bluesky UNLIMITED

Sustainability & Energy Statement
Kingston Bridge House, Hampton Wick. KT1 4AG

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Executive Summary

This Sustainability and Energy Statement considers the sustainability issues relating to the proposed conversion and extension of Kingston Bridge House, Hampton Wick to provide a total of 70, Studio, 1, 2 & 3-bedroom apartments.

The Statement sets out the commitments of the applicant to the site and the targets that will be applied to the development. 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 building exceed the requirements of the Building Regulations.

The methodology used has been based upon the policy set out in the London Plan, 2021 (and provided in 'Energy Assessment Guidance' published by the Mayor of London) and uses the carbon factors for gas and electricity proposed for SAP 10.

In order to demonstrate the energy efficiency of the building a set of SAP calculations have been prepared for the 'Be Lean' scenario based on the use of gas boilers to each apartment. This is not the proposed strategy but purely demonstrates the reduction from the 'Be Lean' condition.

The Compliance Reports, TER and DER Worksheets for this option are attached as Appendix 1 and the 'Be Lean' spreadsheet based on the SAP 10 carbon factors is attached as Appendix 2.

It is proposed to install a communal heating system using a Daikin Altherma Geo-Collective air source heat pump system. Each apartment will have its own heat pump cylinder and heating controls, which will be connected to a medium temperature heating loop within the building, which in turn will be connected to a common outdoor chiller unit (s), which will be located on the roof of the building. The 'Be Green' SAP 10 spreadsheet is attached as Appendix 4, which uses the energy demand calculations from the SAP calculations (DER Worksheets attached as Appendix 3) to calculate the total site emissions.

In order to maximise the reduction in emissions it is also proposed to install a photovoltaic array of 155 x 400W photovoltaic panels (62.0 kW). A Roof Plan showing the indicative layout of the panels is attached as Appendix 5.

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	57.980	
Be Lean - after energy efficiency (DER) – based on gas	52.074	**10.19%**
Be Clean		
Be Clean	52.074	10.19%
Be Green - ASHPs		
Emissions – after communal ASHP heating system (Be Green)	18.133	**68.73%**
Be Green – ASHPs AND Photovoltaic Panels		
Emissions – after renewable technologies (Be Green)	4.958	**91.45%**

The residual emissions are 4.958 tonnes and therefore, using the carbon offset charge the payment should be **£14,130** (4.958 x £2,850).

The London Borough of Richmond upon Thames Sustainable Construction Checklist is attached as Appendix 6.

It is also a requirement to calculate the unregulated emissions from the development and the spreadsheet attached as Appendix 7 provides a unit-by-unit breakdown of what these emissions will be and the total for the site. The unregulated emissions are **33,983 kg CO_2 per year**.

The Good Homes Alliance (GHA) Early Stage Overheating Risk Tool has been completed and is attached as Appendix 8.

1.0 Introduction

This report has been commissioned by the Westcombe Group and provides a Sustainability and Energy Statement for the extension and conversion of Kingston Bridge House, Hampton Wick to create 70, Studio, 1, 2 & 3-bedroom apartments.

The description of development is;

'Façade and elevational improvements, infill extension at ground floor level, and change of use of the building to provide 70 new homes with associated landscaping, access, parking/refuse provision, and external alterations.'

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

The alterations to the building 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 building that has the greatest impact on energy demand and are the most difficult and costly to change in the future, namely the building fabric.

Once a cost-effective structure has 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."

Regional and Local Policies

The Development Plan comprises the London Plan (2021) and the London Borough of Richmond Local Plan (2018).

London Plan, published March 2021 **–** the following policies are relevant to the application:

Policy SI 1 Improving air quality

A *Development Plans, through relevant strategic, site-specific and area-based policies, should seek opportunities to identify and deliver further improvements to air quality and should not reduce air quality benefits that result from the Mayor's or boroughs' activities to improve air quality.*

B *To tackle poor air quality, protect health and meet legal obligations the following criteria should be addressed:*

1) Development proposals should not:

a) lead to further deterioration of existing poor air quality

b) create any new areas that exceed air quality limits, or delay the date at which compliance will be achieved in areas that are currently in exceedance of legal limits

c) create unacceptable risk of high levels of exposure to poor air quality.

2) In order to meet the requirements in Part 1, as a minimum:

a) development proposals must be at least Air Quality Neutral

b) development proposals should use design solutions to prevent or minimise increased exposure to existing air pollution and make provision to address local problems of air quality in preference to post-design or retro-fitted mitigation measures

c) major development proposals must be submitted with an Air Quality Assessment. Air quality assessments should show how the development will meet the requirements of B1

d) development proposals in Air Quality Focus Areas or that are likely to be used by large numbers of people particularly vulnerable to poor air quality, such as children or older people should demonstrate that design measures have been used to minimise exposure.

C *Masterplans and development briefs for large-scale development proposals subject to an Environmental Impact Assessment should consider how local air quality can be improved across the area of the proposal as part of an air quality positive approach. To achieve this a statement should be submitted demonstrating:*

1) how proposals have considered ways to maximise benefits to local air quality, and

2) what measures or design features will be put in place to reduce exposure to pollution, and how they will achieve this.

D *In order to reduce the impact on air quality during the construction and demolition phase development proposals must demonstrate how they plan to comply with the Non-Road Mobile Machinery Low Emission Zone and reduce emissions from the demolition and construction of buildings following best practice guidance.*

E *Development proposals should ensure that where emissions need to be reduced to meet the requirements of Air Quality Neutral or to make the impact of development on local air quality acceptable, this is done on-site. Where it can be demonstrated that emissions cannot be further reduced by on-site measures, off-site measures to improve local air quality may be acceptable, provided that equivalent air quality benefits can be demonstrated within the area affected by the development.*

Policy SI 2 Minimising greenhouse gas emissions

A *Major development should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:*

1) *be lean: use less energy and manage demand during operation*
2) *be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly*
3) *be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site*
4) *be seen: monitor, verify and report on energy performance.*

B *Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.*

C *A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:*

1) *through a cash in lieu contribution to the borough's carbon offset fund, or*
2) *off-site provided that an alternative proposal is identified and delivery is certain.*

D *Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported on annually.*

E *Major development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e. unregulated emissions.*

F *Development proposals referable to the Mayor should calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.*

Policy SI 4 Managing heat risk

A *Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.*

B Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:

1) reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure

2) minimise internal heat generation through energy efficient design

3) manage the heat within the building through exposed internal thermal mass and high ceilings

4) provide passive ventilation

5) provide mechanical ventilation

6) provide active cooling systems.

Policy SI 5 Water infrastructure

A In order to minimise the use of mains water, water supplies and resources should be protected and conserved in a sustainable manner.

B Development Plans should promote improvements to water supply infrastructure to contribute to security of supply. This should be done in a timely, efficient and sustainable manner taking energy consumption into account.

C Development proposals should:

1) through the use of Planning Conditions minimise the use of mains water in line with the Optional Requirement of the Building Regulations (residential development), achieving mains water consumption of 105 litres or less per head per day (excluding allowance of up to five litres for external water consumption)

2) achieve at least the BREEAM excellent standard for the 'Wat 01' water category or equivalent (commercial development)

3) incorporate measures such as smart metering, water saving and recycling measures, including retrofitting, to help to achieve lower water consumption rates and to maximise future-proofing.

D In terms of water quality, Development Plans should:

1) promote the protection and improvement of the water environment in line with the Thames River Basin Management Plan, and should take account of Catchment Plans

2) support wastewater treatment infrastructure investment to accommodate London's growth and climate change impacts. Such infrastructure should be constructed in a timely and sustainable manner taking account of new, smart technologies, intensification opportunities on existing sites, and energy implications. Boroughs should work with Thames Water in relation to local wastewater infrastructure requirements.

E Development proposals should:

1) seek to improve the water environment and ensure that adequate wastewater infrastructure capacity is provided

2) *take action to minimise the potential for misconnections between foul and surface water networks. F Development Plans and proposals for strategically or locally defined growth locations with particular flood risk constraints or where there is insufficient water infrastructure capacity should be informed by Integrated Water Management Strategies at an early stage.*

London Borough of Richmond

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

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

Local Plan (2018)

Policy LP 22 - Sustainable Design and Construction

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

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

Reducing Carbon Dioxide Emissions

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

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

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

C. This should be achieved by following the Energy Hierarchy:

1. *Be lean: use less energy*
2. *Be clean: supply energy efficiently*
3. *Be green: use renewable energy*

Decentralised Energy Networks

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

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

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

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

3.0 Assessment Methodology

The baseline carbon dioxide emissions from the building has 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.

Emission Factors

The CO_2 emission factors, where applicable, used throughout this report have been taken from the preliminary 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 extension and conversion of an existing building to create 70, Studio, 1, 2 and 3-bedroom apartments.

The accommodation schedule in detail is;

Unit Type	Number	Area	Total Area
		m^2	m^2
Studio apartment	6	37.5	225.0
1-Bedroom apartment	21	50.0	1,050.0
1-Bedroom apartment	6	51.1	306.6
1-Bedroom apartment	1	51.2	51.2
1-Bedroom apartment	6	53.9	323.4
1-Bedroom apartment	1	55.6	55.6
1-Bedroom apartment	3	60.5	181.5
1-Bedroom apartment	6	61.0	366.0
1-Bedroom apartment	1	61.4	61.4
2-Bedroom apartment	1	62.3	62.3
2-Bedroom apartment	3	63.9	191.7
2-Bedroom apartment	3	65.2	195.6
2-Bedroom apartment	1	65.5	65.5
2-Bedroom apartment	1	67.9	67.9
2-Bedroom apartment	3	74.9	224.7
3-Bedroom apartment	3	84.3	252.9
3-Bedroom apartment	3	86.0	258.0
3-Bedroom apartment	1	86.7	86.7
Total	**70**		**4,026**

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 proposal is for the extension and conversion of an existing building and therefore the orientation of the window and door opening is largely fixed within the existing building. However, the apartments benefit from an orientation towards; (i) northeast, (ii) southwest, (iii) northwest or (iv) southeast.

All apartments will benefit from access to direct sunlight at some point throughout the day and there are no units with a solely northerly aspect.

Natural Daylighting

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

Efficient Building Fabric

Building Envelope

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

The western part of the building currently has an undercroft, which will be partially infilled to provide accommodation. The ground floors to this element to the eastern part of the building will be insulated with 150mm 'Kingspan' PIR insulation or similar.

The new walls and existing walls will be insulated to achieve the U-value set out in the table below.

All windows and external doors will be replaced and will be 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^2K	W/m^2K	
Floor	**0.25**	**0.13**	**52%**
External Walls	**0.30**	**0.18**	**40%**
Flat Roof	**0.20**	**0.13**	**35%**
Windows	**2.00**	**1.20**	**40%**
Entrance Doors		**1.60**	

'g' Value for Glazing to Ground-floor units	**0.30**
'g' Value for Glazing to Mid-floor units	**0.63**
'g' Value for Glazing to Top-floor units	**0.35**

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 m^3 of air per hour per m^2 of envelope area, at 50Pa. It is proposed to achieve a 60% improvement over Building Regulations and the building will target a permeability of 4.0 $m^3/hr/m^2$.

Thermal Bridging

The significance of Thermal Bridging, as a potentially major source of fabric heat losses, is increasingly understood. Improving the U-values for the main building fabric without accurately addressing the Thermal Bridging is no longer an option and will not achieve the fabric energy efficiency and energy and CO_2 reduction targets set out in this strategy.

The building will use the Accredited Construction Details where applicable and bespoke details where ACDs do not exist.

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 2021 to address the possibility of overheating and poor air quality. Additional mechanical purge ventilation will be installed to all ground-floor bedrooms.

Active Design Measures will include;

Efficient Lighting and Controls

Throughout the scheme natural lighting will be optimised.

Approved Document L1A requires three in four light fittings (75%) to be dedicated low energy fittings. The 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 combination boiler installed to each apartment but the assessment considers other options for providing space heating and hot water.

Overheating

The GLA Energy Assessment Guidance defines the elements of the overheating hierarchy as set out below. The proposal is for the conversion and refurbishment of an existing building and therefore some elements of the hierarchy are difficult to achieve.

1. Reduce the amount of heat entering the building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure.

The orientation of the openings is largely fixed within the constraints of the existing structure. The shape and size of the floor plate only really allows for single aspect units. However, the creation of external 'add-on' balconies and inset balconies provides shading to the larger glazed openings on the apartment below. All windows and external doors will be new and the specification includes the installation of glazing with a 'g' value of 0.30 to ground-floor units, 0.63 to mid-floor units and 0.35 to top-floor units.

2. Minimise internal heat generation through energy efficient design:

It is proposed to install a medium temperature heating loop within the building. However, the outdoor units will be located on the roof and the distribution network will be largely vertical.

3. Manage the heat within the building through exposed internal thermal mass and high ceilings:

The proposal is for the conversion of an existing building and the ceiling heights are fixed by the existing structure. However, that structure is a heavy weight frame will assist in provide increased thermal mass.

4. Provide passive ventilation:

All windows will be openable to allow for passive ventilation.

5. Provide mechanical ventilation:

Mechanical extract ventilation will be provided to appropriate rooms.

6. Provide active cooling systems:

It is not proposed to provide any active cooling systems.

The Good Homes Alliance (GHA) Early Stage Overheating Risk Tool has been completed and is attached as Appendix 8.

In addition, a full Overheating Heating based on CIBSE TM59 has been prepared and now accompanies the application. This Statement has been revised to accord with the conclusions of the Over

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

The GLA Energy Assessment Guidance requires the energy efficient of a building (Be Lean) to be expressed using a gas heating system as a baseline.

A set of calculations have therefore been prepared on this basis, which 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 with a southeast aspect at 51.5 m^2 modelled as a ground, mid and top-floor unit.

Calculations have also been prepared for a 2-Bedroom apartment with a northeast aspect at 65.2 m^2 and a 3-Bedroom apartment with a southwest aspect at 83.0 m^2, which are both modelled as ground, mid and top-floor units.

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 – 51.5 m^2 Ground-floor	Energy Demand TER	Energy Demand DER
	kWh/yr	kWh/yr
Space heating	1,621	1,934
Water heating	1,954	1,549
Electricity for pumps, fans & lighting	335	335
Total	**3,910**	**3,818**

1-Bedroom apartment – 51.5 m^2 Mid-floor	Energy Demand TER	Energy Demand DER
	kWh/yr	kWh/yr
Space heating	1,041	936
Water heating	1,973	1,557
Electricity for pumps, fans & lighting	335	335
Total	**3,349**	**2,828**

1-Bedroom apartment – 51.5 m^2 Top-floor	Energy Demand TER	Energy Demand DER
	kWh/yr	kWh/yr
Space heating	1,664	1,978
Water heating	1,953	1,548
Electricity for pumps, fans & lighting	335	335
Total	**3,952**	**3,861**

2-Bedroom apartment – 65.2 m^2 Ground-floor	Energy Demand TER	Energy Demand DER
	kWh/yr	kWh/yr
Space heating	2,514	2,788
Water heating	2,179	1,711
Electricity for pumps, fans & lighting	386	386
Total	**5,079**	**4,885**

2-Bedroom apartment – 65.2 m^2 Mid-floor	Energy Demand TER	Energy Demand DER
	kWh/yr	kWh/yr
Space heating	1,801	1,745
Water heating	2,195	1,717
Electricity for pumps, fans & lighting	386	386
Total	**4,382**	**3,848**

2-Bedroom apartment – 65.2 m^2 Top-floor	Energy Demand TER	Energy Demand DER
	kWh/yr	kWh/yr
Space heating	2,339	2,486
Water heating	2,183	1,713
Electricity for pumps, fans & lighting	386	386
Total	**4,908**	**4,585**

3-Bedroom apartment – 83.0 m^2 Ground-floor	Energy Demand TER	Energy Demand DER
	kWh/yr	kWh/yr
Space heating	2,622	3,309
Water heating	2,424	1,878
Electricity for pumps, fans & lighting	430	430
Total	**5,476**	**5,617**

3-Bedroom apartment – 83.0 m^2 Mid-floor	Energy Demand TER	Energy Demand DER
	kWh/yr	kWh/yr
Space heating	1,831	1,606
Water heating	2,444	1,888
Electricity for pumps, fans & lighting	430	430
Total	**4,705**	**3,924**

3-Bedroom apartment – 83.0 m^2 Top-floor	Energy Demand TER	Energy Demand DER
	kWh/yr	kWh/yr
Space heating	2,659	3,258
Water heating	2,423	1,878
Electricity for pumps, fans & lighting	430	430
Total	**5,512**	**5,566**

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 emissions using the emerging carbon emissions factors and as required by the GLA Energy Assessment Guidance.

The maximum allowable carbon dioxide emissions from the site (TER) are assessed as **57,980 kg CO_2 per year**, with the actual carbon dioxide emissions (DER) assessed as **52,074 kg CO_2 per year.**

The reduction in emissions using from energy efficiency for the 'Be Lean' scenario and using the SAP 10 carbon factors is **5,905 kg CO_2 per year**, which equates to;

- **10.19%**

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 Church Grove to be 4.8 m/s at 10m above ground level and 5.6 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 to the atmosphere and through transportation.

Consequently CHP can demonstrate significant CO_2 savings and although not necessary classed as renewable energy (depending on the fuel used) the technology is low carbon.

Historically CO_2 savings have been achieved because gas has been used to generate electricity and gas has had a lower emissions factor than electricity, However, with the de-carbonisation of the electricity grid the benefit of CHP is negated.

CHP is longer an appropriate technology.

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^o 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 in order to use ground source heat pumps the collection system would need to include a number of boreholes. There are limited opportunities to place these away from the building and there is insufficient ground area to accommodate the required number.

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

Solar

(i) Solar Water Heating

Solar hot water panels use the suns 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 13 top-floor apartments is 21,426 kWh per year (based on the gas system) and assuming panels would reduce demand by 50% the reduction in CO_2 emissions would be 2,250 kg CO_2 per year. When combined with the energy efficiency measures incorporated into the scheme this equates to a total reduction of 14.07%.

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 a conventional gas boiler with hot water cylinders in selected units.

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 building contains large flat roofs and photovoltaic panels could be installed without detrimentally impacting on the aesthetics of the development. The Roof Plan attached as Appendix 5 demonstrate a total of 155 panels could be installed. These would be installed on racks and gently inclined towards the southwest and southeast. Assuming the installation of 400W panels the total reduction in emissions from the array would be **13,175 kg CO_2 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.

ASHP tend to have a lower coefficient of performance (CoP) than GSHP but are considerably less costly to install. They work well where there is a large low temperature demand but the efficiency can be impacted on, for example where there is a high hot water demand.

The proposal is appropriate for the installation of air source heat pumps and the SAP calculations have been based on the installation of a communal system with each apartment having an individual indoor unit, all connected to a common outdoor chiller.

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

Be Clean

We understand there are no heat networks in the vicinity of the development and therefore it is proposed to install a communal heating system within the scheme, which will be fuelled by heat pumps.

Be Green

Using the methodology set out in the Mayor of London's 'Energy Assessment Guidance', the carbon emissions have been calculated using the SAP 10 carbon factors but using the SAP 2012 methodology.

The apartments modelled above under the 'Be Lean' scenario have been remodelled using a Daikin Altherma Geo-Collective communal heating system using heat pumps in lieu of a gas system.

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

1-Bedroom apartment – 51.5 m^2 Ground-floor	Energy Demand DER
	kWh/yr
Space heating and Hot water	877
Heating distribution	35
Electricity for fans & lighting	260
Total	**1,172**

1-Bedroom apartment – 51.5 m^2 Mid-floor	Energy Demand DER
	kWh/yr
Space heating and Hot water	644
Heating distribution	26
Electricity for fans & lighting	260
Total	**930**

1-Bedroom apartment – 51.5 m^2 Top-floor	Energy Demand DER
	kWh/yr
Space heating and Hot water	888
Heating distribution	36
Electricity for fans & lighting	260
Total	**1,184**

2-Bedroom apartment – 65.2 m² Ground-floor	Energy Demand DER
	kWh/yr
Space heating and Hot water	1,122
Heating distribution	45
Electricity for fans & lighting	311
Total	**1,478**

2-Bedroom apartment – 65.2 m² Mid-floor	Energy Demand DER
	kWh/yr
Space heating and Hot water	872
Heating distribution	35
Electricity for fans & lighting	311
Total	**1,218**

2-Bedroom apartment – 65.2 m² Top-floor	Energy Demand DER
	kWh/yr
Space heating and Hot water	1,048
Heating distribution	42
Electricity for fans & lighting	311
Total	**1,401**

3-Bedroom apartment – 83.0 m² Ground-floor	Energy Demand DER
	kWh/yr
Space heating and Hot water	1,292
Heating distribution	52
Electricity for fans & lighting	355
Total	**1,699**

3-Bedroom apartment – 83.0 m² Mid-floor	Energy Demand DER
	kWh/yr
Space heating and Hot water	889
Heating distribution	36
Electricity for fans & lighting	355
Total	**1,280**

3-Bedroom apartment – 83.0 m^2 Top-floor	Energy Demand DER
	kWh/yr
Space heating and Hot water	1,281
Heating distribution	51
Electricity for fans & lighting	355
Total	**1,687**

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 emissions using the SAP 10 carbon emissions factors and as required by the GLA Energy Assessment Guidance.

The actual carbon dioxide emissions (DER) assessed as **18,133 kg CO_2 per year.**

The reduction in emissions from energy efficiency measures and the installation of a communal heating system using air source heat pumps (compared to the TER baseline – Be Lean) and using the SAP 10 carbon factors is **39,847 kg CO_2 per year**, which equates to;

- **68.73%**

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 CO_2 emissions are calculated as **57,980 kg CO_2 per year** (TER) and **52,074 kg CO_2 per year** (DER).

This equates to a reduction of **5,905 kg CO_2 per year** or **10.19%** of the total TER emissions and is therefore compliant with the GLA energy planning guidance. The Compliance Reports, TER and DER Worksheets are attached as Appendix 1 and the SAP 10 'Be Lean' spreadsheet is attached as Appendix 2.

Be Clean – It is proposed to provide a communal heating system on site fuelled by heat pumps.

Be Green - ASHPs

A further set of calculations has been prepared for the proposed energy strategy. This proposes the installation of a communal heating system using a Daikin Altherma Geo-Collective system. The system includes individual heat pumps and cylinders within each apartment all connected to a common outdoor chiller unit. The DER Worksheets for the modelled units and based on this system are attached as Appendix 3 and the 'Be Green' spreadsheet is attached as Appendix 4.

The actual carbon dioxide emissions (DER) are assessed as **18,133 kg CO_2 per year.**

The reduction in emissions from energy efficiency measures and installing a communal air source heat pump system and using the SAP 10 carbon factors is **39,847 kg CO_2 per year**, which equates to **68.73%.**

Be Green – Photovoltaic Panels

In addition, it is proposed to install a photovoltaic array of 62 kW on the roof of the building. The array will be comprised of 155 x 400W panels, which will be installed on racks and inclined towards the southwest and southeast. The panels will reduce emissions by a further **13,175 kg CO_2 per year** (based on panels inclined at 20 degrees, orientated to due southwest and southeast at postcode KT1 and using the SAP 10 emissions factors).

A Roof Plan showing the indicative location of the panels is attached as Appendix 5.

<u>Summary</u>

The total reduction in emissions from energy efficiency, low-carbon and renewable technologies are calculated as; 53,022 kg CO_2 per year, which equates to a reduction of <u>91.45%</u> (% of TER).

The residual emissions are **4.958 tonnes**, which requires a carbon offset payment of **£14,130** (based on the carbon offset payment of £2,850 per tonne).

6.0 Climate change adaption and Water resources

Sustainable Drainage Systems (SUDS)

The site lies within Flood Zone 1 and Flood Zone 2 and a site-specific Flood Risk Assessment has been prepared which considers the issues and sets out what measures may be incorporated.

The existing site is mostly covered with buildings and hard surfacing and the proposal does not increase the volume or rate of surface water run-off. It is understood that it will be disposed of into the combined sewer in Church Grove.

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 110 litres per person per day is achieved.

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	6/36 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 based on Gas

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.59

Property Address: Kingston Bridge 1BF 52 GND GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	51.5	(1a) x	2.7	(2a) =	139.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	51.5	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	139.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =		÷ (5) =	
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)		0.27	(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) =		0.23	(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

0.29	0.29	0.28	0.25	0.25	0.22	0.22	0.21	0.23	0.25	0.26	0.27

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

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

(25)m=	0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.53	0.53	0.53	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			2.88	x1/[1/(1.2)+ 0.04]		=	3.3			(27)
Windows Type 2			1.86	x1/[1/(1.2)+ 0.04]		=	2.13			(27)
Floor			51.5	x	0.13	=	6.695			(28)
Walls		6.6	24.15	x	0.18	=	4.35			(29)
Total area of elements, m²			82.25							(31)
Party wall			53.34	x	0	=	0			(32)
Party ceiling			51.1							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 18.6 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 10256.59 (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 7.32 (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 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	24.94	24.86	24.78	24.43	24.36	24.05	24.05	23.99	24.17	24.36	24.49	24.64	(38)

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

(39)m=	50.86	50.78	50.71	50.35	50.28	49.97	49.97	49.92	50.09	50.28	50.42	50.56	

Average = Sum(39)$_{1…12}$ /12= 50.35 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.99	0.99	0.98	0.98	0.98	0.97	0.97	0.97	0.97	0.98	0.98	0.98

Average = Sum(40)$_{1...12}$ /12= 0.98 (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 1.73 (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 75.39 (43)

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

	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=	82.93	79.91	76.9	73.88	70.87	67.85	67.85	70.87	73.88	76.9	79.91	82.93	
										Total = Sum(44)$_{1...12}$ =		904.68	(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=	122.98	107.56	110.99	96.77	92.85	80.12	74.24	85.2	86.21	100.47	109.68	119.1	
										Total = Sum(45)$_{1...12}$ =		1186.18	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	18.45	16.13	16.65	14.51	13.93	12.02	11.14	12.78	12.93	15.07	16.45	17.87	(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (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=	16.05	14.47	15.98	15.42	15.9	15.35	15.83	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=	139.03	122.03	126.97	112.19	108.75	95.47	90.08	101.07	101.6	116.42	125.16	135.14	(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=	139.03	122.03	126.97	112.19	108.75	95.47	90.08	101.07	101.6	116.42	125.16	135.14	

Output from water heater (annual)$_{1...12}$ 1373.92 (64)

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

(65)m=	44.9	39.38	40.9	36.03	34.85	30.48	28.65	32.3	32.51	37.39	40.34	43.61	(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=	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	14.74	13.09	10.65	8.06	6.02	5.09	5.5	7.14	9.59	12.17	14.21	15.15	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	151.13	152.7	148.74	140.33	129.71	119.73	113.06	111.49	115.45	123.86	134.48	144.46	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	(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=	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	(71)
Water heating gains (Table 5)													
(72)m=	60.36	58.6	54.97	50.04	46.84	42.33	38.5	43.41	45.16	50.26	56.03	58.62	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	278.24	276.41	266.38	250.45	234.59	219.16	209.07	214.06	222.21	238.31	256.73	270.24	(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)	
Southeast 0.9x	0.77	x	2.88	x	36.79	x	0.3	x	0.7	=	15.42	(77)
Southeast 0.9x	0.77	x	1.86	x	36.79	x	0.3	x	0.7	=	19.92	(77)
Southeast 0.9x	0.77	x	2.88	x	62.67	x	0.3	x	0.7	=	26.27	(77)
Southeast 0.9x	0.77	x	1.86	x	62.67	x	0.3	x	0.7	=	33.93	(77)
Southeast 0.9x	0.77	x	2.88	x	85.75	x	0.3	x	0.7	=	35.94	(77)

Southeast 0.9x	0.77	x	1.86	x	85.75	x	0.3	x	0.7	=	46.42	(77)
Southeast 0.9x	0.77	x	2.88	x	106.25	x	0.3	x	0.7	=	44.53	(77)
Southeast 0.9x	0.77	x	1.86	x	106.25	x	0.3	x	0.7	=	57.52	(77)
Southeast 0.9x	0.77	x	2.88	x	119.01	x	0.3	x	0.7	=	49.88	(77)
Southeast 0.9x	0.77	x	1.86	x	119.01	x	0.3	x	0.7	=	64.43	(77)
Southeast 0.9x	0.77	x	2.88	x	118.15	x	0.3	x	0.7	=	49.52	(77)
Southeast 0.9x	0.77	x	1.86	x	118.15	x	0.3	x	0.7	=	63.96	(77)
Southeast 0.9x	0.77	x	2.88	x	113.91	x	0.3	x	0.7	=	47.74	(77)
Southeast 0.9x	0.77	x	1.86	x	113.91	x	0.3	x	0.7	=	61.67	(77)
Southeast 0.9x	0.77	x	2.88	x	104.39	x	0.3	x	0.7	=	43.75	(77)
Southeast 0.9x	0.77	x	1.86	x	104.39	x	0.3	x	0.7	=	56.51	(77)
Southeast 0.9x	0.77	x	2.88	x	92.85	x	0.3	x	0.7	=	38.92	(77)
Southeast 0.9x	0.77	x	1.86	x	92.85	x	0.3	x	0.7	=	50.27	(77)
Southeast 0.9x	0.77	x	2.88	x	69.27	x	0.3	x	0.7	=	29.03	(77)
Southeast 0.9x	0.77	x	1.86	x	69.27	x	0.3	x	0.7	=	37.5	(77)
Southeast 0.9x	0.77	x	2.88	x	44.07	x	0.3	x	0.7	=	18.47	(77)
Southeast 0.9x	0.77	x	1.86	x	44.07	x	0.3	x	0.7	=	23.86	(77)
Southeast 0.9x	0.77	x	2.88	x	31.49	x	0.3	x	0.7	=	13.2	(77)
Southeast 0.9x	0.77	x	1.86	x	31.49	x	0.3	x	0.7	=	17.05	(77)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	35.34	60.2	82.37	102.05	114.31	113.48	109.41	100.27	89.18	66.53	42.33	30.24	(83)

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

(84)m=	313.58	336.6	348.74	352.5	348.9	332.64	318.48	314.33	311.39	304.84	299.06	300.48	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.95	0.84	0.66	0.69	0.89	0.98	1	1	(86)

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

(87)m=	19.99	20.09	20.27	20.5	20.74	20.92	20.98	20.98	20.87	20.58	20.24	19.97	(87)

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

(88)m=	20.09	20.09	20.1	20.1	20.1	20.11	20.11	20.11	20.11	20.1	20.1	20.1	(88)

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

(89)m=	1	0.99	0.99	0.97	0.92	0.76	0.54	0.58	0.84	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=	18.74	18.89	19.15	19.49	19.82	20.05	20.1	20.1	20	19.6	19.11	18.71	(90)

fLA = Living area ÷ (4) = 0.49 (91)

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

(92)m=	19.35	19.48	19.69	19.98	20.27	20.47	20.53	20.53	20.42	20.08	19.66	19.32	(92)

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

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(93)m=	19.35	19.48	19.69	19.98	20.27	20.47	20.53	20.53	20.42	20.08	19.66	19.32	(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	0.99	0.97	0.93	0.79	0.6	0.63	0.86	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	312.42	334.53	344.62	342.75	322.85	264.11	191.56	199.4	267.51	295.95	296.9	299.6	(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=	765.41	740.18	668.92	558.08	430.84	293.41	196.37	205.94	316.64	476.47	633.3	764.45	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	337.02	272.6	241.27	155.04	80.34	0	0	0	0	134.31	242.21	345.84	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1808.63 (98)

Space heating requirement in kWh/m²/year 35.12 (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) × [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)													
	337.02	272.6	241.27	155.04	80.34	0	0	0	0	134.31	242.21	345.84	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	360.45	291.55	258.05	165.81	85.93	0	0	0	0	143.64	259.04	369.88	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1934.36 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (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)													
	139.03	122.03	126.97	112.19	108.75	95.47	90.08	101.07	101.6	116.42	125.16	135.14	
Efficiency of water heater												87.3	(216)
(217)m=	89.54	89.49	89.37	89.13	88.63	87.3	87.3	87.3	87.3	88.99	89.38	89.58	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	155.27	136.37	142.08	125.87	122.7	109.36	103.18	115.78	116.38	130.83	140.03	150.86	

Total = Sum(219a)$_{1...12}$ = 1548.71 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1934.36

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Water heating fuel used		1548.71	
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		260.28	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		3818.36	(338)

12a. CO_2 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	=	417.82	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	334.52	(264)
Space and water heating	(261) + (262) + (263) + (264) =			752.34	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	135.09	(268)
Total CO2, kg/year		sum of (265)…(271) =		926.36	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		17.99	(273)
EI rating (section 14)				87	(274)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.59

Property Address: Kingston Bridge 1BF 52 GND GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	51.5	(1a) x	2.7	(2a) =	139.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	51.5	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	139.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =		÷ (5) =	

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)	0.39	(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) =	0.33	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

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

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

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	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			2.88	x1/[1/(1.4)+ 0.04]		=	3.82			(27)
Windows Type 2			1.86	x1/[1/(1.4)+ 0.04]		=	2.47			(27)
Floor			51.5	x	0.13	=	6.695			(28)
Walls		6.6	24.15	x	0.18	=	4.35			(29)
Total area of elements, m²			82.25							(31)
Party wall			53.34	x	0	=	0			(32)
Party ceiling			51.1							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 19.79 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 10256.59 (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 4.88 (36)

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

Total fabric heat loss (33) + (36) = 24.67 (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=	27.12	26.96	26.8	26.05	25.91	25.26	25.26	25.14	25.51	25.91	26.2	26.49	(38)

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

(39)m=	51.8	51.63	51.47	50.73	50.59	49.94	49.94	49.82	50.19	50.59	50.87	51.17	

Average = Sum(39)$_{1…12}$ /12= 50.73 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.01	1	1	0.98	0.98	0.97	0.97	0.97	0.97	0.98	0.99	0.99

Average = Sum(40)$_{1...12}$ /12= 0.98 (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 1.73 (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 75.39 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	82.93	79.91	76.9	73.88	70.87	67.85	67.85	70.87	73.88	76.9	79.91	82.93

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

Total = Sum(44)$_{1...12}$ = 904.68 (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=	122.98	107.56	110.99	96.77	92.85	80.12	74.24	85.2	86.21	100.47	109.68	119.1

Total = Sum(45)$_{1...12}$ = 1186.18 (45)

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

(46)m=	18.45	16.13	16.65	14.51	13.93	12.02	11.14	12.78	12.93	15.07	16.45	17.87	(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (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)

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

(61)m=	42.26	36.78	39.19	36.44	36.11	33.46	34.58	36.11	36.44	39.19	39.41	42.26	(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=	165.24	144.34	150.18	133.2	128.96	113.58	108.82	121.31	122.65	139.66	149.09	161.36	(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=	165.24	144.34	150.18	133.2	128.96	113.58	108.82	121.31	122.65	139.66	149.09	161.36	

Output from water heater (annual)$_{1...12}$ 1638.4 (64)

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

(65)m=	51.46	44.96	46.7	41.28	39.9	35.01	33.33	37.36	37.78	43.2	46.32	50.17	(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=	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	(66)

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

(67)m=	14.74	13.09	10.65	8.06	6.02	5.09	5.5	7.14	9.59	12.17	14.21	15.15	(67)

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

(68)m=	151.13	152.7	148.74	140.33	129.71	119.73	113.06	111.49	115.45	123.86	134.48	144.46	(68)

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

(69)m=	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	(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=	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	(71)

Water heating gains (Table 5)

(72)m=	69.16	66.9	62.77	57.34	53.63	48.62	44.8	50.21	52.47	58.07	64.33	67.43	(72)

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

(73)m=	287.04	284.71	274.18	257.74	241.38	225.45	215.37	220.86	229.51	246.12	265.04	279.05	(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)	
Southeast 0.9x	0.77	x	2.88	x	36.79	x	0.63	x	0.7	=	32.38	(77)
Southeast 0.9x	0.77	x	1.86	x	36.79	x	0.63	x	0.7	=	41.83	(77)
Southeast 0.9x	0.77	x	2.88	x	62.67	x	0.63	x	0.7	=	55.16	(77)
Southeast 0.9x	0.77	x	1.86	x	62.67	x	0.63	x	0.7	=	71.25	(77)
Southeast 0.9x	0.77	x	2.88	x	85.75	x	0.63	x	0.7	=	75.48	(77)

Southeast	0.9x	0.77	x	1.86	x	85.75	x	0.63	x	0.7	=	97.49	(77)
Southeast	0.9x	0.77	x	2.88	x	106.25	x	0.63	x	0.7	=	93.52	(77)
Southeast	0.9x	0.77	x	1.86	x	106.25	x	0.63	x	0.7	=	120.8	(77)
Southeast	0.9x	0.77	x	2.88	x	119.01	x	0.63	x	0.7	=	104.75	(77)
Southeast	0.9x	0.77	x	1.86	x	119.01	x	0.63	x	0.7	=	135.3	(77)
Southeast	0.9x	0.77	x	2.88	x	118.15	x	0.63	x	0.7	=	103.99	(77)
Southeast	0.9x	0.77	x	1.86	x	118.15	x	0.63	x	0.7	=	134.32	(77)
Southeast	0.9x	0.77	x	2.88	x	113.91	x	0.63	x	0.7	=	100.26	(77)
Southeast	0.9x	0.77	x	1.86	x	113.91	x	0.63	x	0.7	=	129.5	(77)
Southeast	0.9x	0.77	x	2.88	x	104.39	x	0.63	x	0.7	=	91.88	(77)
Southeast	0.9x	0.77	x	1.86	x	104.39	x	0.63	x	0.7	=	118.68	(77)
Southeast	0.9x	0.77	x	2.88	x	92.85	x	0.63	x	0.7	=	81.73	(77)
Southeast	0.9x	0.77	x	1.86	x	92.85	x	0.63	x	0.7	=	105.56	(77)
Southeast	0.9x	0.77	x	2.88	x	69.27	x	0.63	x	0.7	=	60.97	(77)
Southeast	0.9x	0.77	x	1.86	x	69.27	x	0.63	x	0.7	=	78.75	(77)
Southeast	0.9x	0.77	x	2.88	x	44.07	x	0.63	x	0.7	=	38.79	(77)
Southeast	0.9x	0.77	x	1.86	x	44.07	x	0.63	x	0.7	=	50.1	(77)
Southeast	0.9x	0.77	x	2.88	x	31.49	x	0.63	x	0.7	=	27.71	(77)
Southeast	0.9x	0.77	x	1.86	x	31.49	x	0.63	x	0.7	=	35.8	(77)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	74.21	126.42	172.97	214.31	240.05	238.31	229.76	210.56	187.29	139.72	88.89	63.51	(83)

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

(84)m=	361.26	411.12	447.14	472.06	481.43	463.76	445.13	431.42	416.8	385.83	353.93	342.56	(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	0.84	0.66	0.49	0.52	0.76	0.95	0.99	1	(86)

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

(87)m=	20.05	20.21	20.42	20.68	20.88	20.98	21	20.99	20.95	20.7	20.33	20.03	(87)

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

(88)m=	20.08	20.08	20.08	20.1	20.1	20.11	20.11	20.11	20.1	20.1	20.09	20.09	(88)

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

(89)m=	0.99	0.99	0.97	0.92	0.79	0.58	0.39	0.43	0.69	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=	18.82	19.04	19.35	19.72	19.98	20.09	20.11	20.11	20.06	19.76	19.24	18.79	(90)

fLA = Living area ÷ (4) = | 0.49 | (91)

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

(92)m=	19.42	19.61	19.87	20.19	20.42	20.52	20.54	20.54	20.49	20.22	19.77	19.39	(92)

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

(93)m=	19.42	19.61	19.87	20.19	20.42	20.52	20.54	20.54	20.49	20.22	19.77	19.39	(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	0.92	0.81	0.62	0.44	0.47	0.72	0.93	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	358.69	405.01	432.5	434.06	390.51	287.35	195.71	204.66	301.05	358.91	348.55	340.7	(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=	783.14	759.39	688.27	572.56	440.87	295.71	196.69	206.17	320.83	486.42	644.34	777.27	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	315.79	238.14	190.29	99.72	37.46	0	0	0	0	94.86	212.98	324.81	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1514.05 (98)

Space heating requirement in kWh/m²/year 29.4 (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) × [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)													
	315.79	238.14	190.29	99.72	37.46	0	0	0	0	94.86	212.98	324.81	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	338.1	254.97	203.74	106.77	40.11	0	0	0	0	101.57	228.03	347.76	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1621.04 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (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)

	165.24	144.34	150.18	133.2	128.96	113.58	108.82	121.31	122.65	139.66	149.09	161.36	
Efficiency of water heater												80.3	(216)
(217)m=	86.66	86.3	85.65	84.33	82.37	80.3	80.3	80.3	80.3	84.1	85.95	86.78	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	190.69	167.25	175.34	157.94	156.56	141.45	135.52	151.07	152.74	166.06	173.46	185.95	

Total = Sum(219a)$_{1...12}$ = 1954.03 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1621.04

TER WorkSheet: New dwelling design stage

Water heating fuel used			1954.03	
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			260.28	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			3910.36	(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	=	350.14	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	422.07	(264)
Space and water heating	(261) + (262) + (263) + (264) =			772.22	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	135.09	(268)
Total CO2, kg/year		sum of (265)…(271) =		946.23	(272)

TER = 18.37 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.59

Property Address: Kingston Bridge 1BF 52 MID GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	51.5	(1a) x	2.7	(2a) =	139.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	51.5	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	139.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =		÷ (5) =	

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)	0.27	(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) =	0.23	(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

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

0.29	0.29	0.28	0.25	0.25	0.22	0.22	0.21	0.23	0.25	0.26	0.27

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

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

(25)m=	0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.53	0.53	0.53	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			2.88		x1/[1/(1.2)+ 0.04]	=	3.3			(27)
Windows Type 2			1.86		x1/[1/(1.2)+ 0.04]	=	2.13			(27)
Walls		6.6	24.15	x	0.18	=	4.35			(29)
Total area of elements, m²			30.75							(31)
Party wall			53.34	x	0	=	0			(32)
Party floor			51.5							(32a)
Party ceiling			51.1							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 11.9 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 10514.09 (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 3.14 (36)

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

Total fabric heat loss (33) + (36) = 15.04 (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=	24.94	24.86	24.78	24.43	24.36	24.05	24.05	23.99	24.17	24.36	24.49	24.64	(38)

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

(39)m=	39.98	39.9	39.83	39.47	39.4	39.09	39.09	39.04	39.21	39.4	39.54	39.68	

Average = Sum(39)$_{1…12}$ /12= 39.47 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.78	0.77	0.77	0.77	0.77	0.76	0.76	0.76	0.76	0.77	0.77	0.77

Average = Sum(40)$_{1…12}$ /12= 0.77 (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 1.73 (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 75.39 (43)

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

	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=	82.93	79.91	76.9	73.88	70.87	67.85	67.85	70.87	73.88	76.9	79.91	82.93

Total = Sum(44)$_{1…12}$ = 904.68 (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=	122.98	107.56	110.99	96.77	92.85	80.12	74.24	85.2	86.21	100.47	109.68	119.1

Total = Sum(45)$_{1…12}$ = 1186.18 (45)

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

(46)m=	18.45	16.13	16.65	14.51	13.93	12.02	11.14	12.78	12.93	15.07	16.45	17.87	(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (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)

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

(61)m=	16.05	14.47	15.98	15.42	15.9	15.35	15.83	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=	139.03	122.03	126.97	112.19	108.75	95.47	90.08	101.07	101.6	116.42	125.16	135.14	(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=	139.03	122.03	126.97	112.19	108.75	95.47	90.08	101.07	101.6	116.42	125.16	135.14	

Output from water heater (annual)$_{1...12}$ 1373.92 (64)

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

(65)m=	44.9	39.38	40.9	36.03	34.85	30.48	28.65	32.3	32.51	37.39	40.34	43.61	(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=	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	(66)

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

(67)m=	14.74	13.09	10.65	8.06	6.02	5.09	5.5	7.14	9.59	12.17	14.21	15.15	(67)

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

(68)m=	151.13	152.7	148.74	140.33	129.71	119.73	113.06	111.49	115.45	123.86	134.48	144.46	(68)

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

(69)m=	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	(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=	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	(71)

Water heating gains (Table 5)

(72)m=	60.36	58.6	54.97	50.04	46.84	42.33	38.5	43.41	45.16	50.26	56.03	58.62	(72)

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

(73)m=	278.24	276.41	266.38	250.45	234.59	219.16	209.07	214.06	222.21	238.31	256.73	270.24	(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)	
Southeast 0.9x	0.77	x	2.88	x	36.79	x	0.63	x	0.7	=	32.38	(77)
Southeast 0.9x	0.77	x	1.86	x	36.79	x	0.63	x	0.7	=	41.83	(77)
Southeast 0.9x	0.77	x	2.88	x	62.67	x	0.63	x	0.7	=	55.16	(77)
Southeast 0.9x	0.77	x	1.86	x	62.67	x	0.63	x	0.7	=	71.25	(77)
Southeast 0.9x	0.77	x	2.88	x	85.75	x	0.63	x	0.7	=	75.48	(77)

Southeast 0.9x	0.77	x	1.86	x	85.75	x	0.63	x	0.7	=	97.49	(77)
Southeast 0.9x	0.77	x	2.88	x	106.25	x	0.63	x	0.7	=	93.52	(77)
Southeast 0.9x	0.77	x	1.86	x	106.25	x	0.63	x	0.7	=	120.8	(77)
Southeast 0.9x	0.77	x	2.88	x	119.01	x	0.63	x	0.7	=	104.75	(77)
Southeast 0.9x	0.77	x	1.86	x	119.01	x	0.63	x	0.7	=	135.3	(77)
Southeast 0.9x	0.77	x	2.88	x	118.15	x	0.63	x	0.7	=	103.99	(77)
Southeast 0.9x	0.77	x	1.86	x	118.15	x	0.63	x	0.7	=	134.32	(77)
Southeast 0.9x	0.77	x	2.88	x	113.91	x	0.63	x	0.7	=	100.26	(77)
Southeast 0.9x	0.77	x	1.86	x	113.91	x	0.63	x	0.7	=	129.5	(77)
Southeast 0.9x	0.77	x	2.88	x	104.39	x	0.63	x	0.7	=	91.88	(77)
Southeast 0.9x	0.77	x	1.86	x	104.39	x	0.63	x	0.7	=	118.68	(77)
Southeast 0.9x	0.77	x	2.88	x	92.85	x	0.63	x	0.7	=	81.73	(77)
Southeast 0.9x	0.77	x	1.86	x	92.85	x	0.63	x	0.7	=	105.56	(77)
Southeast 0.9x	0.77	x	2.88	x	69.27	x	0.63	x	0.7	=	60.97	(77)
Southeast 0.9x	0.77	x	1.86	x	69.27	x	0.63	x	0.7	=	78.75	(77)
Southeast 0.9x	0.77	x	2.88	x	44.07	x	0.63	x	0.7	=	38.79	(77)
Southeast 0.9x	0.77	x	1.86	x	44.07	x	0.63	x	0.7	=	50.1	(77)
Southeast 0.9x	0.77	x	2.88	x	31.49	x	0.63	x	0.7	=	27.71	(77)
Southeast 0.9x	0.77	x	1.86	x	31.49	x	0.63	x	0.7	=	35.8	(77)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	74.21	126.42	172.97	214.31	240.05	238.31	229.76	210.56	187.29	139.72	88.89	63.51	(83)

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

(84)m=	352.45	402.82	439.35	464.76	474.64	457.48	438.83	424.62	409.49	378.03	345.62	333.75	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.96	0.89	0.74	0.54	0.39	0.42	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=	20.38	20.52	20.7	20.87	20.97	21	21	21	20.99	20.87	20.59	20.35	(87)

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

(88)m=	20.27	20.28	20.28	20.28	20.28	20.29	20.29	20.29	20.29	20.28	20.28	20.28	(88)

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

(89)m=	0.99	0.98	0.95	0.86	0.69	0.48	0.33	0.36	0.59	0.88	0.98	0.99	(89)

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

(90)m=	19.45	19.65	19.9	20.14	20.26	20.29	20.29	20.29	20.28	20.14	19.76	19.4	(90)

fLA = Living area ÷ (4) = 0.49 (91)

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

(92)m=	19.9	20.07	20.29	20.5	20.6	20.63	20.63	20.63	20.62	20.5	20.16	19.86	(92)

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

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(93)m=	19.9	20.07	20.29	20.5	20.6	20.63	20.63	20.63	20.62	20.5	20.16	19.86		(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	0.95	0.87	0.71	0.51	0.36	0.39	0.62	0.89	0.98	0.99		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	349.54	394.64	417.09	403.79	338.89	234.75	157.63	165.16	252.33	336.04	338.55	331.76		(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=	623.64	605.37	549.02	457.67	350.79	235.79	157.7	165.29	255.84	389.92	516.44	621.35		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	203.93	141.61	98.15	38.8	8.85	0	0	0	0	40.09	128.08	215.45		
Total per year (kWh/year) = Sum(98)1...5,9...12 =													874.97	(98)
Space heating requirement in kWh/m²/year													16.99	(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) × [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)														
	203.93	141.61	98.15	38.8	8.85	0	0	0	0	40.09	128.08	215.45		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	218.11	151.46	104.97	41.5	9.47	0	0	0	0	42.88	136.99	230.43		
Total (kWh/year) =Sum(211)1...5,10...12=													935.8	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)														
	139.03	122.03	126.97	112.19	108.75	95.47	90.08	101.07	101.6	116.42	125.16	135.14		
Efficiency of water heater													87.3	(216)
(217)m=	89.17	88.99	88.67	88.1	87.53	87.3	87.3	87.3	87.3	88.1	88.89	89.24		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	155.91	137.13	143.2	127.34	124.24	109.36	103.18	115.78	116.38	132.15	140.81	151.43		
Total = Sum(219a)1...12 =													1556.91	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		935.8

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Water heating fuel used			1556.91	
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			260.28	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			2828	(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	=	202.13	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	336.29	(264)
Space and water heating	(261) + (262) + (263) + (264) =			538.43	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	135.09	(268)
Total CO2, kg/year		sum of (265)…(271) =		712.44	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		13.83	(273)
EI rating (section 14)				90	(274)

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User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.59

Property Address: Kingston Bridge 1BF 52 MID GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	51.5	(1a) x	2.7	(2a) =	139.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	51.5	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	139.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =		÷ (5) =		

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)	0.39	(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) =	0.33	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

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

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

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	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			2.88	x1/[1/(1.4)+ 0.04]		=	3.82			(27)
Windows Type 2			1.86	x1/[1/(1.4)+ 0.04]		=	2.47			(27)
Walls		6.6	24.15	x	0.18	=	4.35			(29)
Total area of elements, m²			30.75							(31)
Party wall			53.34	x	0	=	0			(32)
Party floor			51.5							(32a)
Party ceiling			51.1							(32b)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 13.1 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 10514.09 (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 2.27 (36)

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

Total fabric heat loss (33) + (36) = 15.37 (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=	27.12	26.96	26.8	26.05	25.91	25.26	25.26	25.14	25.51	25.91	26.2	26.49	(38)

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

(39)m=	42.49	42.33	42.17	41.43	41.29	40.64	40.64	40.51	40.89	41.29	41.57	41.86	

Average = Sum(39)$_{1…12}$ /12= 41.43 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	0.83	0.82	0.82	0.8	0.8	0.79	0.79	0.79	0.79	0.8	0.81	0.81

Average = Sum(40)$_{1…12}$ /12= 0.8 (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 — 1.73 (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 — 75.39 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	82.93	79.91	76.9	73.88	70.87	67.85	67.85	70.87	73.88	76.9	79.91	82.93

Total = Sum(44)$_{1…12}$ = 904.68 (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=	122.98	107.56	110.99	96.77	92.85	80.12	74.24	85.2	86.21	100.47	109.68	119.1

Total = Sum(45)$_{1…12}$ = 1186.18 (45)

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

(46)m=	18.45	16.13	16.65	14.51	13.93	12.02	11.14	12.78	12.93	15.07	16.45	17.87	(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) — 0 (55)

Water storage loss calculated for each month — ((56)m = (55) × (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)

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

(61)m=	42.26	36.78	39.19	36.44	36.11	33.46	34.58	36.11	36.44	39.19	39.41	42.26	(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=	165.24	144.34	150.18	133.2	128.96	113.58	108.82	121.31	122.65	139.66	149.09	161.36	(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=	165.24	144.34	150.18	133.2	128.96	113.58	108.82	121.31	122.65	139.66	149.09	161.36	

Output from water heater (annual)$_{1...12}$ 1638.4 (64)

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

(65)m=	51.46	44.96	46.7	41.28	39.9	35.01	33.33	37.36	37.78	43.2	46.32	50.17	(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=	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	(66)

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

(67)m=	14.74	13.09	10.65	8.06	6.02	5.09	5.5	7.14	9.59	12.17	14.21	15.15	(67)

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

(68)m=	151.13	152.7	148.74	140.33	129.71	119.73	113.06	111.49	115.45	123.86	134.48	144.46	(68)

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

(69)m=	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	(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=	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	(71)

Water heating gains (Table 5)

(72)m=	69.16	66.9	62.77	57.34	53.63	48.62	44.8	50.21	52.47	58.07	64.33	67.43	(72)

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

(73)m=	287.04	284.71	274.18	257.74	241.38	225.45	215.37	220.86	229.51	246.12	265.04	279.05	(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)	
Southeast	0.9x	0.77	x	2.88	x	36.79	x	0.63	x	0.7	=	32.38	(77)
Southeast	0.9x	0.77	x	1.86	x	36.79	x	0.63	x	0.7	=	41.83	(77)
Southeast	0.9x	0.77	x	2.88	x	62.67	x	0.63	x	0.7	=	55.16	(77)
Southeast	0.9x	0.77	x	1.86	x	62.67	x	0.63	x	0.7	=	71.25	(77)
Southeast	0.9x	0.77	x	2.88	x	85.75	x	0.63	x	0.7	=	75.48	(77)

Southeast 0.9x	0.77	x	1.86	x	85.75	x	0.63	x	0.7	=	97.49	(77)
Southeast 0.9x	0.77	x	2.88	x	106.25	x	0.63	x	0.7	=	93.52	(77)
Southeast 0.9x	0.77	x	1.86	x	106.25	x	0.63	x	0.7	=	120.8	(77)
Southeast 0.9x	0.77	x	2.88	x	119.01	x	0.63	x	0.7	=	104.75	(77)
Southeast 0.9x	0.77	x	1.86	x	119.01	x	0.63	x	0.7	=	135.3	(77)
Southeast 0.9x	0.77	x	2.88	x	118.15	x	0.63	x	0.7	=	103.99	(77)
Southeast 0.9x	0.77	x	1.86	x	118.15	x	0.63	x	0.7	=	134.32	(77)
Southeast 0.9x	0.77	x	2.88	x	113.91	x	0.63	x	0.7	=	100.26	(77)
Southeast 0.9x	0.77	x	1.86	x	113.91	x	0.63	x	0.7	=	129.5	(77)
Southeast 0.9x	0.77	x	2.88	x	104.39	x	0.63	x	0.7	=	91.88	(77)
Southeast 0.9x	0.77	x	1.86	x	104.39	x	0.63	x	0.7	=	118.68	(77)
Southeast 0.9x	0.77	x	2.88	x	92.85	x	0.63	x	0.7	=	81.73	(77)
Southeast 0.9x	0.77	x	1.86	x	92.85	x	0.63	x	0.7	=	105.56	(77)
Southeast 0.9x	0.77	x	2.88	x	69.27	x	0.63	x	0.7	=	60.97	(77)
Southeast 0.9x	0.77	x	1.86	x	69.27	x	0.63	x	0.7	=	78.75	(77)
Southeast 0.9x	0.77	x	2.88	x	44.07	x	0.63	x	0.7	=	38.79	(77)
Southeast 0.9x	0.77	x	1.86	x	44.07	x	0.63	x	0.7	=	50.1	(77)
Southeast 0.9x	0.77	x	2.88	x	31.49	x	0.63	x	0.7	=	27.71	(77)
Southeast 0.9x	0.77	x	1.86	x	31.49	x	0.63	x	0.7	=	35.8	(77)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	74.21	126.42	172.97	214.31	240.05	238.31	229.76	210.56	187.29	139.72	88.89	63.51	(83)

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

(84)m=	361.26	411.12	447.14	472.06	481.43	463.76	445.13	431.42	416.8	385.83	353.93	342.56	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.96	0.9	0.76	0.56	0.4	0.43	0.66	0.91	0.99	1	(86)

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

(87)m=	20.32	20.46	20.65	20.85	20.96	21	21	21	20.99	20.85	20.55	20.3	(87)

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

(88)m=	20.23	20.23	20.24	20.25	20.25	20.26	20.26	20.26	20.26	20.25	20.25	20.24	(88)

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

(89)m=	0.99	0.98	0.95	0.87	0.71	0.49	0.33	0.36	0.6	0.88	0.98	0.99	(89)

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

(90)m=	19.33	19.54	19.8	20.08	20.22	20.26	20.26	20.26	20.25	20.09	19.68	19.3	(90)

fLA = Living area ÷ (4) = 0.49 (91)

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

(92)m=	19.81	19.99	20.21	20.45	20.58	20.62	20.62	20.62	20.61	20.46	20.1	19.78	(92)

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

(93)m=	19.81	19.99	20.21	20.45	20.58	20.62	20.62	20.62	20.61	20.46	20.1	19.78	(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	0.95	0.88	0.73	0.52	0.37	0.4	0.63	0.89	0.98	0.99		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	358.16	402.95	425.86	413.96	350.84	243.08	163.27	170.85	261.44	344.72	346.6	340.37		(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=	659.08	638.67	578.31	478.55	366.51	244.51	163.37	171.03	266.06	407.02	540.56	652.42		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	223.88	158.4	113.43	46.51	11.66	0	0	0	0	46.35	139.65	232.16		
									Total per year (kWh/year) = Sum(98)1...5,9...12 =				972.04	(98)
Space heating requirement in kWh/m²/year													18.87	(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) × [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)														
	223.88	158.4	113.43	46.51	11.66	0	0	0	0	46.35	139.65	232.16		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	239.71	169.6	121.44	49.79	12.48	0	0	0	0	49.63	149.52	248.57		
									Total (kWh/year) =Sum(211)1...5,10...12=				1040.73	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (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)														
	165.24	144.34	150.18	133.2	128.96	113.58	108.82	121.31	122.65	139.66	149.09	161.36		
Efficiency of water heater													80.3	(216)
(217)m=	85.82	85.29	84.36	82.69	81.05	80.3	80.3	80.3	80.3	82.6	84.89	85.97		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	192.55	169.25	178.03	161.08	159.11	141.45	135.52	151.07	152.74	169.08	175.63	187.7		
									Total = Sum(219a)1...12 =				1973.21	(219)

Annual totals	kWh/year	kWh/year
Space heating fuel used, main system 1		1040.73

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Water heating fuel used			1973.21	
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			260.28	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			3349.23	(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	=	224.8	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	426.21	(264)
Space and water heating	(261) + (262) + (263) + (264) =			651.01	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	135.09	(268)
Total CO2, kg/year		sum of (265)…(271) =		825.02	(272)

TER = 16.02 (273)

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User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.59

Property Address: Kingston Bridge 1BF 52 TOP GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	51.5	(1a) x	2.7	(2a) =	139.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	51.5	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	139.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =		÷ (5) =		

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)	0.27	(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) =	0.23	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.29	0.29	0.28	0.25	0.25	0.22	0.22	0.21	0.23	0.25	0.26	0.27

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

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

(25)m=	0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.53	0.53	0.53	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			2.88	x1/[1/(1.2)+ 0.04]		=	3.3			(27)
Windows Type 2			1.86	x1/[1/(1.2)+ 0.04]		=	2.13			(27)
Walls		6.6	24.15	x	0.18	=	4.35			(29)
Roof		0	51.5	x	0.13	=	6.69			(30)
Total area of elements, m²			82.25							(31)
Party wall			53.34	x	0	=	0			(32)
Party floor			51.5							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 18.6 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5867.59 (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 8.79 (36)

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

Total fabric heat loss (33) + (36) = 27.39 (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=	24.94	24.86	24.78	24.43	24.36	24.05	24.05	23.99	24.17	24.36	24.49	24.64	(38)

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

(39)m=	52.33	52.25	52.17	51.82	51.75	51.44	51.44	51.38	51.56	51.75	51.88	52.03	

Average = Sum(39)$_{1…12}$ /12= 51.82 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.02	1.01	1.01	1.01	1	1	1	1	1	1	1.01	1.01		
										Average = Sum(40)$_{1...12}$ /12=			1.01	(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 1.73 (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 75.39 (43)

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

	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=	82.93	79.91	76.9	73.88	70.87	67.85	67.85	70.87	73.88	76.9	79.91	82.93		
										Total = Sum(44)$_{1...12}$ =			904.68	(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=	122.98	107.56	110.99	96.77	92.85	80.12	74.24	85.2	86.21	100.47	109.68	119.1		
										Total = Sum(45)$_{1...12}$ =			1186.18	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)														
(46)m=	18.45	16.13	16.65	14.51	13.93	12.02	11.14	12.78	12.93	15.07	16.45	17.87		(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (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)

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

(61)m=	16.05	14.47	15.98	15.42	15.9	15.35	15.83	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=	139.03	122.03	126.97	112.19	108.75	95.47	90.08	101.07	101.6	116.42	125.16	135.14	(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=	139.03	122.03	126.97	112.19	108.75	95.47	90.08	101.07	101.6	116.42	125.16	135.14	

Output from water heater (annual)$_{1...12}$ 1373.92 (64)

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

(65)m=	44.9	39.38	40.9	36.03	34.85	30.48	28.65	32.3	32.51	37.39	40.34	43.61	(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=	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	14.74	13.09	10.65	8.06	6.02	5.09	5.5	7.14	9.59	12.17	14.21	15.15	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	151.13	152.7	148.74	140.33	129.71	119.73	113.06	111.49	115.45	123.86	134.48	144.46	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	(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=	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	(71)
Water heating gains (Table 5)													
(72)m=	60.36	58.6	54.97	50.04	46.84	42.33	38.5	43.41	45.16	50.26	56.03	58.62	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	278.24	276.41	266.38	250.45	234.59	219.16	209.07	214.06	222.21	238.31	256.73	270.24	(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)	
Southeast 0.9x	0.77	x	2.88	x	36.79	x	0.35	x	0.7	=	17.99	(77)
Southeast 0.9x	0.77	x	1.86	x	36.79	x	0.35	x	0.7	=	23.24	(77)
Southeast 0.9x	0.77	x	2.88	x	62.67	x	0.35	x	0.7	=	30.65	(77)
Southeast 0.9x	0.77	x	1.86	x	62.67	x	0.35	x	0.7	=	39.58	(77)
Southeast 0.9x	0.77	x	2.88	x	85.75	x	0.35	x	0.7	=	41.93	(77)

Southeast 0.9x	0.77	x	1.86	x	85.75	x	0.35	x	0.7	=	54.16	(77)
Southeast 0.9x	0.77	x	2.88	x	106.25	x	0.35	x	0.7	=	51.96	(77)
Southeast 0.9x	0.77	x	1.86	x	106.25	x	0.35	x	0.7	=	67.11	(77)
Southeast 0.9x	0.77	x	2.88	x	119.01	x	0.35	x	0.7	=	58.19	(77)
Southeast 0.9x	0.77	x	1.86	x	119.01	x	0.35	x	0.7	=	75.17	(77)
Southeast 0.9x	0.77	x	2.88	x	118.15	x	0.35	x	0.7	=	57.77	(77)
Southeast 0.9x	0.77	x	1.86	x	118.15	x	0.35	x	0.7	=	74.62	(77)
Southeast 0.9x	0.77	x	2.88	x	113.91	x	0.35	x	0.7	=	55.7	(77)
Southeast 0.9x	0.77	x	1.86	x	113.91	x	0.35	x	0.7	=	71.95	(77)
Southeast 0.9x	0.77	x	2.88	x	104.39	x	0.35	x	0.7	=	51.04	(77)
Southeast 0.9x	0.77	x	1.86	x	104.39	x	0.35	x	0.7	=	65.93	(77)
Southeast 0.9x	0.77	x	2.88	x	92.85	x	0.35	x	0.7	=	45.4	(77)
Southeast 0.9x	0.77	x	1.86	x	92.85	x	0.35	x	0.7	=	58.65	(77)
Southeast 0.9x	0.77	x	2.88	x	69.27	x	0.35	x	0.7	=	33.87	(77)
Southeast 0.9x	0.77	x	1.86	x	69.27	x	0.35	x	0.7	=	43.75	(77)
Southeast 0.9x	0.77	x	2.88	x	44.07	x	0.35	x	0.7	=	21.55	(77)
Southeast 0.9x	0.77	x	1.86	x	44.07	x	0.35	x	0.7	=	27.83	(77)
Southeast 0.9x	0.77	x	2.88	x	31.49	x	0.35	x	0.7	=	15.4	(77)
Southeast 0.9x	0.77	x	1.86	x	31.49	x	0.35	x	0.7	=	19.89	(77)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	41.23	70.23	96.09	119.06	133.36	132.4	127.64	116.98	104.05	77.62	49.38	35.28	(83)

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

(84)m=	319.47	346.64	362.47	369.51	367.95	351.56	336.72	331.04	326.25	315.93	306.11	305.52	(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	0.94	0.82	0.65	0.68	0.88	0.98	1	1	(86)

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

(87)m=	19.96	20.07	20.26	20.5	20.74	20.92	20.98	20.98	20.87	20.57	20.22	19.94	(87)

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

(88)m=	20.07	20.07	20.07	20.08	20.08	20.08	20.08	20.09	20.08	20.08	20.08	20.07	(88)

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

(89)m=	1	0.99	0.99	0.97	0.91	0.74	0.53	0.56	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=	18.68	18.84	19.11	19.47	19.81	20.03	20.08	20.08	19.97	19.57	19.06	18.65	(90)

fLA = Living area ÷ (4) = | 0.49 | (91)

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

(92)m=	19.3	19.44	19.67	19.97	20.26	20.46	20.52	20.51	20.41	20.06	19.63	19.27	(92)

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

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(93)m=	19.3	19.44	19.67	19.97	20.26	20.46	20.52	20.51	20.41	20.06	19.63	19.27	(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	0.99	0.97	0.92	0.78	0.58	0.62	0.85	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	318.18	344.23	357.54	357.68	336.82	273.25	196.88	204.97	276.62	305.74	303.7	304.56	(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=	785.09	759.72	687.06	573.73	443.09	301.53	201.52	211.38	325.36	489.41	649.88	784.14	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	347.38	279.21	245.16	155.56	79.06	0	0	0	0	136.65	249.25	356.81	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1849.09 (98)

Space heating requirement in kWh/m²/year 35.9 (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) × [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)														
	347.38	279.21	245.16	155.56	79.06	0	0	0	0	136.65	249.25	356.81		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	371.53	298.62	262.21	166.37	84.56	0	0	0	0	146.15	266.58	381.61		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1977.63	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (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)														
	139.03	122.03	126.97	112.19	108.75	95.47	90.08	101.07	101.6	116.42	125.16	135.14		
Efficiency of water heater													87.3	(216)
(217)m=	89.56	89.5	89.38	89.13	88.62	87.3	87.3	87.3	87.3	89	89.4	89.6		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	155.24	136.35	142.06	125.87	122.71	109.36	103.18	115.78	116.38	130.81	140	150.83		
Total = Sum(219a)$_{1...12}$ =													1548.56	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1977.63

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Water heating fuel used			1548.56	
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			260.28	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			3861.48	(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 =	427.17	(261)
Space heating (secondary)	(215) x	0.519 =	0	(263)
Water heating	(219) x	0.216 =	334.49	(264)
Space and water heating	(261) + (262) + (263) + (264) =		761.66	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93	(267)
Electricity for lighting	(232) x	0.519 =	135.09	(268)
Total CO2, kg/year		sum of (265)…(271) =	935.67	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	18.17	(273)
EI rating (section 14)			87	(274)

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User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.59

Property Address: Kingston Bridge 1BF 52 TOP GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	51.5	(1a) x	2.7	(2a) =	139.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	51.5	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	139.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =		÷ (5) =		
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)			0.39	(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) =		0.33	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

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

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

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	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			2.88	x1/[1/(1.4)+ 0.04] =	3.82			(27)
Windows Type 2			1.86	x1/[1/(1.4)+ 0.04] =	2.47			(27)
Walls		6.6	24.15	x 0.18 =	4.35			(29)
Roof		0	51.5	x 0.13 =	6.69			(30)
Total area of elements, m²			82.25					(31)
Party wall			53.34	x 0 =	0			(32)
Party floor			51.5					(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 19.79 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5867.59 (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 5.56 (36)

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

Total fabric heat loss (33) + (36) = 25.35 (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=	27.12	26.96	26.8	26.05	25.91	25.26	25.26	25.14	25.51	25.91	26.2	26.49	(38)

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

(39)m=	52.47	52.31	52.15	51.4	51.26	50.61	50.61	50.49	50.86	51.26	51.55	51.84	

Average = Sum(39)$_{1…12}$ /12= 51.4 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.02	1.02	1.01	1	1	0.98	0.98	0.98	0.99	1	1	1.01

Average = Sum(40)$_{1...12}$ /12= 1 (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 1.73 (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 75.39 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	82.93	79.91	76.9	73.88	70.87	67.85	67.85	70.87	73.88	76.9	79.91	82.93

Total = Sum(44)$_{1...12}$ = 904.68 (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=	122.98	107.56	110.99	96.77	92.85	80.12	74.24	85.2	86.21	100.47	109.68	119.1

Total = Sum(45)$_{1...12}$ = 1186.18 (45)

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

(46)m=	18.45	16.13	16.65	14.51	13.93	12.02	11.14	12.78	12.93	15.07	16.45	17.87	(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (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)

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

(61)m=	42.26	36.78	39.19	36.44	36.11	33.46	34.58	36.11	36.44	39.19	39.41	42.26	(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=	165.24	144.34	150.18	133.2	128.96	113.58	108.82	121.31	122.65	139.66	149.09	161.36	(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=	165.24	144.34	150.18	133.2	128.96	113.58	108.82	121.31	122.65	139.66	149.09	161.36	

Output from water heater (annual)$_{1...12}$ 1638.4 (64)

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

(65)m=	51.46	44.96	46.7	41.28	39.9	35.01	33.33	37.36	37.78	43.2	46.32	50.17	(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=	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	(66)

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

(67)m=	14.74	13.09	10.65	8.06	6.02	5.09	5.5	7.14	9.59	12.17	14.21	15.15	(67)

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

(68)m=	151.13	152.7	148.74	140.33	129.71	119.73	113.06	111.49	115.45	123.86	134.48	144.46	(68)

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

(69)m=	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	(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=	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	(71)

Water heating gains (Table 5)

(72)m=	69.16	66.9	62.77	57.34	53.63	48.62	44.8	50.21	52.47	58.07	64.33	67.43	(72)

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

(73)m=	287.04	284.71	274.18	257.74	241.38	225.45	215.37	220.86	229.51	246.12	265.04	279.05	(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)	
Southeast 0.9x	0.77	x	2.88	x	36.79	x	0.63	x	0.7	=	32.38	(77)
Southeast 0.9x	0.77	x	1.86	x	36.79	x	0.63	x	0.7	=	41.83	(77)
Southeast 0.9x	0.77	x	2.88	x	62.67	x	0.63	x	0.7	=	55.16	(77)
Southeast 0.9x	0.77	x	1.86	x	62.67	x	0.63	x	0.7	=	71.25	(77)
Southeast 0.9x	0.77	x	2.88	x	85.75	x	0.63	x	0.7	=	75.48	(77)

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Southeast 0.9x	0.77	x	1.86	x	85.75	x	0.63	x	0.7	=	97.49	(77)
Southeast 0.9x	0.77	x	2.88	x	106.25	x	0.63	x	0.7	=	93.52	(77)
Southeast 0.9x	0.77	x	1.86	x	106.25	x	0.63	x	0.7	=	120.8	(77)
Southeast 0.9x	0.77	x	2.88	x	119.01	x	0.63	x	0.7	=	104.75	(77)
Southeast 0.9x	0.77	x	1.86	x	119.01	x	0.63	x	0.7	=	135.3	(77)
Southeast 0.9x	0.77	x	2.88	x	118.15	x	0.63	x	0.7	=	103.99	(77)
Southeast 0.9x	0.77	x	1.86	x	118.15	x	0.63	x	0.7	=	134.32	(77)
Southeast 0.9x	0.77	x	2.88	x	113.91	x	0.63	x	0.7	=	100.26	(77)
Southeast 0.9x	0.77	x	1.86	x	113.91	x	0.63	x	0.7	=	129.5	(77)
Southeast 0.9x	0.77	x	2.88	x	104.39	x	0.63	x	0.7	=	91.88	(77)
Southeast 0.9x	0.77	x	1.86	x	104.39	x	0.63	x	0.7	=	118.68	(77)
Southeast 0.9x	0.77	x	2.88	x	92.85	x	0.63	x	0.7	=	81.73	(77)
Southeast 0.9x	0.77	x	1.86	x	92.85	x	0.63	x	0.7	=	105.56	(77)
Southeast 0.9x	0.77	x	2.88	x	69.27	x	0.63	x	0.7	=	60.97	(77)
Southeast 0.9x	0.77	x	1.86	x	69.27	x	0.63	x	0.7	=	78.75	(77)
Southeast 0.9x	0.77	x	2.88	x	44.07	x	0.63	x	0.7	=	38.79	(77)
Southeast 0.9x	0.77	x	1.86	x	44.07	x	0.63	x	0.7	=	50.1	(77)
Southeast 0.9x	0.77	x	2.88	x	31.49	x	0.63	x	0.7	=	27.71	(77)
Southeast 0.9x	0.77	x	1.86	x	31.49	x	0.63	x	0.7	=	35.8	(77)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	74.21	126.42	172.97	214.31	240.05	238.31	229.76	210.56	187.29	139.72	88.89	63.51	(83)

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

(84)m=	361.26	411.12	447.14	472.06	481.43	463.76	445.13	431.42	416.8	385.83	353.93	342.56	(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	0.85	0.67	0.5	0.53	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=	20.03	20.19	20.4	20.67	20.87	20.97	21	20.99	20.94	20.69	20.31	20.01	(87)

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

(88)m=	20.07	20.07	20.07	20.08	20.09	20.1	20.1	20.1	20.09	20.09	20.08	20.08	(88)

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

(89)m=	0.99	0.99	0.97	0.92	0.8	0.59	0.4	0.43	0.69	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=	18.79	19.01	19.32	19.7	19.96	20.08	20.1	20.1	20.05	19.74	19.2	18.76	(90)

fLA = Living area ÷ (4) = 0.49 (91)

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

(92)m=	19.39	19.58	19.85	20.17	20.4	20.51	20.53	20.53	20.48	20.2	19.74	19.36	(92)

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

(93)m=	19.39	19.58	19.85	20.17	20.4	20.51	20.53	20.53	20.48	20.2	19.74	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=	0.99	0.99	0.97	0.92	0.82	0.63	0.44	0.48	0.73	0.93	0.99	0.99		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	358.71	405.09	432.78	434.95	392.58	290.14	197.94	206.96	303.33	359.53	348.62	340.71		(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=	791.93	767.94	696.04	579.17	446.08	299.33	199.06	208.66	324.68	492	651.69	786.12		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	322.31	243.83	195.86	103.84	39.81	0	0	0	0	98.55	218.21	331.38		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													1553.81	(98)
Space heating requirement in kWh/m²/year													30.17	(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) × [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)														
	322.31	243.83	195.86	103.84	39.81	0	0	0	0	98.55	218.21	331.38		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	345.09	261.06	209.71	111.18	42.62	0	0	0	0	105.52	233.63	354.8		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													1663.61	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (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)														
	165.24	144.34	150.18	133.2	128.96	113.58	108.82	121.31	122.65	139.66	149.09	161.36		
Efficiency of water heater													80.3	(216)
(217)m=	86.7	86.36	85.72	84.43	82.47	80.3	80.3	80.3	80.3	84.19	86.01	86.82		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	190.58	167.14	175.2	157.76	156.37	141.45	135.52	151.07	152.74	165.88	173.34	185.85		
Total = Sum(219a)$_{1...12}$ =													1952.89	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1663.61

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Water heating fuel used			1952.89	
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			260.28	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			3951.78	(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	=	359.34	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	421.82	(264)
Space and water heating	(261) + (262) + (263) + (264) =			781.16	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	135.09	(268)
Total CO2, kg/year		sum of (265)…(271) =		955.18	(272)

TER = 18.55 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.59

Property Address: Kingston Bridge 2BF 65 GND GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	65.2	(1a) x	2.7	(2a) =	176.04	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	65.2	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	176.04	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =		÷ (5) =	

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

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) × 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=	0.56	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			5.76	x1/[1/(1.2)+ 0.04]	=	6.6			(27)
Windows Type 2			1.86	x1/[1/(1.2)+ 0.04]	=	2.13			(27)
Floor			65.2	x 0.13	=	8.475999			(28)
Walls		9.48	34.64	x 0.18	=	6.24			(29)
Total area of elements, m²			109.32						(31)
Party wall			44.12	x 0	=	0			(32)
Party ceiling			65.2						(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 25.57 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 12604.26 (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) = 33.55 (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=	32.4	32.27	32.14	31.54	31.43	30.91	30.91	30.81	31.11	31.43	31.66	31.9	(38)

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

(39)m=	65.95	65.82	65.69	65.09	64.98	64.45	64.45	64.36	64.66	64.98	65.2	65.44	

Average = Sum(39)$_{1…12}$ /12= 65.09 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.01	1.01	1.01	1	1	0.99	0.99	0.99	0.99	1	1	1

Average = Sum(40)1…12 /12= 1 (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 2.12 (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 84.65 (43)

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

	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=	93.12	89.73	86.34	82.96	79.57	76.19	76.19	79.57	82.96	86.34	89.73	93.12

Total = Sum(44)1…12 = 1015.8 (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=	138.09	120.77	124.63	108.65	104.25	89.96	83.36	95.66	96.8	112.82	123.15	133.73

Total = Sum(45)1…12 = 1331.88 (45)

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

(46)m=	20.71	18.12	18.69	16.3	15.64	13.49	12.5	14.35	14.52	16.92	18.47	20.06	(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (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)

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

(61)m=	16.16	14.57	16.08	15.5	15.97	15.41	15.89	15.94	15.46	16.03	15.58	16.15	(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=	154.25	135.34	140.7	124.15	120.23	105.37	99.25	111.6	112.26	128.85	138.73	149.88	(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=	154.25	135.34	140.7	124.15	120.23	105.37	99.25	111.6	112.26	128.85	138.73	149.88	

Output from water heater (annual)$_{1...12}$ 1520.61 (64)

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

(65)m=	49.95	43.8	45.46	40	38.66	33.76	31.69	35.79	36.05	41.52	44.84	48.5	(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=	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.63	15.66	12.73	9.64	7.21	6.08	6.57	8.55	11.47	14.56	17	18.12	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	185.85	187.77	182.91	172.57	159.51	147.23	139.03	137.11	141.97	152.31	165.37	177.65	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	(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=	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	(71)
Water heating gains (Table 5)													
(72)m=	67.14	65.18	61.1	55.56	51.96	46.9	42.6	48.11	50.07	55.81	62.28	65.19	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	328.48	326.47	314.61	295.63	276.54	258.08	246.07	251.62	261.37	280.54	302.51	318.82	(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)	
Northeast 0.9x	0.77	x	5.76	x	11.28	x	0.3	x	0.7	=	9.46	(75)
Northeast 0.9x	0.77	x	1.86	x	11.28	x	0.3	x	0.7	=	6.11	(75)
Northeast 0.9x	0.77	x	5.76	x	22.97	x	0.3	x	0.7	=	19.25	(75)
Northeast 0.9x	0.77	x	1.86	x	22.97	x	0.3	x	0.7	=	12.43	(75)
Northeast 0.9x	0.77	x	5.76	x	41.38	x	0.3	x	0.7	=	34.69	(75)

Northeast 0.9x	0.77	x	1.86	x	41.38	x	0.3	x	0.7	=	22.4	(75)
Northeast 0.9x	0.77	x	5.76	x	67.96	x	0.3	x	0.7	=	56.96	(75)
Northeast 0.9x	0.77	x	1.86	x	67.96	x	0.3	x	0.7	=	36.79	(75)
Northeast 0.9x	0.77	x	5.76	x	91.35	x	0.3	x	0.7	=	76.57	(75)
Northeast 0.9x	0.77	x	1.86	x	91.35	x	0.3	x	0.7	=	49.45	(75)
Northeast 0.9x	0.77	x	5.76	x	97.38	x	0.3	x	0.7	=	81.63	(75)
Northeast 0.9x	0.77	x	1.86	x	97.38	x	0.3	x	0.7	=	52.72	(75)
Northeast 0.9x	0.77	x	5.76	x	91.1	x	0.3	x	0.7	=	76.37	(75)
Northeast 0.9x	0.77	x	1.86	x	91.1	x	0.3	x	0.7	=	49.32	(75)
Northeast 0.9x	0.77	x	5.76	x	72.63	x	0.3	x	0.7	=	60.88	(75)
Northeast 0.9x	0.77	x	1.86	x	72.63	x	0.3	x	0.7	=	39.32	(75)
Northeast 0.9x	0.77	x	5.76	x	50.42	x	0.3	x	0.7	=	42.27	(75)
Northeast 0.9x	0.77	x	1.86	x	50.42	x	0.3	x	0.7	=	27.3	(75)
Northeast 0.9x	0.77	x	5.76	x	28.07	x	0.3	x	0.7	=	23.53	(75)
Northeast 0.9x	0.77	x	1.86	x	28.07	x	0.3	x	0.7	=	15.19	(75)
Northeast 0.9x	0.77	x	5.76	x	14.2	x	0.3	x	0.7	=	11.9	(75)
Northeast 0.9x	0.77	x	1.86	x	14.2	x	0.3	x	0.7	=	7.69	(75)
Northeast 0.9x	0.77	x	5.76	x	9.21	x	0.3	x	0.7	=	7.72	(75)
Northeast 0.9x	0.77	x	1.86	x	9.21	x	0.3	x	0.7	=	4.99	(75)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	15.57	31.69	57.09	93.75	126.02	134.35	125.69	100.2	69.56	38.72	19.59	12.71	(83)

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

(84)m=	344.05	358.16	371.7	389.38	402.56	392.43	371.75	351.82	330.93	319.27	322.1	331.53	(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	0.96	0.87	0.72	0.77	0.95	0.99	1	1	(86)

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

(87)m=	19.88	19.96	20.14	20.4	20.68	20.89	20.97	20.96	20.8	20.47	20.13	19.86	(87)

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

(88)m=	20.07	20.08	20.08	20.08	20.09	20.09	20.09	20.09	20.09	20.09	20.08	20.08	(88)

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

(89)m=	1	1	1	0.99	0.95	0.8	0.59	0.65	0.91	0.99	1	1	(89)

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

(90)m=	18.57	18.69	18.95	19.34	19.73	20.01	20.08	20.07	19.9	19.43	18.94	18.55	(90)

fLA = Living area ÷ (4) = 0.38 (91)

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

(92)m=	19.07	19.18	19.4	19.75	20.09	20.35	20.42	20.41	20.25	19.83	19.4	19.05	(92)

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

(93)m=	19.07	19.18	19.4	19.75	20.09	20.35	20.42	20.41	20.25	19.83	19.4	19.05	(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	0.95	0.82	0.64	0.7	0.92	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	343.38	357.14	369.62	383.17	380.67	323.71	237.87	244.82	303.12	314.95	320.96	331.01	(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=	974.04	939.59	847.66	706.03	545.4	370.51	246.46	258.39	397.44	599.73	802.02	971.86	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	469.21	391.4	355.67	232.46	122.57	0	0	0	0	211.88	346.36	476.79	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2606.34 (98)

Space heating requirement in kWh/m²/year 39.97 (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) × [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)													
	469.21	391.4	355.67	232.46	122.57	0	0	0	0	211.88	346.36	476.79	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	501.83	418.61	380.39	248.62	131.09	0	0	0	0	226.61	370.44	509.94	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2787.53 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (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)

	154.25	135.34	140.7	124.15	120.23	105.37	99.25	111.6	112.26	128.85	138.73	149.88

Efficiency of water heater 87.3 (216)

(217)m=	89.69	89.66	89.57	89.36	88.89	87.3	87.3	87.3	87.3	89.26	89.56	89.71	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	171.99	150.95	157.09	138.93	135.26	120.7	113.69	127.84	128.59	144.35	154.9	167.06

Total = Sum(219a)$_{1...12}$ = 1711.35 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2787.53

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Water heating fuel used			1711.35	
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			311.36	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4885.23	(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	=	602.11	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	369.65	(264)
Space and water heating	(261) + (262) + (263) + (264) =			971.76	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	161.59	(268)
Total CO2, kg/year		sum of (265)…(271) =		1172.28	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		17.98	(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: 1.0.5.59

Property Address: Kingston Bridge 2BF 65 GND GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	65.2	(1a) x	2.7	(2a) =	176.04	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	65.2	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	176.04	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =		÷ (5) =		
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)			0.36	(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) =		0.31	(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

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

0.39	0.39	0.38	0.34	0.33	0.29	0.29	0.29	0.31	0.33	0.35	0.36

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=	0.58	0.57	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)

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

(25)m=	0.58	0.57	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(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			5.76	x1/[1/(1.4)+ 0.04]		=	7.64			(27)
Windows Type 2			1.86	x1/[1/(1.4)+ 0.04]		=	2.47			(27)
Floor			65.2	x	0.13	=	8.475999			(28)
Walls		9.48	34.64	x	0.18	=	6.24			(29)
Total area of elements, m²			109.32							(31)
Party wall			44.12	x	0	=	0			(32)
Party ceiling			65.2							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 27.28 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 12604.26 (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 5.52 (36)

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

Total fabric heat loss (33) + (36) = 32.8 (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=	33.56	33.38	33.21	32.4	32.25	31.55	31.55	31.42	31.82	32.25	32.56	32.88	(38)

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

(39)m=	66.36	66.18	66.01	65.2	65.05	64.35	64.35	64.22	64.62	65.05	65.36	65.68	

Average = Sum(39)$_{1…12}$ /12= 65.2 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.02	1.02	1.01	1	1	0.99	0.99	0.98	0.99	1	1	1.01

Average = Sum(40)$_{1…12}$ /12= 1 (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 2.12 (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 84.65 (43)

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

	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=	93.12	89.73	86.34	82.96	79.57	76.19	76.19	79.57	82.96	86.34	89.73	93.12

Total = Sum(44)$_{1…12}$ = 1015.8 (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=	138.09	120.77	124.63	108.65	104.25	89.96	83.36	95.66	96.8	112.82	123.15	133.73

Total = Sum(45)$_{1…12}$ = 1331.88 (45)

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

(46)m=	20.71	18.12	18.69	16.3	15.64	13.49	12.5	14.35	14.52	16.92	18.47	20.06	(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (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)

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

(61)m=	47.45	41.3	44	40.91	40.55	37.57	38.82	40.55	40.91	44	44.25	47.45	(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=	185.54	162.07	168.63	149.56	144.8	127.53	122.19	136.21	137.71	156.82	167.4	181.18	(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=	185.54	162.07	168.63	149.56	144.8	127.53	122.19	136.21	137.71	156.82	167.4	181.18	

Output from water heater (annual)$_{1...12}$ 1839.64 (64)

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

(65)m=	57.78	50.48	52.44	46.35	44.8	39.31	37.42	41.94	42.41	48.51	52.01	56.33	(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):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m=	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.63	15.66	12.73	9.64	7.21	6.08	6.57	8.55	11.47	14.56	17	18.12	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	185.85	187.77	182.91	172.57	159.51	147.23	139.03	137.11	141.97	152.31	165.37	177.65	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	(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=	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	(71)
Water heating gains (Table 5)													
(72)m=	77.66	75.12	70.48	64.38	60.22	54.59	50.3	56.38	58.91	65.2	72.23	75.71	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	339	336.42	323.99	304.45	284.8	265.77	253.77	259.89	270.21	289.94	312.47	329.34	(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)	
Northeast 0.9x	0.77	x	5.76	x	11.28	x	0.63	x	0.7	=	19.86	(75)
Northeast 0.9x	0.77	x	1.86	x	11.28	x	0.63	x	0.7	=	12.83	(75)
Northeast 0.9x	0.77	x	5.76	x	22.97	x	0.63	x	0.7	=	40.43	(75)
Northeast 0.9x	0.77	x	1.86	x	22.97	x	0.63	x	0.7	=	26.11	(75)
Northeast 0.9x	0.77	x	5.76	x	41.38	x	0.63	x	0.7	=	72.84	(75)

Northeast	0.9x	0.77	x	1.86	x	41.38	x	0.63	x	0.7	=	47.04	(75)
Northeast	0.9x	0.77	x	5.76	x	67.96	x	0.63	x	0.7	=	119.62	(75)
Northeast	0.9x	0.77	x	1.86	x	67.96	x	0.63	x	0.7	=	77.26	(75)
Northeast	0.9x	0.77	x	5.76	x	91.35	x	0.63	x	0.7	=	160.8	(75)
Northeast	0.9x	0.77	x	1.86	x	91.35	x	0.63	x	0.7	=	103.85	(75)
Northeast	0.9x	0.77	x	5.76	x	97.38	x	0.63	x	0.7	=	171.43	(75)
Northeast	0.9x	0.77	x	1.86	x	97.38	x	0.63	x	0.7	=	110.71	(75)
Northeast	0.9x	0.77	x	5.76	x	91.1	x	0.63	x	0.7	=	160.37	(75)
Northeast	0.9x	0.77	x	1.86	x	91.1	x	0.63	x	0.7	=	103.57	(75)
Northeast	0.9x	0.77	x	5.76	x	72.63	x	0.63	x	0.7	=	127.85	(75)
Northeast	0.9x	0.77	x	1.86	x	72.63	x	0.63	x	0.7	=	82.57	(75)
Northeast	0.9x	0.77	x	5.76	x	50.42	x	0.63	x	0.7	=	88.76	(75)
Northeast	0.9x	0.77	x	1.86	x	50.42	x	0.63	x	0.7	=	57.32	(75)
Northeast	0.9x	0.77	x	5.76	x	28.07	x	0.63	x	0.7	=	49.41	(75)
Northeast	0.9x	0.77	x	1.86	x	28.07	x	0.63	x	0.7	=	31.91	(75)
Northeast	0.9x	0.77	x	5.76	x	14.2	x	0.63	x	0.7	=	24.99	(75)
Northeast	0.9x	0.77	x	1.86	x	14.2	x	0.63	x	0.7	=	16.14	(75)
Northeast	0.9x	0.77	x	5.76	x	9.21	x	0.63	x	0.7	=	16.22	(75)
Northeast	0.9x	0.77	x	1.86	x	9.21	x	0.63	x	0.7	=	10.48	(75)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	32.69	66.54	119.88	196.88	264.65	282.14	263.94	210.42	146.08	81.32	41.13	26.7	(83)

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

(84)m=	371.69	402.96	443.88	501.34	549.44	547.92	517.71	470.31	416.29	371.26	353.6	356.03	(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	0.71	0.54	0.61	0.88	0.98	1	1	(86)

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

(87)m=	19.91	20.02	20.24	20.55	20.83	20.96	20.99	20.99	20.88	20.54	20.18	19.89	(87)

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

(88)m=	20.07	20.07	20.07	20.08	20.09	20.09	20.09	20.1	20.09	20.09	20.08	20.08	(88)

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

(89)m=	1	1	0.99	0.96	0.85	0.63	0.43	0.5	0.82	0.98	1	1	(89)

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

(90)m=	18.61	18.77	19.08	19.54	19.91	20.07	20.09	20.09	19.99	19.53	19.01	18.59	(90)

fLA = Living area ÷ (4) = 0.38 (91)

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

(92)m=	19.11	19.25	19.53	19.93	20.26	20.41	20.44	20.43	20.33	19.92	19.45	19.09	(92)

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

(93)m=	19.11	19.25	19.53	19.93	20.26	20.41	20.44	20.43	20.33	19.92	19.45	19.09	(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	0.66	0.47	0.54	0.84	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	370.63	400.98	438.42	479.42	469.83	359.42	245.03	255.14	347.84	361.84	351.67	355.24	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	982.62	949.55	859.88	719.22	556.95	374.09	246.95	259.11	402.64	606.21	807.46	977.87	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	455.32	368.64	313.57	172.66	64.81	0	0	0	0	181.81	328.17	463.23	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2348.22 (98)

Space heating requirement in kWh/m²/year 36.02 (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) × [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)													
	455.32	368.64	313.57	172.66	64.81	0	0	0	0	181.81	328.17	463.23	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	487.5	394.69	335.73	184.86	69.39	0	0	0	0	194.66	351.36	495.97	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2514.15 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (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)

	185.54	162.07	168.63	149.56	144.8	127.53	122.19	136.21	137.71	156.82	167.4	181.18

Efficiency of water heater 80.3 (216)

(217)m=	87.22	87.06	86.59	85.41	83.17	80.3	80.3	80.3	80.3	85.42	86.72	87.31	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	212.71	186.17	194.74	175.1	174.1	158.82	152.16	169.63	171.5	183.57	193.04	207.51

Total = Sum(219a)$_{1...12}$ = 2179.05 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2514.15

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Water heating fuel used			2179.05	
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			311.36	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			5079.56	(338)

12a. CO_2 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	=	543.06	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	470.68	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1013.73	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	161.59	(268)
Total CO2, kg/year		sum of (265)…(271) =		1214.25	(272)

TER =	18.62	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.59

Property Address: Kingston Bridge 2BF 65 MID GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	65.2	(1a) x	2.7	(2a) =	176.04	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	65.2	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	176.04	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =		÷ (5) =		
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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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) × 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=	0.56	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			5.76	x1/[1/(1.2)+ 0.04]		=	6.6			(27)
Windows Type 2			1.86	x1/[1/(1.2)+ 0.04]		=	2.13			(27)
Walls		9.48	34.64	x	0.18	=	6.24			(29)
Total area of elements, m²			44.12							(31)
Party wall			44.12	x	0	=	0			(32)
Party floor			65.2							(32a)
Party ceiling			65.2							(32b)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 17.09 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 12930.26 (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 3.89 (36)

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

Total fabric heat loss (33) + (36) = 20.98 (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=	32.4	32.27	32.14	31.54	31.43	30.91	30.91	30.81	31.11	31.43	31.66	31.9	(38)

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

(39)m=	53.39	53.26	53.13	52.53	52.42	51.89	51.89	51.8	52.09	52.42	52.64	52.88	

Average = Sum(39)$_{1…12}$ /12= 52.53 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.82	0.82	0.81	0.81	0.8	0.8	0.8	0.79	0.8	0.8	0.81	0.81

Average = Sum(40)$_{1...12}$ /12= 0.81 (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 2.12 (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 84.65 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	93.12	89.73	86.34	82.96	79.57	76.19	76.19	79.57	82.96	86.34	89.73	93.12

Total = Sum(44)$_{1...12}$ = 1015.8 (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=	138.09	120.77	124.63	108.65	104.25	89.96	83.36	95.66	96.8	112.82	123.15	133.73

Total = Sum(45)$_{1...12}$ = 1331.88 (45)

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

(46)m=	20.71	18.12	18.69	16.3	15.64	13.49	12.5	14.35	14.52	16.92	18.47	20.06	(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (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=	16.16	14.57	16.08	15.5	15.97	15.41	15.89	15.94	15.46	16.03	15.58	16.15	(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=	154.25	135.34	140.7	124.15	120.23	105.37	99.25	111.6	112.26	128.85	138.73	149.88	(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=	154.25	135.34	140.7	124.15	120.23	105.37	99.25	111.6	112.26	128.85	138.73	149.88	

Output from water heater (annual)$_{1...12}$ 1520.61 (64)

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

(65)m=	49.95	43.8	45.46	40	38.66	33.76	31.69	35.79	36.05	41.52	44.84	48.5	(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=	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.63	15.66	12.73	9.64	7.21	6.08	6.57	8.55	11.47	14.56	17	18.12	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	185.85	187.77	182.91	172.57	159.51	147.23	139.03	137.11	141.97	152.31	165.37	177.65	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	(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=	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	(71)
Water heating gains (Table 5)													
(72)m=	67.14	65.18	61.1	55.56	51.96	46.9	42.6	48.11	50.07	55.81	62.28	65.19	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	328.48	326.47	314.61	295.63	276.54	258.08	246.07	251.62	261.37	280.54	302.51	318.82	(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)	
Northeast 0.9x	0.77	x	5.76	x	11.28	x	0.63	x	0.7	=	19.86	(75)
Northeast 0.9x	0.77	x	1.86	x	11.28	x	0.63	x	0.7	=	12.83	(75)
Northeast 0.9x	0.77	x	5.76	x	22.97	x	0.63	x	0.7	=	40.43	(75)
Northeast 0.9x	0.77	x	1.86	x	22.97	x	0.63	x	0.7	=	26.11	(75)
Northeast 0.9x	0.77	x	5.76	x	41.38	x	0.63	x	0.7	=	72.84	(75)

Northeast 0.9x	0.77	x	1.86	x	41.38	x	0.63	x	0.7	=	47.04	(75)
Northeast 0.9x	0.77	x	5.76	x	67.96	x	0.63	x	0.7	=	119.62	(75)
Northeast 0.9x	0.77	x	1.86	x	67.96	x	0.63	x	0.7	=	77.26	(75)
Northeast 0.9x	0.77	x	5.76	x	91.35	x	0.63	x	0.7	=	160.8	(75)
Northeast 0.9x	0.77	x	1.86	x	91.35	x	0.63	x	0.7	=	103.85	(75)
Northeast 0.9x	0.77	x	5.76	x	97.38	x	0.63	x	0.7	=	171.43	(75)
Northeast 0.9x	0.77	x	1.86	x	97.38	x	0.63	x	0.7	=	110.71	(75)
Northeast 0.9x	0.77	x	5.76	x	91.1	x	0.63	x	0.7	=	160.37	(75)
Northeast 0.9x	0.77	x	1.86	x	91.1	x	0.63	x	0.7	=	103.57	(75)
Northeast 0.9x	0.77	x	5.76	x	72.63	x	0.63	x	0.7	=	127.85	(75)
Northeast 0.9x	0.77	x	1.86	x	72.63	x	0.63	x	0.7	=	82.57	(75)
Northeast 0.9x	0.77	x	5.76	x	50.42	x	0.63	x	0.7	=	88.76	(75)
Northeast 0.9x	0.77	x	1.86	x	50.42	x	0.63	x	0.7	=	57.32	(75)
Northeast 0.9x	0.77	x	5.76	x	28.07	x	0.63	x	0.7	=	49.41	(75)
Northeast 0.9x	0.77	x	1.86	x	28.07	x	0.63	x	0.7	=	31.91	(75)
Northeast 0.9x	0.77	x	5.76	x	14.2	x	0.63	x	0.7	=	24.99	(75)
Northeast 0.9x	0.77	x	1.86	x	14.2	x	0.63	x	0.7	=	16.14	(75)
Northeast 0.9x	0.77	x	5.76	x	9.21	x	0.63	x	0.7	=	16.22	(75)
Northeast 0.9x	0.77	x	1.86	x	9.21	x	0.63	x	0.7	=	10.48	(75)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	32.69	66.54	119.88	196.88	264.65	282.14	263.94	210.42	146.08	81.32	41.13	26.7	(83)

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

(84)m=	361.17	393.01	434.49	492.51	541.19	540.22	510.01	462.04	407.45	361.86	343.64	345.52	(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	0.95	0.82	0.61	0.45	0.51	0.81	0.98	1	1	(86)

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

(87)m=	20.19	20.29	20.48	20.74	20.93	20.99	21	21	20.96	20.71	20.4	20.17	(87)

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

(88)m=	20.24	20.24	20.24	20.25	20.25	20.26	20.26	20.26	20.25	20.25	20.25	20.24	(88)

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

(89)m=	1	1	0.99	0.94	0.78	0.54	0.37	0.43	0.75	0.97	1	1	(89)

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

(90)m=	19.14	19.28	19.56	19.95	20.19	20.25	20.26	20.26	20.22	19.9	19.46	19.11	(90)

fLA = Living area ÷ (4) = 0.38 (91)

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

(92)m=	19.54	19.67	19.91	20.25	20.47	20.54	20.54	20.54	20.5	20.21	19.82	19.52	(92)

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

(93)m=	19.54	19.67	19.91	20.25	20.47	20.54	20.54	20.54	20.5	20.21	19.82	19.52	(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	0.94	0.79	0.56	0.4	0.46	0.77	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	360.27	391.08	428.14	461.98	427.81	305.13	204.29	213.9	313.82	350.05	341.76	344.86	(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=	813.53	786.46	712.68	596.32	459.86	308.04	204.53	214.51	333.46	503.66	669.66	809.91	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	337.23	265.7	211.7	96.73	23.84	0	0	0	0	114.28	236.09	346	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1631.57 (98)

Space heating requirement in kWh/m²/year 25.02 (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) × [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)													
	337.23	265.7	211.7	96.73	23.84	0	0	0	0	114.28	236.09	346	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	360.67	284.17	226.42	103.45	25.5	0	0	0	0	122.23	252.5	370.05	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1745 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (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)													
	154.25	135.34	140.7	124.15	120.23	105.37	99.25	111.6	112.26	128.85	138.73	149.88	
Efficiency of water heater												87.3	(216)
(217)m=	89.47	89.39	89.19	88.67	87.81	87.3	87.3	87.3	87.3	88.78	89.29	89.51	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	172.4	151.39	157.75	140.01	136.91	120.7	113.69	127.84	128.59	145.14	155.37	167.44	

Total = Sum(219a)$_{1...12}$ = 1717.24 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1745

Water heating fuel used			1717.24	
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			311.36	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			3848.59	(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	=	376.92	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	370.92	(264)
Space and water heating	(261) + (262) + (263) + (264) =			747.84	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	161.59	(268)
Total CO2, kg/year		sum of (265)…(271) =		948.36	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		14.55	(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: 1.0.5.59

Property Address: Kingston Bridge 2BF 65 MID GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	65.2	(1a) x	2.7	(2a) =	176.04	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	65.2	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	176.04	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =	÷ (5) =		

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)	0.36	(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) =	0.31	(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

0.39	0.39	0.38	0.34	0.33	0.29	0.29	0.29	0.31	0.33	0.35	0.36

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=	0.58	0.57	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)

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

(25)m=	0.58	0.57	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(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			5.76	x1/[1/(1.4)+ 0.04] =	7.64			(27)
Windows Type 2			1.86	x1/[1/(1.4)+ 0.04] =	2.47			(27)
Walls		9.48	34.64	x 0.18 =	6.24			(29)
Total area of elements, m²			44.12					(31)
Party wall			44.12	x 0 =	0			(32)
Party floor			65.2					(32a)
Party ceiling			65.2					(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 18.8 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 12930.26 (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 2.74 (36)

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

Total fabric heat loss (33) + (36) = 21.54 (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=	33.56	33.38	33.21	32.4	32.25	31.55	31.55	31.42	31.82	32.25	32.56	32.88	(38)

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

(39)m=	55.1	54.93	54.76	53.95	53.8	53.1	53.1	52.97	53.37	53.8	54.1	54.42	

Average = Sum(39)$_{1…12}$ /12= 53.95 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.85	0.84	0.84	0.83	0.83	0.81	0.81	0.81	0.82	0.83	0.83	0.83

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 2.12 (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 84.65 (43)

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

	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=	93.12	89.73	86.34	82.96	79.57	76.19	76.19	79.57	82.96	86.34	89.73	93.12

Total = Sum(44)$_{1…12}$ = 1015.8 (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=	138.09	120.77	124.63	108.65	104.25	89.96	83.36	95.66	96.8	112.82	123.15	133.73

Total = Sum(45)$_{1…12}$ = 1331.88 (45)

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

(46)m=	20.71	18.12	18.69	16.3	15.64	13.49	12.5	14.35	14.52	16.92	18.47	20.06	(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (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)

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

(61)m=	47.45	41.3	44	40.91	40.55	37.57	38.82	40.55	40.91	44	44.25	47.45	(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=	185.54	162.07	168.63	149.56	144.8	127.53	122.19	136.21	137.71	156.82	167.4	181.18	(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=	185.54	162.07	168.63	149.56	144.8	127.53	122.19	136.21	137.71	156.82	167.4	181.18	

Output from water heater (annual)$_{1...12}$ 1839.64 (64)

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

(65)m=	57.78	50.48	52.44	46.35	44.8	39.31	37.42	41.94	42.41	48.51	52.01	56.33	(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=	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	(66)

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

(67)m=	17.63	15.66	12.73	9.64	7.21	6.08	6.57	8.55	11.47	14.56	17	18.12	(67)

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

(68)m=	185.85	187.77	182.91	172.57	159.51	147.23	139.03	137.11	141.97	152.31	165.37	177.65	(68)

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

(69)m=	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	(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=	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	(71)

Water heating gains (Table 5)

(72)m=	77.66	75.12	70.48	64.38	60.22	54.59	50.3	56.38	58.91	65.2	72.23	75.71	(72)

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

(73)m=	339	336.42	323.99	304.45	284.8	265.77	253.77	259.89	270.21	289.94	312.47	329.34	(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)	
Northeast	0.9x	0.77	x	5.76	x	11.28	x	0.63	x	0.7	=	19.86	(75)
Northeast	0.9x	0.77	x	1.86	x	11.28	x	0.63	x	0.7	=	12.83	(75)
Northeast	0.9x	0.77	x	5.76	x	22.97	x	0.63	x	0.7	=	40.43	(75)
Northeast	0.9x	0.77	x	1.86	x	22.97	x	0.63	x	0.7	=	26.11	(75)
Northeast	0.9x	0.77	x	5.76	x	41.38	x	0.63	x	0.7	=	72.84	(75)

Northeast 0.9x	0.77	x	1.86	x	41.38	x	0.63	x	0.7	=	47.04	(75)
Northeast 0.9x	0.77	x	5.76	x	67.96	x	0.63	x	0.7	=	119.62	(75)
Northeast 0.9x	0.77	x	1.86	x	67.96	x	0.63	x	0.7	=	77.26	(75)
Northeast 0.9x	0.77	x	5.76	x	91.35	x	0.63	x	0.7	=	160.8	(75)
Northeast 0.9x	0.77	x	1.86	x	91.35	x	0.63	x	0.7	=	103.85	(75)
Northeast 0.9x	0.77	x	5.76	x	97.38	x	0.63	x	0.7	=	171.43	(75)
Northeast 0.9x	0.77	x	1.86	x	97.38	x	0.63	x	0.7	=	110.71	(75)
Northeast 0.9x	0.77	x	5.76	x	91.1	x	0.63	x	0.7	=	160.37	(75)
Northeast 0.9x	0.77	x	1.86	x	91.1	x	0.63	x	0.7	=	103.57	(75)
Northeast 0.9x	0.77	x	5.76	x	72.63	x	0.63	x	0.7	=	127.85	(75)
Northeast 0.9x	0.77	x	1.86	x	72.63	x	0.63	x	0.7	=	82.57	(75)
Northeast 0.9x	0.77	x	5.76	x	50.42	x	0.63	x	0.7	=	88.76	(75)
Northeast 0.9x	0.77	x	1.86	x	50.42	x	0.63	x	0.7	=	57.32	(75)
Northeast 0.9x	0.77	x	5.76	x	28.07	x	0.63	x	0.7	=	49.41	(75)
Northeast 0.9x	0.77	x	1.86	x	28.07	x	0.63	x	0.7	=	31.91	(75)
Northeast 0.9x	0.77	x	5.76	x	14.2	x	0.63	x	0.7	=	24.99	(75)
Northeast 0.9x	0.77	x	1.86	x	14.2	x	0.63	x	0.7	=	16.14	(75)
Northeast 0.9x	0.77	x	5.76	x	9.21	x	0.63	x	0.7	=	16.22	(75)
Northeast 0.9x	0.77	x	1.86	x	9.21	x	0.63	x	0.7	=	10.48	(75)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	32.69	66.54	119.88	196.88	264.65	282.14	263.94	210.42	146.08	81.32	41.13	26.7	(83)

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

(84)m=	371.69	402.96	443.88	501.34	549.44	547.92	517.71	470.31	416.29	371.26	353.6	356.03	(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	0.95	0.82	0.61	0.45	0.51	0.81	0.98	1	1	(86)

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

(87)m=	20.16	20.26	20.46	20.73	20.93	20.99	21	21	20.95	20.7	20.39	20.15	(87)

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

(88)m=	20.21	20.22	20.22	20.23	20.23	20.24	20.24	20.24	20.24	20.23	20.23	20.22	(88)

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

(89)m=	1	1	0.99	0.94	0.78	0.54	0.37	0.43	0.75	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=	19.08	19.23	19.52	19.91	20.16	20.24	20.24	20.24	20.2	19.87	19.42	19.07	(90)

fLA = Living area ÷ (4) = 0.38 (91)

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

(92)m=	19.5	19.63	19.88	20.23	20.46	20.53	20.53	20.53	20.49	20.19	19.79	19.48	(92)

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

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(93)m=	19.5	19.63	19.88	20.23	20.46	20.53	20.53	20.53	20.49	20.19	19.79	19.48	(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	0.94	0.79	0.57	0.4	0.46	0.77	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	370.61	400.76	437.02	469.96	435.85	311.28	208.45	218.14	320.07	358.38	351.41	355.24	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	837.41	808.97	732.57	611.09	471.05	314.61	208.74	218.83	340.92	515.93	686.79	831.62	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	347.3	274.32	219.88	101.61	26.19	0	0	0	0	117.21	241.48	354.42	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1682.42 (98)

Space heating requirement in kWh/m²/year 25.8 (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) × [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)													
	347.3	274.32	219.88	101.61	26.19	0	0	0	0	117.21	241.48	354.42	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	371.84	293.7	235.42	108.79	28.04	0	0	0	0	125.49	258.54	379.47	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1801.3 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (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)													
	185.54	162.07	168.63	149.56	144.8	127.53	122.19	136.21	137.71	156.82	167.4	181.18	
Efficiency of water heater												80.3	(216)
(217)m=	86.61	86.37	85.72	84.1	81.7	80.3	80.3	80.3	80.3	84.33	85.97	86.71	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	214.23	187.66	196.72	177.84	177.24	158.82	152.16	169.63	171.5	185.95	194.71	208.95	

Total = Sum(219a)$_{1...12}$ = 2195.4 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1801.3

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Water heating fuel used			2195.4	
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			311.36	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4383.06	(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	=	389.08	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	474.21	(264)
Space and water heating	(261) + (262) + (263) + (264) =				863.29	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	161.59	(268)
Total CO2, kg/year			sum of (265)…(271) =		1063.81	(272)

TER = 16.32 (273)

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User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.59

Property Address: Kingston Bridge 2BF 65 TOP GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	65.2	(1a) x	2.7	(2a) =	176.04	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	65.2	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	176.04	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =		÷ (5) =		
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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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) × 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=	0.56	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			5.76	x1/[1/(1.2)+ 0.04] =	6.6			(27)
Windows Type 2			1.86	x1/[1/(1.2)+ 0.04] =	2.13			(27)
Walls		9.48	34.64	x 0.18 =	6.24			(29)
Roof		0	65.2	x 0.13 =	8.48			(30)
Total area of elements, m²			109.32					(31)
Party wall			44.12	x 0 =	0			(32)
Party floor			65.2					(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 25.57 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6997.06 (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 3.89 (36)

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

Total fabric heat loss (33) + (36) = 29.46 (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=	32.4	32.27	32.14	31.54	31.43	30.91	30.91	30.81	31.11	31.43	31.66	31.9	(38)

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

(39)m=	61.86	61.73	61.6	61	60.89	60.37	60.37	60.27	60.57	60.89	61.12	61.36	

Average = Sum(39)$_{1…12}$ /12= 61 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.95	0.95	0.94	0.94	0.93	0.93	0.93	0.92	0.93	0.93	0.94	0.94

Average = Sum(40)1…12 /12= 0.94 (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 2.12 (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 84.65 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	93.12	89.73	86.34	82.96	79.57	76.19	76.19	79.57	82.96	86.34	89.73	93.12

Total = Sum(44)1…12 = 1015.8 (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=	138.09	120.77	124.63	108.65	104.25	89.96	83.36	95.66	96.8	112.82	123.15	133.73

Total = Sum(45)1…12 = 1331.88 (45)

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

(46)m=	20.71	18.12	18.69	16.3	15.64	13.49	12.5	14.35	14.52	16.92	18.47	20.06

(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (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=	16.16	14.57	16.08	15.5	15.97	15.41	15.89	15.94	15.46	16.03	15.58	16.15	(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=	154.25	135.34	140.7	124.15	120.23	105.37	99.25	111.6	112.26	128.85	138.73	149.88	(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=	154.25	135.34	140.7	124.15	120.23	105.37	99.25	111.6	112.26	128.85	138.73	149.88	

Output from water heater (annual)$_{1...12}$ 1520.61 (64)

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

(65)m=	49.95	43.8	45.46	40	38.66	33.76	31.69	35.79	36.05	41.52	44.84	48.5	(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=	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	(66)

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

(67)m=	17.63	15.66	12.73	9.64	7.21	6.08	6.57	8.55	11.47	14.56	17	18.12	(67)

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

(68)m=	185.85	187.77	182.91	172.57	159.51	147.23	139.03	137.11	141.97	152.31	165.37	177.65	(68)

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

(69)m=	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	(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=	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	(71)

Water heating gains (Table 5)

(72)m=	67.14	65.18	61.1	55.56	51.96	46.9	42.6	48.11	50.07	55.81	62.28	65.19	(72)

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

(73)m=	328.48	326.47	314.61	295.63	276.54	258.08	246.07	251.62	261.37	280.54	302.51	318.82	(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)	
Northeast 0.9x	0.77	x	5.76	x	11.28	x	0.35	x	0.7	=	11.03	(75)
Northeast 0.9x	0.77	x	1.86	x	11.28	x	0.35	x	0.7	=	7.13	(75)
Northeast 0.9x	0.77	x	5.76	x	22.97	x	0.35	x	0.7	=	22.46	(75)
Northeast 0.9x	0.77	x	1.86	x	22.97	x	0.35	x	0.7	=	14.51	(75)
Northeast 0.9x	0.77	x	5.76	x	41.38	x	0.35	x	0.7	=	40.47	(75)

Northeast 0.9x	0.77	x	1.86	x	41.38	x	0.35	x	0.7	=	26.13	(75)
Northeast 0.9x	0.77	x	5.76	x	67.96	x	0.35	x	0.7	=	66.46	(75)
Northeast 0.9x	0.77	x	1.86	x	67.96	x	0.35	x	0.7	=	42.92	(75)
Northeast 0.9x	0.77	x	5.76	x	91.35	x	0.35	x	0.7	=	89.33	(75)
Northeast 0.9x	0.77	x	1.86	x	91.35	x	0.35	x	0.7	=	57.69	(75)
Northeast 0.9x	0.77	x	5.76	x	97.38	x	0.35	x	0.7	=	95.24	(75)
Northeast 0.9x	0.77	x	1.86	x	97.38	x	0.35	x	0.7	=	61.51	(75)
Northeast 0.9x	0.77	x	5.76	x	91.1	x	0.35	x	0.7	=	89.09	(75)
Northeast 0.9x	0.77	x	1.86	x	91.1	x	0.35	x	0.7	=	57.54	(75)
Northeast 0.9x	0.77	x	5.76	x	72.63	x	0.35	x	0.7	=	71.03	(75)
Northeast 0.9x	0.77	x	1.86	x	72.63	x	0.35	x	0.7	=	45.87	(75)
Northeast 0.9x	0.77	x	5.76	x	50.42	x	0.35	x	0.7	=	49.31	(75)
Northeast 0.9x	0.77	x	1.86	x	50.42	x	0.35	x	0.7	=	31.85	(75)
Northeast 0.9x	0.77	x	5.76	x	28.07	x	0.35	x	0.7	=	27.45	(75)
Northeast 0.9x	0.77	x	1.86	x	28.07	x	0.35	x	0.7	=	17.73	(75)
Northeast 0.9x	0.77	x	5.76	x	14.2	x	0.35	x	0.7	=	13.88	(75)
Northeast 0.9x	0.77	x	1.86	x	14.2	x	0.35	x	0.7	=	8.97	(75)
Northeast 0.9x	0.77	x	5.76	x	9.21	x	0.35	x	0.7	=	9.01	(75)
Northeast 0.9x	0.77	x	1.86	x	9.21	x	0.35	x	0.7	=	5.82	(75)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	18.16	36.97	66.6	109.38	147.03	156.75	146.63	116.9	81.16	45.18	22.85	14.83	(83)

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

(84)m=	346.64	363.44	381.21	405.01	423.56	414.82	392.7	368.52	342.53	325.72	325.36	333.65	(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	0.65	0.71	0.93	0.99	1	1	(86)

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

(87)m=	19.97	20.06	20.23	20.49	20.75	20.93	20.99	20.98	20.85	20.53	20.21	19.96	(87)

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

(88)m=	20.13	20.13	20.13	20.14	20.14	20.15	20.15	20.15	20.14	20.14	20.14	20.13	(88)

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

(89)m=	1	1	0.99	0.98	0.92	0.75	0.54	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=	18.74	18.86	19.12	19.51	19.87	20.1	20.14	20.14	20	19.57	19.1	18.72	(90)

fLA = Living area ÷ (4) = 0.38 (91)

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

(92)m=	19.21	19.32	19.55	19.88	20.21	20.42	20.46	20.46	20.33	19.94	19.53	19.19	(92)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(93)m=	19.21	19.32	19.55	19.88	20.21	20.42	20.46	20.46	20.33	19.94	19.53	19.19		(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	0.78	0.58	0.64	0.89	0.98	1	1		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	345.96	362.34	378.74	396.74	392.69	322.34	229.03	237.22	306.45	320.58	324.15	333.13		(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=	922.54	890.19	803.72	670.06	518.13	351.14	233.3	244.66	377.22	568.65	759.49	919.95		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	428.98	354.72	316.18	196.79	93.32	0	0	0	0	184.56	313.44	436.6		
									Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =				2324.59	(98)
Space heating requirement in kWh/m²/year													35.65	(99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [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)														
	428.98	354.72	316.18	196.79	93.32	0	0	0	0	184.56	313.44	436.6		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	458.8	379.38	338.16	210.47	99.81	0	0	0	0	197.39	335.24	466.95		
									Total (kWh/year) =Sum(211)$_{1...5,10...12}$=				2486.19	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (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)														
	154.25	135.34	140.7	124.15	120.23	105.37	99.25	111.6	112.26	128.85	138.73	149.88		
Efficiency of water heater													87.3	(216)
(217)m=	89.63	89.59	89.49	89.23	88.67	87.3	87.3	87.3	87.3	89.16	89.49	89.66		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	172.09	151.06	157.23	139.13	135.59	120.7	113.69	127.84	128.59	144.52	155.02	167.16		
									Total = Sum(219a)$_{1...12}$ =				1712.61	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2486.19

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Water heating fuel used			1712.61	
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			311.36	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4585.16	(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	=	537.02	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	369.92	(264)
Space and water heating	(261) + (262) + (263) + (264) =			906.94	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	161.59	(268)
Total CO2, kg/year		sum of (265)…(271) =		1107.46	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		16.99	(273)
El 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: 1.0.5.59

Property Address: Kingston Bridge 2BF 65 TOP GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	65.2	(1a) x	2.7	(2a) =	176.04	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	65.2	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	176.04	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =		÷ (5) =		
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)			0.36	(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) =		0.31	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.39	0.39	0.38	0.34	0.33	0.29	0.29	0.29	0.31	0.33	0.35	0.36

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=	0.58	0.57	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)

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

(25)m=	0.58	0.57	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(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			5.76	x1/[1/(1.4)+ 0.04] =	7.64			(27)
Windows Type 2			1.86	x1/[1/(1.4)+ 0.04] =	2.47			(27)
Walls		9.48	34.64	x 0.18 =	6.24			(29)
Roof		0	65.2	x 0.13 =	8.48			(30)
Total area of elements, m²			109.32					(31)
Party wall			44.12	x 0 =	0			(32)
Party floor			65.2					(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 27.28 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6997.06 (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 2.74 (36)

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

Total fabric heat loss (33) + (36) = 30.02 (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=	33.56	33.38	33.21	32.4	32.25	31.55	31.55	31.42	31.82	32.25	32.56	32.88	(38)

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

(39)m=	63.58	63.4	63.23	62.42	62.27	61.57	61.57	61.44	61.84	62.27	62.58	62.9	

Average = Sum(39)$_{1…12}$ /12= 62.42 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	0.98	0.97	0.97	0.96	0.96	0.94	0.94	0.94	0.95	0.96	0.96	0.96

Average = Sum(40)$_{1...12}$ /12= 0.96 (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 — 2.12 (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 — 84.65 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	93.12	89.73	86.34	82.96	79.57	76.19	76.19	79.57	82.96	86.34	89.73	93.12

Total = Sum(44)$_{1...12}$ = 1015.8 (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=	138.09	120.77	124.63	108.65	104.25	89.96	83.36	95.66	96.8	112.82	123.15	133.73

Total = Sum(45)$_{1...12}$ = 1331.88 (45)

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

(46)m=	20.71	18.12	18.69	16.3	15.64	13.49	12.5	14.35	14.52	16.92	18.47	20.06	(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) — 0 (55)

Water storage loss calculated for each month — ((56)m = (55) × (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)

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

(61)m=	47.45	41.3	44	40.91	40.55	37.57	38.82	40.55	40.91	44	44.25	47.45	(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=	185.54	162.07	168.63	149.56	144.8	127.53	122.19	136.21	137.71	156.82	167.4	181.18	(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=	185.54	162.07	168.63	149.56	144.8	127.53	122.19	136.21	137.71	156.82	167.4	181.18	

Output from water heater (annual)$_{1...12}$ 1839.64 (64)

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

(65)m=	57.78	50.48	52.44	46.35	44.8	39.31	37.42	41.94	42.41	48.51	52.01	56.33	(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=	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.63	15.66	12.73	9.64	7.21	6.08	6.57	8.55	11.47	14.56	17	18.12	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	185.85	187.77	182.91	172.57	159.51	147.23	139.03	137.11	141.97	152.31	165.37	177.65	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	(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=	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	(71)
Water heating gains (Table 5)													
(72)m=	77.66	75.12	70.48	64.38	60.22	54.59	50.3	56.38	58.91	65.2	72.23	75.71	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	339	336.42	323.99	304.45	284.8	265.77	253.77	259.89	270.21	289.94	312.47	329.34	(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)	
Northeast 0.9x	0.77	x	5.76	x	11.28	x	0.63	x	0.7	=	19.86	(75)
Northeast 0.9x	0.77	x	1.86	x	11.28	x	0.63	x	0.7	=	12.83	(75)
Northeast 0.9x	0.77	x	5.76	x	22.97	x	0.63	x	0.7	=	40.43	(75)
Northeast 0.9x	0.77	x	1.86	x	22.97	x	0.63	x	0.7	=	26.11	(75)
Northeast 0.9x	0.77	x	5.76	x	41.38	x	0.63	x	0.7	=	72.84	(75)

Northeast	0.9x	0.77	x	1.86	x	41.38	x	0.63	x	0.7	=	47.04	(75)
Northeast	0.9x	0.77	x	5.76	x	67.96	x	0.63	x	0.7	=	119.62	(75)
Northeast	0.9x	0.77	x	1.86	x	67.96	x	0.63	x	0.7	=	77.26	(75)
Northeast	0.9x	0.77	x	5.76	x	91.35	x	0.63	x	0.7	=	160.8	(75)
Northeast	0.9x	0.77	x	1.86	x	91.35	x	0.63	x	0.7	=	103.85	(75)
Northeast	0.9x	0.77	x	5.76	x	97.38	x	0.63	x	0.7	=	171.43	(75)
Northeast	0.9x	0.77	x	1.86	x	97.38	x	0.63	x	0.7	=	110.71	(75)
Northeast	0.9x	0.77	x	5.76	x	91.1	x	0.63	x	0.7	=	160.37	(75)
Northeast	0.9x	0.77	x	1.86	x	91.1	x	0.63	x	0.7	=	103.57	(75)
Northeast	0.9x	0.77	x	5.76	x	72.63	x	0.63	x	0.7	=	127.85	(75)
Northeast	0.9x	0.77	x	1.86	x	72.63	x	0.63	x	0.7	=	82.57	(75)
Northeast	0.9x	0.77	x	5.76	x	50.42	x	0.63	x	0.7	=	88.76	(75)
Northeast	0.9x	0.77	x	1.86	x	50.42	x	0.63	x	0.7	=	57.32	(75)
Northeast	0.9x	0.77	x	5.76	x	28.07	x	0.63	x	0.7	=	49.41	(75)
Northeast	0.9x	0.77	x	1.86	x	28.07	x	0.63	x	0.7	=	31.91	(75)
Northeast	0.9x	0.77	x	5.76	x	14.2	x	0.63	x	0.7	=	24.99	(75)
Northeast	0.9x	0.77	x	1.86	x	14.2	x	0.63	x	0.7	=	16.14	(75)
Northeast	0.9x	0.77	x	5.76	x	9.21	x	0.63	x	0.7	=	16.22	(75)
Northeast	0.9x	0.77	x	1.86	x	9.21	x	0.63	x	0.7	=	10.48	(75)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	32.69	66.54	119.88	196.88	264.65	282.14	263.94	210.42	146.08	81.32	41.13	26.7	(83)

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

(84)m=	371.69	402.96	443.88	501.34	549.44	547.92	517.71	470.31	416.29	371.26	353.6	356.03	(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	0.88	0.69	0.52	0.59	0.87	0.98	1	1	(86)

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

(87)m=	19.97	20.08	20.29	20.6	20.85	20.97	21	20.99	20.9	20.58	20.23	19.95	(87)

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

(88)m=	20.1	20.11	20.11	20.12	20.12	20.13	20.13	20.13	20.13	20.12	20.12	20.11	(88)

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

(89)m=	1	1	0.99	0.96	0.83	0.61	0.42	0.48	0.8	0.97	1	1	(89)

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

(90)m=	18.72	18.88	19.19	19.63	19.98	20.11	20.13	20.13	20.04	19.62	19.11	18.7	(90)

fLA = Living area ÷ (4) = 0.38 (91)

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

(92)m=	19.2	19.34	19.61	20	20.31	20.44	20.46	20.46	20.37	19.98	19.54	19.18	(92)

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

(93)m=	19.2	19.34	19.61	20	20.31	20.44	20.46	20.46	20.37	19.98	19.54	19.18	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.95	0.84	0.64	0.46	0.52	0.82	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	370.64	400.95	438.2	477.82	463.41	348.83	236.42	246.61	342.51	361.27	351.64	355.25	(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=	947.44	915.49	829.06	693.12	536.31	359.73	237.72	249.39	387.85	584.41	778.25	942.43	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	429.14	345.77	290.8	155.02	54.23	0	0	0	0	166.02	307.16	436.86	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2185 (98)

Space heating requirement in kWh/m²/year 33.51 (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) × [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)													
	429.14	345.77	290.8	155.02	54.23	0	0	0	0	166.02	307.16	436.86	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	459.46	370.2	311.35	165.98	58.06	0	0	0	0	177.75	328.87	467.73	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2339.4 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (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)													
	185.54	162.07	168.63	149.56	144.8	127.53	122.19	136.21	137.71	156.82	167.4	181.18	
Efficiency of water heater												80.3	(216)
(217)m=	87.09	86.91	86.41	85.14	82.82	80.3	80.3	80.3	80.3	85.19	86.56	87.19	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	213.03	186.48	195.14	175.66	174.84	158.82	152.16	169.63	171.5	184.07	193.39	207.81	

Total = Sum(219a)$_{1...12}$ = 2182.53 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2339.4

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Water heating fuel used			2182.53	
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			311.36	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4908.29	(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	=	505.31	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	471.43	(264)
Space and water heating	(261) + (262) + (263) + (264) =			976.74	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	161.59	(268)
Total CO2, kg/year		sum of (265)…(271) =		1177.26	(272)

TER = 18.06 (273)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.59

Property Address: Kingston Bridge 3BF 83 GND GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	83	(1a)	x	2.7	(2a)	=	224.1	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	83	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	224.1	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =		÷ (5) =		
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)			0.29	(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) =			0.25	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.31	0.31	0.3	0.27	0.26	0.23	0.23	0.23	0.25	0.26	0.28	0.29

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=	0.55	0.55	0.55	0.54	0.53	0.53	0.53	0.53	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	0.55	0.55	0.54	0.53	0.53	0.53	0.53	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			2.88	x1/[1/(1.2)+ 0.04] =	3.3			(27)
Windows Type 2			1.86	x1/[1/(1.2)+ 0.04] =	2.13			(27)
Floor			83	x 0.13 =	10.79			(28)
Walls		19.62	30.6	x 0.18 =	5.51			(29)
Total area of elements, m²			133.22					(31)
Party wall			57.08	x 0 =	0			(32)
Party ceiling			83					(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 38.76 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 15941.96 (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 9.26 (36)

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

Total fabric heat loss (33) + (36) = 48.03 (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=	40.61	40.47	40.33	39.68	39.56	38.99	38.99	38.89	39.21	39.56	39.81	40.06	(38)

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

(39)m=	88.64	88.49	88.36	87.71	87.59	87.02	87.02	86.91	87.24	87.59	87.83	88.09	

Average = Sum(39)$_{1…12}$ /12= 87.71 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.07	1.07	1.06	1.06	1.06	1.05	1.05	1.05	1.05	1.06	1.06	1.06

Average = Sum(40)1…12 /12= 1.06 (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 2.52 (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 93.99 (43)

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

	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=	103.39	99.63	95.87	92.11	88.35	84.59	84.59	88.35	92.11	95.87	99.63	103.39

Total = Sum(44)1…12 = 1127.84 (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=	153.32	134.09	138.37	120.64	115.75	99.89	92.56	106.21	107.48	125.26	136.73	148.48

Total = Sum(45)1…12 = 1478.77 (45)

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

(46)m=	23	20.11	20.76	18.1	17.36	14.98	13.88	15.93	16.12	18.79	20.51	22.27	(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (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)

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

(61)m=	16.27	14.67	16.18	15.59	16.05	15.47	15.95	16.02	15.53	16.13	15.69	16.25	(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=	169.58	148.76	154.55	136.22	131.8	115.36	108.51	122.23	123.02	141.39	152.42	164.73	(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=	169.58	148.76	154.55	136.22	131.8	115.36	108.51	122.23	123.02	141.39	152.42	164.73	

Output from water heater (annual)$_{1...12}$ | 1668.57 | (64)

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

(65)m=	55.04	48.25	50.05	44.01	42.5	37.08	34.76	39.32	39.62	45.68	49.39	53.43	(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=	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	(66)

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

(67)m=	20.11	17.86	14.53	11	8.22	6.94	7.5	9.75	13.08	16.61	19.39	20.67	(67)

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

(68)m=	225.6	227.94	222.04	209.48	193.63	178.73	168.77	166.43	172.33	184.89	200.74	215.64	(68)

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

(69)m=	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	(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=	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	(71)

Water heating gains (Table 5)

(72)m=	73.98	71.81	67.28	61.12	57.12	51.5	46.73	52.85	55.03	61.4	68.59	71.82	(72)

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

(73)m=	383.45	381.37	367.6	345.36	322.73	300.93	286.76	292.79	304.2	326.66	352.48	371.89	(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)	
Southwest	0.9x	0.77	x	2.88	x	36.79		0.3	x	0.7	=	15.42	(79)
Southwest	0.9x	0.77	x	1.86	x	36.79		0.3	x	0.7	=	89.64	(79)
Southwest	0.9x	0.77	x	2.88	x	62.67		0.3	x	0.7	=	26.27	(79)
Southwest	0.9x	0.77	x	1.86	x	62.67		0.3	x	0.7	=	152.68	(79)
Southwest	0.9x	0.77	x	2.88	x	85.75		0.3	x	0.7	=	35.94	(79)

Southwest	0.9x	0.77	x	1.86	x	85.75	0.3	x	0.7	=	208.91	(79)
Southwest	0.9x	0.77	x	2.88	x	106.25	0.3	x	0.7	=	44.53	(79)
Southwest	0.9x	0.77	x	1.86	x	106.25	0.3	x	0.7	=	258.85	(79)
Southwest	0.9x	0.77	x	2.88	x	119.01	0.3	x	0.7	=	49.88	(79)
Southwest	0.9x	0.77	x	1.86	x	119.01	0.3	x	0.7	=	289.93	(79)
Southwest	0.9x	0.77	x	2.88	x	118.15	0.3	x	0.7	=	49.52	(79)
Southwest	0.9x	0.77	x	1.86	x	118.15	0.3	x	0.7	=	287.83	(79)
Southwest	0.9x	0.77	x	2.88	x	113.91	0.3	x	0.7	=	47.74	(79)
Southwest	0.9x	0.77	x	1.86	x	113.91	0.3	x	0.7	=	277.5	(79)
Southwest	0.9x	0.77	x	2.88	x	104.39	0.3	x	0.7	=	43.75	(79)
Southwest	0.9x	0.77	x	1.86	x	104.39	0.3	x	0.7	=	254.31	(79)
Southwest	0.9x	0.77	x	2.88	x	92.85	0.3	x	0.7	=	38.92	(79)
Southwest	0.9x	0.77	x	1.86	x	92.85	0.3	x	0.7	=	226.2	(79)
Southwest	0.9x	0.77	x	2.88	x	69.27	0.3	x	0.7	=	29.03	(79)
Southwest	0.9x	0.77	x	1.86	x	69.27	0.3	x	0.7	=	168.75	(79)
Southwest	0.9x	0.77	x	2.88	x	44.07	0.3	x	0.7	=	18.47	(79)
Southwest	0.9x	0.77	x	1.86	x	44.07	0.3	x	0.7	=	107.36	(79)
Southwest	0.9x	0.77	x	2.88	x	31.49	0.3	x	0.7	=	13.2	(79)
Southwest	0.9x	0.77	x	1.86	x	31.49	0.3	x	0.7	=	76.71	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	105.06	178.95	244.85	303.38	339.81	337.35	325.24	298.07	265.12	197.78	125.83	89.91	(83)

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

(84)m=	488.51	560.32	612.45	648.74	662.54	638.28	612	590.85	569.32	524.44	478.32	461.8	(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	0.92	0.78	0.61	0.65	0.87	0.98	1	1	(86)

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

(87)m=	19.86	20	20.22	20.5	20.76	20.93	20.99	20.98	20.87	20.54	20.14	19.83	(87)

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

(88)m=	20.03	20.03	20.03	20.04	20.04	20.04	20.04	20.04	20.04	20.04	20.04	20.03	(88)

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

(89)m=	1	0.99	0.99	0.96	0.88	0.7	0.48	0.53	0.8	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=	18.5	18.71	19.03	19.44	19.79	20	20.04	20.04	19.94	19.5	18.92	18.46	(90)

fLA = Living area ÷ (4) = 0.3 (91)

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

(92)m=	18.91	19.1	19.39	19.76	20.08	20.28	20.32	20.32	20.22	19.81	19.29	18.87	(92)

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

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(93)m=	18.91	19.1	19.39	19.76	20.08	20.28	20.32	20.32	20.22	19.81	19.29	18.87	(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	0.96	0.88	0.72	0.52	0.56	0.82	0.96	0.99	1		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	486.83	556.14	602	620.07	585.25	459.49	319.06	333.21	464.27	505.19	474.82	460.6		(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=	1295.04	1256.8	1139.15	952.5	734.24	494.06	324.01	340.72	533.82	806.9	1070.65	1292.43		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	601.31	470.84	399.64	239.35	110.85	0	0	0	0	224.47	429	618.88		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													3094.33	(98)
Space heating requirement in kWh/m²/year													37.28	(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) × [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)														
	601.31	470.84	399.64	239.35	110.85	0	0	0	0	224.47	429	618.88		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	643.11	503.57	427.42	255.99	118.55	0	0	0	0	240.07	458.82	661.9		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													3309.44	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (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)														
	169.58	148.76	154.55	136.22	131.8	115.36	108.51	122.23	123.02	141.39	152.42	164.73		
Efficiency of water heater													87.3	(216)
(217)m=	89.78	89.71	89.58	89.31	88.73	87.3	87.3	87.3	87.3	89.24	89.64	89.81		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	188.9	165.83	172.52	152.52	148.54	132.14	124.3	140.01	140.91	158.44	170.04	183.42		
Total = Sum(219a)$_{1...12}$ =													1877.57	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3309.44

Water heating fuel used		1877.57	
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		355.19	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		5617.2	(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	=	714.84	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	405.55	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1120.39	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	184.34	(268)
Total CO2, kg/year		sum of (265)…(271) =		1343.66	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		16.19	(273)
EI rating (section 14)				86	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Software Name: Stroma FSAP 2012
Stroma Number:
Software Version: Version: 1.0.5.59

Property Address: Kingston Bridge 3BF 83 GND GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)			Volume(m³)	
Ground floor	83	(1a) x	2.7	(2a)	=	224.1	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	83	(4)					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	224.1	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =		÷ (5) =	
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)		0.38	(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) =	0.33	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.38

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

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

(25)m=	0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(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			2.88	x1/[1/(1.4)+ 0.04] =	3.82			(27)
Windows Type 2			1.86	x1/[1/(1.4)+ 0.04] =	2.47			(27)
Floor			83	x 0.13 =	10.79			(28)
Walls		19.62	30.6	x 0.18 =	5.51			(29)
Total area of elements, m²			133.22					(31)
Party wall			57.08	x 0 =	0			(32)
Party ceiling			83					(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 42.31 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 15941.96 (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 6.42 (36)

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

Total fabric heat loss (33) + (36) = 48.73 (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=	43.38	43.13	42.88	41.74	41.53	40.53	40.53	40.34	40.91	41.53	41.96	42.41	(38)

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

(39)m=	92.1	91.86	91.61	90.47	90.25	89.26	89.26	89.07	89.64	90.25	90.69	91.14	

Average = Sum(39)$_{1…12}$ /12= 90.47 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.11	1.11	1.1	1.09	1.09	1.08	1.08	1.07	1.08	1.09	1.09	1.1

Average = Sum(40)$_{1…12}$ /12= 1.09 (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 2.52 (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 93.99 (43)

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

	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=	103.39	99.63	95.87	92.11	88.35	84.59	84.59	88.35	92.11	95.87	99.63	103.39

Total = Sum(44)$_{1…12}$ = 1127.84 (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=	153.32	134.09	138.37	120.64	115.75	99.89	92.56	106.21	107.48	125.26	136.73	148.48

Total = Sum(45)$_{1…12}$ = 1478.77 (45)

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

(46)m=	23	20.11	20.76	18.1	17.36	14.98	13.88	15.93	16.12	18.79	20.51	22.27	(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (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)

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

(61)m=	50.96	45.86	48.85	45.42	45.02	41.71	43.11	45.02	45.42	48.85	49.13	50.96	(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=	204.28	179.95	187.22	166.06	160.77	141.6	135.66	151.23	152.9	174.11	185.86	199.44	(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=	204.28	179.95	187.22	166.06	160.77	141.6	135.66	151.23	152.9	174.11	185.86	199.44	

Output from water heater (annual)$_{1...12}$ 2039.09 (64)

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

(65)m=	63.72	56.05	58.22	51.47	49.74	43.64	41.55	46.57	47.09	53.86	57.75	62.11	(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=	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	(66)

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

(67)m=	20.11	17.86	14.53	11	8.22	6.94	7.5	9.75	13.08	16.61	19.39	20.67	(67)

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

(68)m=	225.6	227.94	222.04	209.48	193.63	178.73	168.77	166.43	172.33	184.89	200.74	215.64	(68)

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

(69)m=	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	(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=	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	(71)

Water heating gains (Table 5)

(72)m=	85.64	83.41	78.25	71.48	66.86	60.61	55.85	62.6	65.41	72.39	80.2	83.48	(72)

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

(73)m=	395.11	392.97	378.58	355.72	332.47	310.04	295.88	302.53	314.58	337.66	364.09	383.55	(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)	
Southwest 0.9x	0.77	x	2.88	x	36.79	0.63	x	0.7	=	32.38	(79)
Southwest 0.9x	0.77	x	1.86	x	36.79	0.63	x	0.7	=	188.24	(79)
Southwest 0.9x	0.77	x	2.88	x	62.67	0.63	x	0.7	=	55.16	(79)
Southwest 0.9x	0.77	x	1.86	x	62.67	0.63	x	0.7	=	320.64	(79)
Southwest 0.9x	0.77	x	2.88	x	85.75	0.63	x	0.7	=	75.48	(79)

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Southwest	0.9x	0.77	x	1.86	x	85.75	0.63	x	0.7	=	438.71	(79)
Southwest	0.9x	0.77	x	2.88	x	106.25	0.63	x	0.7	=	93.52	(79)
Southwest	0.9x	0.77	x	1.86	x	106.25	0.63	x	0.7	=	543.58	(79)
Southwest	0.9x	0.77	x	2.88	x	119.01	0.63	x	0.7	=	104.75	(79)
Southwest	0.9x	0.77	x	1.86	x	119.01	0.63	x	0.7	=	608.85	(79)
Southwest	0.9x	0.77	x	2.88	x	118.15	0.63	x	0.7	=	103.99	(79)
Southwest	0.9x	0.77	x	1.86	x	118.15	0.63	x	0.7	=	604.45	(79)
Southwest	0.9x	0.77	x	2.88	x	113.91	0.63	x	0.7	=	100.26	(79)
Southwest	0.9x	0.77	x	1.86	x	113.91	0.63	x	0.7	=	582.76	(79)
Southwest	0.9x	0.77	x	2.88	x	104.39	0.63	x	0.7	=	91.88	(79)
Southwest	0.9x	0.77	x	1.86	x	104.39	0.63	x	0.7	=	534.06	(79)
Southwest	0.9x	0.77	x	2.88	x	92.85	0.63	x	0.7	=	81.73	(79)
Southwest	0.9x	0.77	x	1.86	x	92.85	0.63	x	0.7	=	475.03	(79)
Southwest	0.9x	0.77	x	2.88	x	69.27	0.63	x	0.7	=	60.97	(79)
Southwest	0.9x	0.77	x	1.86	x	69.27	0.63	x	0.7	=	354.37	(79)
Southwest	0.9x	0.77	x	2.88	x	44.07	0.63	x	0.7	=	38.79	(79)
Southwest	0.9x	0.77	x	1.86	x	44.07	0.63	x	0.7	=	225.46	(79)
Southwest	0.9x	0.77	x	2.88	x	31.49	0.63	x	0.7	=	27.71	(79)
Southwest	0.9x	0.77	x	1.86	x	31.49	0.63	x	0.7	=	161.09	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	220.62	375.8	514.18	637.1	713.6	708.44	683.01	625.94	556.75	415.34	264.25	188.81	(83)

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

(84)m=	615.73	768.77	892.76	992.82	1046.07	1018.48	978.9	928.47	871.33	752.99	628.35	572.36	(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	0.88	0.74	0.55	0.4	0.44	0.67	0.92	0.99	1	(86)

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

(87)m=	19.94	20.18	20.46	20.74	20.92	20.99	21	21	20.96	20.72	20.27	19.9	(87)

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

(88)m=	19.99	20	20	20.01	20.01	20.02	20.02	20.02	20.02	20.01	20.01	20	(88)

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

(89)m=	0.99	0.98	0.94	0.85	0.68	0.47	0.31	0.35	0.59	0.89	0.98	1	(89)

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

(90)m=	18.6	18.94	19.34	19.73	19.94	20.01	20.02	20.02	19.99	19.71	19.08	18.55	(90)

fLA = Living area ÷ (4) = 0.3 (91)

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

(92)m=	19.01	19.31	19.67	20.04	20.24	20.31	20.31	20.32	20.28	20.01	19.44	18.95	(92)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(93)m=	19.01	19.31	19.67	20.04	20.24	20.31	20.31	20.32	20.28	20.01	19.44	18.95		(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	0.85	0.69	0.49	0.34	0.37	0.61	0.89	0.98	0.99		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	609.99	748.79	835.34	839.95	722.69	502.77	330.86	347.54	534.69	667.29	614.55	568.52		(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=	1354.44	1323.57	1206.8	1007.48	770.37	509.3	331.57	348.74	554.28	849.31	1118.86	1344.71		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	553.87	386.25	276.36	120.62	35.47	0	0	0	0	135.42	363.1	577.48		
										Total per year (kWh/year) = Sum(98)1...5,9...12 =			2448.59	(98)
Space heating requirement in kWh/m²/year													29.5	(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) × [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)														
	553.87	386.25	276.36	120.62	35.47	0	0	0	0	135.42	363.1	577.48		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	593.01	413.55	295.89	129.14	37.98	0	0	0	0	144.99	388.76	618.29		
									Total (kWh/year) =Sum(211)1...5,10...12=				2621.62	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)														
	204.28	179.95	187.22	166.06	160.77	141.6	135.66	151.23	152.9	174.11	185.86	199.44		
Efficiency of water heater													80.3	(216)
(217)m=	87.44	86.93	86.03	84.26	81.96	80.3	80.3	80.3	80.3	84.43	86.71	87.57		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	233.63	207.01	217.63	197.08	196.17	176.34	168.95	188.34	190.42	206.23	214.35	227.74		
									Total = Sum(219a)1...12 =				2423.87	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2621.62

Water heating fuel used			2423.87	
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			355.19	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			5475.67	(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	=	566.27	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	523.56	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1089.83	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	184.34	(268)
Total CO2, kg/year		sum of (265)…(271) =		1313.09	(272)

TER = 15.82 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.59

Property Address: Kingston Bridge 3BF 83 MID GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	83	(1a) x	2.7	(2a) =	224.1	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	83	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	224.1	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =		÷ (5) =	

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)	0.29	(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) =	0.25	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.31	0.31	0.3	0.27	0.26	0.23	0.23	0.23	0.25	0.26	0.28	0.29

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=	0.55	0.55	0.55	0.54	0.53	0.53	0.53	0.53	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	0.55	0.55	0.54	0.53	0.53	0.53	0.53	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			2.88	x1/[1/(1.2)+ 0.04]		=	3.3			(27)
Windows Type 2			1.86	x1/[1/(1.2)+ 0.04]		=	2.13			(27)
Walls		19.62	30.6	x	0.18	=	5.51			(29)
Total area of elements, m²			50.22							(31)
Party wall			57.08	x	0	=	0			(32)
Party floor			83							(32a)
Party ceiling			83							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 27.97 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 16356.96 (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 4.21 (36)

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

Total fabric heat loss (33) + (36) = 32.18 (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=	40.61	40.47	40.33	39.68	39.56	38.99	38.99	38.89	39.21	39.56	39.81	40.06	(38)

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

(39)m=	72.79	72.65	72.51	71.86	71.74	71.17	71.17	71.07	71.39	71.74	71.98	72.24	

Average = Sum(39)$_{1…12}$ /12= 71.86 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.88	0.88	0.87	0.87	0.86	0.86	0.86	0.86	0.86	0.86	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 2.52 (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 93.99 (43)

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

	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=	103.39	99.63	95.87	92.11	88.35	84.59	84.59	88.35	92.11	95.87	99.63	103.39	

Total = Sum(44)$_{1…12}$ = 1127.84 (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=	153.32	134.09	138.37	120.64	115.75	99.89	92.56	106.21	107.48	125.26	136.73	148.48	

Total = Sum(45)$_{1…12}$ = 1478.77 (45)

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

(46)m=	23	20.11	20.76	18.1	17.36	14.98	13.88	15.93	16.12	18.79	20.51	22.27	(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (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)

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

(61)m=	16.27	14.67	16.18	15.59	16.05	15.47	15.95	16.02	15.53	16.13	15.69	16.25	(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=	169.58	148.76	154.55	136.22	131.8	115.36	108.51	122.23	123.02	141.39	152.42	164.73	(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=	169.58	148.76	154.55	136.22	131.8	115.36	108.51	122.23	123.02	141.39	152.42	164.73	

Output from water heater (annual)$_{1...12}$ 1668.57 (64)

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

(65)m=	55.04	48.25	50.05	44.01	42.5	37.08	34.76	39.32	39.62	45.68	49.39	53.43	(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=	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	(66)

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

(67)m=	20.11	17.86	14.53	11	8.22	6.94	7.5	9.75	13.08	16.61	19.39	20.67	(67)

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

(68)m=	225.6	227.94	222.04	209.48	193.63	178.73	168.77	166.43	172.33	184.89	200.74	215.64	(68)

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

(69)m=	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	(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=	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	(71)

Water heating gains (Table 5)

(72)m=	73.98	71.81	67.28	61.12	57.12	51.5	46.73	52.85	55.03	61.4	68.59	71.82	(72)

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

(73)m=	383.45	381.37	367.6	345.36	322.73	300.93	286.76	292.79	304.2	326.66	352.48	371.89	(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)	
Southwest 0.9x	0.77	x	2.88	x	36.79	0.63	x	0.7	=	32.38	(79)
Southwest 0.9x	0.77	x	1.86	x	36.79	0.63	x	0.7	=	188.24	(79)
Southwest 0.9x	0.77	x	2.88	x	62.67	0.63	x	0.7	=	55.16	(79)
Southwest 0.9x	0.77	x	1.86	x	62.67	0.63	x	0.7	=	320.64	(79)
Southwest 0.9x	0.77	x	2.88	x	85.75	0.63	x	0.7	=	75.48	(79)

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Southwest	0.9x	0.77	x	1.86	x	85.75	0.63	x	0.7	=	438.71	(79)
Southwest	0.9x	0.77	x	2.88	x	106.25	0.63	x	0.7	=	93.52	(79)
Southwest	0.9x	0.77	x	1.86	x	106.25	0.63	x	0.7	=	543.58	(79)
Southwest	0.9x	0.77	x	2.88	x	119.01	0.63	x	0.7	=	104.75	(79)
Southwest	0.9x	0.77	x	1.86	x	119.01	0.63	x	0.7	=	608.85	(79)
Southwest	0.9x	0.77	x	2.88	x	118.15	0.63	x	0.7	=	103.99	(79)
Southwest	0.9x	0.77	x	1.86	x	118.15	0.63	x	0.7	=	604.45	(79)
Southwest	0.9x	0.77	x	2.88	x	113.91	0.63	x	0.7	=	100.26	(79)
Southwest	0.9x	0.77	x	1.86	x	113.91	0.63	x	0.7	=	582.76	(79)
Southwest	0.9x	0.77	x	2.88	x	104.39	0.63	x	0.7	=	91.88	(79)
Southwest	0.9x	0.77	x	1.86	x	104.39	0.63	x	0.7	=	534.06	(79)
Southwest	0.9x	0.77	x	2.88	x	92.85	0.63	x	0.7	=	81.73	(79)
Southwest	0.9x	0.77	x	1.86	x	92.85	0.63	x	0.7	=	475.03	(79)
Southwest	0.9x	0.77	x	2.88	x	69.27	0.63	x	0.7	=	60.97	(79)
Southwest	0.9x	0.77	x	1.86	x	69.27	0.63	x	0.7	=	354.37	(79)
Southwest	0.9x	0.77	x	2.88	x	44.07	0.63	x	0.7	=	38.79	(79)
Southwest	0.9x	0.77	x	1.86	x	44.07	0.63	x	0.7	=	225.46	(79)
Southwest	0.9x	0.77	x	2.88	x	31.49	0.63	x	0.7	=	27.71	(79)
Southwest	0.9x	0.77	x	1.86	x	31.49	0.63	x	0.7	=	161.09	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	220.62	375.8	514.18	637.1	713.6	708.44	683.01	625.94	556.75	415.34	264.25	188.81	(83)

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

(84)m=	604.07	757.16	881.78	982.46	1036.33	1009.37	969.77	918.73	860.96	742	616.74	560.69	(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	0.93	0.81	0.63	0.45	0.32	0.36	0.57	0.87	0.98	1	(86)

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

(87)m=	20.27	20.49	20.72	20.91	20.98	21	21	21	20.99	20.88	20.53	20.22	(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	20.2	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	0.97	0.91	0.77	0.58	0.39	0.26	0.29	0.5	0.83	0.98	0.99	(89)

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

(90)m=	19.22	19.53	19.86	20.1	20.18	20.2	20.2	20.2	20.2	20.07	19.6	19.15	(90)

fLA = Living area ÷ (4) = | 0.3 | (91)

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

(92)m=	19.53	19.82	20.12	20.34	20.42	20.44	20.44	20.44	20.44	20.31	19.88	19.47	(92)

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

(93)m=	19.53	19.82	20.12	20.34	20.42	20.44	20.44	20.44	20.44	20.31	19.88	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	0.97	0.91	0.78	0.59	0.41	0.28	0.31	0.52	0.84	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	597.93	731.37	799.48	762.9	615.51	414.97	273.49	287.3	448.8	619.92	599.71	556.84	(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=	1108.74	1083.87	987.31	822.28	625.81	415.81	273.55	287.41	452.36	696.83	919.92	1103.23	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	380.04	236.88	139.75	42.75	7.66	0	0	0	0	57.22	230.55	406.51	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1501.37 (98)

Space heating requirement in kWh/m²/year 18.09 (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) × [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)													
	380.04	236.88	139.75	42.75	7.66	0	0	0	0	57.22	230.55	406.51	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	406.46	253.35	149.46	45.73	8.19	0	0	0	0	61.2	246.58	434.77	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1605.75 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (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)													
	169.58	148.76	154.55	136.22	131.8	115.36	108.51	122.23	123.02	141.39	152.42	164.73	
Efficiency of water heater												87.3	(216)
(217)m=	89.49	89.24	88.79	88.04	87.47	87.3	87.3	87.3	87.3	88.2	89.2	89.55	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	189.5	166.7	174.06	154.72	150.69	132.14	124.3	140.01	140.91	160.3	170.88	183.94	

Total = Sum(219a)$_{1...12}$ = 1888.16 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1605.75

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Water heating fuel used			1888.16	
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			355.19	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			3924.09	(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	=	346.84	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	407.84	(264)
Space and water heating	(261) + (262) + (263) + (264) =				754.68	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	184.34	(268)
Total CO2, kg/year			sum of (265)…(271) =		977.95	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		11.78	(273)
EI rating (section 14)					90	(274)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.59

Property Address: Kingston Bridge 3BF 83 MID GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	83	(1a) x	2.7	(2a) =	224.1	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	83	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	224.1	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =		÷ (5) =	

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)	0.38	(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) =	0.33	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.38

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

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

(25)m=	0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(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			2.88	x1/[1/(1.4)+ 0.04]		=	3.82			(27)
Windows Type 2			1.86	x1/[1/(1.4)+ 0.04]		=	2.47			(27)
Walls		19.62	30.6	x	0.18	=	5.51			(29)
Total area of elements, m²			50.22							(31)
Party wall			57.08	x	0	=	0			(32)
Party floor			83							(32a)
Party ceiling			83							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 31.52 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 16356.96 (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 3.05 (36)

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

Total fabric heat loss (33) + (36) = 34.57 (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=	43.38	43.13	42.88	41.74	41.53	40.53	40.53	40.34	40.91	41.53	41.96	42.41	(38)

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

(39)m=	77.95	77.7	77.46	76.31	76.1	75.1	75.1	74.92	75.49	76.1	76.53	76.98	

Average = Sum(39)$_{1…12}$ /12= 76.31 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.94	0.94	0.93	0.92	0.92	0.9	0.9	0.9	0.91	0.92	0.92	0.93

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 2.52 (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 93.99 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	103.39	99.63	95.87	92.11	88.35	84.59	84.59	88.35	92.11	95.87	99.63	103.39

Total = Sum(44)$_{1…12}$ = 1127.84 (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=	153.32	134.09	138.37	120.64	115.75	99.89	92.56	106.21	107.48	125.26	136.73	148.48

Total = Sum(45)$_{1…12}$ = 1478.77 (45)

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

(46)m=	23	20.11	20.76	18.1	17.36	14.98	13.88	15.93	16.12	18.79	20.51	22.27	(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (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)

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

(61)m=	50.96	45.86	48.85	45.42	45.02	41.71	43.11	45.02	45.42	48.85	49.13	50.96	(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=	204.28	179.95	187.22	166.06	160.77	141.6	135.66	151.23	152.9	174.11	185.86	199.44	(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=	204.28	179.95	187.22	166.06	160.77	141.6	135.66	151.23	152.9	174.11	185.86	199.44	

Output from water heater (annual)$_{1...12}$ 2039.09 (64)

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

(65)m=	63.72	56.05	58.22	51.47	49.74	43.64	41.55	46.57	47.09	53.86	57.75	62.11	(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=	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	(66)

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

(67)m=	20.11	17.86	14.53	11	8.22	6.94	7.5	9.75	13.08	16.61	19.39	20.67	(67)

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

(68)m=	225.6	227.94	222.04	209.48	193.63	178.73	168.77	166.43	172.33	184.89	200.74	215.64	(68)

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

(69)m=	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	(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=	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	(71)

Water heating gains (Table 5)

(72)m=	85.64	83.41	78.25	71.48	66.86	60.61	55.85	62.6	65.41	72.39	80.2	83.48	(72)

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

(73)m=	395.11	392.97	378.58	355.72	332.47	310.04	295.88	302.53	314.58	337.66	364.09	383.55	(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)	
Southwest 0.9x	0.77	x	2.88	x	36.79	0.63	x	0.7	=	32.38	(79)
Southwest 0.9x	0.77	x	1.86	x	36.79	0.63	x	0.7	=	188.24	(79)
Southwest 0.9x	0.77	x	2.88	x	62.67	0.63	x	0.7	=	55.16	(79)
Southwest 0.9x	0.77	x	1.86	x	62.67	0.63	x	0.7	=	320.64	(79)
Southwest 0.9x	0.77	x	2.88	x	85.75	0.63	x	0.7	=	75.48	(79)

Southwest0.9x	0.77	x	1.86	x	85.75		0.63	x	0.7	=	438.71	(79)
Southwest0.9x	0.77	x	2.88	x	106.25		0.63	x	0.7	=	93.52	(79)
Southwest0.9x	0.77	x	1.86	x	106.25		0.63	x	0.7	=	543.58	(79)
Southwest0.9x	0.77	x	2.88	x	119.01		0.63	x	0.7	=	104.75	(79)
Southwest0.9x	0.77	x	1.86	x	119.01		0.63	x	0.7	=	608.85	(79)
Southwest0.9x	0.77	x	2.88	x	118.15		0.63	x	0.7	=	103.99	(79)
Southwest0.9x	0.77	x	1.86	x	118.15		0.63	x	0.7	=	604.45	(79)
Southwest0.9x	0.77	x	2.88	x	113.91		0.63	x	0.7	=	100.26	(79)
Southwest0.9x	0.77	x	1.86	x	113.91		0.63	x	0.7	=	582.76	(79)
Southwest0.9x	0.77	x	2.88	x	104.39		0.63	x	0.7	=	91.88	(79)
Southwest0.9x	0.77	x	1.86	x	104.39		0.63	x	0.7	=	534.06	(79)
Southwest0.9x	0.77	x	2.88	x	92.85		0.63	x	0.7	=	81.73	(79)
Southwest0.9x	0.77	x	1.86	x	92.85		0.63	x	0.7	=	475.03	(79)
Southwest0.9x	0.77	x	2.88	x	69.27		0.63	x	0.7	=	60.97	(79)
Southwest0.9x	0.77	x	1.86	x	69.27		0.63	x	0.7	=	354.37	(79)
Southwest0.9x	0.77	x	2.88	x	44.07		0.63	x	0.7	=	38.79	(79)
Southwest0.9x	0.77	x	1.86	x	44.07		0.63	x	0.7	=	225.46	(79)
Southwest0.9x	0.77	x	2.88	x	31.49		0.63	x	0.7	=	27.71	(79)
Southwest0.9x	0.77	x	1.86	x	31.49		0.63	x	0.7	=	161.09	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	220.62	375.8	514.18	637.1	713.6	708.44	683.01	625.94	556.75	415.34	264.25	188.81	(83)

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

(84)m=	615.73	768.77	892.76	992.82	1046.07	1018.48	978.9	928.47	871.33	752.99	628.35	572.36	(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	0.93	0.82	0.65	0.47	0.34	0.37	0.59	0.88	0.98	1	(86)

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

(87)m=	20.19	20.41	20.66	20.88	20.97	21	21	21	20.99	20.85	20.47	20.15	(87)

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

(88)m=	20.13	20.14	20.14	20.15	20.15	20.16	20.16	20.17	20.16	20.15	20.15	20.14	(88)

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

(89)m=	0.99	0.97	0.92	0.79	0.6	0.41	0.27	0.3	0.52	0.84	0.98	0.99	(89)

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

(90)m=	19.06	19.38	19.73	20.02	20.13	20.16	20.16	20.17	20.15	19.99	19.48	19.01	(90)

fLA = Living area ÷ (4) = | 0.3 | (91)

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

(92)m=	19.4	19.69	20.01	20.28	20.38	20.41	20.42	20.42	20.4	20.25	19.78	19.35	(92)

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

(93)m=	19.4	19.69	20.01	20.28	20.38	20.41	20.42	20.42	20.4	20.25	19.78	19.35	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.97	0.91	0.79	0.62	0.43	0.29	0.32	0.54	0.85	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	609.36	743.95	816.73	788.86	645.09	435.18	286.42	300.69	470.37	637.92	611.38	568.23	(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, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1177	1149.45	1046.46	868.32	660.82	436.58	286.53	300.9	475.87	734.37	970.5	1166.36	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	422.33	272.5	170.92	57.21	11.71	0	0	0	0	71.76	258.57	445	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1710 (98)

Space heating requirement in kWh/m²/year 20.6 (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) × [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)													
	422.33	272.5	170.92	57.21	11.71	0	0	0	0	71.76	258.57	445	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	452.17	291.75	183	61.26	12.54	0	0	0	0	76.83	276.84	476.45	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1830.83 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (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)

	204.28	179.95	187.22	166.06	160.77	141.6	135.66	151.23	152.9	174.11	185.86	199.44

Efficiency of water heater 80.3 (216)

(217)m=	86.84	86.09	84.82	82.67	80.91	80.3	80.3	80.3	80.3	83.01	85.88	87.01	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	235.23	209.01	220.72	200.88	198.7	176.34	168.95	188.34	190.42	209.76	216.41	229.21

Total = Sum(219a)$_{1...12}$ = 2443.95 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1830.83

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Water heating fuel used			2443.95	
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			355.19	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4704.97	(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	=	395.46	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	527.89	(264)
Space and water heating	(261) + (262) + (263) + (264) =			923.35	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	184.34	(268)
Total CO2, kg/year		sum of (265)…(271) =		1146.62	(272)

TER = 13.81 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.59

Property Address: Kingston Bridge 3BF 83 TOP GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	83	(1a) x	2.7	(2a) =	224.1	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	83	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	224.1	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =		÷ (5) =		
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)			0.29	(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) =		0.25	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.31	0.31	0.3	0.27	0.26	0.23	0.23	0.23	0.25	0.26	0.28	0.29

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=	0.55	0.55	0.55	0.54	0.53	0.53	0.53	0.53	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	0.55	0.55	0.54	0.53	0.53	0.53	0.53	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			2.88	x1/[1/(1.2)+ 0.04]		=	3.3			(27)
Windows Type 2			1.86	x1/[1/(1.2)+ 0.04]		=	2.13			(27)
Walls		19.62	30.6	x	0.18	=	5.51			(29)
Roof		0	83	x	0.13	=	10.79			(30)
Total area of elements, m²			133.22							(31)
Party wall			57.08	x	0	=	0			(32)
Party floor			83							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 38.76 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8803.96 (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 10.77 (36)

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

Total fabric heat loss (33) + (36) = 49.53 (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=	40.61	40.47	40.33	39.68	39.56	38.99	38.99	38.89	39.21	39.56	39.81	40.06	(38)

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

(39)m=	90.14	90	89.86	89.21	89.09	88.52	88.52	88.42	88.74	89.09	89.34	89.59	

Average = Sum(39)$_{1…12}$ /12= 89.21 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.09	1.08	1.08	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.08	1.08

Average = Sum(40)1…12 /12= 1.07 (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 2.52 (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 93.99 (43)

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

	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=	103.39	99.63	95.87	92.11	88.35	84.59	84.59	88.35	92.11	95.87	99.63	103.39

Total = Sum(44)1…12 = 1127.84 (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=	153.32	134.09	138.37	120.64	115.75	99.89	92.56	106.21	107.48	125.26	136.73	148.48

Total = Sum(45)1…12 = 1478.77 (45)

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

(46)m=	23	20.11	20.76	18.1	17.36	14.98	13.88	15.93	16.12	18.79	20.51	22.27

(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (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)

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

(61)m=	16.27	14.67	16.18	15.59	16.05	15.47	15.95	16.02	15.53	16.13	15.69	16.25	(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=	169.58	148.76	154.55	136.22	131.8	115.36	108.51	122.23	123.02	141.39	152.42	164.73	(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=	169.58	148.76	154.55	136.22	131.8	115.36	108.51	122.23	123.02	141.39	152.42	164.73	

Output from water heater (annual)$_{1...12}$ 1668.57 (64)

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

(65)m=	55.04	48.25	50.05	44.01	42.5	37.08	34.76	39.32	39.62	45.68	49.39	53.43	(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=	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	(66)

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

(67)m=	20.11	17.86	14.53	11	8.22	6.94	7.5	9.75	13.08	16.61	19.39	20.67	(67)

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

(68)m=	225.6	227.94	222.04	209.48	193.63	178.73	168.77	166.43	172.33	184.89	200.74	215.64	(68)

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

(69)m=	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	(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=	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	(71)

Water heating gains (Table 5)

(72)m=	73.98	71.81	67.28	61.12	57.12	51.5	46.73	52.85	55.03	61.4	68.59	71.82	(72)

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

(73)m=	383.45	381.37	367.6	345.36	322.73	300.93	286.76	292.79	304.2	326.66	352.48	371.89	(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)	
Southwest 0.9x	0.77	x	2.88	x	36.79	0.35	x	0.7	=	17.99	(79)
Southwest 0.9x	0.77	x	1.86	x	36.79	0.35	x	0.7	=	104.58	(79)
Southwest 0.9x	0.77	x	2.88	x	62.67	0.35	x	0.7	=	30.65	(79)
Southwest 0.9x	0.77	x	1.86	x	62.67	0.35	x	0.7	=	178.13	(79)
Southwest 0.9x	0.77	x	2.88	x	85.75	0.35	x	0.7	=	41.93	(79)

Southwest0.9x	0.77	x	1.86	x	85.75		0.35	x	0.7	=	243.73	(79)
Southwest0.9x	0.77	x	2.88	x	106.25		0.35	x	0.7	=	51.96	(79)
Southwest0.9x	0.77	x	1.86	x	106.25		0.35	x	0.7	=	301.99	(79)
Southwest0.9x	0.77	x	2.88	x	119.01		0.35	x	0.7	=	58.19	(79)
Southwest0.9x	0.77	x	1.86	x	119.01		0.35	x	0.7	=	338.25	(79)
Southwest0.9x	0.77	x	2.88	x	118.15		0.35	x	0.7	=	57.77	(79)
Southwest0.9x	0.77	x	1.86	x	118.15		0.35	x	0.7	=	335.81	(79)
Southwest0.9x	0.77	x	2.88	x	113.91		0.35	x	0.7	=	55.7	(79)
Southwest0.9x	0.77	x	1.86	x	113.91		0.35	x	0.7	=	323.75	(79)
Southwest0.9x	0.77	x	2.88	x	104.39		0.35	x	0.7	=	51.04	(79)
Southwest0.9x	0.77	x	1.86	x	104.39		0.35	x	0.7	=	296.7	(79)
Southwest0.9x	0.77	x	2.88	x	92.85		0.35	x	0.7	=	45.4	(79)
Southwest0.9x	0.77	x	1.86	x	92.85		0.35	x	0.7	=	263.9	(79)
Southwest0.9x	0.77	x	2.88	x	69.27		0.35	x	0.7	=	33.87	(79)
Southwest0.9x	0.77	x	1.86	x	69.27		0.35	x	0.7	=	196.87	(79)
Southwest0.9x	0.77	x	2.88	x	44.07		0.35	x	0.7	=	21.55	(79)
Southwest0.9x	0.77	x	1.86	x	44.07		0.35	x	0.7	=	125.26	(79)
Southwest0.9x	0.77	x	2.88	x	31.49		0.35	x	0.7	=	15.4	(79)
Southwest0.9x	0.77	x	1.86	x	31.49		0.35	x	0.7	=	89.49	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	122.57	208.78	285.66	353.94	396.45	393.58	379.45	347.74	309.31	230.74	146.81	104.89	(83)

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

(84)m=	506.02	590.14	653.26	699.3	719.18	694.51	666.21	640.53	613.51	557.4	499.29	476.78	(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	0.89	0.75	0.57	0.61	0.84	0.97	1	1	(86)

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

(87)m=	19.85	20.01	20.25	20.53	20.79	20.94	20.99	20.98	20.89	20.56	20.15	19.82	(87)

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

(88)m=	20.01	20.01	20.02	20.02	20.02	20.03	20.03	20.03	20.03	20.02	20.02	20.02	(88)

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

(89)m=	1	0.99	0.98	0.95	0.85	0.66	0.45	0.49	0.77	0.96	0.99	1	(89)

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

(90)m=	18.48	18.72	19.05	19.47	19.81	19.99	20.02	20.02	19.94	19.51	18.91	18.44	(90)

fLA = Living area ÷ (4) = 0.3 (91)

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

(92)m=	18.9	19.11	19.41	19.79	20.1	20.28	20.31	20.31	20.22	19.83	19.29	18.85	(92)

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

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(93)m=	18.9	19.11	19.41	19.79	20.1	20.28	20.31	20.31	20.22	19.83	19.29	18.85	(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	0.94	0.86	0.68	0.49	0.53	0.79	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	503.98	584.7	639.1	660.15	617.07	474.24	324.96	339.88	482.76	532.47	494.92	475.35	(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=	1315.74	1278.54	1160.37	971.46	748.69	502.57	328.84	345.91	543.44	821.93	1088.59	1312.89	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	603.95	466.26	387.82	224.14	97.92	0	0	0	0	215.36	427.44	623.13	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3046.04 (98)

Space heating requirement in kWh/m²/year 36.7 (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) × [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)													
	603.95	466.26	387.82	224.14	97.92	0	0	0	0	215.36	427.44	623.13	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	645.94	498.68	414.79	239.73	104.73	0	0	0	0	230.33	457.16	666.45	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3257.79 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (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)

	169.58	148.76	154.55	136.22	131.8	115.36	108.51	122.23	123.02	141.39	152.42	164.73	
Efficiency of water heater												87.3	(216)
(217)m=	89.78	89.7	89.56	89.26	88.64	87.3	87.3	87.3	87.3	89.2	89.64	89.81	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	188.89	165.84	172.56	152.61	148.7	132.14	124.3	140.01	140.91	158.5	170.04	183.41

Total = Sum(219a)$_{1...12}$ = 1877.91 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3257.79

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Water heating fuel used			1877.91	
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			355.19	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			5565.89	(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	=	703.68	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	405.63	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1109.31	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	184.34	(268)
Total CO2, kg/year		sum of (265)…(271) =		1332.58	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		16.06	(273)
EI rating (section 14)				86	(274)

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User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version: Version: 1.0.5.59

Property Address: Kingston Bridge 3BF 83 TOP GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	83	(1a)	x	2.7	(2a)	=	224.1	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	83	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	224.1	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =		÷ (5) =	
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)	0.38	(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) =	0.33	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.38

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

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

(25)m=	0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(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			2.88	x1/[1/(1.4)+ 0.04]		=	3.82			(27)
Windows Type 2			1.86	x1/[1/(1.4)+ 0.04]		=	2.47			(27)
Walls		19.62	30.6	x	0.18	=	5.51			(29)
Roof		0	83	x	0.13	=	10.79			(30)
Total area of elements, m²			133.22							(31)
Party wall			57.08	x	0	=	0			(32)
Party floor			83							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 42.31 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8803.96 (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 7.08 (36)

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

Total fabric heat loss (33) + (36) = 49.39 (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=	43.38	43.13	42.88	41.74	41.53	40.53	40.53	40.34	40.91	41.53	41.96	42.41	(38)

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

(39)m=	92.76	92.52	92.27	91.13	90.91	89.92	89.92	89.73	90.3	90.91	91.35	91.8	

Average = Sum(39)$_{1…12}$ /12= 91.13 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(40)m=	1.12	1.11	1.11	1.1	1.1	1.08	1.08	1.08	1.09	1.1	1.1	1.11		
											Average = Sum(40)1…12 /12=		1.1	(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 2.52 (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 93.99 (43)

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

	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=	103.39	99.63	95.87	92.11	88.35	84.59	84.59	88.35	92.11	95.87	99.63	103.39		
											Total = Sum(44)1…12 =		1127.84	(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=	153.32	134.09	138.37	120.64	115.75	99.89	92.56	106.21	107.48	125.26	136.73	148.48		
											Total = Sum(45)1…12 =		1478.77	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)														
(46)m=	23	20.11	20.76	18.1	17.36	14.98	13.88	15.93	16.12	18.79	20.51	22.27		(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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

(61)m=	50.96	45.86	48.85	45.42	45.02	41.71	43.11	45.02	45.42	48.85	49.13	50.96	(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=	204.28	179.95	187.22	166.06	160.77	141.6	135.66	151.23	152.9	174.11	185.86	199.44	(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=	204.28	179.95	187.22	166.06	160.77	141.6	135.66	151.23	152.9	174.11	185.86	199.44

Output from water heater (annual)$_{1...12}$ 2039.09 (64)

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

(65)m=	63.72	56.05	58.22	51.47	49.74	43.64	41.55	46.57	47.09	53.86	57.75	62.11	(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=	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	(66)

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

(67)m=	20.11	17.86	14.53	11	8.22	6.94	7.5	9.75	13.08	16.61	19.39	20.67	(67)

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

(68)m=	225.6	227.94	222.04	209.48	193.63	178.73	168.77	166.43	172.33	184.89	200.74	215.64	(68)

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

(69)m=	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	(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=	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	(71)

Water heating gains (Table 5)

(72)m=	85.64	83.41	78.25	71.48	66.86	60.61	55.85	62.6	65.41	72.39	80.2	83.48	(72)

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

(73)m=	395.11	392.97	378.58	355.72	332.47	310.04	295.88	302.53	314.58	337.66	364.09	383.55	(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)	
Southwest 0.9x	0.77	x	2.88	x	36.79	0.63	x	0.7	=	32.38	(79)
Southwest 0.9x	0.77	x	1.86	x	36.79	0.63	x	0.7	=	188.24	(79)
Southwest 0.9x	0.77	x	2.88	x	62.67	0.63	x	0.7	=	55.16	(79)
Southwest 0.9x	0.77	x	1.86	x	62.67	0.63	x	0.7	=	320.64	(79)
Southwest 0.9x	0.77	x	2.88	x	85.75	0.63	x	0.7	=	75.48	(79)

Southwest0.9x	0.77	x	1.86	x	85.75		0.63	x	0.7	=	438.71	(79)
Southwest0.9x	0.77	x	2.88	x	106.25		0.63	x	0.7	=	93.52	(79)
Southwest0.9x	0.77	x	1.86	x	106.25		0.63	x	0.7	=	543.58	(79)
Southwest0.9x	0.77	x	2.88	x	119.01		0.63	x	0.7	=	104.75	(79)
Southwest0.9x	0.77	x	1.86	x	119.01		0.63	x	0.7	=	608.85	(79)
Southwest0.9x	0.77	x	2.88	x	118.15		0.63	x	0.7	=	103.99	(79)
Southwest0.9x	0.77	x	1.86	x	118.15		0.63	x	0.7	=	604.45	(79)
Southwest0.9x	0.77	x	2.88	x	113.91		0.63	x	0.7	=	100.26	(79)
Southwest0.9x	0.77	x	1.86	x	113.91		0.63	x	0.7	=	582.76	(79)
Southwest0.9x	0.77	x	2.88	x	104.39		0.63	x	0.7	=	91.88	(79)
Southwest0.9x	0.77	x	1.86	x	104.39		0.63	x	0.7	=	534.06	(79)
Southwest0.9x	0.77	x	2.88	x	92.85		0.63	x	0.7	=	81.73	(79)
Southwest0.9x	0.77	x	1.86	x	92.85		0.63	x	0.7	=	475.03	(79)
Southwest0.9x	0.77	x	2.88	x	69.27		0.63	x	0.7	=	60.97	(79)
Southwest0.9x	0.77	x	1.86	x	69.27		0.63	x	0.7	=	354.37	(79)
Southwest0.9x	0.77	x	2.88	x	44.07		0.63	x	0.7	=	38.79	(79)
Southwest0.9x	0.77	x	1.86	x	44.07		0.63	x	0.7	=	225.46	(79)
Southwest0.9x	0.77	x	2.88	x	31.49		0.63	x	0.7	=	27.71	(79)
Southwest0.9x	0.77	x	1.86	x	31.49		0.63	x	0.7	=	161.09	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	220.62	375.8	514.18	637.1	713.6	708.44	683.01	625.94	556.75	415.34	264.25	188.81	(83)

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

(84)m=	615.73	768.77	892.76	992.82	1046.07	1018.48	978.9	928.47	871.33	752.99	628.35	572.36	(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	0.96	0.88	0.74	0.55	0.4	0.44	0.68	0.92	0.99	1	(86)

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

(87)m=	19.93	20.16	20.45	20.74	20.92	20.99	21	21	20.96	20.71	20.26	19.89	(87)

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

(88)m=	19.99	19.99	19.99	20	20	20.01	20.01	20.02	20.01	20	20	20	(88)

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

(89)m=	0.99	0.98	0.94	0.85	0.68	0.47	0.31	0.35	0.59	0.89	0.98	1	(89)

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

(90)m=	18.58	18.92	19.32	19.72	19.93	20.01	20.01	20.01	19.98	19.69	19.06	18.52	(90)

fLA = Living area ÷ (4) = | 0.3 | (91)

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

(92)m=	18.99	19.29	19.66	20.02	20.23	20.3	20.31	20.31	20.28	20	19.42	18.94	(92)

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

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(93)m=	18.99	19.29	19.66	20.02	20.23	20.3	20.31	20.31	20.28	20	19.42	18.94	(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	0.97	0.94	0.85	0.69	0.5	0.34	0.38	0.62	0.89	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	610.01	748.93	835.92	841.67	725.69	505.69	332.85	349.62	537.3	668.24	614.64	568.52	(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=	1362.5	1331.46	1214.04	1013.74	775.31	512.6	333.6	350.9	557.82	854.47	1125.58	1352.8	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	559.85	391.46	281.33	123.89	36.92	0	0	0	0	138.56	367.88	583.5	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2483.39 (98)

Space heating requirement in kWh/m²/year 29.92 (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) × [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)													
	559.85	391.46	281.33	123.89	36.92	0	0	0	0	138.56	367.88	583.5	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	599.41	419.13	301.21	132.64	39.53	0	0	0	0	148.35	393.87	624.74	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2658.88 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (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)													
	204.28	179.95	187.22	166.06	160.77	141.6	135.66	151.23	152.9	174.11	185.86	199.44	
Efficiency of water heater												80.3	(216)
(217)m=	87.46	86.96	86.07	84.33	82.01	80.3	80.3	80.3	80.3	84.48	86.74	87.59	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	233.57	206.94	217.51	196.92	196.04	176.34	168.95	188.34	190.42	206.09	214.28	227.69	

Total = Sum(219a)$_{1...12}$ = 2423.07 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2658.88

TER WorkSheet: New dwelling design stage

Water heating fuel used			2423.07	
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			355.19	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			5512.14	(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	=	574.32	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	523.38	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1097.7	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	184.34	(268)
Total CO2, kg/year		sum of (265)…(271) =		1320.97	(272)

TER = 15.92 (273)

Appendix 2: 'Be Lean' SAP 10 Spreadsheet

Be Lean - SAP 2012 Methodology SAP 10 Carbon Factors

Project	Kingston Bridge House, Hampton Wick
Client	Westcombe
Date	Mar-23
Rev	C

SAP 2012	Carbon Factor	SAP 10	Carbon Factor
Gas	0.216	Gas	0.210
Grid Elec	0.519	Grid Elec	0.233

TER

Plot	Bedrooms	Floor Area	Location	Space Htg	Water Htg	Pumps/ Lighting	Emissions
1	3	86.7	GND	2739	2532	449	1212
2	1	55.6	GND	1750	2110	362	895
3	2	67.9	GND	2618	2269	402	1120
4	1	65.5	GND	2062	2485	426	1054
5	2	61.4	GND	2367	2052	364	1013
6	1	51.2	GND	1612	1943	333	824
7	1	50.0	GND	1574	1897	325	805
8	1	50.0	GND	1574	1897	325	805
9	1	50.0	GND	1574	1897	325	805
10	2	62.3	GND	2402	2082	369	1028
11	3	84.3	MID	1860	2482	437	1014
12	1	60.5	MID	1223	2318	394	835
13	2	74.9	MID	2069	2522	443	1067
14	1	65.2	MID	1318	2498	424	900
15	3	86.0	MID	1897	2532	446	1034
16	2	63.9	MID	1765	2151	378	911
17	2	61.0	MID	1685	2054	361	869
18	1	51.1	MID	1033	1958	332	705
19	1	50.0	MID	1011	1916	325	690
20	1	50.0	MID	1011	1916	325	690
21	1	50.0	MID	1011	1916	325	690
22	ST	37.5	MID	758	1437	244	518
23	1	53.9	MID	1090	2065	351	744
24	3	84.3	MID	1860	2482	437	1014
25	1	60.5	MID	1223	2318	394	835
26	2	74.9	MID	2069	2522	443	1067
27	1	65.2	MID	1318	2498	424	900
28	3	86.0	MID	1897	2532	446	1034
29	2	63.9	MID	1765	2151	378	911
30	2	61.0	MID	1685	2054	361	869
31	1	51.1	MID	1033	1958	332	705
32	1	50.0	MID	1011	1916	325	690
33	1	50.0	MID	1011	1916	325	690
34	1	50.0	MID	1011	1916	325	690
35	ST	37.5	MID	758	1437	244	518
36	1	53.9	MID	1090	2065	351	744
37	3	84.3	TOP	2701	2461	437	1186
38	1	60.5	TOP	1955	2294	394	984
39	2	74.9	TOP	2687	2508	443	1194
40	2	65.2	TOP	2339	2183	386	1040
41	3	86.0	TOP	2755	2511	446	1210
42	2	63.9	TOP	2292	2139	378	1019
43	2	61.0	MID	1685	2054	361	869
44	1	51.1	MID	1033	1958	332	705
45	1	50.0	MID	1011	1916	325	690
46	1	50.0	MID	1011	1916	325	690
47	1	50.0	MID	1011	1916	325	690
48	ST	37.5	MID	758	1437	244	518
49	1	53.9	MID	1090	2065	351	744
50	2	61.0	MID	1685	2054	361	869
51	1	51.1	MID	1033	1958	332	705
52	1	50.0	MID	1011	1916	325	690
53	1	50.0	MID	1011	1916	325	690
54	1	50.0	MID	1011	1916	325	690
55	ST	37.5	MID	758	1437	244	518
56	1	53.9	MID	1090	2065	351	744
57	2	61.0	MID	1685	2054	361	869
58	1	51.1	MID	1033	1958	332	705
59	1	50.0	MID	1011	1916	325	690
60	1	50.0	MID	1011	1916	325	690
61	1	50.0	MID	1011	1916	325	690
62	ST	37.5	MID	758	1437	244	518
63	1	53.9	MID	1090	2065	351	744
64	2	61.0	TOP	2188	2042	361	973
65	1	51.1	TOP	1651	1938	332	831
66	1	50.0	TOP	1616	1896	325	813
67	1	50.0	TOP	1616	1896	325	813
68	1	50.0	TOP	1616	1896	325	813
69	ST	37.5	TOP	1212	1422	244	610
70	1	53.9	TOP	1742	2044	351	877
		4026.0					
							57979.6

DER - Based on Gas Heating with SAP 10 Carbon Factors

Plot	Space Htg	Water Htg	Pumps/ Lighting	Emissions
1	3457	1962	449	1242.5
2	2088	1672	362	874.0
3	2903	1782	402	1077.7
4	2460	1970	426	1029.6
5	2626	1611	364	974.5
6	1923	1540	333	804.8
7	1878	1504	326	786.0
8	1878	1504	326	786.0
9	1878	1504	326	786.0
10	2664	1635	369	988.8
11	1631	1918	437	847.0
12	1100	1829	394	706.8
13	2005	1972	444	938.5
14	1185	1971	424	761.7
15	1664	1956	446	864.1
16	1710	1682	379	800.7
17	1633	1606	361	764.3
18	929	1545	333	597.0
19	909	1512	326	584.1
20	909	1512	326	584.1
21	909	1512	326	584.1
22	682	1134	244	438.1
23	980	1630	351	629.7
24	1631	1918	437	847.0
25	1100	1829	394	706.8
26	2005	1972	444	938.5
27	1185	1971	424	761.7
28	1664	1956	446	864.1
29	1710	1682	379	800.7
30	1633	1606	361	764.3
31	929	1545	333	597.0
32	909	1512	326	584.1
33	909	1512	326	584.1
34	909	1512	326	584.1
35	682	1134	244	438.1
36	980	1630	351	629.7
37	3309	1907	437	1197.3
38	2324	1819	394	961.6
39	2856	1968	444	1116.4
40	2486	1713	386	971.8
41	3376	1946	446	1221.4
42	2436	1679	379	952.4
43	1633	1606	361	764.3
44	929	1545	333	597.0
45	909	1512	326	584.1
46	909	1512	326	584.1
47	909	1512	326	584.1
48	682	1134	244	438.1
49	980	1630	351	629.7
50	1633	1606	361	764.3
51	929	1545	333	597.0
52	909	1512	326	584.1
53	909	1512	326	584.1
54	909	1512	326	584.1
55	682	1134	244	438.1
56	980	1630	351	629.7
57	1633	1606	361	764.3
58	929	1545	333	597.0
59	909	1512	326	584.1
60	909	1512	326	584.1
61	909	1512	326	584.1
62	682	1134	244	438.1
63	980	1630	351	629.7
64	2326	1603	361	909.2
65	1963	1536	333	812.2
66	1920	1503	326	794.7
67	1920	1503	326	794.7
68	1920	1503	326	794.7
69	1440	1127	244	596.1
70	2070	1620	351	856.7
				52074.2

Total Site Target Emissions	**57,980**	$kgCO_2$ per year
Total Site Design Emissions (Be Clean)	**52,074**	$kgCO_2$ per year
Total Reduction	**5,905**	$kgCO_2$ per year
% Reduction	**10.19%**	

Appendix 3 – DER Worksheets for Modelled Units using a Communal ASHP System

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.59

Property Address: Kingston Bridge 1BF GND 52 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	51.5	(1a) x	2.7	(2a) =	139.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	51.5	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	139.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =	÷ (5) =		
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)		0.27	(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) =	0.23	(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

0.29	0.29	0.28	0.25	0.25	0.22	0.22	0.21	0.23	0.25	0.26	0.27

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

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

(25)m=	0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.53	0.53	0.53	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			2.88	x1/[1/(1.2)+ 0.04]	=	3.3			(27)
Windows Type 2			1.86	x1/[1/(1.2)+ 0.04]	=	2.13			(27)
Floor			51.5	x 0.13	=	6.695			(28)
Walls		6.6	24.15	x 0.18	=	4.35			(29)
Total area of elements, m²			82.25						(31)
Party wall			53.34	x 0	=	0			(32)
Party ceiling			51.1						(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 18.6 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 10256.59 (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 7.32 (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 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	24.94	24.86	24.78	24.43	24.36	24.05	24.05	23.99	24.17	24.36	24.49	24.64	(38)

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

(39)m=	50.86	50.78	50.71	50.35	50.28	49.97	49.97	49.92	50.09	50.28	50.42	50.56	

Average = Sum(39)$_{1…12}$ /12= 50.35 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.99	0.99	0.98	0.98	0.98	0.97	0.97	0.97	0.97	0.98	0.98	0.98

Average = Sum(40)$_{1…12}$ /12= 0.98 (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 1.73 (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 75.39 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	82.93	79.91	76.9	73.88	70.87	67.85	67.85	70.87	73.88	76.9	79.91	82.93

Total = Sum(44)$_{1…12}$ = 904.68 (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=	122.98	107.56	110.99	96.77	92.85	80.12	74.24	85.2	86.21	100.47	109.68	119.1

Total = Sum(45)$_{1…12}$ = 1186.18 (45)

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

(46)m=	18.45	16.13	16.65	14.51	13.93	12.02	11.14	12.78	12.93	15.07	16.45	17.87	(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.72 (55)

Water storage loss calculated for each month ((56)m = (55) × (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)

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	(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=	168.56	148.73	156.58	140.88	138.43	124.23	119.83	130.78	130.33	146.06	153.79	164.68	(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=	168.56	148.73	156.58	140.88	138.43	124.23	119.83	130.78	130.33	146.06	153.79	164.68	

Output from water heater (annual)$_{1...12}$ 1722.88 (64)

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

(65)m=	77.36	68.7	73.37	67.46	67.34	61.93	61.15	64.79	63.96	69.87	71.76	76.07	(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=	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	(66)

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

(67)m=	14.74	13.09	10.65	8.06	6.02	5.09	5.5	7.14	9.59	12.17	14.21	15.15	(67)

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

(68)m=	151.13	152.7	148.74	140.33	129.71	119.73	113.06	111.49	115.45	123.86	134.48	144.46	(68)

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

(69)m=	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	(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=	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	(71)

Water heating gains (Table 5)

(72)m=	103.97	102.23	98.62	93.7	90.51	86.01	82.19	87.09	88.83	93.92	99.66	102.24	(72)

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

(73)m=	318.86	317.04	307.02	291.11	275.26	259.85	249.77	254.74	262.88	278.96	297.37	310.86	(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)	
Southeast 0.9x	0.77	x	2.88	x	36.79	x	0.3	x	0.7	=	15.42	(77)
Southeast 0.9x	0.77	x	1.86	x	36.79	x	0.3	x	0.7	=	19.92	(77)
Southeast 0.9x	0.77	x	2.88	x	62.67	x	0.3	x	0.7	=	26.27	(77)
Southeast 0.9x	0.77	x	1.86	x	62.67	x	0.3	x	0.7	=	33.93	(77)
Southeast 0.9x	0.77	x	2.88	x	85.75	x	0.3	x	0.7	=	35.94	(77)

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Southeast	0.9x	0.77	x	1.86	x	85.75	x	0.3	x	0.7	=	46.42	(77)
Southeast	0.9x	0.77	x	2.88	x	106.25	x	0.3	x	0.7	=	44.53	(77)
Southeast	0.9x	0.77	x	1.86	x	106.25	x	0.3	x	0.7	=	57.52	(77)
Southeast	0.9x	0.77	x	2.88	x	119.01	x	0.3	x	0.7	=	49.88	(77)
Southeast	0.9x	0.77	x	1.86	x	119.01	x	0.3	x	0.7	=	64.43	(77)
Southeast	0.9x	0.77	x	2.88	x	118.15	x	0.3	x	0.7	=	49.52	(77)
Southeast	0.9x	0.77	x	1.86	x	118.15	x	0.3	x	0.7	=	63.96	(77)
Southeast	0.9x	0.77	x	2.88	x	113.91	x	0.3	x	0.7	=	47.74	(77)
Southeast	0.9x	0.77	x	1.86	x	113.91	x	0.3	x	0.7	=	61.67	(77)
Southeast	0.9x	0.77	x	2.88	x	104.39	x	0.3	x	0.7	=	43.75	(77)
Southeast	0.9x	0.77	x	1.86	x	104.39	x	0.3	x	0.7	=	56.51	(77)
Southeast	0.9x	0.77	x	2.88	x	92.85	x	0.3	x	0.7	=	38.92	(77)
Southeast	0.9x	0.77	x	1.86	x	92.85	x	0.3	x	0.7	=	50.27	(77)
Southeast	0.9x	0.77	x	2.88	x	69.27	x	0.3	x	0.7	=	29.03	(77)
Southeast	0.9x	0.77	x	1.86	x	69.27	x	0.3	x	0.7	=	37.5	(77)
Southeast	0.9x	0.77	x	2.88	x	44.07	x	0.3	x	0.7	=	18.47	(77)
Southeast	0.9x	0.77	x	1.86	x	44.07	x	0.3	x	0.7	=	23.86	(77)
Southeast	0.9x	0.77	x	2.88	x	31.49	x	0.3	x	0.7	=	13.2	(77)
Southeast	0.9x	0.77	x	1.86	x	31.49	x	0.3	x	0.7	=	17.05	(77)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	35.34	60.2	82.37	102.05	114.31	113.48	109.41	100.27	89.18	66.53	42.33	30.24	(83)

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

(84)m=	354.2	377.23	389.39	393.16	389.57	373.33	359.18	355.01	352.06	345.5	339.7	341.11	(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	0.92	0.78	0.6	0.63	0.84	0.97	0.99	1	(86)

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

(87)m=	20.07	20.17	20.34	20.57	20.79	20.95	20.99	20.99	20.91	20.64	20.32	20.04	(87)

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

(88)m=	20.09	20.09	20.1	20.1	20.1	20.11	20.11	20.11	20.11	20.1	20.1	20.1	(88)

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

(89)m=	0.99	0.99	0.98	0.96	0.88	0.7	0.48	0.52	0.78	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=	18.85	19	19.25	19.59	19.89	20.07	20.1	20.1	20.03	19.69	19.22	18.82	(90)

fLA = Living area ÷ (4) = 0.49 (91)

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

(92)m=	19.44	19.57	19.78	20.06	20.33	20.49	20.53	20.53	20.46	20.15	19.75	19.41	(92)

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

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(93)m=	19.44	19.57	19.78	20.06	20.33	20.49	20.53	20.53	20.46	20.15	19.75	19.41	(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	0.96	0.89	0.74	0.54	0.57	0.81	0.95	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	351.88	373.33	381.97	376.45	348.02	274.75	193.81	202.41	283.82	329.1	335.34	339.28	(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=	770.11	744.81	673.39	562.09	433.78	294.56	196.61	206.27	318.46	480.41	637.86	769.15	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	311.17	249.64	216.81	133.67	63.81	0	0	0	0	112.57	217.82	319.82	

	Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	1625.31	(98)
Space heating requirement in kWh/m²/year		31.56	(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		**kWh/year**	
Annual space heating requirement		1625.31	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1706.57	(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		1722.88	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1809.02	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	35.16	(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)

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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)				260.28	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =				3775.88	(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)] x 100 ÷ (367b) x		0.52	=	455.01	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	18.25	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	473.26	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				473.26	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	135.09	(379)
Total CO2, kg/year	sum of (376)…(382) =				608.34	(383)
Dwelling CO2 Emission Rate					11.81	(384)
EI rating (section 14)					91.55	(385)

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User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.59

Property Address: Kingston Bridge 1BF MID 52 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	51.5	(1a) x	2.7	(2a) =	139.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	51.5	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	139.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =	÷ (5) =		
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)	0.27	(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) =	0.23	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.29	0.29	0.28	0.25	0.25	0.22	0.22	0.21	0.23	0.25	0.26	0.27

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

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

(25)m=	0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.53	0.53	0.53	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			2.88	x1/[1/(1.2)+ 0.04] =	3.3			(27)
Windows Type 2			1.86	x1/[1/(1.2)+ 0.04] =	2.13			(27)
Walls		6.6	24.15	x 0.18 =	4.35			(29)
Total area of elements, m²			30.75					(31)
Party wall			53.34	x 0 =	0			(32)
Party floor			51.5					(32a)
Party ceiling			51.1					(32b)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 11.9 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 11745.9 (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 3.14 (36)

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

Total fabric heat loss (33) + (36) = 15.04 (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=	24.94	24.86	24.78	24.43	24.36	24.05	24.05	23.99	24.17	24.36	24.49	24.64	(38)

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

(39)m=	39.98	39.9	39.83	39.47	39.4	39.09	39.09	39.04	39.21	39.4	39.54	39.68	

Average = Sum(39)$_{1…12}$ /12= 39.47 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.78	0.77	0.77	0.77	0.77	0.76	0.76	0.76	0.76	0.77	0.77	0.77

Average = Sum(40)$_{1\ldots12}$ /12= 0.77 (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 1.73 (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 75.39 (43)

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

	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=	82.93	79.91	76.9	73.88	70.87	67.85	67.85	70.87	73.88	76.9	79.91	82.93

Total = Sum(44)$_{1\ldots12}$ = 904.68 (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=	122.98	107.56	110.99	96.77	92.85	80.12	74.24	85.2	86.21	100.47	109.68	119.1

Total = Sum(45)$_{1\ldots12}$ = 1186.18 (45)

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

(46)m=	18.45	16.13	16.65	14.51	13.93	12.02	11.14	12.78	12.93	15.07	16.45	17.87	(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.72 (55)

Water storage loss calculated for each month ((56)m = (55) × (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)

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)

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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=	168.56	148.73	156.58	140.88	138.43	124.23	119.83	130.78	130.33	146.06	153.79	164.68	(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=	168.56	148.73	156.58	140.88	138.43	124.23	119.83	130.78	130.33	146.06	153.79	164.68

Output from water heater (annual)$_{1...12}$ 1722.88 (64)

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

(65)m=	77.36	68.7	73.37	67.46	67.34	61.93	61.15	64.79	63.96	69.87	71.76	76.07	(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=	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	14.74	13.09	10.65	8.06	6.02	5.09	5.5	7.14	9.59	12.17	14.21	15.15	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	151.13	152.7	148.74	140.33	129.71	119.73	113.06	111.49	115.45	123.86	134.48	144.46	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	(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=	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	(71)
Water heating gains (Table 5)													
(72)m=	103.97	102.23	98.62	93.7	90.51	86.01	82.19	87.09	88.83	93.92	99.66	102.24	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	318.86	317.04	307.02	291.11	275.26	259.85	249.77	254.74	262.88	278.96	297.37	310.86	(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)	
Southeast	0.9x	0.77	x	2.88	x	36.79	x	0.63	x	0.7	=	32.38	(77)
Southeast	0.9x	0.77	x	1.86	x	36.79	x	0.63	x	0.7	=	41.83	(77)
Southeast	0.9x	0.77	x	2.88	x	62.67	x	0.63	x	0.7	=	55.16	(77)
Southeast	0.9x	0.77	x	1.86	x	62.67	x	0.63	x	0.7	=	71.25	(77)
Southeast	0.9x	0.77	x	2.88	x	85.75	x	0.63	x	0.7	=	75.48	(77)

Southeast	0.9x	0.77	x	1.86	x	85.75	x	0.63	x	0.7	=	97.49	(77)
Southeast	0.9x	0.77	x	2.88	x	106.25	x	0.63	x	0.7	=	93.52	(77)
Southeast	0.9x	0.77	x	1.86	x	106.25	x	0.63	x	0.7	=	120.8	(77)
Southeast	0.9x	0.77	x	2.88	x	119.01	x	0.63	x	0.7	=	104.75	(77)
Southeast	0.9x	0.77	x	1.86	x	119.01	x	0.63	x	0.7	=	135.3	(77)
Southeast	0.9x	0.77	x	2.88	x	118.15	x	0.63	x	0.7	=	103.99	(77)
Southeast	0.9x	0.77	x	1.86	x	118.15	x	0.63	x	0.7	=	134.32	(77)
Southeast	0.9x	0.77	x	2.88	x	113.91	x	0.63	x	0.7	=	100.26	(77)
Southeast	0.9x	0.77	x	1.86	x	113.91	x	0.63	x	0.7	=	129.5	(77)
Southeast	0.9x	0.77	x	2.88	x	104.39	x	0.63	x	0.7	=	91.88	(77)
Southeast	0.9x	0.77	x	1.86	x	104.39	x	0.63	x	0.7	=	118.68	(77)
Southeast	0.9x	0.77	x	2.88	x	92.85	x	0.63	x	0.7	=	81.73	(77)
Southeast	0.9x	0.77	x	1.86	x	92.85	x	0.63	x	0.7	=	105.56	(77)
Southeast	0.9x	0.77	x	2.88	x	69.27	x	0.63	x	0.7	=	60.97	(77)
Southeast	0.9x	0.77	x	1.86	x	69.27	x	0.63	x	0.7	=	78.75	(77)
Southeast	0.9x	0.77	x	2.88	x	44.07	x	0.63	x	0.7	=	38.79	(77)
Southeast	0.9x	0.77	x	1.86	x	44.07	x	0.63	x	0.7	=	50.1	(77)
Southeast	0.9x	0.77	x	2.88	x	31.49	x	0.63	x	0.7	=	27.71	(77)
Southeast	0.9x	0.77	x	1.86	x	31.49	x	0.63	x	0.7	=	35.8	(77)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	74.21	126.42	172.97	214.31	240.05	238.31	229.76	210.56	187.29	139.72	88.89	63.51	(83)

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

(84)m=	393.07	443.45	479.99	505.42	515.31	498.16	479.53	465.3	450.16	418.68	386.26	374.38	(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	0.94	0.85	0.69	0.5	0.36	0.39	0.59	0.87	0.97	0.99	(86)

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

(87)m=	20.45	20.59	20.75	20.91	20.98	21	21	21	20.99	20.91	20.66	20.42	(87)

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

(88)m=	20.27	20.28	20.28	20.28	20.28	20.29	20.29	20.29	20.29	20.28	20.28	20.28	(88)

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

(89)m=	0.99	0.97	0.93	0.82	0.64	0.45	0.3	0.33	0.54	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=	19.56	19.75	19.98	20.18	20.27	20.29	20.29	20.29	20.28	20.19	19.86	19.51	(90)

fLA = Living area ÷ (4) = | 0.49 | (91)

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

(92)m=	19.99	20.16	20.35	20.53	20.61	20.63	20.63	20.63	20.63	20.54	20.25	19.95	(92)

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

(93)m=	19.99	20.16	20.35	20.53	20.61	20.63	20.63	20.63	20.63	20.54	20.25	19.95	(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	0.83	0.67	0.47	0.33	0.36	0.56	0.84	0.96	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	387.27	429.09	444.85	419.39	343.33	235.21	157.66	165.22	253.93	353.6	372.7	370.18	(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, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	627.34	608.75	551.71	459.12	351.18	235.83	157.7	165.29	255.98	391.55	519.76	625.08	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	178.61	120.73	79.5	28.61	5.84	0	0	0	0	28.23	105.88	189.65	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 737.06 (98)

Space heating requirement in kWh/m²/year 14.31 (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		**kWh/year**	
Annual space heating requirement		737.06	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	773.91	(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		1722.88	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1809.02	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	25.83	(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)

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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)				260.28	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =				2843.22	(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)] x 100 ÷ (367b) x		0.52	=	334.3	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	13.41	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	347.71	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				347.71	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	135.09	(379)
Total CO2, kg/year	sum of (376)…(382) =				482.79	(383)
Dwelling CO2 Emission Rate					9.37	(384)
EI rating (section 14)					93.3	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.59

Property Address: Kingston Bridge 1BF TOP 52 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	51.5	(1a) x	2.7	(2a) =	139.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	51.5	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		139.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =		÷ (5) =		
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)			0.27	(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) =		0.23	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.29	0.29	0.28	0.25	0.25	0.22	0.22	0.21	0.23	0.25	0.26	0.27

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

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

(25)m=	0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.53	0.53	0.53	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			2.88	x1/[1/(1.2)+ 0.04]		=	3.3			(27)
Windows Type 2			1.86	x1/[1/(1.2)+ 0.04]		=	2.13			(27)
Walls		6.6	24.15	x	0.18	=	4.35			(29)
Roof		0	51.5	x	0.13	=	6.69			(30)
Total area of elements, m²			82.25							(31)
Party wall			53.34	x	0	=	0			(32)
Party floor			51.5							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 18.6 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5867.59 (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 8.79 (36)

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

Total fabric heat loss (33) + (36) = 27.39 (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=	24.94	24.86	24.78	24.43	24.36	24.05	24.05	23.99	24.17	24.36	24.49	24.64	(38)

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

(39)m=	52.33	52.25	52.17	51.82	51.75	51.44	51.44	51.38	51.56	51.75	51.88	52.03	

Average = Sum(39)$_{1…12}$ /12= 51.82 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(40)m=	1.02	1.01	1.01	1.01	1	1	1	1	1	1	1.01	1.01		
											Average = Sum(40)$_{1...12}$ /12=		1.01	(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 1.73 (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 75.39 (43)

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

	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=	82.93	79.91	76.9	73.88	70.87	67.85	67.85	70.87	73.88	76.9	79.91	82.93		
											Total = Sum(44)$_{1...12}$ =		904.68	(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=	122.98	107.56	110.99	96.77	92.85	80.12	74.24	85.2	86.21	100.47	109.68	119.1		
											Total = Sum(45)$_{1...12}$ =		1186.18	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)														
(46)m=	18.45	16.13	16.65	14.51	13.93	12.02	11.14	12.78	12.93	15.07	16.45	17.87		(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) x (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) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0.72	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(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) ÷ 365 × (41)m

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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=	168.56	148.73	156.58	140.88	138.43	124.23	119.83	130.78	130.33	146.06	153.79	164.68	(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=	168.56	148.73	156.58	140.88	138.43	124.23	119.83	130.78	130.33	146.06	153.79	164.68	

Output from water heater (annual)$_{1...12}$ 1722.88 (64)

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

(65)m=	77.36	68.7	73.37	67.46	67.34	61.93	61.15	64.79	63.96	69.87	71.76	76.07	(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=	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	14.74	13.09	10.65	8.06	6.02	5.09	5.5	7.14	9.59	12.17	14.21	15.15	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	151.13	152.7	148.74	140.33	129.71	119.73	113.06	111.49	115.45	123.86	134.48	144.46	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	(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=	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	(71)
Water heating gains (Table 5)													
(72)m=	103.97	102.23	98.62	93.7	90.51	86.01	82.19	87.09	88.83	93.92	99.66	102.24	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	318.86	317.04	307.02	291.11	275.26	259.85	249.77	254.74	262.88	278.96	297.37	310.86	(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)	
Southeast 0.9x	0.77	x	2.88	x	36.79	x	0.35	x	0.7	=	17.99	(77)
Southeast 0.9x	0.77	x	1.86	x	36.79	x	0.35	x	0.7	=	23.24	(77)
Southeast 0.9x	0.77	x	2.88	x	62.67	x	0.35	x	0.7	=	30.65	(77)
Southeast 0.9x	0.77	x	1.86	x	62.67	x	0.35	x	0.7	=	39.58	(77)
Southeast 0.9x	0.77	x	2.88	x	85.75	x	0.35	x	0.7	=	41.93	(77)

Southeast 0.9x	0.77	x	1.86	x	85.75	x	0.35	x	0.7	=	54.16	(77)
Southeast 0.9x	0.77	x	2.88	x	106.25	x	0.35	x	0.7	=	51.96	(77)
Southeast 0.9x	0.77	x	1.86	x	106.25	x	0.35	x	0.7	=	67.11	(77)
Southeast 0.9x	0.77	x	2.88	x	119.01	x	0.35	x	0.7	=	58.19	(77)
Southeast 0.9x	0.77	x	1.86	x	119.01	x	0.35	x	0.7	=	75.17	(77)
Southeast 0.9x	0.77	x	2.88	x	118.15	x	0.35	x	0.7	=	57.77	(77)
Southeast 0.9x	0.77	x	1.86	x	118.15	x	0.35	x	0.7	=	74.62	(77)
Southeast 0.9x	0.77	x	2.88	x	113.91	x	0.35	x	0.7	=	55.7	(77)
Southeast 0.9x	0.77	x	1.86	x	113.91	x	0.35	x	0.7	=	71.95	(77)
Southeast 0.9x	0.77	x	2.88	x	104.39	x	0.35	x	0.7	=	51.04	(77)
Southeast 0.9x	0.77	x	1.86	x	104.39	x	0.35	x	0.7	=	65.93	(77)
Southeast 0.9x	0.77	x	2.88	x	92.85	x	0.35	x	0.7	=	45.4	(77)
Southeast 0.9x	0.77	x	1.86	x	92.85	x	0.35	x	0.7	=	58.65	(77)
Southeast 0.9x	0.77	x	2.88	x	69.27	x	0.35	x	0.7	=	33.87	(77)
Southeast 0.9x	0.77	x	1.86	x	69.27	x	0.35	x	0.7	=	43.75	(77)
Southeast 0.9x	0.77	x	2.88	x	44.07	x	0.35	x	0.7	=	21.55	(77)
Southeast 0.9x	0.77	x	1.86	x	44.07	x	0.35	x	0.7	=	27.83	(77)
Southeast 0.9x	0.77	x	2.88	x	31.49	x	0.35	x	0.7	=	15.4	(77)
Southeast 0.9x	0.77	x	1.86	x	31.49	x	0.35	x	0.7	=	19.89	(77)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	41.23	70.23	96.09	119.06	133.36	132.4	127.64	116.98	104.05	77.62	49.38	35.28	(83)

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

(84)m=	360.09	387.27	403.12	410.17	408.62	392.24	377.41	371.72	366.92	356.58	346.75	346.15	(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	0.77	0.59	0.62	0.84	0.96	0.99	1	(86)

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

(87)m=	20.04	20.15	20.33	20.57	20.79	20.95	20.99	20.99	20.91	20.64	20.29	20.01	(87)

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

(88)m=	20.07	20.07	20.07	20.08	20.08	20.08	20.08	20.09	20.08	20.08	20.08	20.07	(88)

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

(89)m=	0.99	0.99	0.98	0.95	0.87	0.68	0.47	0.5	0.77	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=	18.79	18.95	19.22	19.56	19.87	20.05	20.08	20.08	20.01	19.66	19.17	18.76	(90)

fLA = Living area ÷ (4) = 0.49 (91)

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

(92)m=	19.4	19.53	19.76	20.05	20.32	20.48	20.52	20.52	20.44	20.13	19.72	19.36	(92)

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

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(93)m=	19.4	19.53	19.76	20.05	20.32	20.48	20.52	20.52	20.44	20.13	19.72	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=	0.99	0.99	0.98	0.95	0.88	0.72	0.53	0.56	0.8	0.95	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	357.58	382.87	394.55	390.68	360.87	283.1	198.95	207.79	292.2	338.46	342.02	344.19	(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=	789.9	764.45	691.6	577.76	445.96	302.62	201.75	211.69	327.13	493.39	654.55	788.95	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	321.65	256.42	221	134.7	63.3	0	0	0	0	115.27	225.02	330.9	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	1668.26	(98)
Space heating requirement in kWh/m²/year	32.39	(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		**kWh/year**	
Annual space heating requirement		1668.26	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1751.68	(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		1722.88	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1809.02	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	35.61	(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)

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)				260.28	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =				3820.98	(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)] x 100 ÷ (367b) x		0.52	=	460.85	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	18.48	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	479.33	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				479.33	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	135.09	(379)
Total CO2, kg/year	sum of (376)…(382) =				614.42	(383)
Dwelling CO2 Emission Rate					11.93	(384)
EI rating (section 14)					91.47	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.59

Property Address: Kingston Bridge 2BF GND 65 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	65.2	(1a) x	2.7	(2a) =	176.04	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	65.2	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	176.04	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =		÷ (5) =		
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

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) × 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=	0.56	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			5.76	x1/[1/(1.2)+ 0.04]		=	6.6			(27)
Windows Type 2			1.86	x1/[1/(1.2)+ 0.04]		=	2.13			(27)
Floor			65.2	x	0.13	=	8.475999			(28)
Walls		9.48	34.64	x	0.18	=	6.24			(29)
Total area of elements, m²			109.32							(31)
Party wall			44.12	x	0	=	0			(32)
Party ceiling			65.2							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 25.57 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 12604.26 (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) = 33.55 (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=	32.4	32.27	32.14	31.54	31.43	30.91	30.91	30.81	31.11	31.43	31.66	31.9	(38)

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

(39)m=	65.95	65.82	65.69	65.09	64.98	64.45	64.45	64.36	64.66	64.98	65.2	65.44	

Average = Sum(39)$_{1…12}$ /12= 65.09 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.01	1.01	1.01	1	1	0.99	0.99	0.99	0.99	1	1	1

Average = Sum(40)1…12 /12= 1 (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 2.12 (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 84.65 (43)

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

	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=	93.12	89.73	86.34	82.96	79.57	76.19	76.19	79.57	82.96	86.34	89.73	93.12	
											Total = Sum(44)1…12 =	1015.8	(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=	138.09	120.77	124.63	108.65	104.25	89.96	83.36	95.66	96.8	112.82	123.15	133.73	
											Total = Sum(45)1…12 =	1331.88	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.71	18.12	18.69	16.3	15.64	13.49	12.5	14.35	14.52	16.92	18.47	20.06	(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.72 (55)

Water storage loss calculated for each month ((56)m = (55) × (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)

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)

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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=	183.67	161.94	170.21	152.76	149.84	134.08	128.95	141.24	140.92	158.4	167.26	179.31	(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=	183.67	161.94	170.21	152.76	149.84	134.08	128.95	141.24	140.92	158.4	167.26	179.31	

Output from water heater (annual)$_{1...12}$ | 1868.57 | (64)

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

(65)m=	82.38	73.09	77.9	71.42	71.13	65.2	64.18	68.27	67.48	73.98	76.24	80.93	(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=	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.63	15.66	12.73	9.64	7.21	6.08	6.57	8.55	11.47	14.56	17	18.12	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	185.85	187.77	182.91	172.57	159.51	147.23	139.03	137.11	141.97	152.31	165.37	177.65	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	(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=	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	(71)
Water heating gains (Table 5)													
(72)m=	110.73	108.77	104.71	99.19	95.61	90.56	86.27	91.77	93.72	99.43	105.88	108.78	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	369.07	367.07	355.22	336.26	317.18	298.74	286.74	292.28	302.02	321.17	343.12	359.41	(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)	
Northeast 0.9x	0.77	x	5.76	x	11.28	x	0.3	x	0.7	=	9.46	(75)
Northeast 0.9x	0.77	x	1.86	x	11.28	x	0.3	x	0.7	=	6.11	(75)
Northeast 0.9x	0.77	x	5.76	x	22.97	x	0.3	x	0.7	=	19.25	(75)
Northeast 0.9x	0.77	x	1.86	x	22.97	x	0.3	x	0.7	=	12.43	(75)
Northeast 0.9x	0.77	x	5.76	x	41.38	x	0.3	x	0.7	=	34.69	(75)

Northeast 0.9x	0.77	x	1.86	x	41.38	x	0.3	x	0.7	=	22.4	(75)
Northeast 0.9x	0.77	x	5.76	x	67.96	x	0.3	x	0.7	=	56.96	(75)
Northeast 0.9x	0.77	x	1.86	x	67.96	x	0.3	x	0.7	=	36.79	(75)
Northeast 0.9x	0.77	x	5.76	x	91.35	x	0.3	x	0.7	=	76.57	(75)
Northeast 0.9x	0.77	x	1.86	x	91.35	x	0.3	x	0.7	=	49.45	(75)
Northeast 0.9x	0.77	x	5.76	x	97.38	x	0.3	x	0.7	=	81.63	(75)
Northeast 0.9x	0.77	x	1.86	x	97.38	x	0.3	x	0.7	=	52.72	(75)
Northeast 0.9x	0.77	x	5.76	x	91.1	x	0.3	x	0.7	=	76.37	(75)
Northeast 0.9x	0.77	x	1.86	x	91.1	x	0.3	x	0.7	=	49.32	(75)
Northeast 0.9x	0.77	x	5.76	x	72.63	x	0.3	x	0.7	=	60.88	(75)
Northeast 0.9x	0.77	x	1.86	x	72.63	x	0.3	x	0.7	=	39.32	(75)
Northeast 0.9x	0.77	x	5.76	x	50.42	x	0.3	x	0.7	=	42.27	(75)
Northeast 0.9x	0.77	x	1.86	x	50.42	x	0.3	x	0.7	=	27.3	(75)
Northeast 0.9x	0.77	x	5.76	x	28.07	x	0.3	x	0.7	=	23.53	(75)
Northeast 0.9x	0.77	x	1.86	x	28.07	x	0.3	x	0.7	=	15.19	(75)
Northeast 0.9x	0.77	x	5.76	x	14.2	x	0.3	x	0.7	=	11.9	(75)
Northeast 0.9x	0.77	x	1.86	x	14.2	x	0.3	x	0.7	=	7.69	(75)
Northeast 0.9x	0.77	x	5.76	x	9.21	x	0.3	x	0.7	=	7.72	(75)
Northeast 0.9x	0.77	x	1.86	x	9.21	x	0.3	x	0.7	=	4.99	(75)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	15.57	31.69	57.09	93.75	126.02	134.35	125.69	100.2	69.56	38.72	19.59	12.71	(83)

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

(84)m=	384.63	398.75	412.31	430.02	443.21	433.1	412.43	392.48	371.58	359.89	362.7	372.12	(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=	1	1	0.99	0.98	0.95	0.83	0.66	0.71	0.92	0.99	1	1	(86)

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

(87)m=	19.94	20.02	20.2	20.46	20.73	20.92	20.98	20.97	20.84	20.52	20.19	19.92	(87)

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

(88)m=	20.07	20.08	20.08	20.08	20.09	20.09	20.09	20.09	20.09	20.09	20.08	20.08	(88)

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

(89)m=	1	1	0.99	0.98	0.92	0.75	0.54	0.59	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=	18.65	18.77	19.03	19.42	19.79	20.03	20.09	20.08	19.95	19.51	19.03	18.63	(90)

fLA = Living area ÷ (4) = 0.38 (91)

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

(92)m=	19.15	19.25	19.48	19.82	20.15	20.37	20.43	20.42	20.29	19.9	19.48	19.13	(92)

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

(93)m=	19.15	19.25	19.48	19.82	20.15	20.37	20.43	20.42	20.29	19.9	19.48	19.13	(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	0.78	0.59	0.64	0.88	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	383.35	396.88	408.62	419.64	409.6	337.4	241.3	250.17	326.92	351.83	360.48	371.1	(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=	979.07	944.59	852.58	710.63	549.02	372.1	246.84	258.98	400.33	604.37	806.96	976.87	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	443.21	368.06	330.3	209.51	103.73	0	0	0	0	187.88	321.47	450.7	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2414.86 (98)

Space heating requirement in kWh/m²/year 37.04 (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		**kWh/year**	
Annual space heating requirement		2414.86	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	2535.61	(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		1868.57	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1962	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	44.98	(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)		311.36	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		4808.96	(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)] x 100 ÷ (367b) x		0.52	=	582.11	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	23.34	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	605.45	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				605.45	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	161.59	(379)
Total CO2, kg/year	sum of (376)…(382) =				767.04	(383)
Dwelling CO2 Emission Rate					11.76	(384)
EI rating (section 14)					90.67	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.59

Property Address: Kingston Bridge 2BF MID 65 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	65.2	(1a) x	2.7	(2a) =	176.04	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	65.2	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		176.04	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =		÷ (5) =	

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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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) × 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=	0.56	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			5.76	x1/[1/(1.2)+ 0.04]		=	6.6			(27)
Windows Type 2			1.86	x1/[1/(1.2)+ 0.04]		=	2.13			(27)
Walls		9.48	34.64	x	0.18	=	6.24			(29)
Total area of elements, m²			44.12							(31)
Party wall			44.12	x	0	=	0			(32)
Party floor			65.2							(32a)
Party ceiling			65.2							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 17.09 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 12930.26 (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 3.89 (36)

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

Total fabric heat loss (33) + (36) = 20.98 (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=	32.4	32.27	32.14	31.54	31.43	30.91	30.91	30.81	31.11	31.43	31.66	31.9	(38)

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

(39)m=	53.39	53.26	53.13	52.53	52.42	51.89	51.89	51.8	52.09	52.42	52.64	52.88	

Average = Sum(39)$_{1…12}$ /12= 52.53 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.82	0.82	0.81	0.81	0.8	0.8	0.8	0.79	0.8	0.8	0.81	0.81	

Average = Sum(40)$_{1...12}$ /12= 0.81 (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 2.12 (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 84.65 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	93.12	89.73	86.34	82.96	79.57	76.19	76.19	79.57	82.96	86.34	89.73	93.12	

Total = Sum(44)$_{1...12}$ = 1015.8 (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=	138.09	120.77	124.63	108.65	104.25	89.96	83.36	95.66	96.8	112.82	123.15	133.73	

Total = Sum(45)$_{1...12}$ = 1331.88 (45)

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

(46)m=	20.71	18.12	18.69	16.3	15.64	13.49	12.5	14.35	14.52	16.92	18.47	20.06	(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.72 (55)

Water storage loss calculated for each month ((56)m = (55) × (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)

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)

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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=	183.67	161.94	170.21	152.76	149.84	134.08	128.95	141.24	140.92	158.4	167.26	179.31	(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=	183.67	161.94	170.21	152.76	149.84	134.08	128.95	141.24	140.92	158.4	167.26	179.31	

Output from water heater (annual)1…12 | 1868.57 | (64)

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

(65)m=	82.38	73.09	77.9	71.42	71.13	65.2	64.18	68.27	67.48	73.98	76.24	80.93	(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=	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.63	15.66	12.73	9.64	7.21	6.08	6.57	8.55	11.47	14.56	17	18.12	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	185.85	187.77	182.91	172.57	159.51	147.23	139.03	137.11	141.97	152.31	165.37	177.65	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	(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=	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	(71)
Water heating gains (Table 5)													
(72)m=	110.73	108.77	104.71	99.19	95.61	90.56	86.27	91.77	93.72	99.43	105.88	108.78	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	369.07	367.07	355.22	336.26	317.18	298.74	286.74	292.28	302.02	321.17	343.12	359.41	(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)	
Northeast 0.9x	0.77	x	5.76	x	11.28	x	0.63	x	0.7	=	19.86	(75)
Northeast 0.9x	0.77	x	1.86	x	11.28	x	0.63	x	0.7	=	12.83	(75)
Northeast 0.9x	0.77	x	5.76	x	22.97	x	0.63	x	0.7	=	40.43	(75)
Northeast 0.9x	0.77	x	1.86	x	22.97	x	0.63	x	0.7	=	26.11	(75)
Northeast 0.9x	0.77	x	5.76	x	41.38	x	0.63	x	0.7	=	72.84	(75)

Northeast 0.9x	0.77	x	1.86	x	41.38	x	0.63	x	0.7	=	47.04	(75)
Northeast 0.9x	0.77	x	5.76	x	67.96	x	0.63	x	0.7	=	119.62	(75)
Northeast 0.9x	0.77	x	1.86	x	67.96	x	0.63	x	0.7	=	77.26	(75)
Northeast 0.9x	0.77	x	5.76	x	91.35	x	0.63	x	0.7	=	160.8	(75)
Northeast 0.9x	0.77	x	1.86	x	91.35	x	0.63	x	0.7	=	103.85	(75)
Northeast 0.9x	0.77	x	5.76	x	97.38	x	0.63	x	0.7	=	171.43	(75)
Northeast 0.9x	0.77	x	1.86	x	97.38	x	0.63	x	0.7	=	110.71	(75)
Northeast 0.9x	0.77	x	5.76	x	91.1	x	0.63	x	0.7	=	160.37	(75)
Northeast 0.9x	0.77	x	1.86	x	91.1	x	0.63	x	0.7	=	103.57	(75)
Northeast 0.9x	0.77	x	5.76	x	72.63	x	0.63	x	0.7	=	127.85	(75)
Northeast 0.9x	0.77	x	1.86	x	72.63	x	0.63	x	0.7	=	82.57	(75)
Northeast 0.9x	0.77	x	5.76	x	50.42	x	0.63	x	0.7	=	88.76	(75)
Northeast 0.9x	0.77	x	1.86	x	50.42	x	0.63	x	0.7	=	57.32	(75)
Northeast 0.9x	0.77	x	5.76	x	28.07	x	0.63	x	0.7	=	49.41	(75)
Northeast 0.9x	0.77	x	1.86	x	28.07	x	0.63	x	0.7	=	31.91	(75)
Northeast 0.9x	0.77	x	5.76	x	14.2	x	0.63	x	0.7	=	24.99	(75)
Northeast 0.9x	0.77	x	1.86	x	14.2	x	0.63	x	0.7	=	16.14	(75)
Northeast 0.9x	0.77	x	5.76	x	9.21	x	0.63	x	0.7	=	16.22	(75)
Northeast 0.9x	0.77	x	1.86	x	9.21	x	0.63	x	0.7	=	10.48	(75)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	32.69	66.54	119.88	196.88	264.65	282.14	263.94	210.42	146.08	81.32	41.13	26.7	(83)

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

(84)m=	401.75	433.61	475.11	533.14	581.83	580.88	550.68	502.7	448.1	402.49	384.25	386.1	(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	0.93	0.78	0.57	0.41	0.47	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=	20.25	20.35	20.54	20.79	20.95	21	21	21	20.97	20.76	20.46	20.23	(87)

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

(88)m=	20.24	20.24	20.24	20.25	20.25	20.26	20.26	20.26	20.25	20.25	20.25	20.24	(88)

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

(89)m=	1	0.99	0.98	0.91	0.74	0.5	0.34	0.4	0.69	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=	19.23	19.37	19.65	20	20.2	20.25	20.26	20.26	20.23	19.97	19.55	19.2	(90)

fLA = Living area ÷ (4) = 0.38 (91)

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

(92)m=	19.62	19.75	19.99	20.3	20.49	20.54	20.54	20.54	20.51	20.27	19.9	19.6	(92)

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

(93)m=	19.62	19.75	19.99	20.3	20.49	20.54	20.54	20.54	20.51	20.27	19.9	19.6	(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	0.92	0.75	0.53	0.37	0.43	0.72	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	399.94	430	464.37	488.21	437.07	306.21	204.39	214.17	321.28	381.56	380.43	384.74	(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=	817.73	790.59	716.53	599.05	460.76	308.14	204.54	214.53	334.17	506.96	673.72	814.1	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	310.84	242.31	187.61	79.81	17.62	0	0	0	0	93.29	211.16	319.44	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	1462.09	(98)
Space heating requirement in kWh/m²/year	22.42	(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		**kWh/year**	
Annual space heating requirement		1462.09	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1535.2	(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		1868.57	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1962	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	34.97	(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)

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)			311.36	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =			3808.55	(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)] x 100 ÷ (367b) x		0.52	=	452.63	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	18.15	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	470.78	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				470.78	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	161.59	(379)
Total CO2, kg/year	sum of (376)…(382) =				632.37	(383)
Dwelling CO2 Emission Rate					9.7	(384)
EI rating (section 14)					92.31	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.59

Property Address: Kingston Bridge 2BF TOP 65 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	65.2	(1a) x	2.7	(2a) =	176.04	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	65.2	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		176.04	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =		÷ (5) =		
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

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) × 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=	0.56	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			5.76	x1/[1/(1.2)+ 0.04]		=	6.6			(27)
Windows Type 2			1.86	x1/[1/(1.2)+ 0.04]		=	2.13			(27)
Walls		9.48	34.64	x	0.18	=	6.24			(29)
Roof		0	65.2	x	0.13	=	8.48			(30)
Total area of elements, m²			109.32							(31)
Party wall			44.12	x	0	=	0			(32)
Party floor			65.2							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 25.57 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6997.06 (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 3.89 (36)

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

Total fabric heat loss (33) + (36) = 29.46 (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=	32.4	32.27	32.14	31.54	31.43	30.91	30.91	30.81	31.11	31.43	31.66	31.9	(38)

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

(39)m=	61.86	61.73	61.6	61	60.89	60.37	60.37	60.27	60.57	60.89	61.12	61.36	

Average = Sum(39)$_{1…12}$ /12= 61 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.95	0.95	0.94	0.94	0.93	0.93	0.93	0.92	0.93	0.93	0.94	0.94	

Average = Sum(40)$_{1…12}$ /12= 0.94 (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 2.12 (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 84.65 (43)

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

	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=	93.12	89.73	86.34	82.96	79.57	76.19	76.19	79.57	82.96	86.34	89.73	93.12	
										Total = Sum(44)$_{1…12}$ =		1015.8	(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=	138.09	120.77	124.63	108.65	104.25	89.96	83.36	95.66	96.8	112.82	123.15	133.73	
										Total = Sum(45)$_{1…12}$ =		1331.88	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.71	18.12	18.69	16.3	15.64	13.49	12.5	14.35	14.52	16.92	18.47	20.06	(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.72 (55)

Water storage loss calculated for each month ((56)m = (55) × (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)

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)

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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=	183.67	161.94	170.21	152.76	149.84	134.08	128.95	141.24	140.92	158.4	167.26	179.31	(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=	183.67	161.94	170.21	152.76	149.84	134.08	128.95	141.24	140.92	158.4	167.26	179.31	

Output from water heater (annual)$_{1...12}$ 1868.57 (64)

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

(65)m=	82.38	73.09	77.9	71.42	71.13	65.2	64.18	68.27	67.48	73.98	76.24	80.93	(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=	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	106.21	(66)

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

(67)m=	17.63	15.66	12.73	9.64	7.21	6.08	6.57	8.55	11.47	14.56	17	18.12	(67)

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

(68)m=	185.85	187.77	182.91	172.57	159.51	147.23	139.03	137.11	141.97	152.31	165.37	177.65	(68)

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

(69)m=	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	(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=	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	-84.97	(71)

Water heating gains (Table 5)

(72)m=	110.73	108.77	104.71	99.19	95.61	90.56	86.27	91.77	93.72	99.43	105.88	108.78	(72)

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

(73)m=	369.07	367.07	355.22	336.26	317.18	298.74	286.74	292.28	302.02	321.17	343.12	359.41	(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)	
Northeast 0.9x	0.77	x	5.76	x	11.28	x	0.35	x	0.7	=	11.03	(75)
Northeast 0.9x	0.77	x	1.86	x	11.28	x	0.35	x	0.7	=	7.13	(75)
Northeast 0.9x	0.77	x	5.76	x	22.97	x	0.35	x	0.7	=	22.46	(75)
Northeast 0.9x	0.77	x	1.86	x	22.97	x	0.35	x	0.7	=	14.51	(75)
Northeast 0.9x	0.77	x	5.76	x	41.38	x	0.35	x	0.7	=	40.47	(75)

Northeast 0.9x	0.77	x	1.86	x	41.38	x	0.35	x	0.7	=	26.13	(75)
Northeast 0.9x	0.77	x	5.76	x	67.96	x	0.35	x	0.7	=	66.46	(75)
Northeast 0.9x	0.77	x	1.86	x	67.96	x	0.35	x	0.7	=	42.92	(75)
Northeast 0.9x	0.77	x	5.76	x	91.35	x	0.35	x	0.7	=	89.33	(75)
Northeast 0.9x	0.77	x	1.86	x	91.35	x	0.35	x	0.7	=	57.69	(75)
Northeast 0.9x	0.77	x	5.76	x	97.38	x	0.35	x	0.7	=	95.24	(75)
Northeast 0.9x	0.77	x	1.86	x	97.38	x	0.35	x	0.7	=	61.51	(75)
Northeast 0.9x	0.77	x	5.76	x	91.1	x	0.35	x	0.7	=	89.09	(75)
Northeast 0.9x	0.77	x	1.86	x	91.1	x	0.35	x	0.7	=	57.54	(75)
Northeast 0.9x	0.77	x	5.76	x	72.63	x	0.35	x	0.7	=	71.03	(75)
Northeast 0.9x	0.77	x	1.86	x	72.63	x	0.35	x	0.7	=	45.87	(75)
Northeast 0.9x	0.77	x	5.76	x	50.42	x	0.35	x	0.7	=	49.31	(75)
Northeast 0.9x	0.77	x	1.86	x	50.42	x	0.35	x	0.7	=	31.85	(75)
Northeast 0.9x	0.77	x	5.76	x	28.07	x	0.35	x	0.7	=	27.45	(75)
Northeast 0.9x	0.77	x	1.86	x	28.07	x	0.35	x	0.7	=	17.73	(75)
Northeast 0.9x	0.77	x	5.76	x	14.2	x	0.35	x	0.7	=	13.88	(75)
Northeast 0.9x	0.77	x	1.86	x	14.2	x	0.35	x	0.7	=	8.97	(75)
Northeast 0.9x	0.77	x	5.76	x	9.21	x	0.35	x	0.7	=	9.01	(75)
Northeast 0.9x	0.77	x	1.86	x	9.21	x	0.35	x	0.7	=	5.82	(75)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	18.16	36.97	66.6	109.38	147.03	156.75	146.63	116.9	81.16	45.18	22.85	14.83	(83)

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

(84)m=	387.23	404.03	421.82	445.64	464.21	455.49	433.37	409.18	383.17	366.35	365.97	374.24	(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	0.78	0.6	0.66	0.89	0.98	1	1	(86)
Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)													
(87)m=	20.03	20.12	20.29	20.55	20.8	20.95	20.99	20.99	20.89	20.59	20.27	20.02	(87)
Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)													
(88)m=	20.13	20.13	20.13	20.14	20.14	20.15	20.15	20.15	20.14	20.14	20.14	20.13	(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=	18.83	18.95	19.21	19.58	19.92	20.11	20.14	20.14	20.04	19.65	19.19	18.81	(90)

fLA = Living area ÷ (4) = 0.38 (91)

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

(92)m=	19.29	19.4	19.62	19.95	20.26	20.43	20.47	20.46	20.37	20.01	19.6	19.27	(92)

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

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(93)m=	19.29	19.4	19.62	19.95	20.26	20.43	20.47	20.46	20.37	20.01	19.6	19.27	(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	0.99	0.97	0.9	0.73	0.53	0.59	0.85	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	385.89	401.98	417.43	432.01	418.15	331.72	230.82	240.35	326.72	356.72	363.55	373.18	(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, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	927.31	894.93	808.35	674.27	521.11	352.15	233.49	244.99	379.53	572.95	764.16	924.7	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	402.81	331.26	290.85	174.43	76.6	0	0	0	0	160.88	288.45	410.33	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2135.61	(98)
Space heating requirement in kWh/m²/year	32.75	(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		**kWh/year**	
Annual space heating requirement		2135.61	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	2242.39	(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		1868.57	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1962	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	42.04	(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)

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)				311.36	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =				4515.74	(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)] x 100 ÷ (367b) x		0.52	=	544.16	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	21.82	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	565.98	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				565.98	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	161.59	(379)
Total CO2, kg/year	sum of (376)…(382) =				727.57	(383)
Dwelling CO2 Emission Rate					11.16	(384)
EI rating (section 14)					91.15	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version: Version: 1.0.5.59

Property Address: Kingston Bridge 3BF GND 83 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	83	(1a) x	2.7	(2a) =	224.1	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	83	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	224.1	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =		÷ (5) =		
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)			0.29	(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) =	0.25	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.31	0.31	0.3	0.27	0.26	0.23	0.23	0.23	0.25	0.26	0.28	0.29

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=	0.55	0.55	0.55	0.54	0.53	0.53	0.53	0.53	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	0.55	0.55	0.54	0.53	0.53	0.53	0.53	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			2.88	x1/[1/(1.2)+ 0.04] =	3.3			(27)
Windows Type 2			1.86	x1/[1/(1.2)+ 0.04] =	2.13			(27)
Floor			83	x 0.13 =	10.79			(28)
Walls		19.62	30.6	x 0.18 =	5.51			(29)
Total area of elements, m²			133.22					(31)
Party wall			57.08	x 0 =	0			(32)
Party ceiling			83					(32b)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 38.76 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 15941.96 (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 9.26 (36)

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

Total fabric heat loss (33) + (36) = 48.03 (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=	40.61	40.47	40.33	39.68	39.56	38.99	38.99	38.89	39.21	39.56	39.81	40.06	(38)

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

(39)m=	88.64	88.49	88.36	87.71	87.59	87.02	87.02	86.91	87.24	87.59	87.83	88.09	

Average = Sum(39)$_{1…12}$ /12= 87.71 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(40)m=	1.07	1.07	1.06	1.06	1.06	1.05	1.05	1.05	1.05	1.06	1.06	1.06

Average = Sum(40)$_{1…12}$ /12= 1.06 (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 2.52 (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 93.99 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	103.39	99.63	95.87	92.11	88.35	84.59	84.59	88.35	92.11	95.87	99.63	103.39

Total = Sum(44)$_{1…12}$ = 1127.84 (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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(45)m=	153.32	134.09	138.37	120.64	115.75	99.89	92.56	106.21	107.48	125.26	136.73	148.48

Total = Sum(45)$_{1…12}$ = 1478.77 (45)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(46)m=	23	20.11	20.76	18.1	17.36	14.98	13.88	15.93	16.12	18.79	20.51	22.27

(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.72 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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) ÷ 365 × (41)m

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26

(59)

Combi loss 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=	198.9	175.26	183.95	164.75	161.33	144	138.14	151.79	151.59	170.84	180.84	194.06	(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=	198.9	175.26	183.95	164.75	161.33	144	138.14	151.79	151.59	170.84	180.84	194.06	

Output from water heater (annual)$_{1...12}$ 2015.47 (64)

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

(65)m=	87.44	77.52	82.47	75.4	74.95	68.5	67.24	71.78	71.03	78.11	80.75	85.84	(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=	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	(66)

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

(67)m=	20.11	17.86	14.53	11	8.22	6.94	7.5	9.75	13.08	16.61	19.39	20.67	(67)

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

(68)m=	225.6	227.94	222.04	209.48	193.63	178.73	168.77	166.43	172.33	184.89	200.74	215.64	(68)

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

(69)m=	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	(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=	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	(71)

Water heating gains (Table 5)

(72)m=	117.53	115.36	110.85	104.72	100.74	95.14	90.38	96.48	98.65	104.99	112.16	115.37	(72)

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

(73)m=	424	421.92	408.18	385.96	363.35	341.57	327.41	333.42	344.82	367.26	393.05	412.44	(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)	
Southwest 0.9x	0.77	x	2.88	x	36.79	0.3	x	0.7	=	15.42	(79)
Southwest 0.9x	0.77	x	1.86	x	36.79	0.3	x	0.7	=	89.64	(79)
Southwest 0.9x	0.77	x	2.88	x	62.67	0.3	x	0.7	=	26.27	(79)
Southwest 0.9x	0.77	x	1.86	x	62.67	0.3	x	0.7	=	152.68	(79)
Southwest 0.9x	0.77	x	2.88	x	85.75	0.3	x	0.7	=	35.94	(79)

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Southwest0.9x	0.77	x	1.86	x	85.75		0.3	x	0.7	=	208.91	(79)
Southwest0.9x	0.77	x	2.88	x	106.25		0.3	x	0.7	=	44.53	(79)
Southwest0.9x	0.77	x	1.86	x	106.25		0.3	x	0.7	=	258.85	(79)
Southwest0.9x	0.77	x	2.88	x	119.01		0.3	x	0.7	=	49.88	(79)
Southwest0.9x	0.77	x	1.86	x	119.01		0.3	x	0.7	=	289.93	(79)
Southwest0.9x	0.77	x	2.88	x	118.15		0.3	x	0.7	=	49.52	(79)
Southwest0.9x	0.77	x	1.86	x	118.15		0.3	x	0.7	=	287.83	(79)
Southwest0.9x	0.77	x	2.88	x	113.91		0.3	x	0.7	=	47.74	(79)
Southwest0.9x	0.77	x	1.86	x	113.91		0.3	x	0.7	=	277.5	(79)
Southwest0.9x	0.77	x	2.88	x	104.39		0.3	x	0.7	=	43.75	(79)
Southwest0.9x	0.77	x	1.86	x	104.39		0.3	x	0.7	=	254.31	(79)
Southwest0.9x	0.77	x	2.88	x	92.85		0.3	x	0.7	=	38.92	(79)
Southwest0.9x	0.77	x	1.86	x	92.85		0.3	x	0.7	=	226.2	(79)
Southwest0.9x	0.77	x	2.88	x	69.27		0.3	x	0.7	=	29.03	(79)
Southwest0.9x	0.77	x	1.86	x	69.27		0.3	x	0.7	=	168.75	(79)
Southwest0.9x	0.77	x	2.88	x	44.07		0.3	x	0.7	=	18.47	(79)
Southwest0.9x	0.77	x	1.86	x	44.07		0.3	x	0.7	=	107.36	(79)
Southwest0.9x	0.77	x	2.88	x	31.49		0.3	x	0.7	=	13.2	(79)
Southwest0.9x	0.77	x	1.86	x	31.49		0.3	x	0.7	=	76.71	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	105.06	178.95	244.85	303.38	339.81	337.35	325.24	298.07	265.12	197.78	125.83	89.91	(83)

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

(84)m=	529.06	600.87	653.03	689.34	703.16	678.92	652.66	631.49	609.94	565.03	518.88	502.35	(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	0.75	0.57	0.61	0.84	0.97	0.99	1	(86)

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

(87)m=	19.91	20.05	20.27	20.54	20.79	20.95	20.99	20.99	20.9	20.58	20.19	19.87	(87)

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

(88)m=	20.03	20.03	20.03	20.04	20.04	20.04	20.04	20.04	20.04	20.04	20.04	20.03	(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	0.46	0.5	0.77	0.96	0.99	1	(89)

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

(90)m=	18.57	18.78	19.1	19.49	19.82	20	20.04	20.04	19.96	19.55	18.99	18.53	(90)

fLA = Living area ÷ (4) = 0.3 (91)

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

(92)m=	18.97	19.16	19.45	19.81	20.12	20.29	20.33	20.32	20.24	19.86	19.35	18.93	(92)

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

(93)m=	18.97	19.16	19.45	19.81	20.12	20.29	20.33	20.32	20.24	19.86	19.35	18.93	(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	0.86	0.69	0.49	0.53	0.78	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	526.46	594.84	638.66	651.68	606.54	467.08	320.45	335.31	478.37	537.92	513.5	500.45	(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=	1300.42	1262.07	1144.17	956.81	737.05	494.98	324.18	340.98	535.6	811.35	1075.89	1297.81	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	575.83	448.38	376.1	219.69	97.1	0	0	0	0	203.43	404.92	593.24	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2918.69	(98)
Space heating requirement in kWh/m²/year	35.16	(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		**kWh/year**	
Annual space heating requirement		2918.69	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	3064.62	(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		2015.47	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2116.24	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	51.81	(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)

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)		355.19	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		5536.05	(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)] x 100 ÷ (367b) x		0.52	=	670.54	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	26.89	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	697.43	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				697.43	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	184.34	(379)
Total CO2, kg/year	sum of (376)…(382) =				881.77	(383)
Dwelling CO2 Emission Rate					10.62	(384)
EI rating (section 14)					90.77	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.59

Property Address: Kingston Bridge 3BF MID 83 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	83	(1a) x	2.7	(2a) =	224.1	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	83	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	224.1	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) = ÷ (5) =

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)	0.29	(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) =	0.25	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.31	0.31	0.3	0.27	0.26	0.23	0.23	0.23	0.25	0.26	0.28	0.29

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=	0.55	0.55	0.55	0.54	0.53	0.53	0.53	0.53	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	0.55	0.55	0.54	0.53	0.53	0.53	0.53	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			2.88	x1/[1/(1.2)+ 0.04]		=	3.3			(27)
Windows Type 2			1.86	x1/[1/(1.2)+ 0.04]		=	2.13			(27)
Walls		19.62	30.6	x	0.18	=	5.51			(29)
Total area of elements, m²			50.22							(31)
Party wall			57.08	x	0	=	0			(32)
Party floor			83							(32a)
Party ceiling			83							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 27.97 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 16356.96 (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 4.21 (36)

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

Total fabric heat loss (33) + (36) = 32.18 (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=	40.61	40.47	40.33	39.68	39.56	38.99	38.99	38.89	39.21	39.56	39.81	40.06	(38)

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

(39)m=	72.79	72.65	72.51	71.86	71.74	71.17	71.17	71.07	71.39	71.74	71.98	72.24	

Average = Sum(39)$_{1…12}$ /12= 71.86 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.88	0.88	0.87	0.87	0.86	0.86	0.86	0.86	0.86	0.86	0.87	0.87

Average = Sum(40)$_{1\ldots12}$ /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 2.52 (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 93.99 (43)

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

	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=	103.39	99.63	95.87	92.11	88.35	84.59	84.59	88.35	92.11	95.87	99.63	103.39

Total = Sum(44)$_{1\ldots12}$ = 1127.84 (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=	153.32	134.09	138.37	120.64	115.75	99.89	92.56	106.21	107.48	125.26	136.73	148.48

Total = Sum(45)$_{1\ldots12}$ = 1478.77 (45)

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

(46)m=	23	20.11	20.76	18.1	17.36	14.98	13.88	15.93	16.12	18.79	20.51	22.27	(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.72 (55)

Water storage loss calculated for each month ((56)m = (55) × (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)

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)

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=	198.9	175.26	183.95	164.75	161.33	144	138.14	151.79	151.59	170.84	180.84	194.06	(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=	198.9	175.26	183.95	164.75	161.33	144	138.14	151.79	151.59	170.84	180.84	194.06	

Output from water heater (annual)$_{1...12}$ 2015.47 (64)

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

(65)m=	87.44	77.52	82.47	75.4	74.95	68.5	67.24	71.78	71.03	78.11	80.75	85.84	(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):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m=	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	20.11	17.86	14.53	11	8.22	6.94	7.5	9.75	13.08	16.61	19.39	20.67	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	225.6	227.94	222.04	209.48	193.63	178.73	168.77	166.43	172.33	184.89	200.74	215.64	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	(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=	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	(71)
Water heating gains (Table 5)													
(72)m=	117.53	115.36	110.85	104.72	100.74	95.14	90.38	96.48	98.65	104.99	112.16	115.37	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	424	421.92	408.18	385.96	363.35	341.57	327.41	333.42	344.82	367.26	393.05	412.44	(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)	
Southwest 0.9x	0.77	x	2.88	x	36.79	0.63	x	0.7	=	32.38	(79)
Southwest 0.9x	0.77	x	1.86	x	36.79	0.63	x	0.7	=	188.24	(79)
Southwest 0.9x	0.77	x	2.88	x	62.67	0.63	x	0.7	=	55.16	(79)
Southwest 0.9x	0.77	x	1.86	x	62.67	0.63	x	0.7	=	320.64	(79)
Southwest 0.9x	0.77	x	2.88	x	85.75	0.63	x	0.7	=	75.48	(79)

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Southwest	0.9x	0.77	x	1.86	x	85.75	0.63	x	0.7	=	438.71	(79)
Southwest	0.9x	0.77	x	2.88	x	106.25	0.63	x	0.7	=	93.52	(79)
Southwest	0.9x	0.77	x	1.86	x	106.25	0.63	x	0.7	=	543.58	(79)
Southwest	0.9x	0.77	x	2.88	x	119.01	0.63	x	0.7	=	104.75	(79)
Southwest	0.9x	0.77	x	1.86	x	119.01	0.63	x	0.7	=	608.85	(79)
Southwest	0.9x	0.77	x	2.88	x	118.15	0.63	x	0.7	=	103.99	(79)
Southwest	0.9x	0.77	x	1.86	x	118.15	0.63	x	0.7	=	604.45	(79)
Southwest	0.9x	0.77	x	2.88	x	113.91	0.63	x	0.7	=	100.26	(79)
Southwest	0.9x	0.77	x	1.86	x	113.91	0.63	x	0.7	=	582.76	(79)
Southwest	0.9x	0.77	x	2.88	x	104.39	0.63	x	0.7	=	91.88	(79)
Southwest	0.9x	0.77	x	1.86	x	104.39	0.63	x	0.7	=	534.06	(79)
Southwest	0.9x	0.77	x	2.88	x	92.85	0.63	x	0.7	=	81.73	(79)
Southwest	0.9x	0.77	x	1.86	x	92.85	0.63	x	0.7	=	475.03	(79)
Southwest	0.9x	0.77	x	2.88	x	69.27	0.63	x	0.7	=	60.97	(79)
Southwest	0.9x	0.77	x	1.86	x	69.27	0.63	x	0.7	=	354.37	(79)
Southwest	0.9x	0.77	x	2.88	x	44.07	0.63	x	0.7	=	38.79	(79)
Southwest	0.9x	0.77	x	1.86	x	44.07	0.63	x	0.7	=	225.46	(79)
Southwest	0.9x	0.77	x	2.88	x	31.49	0.63	x	0.7	=	27.71	(79)
Southwest	0.9x	0.77	x	1.86	x	31.49	0.63	x	0.7	=	161.09	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	220.62	375.8	514.18	637.1	713.6	708.44	683.01	625.94	556.75	415.34	264.25	188.81	(83)

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

(84)m=	644.62	797.72	922.36	1023.06	1076.95	1050.01	1010.42	959.36	901.58	782.59	657.3	601.25	(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=	0.99	0.97	0.91	0.78	0.61	0.43	0.31	0.34	0.54	0.84	0.97	0.99	(86)

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

(87)m=	20.31	20.53	20.75	20.92	20.99	21	21	21	20.99	20.9	20.57	20.27	(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	20.2	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	0.96	0.89	0.75	0.56	0.38	0.25	0.28	0.48	0.8	0.97	0.99	(89)

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

(90)m=	19.28	19.59	19.89	20.11	20.19	20.2	20.2	20.2	20.2	20.09	19.66	19.22	(90)

fLA = Living area ÷ (4) = 0.3 (91)

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

(92)m=	19.59	19.87	20.15	20.36	20.43	20.44	20.44	20.44	20.44	20.33	19.93	19.53	(92)

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

(93)m=	19.59	19.87	20.15	20.36	20.43	20.44	20.44	20.44	20.44	20.33	19.93	19.53	(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	0.96	0.89	0.76	0.57	0.4	0.27	0.3	0.5	0.81	0.96	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	635.67	763.94	822.31	772.52	617.52	415.16	273.51	287.33	449.67	634.12	633.41	595.4	(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)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1113.13	1087.67	989.92	823.31	626.01	415.83	273.56	287.42	452.45	698.37	923.81	1107.67	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	355.23	217.55	124.7	36.56	6.32	0	0	0	0	47.8	209.09	381.13	

	Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ =	1378.4	(98)
Space heating requirement in kWh/m²/year		16.61	(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		**kWh/year**	
Annual space heating requirement		1378.4	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1447.32	(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		2015.47	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2116.24	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	35.64	(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)

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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)				355.19	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =				3918.74	(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)] x 100 ÷ (367b) x		0.52	=	461.22	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	18.49	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	479.71	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				479.71	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	184.34	(379)
Total CO2, kg/year	sum of (376)…(382) =				664.05	(383)
Dwelling CO2 Emission Rate					8	(384)
EI rating (section 14)					93.05	(385)

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User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.59

Property Address: Kingston Bridge 3BF TOP 83 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	83	(1a) x	2.7	(2a) =	224.1	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	83	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	224.1	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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) =		÷ (5) =		
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)			0.29	(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) =		0.25	(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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.31	0.31	0.3	0.27	0.26	0.23	0.23	0.23	0.25	0.26	0.28	0.29

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=	0.55	0.55	0.55	0.54	0.53	0.53	0.53	0.53	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	0.55	0.55	0.54	0.53	0.53	0.53	0.53	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			2.88	x1/[1/(1.2)+ 0.04] =	3.3			(27)
Windows Type 2			1.86	x1/[1/(1.2)+ 0.04] =	2.13			(27)
Walls		19.62	30.6	x 0.18 =	5.51			(29)
Roof		0	83	x 0.13 =	10.79			(30)
Total area of elements, m²			133.22					(31)
Party wall			57.08	x 0 =	0			(32)
Party floor			83					(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-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) = 38.76 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8803.96 (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 10.77 (36)

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

Total fabric heat loss (33) + (36) = 49.53 (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=	40.61	40.47	40.33	39.68	39.56	38.99	38.99	38.89	39.21	39.56	39.81	40.06	(38)

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

(39)m=	90.14	90	89.86	89.21	89.09	88.52	88.52	88.42	88.74	89.09	89.34	89.59	

Average = Sum(39)$_{1…12}$ /12= 89.21 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.09	1.08	1.08	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.08	1.08	

Average = Sum(40)$_{1...12}$ /12= 1.07 (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 2.52 (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 93.99 (43)

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

	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=	103.39	99.63	95.87	92.11	88.35	84.59	84.59	88.35	92.11	95.87	99.63	103.39	

Total = Sum(44)$_{1...12}$ = 1127.84 (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=	153.32	134.09	138.37	120.64	115.75	99.89	92.56	106.21	107.48	125.26	136.73	148.48	

Total = Sum(45)$_{1...12}$ = 1478.77 (45)

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

(46)m=	23	20.11	20.76	18.1	17.36	14.98	13.88	15.93	16.12	18.79	20.51	22.27	(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) x (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) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.72 (55)

Water storage loss calculated for each month ((56)m = (55) × (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)

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)

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=	198.9	175.26	183.95	164.75	161.33	144	138.14	151.79	151.59	170.84	180.84	194.06	(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=	198.9	175.26	183.95	164.75	161.33	144	138.14	151.79	151.59	170.84	180.84	194.06	

Output from water heater (annual)$_{1...12}$ 2015.47 (64)

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

(65)m=	87.44	77.52	82.47	75.4	74.95	68.5	67.24	71.78	71.03	78.11	80.75	85.84	(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=	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	125.87	(66)

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

(67)m=	20.11	17.86	14.53	11	8.22	6.94	7.5	9.75	13.08	16.61	19.39	20.67	(67)

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

(68)m=	225.6	227.94	222.04	209.48	193.63	178.73	168.77	166.43	172.33	184.89	200.74	215.64	(68)

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

(69)m=	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	(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=	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	(71)

Water heating gains (Table 5)

(72)m=	117.53	115.36	110.85	104.72	100.74	95.14	90.38	96.48	98.65	104.99	112.16	115.37	(72)

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

(73)m=	424	421.92	408.18	385.96	363.35	341.57	327.41	333.42	344.82	367.26	393.05	412.44	(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)	
Southwest 0.9x	0.77	x	2.88	x	36.79	0.35	x	0.7	=	17.99	(79)
Southwest 0.9x	0.77	x	1.86	x	36.79	0.35	x	0.7	=	104.58	(79)
Southwest 0.9x	0.77	x	2.88	x	62.67	0.35	x	0.7	=	30.65	(79)
Southwest 0.9x	0.77	x	1.86	x	62.67	0.35	x	0.7	=	178.13	(79)
Southwest 0.9x	0.77	x	2.88	x	85.75	0.35	x	0.7	=	41.93	(79)

Southwest0.9x	0.77	x	1.86	x	85.75		0.35	x	0.7	=	243.73	(79)
Southwest0.9x	0.77	x	2.88	x	106.25		0.35	x	0.7	=	51.96	(79)
Southwest0.9x	0.77	x	1.86	x	106.25		0.35	x	0.7	=	301.99	(79)
Southwest0.9x	0.77	x	2.88	x	119.01		0.35	x	0.7	=	58.19	(79)
Southwest0.9x	0.77	x	1.86	x	119.01		0.35	x	0.7	=	338.25	(79)
Southwest0.9x	0.77	x	2.88	x	118.15		0.35	x	0.7	=	57.77	(79)
Southwest0.9x	0.77	x	1.86	x	118.15		0.35	x	0.7	=	335.81	(79)
Southwest0.9x	0.77	x	2.88	x	113.91		0.35	x	0.7	=	55.7	(79)
Southwest0.9x	0.77	x	1.86	x	113.91		0.35	x	0.7	=	323.75	(79)
Southwest0.9x	0.77	x	2.88	x	104.39		0.35	x	0.7	=	51.04	(79)
Southwest0.9x	0.77	x	1.86	x	104.39		0.35	x	0.7	=	296.7	(79)
Southwest0.9x	0.77	x	2.88	x	92.85		0.35	x	0.7	=	45.4	(79)
Southwest0.9x	0.77	x	1.86	x	92.85		0.35	x	0.7	=	263.9	(79)
Southwest0.9x	0.77	x	2.88	x	69.27		0.35	x	0.7	=	33.87	(79)
Southwest0.9x	0.77	x	1.86	x	69.27		0.35	x	0.7	=	196.87	(79)
Southwest0.9x	0.77	x	2.88	x	44.07		0.35	x	0.7	=	21.55	(79)
Southwest0.9x	0.77	x	1.86	x	44.07		0.35	x	0.7	=	125.26	(79)
Southwest0.9x	0.77	x	2.88	x	31.49		0.35	x	0.7	=	15.4	(79)
Southwest0.9x	0.77	x	1.86	x	31.49		0.35	x	0.7	=	89.49	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	122.57	208.78	285.66	353.94	396.45	393.58	379.45	347.74	309.31	230.74	146.81	104.89	(83)

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

(84)m=	546.57	630.7	693.84	739.9	759.8	735.15	706.86	681.16	654.13	598	539.86	517.33	(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	0.72	0.54	0.58	0.81	0.96	0.99	1	(86)

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

(87)m=	19.9	20.06	20.29	20.57	20.81	20.95	20.99	20.99	20.91	20.6	20.19	19.87	(87)

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

(88)m=	20.01	20.01	20.02	20.02	20.02	20.03	20.03	20.03	20.03	20.02	20.02	20.02	(88)

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

(89)m=	1	0.99	0.98	0.94	0.83	0.63	0.43	0.47	0.74	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=	18.55	18.78	19.11	19.52	19.84	20	20.03	20.02	19.95	19.56	18.98	18.5	(90)

fLA = Living area ÷ (4) = | 0.3 | (91)

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

(92)m=	18.96	19.16	19.47	19.84	20.13	20.29	20.32	20.31	20.24	19.87	19.34	18.91	(92)

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

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(93)m=	18.96	19.16	19.47	19.84	20.13	20.29	20.32	20.31	20.24	19.87	19.34	18.91	(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	0.46	0.5	0.76	0.94	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	543.48	623.03	674.9	689.98	635.76	480.23	325.99	341.48	494.81	563.93	533.31	515.1	(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=	1321.18	1283.84	1165.35	975.58	751.16	503.3	328.97	346.1	544.97	826.27	1093.86	1318.33	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	578.61	444.06	364.89	205.63	85.86	0	0	0	0	195.18	403.6	597.61	

	Total per year (kWh/year) = Sum(98)1...5,9...12 =	2875.45	(98)
Space heating requirement in kWh/m²/year		34.64	(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		**kWh/year**	
Annual space heating requirement		2875.45	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	3019.22	(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		2015.47	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2116.24	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	51.35	(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)

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)			355.19	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =			5490.65	(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)] x 100 ÷ (367b) x		0.52	=	664.66	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	26.65	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	691.32	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				691.32	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	184.34	(379)
Total CO2, kg/year	sum of (376)…(382) =				875.66	(383)
Dwelling CO2 Emission Rate					10.55	(384)
EI rating (section 14)					90.83	(385)

Appendix 4: ‘Be Green’ SAP 10 Spreadsheet

Be Green (Communal ASHPs) - SAP 2012 Methodology SAP 10 Carbon Factors

Project	Kingston Bridge House, Hampton Wick
Client	Westcombe
Date	Mar-23
Rev	C

SAP 2012	Carbon Factor	SAP 10	Carbon Factor
Gas	0.216	Gas	0.210
Grid Elec	0.519	Grid Elec	0.233

TER

Plot	Bedrooms	Floor Area	Location	Space Htg	Water Htg	Pumps/ Lighting	Emissions
1	3	86.7	GND	2739	2532	449	1212
2	1	55.6	GND	1750	2110	362	895
3	2	67.9	GND	2618	2269	402	1120
4	1	65.5	GND	2062	2485	426	1054
5	2	61.4	GND	2367	2052	364	1013
6	1	51.2	GND	1612	1943	333	824
7	1	50.0	GND	1574	1897	325	805
8	1	50.0	GND	1574	1897	325	805
9	1	50.0	GND	1574	1897	325	805
10	2	62.3	GND	2402	2082	369	1028
11	3	84.3	MID	1860	2482	437	1014
12	1	60.5	MID	1223	2318	394	835
13	2	74.9	MID	2069	2522	443	1067
14	1	65.2	MID	1318	2498	424	900
15	3	86.0	MID	1897	2532	446	1034
16	2	63.9	MID	1765	2151	378	911
17	2	61.0	MID	1685	2054	361	869
18	1	51.1	MID	1033	1958	332	705
19	1	50.0	MID	1011	1916	325	690
20	1	50.0	MID	1011	1916	325	690
21	1	50.0	MID	1011	1916	325	690
22	ST	37.5	MID	758	1437	244	518
23	1	53.9	MID	1090	2065	351	744
24	3	84.3	MID	1860	2482	437	1014
25	1	60.5	MID	1223	2318	394	835
26	2	74.9	MID	2069	2522	443	1067
27	1	65.2	MID	1318	2498	424	900
28	3	86.0	MID	1897	2532	446	1034
29	2	63.9	MID	1765	2151	378	911
30	2	61.0	MID	1685	2054	361	869
31	1	51.1	MID	1033	1958	332	705
32	1	50.0	MID	1011	1916	325	690
33	1	50.0	MID	1011	1916	325	690
34	1	50.0	MID	1011	1916	325	690
35	ST	37.5	MID	758	1437	244	518
36	1	53.9	MID	1090	2065	351	744
37	3	84.3	TOP	2701	2461	437	1186
38	1	60.5	TOP	1955	2294	394	984
39	2	74.9	TOP	2687	2508	443	1194
40	2	65.2	TOP	2339	2183	386	1040
41	3	86.0	TOP	2755	2511	446	1210
42	2	63.9	TOP	2292	2139	378	1019
43	2	61.0	MID	1685	2054	361	869
44	1	51.1	MID	1033	1958	332	705
45	1	50.0	MID	1011	1916	325	690
46	1	50.0	MID	1011	1916	325	690
47	1	50.0	MID	1011	1916	325	690
48	ST	37.5	MID	758	1437	244	518
49	1	53.9	MID	1090	2065	351	744
50	2	61.0	MID	1685	2054	361	869
51	1	51.1	MID	1033	1958	332	705
52	1	50.0	MID	1011	1916	325	690
53	1	50.0	MID	1011	1916	325	690
54	1	50.0	MID	1011	1916	325	690
55	ST	37.5	MID	758	1437	244	518
56	1	53.9	MID	1090	2065	351	744
57	2	61.0	MID	1685	2054	361	869
58	1	51.1	MID	1033	1958	332	705
59	1	50.0	MID	1011	1916	325	690
60	1	50.0	MID	1011	1916	325	690
61	1	50.0	MID	1011	1916	325	690
62	ST	37.5	MID	758	1437	244	518
63	1	53.9	MID	1090	2065	351	744
64	2	61.0	TOP	2188	2042	361	973
65	1	51.1	TOP	1651	1938	332	831
66	1	50.0	TOP	1616	1896	325	813
67	1	50.0	TOP	1616	1896	325	813
68	1	50.0	TOP	1616	1896	325	813
69	ST	37.5	TOP	1212	1422	244	610
70	1	53.9	TOP	1742	2044	351	877
		4026.0					
							57979.6

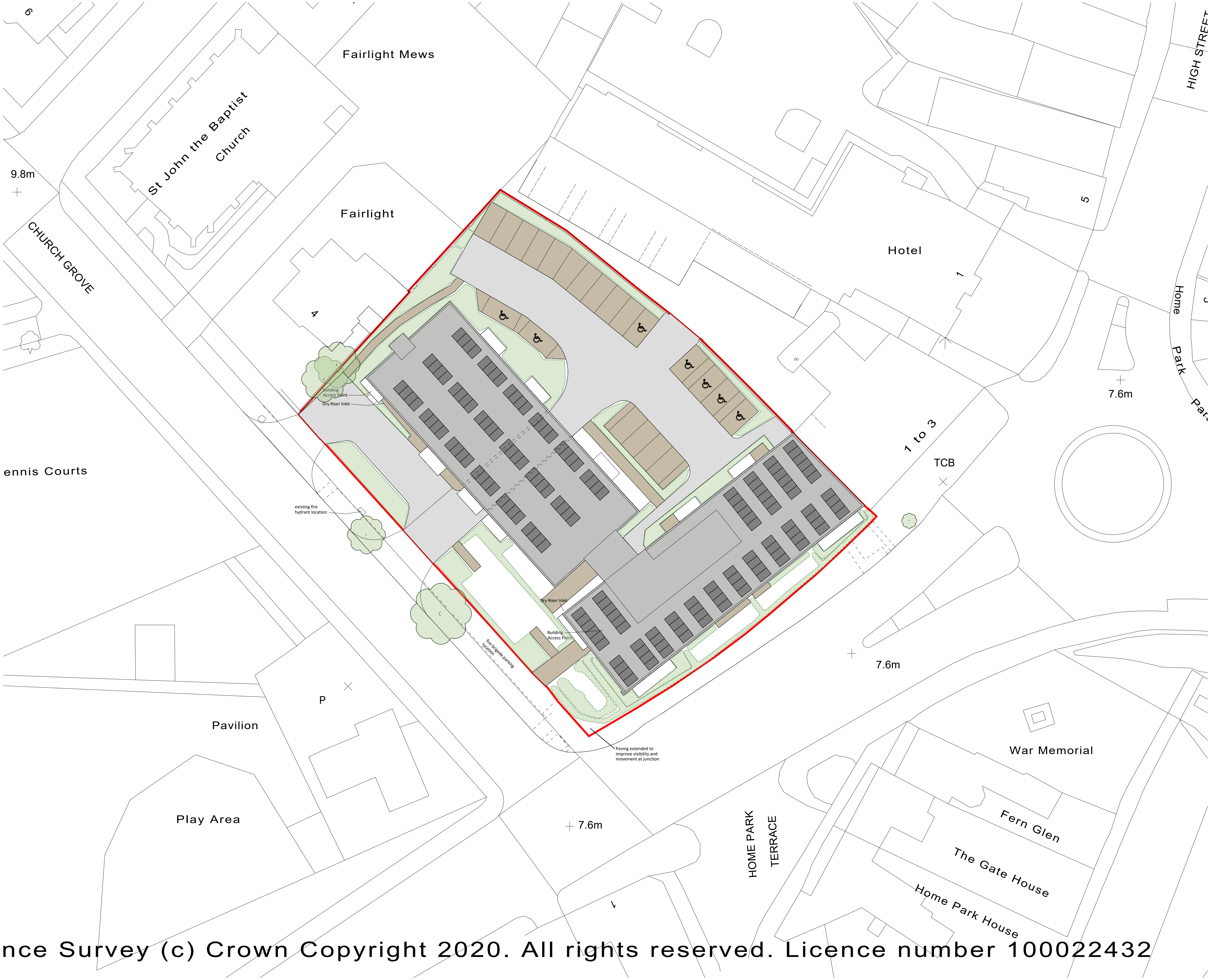
DER - Based on Communal ASHP System

Plot	Heating	Distribution	Lighting	Emissions
1	1350	54	371	413.5
2	947	38	281	294.9
3	1168	47	324	358.6
4	1115	45	331	347.4
5	1056	42	293	324.3
6	872	35	259	271.5
7	851	34	253	265.2
8	851	34	253	265.2
9	851	34	253	265.2
10	1072	43	298	329.0
11	903	36	361	302.8
12	757	30	306	254.6
13	1002	40	358	326.1
14	815	33	330	274.4
15	921	37	368	308.9
16	855	34	305	278.2
17	816	33	291	265.6
18	639	26	258	215.1
19	625	25	253	210.4
20	625	25	253	210.4
21	625	25	253	210.4
22	469	19	190	157.8
23	674	27	272	226.8
24	903	36	361	302.8
25	757	30	306	254.6
26	1002	40	358	326.1
27	815	33	330	274.4
28	921	37	368	308.9
29	855	34	305	278.2
30	816	33	291	265.6
31	639	26	258	215.1
32	625	25	253	210.4
33	625	25	253	210.4
34	625	25	253	210.4
35	469	19	190	157.8
36	674	27	272	226.8
37	1301	52	361	399.3
38	1043	42	306	324.0
39	1204	48	358	375.2
40	1048	42	311	326.6
41	1327	53	368	407.3
42	1028	41	305	320.1
43	816	33	291	265.6
44	639	26	258	215.1
45	625	25	253	210.4
46	625	25	253	210.4
47	625	25	253	210.4
48	469	19	190	157.8
49	674	27	272	226.8
50	816	33	291	265.6
51	639	26	258	215.1
52	625	25	253	210.4
53	625	25	253	210.4
54	625	25	253	210.4
55	469	19	190	157.8
56	674	27	272	226.8
57	816	33	291	265.6
58	639	26	258	215.1
59	625	25	253	210.4
60	625	25	253	210.4
61	625	25	253	210.4
62	469	19	190	157.8
63	674	27	272	226.8
64	981	39	291	305.6
65	881	35	258	273.7
66	862	35	253	267.8
67	862	35	253	267.8
68	862	35	253	267.8
69	647	26	190	200.9
70	929	37	272	288.7
	55984	2245	19595	**18133.0**

Total Site Target Emissions (Be Lean)	**57,980**	$kgCO_2$ per year
Total Site Design Emissions (Be Green - ASHPs)	**18,133**	$kgCO_2$ per year
Total Reduction	**39,847**	$kgCO_2$ per year
% Reduction	**68.73%**	

Total Energy 77824

Appendix 5 – Roof Plans showing Indicative Layout of Photovoltaic Panels



Rev	Date	Description

fluent®
ARCHITECTURAL DESIGN SERVICES

FLUENT
ARCHITECTURAL DESIGN SERVICES
69-71 WINDMILL ROAD, SUNBURY,
MIDDLESEX, TW16 7DT
TEL: 0800 0438838
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WEB: FLUENT-ADS.CO.UK

Kingston Bridge House
Church Grove, Hampton Wick

Proposed Site Plan

0 10 20

Scale	Dwg No.
1:500 @ A3	FLU.1191.3.10
Date	Rev
07.10.20	H
Drawn	
N.Millin	

Appendix 6 – London Borough of Richmond Sustainable Construction Checklist

LBRUT Sustainable Construction Checklist - June 2020

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

Property Name (if relevant): Kingston Bridge House, Church Grove, Hampton Wick
Application No. (if known):

Address (include. postcode): Kingston Bridge House, Church Grove, Hampton Wick
Completed by: Ivan Ball - Bluesky Unlimited

For Non-Residential
Size of development (m2):

For Residential
Number of dwellings: 70

1 MINIMUM COMPLIANCE (RESIDENTIAL AND NON-RESIDENTIAL)

Energy Assessment
Has an energy assessment been submitted that demonstrates the expected energy and carbon dioxide emissions saving from energy efficiency and renewable energy measures, including the feasibility of CHP/CCHP and community heating systems? If yes, please select TRUE. — **Please Select:**

Carbon Dioxide emissions reduction

What is the on site carbon dioxide emissions reduction against a Building Regulations Part L (2013) baseline — 91.53 %
Policy LP 22 B. and Draft London Plan Policy 9.2.5 require a 35% onsite reduction in CO_2 emissions beyond Building Regulations 2013.

What is the percentage reduction from efficiency measures alone — 10.57 %
Policy LP 22 C. and Draft London Plan Policy 9.2.6 require a 10% onsite reduction in CO2 emissions beyond Building Regulations 2013 from efficiency measures for residential and 15% for non-residential.

Percentage of **total** site CO2 emissions saved through renewable energy installation? — 80.96 %

What is the total remaining carbon to be offset — 4.913 Tonne
Policy LP 22 B. and Draft London Plan Policy 9.2.4 require Major developments to achieve Zero Carbon after offsetting.

Are remaining emissions going to be offset through offset fund payment in accordance with current guidelines issued for the cost per tonne of CO2? — **TRUE**

What is the total predicted cost of offset? — 14002 £
The London Plan sets this as £95/tonne per year over 30 years, this should be updated based on As Build calculations.

1A MINIMUM POLICY COMPLIANCE (NON-RESIDENTIAL AND DOMESTIC REFURBISHMENT)

Please check the Guidance Section of this SPD for the policy requirements

Environmental Rating of development:

Non-Residential new-build (100sqm or more)
BREEAM Level — **Please Select** — Have you attached a pre-assessment to support this? — **Please Select:**
Excellent required under Policy LP22 A 3

Extensions and conversions for residential dwellings
BREEAM Domestic Refurbishment — **Please Select** — Have you attached a pre-assessment to support this? — **Please Select:**
Excellent required under Policy LP22 A 4

Extensions and conversions for non-residential buildings
BREEAM Level — **Please Select** — Have you attached a pre-assessment to support this? — **Please Select:**
Excellent required under Policy LP 22

Score awarded for Environmental Rating: **Subtotal** 0
BREEAM: Good = *0*, Very Good = 4, Excellent = *8*, Outstanding = *16*

1B MINIMUM POLICY COMPLIANCE (RESIDENTIAL)

Water Usage

	Score	
Internal water usage after gray/rainwater systems limited to 105 litres person per day. (Excluding an allowance 5 litres per person per day for external water consumption). Calculations using the water efficiency calculator for new dwellings have been submitted. *110l/p/d Required for new dwellings under Policy LP22 A 2 105l/p/d required under Draft London Plan Policy SI5*	*1*	**TRUE**

Subtotal 1

2. ENERGY USE AND POLLUTION

2.1 Need for Cooling

a. How does the development incorporate cooling measures? Tick all that apply:

	Score	
Energy efficient design incorporating specific heat demand to less than or equal to 15 kWh/sqm	*6*	**TRUE**
Reduce heat entering a building through providing/improving insulation and living roofs and walls	*2*	**FALSE**
Reduce heat entering a building through shading	*3*	**TRUE**
Exposed thermal mass and high ceilings	*4*	**TRUE**
Passive ventilation	*3*	**TRUE**
Mechanical ventilation with heat recovery	*1*	**FALSE**
Active cooling systems, i.e. Air Conditioning Unit	*0*	**FALSE**

See Draft London Plan SI4

2.2 Heat Generation

b. How have the heating and cooling systems, with preference to the heating system hierarchy, been selected (defined in London Plan policy **SI3)** Tick all heating and cooling systems that will be used in the development:

	Score	
Connection to existing heating or cooling networks powered by renewable energy	*6*	**FALSE**
Connection to existing heating or cooling networks powered by gas or electricity	*5*	**FALSE**
Site wide CHP network powered by renewable energy	*4*	**FALSE**
Site wide CHP network powered by gas	*3*	**FALSE**
Communal heating and cooling powered by renewable energy	*2*	**TRUE**
Communal heating and cooling powered by gas or electricity	*1*	**TRUE**
Individual heating and cooling	*0*	**FALSE**

See Draft London Plan SI3

2.3 Pollution: Air, Noise and Light

a.	Does the development plan to implement reduction strategies for dust emissions from construction sites?	*2*	**TRUE**
b.	Does the development plan to include a biomass boiler? If yes, please refer to the biomass guidelines for the Borough of Richmond, please see guidance for supplementary information. If the proposed boiler is of a qualifying size, you may need to complete the information request form found on the Richmond website.		**FALSE**
c.	Has an air quality impact assessment been provided		**FALSE**
	If yes, has 'Emissions Neutral' been achieved	*1*	**TRUE**
	If yes, have occupants of new development been protected from existing pollution	*1*	**FALSE**
	If no to any of the above are there any sensitive receptors as defined in Policy LP 10 present?	*-1*	**FALSE**
	see Policy LP 10		
d.	Please tick only one option below		
	Has the development taken measures to reduce existing noise and enhance the existing soundscape of the site?	*3*	**TRUE**
	Has the development taken care to not create any new noise generation/transmission issues in its intended operation?	*1*	**TRUE**
	see Policy LP 10		
e.	Has the development taken measures to reduce light pollution impacts on character, residential amenity and biodiversity?	*3*	**TRUE**

see Policy LP 10

			Score	
f.	Have you attached a Lighting Pollution Report?		-	
		Subtotal	**29**	

Please give any additional relevant comments to the Energy Use and Pollution Section below

Whilst the energy demand figures quoted in 5.4 of the Sustainability and Energy Statement (26/09/22) sum the space heating and hot water demand, the demand for space heating will be less than 15 kWh/sqm for each of the modelled units. A communal heating system will be installed which will be powered by heat pumps. A Construction Plan will be prepared, which will seek to reduce dust, noise and other disturbancies to immediate neighbours

3. TRANSPORT

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

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

Please explain:

The proposal only includes a total of 21 car parking spaces of which seven are allocated to disabled residents and visitors.

			Score	
b.	Does your development provide for 100% active provision for electric vehicle charging point(s) and have you successfully demonstrated that it would be able to operate satisfactorily in the future expectation of all vehicles being electrically powered?		2	TRUE
c.	**For major developments ONLY**: Has a Transport Assessment been produced for your development based on TfL's Best Practice Guidance?			
	If you have provided a Transport Assessment as part of your planning application, please tick here and move to Section 3 of this Checklist.		5	TRUE
	See policy LP44			
d.	**For smaller developments ONLY**: Have you provided a Transport Statement?		5	FALSE
e.	Does your development provide cycle storage? (Standard space requirements are set out in the Council's Parking Standards - Local Plan Appendix 3)		2	TRUE
	If so, for how many bicycles?	160		
	Is this shown on the site plans?			TRUE
	See Local Plan Appendix 3			
f.	Will the development create or improve links with local and wider transport networks? If yes, please provide details.		2	FALSE
		Subtotal	**9**	

Please give any additional relevant comments to the Transport Section below

4 BIODIVERSITY

4.1 Minimising the threat to biodiversity from new buildings, lighting, hard surfacing and people

					Score	
a.	Does your development involve the loss of an ecological feature or habitat, including a loss of garden or other green space? (Indicate if yes)				-2	FALSE
	If so, please state how much in sqm?			See DAS sqm		
b.	Does your development involve the removal of any tree(s)? (Indicate if yes)					FALSE
	If so, has a tree report been provided in support of your application? (Indicate if yes)					FALSE
c.	Does your development plan to add (and not remove) any tree(s) on site? (Indicate if yes)					FALSE
d.	Please indicate which features and/or habitats that your development will incorporate to improve on site biodiversity:					
	Pond, reedbed or extensive native planting	6	Area provided:	sqm		FALSE
	An extensive green roof	5	Area provided:	sqm		FALSE
	An intensive green roof	4	Area provided:	sqm		FALSE
	Garden space	4	Area provided:	sqm		FALSE
	Additional native and/or wildlife friendly planting to peripheral areas	3	Area provided:	sqm		TRUE
	Additional planting to peripheral areas	2	Area provided:	sqm		TRUE
	A living wall	2	Area provided:	sqm		FALSE
	Bat boxes	0.5				TRUE
	Bird boxes	0.5				TRUE
	Swift boxes	0.5				TRUE
	Other	0.5				FALSE
e.	Does your development use at least 70% of available roof plate as green/brown roof				1	FALSE
	Policy LP 17 requires 70%					
				Subtotal	**6.5**	

Please give any additional relevant comments to the Biodiversity Section below

The proposal is for the conversion of an existing building and there is only limited external space for landscape and ecological enhancements. However, the peripheral areas could be used to provide addit

5 FLOODING AND DRAINAGE

5.1 Mitigating the risks of flooding and other impacts of climate change in the borough

			Score	
a.	Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes)		-2	FALSE
	Have you submitted a Flood Risk Assessment? (Indicate if yes)			TRUE
b.	Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick all that apply)			
	Store rainwater for later use		5	FALSE
	Use of infiltration techniques such as porous surfacing materials to allow drainage on-site		3	TRUE
	Attenuate rainwater in ponds or open water features		4	FALSE
	Store rainwater in tanks for gradual release to a watercourse		3	FALSE
	Discharge rainwater directly to watercourse		2	FALSE
	Discharge rainwater to surface water drain		1	FALSE
	Discharge rainwater to combined sewer		0	TRUE
	Have you submitted a Drainage Statement (Indicate if yes)			TRUE
	See Policy LP 21 and Draft London Plan SL 13			
c.	Please give the change in area of permeable surfacing which will result from your development proposal:	0 sqm		
	Please provide details of the permeable surfacing below	*please represent a loss in permeable area as a negative number*		
		Subtotal	**3**	

Please give any additional relevant comments to the Flooding and Drainage Section below

The site lies within Flood Zone 1 and Flood Zone 2 and a site specific FRA has been prepared. There is limited soft landscaping and therefore it is not proposed to store any rainwater runoff for reuse.

6 IMPROVING RESOURCE EFFICIENCY

6.1 Reduce waste generated and amount disposed of by landfill though increasing level of re-use and recycling

			Score	
a.	Will demolition be required on your site prior to construction? *[Points will only be awarded if 10% or greater of demolition waste is reused/recycled]*		1	TRUE
	If so, what percentage of demolition waste will be reused in the new development?	20 %		
	What percentage of demolition waste will be recycled?	80 %		
b.	Does your site have any contaminated land?		1	FALSE
	Have you submitted an assessment of the site contamination?		2	FALSE

Are plans in place to remediate the contamination?	*2*	FALSE
Have you submitted a remediation plan?	*1*	FALSE
Are plans in place to include composting on site?	*1*	FALSE

c. Will a waste management plan and facilities be in place in line with Policy LP24 — Yes

6.2 Reducing levels of water waste

a. Will the following measures of water conservation be incorporated into the development? (Please tick all that apply):

Fitting of water efficient taps, shower heads etc	*1*	TRUE
Use of water efficient A or B rated appliances	*1*	TRUE
Rainwater harvesting for internal use	*4*	FALSE
Greywater systems	*4*	FALSE
Fit a water meter	*1*	TRUE

Subtotal 3

Please give any additional relevant comments to the Improving Resource Efficiency Section below

It is understood there is no contamination within the site. A Site Waste Management Plan will be prepared and followed at the construction stage. It is not proposed to provide any rainwater or greywater ha

7 ACCESSIBILITY

7.1 Ensure flexible adaptable and long-term use of structures

a. **If the development is residential,** will it meet the requirements of the nationally described space standard for internal space and layout? *1* TRUE

If the standards are not met, in the space below, please provide details of the functionality of the internal space and layout

The standards of the SPD will be met.

AND

b. **If the development is residential**, will it meet Building Regulation Requirement M4 (2) 'accessible and adaptable dwellings'? *2* TRUE

If this is not met, in the space below, please provide details of any accessibility measures included in the development.

For major residential developments, are 10% or more of the units in the development to Building Regulation Requirement M4 (3) 'wheelchair user dwellings'? *1* TRUE

OR

c. **If the development is non-residential,** does it comply with requirements included in Richmond's Local Plan LP1, LP28.B, LP30 & LP45 *2* FALSE

Please provide details of the accessibility measures specified in the Local Plan that will be included in the development

Subtotal 4

Please give any additional relevant comments to the Design Standards and Accessibility Section below

LBRUT Sustainable Construction Checklist- Scoring Matrix for *New Construction* **(Non-Residential and domestic refurb)** ***TOTAL*** ***55.5***

Score	Rating	Significance
84 or more	*A+*	Project strives to achieve highest standard in energy efficient sustainable development
75-83	*A*	Makes a major contribution towards achieving sustainable development in Richmond
56-74	*B*	Helps to significantly improve the Borough's stock of sustainable developments
40-55	*C*	Minimal effort to increase sustainability beyond general compliance
39 or less	*FAIL*	Does not comply with SPD Policy

LBRUT Sustainable Construction Checklist- Scoring Matrix for New Construction **Residential new-build**

Score	Rating	Significance
85 or more	A++	Project strives to achieve highest standard in energy efficient sustainable development
68-84	*A+*	Project strives to achieve higher standard in energy efficient sustainable development
59-67	*A*	Makes a major contribution towards achieving sustainable development in Richmond
39-58	*B*	Helps to significantly improve the Borough's stock of sustainable developments
24-38	*C*	Minimal effort to increase sustainability beyond general compliance
23 or less	*FAIL*	Does not comply with SPD Policy

Authorisation:

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

Signature ________________ **Date** ________________

Appendix 7 – Calculation of Unregulated Emissions

Calculation of Unregulated Emissions

Project Kingston Bridge House, Hampton Wick
Client Westcombe
Date Sep-22
Rev A

Electrical Appliances $E_a = 207.8 \times (TFA \times N)^{0.4714}$

Cooking $E_c = 138 + 28 \times N$

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

Plot	Bedrooms	Floor Area	Number of Occupants	Energy Demand Appliances	Energy Demand Cooking	Emissions for Apps & Cooking
		m^2		kWh	kWh	kg CO_2
1	3	86.7	3	2661	210	669
2	1	55.6	2	1848	190	475
3	2	67.9	2	2198	199	559
4	1	65.5	2	2132	198	543
5	2	61.4	2	2017	195	515
6	1	51.2	2	1718	186	444
7	1	50.0	2	1683	185	435
8	1	50.0	2	1683	185	435
9	1	50.0	2	1683	185	435
10	2	62.3	2	2042	195	521
11	3	84.3	3	2608	209	656
12	1	60.5	2	1991	194	509
13	2	74.9	2	2382	204	603
14	1	65.2	2	2124	197	541
15	3	86.0	3	2646	210	665
16	2	63.9	2	2087	197	532
17	2	61.0	2	2005	194	512
18	1	51.1	2	1715	186	443
19	1	50.0	2	1683	185	435
20	1	50.0	2	1683	185	435
21	1	50.0	2	1683	185	435
22	ST	37.5	1	1318	176	348
23	1	53.9	2	1798	189	463
24	3	84.3	3	2608	209	656
25	1	60.5	2	1991	194	509
26	2	74.9	2	2382	204	603
27	1	65.2	2	2124	197	541
28	3	86.0	3	2646	210	665
29	2	63.9	2	2087	197	532
30	2	61.0	2	2005	194	512
31	1	51.1	2	1715	186	443
32	1	50.0	2	1683	185	435
33	1	50.0	2	1683	185	435
34	1	50.0	2	1683	185	435
35	ST	37.5	1	1318	176	348
36	1	53.9	2	1798	189	463
37	3	84.3	3	2608	209	656
38	1	60.5	2	1991	194	509
39	2	74.9	2	2382	204	603
40	2	65.2	2	2124	197	541
41	3	86.0	3	2646	210	665
42	2	63.9	2	2087	197	532
43	2	61.0	2	2005	194	512
44	1	51.1	2	1715	186	443
45	1	50.0	2	1683	185	435
46	1	50.0	2	1683	185	435
47	1	50.0	2	1683	185	435
48	ST	37.5	1	1318	176	348
49	1	53.9	2	1798	189	463
50	2	61.0	2	2005	194	512
51	1	51.1	2	1715	186	443
52	1	50.0	2	1683	185	435
53	1	50.0	2	1683	185	435
54	1	50.0	2	1683	185	435
55	ST	37.5	1	1318	176	348
56	1	53.9	2	1798	189	463
57	2	61.0	2	2005	194	512
58	1	51.1	2	1715	186	443
59	1	50.0	2	1683	185	435
60	1	50.0	2	1683	185	435
61	1	50.0	2	1683	185	435
62	ST	37.5	1	1318	176	348
63	1	53.9	2	1798	189	463
64	2	61.0	2	2005	194	512
65	1	51.1	2	1715	186	443
66	1	50.0	2	1683	185	435
67	1	50.0	2	1683	185	435
68	1	50.0	2	1683	185	435
69	ST	37.5	1	1318	176	348
70	1	53.9	2	1798	189	463
		4026.0				

Total Carbon Emissions for Unregulated Demand (Appliances & Cooking) **33,983** kg CO_2 per year

Appendix 8 – GHA Early Stage Overheating Risk Tool

EARLY STAGE OVERHEATING RISK TOOL

Version 1.0, July 2019

Good Homes Alliance

This tool provides guidance on how to assess overheating risk in residential schemes at the early stages of design. It is specifically a pre-detail design assessment intended to help identify factors that could contribute to or mitigate the likelihood of overheating.

The questions can be answered for an overall scheme or for individual units. Score zero wherever the question does not apply. Additional information is provided in the accompanying guidance, with examples of scoring and advice on next steps.

Find out more information and download accompanying guidance at goodhomes.org.uk/overheating-in-new-homes.

KEY FACTORS INCREASING THE LIKELIHOOD OF OVERHEATING | **KEY FACTORS REDUCING THE LIKELIHOOD OF OVERHEATING**

Geographical and local context

Question	Option	Points	Score
#1 Where is the scheme in the UK? See guidance for map	South east	4	4
	Northern England, Scotland & NI	0	
	Rest of England and Wales	2	
#2 Is the site likely to see an Urban Heat Island effect? See guidance for details	Central London (see guidance)	3	2
	Grtr London, Manchester, B'ham	2	
	Other cities, towns & dense sub-urban areas	1	

Question	Points	Score
#8 Do the site surroundings feature significant blue/green infrastructure? Proximity to green spaces and large water bodies has beneficial effects on local temperatures; as guidance, this would require at least 50% of surroundings within a 100m radius to be blue/green, or a rural context	1	1

Site characteristics

Question	Option	Points	Score
#3 Does the site have barriers to windows opening? - Noise/Acoustic risks - Poor air quality/smells e.g. near factory or car park or very busy road - Security risks/crime - Adjacent to heat rejection plant	**Day** - reasons to keep all windows closed	8	0
	Day - barriers some of the time, or for some windows e.g. on quiet side	4	
	Night - reasons to keep all windows closed	8	0
	Night - bedroom windows OK to open, but other windows are likely to stay closed	4	

Question	Points	Score
#9 Are immediate surrounding surfaces in majority pale in colour, or blue/green? Lighter surfaces reflect more heat and absorb less so their temperatures remain lower; consider horizontal and vertical surfaces within 10m of the scheme	1	1
#10 Does the site have existing tall trees or buildings that will shade solar-exposed glazed areas? Shading onto east, south and west facing areas can reduce solar gains, but may also reduce daylight levels	1	0

Scheme characteristics and dwelling design

Question	Points	Score
#4 Are the dwellings flats? Flats often combine a number of factors contributing to overheating risk e.g. dwelling size, heat gains from surrounding areas; other dense and enclosed dwellings may be similarly affected - see guidance for examples	3	3
#5 Does the scheme have community heating? i.e. with hot pipework operating during summer, especially in internal areas, leading to heat gains and higher temperatures	3	3

Question	Option	Points	Score
#11 Do dwellings have high exposed thermal mass AND a means for secure and quiet night ventilation? Thermal mass can help slow down temperature rises, but it can also cause properties to be slower to cool, so needs to be used with care - see guidance		1	1
#12 Do floor-to-ceiling heights allow ceiling fans, now or in the future? Higher ceilings increase stratification and air movement, and offer the potential for ceiling fans	>2.8m and fan installed	2	1
	> 2.8m	1	

Solar heat gains and ventilation

Question	Option	Points	Score
#6 What is the estimated average glazing ratio for the dwellings? (as a proportion of the facade on solar-exposed areas i.e. orientations facing east, south, west, and anything in between). Higher proportions of glazing allow higher heat gains into the space	>65%	12	4
	>50%	7	
	>35%	4	
#7 Are the dwellings single aspect? Single aspect dwellings have all openings on the same facade. This reduces the potential for ventilation	Single-aspect	3	3
	Dual aspect	0	

Question	Glazing	Full	Part	Score
#13 Is there useful external shading? Shading should apply to solar exposed (E/S/W) glazing. It may include shading devices, balconies above, facade articulation etc. See guidance on "full" and "part". Scoring depends on glazing proportions as per **#6**	>65%	6	3	2
	>50%	4	2	
	>35%	2	1	

Question	Aspect	= Part F	+50%	+100%	Score
#14 Do windows & openings support effective ventilation? Larger, effective and secure openings will help dissipate heat - see guidance (Openings compared to Part F purge rates)	Single-aspect	minimum required	3	4	4
	Dual aspect		2	3	

TOTAL SCORE 9 = Sum of contributing factors: 19 *minus* Sum of mitigating factors: 10

High — 12 — Medium — 8 — Low

score >12: Incorporate design changes to reduce risk factors and increase mitigation factors AND Carry out a detailed assessment (e.g. dynamic modelling against CIBSE TM59)	**score between 8 and 12:** Seek design changes to reduce risk factors and/or increase mitigation factors AND Carry out a detailed assessment (e.g. dynamic modelling against CIBSE TM59)	**score <8:** Ensure the mitigating measures are retained, and that risk factors do not increase (e.g. in planning conditions)