	344.44	323.26	301.94	281.55	268.49	274.62	285.7	307.09	331.46	349.56
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------

 (73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m ²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)						
South	0.9x <table><tr><td>0.77</td></tr></table>	0.77	x <table><tr><td>3.78</td></tr></table>	3.78	x <table><tr><td>46.75</td></tr></table>	46.75	x <table><tr><td>0.63</td></tr></table>	0.63	x <table><tr><td>0.7</td></tr></table>	0.7	= <table><tr><td>54.01</td></tr></table> (78)	54.01
0.77												
3.78												
46.75												
0.63												
0.7												
54.01												
South	0.9x <table><tr><td>0.77</td></tr></table>	0.77	x <table><tr><td>1.44</td></tr></table>	1.44	x <table><tr><td>46.75</td></tr></table>	46.75	x <table><tr><td>0.63</td></tr></table>	0.63	x <table><tr><td>0.7</td></tr></table>	0.7	= <table><tr><td>20.57</td></tr></table> (78)	20.57
0.77												
1.44												
46.75												
0.63												
0.7												
20.57												
South	0.9x <table><tr><td>0.77</td></tr></table>	0.77	x <table><tr><td>1.44</td></tr></table>	1.44	x <table><tr><td>46.75</td></tr></table>	46.75	x <table><tr><td>0.63</td></tr></table>	0.63	x <table><tr><td>0.7</td></tr></table>	0.7	= <table><tr><td>20.57</td></tr></table> (78)	20.57
0.77												
1.44												
46.75												
0.63												
0.7												
20.57												
South	0.9x <table><tr><td>0.77</td></tr></table>	0.77	x <table><tr><td>3.78</td></tr></table>	3.78	x <table><tr><td>76.57</td></tr></table>	76.57	x <table><tr><td>0.63</td></tr></table>	0.63	x <table><tr><td>0.7</td></tr></table>	0.7	= <table><tr><td>88.45</td></tr></table> (78)	88.45
0.77												
3.78												
76.57												
0.63												
0.7												
88.45												
South	0.9x <table><tr><td>0.77</td></tr></table>	0.77	x <table><tr><td>1.44</td></tr></table>	1.44	x <table><tr><td>76.57</td></tr></table>	76.57	x <table><tr><td>0.63</td></tr></table>	0.63	x <table><tr><td>0.7</td></tr></table>	0.7	= <table><tr><td>33.7</td></tr></table> (78)	33.7
0.77												
1.44												
76.57												
0.63												
0.7												
33.7												

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 95.16 155.84 198.52 224.37 233.81 225.01 219.85 213.5 207.38 168.09 112.8 82.23 (83)

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

(84)m= 455.3 513.61 542.96 547.63 535.75 506.56 488.33 488.12 493.08 475.18 444.26 431.79 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	1	0.99	0.99	0.97	0.91	0.76	0.57	0.6	0.82	0.96	0.99	1

(86)

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

(87)m= 20.14 20.27 20.44 20.65 20.84 20.96 20.99 20.99 20.94 20.71 20.38 20.11 (87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.17	20.18	20.18	20.18	20.19	20.19	20.19	20.19	20.19	20.19	20.18	20.18	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	0.99	0.98	0.95	0.87	0.69	0.47	0.5	0.75	0.95	0.99	1	(89)
--------	---	------	------	------	------	------	------	-----	------	------	------	---	------

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

(90)m=	19.02	19.21	19.46	19.77	20.02	20.17	20.19	20.19	20.14	19.85	19.38	18.98	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.34 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.39	19.57	19.79	20.07	20.3	20.44	20.46	20.46	20.41	20.14	19.71	19.36	(92)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	19.39	19.57	19.79	20.07	20.3	20.44	20.46	20.46	20.41	20.14	19.71	19.36	(93)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	1	0.99	0.98	0.95	0.88	0.71	0.51	0.53	0.77	0.95	0.99	1	(94)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	453.35	508.77	531.91	521.4	471.55	359.62	247.3	259.16	379.73	450.74	439.87	430.42	(95)
--------	--------	--------	--------	-------	--------	--------	-------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m - (96)m]

(97)m=	996.14	965.89	873.9	727.4	559.17	376.35	249.05	261.54	408.4	620.27	823.07	992.71	(97)
--------	--------	--------	-------	-------	--------	--------	--------	--------	-------	--------	--------	--------	------

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

(98)m=	403.83	307.18	254.44	148.32	65.19	0	0	0	0	126.13	275.9	418.34	(98)
--------	--------	--------	--------	--------	-------	---	---	---	---	--------	-------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 1999.33 \quad (98)$$

Space heating requirement in kWh/m²/year

$$27.02 \quad (99)$$

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) = 1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] = 1 \quad (204)$$

Efficiency of main space heating system 1

$$93.5 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

kWh/year

Space heating requirement (calculated above)

403.83	307.18	254.44	148.32	65.19	0	0	0	0	126.13	275.9	418.34
--------	--------	--------	--------	-------	---	---	---	---	--------	-------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

431.91	328.53	272.13	158.63	69.72	0	0	0	0	134.89	295.08	447.42
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 2138.32 \quad (211)$$

Space heating fuel (secondary), kWh/month

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	(215)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

162.65	142.68	148.27	130.75	126.56	110.83	104.32	117.41	118.14	135.7	146.22	158.01
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------

Efficiency of water heater

87.3 (216)

(217)m= 89.56 89.46 89.29 88.97 88.36 87.3 87.3 87.3 87.3 88.81 89.37 89.6 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

181.61	159.49	166.05	146.96	143.23	126.96	119.49	134.49	135.33	152.8	163.62	176.35
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------

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

1806.36 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

2138.32

Water heating fuel used

1806.36

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75 (231)

Electricity for lighting

383.53 (232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	461.88 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	390.17 (264)
Space and water heating	(261) + (262) + (263) + (264) =		852.05 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	199.05 (268)
Total CO2, kg/year		sum of (265)...(271) =	1090.03 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	14.73 (273)
EI rating (section 14)			88 (274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Caversham 2BF TOP 74 South

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	74 (1a) x	2.4 (2a) =	177.6 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	177.6 (5)

2. Ventilation rate:

	main heating	secondary heating	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				3 x 10 =	30 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30 ÷ (5) = 0.17 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.42 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.36 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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TER WorkSheet: New dwelling design stage

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

0.45	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42
------	------	------	------	------	------	------	------	------	------	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59
-----	-----	-----	------	------	------	------	------	------	------	------	------

(24d)

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

(25)m=

0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59
-----	-----	-----	------	------	------	------	------	------	------	------	------

(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		
Windows Type 3			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		
Walls	25.04	6.66	18.38	$\times 0.18 =$	3.31		
Roof	74	0	74	$\times 0.13 =$	9.62		
Total area of elements, m²			99.04				
Party wall			59.55	$\times 0 =$	0		
Party floor			74				

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 21.76 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5919.75 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 5.92 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 27.67 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	35.34	35.11	34.88	33.8	33.6	32.66	32.66	32.48	33.02	33.6	34.01	34.43

(38)

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

(39)m=

63.02	62.78	62.55	61.47	61.27	60.33	60.33	60.16	60.69	61.27	61.68	62.11
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Average = Sum(39)_{1...12} /12= 61.47 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.85	0.85	0.85	0.83	0.83	0.82	0.82	0.81	0.82	0.83	0.83	0.84		
	Average = Sum(40) _{1...12} / 12 =												0.83	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.34

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

89.76

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
	Total = Sum(44) _{1...12} =												1077.07	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8		
	Total = Sum(45) _{1...12} =												1412.21	(45)

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

(46)m=	21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

TER WorkSheet: New dwelling design stage

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

(61)m=	50.31	43.79	46.65	43.38	42.99	39.84	41.16	42.99	43.38	46.65	46.92	50.31	(61)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	196.73	171.85	178.8	158.58	153.54	135.23	129.56	144.43	146.02	166.27	177.49	192.11	(62)
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	196.73	171.85	178.8	158.58	153.54	135.23	129.56	144.43	146.02	166.27	177.49	192.11	
Output from water heater (annual) _{1...12}												1950.6	(64)

Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m=	61.26	53.53	55.6	49.15	47.5	41.68	39.68	44.47	44.97	51.44	55.15	59.73	(65)
--------	-------	-------	------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	(66)

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

(67)m=	21.72	19.29	15.69	11.88	8.88	7.49	8.1	10.53	14.13	17.94	20.94	22.32	(67)
--------	-------	-------	-------	-------	------	------	-----	-------	-------	-------	-------	-------	------

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

(68)m=	206.45	208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34	(68)
--------	--------	--------	--------	-------	--------	--------	--------	-------	-------	-------	-------	--------	------

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

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(69)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	82.34	79.65	74.73	68.26	63.85	57.88	53.34	59.78	62.46	69.14	76.59	80.28	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	371.59	368.62	354.7	332.93	311.01	290.02	276.97	283.7	295.38	317.36	342.32	361.02	(73)
--------	--------	--------	-------	--------	--------	--------	--------	-------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)		
South	0.9x	0.77	x	3.78	x	46.75	x	0.63	x	0.7	=	54.01	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57	(78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.63	x	0.7	=	88.45	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)

TER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 95.16 155.84 198.52 224.37 233.81 225.01 219.85 213.5 207.38 168.09 112.8 82.23 (83)

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

(84)m= 466.75 524.46 553.22 557.3 544.81 515.03 496.81 497.2 502.76 485.45 455.12 443.25 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	1	0.99	0.98	0.96	0.89	0.72	0.53	0.55	0.78	0.95	0.99	1

(86)

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

(87)m= 20.21 20.34 20.51 20.72 20.88 20.98 21 21 20.96 20.77 20.45 20.19 (87)

TER WorkSheet: New dwelling design stage

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

(88)m=	20.21	20.21	20.21	20.23	20.23	20.24	20.24	20.24	20.24	20.23	20.22	20.22	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	0.99	0.98	0.94	0.85	0.65	0.44	0.46	0.71	0.94	0.99	1	(89)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

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

(90)m=	19.15	19.34	19.59	19.89	20.11	20.23	20.24	20.24	20.21	19.96	19.52	19.13	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.34 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.51	19.68	19.9	20.17	20.37	20.48	20.5	20.5	20.46	20.23	19.83	19.49	(92)
--------	-------	-------	------	-------	-------	-------	------	------	-------	-------	-------	-------	------

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

(93)m=	19.51	19.68	19.9	20.17	20.37	20.48	20.5	20.5	20.46	20.23	19.83	19.49	(93)
--------	-------	-------	------	-------	-------	-------	------	------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	0.99	0.99	0.98	0.94	0.86	0.67	0.47	0.49	0.73	0.94	0.99	1	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	---	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	464.41	518.65	539.88	525.01	466.99	345.02	234.17	245.27	368.26	454.72	449.67	441.59	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m – (96)m]

(97)m=	958.52	927.97	838.38	692.78	531.35	354.73	235.01	246.41	386.15	590.26	785.38	949.54	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	367.62	275.06	222.08	120.79	47.88	0	0	0	0	100.84	241.71	377.91	(98)
--------	--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 1753.9 \quad (98)$$

Space heating requirement in kWh/m²/year

$$23.7 \quad (99)$$

9a. Energy requirements – Individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

$$1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

$$1 \quad (204)$$

Efficiency of main space heating system 1

$$93.4 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

367.62	275.06	222.08	120.79	47.88	0	0	0	0	100.84	241.71	377.91
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

393.6	294.5	237.77	129.33	51.27	0	0	0	0	107.97	258.79	404.62
-------	-------	--------	--------	-------	---	---	---	---	--------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 1877.83 \quad (211)$$

Space heating fuel (secondary), kWh/month

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	(215)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

TER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

196.73	171.85	178.8	158.58	153.54	135.23	129.56	144.43	146.02	166.27	177.49	192.11
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

80.3 (216)

(217)m= 86.6 86.23 85.6 84.38 82.49 80.3 80.3 80.3 80.3 83.84 85.83 86.72 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

227.16	199.29	208.88	187.95	186.13	168.4	161.34	179.86	181.84	198.33	206.8	221.52
--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	-------	--------

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

2327.5 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1877.83

Water heating fuel used

2327.5

Electricity for pumps, fans and electric keep-hot

central heating pump:

30

(230c)

boiler with a fan-assisted flue

45

(230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75

(231)

Electricity for lighting

383.53

(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	405.61 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	502.74 (264)
Space and water heating	(261) + (262) + (263) + (264) =		908.35 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	199.05 (268)
Total CO2, kg/year	sum of (265)...(271) =		1146.33 (272)

TER =

15.49 (273)

Appendix 2: ‘Be Lean’ SAP 10 Spreadsheet

Be Lean - SAP 2012 Methodology

Project 209-219 Henley Road, Caversham
Client
Date Feb-22
Rev D



SAP 2012 Carbon Factor
Gas 0.21
Grid Elec 0.233

Residential

TER										DER - Based on Gas Heating				
Plot		Bedrooms	Floor Area	Aspects	Orientation	Space Htg	Water Htg	Pumps/ Lighting	Emissions	Plot	Space Htg	Water Htg	Pumps/ Lighting	Emissions
A3	EXP	1	51.0	1	North	1744	1920	345	849.9	A3	1649	1527	345	747.3
A4	EXP	1	51.0	1	North	1744	1920	345	849.9	A4	1649	1527	345	747.3
A9	EXP	1	51.0	1	South	1388	1911	344	773.0	A9	1293	1513	344	669.5
A10	EXP	1	51.0	1	South	1388	1911	344	773.0	A10	1293	1513	344	669.5
A14	MID	1	51.0	1	North	940	1946	345	686.4	A14	909	1533	345	593.3
A15	MID	1	51.0	1	North	940	1946	345	686.4	A15	909	1533	345	593.3
A20	MID	1	51.0	1	South	642	1942	344	622.8	A20	611	1519	344	527.7
A21	MID	1	51.0	1	South	642	1942	344	622.8	A21	611	1519	344	527.7
A25	MID	1	51.0	1	North	940	1946	345	686.4	A25	909	1533	345	593.3
A26	MID	1	51.0	1	North	940	1946	345	686.4	A26	909	1533	345	593.3
B3	EXP	1	51.0	1	North	1744	1920	345	849.9	B3	1649	1527	345	747.3
B11	MID	1	51.0	2	North	940	1946	345	686.4	B11	909	1533	345	593.3
A28	MID	1	56.0	1	South	705	2132	378	683.9	A28	671	1668	378	579.4
A32	TOP	2	61.0	1	North	1992	1907	378	907.0	A32	2201	1487	378	862.6
B2	EXP	1	61.0	1	North	2086	2297	413	1016.6	B2	1972	1826	413	893.9
B10	MID	1	61.0	1	South	768	2323	412	745.0	B10	731	1817	412	631.1
A6	MID	1	63.0	1	North	1161	2404	426	847.9	A6	1123	1894	426	732.9
A17	TOP	1	63.0	1	North	1974	2376	426	1012.7	A17	2237	1885	426	964.9
A16	MID	2	66.0	1	North	1368	2084	409	820.4	A16	1350	1614	409	718.0
A27	MID	2	66.0	1	North	1368	2084	409	820.4	A27	1350	1614	409	718.0
A34	TOP	2	66.0	1	North	2155	2064	409	981.3	A34	2381	1609	409	933.4
A5	EXP	2	67.0	1	North	2369	2091	416	1033.6	A5	2267	1633	416	915.9
A1	EXP	2	68.0	2		2405	2123	422	1049.1	A1	2301	1658	422	929.6
A33	TOP	2	69.0	1	North	2253	2158	428	1025.9	A33	2490	1682	428	975.8
B4	EXP	2	69.0	1	North	2440	2154	428	1064.5	B4	2335	1682	428	943.3
B12	MID	2	69.0	1	North	1430	2179	428	857.7	B12	1412	1688	428	750.6
B19	TOP	1	69.0	1	North	2162	2602	467	1109.2	B19	2450	2065	467	1056.8
A29	MID	2	70.0	1	South	980	2231	434	775.4	A29	954	1718	434	662.1
A13	MID	2	72.0	1	North	1493	2274	447	895.0	A13	1473	1761	447	783.2
A24	MID	2	72.0	1	North	1493	2274	447	895.0	A24	1473	1761	447	783.2
A36	TOP	2	72.0	1	South	1827	2265	447	963.4	A36	2080	1757	447	909.9
B1	MID	2	72.0	2	North	1493	2274	447	895.0	B1	1473	1761	447	783.2
B5	EXP	2	72.0	1	North	2546	2248	447	1110.8	B5	2436	1755	447	984.3
B9	MID	2	72.0	1	South	1008	2294	447	797.5	B9	981	1767	447	681.1
B13	MID	2	72.0	1	North	1493	2274	447	895.0	B13	1473	1761	447	783.2
B14	MID	2	72.0	1	North	1493	2274	447	895.0	B14	1473	1761	447	783.2
A2	EXP	2	73.0	1	North	2582	2279	453	1126.2	A2	2470	1780	453	998.0
A8	EXP	2	73.0	1	South	2026	2292	453	1012.3	A8	1910	1784	453	881.1
A11	EXP	2	73.0	1	South	2026	2292	453	1012.3	A11	1910	1784	453	881.1
A19	MID	2	73.0	1	South	1022	2326	453	808.6	A19	994	1791	453	690.5
A22	MID	2	73.0	1	South	1022	2326	453	808.6	A22	994	1791	453	690.5
A31	MID	2	73.0	1	South	1022	2326	453	808.6	A31	994	1791	453	690.5
B6	EXP	2	73.0	1	South	2026	2292	453	1012.3	B6	1910	1784	453	881.1
B7	EXP	2	73.0	1	South	2026	2292	453	1012.3	B7	1910	1784	453	881.1
B8	MID	2	73.0	1	South	1022	2326	453	808.6	B8	994	1791	453	690.5
B15	MID	2	73.0	1	South	1022	2326	453	808.6	B15	994	1791	453	690.5
B16	MID	2	73.0	1	South	1022	2326	453	808.6	B16	994	1791	453	690.5
A37	TOP	2	76.0	1	South	1929	2391	471	1017.0	A37	2196	1855	471	960.5
B17	TOP	2	76.0	1	South	1929	2391	471	1017.0	B17	2196	1855	471	960.5
B20	TOP	2	78.0	1	North	2547	2439	484	1159.7	B20	2814	1902	484	1103.1
A30	MID	2	79.0	1	South	1106	2517	490	875.1	A30	1076	1939	490	747.3
A12	MID	2	80.0	2		1658	2526	496	994.4	A12	1637	1957	496	870.3
A23	TOP	2	80.0	2		2612	2502	496	1189.5	A23	2886	1950	496	1131.3
B22	TOP	2	83.0	1	South	2106	2611	515	1110.6	B22	2398	2026	515	1048.9
A7	EXP	2	84.0	1	South	2332	2637	521	1164.8	A7	2198	2052	521	1013.9
A18	TOP	2	84.0	1	South	2132	2643	521	1124.0	A18	2427	2050	521	1061.6
B21	TOP	2	89.0	1	South	2259	2800	552	1190.9	B21	2571	2172	552	1124.8
B18	TOP	2	90.0	1	South	2284	2831	558	1204.3	B18	2600	2196	558	1137.4
A35	TOP	2	99.0	1	South	2512	3114	614	1324.7	A35	2860	2416	614	1251.1
4033.0										54269.3				
										84838.6				

Total Site Target Emissions 54,269 kgCO₂ per year
Total Site Design Emissions (Be Lean) 48,439 kgCO₂ per year
Total Reduction from Energy Efficiency 5,831 kgCO₂ per year
% Reduction from Energy Efficiency 10.74%

Communal and Circulation Accommodation

TER							BER				
Plot	Floor Area	Use	Heating	Cooling	Aux/ Lighting	Hot Water	Heating	Cooling	Aux/ Lighting	Hot Water	Emissions
Block A	239.0		6161	0	13284	468	2892	0	13267	468	88.0
Block B	194.0		5001	0	10783	380	2347	0	10769	380	88.0
8,406							7,019				

Total Site Target Emissions 8,406 kgCO₂ per year
Total Site Design Emissions (Be Lean) 7,019 kgCO₂ per year
Total Reduction 1,387 kgCO₂ per year
% Reduction 16.50%

Combined Reduction

Total Site Target Emissions 62,675 kgCO₂ per year
Total Site Design Emissions (Be Lean) 55,457 kgCO₂ per year
Total Reduction 7,218 kgCO₂ per year
% Reduction 11.52%

Appendix 3 – DER Worksheets for Modelled Units using Communal ASHPs

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.58

Property Address: Caversham 1BF EXP 53 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	53 (1a)	2.4 (2a)	127.2 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	127.2 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				1	10 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10 ÷ (5) = 0.08 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 4 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.28 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.24 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

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

0.3	0.3	0.29	0.26	0.25	0.22	0.22	0.22	0.24	0.25	0.27	0.28
-----	-----	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.55 0.54 0.54 0.53 0.53 0.53 0.53 0.52 0.53 0.53 0.54 0.54 (24d)

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

(25)m= 0.55 0.54 0.54 0.53 0.53 0.53 0.53 0.52 0.53 0.53 0.54 0.54 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.2) + 0.04] =$	4.33		(27)
Windows Type 2			1.44	$\times 1/[1/(1.2) + 0.04] =$	1.65		(27)
Floor			53	$\times$	0.11		(28)
Walls	19.1	5.22	13.88	$\times$	0.19		(29)
Total area of elements, m²			72.1				(31)
Party wall			53.68	$\times$	0		(32)
Party ceiling			53				(32b)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 14.44 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 7471.37 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 7.98 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 22.42 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	22.9	22.83	22.75	22.41	22.35	22.05	22.05	22	22.17	22.35	22.48	22.61

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

(39)m=	45.32	45.25	45.18	44.84	44.77	44.47	44.47	44.42	44.59	44.77	44.9	45.04
Average = Sum(39) _{1...12} /12=												44.84 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.86	0.85	0.85	0.85	0.84	0.84	0.84	0.84	0.84	0.84	0.85	0.85		
	Average = Sum(40) _{1...12} / 12 =												0.85	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.78

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

76.44

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	84.08	81.03	77.97	74.91	71.85	68.8	68.8	71.85	74.91	77.97	81.03	84.08		
	Total = Sum(44) _{1...12} =												917.29	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	124.7	109.06	112.54	98.11	94.14	81.24	75.28	86.38	87.42	101.88	111.2	120.76		
	Total = Sum(45) _{1...12} =												1202.71	(45)

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

(46)m=	18.7	16.36	16.88	14.72	14.12	12.19	11.29	12.96	13.11	15.28	16.68	18.11		(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

180

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

1.2

(48)

Temperature factor from Table 2b

0.6

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.72

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.72

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32		(56)
--------	-------	-------	-------	------	-------	------	-------	-------	------	-------	------	-------	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32		(57)
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Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

DER WorkSheet: New dwelling design stage

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

(61)m=

0	0	0	0	0	0	0	0	0	0	0	0
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 (61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=

170.28	150.23	158.12	142.23	139.73	125.35	120.86	131.97	131.53	147.46	155.32	166.34
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (63)

Output from water heater

(64)m=

170.28	150.23	158.12	142.23	139.73	125.35	120.86	131.97	131.53	147.46	155.32	166.34
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Output from water heater (annual)_{1...12}

1739.41

 (64)

Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m=

77.93	69.2	73.89	67.91	67.77	62.3	61.5	65.19	64.36	70.34	72.27	76.62
-------	------	-------	-------	-------	------	------	-------	-------	-------	-------	-------

 (65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93

 (66)

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

(67)m=

16.01	14.22	11.56	8.75	6.54	5.52	5.97	7.76	10.42	13.22	15.43	16.45
-------	-------	-------	------	------	------	------	------	-------	-------	-------	-------

 (67)

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

(68)m=

155.02	156.63	152.57	143.94	133.05	122.81	115.97	114.36	118.42	127.05	137.94	148.18
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (68)

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

(69)m=

31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (69)

Pumps and fans gains (Table 5a)

(70)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=

-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m=

104.74	102.98	99.31	94.32	91.09	86.53	82.66	87.62	89.38	94.54	100.37	102.98
--------	--------	-------	-------	-------	-------	-------	-------	-------	-------	--------	--------

 (72)

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

(73)m=

325.45	323.5	313.12	296.7	280.36	264.54	254.28	259.42	267.89	284.49	303.42	317.29
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------

 (73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	3.78	x	46.75	x	0.63	x	0.7	=	54.01 (78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57 (78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.63	x	0.7	=	88.45 (78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7 (78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67 (78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	74.58	122.15	155.6	175.86	183.25	176.36	172.31	167.34	162.54	131.75	88.41	64.45	(83)
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

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

(84)m=	400.03	445.65	468.72	472.56	463.61	440.9	426.59	426.76	430.43	416.24	391.83	381.74	(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	0.98	0.96	0.92	0.82	0.63	0.46	0.48	0.69	0.91	0.98	0.99	(86)

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

(87)m=	20.33	20.46	20.62	20.8	20.93	20.99	21	21	20.98	20.84	20.55	20.29	(87)
--------	-------	-------	-------	------	-------	-------	----	----	-------	-------	-------	-------	------

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

(88)m=	20.21	20.21	20.21	20.21	20.21	20.22	20.22	20.22	20.22	20.21	20.21	20.21	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.98	0.95	0.89	0.77	0.56	0.38	0.4	0.62	0.88	0.97	0.99	(89)
--------	------	------	------	------	------	------	------	-----	------	------	------	------	------

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

(90)m=	19.31	19.5	19.74	19.98	20.15	20.21	20.22	20.22	20.2	20.04	19.64	19.27	(90)
--------	-------	------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

fLA = Living area ÷ (4) = 0.47 (91)

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

(92)m=	19.79	19.95	20.15	20.37	20.52	20.58	20.59	20.59	20.57	20.42	20.07	19.75	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

DER WorkSheet: New dwelling design stage

(93)m=	19.79	19.95	20.15	20.37	20.52	20.58	20.59	20.59	20.57	20.42	20.07	19.75	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, h_m :

(94)m=	0.99	0.98	0.95	0.9	0.79	0.59	0.41	0.43	0.65	0.89	0.97	0.99	(94)
--------	------	------	------	-----	------	------	------	------	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	395.29	435.09	446.59	425.18	365.14	261.88	176.97	185.52	281.05	369.88	381.4	378.23	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	702.15	681.13	616.78	514.08	394.67	265.88	177.31	185.98	288.46	439.44	582.45	700.45	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	228.3	165.34	126.62	64.01	21.97	0	0	0	0	51.76	144.75	239.73	
--------	-------	--------	--------	-------	-------	---	---	---	---	-------	--------	--------	--

Total per year ($kWh/year$) = $Sum(98)_{1...12} =$ 1042.48 (98)

Space heating requirement in $kWh/m^2/year$

19.67 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none

0 (301)

Fraction of space heat from community system 1 – (301) =

1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump

1 (303a)

Fraction of total space heat from Community heat pump

(302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system

1 (305)

Distribution loss factor (Table 12c) for community heating system

1.05 (306)

Space heating

Annual space heating requirement

kWh/year
1042.48

Space heat from Community heat pump

(98) x (304a) x (305) x (306) = 1094.6 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)

0 (308)

Space heating requirement from secondary/supplementary system

(98) x (301) x 100 ÷ (308) = 0 (309)

Water heating

Annual water heating requirement

1739.41

If DHW from community scheme:

Water heat from Community heat pump

(64) x (303a) x (305) x (306) = 1826.38 (310a)

Electricity used for heat distribution

$0.01 \times [(307a) \dots (307e) + (310a) \dots (310e)] =$ 29.21 (313)

Cooling System Energy Efficiency Ratio

0 (314)

Space cooling (if there is a fixed cooling system, if not enter 0)

= (107) ÷ (314) = 0 (315)

Electricity for pumps and fans within dwelling (Table 4f):

mechanical ventilation - balanced, extract or positive input from outside

0 (330a)

DER WorkSheet: New dwelling design stage

warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	$= (330a) + (330b) + (330g) =$	0	(331)
Energy for lighting (calculated in Appendix L)		282.73	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		3203.71	(338)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)			
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		401 (367a)
CO2 associated with heat source 1	$[(307b) + (310b)] \times 100 \div (367b) \times$	0.52	= 378.05 (367)
Electrical energy for heat distribution	$[(313) \times$	0.52	= 15.16 (372)
Total CO2 associated with community systems	$(363)...(366) + (368)...(372)$		= 393.21 (373)
CO2 associated with space heating (secondary)	$(309) \times$	0	= 0 (374)
CO2 associated with water from immersion heater or instantaneous heater	$(312) \times$	0.52	= 0 (375)
Total CO2 associated with space and water heating	$(373) + (374) + (375) =$		393.21 (376)
CO2 associated with electricity for pumps and fans within dwelling	$(331) \times$	0.52	= 0 (378)
CO2 associated with electricity for lighting	$(332) \times$	0.52	= 146.74 (379)
Total CO2, kg/year	sum of (376)...(382) =		539.95 (383)
Dwelling CO2 Emission Rate	$(383) \div (4) =$		10.19 (384)
EI rating (section 14)			92.62 (385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.58

Property Address: Caversham 1BF EXP 53 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	53 (1a)	2.4 (2a)	127.2 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	127.2 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				2	20 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.16 (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]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.41 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.35 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

TER WorkSheet: New dwelling design stage

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

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.6 0.59 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.58 0.58 (24d)

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

(25)m= 0.6 0.59 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.58 0.58 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Floor			53	$\times$	0.13		(28)
Walls	19.1	5.22	13.88	$\times$	0.18		(29)
Total area of elements, m²			72.1				(31)
Party wall			53.68	$\times$	0		(32)
Party ceiling			53				(32b)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 16.31 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 7471.37 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 7.26 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 23.57 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	25.08	24.92	24.76	24.03	23.89	23.26	23.26	23.14	23.5	23.89	24.17	24.46

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

(39)m=	48.64	48.49	48.33	47.6	47.46	46.83	46.83	46.71	47.07	47.46	47.74	48.03
Average = Sum(39) _{1...12} /12=												47.6

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.92	0.91	0.91	0.9	0.9	0.88	0.88	0.88	0.89	0.9	0.9	0.91		
Average = Sum(40) _{1...12} / 12 =													0.9	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.78

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

76.44

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	84.08	81.03	77.97	74.91	71.85	68.8	68.8	71.85	74.91	77.97	81.03	84.08		
Total = Sum(44) _{1...12} =													917.29	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	124.7	109.06	112.54	98.11	94.14	81.24	75.28	86.38	87.42	101.88	111.2	120.76		
Total = Sum(45) _{1...12} =													1202.71	(45)

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

(46)m=	18.7	16.36	16.88	14.72	14.12	12.19	11.29	12.96	13.11	15.28	16.68	18.11		(46)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

150

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

1.55

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.84

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.84

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

TER WorkSheet: New dwelling design stage

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	173.94	153.54	161.78	145.77	143.39	128.89	124.52	135.63	135.07	151.12	158.86	170	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-----	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	173.94	153.54	161.78	145.77	143.39	128.89	124.52	135.63	135.07	151.12	158.86	170	
Output from water heater (annual) _{1...12}												1782.5	(64)

Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m=	80.86	71.84	76.81	70.75	70.7	65.14	64.42	68.12	67.19	73.27	75.1	79.55	(65)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	(66)

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

(67)m=	16.01	14.22	11.56	8.75	6.54	5.52	5.97	7.76	10.42	13.22	15.43	16.45	(67)
--------	-------	-------	-------	------	------	------	------	------	-------	-------	-------	-------	------

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

(68)m=	155.02	156.63	152.57	143.94	133.05	122.81	115.97	114.36	118.42	127.05	137.94	148.18	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	108.68	106.91	103.24	98.26	95.02	90.47	86.59	91.56	93.32	98.48	104.3	106.92	(72)
--------	--------	--------	--------	-------	-------	-------	-------	-------	-------	-------	-------	--------	------

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

(73)m=	332.38	330.43	320.06	303.64	287.29	271.48	261.21	266.36	274.83	291.43	310.36	324.23	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	3.78	x	46.75	x	0.63	x	0.7	=	54.01	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57	(78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.63	x	0.7	=	88.45	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67	(78)

TER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	74.58	122.15	155.6	175.86	183.25	176.36	172.31	167.34	162.54	131.75	88.41	64.45	(83)
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

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

(84)m=	406.97	452.58	475.65	479.49	470.55	447.84	433.52	433.69	437.37	423.18	398.76	388.68	(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	0.98	0.97	0.93	0.83	0.65	0.47	0.49	0.71	0.92	0.98	0.99	(86)

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

(87)m=	20.24	20.38	20.55	20.75	20.91	20.98	21	21	20.97	20.8	20.5	20.22	(87)
--------	-------	-------	-------	-------	-------	-------	----	----	-------	------	------	-------	------

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

(88)m=	20.15	20.15	20.16	20.17	20.17	20.18	20.18	20.18	20.18	20.17	20.17	20.16	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.98	0.96	0.9	0.78	0.57	0.39	0.41	0.64	0.89	0.98	0.99	(89)
--------	------	------	------	-----	------	------	------	------	------	------	------	------	------

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

(90)m=	19.15	19.35	19.6	19.89	20.08	20.17	20.18	20.18	20.16	19.96	19.53	19.13	(90)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.47 (91)

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

(92)m=	19.67	19.84	20.05	20.3	20.47	20.55	20.57	20.57	20.54	20.36	19.98	19.64	(92)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

TER WorkSheet: New dwelling design stage

(93)m=	19.67	19.84	20.05	20.3	20.47	20.55	20.57	20.57	20.54	20.36	19.98	19.64	(93)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, h_m :

(94)m=	0.99	0.98	0.96	0.91	0.8	0.61	0.43	0.45	0.67	0.9	0.97	0.99	(94)
--------	------	------	------	------	-----	------	------	------	------	-----	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	402.2	442.39	454.85	435.09	377.73	273.17	185.19	193.91	292.93	379.24	388.5	385.07	(95)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	747.58	724.2	654.94	542.49	416.3	278.82	185.72	194.62	303.22	463.12	615.1	741.69	(97)
--------	--------	-------	--------	--------	-------	--------	--------	--------	--------	--------	-------	--------	------

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

(98)m=	256.96	189.38	148.87	77.33	28.69	0	0	0	0	62.4	163.15	265.33	
--------	--------	--------	--------	-------	-------	---	---	---	---	------	--------	--------	--

Total per year ($kWh/year$) = $Sum(98)_{1...5,9...12} =$ 1192.11 (98)

Space heating requirement in $kWh/m^2/year$

22.49 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = $1 - (201) =$

1 (202)

Fraction of total heating from main system 1

(204) = $(202) \times [1 - (203)] =$

1 (204)

Efficiency of main space heating system 1

93.5 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

256.96	189.38	148.87	77.33	28.69	0	0	0	0	62.4	163.15	265.33
--------	--------	--------	-------	-------	---	---	---	---	------	--------	--------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$

274.83	202.54	159.21	82.71	30.69	0	0	0	0	66.74	174.49	283.77
--------	--------	--------	-------	-------	---	---	---	---	-------	--------	--------

Total ($kWh/year$) = $Sum(211)_{1...5,10...12} =$ 1274.98 (211)

Space heating fuel (secondary), $kWh/month$

= $\{[(98)m \times (201)]\} \times 100 \div (208)$

(215)m=	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---

Total ($kWh/year$) = $Sum(215)_{1...5,10...12} =$ 0 (215)

Water heating

Output from water heater (calculated above)

173.94	153.54	161.78	145.77	143.39	128.89	124.52	135.63	135.07	151.12	158.86	170
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-----

Efficiency of water heater

79.8 (216)

(217)m=	85.85	85.37	84.59	83.21	81.4	79.8	79.8	79.8	79.8	82.66	84.88	86	(217)
---------	-------	-------	-------	-------	------	------	------	------	------	-------	-------	----	-------

Fuel for water heating, $kWh/month$

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	202.6	179.84	191.25	175.18	176.14	161.52	156.04	169.96	169.26	182.83	187.15	197.69
---------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Total = $Sum(219a)_{1...12} =$ 2149.45 (219)

Annual totals

$kWh/year$

$kWh/year$

Space heating fuel used, main system 1

1274.98

TER WorkSheet: New dwelling design stage

Water heating fuel used		2149.45	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75 (231)
Electricity for lighting		282.73	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		3782.16	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	275.4	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	464.28	(264)
Space and water heating	(261) + (262) + (263) + (264) =			739.68	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	146.74	(268)
Total CO2, kg/year	sum of (265)...(271) =			925.34	(272)
TER =				25.14	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.58

Property Address: Caversham 1BF MID 53 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	53 (1a) x	2.4 (2a) =	127.2 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	127.2 (5)

2. Ventilation rate:

	main heating	secondary heating	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				1 x 10 =	10 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10 ÷ (5) = 0.08 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 4 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.28 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.24 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

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

0.3	0.3	0.29	0.26	0.25	0.22	0.22	0.22	0.24	0.25	0.27	0.28
-----	-----	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.55 0.54 0.54 0.53 0.53 0.53 0.53 0.52 0.53 0.53 0.54 0.54 (24d)

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

(25)m= 0.55 0.54 0.54 0.53 0.53 0.53 0.53 0.52 0.53 0.53 0.54 0.54 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.2) + 0.04] =$	4.33		(27)
Windows Type 2			1.44	$\times 1/[1/(1.2) + 0.04] =$	1.65		(27)
Walls	19.1	5.22	13.88	$\times 0.19 =$	2.64		(29)
Total area of elements, m²			19.1				(31)
Party wall			53.68	$\times 0 =$	0		(32)
Party floor			53				(32a)
Party ceiling			53				(32b)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 8.61 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5616.37 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 2.41 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 11.03 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	22.9	22.83	22.75	22.41	22.35	22.05	22.05	22	22.17	22.35	22.48	22.61

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

(39)m=	33.93	33.85	33.78	33.44	33.37	33.08	33.08	33.02	33.19	33.37	33.5	33.64
Average = Sum(39) _{1...12} /12=												33.44 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.64	0.64	0.64	0.63	0.63	0.62	0.62	0.62	0.63	0.63	0.63	0.63		
Average = Sum(40) _{1...12} / 12 =													0.63	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.78

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

76.44

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	84.08	81.03	77.97	74.91	71.85	68.8	68.8	71.85	74.91	77.97	81.03	84.08		
Total = Sum(44) _{1...12} =													917.29	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times nm \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	124.7	109.06	112.54	98.11	94.14	81.24	75.28	86.38	87.42	101.88	111.2	120.76		
Total = Sum(45) _{1...12} =													1202.71	(45)

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

(46)m=	18.7	16.36	16.88	14.72	14.12	12.19	11.29	12.96	13.11	15.28	16.68	18.11		(46)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

180

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

1.2

(48)

Temperature factor from Table 2b

0.6

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.72

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.72

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32		(56)
--------	-------	-------	-------	------	-------	------	-------	-------	------	-------	------	-------	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32		(57)
--------	-------	-------	-------	------	-------	------	-------	-------	------	-------	------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

DER WorkSheet: New dwelling design stage

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

(61)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=

170.28	150.23	158.12	142.23	139.73	125.35	120.86	131.97	131.53	147.46	155.32	166.34
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (63)

Output from water heater

(64)m=

170.28	150.23	158.12	142.23	139.73	125.35	120.86	131.97	131.53	147.46	155.32	166.34
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Output from water heater (annual)_{1...12}

1739.41

 (64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=

77.93	69.2	73.89	67.91	67.77	62.3	61.5	65.19	64.36	70.34	72.27	76.62
-------	------	-------	-------	-------	------	------	-------	-------	-------	-------	-------

 (65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93

 (66)

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

(67)m=

16.01	14.22	11.56	8.75	6.54	5.52	5.97	7.76	10.42	13.22	15.43	16.45
-------	-------	-------	------	------	------	------	------	-------	-------	-------	-------

 (67)

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

(68)m=

155.02	156.63	152.57	143.94	133.05	122.81	115.97	114.36	118.42	127.05	137.94	148.18
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (68)

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

(69)m=

31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (69)

Pumps and fans gains (Table 5a)

(70)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=

-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m=

104.74	102.98	99.31	94.32	91.09	86.53	82.66	87.62	89.38	94.54	100.37	102.98
--------	--------	-------	-------	-------	-------	-------	-------	-------	-------	--------	--------

 (72)

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

(73)m=

325.45	323.5	313.12	296.7	280.36	264.54	254.28	259.42	267.89	284.49	303.42	317.29
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------

 (73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	3.78	x	46.75	x	0.63	x	0.7	=	54.01 (78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57 (78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.63	x	0.7	=	88.45 (78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7 (78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67 (78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	74.58	122.15	155.6	175.86	183.25	176.36	172.31	167.34	162.54	131.75	88.41	64.45	(83)
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

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

(84)m=	400.03	445.65	468.72	472.56	463.61	440.9	426.59	426.76	430.43	416.24	391.83	381.74	(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=	0.98	0.96	0.91	0.81	0.66	0.48	0.34	0.36	0.53	0.8	0.95	0.99	(86)

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

(87)m=	20.66	20.77	20.88	20.96	20.99	21	21	21	21	20.97	20.82	20.63	(87)
--------	-------	-------	-------	-------	-------	----	----	----	----	-------	-------	-------	------

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

(88)m=	20.39	20.4	20.4	20.4	20.4	20.41	20.41	20.41	20.41	20.4	20.4	20.4	(88)
--------	-------	------	------	------	------	-------	-------	-------	-------	------	------	------	------

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

(89)m=	0.98	0.95	0.89	0.78	0.62	0.44	0.3	0.31	0.49	0.76	0.94	0.98	(89)
--------	------	------	------	------	------	------	-----	------	------	------	------	------	------

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

(90)m=	19.95	20.11	20.25	20.36	20.4	20.41	20.41	20.41	20.41	20.37	20.18	19.91	(90)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) = 0.47 (91)

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

(92)m=	20.29	20.42	20.55	20.64	20.68	20.69	20.69	20.69	20.69	20.65	20.48	20.25	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

DER WorkSheet: New dwelling design stage

(93)m=	20.29	20.42	20.55	20.64	20.68	20.69	20.69	20.69	20.69	20.65	20.48	20.25	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, h_m :

(94)m=	0.98	0.95	0.9	0.79	0.64	0.46	0.32	0.33	0.51	0.78	0.94	0.98	(94)
--------	------	------	-----	------	------	------	------	------	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	390.91	423.38	420.63	375.41	296.82	201.18	135.19	141.58	218.21	323.15	369.33	375.18	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times ((93)m - (96)m)]$

(97)m=	542.36	525.35	474.47	392.63	299.63	201.33	135.19	141.59	218.58	335.56	448.33	539.98	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	112.67	68.52	40.05	12.4	2.09	0	0	0	0	9.23	56.88	122.61	
--------	--------	-------	-------	------	------	---	---	---	---	------	-------	--------	--

Total per year ($kWh/year$) = $Sum(98)_{1...12} =$ 424.47 (98)

Space heating requirement in $kWh/m^2/year$

8.01 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none

0 (301)

Fraction of space heat from community system 1 – (301) =

1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump

1 (303a)

Fraction of total space heat from Community heat pump

(302) x (303a) =

1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system

1 (305)

Distribution loss factor (Table 12c) for community heating system

1.05 (306)

Space heating

Annual space heating requirement

kWh/year
424.47

Space heat from Community heat pump

(98) x (304a) x (305) x (306) =

445.69 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)

0 (308)

Space heating requirement from secondary/supplementary system

(98) x (301) x 100 ÷ (308) =

0 (309)

Water heating

Annual water heating requirement

1739.41

If DHW from community scheme:

Water heat from Community heat pump

(64) x (303a) x (305) x (306) =

1826.38 (310a)

Electricity used for heat distribution

$0.01 \times [(307a) \dots (307e) + (310a) \dots (310e)] =$

22.72 (313)

Cooling System Energy Efficiency Ratio

0 (314)

Space cooling (if there is a fixed cooling system, if not enter 0)

= (107) ÷ (314) =

0 (315)

Electricity for pumps and fans within dwelling (Table 4f):

mechanical ventilation - balanced, extract or positive input from outside

0 (330a)

DER WorkSheet: New dwelling design stage

warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	$= (330a) + (330b) + (330g) =$	0	(331)
Energy for lighting (calculated in Appendix L)		282.73	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		2554.8	(338)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)			
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		401 (367a)
CO2 associated with heat source 1	$[(307b) + (310b)] \times 100 \div (367b) \times$	0.52	= 294.07 (367)
Electrical energy for heat distribution	$[(313) \times$	0.52	= 11.79 (372)
Total CO2 associated with community systems	$(363)...(366) + (368)...(372)$		= 305.86 (373)
CO2 associated with space heating (secondary)	$(309) \times$	0	= 0 (374)
CO2 associated with water from immersion heater or instantaneous heater	$(312) \times$	0.52	= 0 (375)
Total CO2 associated with space and water heating	$(373) + (374) + (375) =$		305.86 (376)
CO2 associated with electricity for pumps and fans within dwelling	$(331) \times$	0.52	= 0 (378)
CO2 associated with electricity for lighting	$(332) \times$	0.52	= 146.74 (379)
Total CO2, kg/year	sum of (376)...(382) =		452.59 (383)
Dwelling CO2 Emission Rate	$(383) \div (4) =$		8.54 (384)
EI rating (section 14)			93.81 (385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.58

Property Address: Caversham 1BF MID 53 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	53 (1a) x	2.4 (2a) =	127.2 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	127.2 (5)

2. Ventilation rate:

	main heating	secondary heating	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				2 x 10 =	20 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20 ÷ (5) = 0.16 (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]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry 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

Percentage of windows and doors draught stripped

Window infiltration

0.25 - [0.2 x (14) ÷ 100] =

Infiltration rate

(8) + (10) + (11) + (12) + (13) + (15) =

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) ÷ 20] + (8), otherwise (18) = (16)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered

Shelter factor

(20) = 1 - [0.075 x (19)] =

Infiltration rate incorporating shelter factor

(21) = (18) x (20) =

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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TER WorkSheet: New dwelling design stage

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

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.6 0.59 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.58 0.58 (24d)

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

(25)m= 0.6 0.59 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.58 0.58 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Walls	19.1	5.22	13.88	$\times 0.18 =$	2.5		(29)
Total area of elements, m²			19.1				(31)
Party wall			53.68	$\times 0 =$	0		(32)
Party floor			53				(32a)
Party ceiling			53				(32b)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 9.42 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5616.37 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 1.69 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 11.11 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	25.08	24.92	24.76	24.03	23.89	23.26	23.26	23.14	23.5	23.89	24.17	24.46

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

(39)m= 36.19 36.03 35.87 35.14 35 34.37 34.37 34.25 34.61 35 35.28 35.57
Average = Sum(39)_{1...12} /12= 35.14 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.68	0.68	0.68	0.66	0.66	0.65	0.65	0.65	0.65	0.66	0.67	0.67		
	Average = Sum(40) _{1...12} / 12 =												0.66	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.78

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

76.44

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	84.08	81.03	77.97	74.91	71.85	68.8	68.8	71.85	74.91	77.97	81.03	84.08		
	Total = Sum(44) _{1...12} =												917.29	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	124.7	109.06	112.54	98.11	94.14	81.24	75.28	86.38	87.42	101.88	111.2	120.76		
	Total = Sum(45) _{1...12} =												1202.71	(45)

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

(46)m=	18.7	16.36	16.88	14.72	14.12	12.19	11.29	12.96	13.11	15.28	16.68	18.11		(46)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

150

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

1.55

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.84

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.84

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
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TER WorkSheet: New dwelling design stage

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	173.94	153.54	161.78	145.77	143.39	128.89	124.52	135.63	135.07	151.12	158.86	170	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-----	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	173.94	153.54	161.78	145.77	143.39	128.89	124.52	135.63	135.07	151.12	158.86	170	
Output from water heater (annual) _{1...12}												1782.5	(64)

Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m=	80.86	71.84	76.81	70.75	70.7	65.14	64.42	68.12	67.19	73.27	75.1	79.55	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	(66)

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

(67)m=	16.01	14.22	11.56	8.75	6.54	5.52	5.97	7.76	10.42	13.22	15.43	16.45	(67)
--------	-------	-------	-------	------	------	------	------	------	-------	-------	-------	-------	------

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

(68)m=	155.02	156.63	152.57	143.94	133.05	122.81	115.97	114.36	118.42	127.05	137.94	148.18	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	108.68	106.91	103.24	98.26	95.02	90.47	86.59	91.56	93.32	98.48	104.3	106.92	(72)
--------	--------	--------	--------	-------	-------	-------	-------	-------	-------	-------	-------	--------	------

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

(73)m=	332.38	330.43	320.06	303.64	287.29	271.48	261.21	266.36	274.83	291.43	310.36	324.23	(73)
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6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	3.78	x	46.75	x	0.63	x	0.7	=	54.01	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57	(78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.63	x	0.7	=	88.45	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67	(78)

TER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	74.58	122.15	155.6	175.86	183.25	176.36	172.31	167.34	162.54	131.75	88.41	64.45	(83)
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

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

(84)m=	406.97	452.58	475.65	479.49	470.55	447.84	433.52	433.69	437.37	423.18	398.76	388.68	(84)
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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=	0.98	0.96	0.92	0.83	0.68	0.49	0.35	0.36	0.54	0.81	0.96	0.99	(86)

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

(87)m=	20.61	20.72	20.84	20.95	20.99	21	21	21	21	20.96	20.79	20.59	(87)
--------	-------	-------	-------	-------	-------	----	----	----	----	-------	-------	-------	------

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

(88)m=	20.36	20.36	20.36	20.37	20.38	20.39	20.39	20.39	20.38	20.38	20.37	20.37	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.96	0.91	0.8	0.64	0.44	0.3	0.31	0.5	0.78	0.95	0.98	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.84	20.01	20.17	20.32	20.37	20.39	20.39	20.39	20.38	20.34	20.11	19.82	(90)
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fLA = Living area ÷ (4) =

0.47 (91)

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

(92)m=	20.2	20.34	20.49	20.61	20.66	20.68	20.68	20.68	20.67	20.63	20.43	20.18	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

TER WorkSheet: New dwelling design stage

(93)m=	20.2	20.34	20.49	20.61	20.66	20.68	20.68	20.68	20.67	20.63	20.43	20.18	(93)
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8. Space heating requirement

Set $T_{i,m}$ to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, h_m :

(94)m=	0.98	0.96	0.91	0.81	0.66	0.47	0.32	0.34	0.52	0.79	0.95	0.98	(94)
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Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	398.51	432.5	432.42	388.51	309.48	208.57	140.07	146.47	226.94	334.64	377.62	382.36	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	575.39	556.38	501.78	411.59	313.65	208.8	140.08	146.48	227.49	351.1	470.33	568.44	(97)
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	-------	--------	--------	------

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

(98)m=	131.6	83.25	51.6	16.62	3.1	0	0	0	0	12.25	66.75	138.44	
--------	-------	-------	------	-------	-----	---	---	---	---	-------	-------	--------	--

Total per year ($kWh/year$) = $Sum(98)_{1...5,9...12} =$ 503.62 (98)

Space heating requirement in $kWh/m^2/year$

9.5 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = $1 - (201) =$

1 (202)

Fraction of total heating from main system 1

(204) = $(202) \times [1 - (203)] =$

1 (204)

Efficiency of main space heating system 1

93.5 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

$kWh/year$

Space heating requirement (calculated above)

131.6	83.25	51.6	16.62	3.1	0	0	0	0	12.25	66.75	138.44
-------	-------	------	-------	-----	---	---	---	---	-------	-------	--------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$

(211)

140.74	89.04	55.19	17.78	3.32	0	0	0	0	13.1	71.39	148.07
--------	-------	-------	-------	------	---	---	---	---	------	-------	--------

Total ($kWh/year$) = $Sum(211)_{1...5,10...12} =$ 538.63 (211)

Space heating fuel (secondary), $kWh/month$

= $\{[(98)m \times (201)]\} \times 100 \div (208)$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	
---------	---	---	---	---	---	---	---	---	---	---	---	--

Total ($kWh/year$) = $Sum(215)_{1...5,10...12} =$ 0 (215)

Water heating

Output from water heater (calculated above)

173.94	153.54	161.78	145.77	143.39	128.89	124.52	135.63	135.07	151.12	158.86	170
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-----

Efficiency of water heater

79.8 (216)

(217)m=	84.08	83.26	82.15	80.78	80	79.8	79.8	79.8	79.8	80.51	82.69	84.27	(217)
---------	-------	-------	-------	-------	----	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	206.87	184.4	196.94	180.46	179.23	161.52	156.04	169.96	169.26	187.69	192.11	201.73	
---------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--

Total = $Sum(219a)_{1...12} =$ 2186.21 (219)

Annual totals

$kWh/year$

$kWh/year$

Space heating fuel used, main system 1

538.63

TER WorkSheet: New dwelling design stage

Water heating fuel used		2186.21	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75 (231)
Electricity for lighting		282.73	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		3082.57	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	=	116.34 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	472.22 (264)
Space and water heating	(261) + (262) + (263) + (264) =			588.57 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93 (267)
Electricity for lighting	(232) x	0.519	=	146.74 (268)
Total CO2, kg/year	sum of (265)...(271) =			774.23 (272)
TER =				20.72 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.58

Property Address: Caversham 1BF TOP 53 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	53 (1a) x	2.4 (2a) =	127.2 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	127.2 (5)

2. Ventilation rate:

	main heating	secondary heating	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				1 x 10 =	10 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10 ÷ (5) = 0.08 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 4 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.28 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.24 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

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

0.3	0.3	0.29	0.26	0.25	0.22	0.22	0.22	0.24	0.25	0.27	0.28
-----	-----	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.55 0.54 0.54 0.53 0.53 0.53 0.53 0.52 0.53 0.53 0.54 0.54 (24d)

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

(25)m= 0.55 0.54 0.54 0.53 0.53 0.53 0.53 0.52 0.53 0.53 0.54 0.54 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.2) + 0.04] =$	4.33		(27)
Windows Type 2			1.44	$\times 1/[1/(1.2) + 0.04] =$	1.65		(27)
Walls	19.1	5.22	13.88	$\times$ 0.19	2.64		(29)
Roof	53	0	53	$\times$ 0.15	7.95		(30)
Total area of elements, m²			72.1				(31)
Party wall			53.68	$\times$ 0	0		(32)
Party floor			53				(32a)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 16.56 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 4503.37 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 8.42 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 24.98 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	22.9	22.83	22.75	22.41	22.35	22.05	22.05	22	22.17	22.35	22.48	22.61

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

(39)m=	47.88	47.81	47.73	47.39	47.33	47.03	47.03	46.98	47.15	47.33	47.46	47.59
Average = Sum(39) _{1...12} /12=												47.39

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.9	0.9	0.9	0.89	0.89	0.89	0.89	0.89	0.89	0.9	0.9		
Average = Sum(40) _{1...12} / 12 =												0.89	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.78

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

76.44

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	84.08	81.03	77.97	74.91	71.85	68.8	68.8	71.85	74.91	77.97	81.03	84.08	
Total = Sum(44) _{1...12} =												917.29	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	124.7	109.06	112.54	98.11	94.14	81.24	75.28	86.38	87.42	101.88	111.2	120.76	
Total = Sum(45) _{1...12} =												1202.71	(45)

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

(46)m=	18.7	16.36	16.88	14.72	14.12	12.19	11.29	12.96	13.11	15.28	16.68	18.11	(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

180

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

1.2

(48)

Temperature factor from Table 2b

0.6

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.72

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.72

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(56)
--------	-------	-------	-------	------	-------	------	-------	-------	------	-------	------	-------	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(57)
--------	-------	-------	-------	------	-------	------	-------	-------	------	-------	------	-------	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

DER WorkSheet: New dwelling design stage

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

(61)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=

170.28	150.23	158.12	142.23	139.73	125.35	120.86	131.97	131.53	147.46	155.32	166.34
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (63)

Output from water heater

(64)m=

170.28	150.23	158.12	142.23	139.73	125.35	120.86	131.97	131.53	147.46	155.32	166.34
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Output from water heater (annual)_{1...12}

1739.41

 (64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=

77.93	69.2	73.89	67.91	67.77	62.3	61.5	65.19	64.36	70.34	72.27	76.62
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 (65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93

 (66)

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

(67)m=

16.01	14.22	11.56	8.75	6.54	5.52	5.97	7.76	10.42	13.22	15.43	16.45
-------	-------	-------	------	------	------	------	------	-------	-------	-------	-------

 (67)

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

(68)m=

155.02	156.63	152.57	143.94	133.05	122.81	115.97	114.36	118.42	127.05	137.94	148.18
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (68)

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

(69)m=

31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (69)

Pumps and fans gains (Table 5a)

(70)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=

-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m=

104.74	102.98	99.31	94.32	91.09	86.53	82.66	87.62	89.38	94.54	100.37	102.98
--------	--------	-------	-------	-------	-------	-------	-------	-------	-------	--------	--------

 (72)

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

(73)m=

325.45	323.5	313.12	296.7	280.36	264.54	254.28	259.42	267.89	284.49	303.42	317.29
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------

 (73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	3.78	x	46.75	x	0.63	x	0.7	=	54.01 (78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57 (78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.63	x	0.7	=	88.45 (78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7 (78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67 (78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	74.58	122.15	155.6	175.86	183.25	176.36	172.31	167.34	162.54	131.75	88.41	64.45	(83)
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

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

(84)m=	400.03	445.65	468.72	472.56	463.61	440.9	426.59	426.76	430.43	416.24	391.83	381.74	(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	0.98	0.97	0.93	0.84	0.66	0.48	0.5	0.72	0.92	0.98	0.99	(86)

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

(87)m=	20.25	20.39	20.56	20.75	20.9	20.98	21	21	20.97	20.8	20.49	20.22	(87)
--------	-------	-------	-------	-------	------	-------	----	----	-------	------	-------	-------	------

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

(88)m=	20.16	20.17	20.17	20.17	20.17	20.18	20.18	20.18	20.18	20.17	20.17	20.17	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.98	0.96	0.91	0.79	0.59	0.39	0.41	0.65	0.89	0.98	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	19.18	19.37	19.62	19.89	20.08	20.17	20.18	20.18	20.15	19.95	19.53	19.13	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.47 (91)

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

(92)m=	19.68	19.85	20.06	20.29	20.47	20.55	20.56	20.56	20.54	20.35	19.98	19.65	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

DER WorkSheet: New dwelling design stage

(93)m=	19.68	19.85	20.06	20.29	20.47	20.55	20.56	20.56	20.54	20.35	19.98	19.65	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, h_m :

(94)m=	0.99	0.98	0.96	0.91	0.81	0.62	0.44	0.46	0.68	0.9	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	-----	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	395.63	436.05	448.93	430.53	375.04	273.59	185.83	194.79	292.42	375.08	382.39	378.46	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times ((93)m - (96)m)]$

(97)m=	736.65	714.68	647.28	539.96	415.01	279.89	186.45	195.62	303.57	461.55	611.28	735.1	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

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

(98)m=	253.72	187.24	147.58	78.79	29.74	0	0	0	0	64.33	164.8	265.34	
--------	--------	--------	--------	-------	-------	---	---	---	---	-------	-------	--------	--

Total per year ($kWh/year$) = $Sum(98)_{1...12} =$ 1191.53 (98)

Space heating requirement in $kWh/m^2/year$

22.48 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none

0 (301)

Fraction of space heat from community system 1 – (301) =

1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump

1 (303a)

Fraction of total space heat from Community heat pump

(302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system

1 (305)

Distribution loss factor (Table 12c) for community heating system

1.05 (306)

Space heating

Annual space heating requirement

kWh/year

1191.53

Space heat from Community heat pump

(98) x (304a) x (305) x (306) = 1251.11 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)

0 (308)

Space heating requirement from secondary/supplementary system

(98) x (301) x 100 ÷ (308) = 0 (309)

Water heating

Annual water heating requirement

1739.41

If DHW from community scheme:

Water heat from Community heat pump

(64) x (303a) x (305) x (306) = 1826.38 (310a)

Electricity used for heat distribution

$0.01 \times [(307a) \dots (307e) + (310a) \dots (310e)] =$ 30.77 (313)

Cooling System Energy Efficiency Ratio

0 (314)

Space cooling (if there is a fixed cooling system, if not enter 0)

$= (107) \div (314) =$ 0 (315)

Electricity for pumps and fans within dwelling (Table 4f):

mechanical ventilation - balanced, extract or positive input from outside

0 (330a)

DER WorkSheet: New dwelling design stage

warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	$= (330a) + (330b) + (330g) =$	0	(331)
Energy for lighting (calculated in Appendix L)		282.73	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		3360.21	(338)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)			
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		401 (367a)
CO2 associated with heat source 1	$[(307b) + (310b)] \times 100 \div (367b) \times$	0.52	= 398.31 (367)
Electrical energy for heat distribution	$[(313) \times$	0.52	= 15.97 (372)
Total CO2 associated with community systems	$(363)...(366) + (368)...(372)$		= 414.28 (373)
CO2 associated with space heating (secondary)	$(309) \times$	0	= 0 (374)
CO2 associated with water from immersion heater or instantaneous heater	$(312) \times$	0.52	= 0 (375)
Total CO2 associated with space and water heating	$(373) + (374) + (375) =$		414.28 (376)
CO2 associated with electricity for pumps and fans within dwelling	$(331) \times$	0.52	= 0 (378)
CO2 associated with electricity for lighting	$(332) \times$	0.52	= 146.74 (379)
Total CO2, kg/year	sum of (376)...(382) =		561.02 (383)
Dwelling CO2 Emission Rate	$(383) \div (4) =$		10.59 (384)
EI rating (section 14)			92.33 (385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.58

Property Address: Caversham 1BF TOP 53 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	53 (1a) x	2.4 (2a) =	127.2 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	127.2 (5)

2. Ventilation rate:

	main heating	secondary heating	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				2 x 10 =	20 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20 ÷ (5) = 0.16 (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]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.41 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.35 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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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
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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TER WorkSheet: New dwelling design stage

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

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.6 0.59 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.58 0.58 (24d)

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

(25)m= 0.6 0.59 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.58 0.58 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Walls	19.1	5.22	13.88	$\times$ 0.18	2.5		(29)
Roof	53	0	53	$\times$ 0.13	6.89		(30)
Total area of elements, m²			72.1				(31)
Party wall			53.68	$\times$ 0	0		(32)
Party floor			53				(32a)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 16.31 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 4503.37 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 5.01 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 21.32 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	25.08	24.92	24.76	24.03	23.89	23.26	23.26	23.14	23.5	23.89	24.17	24.46

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

(39)m=	46.4	46.24	46.08	45.35	45.21	44.58	44.58	44.46	44.82	45.21	45.49	45.78
Average = Sum(39) _{1...12} /12=												45.35 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.88	0.87	0.87	0.86	0.85	0.84	0.84	0.84	0.85	0.85	0.86	0.86		
Average = Sum(40) _{1...12} / 12 =													0.86	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.78

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

76.44

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
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Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	84.08	81.03	77.97	74.91	71.85	68.8	68.8	71.85	74.91	77.97	81.03	84.08		
Total = Sum(44) _{1...12} =													917.29	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	124.7	109.06	112.54	98.11	94.14	81.24	75.28	86.38	87.42	101.88	111.2	120.76		
Total = Sum(45) _{1...12} =													1202.71	(45)

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

(46)m=	18.7	16.36	16.88	14.72	14.12	12.19	11.29	12.96	13.11	15.28	16.68	18.11		(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

150

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

1.55

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.84

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.84

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98		(56)
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If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98		(57)
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Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
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TER WorkSheet: New dwelling design stage

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	173.94	153.54	161.78	145.77	143.39	128.89	124.52	135.63	135.07	151.12	158.86	170	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-----	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	(63)
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Output from water heater

(64)m=	173.94	153.54	161.78	145.77	143.39	128.89	124.52	135.63	135.07	151.12	158.86	170	
Output from water heater (annual) _{1...12}												1782.5	(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	80.86	71.84	76.81	70.75	70.7	65.14	64.42	68.12	67.19	73.27	75.1	79.55	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	(66)

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

(67)m=	16.01	14.22	11.56	8.75	6.54	5.52	5.97	7.76	10.42	13.22	15.43	16.45	(67)
--------	-------	-------	-------	------	------	------	------	------	-------	-------	-------	-------	------

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

(68)m=	155.02	156.63	152.57	143.94	133.05	122.81	115.97	114.36	118.42	127.05	137.94	148.18	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	(69)
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Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	(71)
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Water heating gains (Table 5)

(72)m=	108.68	106.91	103.24	98.26	95.02	90.47	86.59	91.56	93.32	98.48	104.3	106.92	(72)
--------	--------	--------	--------	-------	-------	-------	-------	-------	-------	-------	-------	--------	------

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

(73)m=	332.38	330.43	320.06	303.64	287.29	271.48	261.21	266.36	274.83	291.43	310.36	324.23	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	3.78	x	46.75	x	0.63	x	0.7	=	54.01 (78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57 (78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.63	x	0.7	=	88.45 (78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7 (78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67 (78)

TER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	74.58	122.15	155.6	175.86	183.25	176.36	172.31	167.34	162.54	131.75	88.41	64.45	(83)
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

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

(84)m=	406.97	452.58	475.65	479.49	470.55	447.84	433.52	433.69	437.37	423.18	398.76	388.68	(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	0.98	0.96	0.92	0.81	0.62	0.45	0.47	0.68	0.91	0.98	0.99	(86)

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

(87)m=	20.31	20.44	20.61	20.79	20.93	20.99	21	21	20.98	20.84	20.55	20.28	(87)
--------	-------	-------	-------	-------	-------	-------	----	----	-------	-------	-------	-------	------

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

(88)m=	20.19	20.19	20.19	20.21	20.21	20.22	20.22	20.22	20.21	20.21	20.2	20.2	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------	------

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

(89)m=	0.99	0.98	0.95	0.89	0.76	0.55	0.37	0.39	0.61	0.88	0.97	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	19.27	19.47	19.71	19.97	20.14	20.21	20.22	20.22	20.2	20.03	19.63	19.25	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.47 (91)

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

(92)m=	19.76	19.93	20.13	20.36	20.51	20.58	20.59	20.59	20.57	20.41	20.06	19.74	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

TER WorkSheet: New dwelling design stage

(93)m=	19.76	19.93	20.13	20.36	20.51	20.58	20.59	20.59	20.57	20.41	20.06	19.74	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, h_m :

(94)m=	0.99	0.98	0.95	0.9	0.78	0.59	0.41	0.43	0.65	0.88	0.97	0.99	(94)
--------	------	------	------	-----	------	------	------	------	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	401.9	441.53	452.79	430.24	368.87	262.72	177.37	185.71	282.77	374.48	387.57	384.85	(95)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	717.37	694.8	628.2	519.74	398.41	266.49	177.69	186.14	289.92	443.68	589.78	711.28	(97)
--------	--------	-------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	234.71	170.19	130.5	64.44	21.98	0	0	0	0	51.48	145.59	242.86	
--------	--------	--------	-------	-------	-------	---	---	---	---	-------	--------	--------	--

Total per year ($kWh/year$) = $Sum(98)_{1...5,9...12} =$ 1061.76 (98)

Space heating requirement in $kWh/m^2/year$

20.03 (99)

9a. Energy requirements – Individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = $1 - (201) =$

1 (202)

Fraction of total heating from main system 1

(204) = $(202) \times [1 - (203)] =$

1 (204)

Efficiency of main space heating system 1

93.5 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

234.71	170.19	130.5	64.44	21.98	0	0	0	0	51.48	145.59	242.86
--------	--------	-------	-------	-------	---	---	---	---	-------	--------	--------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$

251.02	182.02	139.58	68.92	23.51	0	0	0	0	55.06	155.71	259.75
--------	--------	--------	-------	-------	---	---	---	---	-------	--------	--------

Total ($kWh/year$) = $Sum(211)_{1...5,10...12} =$ 1135.57 (211)

Space heating fuel (secondary), $kWh/month$

= $\{[(98)m \times (201)]\} \times 100 \div (208)$

(215)m=	0	0	0	0	0	0	0	0	0	0	0
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Total ($kWh/year$) = $Sum(215)_{1...5,10...12} =$ 0 (215)

Water heating

Output from water heater (calculated above)

173.94	153.54	161.78	145.77	143.39	128.89	124.52	135.63	135.07	151.12	158.86	170
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Efficiency of water heater

79.8 (216)

(217)m=	85.61	85.09	84.25	82.8	81.07	79.8	79.8	79.8	79.8	82.27	84.58	85.76	(217)
---------	-------	-------	-------	------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	203.17	180.44	192.03	176.05	176.86	161.52	156.04	169.96	169.26	183.68	187.82	198.22
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Total = $Sum(219a)_{1...12} =$ 2155.05 (219)

Annual totals

$kWh/year$

$kWh/year$

Space heating fuel used, main system 1

1135.57

TER WorkSheet: New dwelling design stage

Water heating fuel used		2155.05	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75 (231)
Electricity for lighting		282.73	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		3648.35	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	=	245.28 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	465.49 (264)
Space and water heating	(261) + (262) + (263) + (264) =			710.77 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93 (267)
Electricity for lighting	(232) x	0.519	=	146.74 (268)
Total CO2, kg/year	sum of (265)...(271) =			896.43 (272)
TER =				24.29 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.58

Property Address: Caversham 2BF EXP 74 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	74 (1a) x	2.4 (2a) =	177.6 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	177.6 (5)

2. Ventilation rate:

	main heating	secondary heating	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				2 x 10 =	20 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20 ÷ (5) = 0.11 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 4 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.31 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.27 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

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

0.34	0.33	0.33	0.29	0.29	0.25	0.25	0.25	0.27	0.29	0.3	0.31
------	------	------	------	------	------	------	------	------	------	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.56 0.56 0.55 0.54 0.54 0.53 0.53 0.53 0.54 0.54 0.54 0.55 (24d)

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

(25)m= 0.56 0.56 0.55 0.54 0.54 0.53 0.53 0.53 0.54 0.54 0.54 0.55 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.2) + 0.04] =$	4.33		(27)
Windows Type 2			1.44	$\times 1/[1/(1.2) + 0.04] =$	1.65		(27)
Windows Type 3			1.44	$\times 1/[1/(1.2) + 0.04] =$	1.65		(27)
Floor			74	x 0.11 =	8.14		(28)
Walls	25.04	6.66	18.38	x 0.19 =	3.49		(29)
Total area of elements, m²			99.04				(31)
Party wall			59.55	x 0 =	0		(32)
Party ceiling			74				(32b)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 19.26 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 10063.75 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 9.69 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 28.95 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	32.67	32.54	32.41	31.81	31.7	31.17	31.17	31.07	31.37	31.7	31.92	32.16

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

(39)m= 61.62 61.49 61.36 60.76 60.64 60.12 60.12 60.02 60.32 60.64 60.87 61.11
Average = Sum(39)_{1...12} /12= 60.76 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.83	0.83	0.83	0.82	0.82	0.81	0.81	0.81	0.82	0.82	0.82	0.83		
	Average = Sum(40) _{1...12} / 12 =												0.82	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.34

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

89.76

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
	Total = Sum(44) _{1...12} =												1077.07	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8		
	Total = Sum(45) _{1...12} =												1412.21	(45)

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

(46)m=	21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

180

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

1.2

(48)

Temperature factor from Table 2b

0.6

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.72

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.72

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32		(56)
--------	-------	-------	-------	------	-------	------	-------	-------	------	-------	------	-------	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32		(57)
--------	-------	-------	-------	------	-------	------	-------	-------	------	-------	------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

DER WorkSheet: New dwelling design stage

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	192	169.23	177.72	159.32	156.12	139.5	133.97	147.01	146.75	165.2	174.69	187.38	(62)
--------	-----	--------	--------	--------	--------	-------	--------	--------	--------	-------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	192	169.23	177.72	159.32	156.12	139.5	133.97	147.01	146.75	165.2	174.69	187.38	
Output from water heater (annual) _{1...12}												1948.91	(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	85.15	75.52	80.4	73.6	73.22	67.01	65.86	70.19	69.42	76.24	78.71	83.61	(65)
--------	-------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	(66)

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

(67)m=	21.72	19.29	15.69	11.88	8.88	7.49	8.1	10.53	14.13	17.94	20.94	22.32	(67)
--------	-------	-------	-------	-------	------	------	-----	-------	-------	-------	-------	-------	------

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

(68)m=	206.45	208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34	(68)
--------	--------	--------	--------	-------	--------	--------	--------	-------	-------	-------	-------	--------	------

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

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(69)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	114.45	112.37	108.07	102.22	98.42	93.06	88.52	94.34	96.41	102.47	109.31	112.38	(72)
--------	--------	--------	--------	--------	-------	-------	-------	-------	-------	--------	--------	--------	------

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

(73)m=	400.7	398.34	385.03	363.88	342.57	322.2	309.15	315.26	326.33	347.7	372.04	390.13	(73)
--------	-------	--------	--------	--------	--------	-------	--------	--------	--------	-------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)		
South	0.9x	0.77	x	3.78	x	46.75	x	0.63	x	0.7	=	54.01	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57	(78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.63	x	0.7	=	88.45	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 95.16 155.84 198.52 224.37 233.81 225.01 219.85 213.5 207.38 168.09 112.8 82.23 (83)

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

(84)m= 495.86 554.19 583.55 588.25 576.38 547.21 529 528.76 533.71 515.79 484.84 472.36 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	1	0.99	0.98	0.94	0.86	0.68	0.5	0.52	0.74	0.94	0.99	1

(86)

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

(87)m= 20.28 20.41 20.57 20.76 20.91 20.98 21 21 20.97 20.8 20.51 20.25 (87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.23	20.23	20.23	20.24	20.24	20.24	20.24	20.24	20.24	20.24	20.23	20.23	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.99	0.97	0.93	0.82	0.61	0.41	0.44	0.67	0.92	0.99	1	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	---	------

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

(90)m=	19.26	19.45	19.68	19.95	20.15	20.23	20.24	20.24	20.22	20.02	19.6	19.22	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

fLA = Living area ÷ (4) =	0.34	(91)
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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.61	19.77	19.98	20.22	20.4	20.49	20.5	20.5	20.47	20.28	19.9	19.57	(92)
--------	-------	-------	-------	-------	------	-------	------	------	-------	-------	------	-------	------

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

(93)m=	19.61	19.77	19.98	20.22	20.4	20.49	20.5	20.5	20.47	20.28	19.9	19.57	(93)
--------	-------	-------	-------	-------	------	-------	------	------	-------	-------	------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.97	0.93	0.83	0.63	0.44	0.46	0.7	0.92	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	------	-----	------	------	------	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	492.37	545.87	564.96	545.04	477.24	346.89	233.75	245.18	371.4	473.67	476.74	469.84	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m – (96)m]

(97)m=	943.07	914.32	827.28	687.99	527.77	353.87	234.31	245.96	384.48	587.13	779.42	939.33	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	335.32	247.6	195.17	102.93	37.6	0	0	0	0	84.41	217.93	349.3	(98)
--------	--------	-------	--------	--------	------	---	---	---	---	-------	--------	-------	------

Total per year (kWh/year) = Sum(98) _{1...5,9...12} =	1570.26	(98)
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Space heating requirement in kWh/m²/year

21.22	(99)
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9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none

0	(301)
---	-------

Fraction of space heat from community system 1 – (301) =

1	(302)
---	-------

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump

1	(303a)
---	--------

Fraction of total space heat from Community heat pump

(302) x (303a) =

1	(304a)
---	--------

Factor for control and charging method (Table 4c(3)) for community heating system

1	(305)
---	-------

Distribution loss factor (Table 12c) for community heating system

1.05	(306)
------	-------

Space heating

Annual space heating requirement

kWh/year

1570.26

Space heat from Community heat pump

(98) x (304a) x (305) x (306) =

1648.78	(307a)
---------	--------

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)

0	(308)
---	-------

DER WorkSheet: New dwelling design stage

Space heating requirement from secondary/supplementary system	$(98) \times (301) \times 100 \div (308) =$	0	(309)
Water heating			
Annual water heating requirement		1948.91	
If DHW from community scheme:			
Water heat from Community heat pump	$(64) \times (303a) \times (305) \times (306) =$	2046.35	(310a)
Electricity used for heat distribution	$0.01 \times [(307a) \dots (307e) + (310a) \dots (310e)] =$	36.95	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	$= (107) \div (314) =$	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		0	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	$= (330a) + (330b) + (330g) =$	0	(331)
Energy for lighting (calculated in Appendix L)		383.53	(332)
Total delivered energy for all uses $(307) + (309) + (310) + (312) + (315) + (331) + (332) \dots (237b) =$		4078.66	(338)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)			
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		401 (367a)
CO2 associated with heat source 1	$[(307b)+(310b)] \times 100 \div (367b) \times$	0.52	478.25 (367)
Electrical energy for heat distribution	$[(313) \times$	0.52	19.18 (372)
Total CO2 associated with community systems	$(363) \dots (366) + (368) \dots (372)$		497.42 (373)
CO2 associated with space heating (secondary)	$(309) \times$	0	0 (374)
CO2 associated with water from immersion heater or instantaneous heater	$(312) \times$	0.52	0 (375)
Total CO2 associated with space and water heating	$(373) + (374) + (375) =$		497.42 (376)
CO2 associated with electricity for pumps and fans within dwelling	$(331)) \times$	0.52	0 (378)
CO2 associated with electricity for lighting	$(332))) \times$	0.52	199.05 (379)
Total CO2, kg/year	sum of (376) ... (382) =		696.48 (383)
Dwelling CO2 Emission Rate	$(383) \div (4) =$		9.41 (384)
EI rating (section 14)			92.16 (385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.58

Property Address: Caversham 2BF EXP 74 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	74 (1a)	2.4 (2a)	177.6 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	177.6 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				3	30 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.17 (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

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry 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

Percentage of windows and doors draught stripped

Window infiltration

Infiltration rate

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) ÷ 20] + (8), otherwise (18) = (16)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered

Shelter factor

Infiltration rate incorporating shelter factor

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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TER WorkSheet: New dwelling design stage

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

0.45	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42
------	------	------	------	------	------	------	------	------	------	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.6 0.6 0.6 0.58 0.57 0.56 0.56 0.55 0.56 0.57 0.58 0.59 (24d)

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

(25)m= 0.6 0.6 0.6 0.58 0.57 0.56 0.56 0.55 0.56 0.57 0.58 0.59 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Windows Type 3			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Floor			74	$\times$ 0.13	= 9.62		(28)
Walls	25.04	6.66	18.38	$\times$ 0.18	= 3.31		(29)
Total area of elements, m²			99.04				(31)
Party wall			59.55	$\times$ 0	= 0		(32)
Party ceiling			74				(32b)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 21.76 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 10063.75 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 8.68 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 30.44 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	35.34	35.11	34.88	33.8	33.6	32.66	32.66	32.48	33.02	33.6	34.01	34.43

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

(39)m= 65.78 65.55 65.32 64.24 64.04 63.1 63.1 62.92 63.46 64.04 64.45 64.87
Average = Sum(39)_{1...12} /12= 64.24 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.89	0.89	0.88	0.87	0.87	0.85	0.85	0.85	0.86	0.87	0.87	0.88		
	Average = Sum(40) _{1...12} / 12 =												0.87	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.34

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

89.76

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
	Total = Sum(44) _{1...12} =												1077.07	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8		
	Total = Sum(45) _{1...12} =												1412.21	(45)

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

(46)m=	21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

150

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

1.55

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.84

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.84

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

TER WorkSheet: New dwelling design stage

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

(61)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=

195.66	172.53	181.39	162.86	159.78	143.04	137.63	150.67	150.3	168.86	178.23	191.04
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------

 (62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (63)

Output from water heater

(64)m=

195.66	172.53	181.39	162.86	159.78	143.04	137.63	150.67	150.3	168.86	178.23	191.04
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------

Output from water heater (annual)_{1...12}

1992

 (64)

Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m=

88.08	78.16	83.33	76.43	76.15	69.84	68.78	73.12	72.25	79.17	81.54	86.54
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96

 (66)

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

(67)m=

21.72	19.29	15.69	11.88	8.88	7.49	8.1	10.53	14.13	17.94	20.94	22.32
-------	-------	-------	-------	------	------	-----	-------	-------	-------	-------	-------

 (67)

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

(68)m=

206.45	208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34
--------	--------	--------	-------	--------	--------	--------	-------	-------	-------	-------	--------

 (68)

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

(69)m=

34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7
------	------	------	------	------	------	------	------	------	------	------	------

 (69)

Pumps and fans gains (Table 5a)

(70)m=

3	3	3	3	3	3	3	3	3	3	3	3
---	---	---	---	---	---	---	---	---	---	---	---

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=

-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m=

118.38	116.31	112	106.15	102.35	97	92.45	98.28	100.35	106.41	113.25	116.32
--------	--------	-----	--------	--------	----	-------	-------	--------	--------	--------	--------

 (72)

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

(73)m=

407.64	405.28	391.97	370.81	349.51	329.14	316.09	322.2	333.27	354.63	378.98	397.07
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------

 (73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)							
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>3.78</td></tr></table>	3.78	x	<table><tr><td>46.75</td></tr></table>	46.75	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>54.01</td></tr></table>	54.01	(78)
0.77																			
3.78																			
46.75																			
0.63																			
0.7																			
54.01																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.44</td></tr></table>	1.44	x	<table><tr><td>46.75</td></tr></table>	46.75	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>20.57</td></tr></table>	20.57	(78)
0.77																			
1.44																			
46.75																			
0.63																			
0.7																			
20.57																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.44</td></tr></table>	1.44	x	<table><tr><td>46.75</td></tr></table>	46.75	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>20.57</td></tr></table>	20.57	(78)
0.77																			
1.44																			
46.75																			
0.63																			
0.7																			
20.57																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>3.78</td></tr></table>	3.78	x	<table><tr><td>76.57</td></tr></table>	76.57	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>88.45</td></tr></table>	88.45	(78)
0.77																			
3.78																			
76.57																			
0.63																			
0.7																			
88.45																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.44</td></tr></table>	1.44	x	<table><tr><td>76.57</td></tr></table>	76.57	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>33.7</td></tr></table>	33.7	(78)
0.77																			
1.44																			
76.57																			
0.63																			
0.7																			
33.7																			

TER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 95.16 155.84 198.52 224.37 233.81 225.01 219.85 213.5 207.38 168.09 112.8 82.23 (83)

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

(84)m= 502.79 561.12 590.49 595.18 583.31 554.15 535.93 535.7 540.65 522.72 491.77 479.29 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	1	0.99	0.98	0.95	0.87	0.7	0.51	0.54	0.76	0.94	0.99	1

(86)

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

(87)m= 20.2 20.33 20.51 20.72 20.88 20.98 21 21 20.96 20.77 20.45 20.18 (87)

TER WorkSheet: New dwelling design stage

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

(88)m=	20.18	20.18	20.18	20.19	20.2	20.21	20.21	20.21	20.2	20.2	20.19	20.19	(88)
--------	-------	-------	-------	-------	------	-------	-------	-------	------	------	-------	-------	------

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

(89)m=	0.99	0.99	0.97	0.93	0.83	0.63	0.42	0.45	0.69	0.92	0.99	1	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	---	------

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

(90)m=	19.11	19.31	19.56	19.86	20.08	20.19	20.21	20.21	20.18	19.94	19.49	19.09	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.34 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.48	19.65	19.88	20.15	20.35	20.46	20.47	20.47	20.44	20.22	19.81	19.46	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	19.48	19.65	19.88	20.15	20.35	20.46	20.47	20.47	20.44	20.22	19.81	19.46	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	0.99	0.99	0.97	0.93	0.84	0.65	0.45	0.48	0.71	0.92	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	499.25	553.02	572.91	554.72	490.44	360.08	243.58	255.23	384.92	482.91	483.76	476.68	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m – (96)m]

(97)m=	998.75	967.09	873.95	722.71	554.12	369.67	244.44	256.4	402.46	615.98	819.44	990.01	(97)
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	------

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

(98)m=	371.63	278.26	223.97	120.95	47.38	0	0	0	0	99.01	241.69	381.92	(98)
--------	--------	--------	--------	--------	-------	---	---	---	---	-------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 1764.8 \quad (98)$$

Space heating requirement in kWh/m²/year

$$23.85 \quad (99)$$

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

$$1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

$$1 \quad (204)$$

Efficiency of main space heating system 1

$$93.5 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

371.63	278.26	223.97	120.95	47.38	0	0	0	0	99.01	241.69	381.92
--------	--------	--------	--------	-------	---	---	---	---	-------	--------	--------

$$(211)m = \{ [(98)m \times (204)] \} \times 100 \div (206) \quad (211)$$

397.47	297.6	239.54	129.36	50.67	0	0	0	0	105.89	258.49	408.47
--------	-------	--------	--------	-------	---	---	---	---	--------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 1887.49 \quad (211)$$

Space heating fuel (secondary), kWh/month

$$= \{ [(98)m \times (201)] \} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	(215)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

TER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

195.66	172.53	181.39	162.86	159.78	143.04	137.63	150.67	150.3	168.86	178.23	191.04
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------

Efficiency of water heater

79.8 (216)

(217)m= 86.5 86.08 85.38 84.03 82.02 79.8 79.8 79.8 79.8 83.45 85.63 86.63 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

226.2	200.43	212.45	193.8	194.82	179.25	172.47	188.81	188.34	202.36	208.15	220.53
-------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------

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

2387.61 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1887.49

Water heating fuel used

2387.61

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75 (231)

Electricity for lighting

383.53 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

4733.63 (338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	407.7 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	515.72 (264)
Space and water heating	(261) + (262) + (263) + (264) =		923.42 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	199.05 (268)
Total CO2, kg/year		sum of (265)...(271) =	1161.4 (272)

TER =

22.56 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.58

Property Address: Caversham 2BF MID 74 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	74 (1a)	2.4 (2a)	177.6 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	177.6 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				2	20 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.11 (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

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry 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

Percentage of windows and doors draught stripped

Window infiltration

Infiltration rate

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) ÷ 20] + (8), otherwise (18) = (16)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered

Shelter factor

Infiltration rate incorporating shelter factor

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

DER WorkSheet: New dwelling design stage

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

0.34	0.33	0.33	0.29	0.29	0.25	0.25	0.25	0.27	0.29	0.3	0.31
------	------	------	------	------	------	------	------	------	------	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m x 0.5]

(24d)m=

0.56	0.56	0.55	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.54	0.55
------	------	------	------	------	------	------	------	------	------	------	------

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

(25)m=

0.56	0.56	0.55	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.54	0.55
------	------	------	------	------	------	------	------	------	------	------	------

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.2) + 0.04] =$	4.33		
Windows Type 2			1.44	$\times 1/[1/(1.2) + 0.04] =$	1.65		
Windows Type 3			1.44	$\times 1/[1/(1.2) + 0.04] =$	1.65		
Walls	25.04	6.66	18.38	x 0.19	3.49		
Total area of elements, m²			25.04				
Party wall			59.55	x 0	0		
Party floor			74				
Party ceiling			74				

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 11.12 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 7473.75 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 3.11 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 14.23 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	32.67	32.54	32.41	31.81	31.7	31.17	31.17	31.07	31.37	31.7	31.92	32.16

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

(39)m=	46.9	46.77	46.64	46.04	45.93	45.4	45.4	45.3	45.6	45.93	46.15	46.39
Average = Sum(39) _{1...12} /12=												46.04

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.63	0.63	0.63	0.62	0.62	0.61	0.61	0.61	0.62	0.62	0.62	0.63		
	Average = Sum(40) _{1...12} / 12 =												0.62	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.34

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

89.76

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
	Total = Sum(44) _{1...12} =												1077.07	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8		
	Total = Sum(45) _{1...12} =												1412.21	(45)

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

(46)m=	21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

180

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

1.2

(48)

Temperature factor from Table 2b

0.6

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.72

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.72

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32		(56)
--------	-------	-------	-------	------	-------	------	-------	-------	------	-------	------	-------	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32		(57)
--------	-------	-------	-------	------	-------	------	-------	-------	------	-------	------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

DER WorkSheet: New dwelling design stage

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	192	169.23	177.72	159.32	156.12	139.5	133.97	147.01	146.75	165.2	174.69	187.38	(62)
--------	-----	--------	--------	--------	--------	-------	--------	--------	--------	-------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	192	169.23	177.72	159.32	156.12	139.5	133.97	147.01	146.75	165.2	174.69	187.38	
Output from water heater (annual) _{1...12}												1948.91	(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	85.15	75.52	80.4	73.6	73.22	67.01	65.86	70.19	69.42	76.24	78.71	83.61	(65)
--------	-------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	(66)

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

(67)m=	21.72	19.29	15.69	11.88	8.88	7.49	8.1	10.53	14.13	17.94	20.94	22.32	(67)
--------	-------	-------	-------	-------	------	------	-----	-------	-------	-------	-------	-------	------

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

(68)m=	206.45	208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34	(68)
--------	--------	--------	--------	-------	--------	--------	--------	-------	-------	-------	-------	--------	------

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

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(69)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	114.45	112.37	108.07	102.22	98.42	93.06	88.52	94.34	96.41	102.47	109.31	112.38	(72)
--------	--------	--------	--------	--------	-------	-------	-------	-------	-------	--------	--------	--------	------

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

(73)m=	400.7	398.34	385.03	363.88	342.57	322.2	309.15	315.26	326.33	347.7	372.04	390.13	(73)
--------	-------	--------	--------	--------	--------	-------	--------	--------	--------	-------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	3.78	x	46.75	x	0.63	x	0.7	=	54.01 (78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57 (78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57 (78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.63	x	0.7	=	88.45 (78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7 (78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 95.16 155.84 198.52 224.37 233.81 225.01 219.85 213.5 207.38 168.09 112.8 82.23 (83)

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

(84)m= 495.86 554.19 583.55 588.25 576.38 547.21 529 528.76 533.71 515.79 484.84 472.36 (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	0.98	0.95	0.87	0.72	0.53	0.38	0.39	0.59	0.86	0.98	0.99

(86)

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

(87)m=	20.59	20.7	20.83	20.93	20.99	21	21	21	21	20.95	20.76	20.57
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(87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.4	20.4	20.4	20.41	20.41	20.42	20.42	20.42	20.42	20.41	20.41	20.41	(88)
--------	------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.97	0.93	0.84	0.68	0.48	0.33	0.34	0.54	0.82	0.97	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	19.86	20.02	20.19	20.34	20.4	20.42	20.42	20.42	20.41	20.36	20.11	19.82	(90)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =	0.34	(91)
---------------------------	------	------

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

(92)m=	20.11	20.25	20.41	20.54	20.6	20.61	20.61	20.62	20.61	20.56	20.33	20.07	(92)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	20.11	20.25	20.41	20.54	20.6	20.61	20.61	20.62	20.61	20.56	20.33	20.07	(93)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	0.99	0.97	0.93	0.85	0.7	0.5	0.34	0.36	0.55	0.83	0.97	0.99	(94)
--------	------	------	------	------	-----	-----	------	------	------	------	------	------	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	489.89	538.1	544.93	498.79	401.9	272.68	182.25	190.95	296.04	429.79	468.69	468.2	(95)
--------	--------	-------	--------	--------	-------	--------	--------	--------	--------	--------	--------	-------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m – (96)m]

(97)m=	741.23	717.92	648.52	535.89	408.65	273.04	182.26	190.97	296.94	457.38	610.65	736.44	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	187	120.84	77.08	26.71	5.02	0	0	0	0	20.52	102.21	199.57	(98)
--------	-----	--------	-------	-------	------	---	---	---	---	-------	--------	--------	------

Total per year (kWh/year) = Sum(98) _{1...5,9...12} =	738.95	(98)
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Space heating requirement in kWh/m²/year

9.99	(99)
------	------

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none

0	(301)
---	-------

Fraction of space heat from community system 1 – (301) =

1	(302)
---	-------

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump

1	(303a)
---	--------

Fraction of total space heat from Community heat pump

(302) x (303a) =	1	(304a)
------------------	---	--------

Factor for control and charging method (Table 4c(3)) for community heating system

1	(305)
---	-------

Distribution loss factor (Table 12c) for community heating system

1.05	(306)
------	-------

Space heating

Annual space heating requirement

kWh/year	
----------	--

738.95	
--------	--

Space heat from Community heat pump

(98) x (304a) x (305) x (306) =	775.9	(307a)
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Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)

0	(308)
---	-------

DER WorkSheet: New dwelling design stage

Space heating requirement from secondary/supplementary system	$(98) \times (301) \times 100 \div (308) =$	0	(309)
Water heating			
Annual water heating requirement		1948.91	
If DHW from community scheme:			
Water heat from Community heat pump	$(64) \times (303a) \times (305) \times (306) =$	2046.35	(310a)
Electricity used for heat distribution	$0.01 \times [(307a)...(307e) + (310a)...(310e)] =$	28.22	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	$= (107) \div (314) =$	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		0	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	$= (330a) + (330b) + (330g) =$	0	(331)
Energy for lighting (calculated in Appendix L)		383.53	(332)
Total delivered energy for all uses $(307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =$		3205.78	(338)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)			
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		401 (367a)
CO2 associated with heat source 1	$[(307b)+(310b)] \times 100 \div (367b) \times$	0.52	365.27 (367)
Electrical energy for heat distribution	$[(313) \times$	0.52	14.65 (372)
Total CO2 associated with community systems	$(363)...(366) + (368)...(372)$		379.92 (373)
CO2 associated with space heating (secondary)	$(309) \times$	0	0 (374)
CO2 associated with water from immersion heater or instantaneous heater	$(312) \times$	0.52	0 (375)
Total CO2 associated with space and water heating	$(373) + (374) + (375) =$		379.92 (376)
CO2 associated with electricity for pumps and fans within dwelling	$(331) \times$	0.52	0 (378)
CO2 associated with electricity for lighting	$(332) \times$	0.52	199.05 (379)
Total CO2, kg/year	sum of (376)...(382) =		578.97 (383)
Dwelling CO2 Emission Rate	$(383) \div (4) =$		7.82 (384)
EI rating (section 14)			93.48 (385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.58

Property Address: Caversham 2BF MID 74 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	74 (1a) x	2.4 (2a) =	177.6 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	177.6 (5)

2. Ventilation rate:

	main heating	secondary heating	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				3 x 10 =	30 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30 ÷ (5) = 0.17 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.42 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.36 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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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
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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TER WorkSheet: New dwelling design stage

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

0.45	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42
------	------	------	------	------	------	------	------	------	------	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.6 0.6 0.6 0.58 0.57 0.56 0.56 0.55 0.56 0.57 0.58 0.59 (24d)

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

(25)m= 0.6 0.6 0.6 0.58 0.57 0.56 0.56 0.55 0.56 0.57 0.58 0.59 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Windows Type 3			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Walls	25.04	6.66	18.38	$\times 0.18 =$	3.31		(29)
Total area of elements, m²			25.04				(31)
Party wall			59.55	$\times 0 =$	0		(32)
Party floor			74				(32a)
Party ceiling			74				(32b)

* for windows and roof windows, use effective window U-value calculated using formula $1/[1/(U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 12.14 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 7473.75 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 2.1 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 14.24 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	35.34	35.11	34.88	33.8	33.6	32.66	32.66	32.48	33.02	33.6	34.01	34.43

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

(39)m= 49.59 49.35 49.12 48.04 47.84 46.9 46.9 46.73 47.26 47.84 48.25 48.68
Average = Sum(39)_{1...12} /12= 48.04 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.67	0.67	0.66	0.65	0.65	0.63	0.63	0.63	0.64	0.65	0.65	0.66		
	Average = Sum(40) _{1...12} / 12 =												0.65	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.34

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

89.76

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
	Total = Sum(44) _{1...12} =												1077.07	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8		
	Total = Sum(45) _{1...12} =												1412.21	(45)

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

(46)m=	21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

150

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

1.55

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.84

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.84

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98		(57)
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Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
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TER WorkSheet: New dwelling design stage

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	195.66	172.53	181.39	162.86	159.78	143.04	137.63	150.67	150.3	168.86	178.23	191.04	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	(63)
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Output from water heater

(64)m=	195.66	172.53	181.39	162.86	159.78	143.04	137.63	150.67	150.3	168.86	178.23	191.04	
Output from water heater (annual) _{1...12}												1992	(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	88.08	78.16	83.33	76.43	76.15	69.84	68.78	73.12	72.25	79.17	81.54	86.54	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	(66)

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

(67)m=	21.72	19.29	15.69	11.88	8.88	7.49	8.1	10.53	14.13	17.94	20.94	22.32	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	206.45	208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34	(68)
--------	--------	--------	--------	-------	--------	--------	--------	-------	-------	-------	-------	--------	------

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

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(69)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	118.38	116.31	112	106.15	102.35	97	92.45	98.28	100.35	106.41	113.25	116.32	(72)
--------	--------	--------	-----	--------	--------	----	-------	-------	--------	--------	--------	--------	------

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

(73)m=	407.64	405.28	391.97	370.81	349.51	329.14	316.09	322.2	333.27	354.63	378.98	397.07	(73)
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	3.78	x	46.75	x	0.63	x	0.7	=	54.01	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57	(78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.63	x	0.7	=	88.45	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)

TER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 95.16 155.84 198.52 224.37 233.81 225.01 219.85 213.5 207.38 168.09 112.8 82.23 (83)

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

(84)m= 502.79 561.12 590.49 595.18 583.31 554.15 535.93 535.7 540.65 522.72 491.77 479.29 (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	0.98	0.95	0.88	0.74	0.54	0.38	0.4	0.6	0.87	0.98	0.99

(86)

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

(87)m= 20.54 20.66 20.79 20.92 20.98 21 21 21 21 20.94 20.73 20.52 (87)

TER WorkSheet: New dwelling design stage

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

(88)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	(88)
--------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	------

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

(89)m=	0.99	0.98	0.94	0.85	0.7	0.49	0.33	0.35	0.55	0.84	0.97	0.99	(89)
--------	------	------	------	------	-----	------	------	------	------	------	------	------	------

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

(90)m=	19.76	19.93	20.12	20.3	20.37	20.4	20.4	20.4	20.39	20.32	20.05	19.74	(90)
--------	-------	-------	-------	------	-------	------	------	------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.34 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	20.02	20.18	20.34	20.51	20.58	20.6	20.6	20.6	20.6	20.53	20.28	20.01	(92)
--------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	------

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

(93)m=	20.02	20.18	20.34	20.51	20.58	20.6	20.6	20.6	20.6	20.53	20.28	20.01	(93)
--------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	0.99	0.97	0.94	0.86	0.71	0.51	0.35	0.37	0.57	0.84	0.97	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	497.12	546.32	555.39	511.45	415.57	280.97	187.69	196.4	305.82	441.09	476.4	475.21	(95)
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	-------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m - (96)m]

(97)m=	779.66	753.92	680.07	557.63	424.74	281.47	187.71	196.43	307.07	475.14	635.93	769.38	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	210.21	139.5	92.76	33.25	6.82	0	0	0	0	25.33	114.86	218.86	(98)
--------	--------	-------	-------	-------	------	---	---	---	---	-------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 841.6 \quad (98)$$

Space heating requirement in kWh/m²/year

$$11.37 \quad (99)$$

9a. Energy requirements – Individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

$$1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

$$1 \quad (204)$$

Efficiency of main space heating system 1

$$93.5 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

kWh/year

Space heating requirement (calculated above)

210.21	139.5	92.76	33.25	6.82	0	0	0	0	25.33	114.86	218.86
--------	-------	-------	-------	------	---	---	---	---	-------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

224.82	149.2	99.21	35.56	7.3	0	0	0	0	27.09	122.85	234.08
--------	-------	-------	-------	-----	---	---	---	---	-------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 900.11 \quad (211)$$

Space heating fuel (secondary), kWh/month

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	(215)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

TER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

195.66	172.53	181.39	162.86	159.78	143.04	137.63	150.67	150.3	168.86	178.23	191.04
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------

Efficiency of water heater

79.8 (216)

(217)m= 85.01 84.25 83.13 81.43 80.19 79.8 79.8 79.8 79.8 81.05 83.68 85.18 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	230.17	204.78	218.21	199.99	199.26	179.25	172.47	188.81	188.34	208.34	213	224.28
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-----	--------

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

2426.92 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

900.11

Water heating fuel used

2426.92

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75 (231)

Electricity for lighting

383.53 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

3785.56 (233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	194.42 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	524.22 (264)
Space and water heating	(261) + (262) + (263) + (264) =		718.64 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	199.05 (268)
Total CO2, kg/year		sum of (265)...(271) =	956.62 (272)

TER =

18.27 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.58

Property Address: Caversham 2BF TOP 74 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	74 (1a)	2.4 (2a)	177.6 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	177.6 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				2	20 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20 ÷ (5) = 0.11 (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]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 (12)

If no draught lobby, enter 0.05, else enter 0 (13)

Percentage of windows and doors draught stripped (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.27 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

DER WorkSheet: New dwelling design stage

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

0.34	0.33	0.33	0.29	0.29	0.25	0.25	0.25	0.27	0.29	0.3	0.31
------	------	------	------	------	------	------	------	------	------	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.56 0.56 0.55 0.54 0.54 0.53 0.53 0.53 0.54 0.54 0.54 0.55 (24d)

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

(25)m= 0.56 0.56 0.55 0.54 0.54 0.53 0.53 0.53 0.54 0.54 0.54 0.55 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.2) + 0.04] =$	4.33		(27)
Windows Type 2			1.44	$\times 1/[1/(1.2) + 0.04] =$	1.65		(27)
Windows Type 3			1.44	$\times 1/[1/(1.2) + 0.04] =$	1.65		(27)
Walls	25.04	6.66	18.38	x 0.19 =	3.49		(29)
Roof	74	0	74	x 0.15 =	11.1		(30)
Total area of elements, m²			99.04				(31)
Party wall			59.55	x 0 =	0		(32)
Party floor			74				(32a)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 22.22 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5919.75 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 9.9 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 32.12 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	32.67	32.54	32.41	31.81	31.7	31.17	31.17	31.07	31.37	31.7	31.92	32.16

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

(39)m=	64.79	64.66	64.53	63.93	63.82	63.29	63.29	63.19	63.49	63.82	64.04	64.28
Average = Sum(39) _{1...12} /12=												63.93 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.88	0.87	0.87	0.86	0.86	0.86	0.86	0.85	0.86	0.86	0.87	0.87		
	Average = Sum(40) _{1...12} / 12 =												0.86	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.34

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

89.76

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
	Total = Sum(44) _{1...12} =												1077.07	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8		
	Total = Sum(45) _{1...12} =												1412.21	(45)

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

(46)m=	21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

180

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

1.2

(48)

Temperature factor from Table 2b

0.6

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.72

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.72

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32		(56)
--------	-------	-------	-------	------	-------	------	-------	-------	------	-------	------	-------	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32		(57)
--------	-------	-------	-------	------	-------	------	-------	-------	------	-------	------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

DER WorkSheet: New dwelling design stage

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	192	169.23	177.72	159.32	156.12	139.5	133.97	147.01	146.75	165.2	174.69	187.38	(62)
--------	-----	--------	--------	--------	--------	-------	--------	--------	--------	-------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	192	169.23	177.72	159.32	156.12	139.5	133.97	147.01	146.75	165.2	174.69	187.38	
Output from water heater (annual) _{1...12}												1948.91	(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	85.15	75.52	80.4	73.6	73.22	67.01	65.86	70.19	69.42	76.24	78.71	83.61	(65)
--------	-------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	(66)

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

(67)m=	21.72	19.29	15.69	11.88	8.88	7.49	8.1	10.53	14.13	17.94	20.94	22.32	(67)
--------	-------	-------	-------	-------	------	------	-----	-------	-------	-------	-------	-------	------

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

(68)m=	206.45	208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34	(68)
--------	--------	--------	--------	-------	--------	--------	--------	-------	-------	-------	-------	--------	------

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

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(69)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	114.45	112.37	108.07	102.22	98.42	93.06	88.52	94.34	96.41	102.47	109.31	112.38	(72)
--------	--------	--------	--------	--------	-------	-------	-------	-------	-------	--------	--------	--------	------

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

(73)m=	400.7	398.34	385.03	363.88	342.57	322.2	309.15	315.26	326.33	347.7	372.04	390.13	(73)
--------	-------	--------	--------	--------	--------	-------	--------	--------	--------	-------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)		
South	0.9x	0.77	x	3.78	x	46.75	x	0.63	x	0.7	=	54.01	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57	(78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.63	x	0.7	=	88.45	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 95.16 155.84 198.52 224.37 233.81 225.01 219.85 213.5 207.38 168.09 112.8 82.23 (83)

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

(84)m= 495.86 554.19 583.55 588.25 576.38 547.21 529 528.76 533.71 515.79 484.84 472.36 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	1	0.99	0.98	0.95	0.88	0.71	0.52	0.54	0.77	0.95	0.99	1

(86)

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

(87)m= 20.21 20.34 20.51 20.71 20.88 20.98 21 21 20.96 20.77 20.45 20.19 (87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.19	20.19	20.19	20.2	20.2	20.21	20.21	20.21	20.2	20.2	20.2	20.19	(88)
--------	-------	-------	-------	------	------	-------	-------	-------	------	------	------	-------	------

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

(89)m=	0.99	0.99	0.97	0.94	0.84	0.63	0.43	0.45	0.7	0.93	0.99	1	(89)
--------	------	------	------	------	------	------	------	------	-----	------	------	---	------

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

(90)m=	19.14	19.33	19.57	19.86	20.08	20.19	20.2	20.21	20.17	19.94	19.49	19.1	(90)
--------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	------	------

fLA = Living area ÷ (4) =	0.34	(91)
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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.5	19.67	19.89	20.15	20.35	20.46	20.47	20.47	20.44	20.22	19.82	19.47	(92)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	19.5	19.67	19.89	20.15	20.35	20.46	20.47	20.47	20.44	20.22	19.82	19.47	(93)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	0.99	0.99	0.97	0.93	0.85	0.66	0.46	0.48	0.72	0.93	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	492.55	546.49	566.68	549.59	487.05	360.21	244.13	256.05	383.93	478.1	477.38	469.95	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m – (96)m]

(97)m=	984.94	955	864.15	719.13	552.12	370.62	245.08	257.35	402.53	613.63	814.31	981.43	(97)
--------	--------	-----	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	366.34	274.51	221.32	122.07	48.42	0	0	0	0	100.83	242.59	380.54	(98)
--------	--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------	------

Total per year (kWh/year) = Sum(98) _{1...5,9...12} =	1756.61	(98)
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Space heating requirement in kWh/m²/year

23.74	(99)
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9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none

0	(301)
---	-------

Fraction of space heat from community system 1 – (301) =

1	(302)
---	-------

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump

1	(303a)
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Fraction of total space heat from Community heat pump

(302) x (303a) =	1	(304a)
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Factor for control and charging method (Table 4c(3)) for community heating system

1	(305)
---	-------

Distribution loss factor (Table 12c) for community heating system

1.05	(306)
------	-------

Space heating

Annual space heating requirement

kWh/year	
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1756.61	
---------	--

Space heat from Community heat pump

(98) x (304a) x (305) x (306) =	1844.44	(307a)
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Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)

0	(308)
---	-------

DER WorkSheet: New dwelling design stage

Space heating requirement from secondary/supplementary system	$(98) \times (301) \times 100 \div (308) =$	0	(309)
Water heating			
Annual water heating requirement		1948.91	
If DHW from community scheme:			
Water heat from Community heat pump	$(64) \times (303a) \times (305) \times (306) =$	2046.35	(310a)
Electricity used for heat distribution	$0.01 \times [(307a) \dots (307e) + (310a) \dots (310e)] =$	38.91	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	$= (107) \div (314) =$	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		0	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	$= (330a) + (330b) + (330g) =$	0	(331)
Energy for lighting (calculated in Appendix L)		383.53	(332)
Total delivered energy for all uses $(307) + (309) + (310) + (312) + (315) + (331) + (332) \dots (237b) =$		4274.32	(338)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)			
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		401 (367a)
CO2 associated with heat source 1	$[(307b) + (310b)] \times 100 \div (367b) \times$	0.52	503.57 (367)
Electrical energy for heat distribution	$[(313) \times$	0.52	20.19 (372)
Total CO2 associated with community systems	$(363) \dots (366) + (368) \dots (372)$		523.76 (373)
CO2 associated with space heating (secondary)	$(309) \times$	0	0 (374)
CO2 associated with water from immersion heater or instantaneous heater	$(312) \times$	0.52	0 (375)
Total CO2 associated with space and water heating	$(373) + (374) + (375) =$		523.76 (376)
CO2 associated with electricity for pumps and fans within dwelling	$(331) \times$	0.52	0 (378)
CO2 associated with electricity for lighting	$(332) \times$	0.52	199.05 (379)
Total CO2, kg/year	sum of (376) ... (382) =		722.82 (383)
Dwelling CO2 Emission Rate	$(383) \div (4) =$		9.77 (384)
EI rating (section 14)			91.86 (385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.58

Property Address: Caversham 2BF TOP 74 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	74 (1a)	2.4 (2a)	177.6 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	177.6 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				3	30 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.17 (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

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry 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

Percentage of windows and doors draught stripped

Window infiltration

Infiltration rate

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) ÷ 20] + (8), otherwise (18) = (16)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered

Shelter factor

Infiltration rate incorporating shelter factor

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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TER WorkSheet: New dwelling design stage

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

0.45	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42
------	------	------	------	------	------	------	------	------	------	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.6 0.6 0.6 0.58 0.57 0.56 0.56 0.55 0.56 0.57 0.58 0.59 (24d)

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

(25)m= 0.6 0.6 0.6 0.58 0.57 0.56 0.56 0.55 0.56 0.57 0.58 0.59 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.78	$\times 1/[1/(1.4) + 0.04] =$	5.01		(27)
Windows Type 2			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Windows Type 3			1.44	$\times 1/[1/(1.4) + 0.04] =$	1.91		(27)
Walls	25.04	6.66	18.38	x 0.18 =	3.31		(29)
Roof	74	0	74	x 0.13 =	9.62		(30)
Total area of elements, m²			99.04				(31)
Party wall			59.55	x 0 =	0		(32)
Party floor			74				(32a)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 21.76 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5919.75 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 5.92 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 27.67 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	35.34	35.11	34.88	33.8	33.6	32.66	32.66	32.48	33.02	33.6	34.01	34.43

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

(39)m=	63.02	62.78	62.55	61.47	61.27	60.33	60.33	60.16	60.69	61.27	61.68	62.11
Average = Sum(39) _{1...12} /12=												61.47 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	0.85	0.85	0.85	0.83	0.83	0.82	0.82	0.81	0.82	0.83	0.83	0.84		
	Average = Sum(40) _{1...12} / 12 =												0.83	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.34

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

89.76

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--	--

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)

(44)m=	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73		
	Total = Sum(44) _{1...12} =												1077.07	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.8		
	Total = Sum(45) _{1...12} =												1412.21	(45)

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

(46)m=	21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.4	17.94	19.59	21.27		(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

150

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

1.55

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.84

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.84

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

TER WorkSheet: New dwelling design stage

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

(61)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=

195.66	172.53	181.39	162.86	159.78	143.04	137.63	150.67	150.3	168.86	178.23	191.04
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------

 (62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (63)

Output from water heater

(64)m=

195.66	172.53	181.39	162.86	159.78	143.04	137.63	150.67	150.3	168.86	178.23	191.04
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------

Output from water heater (annual)_{1...12}

1992

 (64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=

88.08	78.16	83.33	76.43	76.15	69.84	68.78	73.12	72.25	79.17	81.54	86.54
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96

 (66)

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

(67)m=

21.72	19.29	15.69	11.88	8.88	7.49	8.1	10.53	14.13	17.94	20.94	22.32
-------	-------	-------	-------	------	------	-----	-------	-------	-------	-------	-------

 (67)

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

(68)m=

206.45	208.59	203.19	191.7	177.19	163.56	154.45	152.3	157.7	169.2	183.7	197.34
--------	--------	--------	-------	--------	--------	--------	-------	-------	-------	-------	--------

 (68)

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

(69)m=

34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7
------	------	------	------	------	------	------	------	------	------	------	------

 (69)

Pumps and fans gains (Table 5a)

(70)m=

3	3	3	3	3	3	3	3	3	3	3	3
---	---	---	---	---	---	---	---	---	---	---	---

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=

-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m=

118.38	116.31	112	106.15	102.35	97	92.45	98.28	100.35	106.41	113.25	116.32
--------	--------	-----	--------	--------	----	-------	-------	--------	--------	--------	--------

 (72)

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

(73)m=

407.64	405.28	391.97	370.81	349.51	329.14	316.09	322.2	333.27	354.63	378.98	397.07
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------

 (73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	3.78	x	46.75	x	0.63	x	0.7	=	54.01 (78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57 (78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57 (78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.63	x	0.7	=	88.45 (78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7 (78)

TER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 95.16 155.84 198.52 224.37 233.81 225.01 219.85 213.5 207.38 168.09 112.8 82.23 (83)

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

(84)m= 502.79 561.12 590.49 595.18 583.31 554.15 535.93 535.7 540.65 522.72 491.77 479.29 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.94	0.86	0.68	0.49	0.51	0.74	0.94	0.99	1	(86)

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

(87)m= 20.26 20.39 20.56 20.75 20.91 20.98 21 21 20.97 20.8 20.5 20.24 (87)

TER WorkSheet: New dwelling design stage

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

(88)m=	20.21	20.21	20.21	20.23	20.23	20.24	20.24	20.24	20.24	20.23	20.22	20.22	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.99	0.97	0.93	0.82	0.6	0.41	0.43	0.67	0.91	0.98	1	(89)
--------	------	------	------	------	------	-----	------	------	------	------	------	---	------

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

(90)m=	19.22	19.41	19.65	19.94	20.14	20.23	20.24	20.24	20.22	20.01	19.58	19.2	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

$$fLA = \text{Living area} \div (4) = 0.34 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.57	19.74	19.96	20.21	20.4	20.48	20.5	20.5	20.47	20.28	19.89	19.55	(92)
--------	-------	-------	-------	-------	------	-------	------	------	-------	-------	-------	-------	------

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

(93)m=	19.57	19.74	19.96	20.21	20.4	20.48	20.5	20.5	20.47	20.28	19.89	19.55	(93)
--------	-------	-------	-------	-------	------	-------	------	------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.97	0.93	0.83	0.63	0.44	0.46	0.69	0.92	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	499.09	552.48	571.42	550.68	481.77	348.3	234.5	245.72	373.83	478.91	483.18	476.58	(95)
--------	--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m – (96)m]

(97)m=	962.39	931.75	841.9	695.57	532.89	355.05	235.04	246.45	386.7	592.88	789.06	953.39	(97)
--------	--------	--------	-------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

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

(98)m=	344.7	254.87	201.24	104.33	38.03	0	0	0	0	84.79	220.24	354.75	(98)
--------	-------	--------	--------	--------	-------	---	---	---	---	-------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 1602.93 \quad (98)$$

Space heating requirement in kWh/m²/year

$$21.66 \quad (99)$$

9a. Energy requirements – Individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

$$1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

$$1 \quad (204)$$

Efficiency of main space heating system 1

$$93.5 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

344.7	254.87	201.24	104.33	38.03	0	0	0	0	84.79	220.24	354.75
-------	--------	--------	--------	-------	---	---	---	---	-------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

368.66	272.59	215.23	111.58	40.67	0	0	0	0	90.68	235.55	379.41
--------	--------	--------	--------	-------	---	---	---	---	-------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 1714.37 \quad (211)$$

Space heating fuel (secondary), kWh/month

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	(215)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

TER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

195.66	172.53	181.39	162.86	159.78	143.04	137.63	150.67	150.3	168.86	178.23	191.04
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------

Efficiency of water heater

79.8 (216)

(217)m= 86.31 85.85 85.09 83.66 81.66 79.8 79.8 79.8 79.8 83.08 85.38 86.44 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	226.69	200.96	213.17	194.66	195.68	179.25	172.47	188.81	188.34	203.24	208.75	221
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-----

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

2393.04 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1714.37

Water heating fuel used

2393.04

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75 (231)

Electricity for lighting

383.53 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

4565.94 (238)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	370.3 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	516.9 (264)
Space and water heating	(261) + (262) + (263) + (264) =		887.2 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	199.05 (268)
Total CO2, kg/year		sum of (265)...(271) =	1125.18 (272)

TER =

21.8 (273)

Appendix 4: ‘Be Green (ASHPs)’ SAP 10 Spreadsheet

Be Green - SAP 2012 Methodology

Project 209-219 Henley Road, Caversham
Client
Date Oct-22
Rev E



SAP 2012 Carbon Factor
Gas 0.21
Grid Elec 0.233

Residential

TER										DER - Based on Communal ASHPs				
Plot		Bedrooms	Floor Area	Aspects	Orientation	Space Htg	Water Htg	Pumps/ Lighting	Emissions	Plot	Htg & Hot Water	Heat Distribution	Lighting	Emissions
A1	EXP	2	68.0	2		1734	2194	421	923.2	A1	845	34	352	286.8
A2	EXP	2	73.0	1	North	1862	2355	452	991.0	A2	907	36	378	307.9
A3	EXP	1	51.0	1	North	1250	2108	351	787.0	A3	713	29	277	237.3
A4	EXP	1	51.0	1	North	1250	2108	351	787.0	A4	713	29	277	237.3
A5	EXP	2	67.0	1	North	1709	2162	415	909.6	A5	833	33	347	282.6
A6	MID	1	63.0	1	North	653	2649	433	794.2	A6	685	27	342	245.7
A7	EXP	2	84.0	1	South	2143	2710	520	1140.4	A7	1044	42	435	354.2
A8	EXP	2	73.0	1	South	1862	2355	452	991.0	A8	907	36	378	307.9
A9	EXP	1	51.0	1	South	1227	2068	344	772.2	A9	700	28	272	232.8
A10	EXP	1	51.0	1	South	1227	2068	344	772.2	A10	700	28	272	232.8
A11	EXP	2	73.0	1	South	1862	2355	452	991.0	A11	907	36	378	307.9
A12	MID	2	80.0	2		973	2624	496	870.8	A12	759	30	414	280.5
A13	MID	2	72.0	1	North	876	2361	446	783.7	A13	683	27	372	252.4
A14	MID	1	51.0	1	North	528	2144	351	643.0	A14	555	22	277	198.9
A15	MID	1	51.0	1	North	528	2144	351	643.0	A15	555	22	277	198.9
A16	MID	2	66.0	1	North	803	2165	409	718.4	A16	627	25	341	231.4
A17	TOP	1	63.0	1	North	1376	2611	433	938.2	A17	928	37	342	304.6
A18	TOP	2	84.0	1	South	1946	2716	520	1100.4	A18	1099	44	435	367.6
A19	MID	2	73.0	1	South	888	2394	452	794.6	A19	693	28	378	255.9
A20	MID	1	51.0	1	South	518	2104	344	630.8	A20	544	22	272	195.1
A21	MID	1	51.0	1	South	518	2104	344	630.8	A21	544	22	272	195.1
A22	MID	2	73.0	1	South	888	2394	452	794.6	A22	693	28	378	255.9
A23	TOP	2	80.0	2		1853	2587	496	1048.0	A23	1047	42	414	350.1
A24	MID	2	72.0	1	North	876	2361	446	783.7	A24	683	27	372	252.4
A25	MID	1	51.0	1	North	528	2144	351	643.0	A25	555	22	277	198.9
A26	MID	1	51.0	1	North	528	2144	351	643.0	A26	555	22	277	198.9
A27	MID	2	66.0	1	North	803	2165	409	718.4	A27	627	25	341	231.4
A28	MID	1	56.0	1	South	569	2310	378	692.7	A28	598	24	298	214.3
A29	MID	2	70.0	1	South	851	2296	434	762.0	A29	664	27	362	245.4
A30	MID	2	79.0	1	South	961	2591	490	859.9	A30	750	30	409	277.0
A31	MID	2	73.0	1	South	888	2394	452	794.6	A31	693	28	378	255.9
A32	TOP	2	61.0	1	North	1413	1973	378	799.1	A32	798	32	316	267.0
A33	TOP	2	69.0	1	North	1599	2231	428	903.9	A33	903	36	357	302.0
A34	TOP	2	66.0	1	North	1529	2134	409	864.6	A34	864	35	341	288.9
A35	TOP	2	99.0	1	South	2294	3201	613	1296.9	A35	1296	52	512	433.3
A36	TOP	2	72.0	1	South	1668	2328	446	943.2	A36	942	38	372	315.1
A37	TOP	2	76.0	1	South	1761	2458	471	995.6	A37	995	40	393	332.6
B1	MID	2	72.0	2	North	876	2361	446	783.7	B1	683	27	372	252.4
B2	EXP	1	61.0	1	North	1496	2521	420	941.4	B2	853	34	331	283.8
B3	EXP	1	51.0	1	North	1250	2108	351	787.0	B3	713	29	277	237.3
B4	EXP	2	69.0	1	North	1760	2226	428	936.7	B4	858	34	357	291.0
B5	EXP	2	72.0	1	North	1836	2323	446	977.5	B5	895	36	372	303.6
B6	EXP	2	73.0	1	South	1862	2355	452	991.0	B6	907	36	378	307.9
B7	EXP	2	73.0	1	South	1862	2355	452	991.0	B7	907	36	378	307.9
B8	MID	2	73.0	1	South	888	2394	452	794.6	B8	693	28	378	255.9
B9	MID	2	72.0	1	South	876	2361	446	783.7	B9	683	27	372	252.4
B10	MID	1	61.0	1	South	620	2516	412	754.5	B10	651	26	325	233.4
B11	MID	1	51.0	2	North	528	2144	351	643.0	B11	555	22	277	198.9
B12	MID	2	69.0	1	North	839	2263	428	751.1	B12	655	26	357	241.9
B13	MID	2	72.0	1	North	876	2361	446	783.7	B13	683	27	372	252.4
B14	MID	2	72.0	1	North	876	2361	446	783.7	B14	683	27	372	252.4
B15	MID	2	73.0	1	South	888	2394	452	794.6	B15	693	28	378	255.9
B16	MID	2	73.0	1	South	888	2394	452	794.6	B16	693	28	378	255.9
B17	TOP	2	76.0	1	South	1761	2458	471	995.6	B17	995	40	393	332.6
B18	TOP	2	90.0	1	South	2085	2910	558	1179.0	B18	1178	47	466	393.9
B19	TOP	1	69.0	1	North	1507	2860	475	1027.5	B19	1016	41	374	333.6
B20	TOP	2	78.0	1	North	1807	2522	483	1021.8	B20	1021	41	403	341.4
B21	TOP	2	89.0	1	South	2062	2878	551	1165.9	B21	1165	47	460	389.5
B22	TOP	2	83.0	1	South	1923	2684	514	1087.3	B22	1086	44	429	363.3
4033.0										50925.1				
										16269.9				

Total Site Target Emissions 50,925 kgCO₂ per year
Total Site Design Emissions (Be Green) 16,270 kgCO₂ per year
Total Reduction from Energy Efficiency 34,655 kgCO₂ per year
% Reduction from Energy Efficiency 68.05%

Communal and Circulation Accommodation

TER							BER				
Plot	Floor Area	Use	Heating	Cooling	Aux/ Lighting	Hot Water	Heating	Cooling	Aux/ Lighting	Hot Water	Emissions
Block A	239.0		6161	0	13284	468	2892	0	13267	468	88.0
Block B	194.0		5001	0	10783	380	2347	0	10769	380	88.0
8,406							7,019				

Total Site Target Emissions 8,406 kgCO₂ per year
Total Site Design Emissions (Be Green) 7,019 kgCO₂ per year
Total Reduction 1,387 kgCO₂ per year
% Reduction 16.50%

Combined Reduction

Total Site Target Emissions (Be Lean) 62,675 kgCO₂ per year
Total Site Design Emissions (Be Green) 23,289 kgCO₂ per year
Total Reduction 39,386 kgCO₂ per year
% Reduction 62.84%

Appendix 5: Roof Plan showing the Indicative Location of Photovoltaic Panels

A4155 HENLEY ROAD
Henley Road

47.078 47.385 47.587 47.188 47.021 46.882 45.223 43.696 45.732 45.869 44.621 42.926 42.477 44.480 43.372 41.682 40.869 43.236 42.345 40.141 39.846 41.427 40.888 40.680 40.210 40.280 39.716 41.153 38.644 40.753 39.111

54 x 400 Photovoltaic Panels

Green Roof

Lounge
129 m²

PROPOSED ACCESS ROAD 1

PROPOSED ACCESS ROAD 2

Proposed limit
of adoption

27 x 400 Photovoltaic Panels

Fluvial Flood Compensation Area to hold 98ms²
1m in depth

Bridge over suds stream

36618

Existing Trees

Landscaping inspired by Japanese gardens.

Henley Road

Proposed Site Plan

Project No:8466

Drawing No :Dwg No

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Scale @ A1:1.250

Date: 06.01.22

Drawn by:TCW

Revision:P2

Status: PL

Checked by:AM

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