

231 Watford Road London HA1 3TU

Energy Strategy Report and Sustainability Statement

ELKOMS Consulting Ltd.



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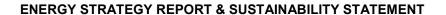
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1.0 Executive Summary

The proposed development project at 231 Watford Road involves the redevelopment of the existing site to create 43 new dwellings arranged across a new build block arranged over ground floor and 4 upper floors.

It has been designed to achieve the highest of environmental performance standards following the Energy Hierarchy as set down by the London Plan and the London Borough of Brent's local plan policies.

The report takes on board the latest GLA guidance on writing energy statements (April 2020) as well as taking into account matters raised with the newly adopted London Plan.

Elkoms Consulting Ltd have been appointed to develop a strategy and advise how the proposed development of new build apartments will comply with these requirements.

A 'Lean, Clean, Green' approach has been adopted and the development achieves an overall improvement (DER/TER) in regulated emissions at over **72.97%** above Part L 2013 standard, through the adoption of high standards of insulation, heat pump driven heating and hot water systems to the flats and a roof mounted PV array.

The adoption of the above strategy, along with a carbon off-set payment of £35,568.00 for this major scheme will meet with London Plan "Zero Carbon" requirements.

Tables 1 and 2 demonstrate how the Watford Road project complies with the London Plan requirements and the GLA guidance relating to zero carbon development.

Table 1: CO₂ Emissions Breakdown – (figures adjusted to SAP 10)

	Carbon Dioxide Emissions (tonnes CO ₂ per annum)	
	Regulated	Unregulated
Base Line: (1) Building Regulations 2013 Part L2A Compliant Development (Notional Building)	46.16	19.76
CO2 emissions after energy demand reduction (be lean)	36.71	19.76
CO2 emissions after energy demand reduction (be lean) AND heat network (be clean)	36.71	19.76
CO2 emissions after energy demand reduction (be lean) AND heat network (be clean) AND renewable energy (be green)	12.48	19.76

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Table 2 – Regulated Emissions Savings – domestic Buildings

	Regulated Carbon Dioxide Savings			
	(Tonnes CO2 per annum)	%		
Savings from energy demand reduction	9.45	20.47		
Savings from heat network	0.00	0.00		
Savings from renewable energy	24.24	52.50		
Total Cumulative Savings	33.69	72.97		
	(Tonne	es CO ₂)		
Carbon Shortfall	12	.48		
Cumulative savings for off- set payment	374.4			
Cash-in-lieu Contribution	£35,5	668.00		

Figure 1 below sets out how the Proposed Development energy efficiency measures and LZC systems reduce CO_2 emissions in line with the London Plan Energy Hierarchy.



Figure 1: The Site Wide Energy Hierarchy and target

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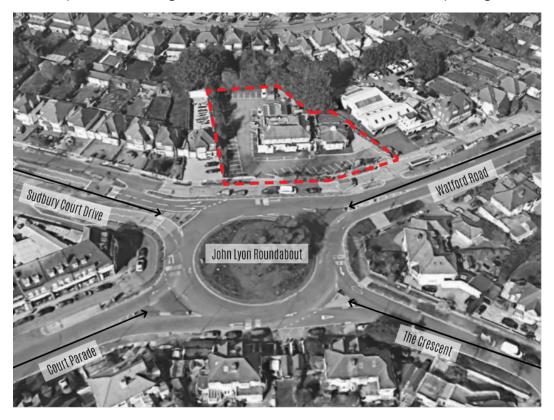


2.0 The Site & Proposal

The site is located in the London Borough of Brent, in front of the John Lyon roundabout and at the junction between Watford Road and Sudbury Court Drive. It is bound by 135 Sudbury Court to the south, Formula One Autocentres to the north and no 15 and 17 Amery Road to the west.

The closest tube and overground station is South Kenton and the site has a PTAL rating of 1b indicating a low level of access to public transport. A few hundred meters north is Northwick Park.

The site comprises an existing restaurant, Mumbai Junction, and its car parking facilities.



The redevelopment proposals are for the demolition of the existing structures to be replaced by a residential development over ground and 4 upper floors with associated parking, cycling and bin storage.

Overall, the proposed scheme will deliver some 43 new flats.

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2.1 Local Planning Context

The site sits within the Borough of Brent Council (Brent).

Section 38(6) of the Planning and Compulsory Purchase Act 2004 requires that the determination of planning applications is made in accordance with the Development Plan unless material considerations indicate otherwise.

The Development Plan for the Site comprises:

- The London Plan (2021);
- Brent Core Strategy (2010);
- Brent Development Management Policies (2016); and
- Brent Policies Map.

Other material considerations include the Draft Brent Local Plan – Main Modifications Version (July 2021); the Brent Design Guide SPD (2018); the Brent Residential Extensions and Alterations SPD (2018); the Mayor of London Housing SPG (2016); the Mayor of London Affordable Housing and Viability SPG (2017); the Mayor of London Sustainable Design and Construction SPG (2014); the Mayor of London Play and Informal Recreation SPG (2012); the Mayor of London Character and Context SPG (2014); the National Planning Policy Framework (NPPF) (2021); and the National Planning Practice Guide (NPPG) (2021).

The London Plan (2021)

The London Plan ('LP') was adopted in March 2021 and sets out the spatial development strategy for Greater London.

Key LP policies relevant to the determination of this application are listed below:

- GG1 (Building strong and inclusive communities);
- GG2 (Making the best use of land);
- GG3 (Creating a healthy city);
- GG4 (Delivering the homes Londoners need);
- GG6 (Increasing efficiency and resilience);
- D2 (Infrastructure requirements for sustainable densities);
- D3 (Optimising site capacity through the design-led approach);
- D4 (Delivering good design);
- D5 (Inclusive design);
- D6 (Housing quality and standards);
- D7 (Accessible housing);
- D12 (Fire safety);
- D14 (Noise);

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- H1 (Increasing housing supply);
- H4 (Delivering affordable housing);
- H5 (Threshold approach to applications);
- H6 (Affordable housing tenure);
- H7 (Monitoring of affordable housing);
- H10 (Housing size mix);

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- S4 (Play and informal recreation);
- HC1 (Heritage conservation and growth);
- Policy G5 (Urban greening);
- G6 (Biodiversity and access to nature);
- G7 (Trees and woodland);
- SI 1 (Improving air quality);
- SI 2 (Minimising greenhouse gas emissions);
- SI 4 (Managing heat risk);
- SI 12 (Flood risk management);
- SI 13 (Sustainable drainage);
- T4 (Assessing and mitigating transport impacts);
- T5 (Cycling);
- T6 (Car parking);
- T6.1 (Residential parking); and
- T7 (Deliveries, servicing and construction).

Brent Core Strategy (2010)

The Brent Core Strategy ('BCS') was adopted in July 2010 and sets out the overarching spatial strategy and key planning policies which will shape new development in the borough.

Key BCS policies relevant to the determination of this application are listed below:

- CP1 (Spatial development strategy);
- CP2 (Population and housing growth);
- CP5 (Placemaking);
- CP6 (Design and density in place shaping);
- CP17 (Protecting and enhancing the suburban character of Brent);
- CP19 (Brent strategic climate change mitigation and adaptation measures); and
- CP21 (A balanced housing stock);

Brent Development Management Policies (2016)

The Brent Development Management Policies ('BDMP') was adopted in November 2016 and contains detailed planning policies which will guide the future development of the Borough.

Key BDMP policies relevant to the determination of this application are listed below:

- DMP 1 (General development management policy);
- DMP 7 (Brent's Heritage Assets);
- DMP 9 A (Managing Flood Risk);
- DMP 9 B (On Site Water Management and Surface Water Attenuation);
- DMP 12 (Parking);

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- DMP 15 (Affordable Housing);
- DMP 13 (Movement of Goods and Materials);
- DMP 18 (Dwelling Size and Residential Outbuildings); and
- DMP 19 (Residential Amenity Space);

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Draft Brent Local Plan

LBB submitted the Draft Brent Local Plan ('DBLP') for Examination in March 2020 and the Examination Hearings took place during September and October 2020. LBB consulted on the Main Modifications to the DBLP from the 8th July – 19th August 2021. The DBLP is at an advanced stage of preparation and weight can therefore be attached to the draft policies.

Key DBLP policies relevant to the determination of this application are listed below:

- DMP1 (Development management general policy)
- BP4 (North West);
- BD1 (Leading the way in good urban design);
- BH1 (Increasing housing supply in Brent);
- BH5 (Affordable housing);
- BH6 (Housing size mix);
- BH13 (Residential amenity space);
- BHC1 (Brent's heritage assets);
- BGI1 (Green and blue infrastructure in Brent);
- BGI2 (Trees and woodlands);
- BSUI1 (Creating a resilient and efficient Brent);
- BSUI2 (Air quality);
- BSUI3 (Managing flood risk)
- BSUI4 (On-site water management and surface water attenuation);
- BT1 (Sustainable travel choice);
- BT2 (Parking and car free development);

Responding to Climate Change

The Development Management Policies DPD and the Area Action Plan will compliment London Plan policies by establishing requirements for sustainable design and construction techniques that maximise the energy efficiency of new buildings, minimise the use of mains water, minimise carbon dioxide emissions in accordance with the London Plan energy hierarchy, and seek to promote and secure opportunities for decentralised energy, especially within the Brent and Wealdstone Intensification Area, onsite renewable energy generation and urban greening.

Premier House sits within the Brent and Wealdstone Intensification Area.

Brent's Development Management policies were adopted in July 2013.

Section 4 deals with Environmental Sustainability:-

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Policy DM 12: Sustainable Design and Layout

- A. The design and layout of development proposals should:
- a. utilise natural systems such as passive solar design and, wherever possible, incorporate high performing energy retention materials, to supplement the benefits of traditional measures such as insulation and double glazing;
- b. make provision for natural ventilation and shading to prevent internal overheating; c. incorporate techniques that enhance biodiversity, such as green roofs and green walls (such techniques will benefit other sustainability objectives including surface water attenuation and the avoidance of internal and urban overheating); and d. where relevant, the design and layout of buildings should incorporate measures to mitigate any significant noise or air pollution arising from the future use of the development.
- B. Proposals that fail to take reasonable steps to secure a sustainable design and layout of development will be resisted.
- C. Appropriate alterations and adaptations that would reduce carbon dioxide emissions from existing homes and non-residential buildings will be supported.

Policy DM 13: Decentralised Energy Systems

- A. Proposals for decentralised energy networks will be supported.
- B. Development proposals should connect to existing decentralised energy networks where feasible.

Policy DM 14: Renewable Energy Technology

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- A. Development proposals should incorporate renewable energy technology where feasible.
- B. Proposals for appropriate renewable energy technology on existing homes and non-residential buildings will be supported.

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2.2 The London Plan



Chapter 9 deals with Sustainable Infrastructure:-

Policy SI1 Improving air quality

A London's air quality should be significantly improved and exposure to poor air quality, especially for vulnerable people, should be reduced:

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) reduce air quality benefits that result from the Mayor's or boroughs' activities to improve air quality
- d) create unacceptable risk of high levels of exposure to poor air quality.
- 5) Air Quality Assessments (AQAs) should be submitted with all major developments, unless they can demonstrate that transport and building emissions will be less than the previous or existing use.

Policy SI2 Minimising greenhouse gas emissions

A Major development should be net zero-carbon. This means reducing carbon dioxide emissions from construction and 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 construction and operation.
- 2) Be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly. Development in Heat Network Priority Areas should follow the heating hierarchy in Policy SI3 Energy infrastructure.
- 3) Be green: generate, store and use renewable energy on-site.
- B Major development should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy and will be expected to monitor and report on energy performance.

C In meeting zero-carbon target a minimum on-site reduction of at least 35 per cent beyond Building Regulations is expected. Residential development should aim to achieve 10 per cent, and non-residential development should aim to achieve 15 per cent through energy

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efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided:

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

Policy SI3 Energy infrastructure

- D Major development proposals within Heat Network Priority Areas should have a communal heating system
- 1) the heat source for the communal heating system should be selected in accordance with the following heating hierarchy:
- a) connect to local existing or planned heat networks
- b) use available local secondary heat sources (in conjunction with heat pump, if required, and a lower temperature heating system)
- c) generate clean heat and/or power from zero-emission sources
- d) use fuel cells (if using natural gas in areas where legal air quality limits are exceeded all development proposals must provide evidence to show that any emissions related to energy generation will be equivalent or lower than those of an ultra-low NOx gas boiler)
- e) use low emission combined heat and power (CHP) (in areas where legal air quality limits are exceeded all development proposals must provide evidence to show that any emissions related to energy generation will be equivalent or lower than those of an ultra-low NOx gas boiler)
- f) use ultra-low NOx gas boilers.
- 2) CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that there is no significant impact on local air quality.
- 3) Where a heat network is planned but not yet in existence the development should be designed for connection at a later date.

Policy SI4 Managing heat risk

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A Development proposals should minimise internal heat gain and the impacts of the urban heat island through design, layout, orientation and materials.

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

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2) reduce the amount of heat entering a building through orientation, shading, albedo, fenestration, insulation and the provision of green roofs and walls

- 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 SI5 Water infrastructure

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- C Development proposals should:
- 1) 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 (commercial development)
- 3) be encouraged to 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.

As a major development scheme, the project at Watford Road will comply with the requirements of the London Plan utilising SAP10 methodology in line with the GLA guidance on the preparation of Energy Statements.

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3.0 Baseline energy results

The first stage of the Mayor's Energy Hierarchy is to consider the baseline energy model.

The following section details the baseline energy requirements for the development – the starting point when considering the energy hierarchy.

3.1 New Build Dwellings

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The baseline emission levels – the Target Emission Rate (TER) - is obtained by applying the design to a reference 'notional' building the characteristics of which are set by regulations – SAP2012; The new Part L Building Regulations 2013 came into force in April 2014 and introduced a completely new notional dwelling as detailed below:-

Element or System	Values
Opening areas (windows and doors)	Same as actual dwelling up to a maximum proportion of 25% of total floor area [1]
External Walls (including opaque elements of curtain walls) [6]	0.18 W/m²K
Party Walls	0.0 W/m ² K
Floor	0.13 W/m²K
Roof	0.13 W/m²K
Windows, roof windows, glazed rooflights and glazed doors	1.4 W/m²K [2] (Whole window U-value)
	g-value = 0.63 [3]
Opaque doors	1.0 W/m²K
Semi glazed doors	1.2 W/m²K
Air tightness	5.0 m ³ /hr/m ²
Linear thermal transmittance	Standardised psi values – See SAP Appendix R, except use of y=0.05 W/m²K if the default value of y=0.15 W/m²K is used in the actual dwelling
Ventilation type	Natural (with extract fans) [4]
Air conditioning	None
Element or System	Values
Heating System	Mains gas If combi boiler in actual dwelling, combi boiler; otherwise regular boiler Radiators
	Room sealed
	Fan flue
	SEDBUK 2009 89.5% efficient
Controls	Time and temperature zone control [5] Weather compensation
	Modulating boiler with interlock
Hot water storage system	Heated by boiler (regular or combi as above) If cylinder specified in actual dwelling, volume of cylinder in actual dwelling. If combi boiler, no cylinder. Otherwise 150 litres. Located in heated space. Thermostat controlled Separate time control for space and water heating
Primary Pipework	Fully Insulated
Hot water cylinder loss factor (if specified)	Declared loss factor equal or better than 0.85 x (0.2 + 0.051 V2/3) kWh/day
Secondary Space Heating	None
Low Energy Lighting	100% Low Energy Lighting

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SAP first creates the notional reference building, based upon the same shape and form as the proposed dwelling and applies the above characteristics as defined in SAP2012.

Once all of the baseline emission rates have been calculated in line with the above Government approved methodologies, they are considered as stage 'zero' of the energy hierarchy as described earlier and Target Emission Rate sets the benchmark for the worst performing, but legally permissible, development.

For the project at Watford Road, a sample of 10 apartments has been selected at lower floor, mid floors and top floor to offer a representative selection to enable an accurate figure for emissions/m² which can then be applied to the full gross internal residential floor area.

In line with the GLA guidance on the preparation of energy statements, the baseline model will assume the use of a centralised heating and LTHW distribution system.

3.3 Unregulated Energy Use

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The baseline un-regulated energy use for cooking & appliances in the residential units have been calculated using the SAP Section 16 methodology; the same calculation used for Code for Sustainable Homes (CfSH) Ene 7.

Appliances = E_A = 207.8 X (TFA X N)^{0.4714} Cooking = (119 + 24N)/TFA N = no of occupant SAP table 1B TFA – Total Floor Areas

The emissions associated with unregulated energy use per sqm is summarised in Table 1 below, with both the SAP2012 and SAP10 levels presented.

Table 3 – Unregulated Energy Use

Unit	CO ₂ emissions - Unregulated Energy Use SAP2012 Kg/sqm	CO₂ emissions - Unregulated Energy Use SAP10 Kg/sqm
Sample 1	15.06	6.78
Sample 2	15.60	7.02
Sample 3	15.13	6.81
Sample 4	15.60	7.02
Sample 5	15.31	6.89
Sample 6	15.13	6.81
Sample 7	15.60	7.02
Sample 8	15.31	6.89
Sample 9	15.69	7.06
Sample 10	15.64	7.04

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The un-regulated emission rates are added to the baseline regulated emission rates (as calculated under 3.1 above) in order to set the total baseline emission rates before then applying the energy hierarchy in line with The London Plan and Brent policies.

3.3 Baseline Results

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The baseline building results have been calculated and are presented in Table 2 below.

The Baseline SAP outputs (which summarise the key data) are attached at **Appendix A**. the SAP10 conversion is attached at **Appendix D**.

Table 4 – Baseline energy consumption and CO2 emissions

Unit	Target Emission Rate	Unregulated Energy Use	Total baseline emissions	Total baseline emissions
	(regulated energy use) Kg/sqm	Kg/sqm	Kg/sqm	Kg
Sample 1	15.7	6.78	22.50	2256.08
Sample 2	15.2	7.02	22.23	1177.98
Sample 3	17.9	6.81	24.68	2281.36
Sample 4	15.2	7.02	22.23	1177.98
Sample 5	14.3	6.89	21.19	1579.57
Sample 6	15.6	6.81	22.42	2072.62
Sample 7	15.2	7.02	22.23	1177.98
Sample 8	14.3	6.89	21.19	1579.57
Sample 9	19.1	7.06	26.19	1257.25
Sample 10	20.1	7.04	27.12	1366.16
Development Total				65933

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4.0 Design for energy efficiency

The first step in the Mayor's 'Energy Hierarchy' as laid out in Chapter 9 of The London Plan, requests that buildings be designed to use improved energy efficiency measures – Be Lean. This will reduce demand for heating, cooling, and lighting, and therefore reduce operational costs while also minimizing associated carbon dioxide emissions.

This section sets out the measures included within the design of the development, to reduce the demand for energy, both gas and electricity (not including energy from renewable sources). The table at the end of this section details the amount of energy used and CO₂ produced by the building after the energy efficiency measures have been included. From these figures the overall reduction in CO₂ emissions, as a result of passive design measures, can be calculated. To achieve reductions in energy demand the following measures have been included within the design and specification of the building:

4.1 Passive Design

The National Planning Policy Framework emphasises the need to take account of climate change over the longer term and plan new developments to avoid increased vulnerability to the range of impacts arising from climate change. The UK Climate Impacts Programme 2009 projections suggest that by the 2080's the UK is likely to experience summer temperatures that are up to 4.2°C higher than they are today.

Accordingly, designers are to ensure buildings are designed and constructed to be comfortable in higher temperatures, without resorting to energy intensive air conditioning.

In line with current GLA Guidance, the project at Watford Road has had been designed to ensure the building is not vulnerable to overheating; to instigate consideration of the risk of overheating with the proposed development, the design team have followed the guidance within the London Plan, which consider the control of overheating using the Cooling Hierarchy:-

1. minimise internal heat generation through energy efficient design

The project will be designed to best practice thermal insulation levels as noted, full details of which are noted under 4.3 below.

Not only does good insulation assist in reducing heat losses in the winter, but it also has a significant impact on preventing heat travelling through the build fabric during the summer.

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2. reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and wall

The development site is within a relatively low-rise townscape, located on the west side of Watford Road and accordingly there is little by way of local topographical shading.

The proposed development has an essentially east-west aspect, but flats have orientation in all directions, however there are very few units with a direct southern aspect.

The livings area have the benefit of large, glazed areas arranged predominantly to the east and west – thus avoiding the peak southern aspect, whilst also introducing natural daylight and attracting useful solar gain.

These same large, glazed area are afforded protection from excessive solar gain during the summer months via the shading offered by the balconies above.

Across the scheme, the glazing to the secondary spaces – bedrooms and bathrooms – is much reduced in keeping with the reduced heat demand associated.

Glazing specification has been a significant consideration as part of the overheating risk mitigation and the specified new glazing will achieve a g-value of 0.55 or better in order to further assist in reducing overheating risk from excessive solar gain.

The top floor units have a higher spec of glazing (g value at circa 0.4) to overcome the lack of shading.

The landscaped grounds and green roof at top floor levels will aid local evaporative cooling.

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

All flats are designed with floor to floor heights at circa 2.6m.

The new build structure is expected to be an RC frame with cast in-situ concrete floors (method of construction to be confirmed), offering very significant thermal mass able to absorb heat during the summer months, which can then be ventilated during the evening or overnight.

4. passive ventilation

All glazing is designed to have opening areas to introduce high levels of natural levels of "purge" ventilation to further assist in the reduction of overheating risks in appropriate areas.

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4.1 mechanical ventilation

Background ventilation will be provided by MVHR units built in the all-in-one ASHP. These units will incorporate a summer by-pass, which will allow the unit to supply fresh air without heat being transferred from the extract air into the supply air.

4.2 Heating System

All-in-one exhaust and supply air source heat pump which provides heating, ventilation, heat recovery and hot water efficiently. With built-in hot water tank, immersion heater, circulation pump, fans and control system, the heat pump provides source of heat.

The ventilation air's energy is converted to residential heating in a three different circuits. From the outgoing ventilation air (1), heating energy is recovered from the dwelling and transported to the heat pump. The heat pump increases the recovered heat's low temperature to a high temperature in the refrigerant circuit (2). The heat is distributed around the house in the heating medium circuit (3).

4.3 Fabric heat loss

Insulation measures will be utilised to ensure the calculated U-values exceed the Building Regulations minima, with specific guidance taken from the design team: -

- New wall constructions will be of a concrete frame with an insulated panelling and will target a U-Value of 0.16W/m²k or better.
- New flat roof constructions are to be of a warm-roof type, achieving a U-Value of 0.12W/m²k
- The newly laid floors will achieve a minimum u value of 0.14/0.15W/m²k subject to perimeter/area ratios

Glazing

• The new glazing for windows and doors will be triple glazed with an area weighted average U-Value of 1.1W/m²K or better.

Air Tightness

• The project be tested to 3.5m³/hr/m² in line with very best practice for naturally ventilated dwellings.

Construction Details

 Heat loss via non-repeating thermal bridging within the new build elements will be minimised by the use of Accredited Construction Details for these new build units.
 An overall Y-Value <0.07 is targeted.

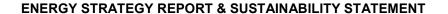




Table5: Passive Elements

Element		Domestic	
Floor U - Value (W/m ² K)		0.14 - 0.15	
Roof U - Value (W/m²K)		0.12	
External	Walls U - Value (W/m²K)	0.16	
Walls be (W/m²K	etween heated spaces)	Solid or Fully filled cavity with sealed edges	
Walls be (W/m²K	tween stairs/lifts/risers)	Solid or Fully filled cavity with sealed edges	
Walls to unheated spaces (W/m ² K)		Solid or Fully filled cavity with sealed edges	
Glazing Glazed doors	U-value (W/m²K)	1.1	
aziı ed d	G-value	0.4	
glaze	Frame type	Metal	
G	Frame Factor	20%	
Opaque	Door	1.0 W/m ² K	
Air permeability (m³/hm² (@ 50Pa)		3.5	
Thermal Bridge Specification		Accredited Construction Details	

4.4 Ventilation

Background ventilation will be provided by MVHR units built in the all-in-one ASHP. These units will incorporate a summer by-pass, which will allow the unit to supply fresh air without heat being transferred from the extract air into the supply air.

4.5 Lighting and appliances

The development will incorporate high efficiency light fittings utilising LED lamps.

Common/circulation areas will also have an absence detection system to ensure lights cannot be left on when not in occupation.

The use of LED lighting will also minimise the internal gains commonly associated with tungsten and fluorescent lighting systems and thereby further reduce the potential for the flats to overheat.

4.6 Energy efficiency results

The above data has been used to update the SAP models, the SAP2012 Dwelling Emission Rate outputs of which are attached at **Appendix B**.

The SAP 10 emission calculations are attached at **Appendix D.**

Table 6 - Energy Efficient emission levels

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Unit	Emission Rate (regulated energy use)	Unregulated Energy Use	Total baseline emissions	Total baseline emissions
	Kg/sqm	Kg/sqm	Kg/sqm	Kg
Sample 1	12.8	6.78	19.54	1959.60
Sample 2	12.1	7.02	19.10	1011.71
Sample 3	14.8	6.81	21.56	1992.84
Sample 4	12.1	7.02	19.10	1011.71
Sample 5	11.3	6.89	18.19	1356.14
Sample 6	12.4	6.81	19.16	1771.14
Sample 7	12.1	7.02	19.10	1011.71
Sample 8	11.3	6.89	18.19	1356.14
Sample 9	14.6	7.06	21.69	1041.14
Sample 10	15.4	7.04	22.45	1131.18
Development Total				56481

The results show that the energy efficiency measures introduced have resulted in the reduction in CO_2 emissions from the development of **14.34%**.

Regulated emissions have been reduced by **20.47%** via the passive design measures highlighted above.

The energy demands of the proposed development are tabulated below.

Table 7– Energy Demand, "Be-Lean"

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Building	Energy demand following energy efficiency measures (Mwh/year)						
	Space	Hot	Lighting	Cooling	Auxiliary	Unregulated	Unregulated
	Heating	Water				electricity	gas
Watford	87573	53373	13465	N/A	N/A	50.21	N/A
Road							



5.0 Supplying Energy Efficiently

5.1 Community Heating/Combined Heat and Power (CHP)

The London Plan, Chapter 9, requires that major developments exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly.

Development in Heat Network Priority Areas should follow the heating hierarchy in Policy SI3 Energy infrastructure.

Therefore, this report must consider the availability of heat networks in the Brent area.

The extract from the London Heat Map (reproduced below) identifies that the site is not within a heat map study area, but is within a Heat Network Priority Area.



Extract from London Heat Map

Clearly, there is a longer term opportunity for the Watford Road project to connect to a DEN, so consideration has to be given to the potential to connect to a DEN.

The possibility for the connection to DH network is taken into consideration within the space provision. The design safeguarding an identified route from the plant room to the property boundary at ground floor level, roadway or similar for flow and return pipes to enable connection to a future area wide DEN.

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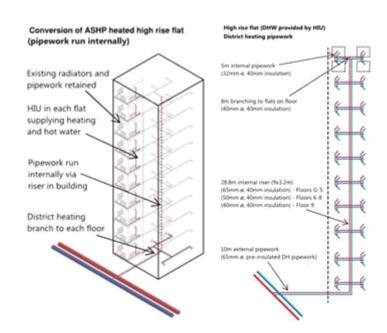


New developments where the detailed connection arrangement to a DEN is unknown, require physical space to be allocated for installation of heat exchangers and any other equipment required to allow connection.

The DHW demand can be met via a packaged skid with dimension at 1.5 m x 0.5 m x 2.0 m (h). With an allowance for a 1 m servicing area around the unit, the drawings demonstrate an allocated plantroom is provided for future DH connections.

As there is no district heating network immediately planned or feasible, a apartment air source heat pumps are proposed for space heating and hot water production. As detailed in the Be Green stage the system will incorporate air source heat pumps technology to maximise efficiency.

If district heating is connected to the building in the future, the individual ASHP and domestic hot water cylinder could be replaced with a new HIU in each apartment, providing heat to the existing underfloor heating manifold network, as well as instantaneous hot water.



In the meantime, in the medium term, the design team have considered decentralised stand-alone Air Source Heat Pumps system.

The proposed solution provides benefit for the tenants such as; standalone systems not require central energy metering and billing system.

The proposed system does not require centralised landlords equipment and relieves roof space to maximise installation of the PV systems.

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The system is significantly more efficient than district heating energy network and has negligible distribution losses. The key advantages over DHEN is shown in the table below:

Table 8- Stand Alone ASHP vs DHEN

	Stand Alone Air Source Heat Pump Nibe F730	District Heating Energy Network DHEN
Efficiency		0.6-0.7 (CHP)
COP (coefficient of performance)		(Dependant of the District Heating Network leading Source)
	2.4-5.3	
Energy Distribution losses	none	15-50% distribution losses subject to the pipework lengths
	73 % over Part L	Dependant of the District Heating Network Source. If CHP led DHEL is unlikely to pass Part L under SAP10 Assessment
CO2 reduction		
Billing system required	No	Yes (Heat meters required for each apartment)
Means of paying the bills	Through electricity bill	Electricity paid by landlord, cost passed to tenant based on energy meter readings

5.2 On-site CHP/Community Heating

A community heating network comprises a series of insulated pipes used to deliver heat, in the form of hot water or steam, to a number of different locations or dwellings. They range from small, providing heat to a house and a couple of holiday cottages for example, to large scale systems supplying housing estates or blocks of flats.

The heat production facility for a community scheme is generally considered to include heat only boilers (HOB) and/or the production of both electricity and heat i.e. CHP.

CHP systems are essentially biomass or fossil fuel fired electricity generators that use the heat by-product to provide space and water heating. The electricity generated can be used directly within the host buildings or sold to electricity suppliers on the national grid.

CHP is, as a rule of thumb, is only operated as a base load as, depending on the technology, it may be difficult and/or inefficient to operate according to daily variations in demand. In a well-designed district heating network heat from CHP will provide between 60% and 80%

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of the annual baseline heat (heating and hot water) requirement with heat-only boiler plants providing the peak load and back-up.

To maximise efficiency of the engine it needs to run for at least 17 hours a day; therefore, the heat load needs to be present for this period.

Clearly, as a domestic development, with only the limited year round DHW demand to support a CHP installation (only 2-4 hours per day in the May – October period), the economy of scale, in terms of year-round demand, simply isn't present and as such the potential use of on-site CHP is very limited.

We must also consider the net carbon benefits from such a system as the de-carbonisation of national grid dilutes the benefits obtained from the higher efficiency of larger-scale CHP led system.

Reference is made to the latest CIBSE Symposium on the topic; "An operational lifetime assessment of the carbon performance of gas fired CHP led district heating" (2016). This paper sets out a calculation methodology to determine the greenhouse gas emissions associated with district heat networks which use gas fired CHP as a heat source.

Currently, Part L calculations and CHP emissions savings are based on the grid based emission rate taken from the SAP 2012 3-year average - 519g/kWhCO2; SAP 2012 introduced a 15-year average at 381g/kWhCO2 to assist designers considering the longer term impacts.

Such a difference will markedly affect the relative calculated performance of a gas CHP engine versus a gas boiler, particularly if any community network losses are removed from the equation through the use of localised boilers.

The CIBSE paper further advises that "Using a typical good practice assumption of 40% thermal efficiency of the CHP, the threshold for net benefit is a grid carbon factor of around 338 gCO2/kWh. Below that threshold, CHP is found to be worse than a gas boiler and grid electricity."

DECC provides data for treating energy and emissions in their guidance; this provides projections of grid emissions factors over the next 85 years. With the rapid and recent introduction of renewable technologies to the grid – wind power and PV - DECC's "Green Book" guidance projects that grid carbon intensity will reach 338 gCO2/kWh by 2017/18 and will reach $300\text{gCO}_2\text{kWh}$ by 2018/19.

This report is based upon the SAP10 figure of 233gCO2/kWh, and it is acknowledged that the carbon content of grid electricity is steadily reducing.

So it can be surmised, that by the time an CHP led community network at Watford Road has reached maturity in 2 or 3 years, the carbon benefits will already have been lost.

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However, this report must also consider the potential for heat only boilers to drive a community heating system; in more recent times, the difference between the actual and assumed efficiency of DH networks has come under the spotlight from a number of different sources.

Indeed, in a recent studies collated by Innovate UK in the Building Data Exchange, inappropriately installed community heating systems were suffering heat losses of 50% or more.

However, when it comes to small scale networks as least, it is becoming very apparent that there is a difference between theoretical and real-world system efficiencies.

In the CBSE Technical symposium "CHP and District Heating - how efficient are these technologies?" (2011), further commentary is made on this issue.

This paper defines an 'equivalent heat efficiency' parameter and a CO₂ content of heat supply to enable Combined Heat and Power (CHP) to be compared to boilers and heat pumps

This report identifies and acknowledge that the heat losses within a well-designed DH network will be at minimum of 15%, so immediately it can be seen that, a large scale modular boiler system offering gross efficiencies at circa 96%, will be less efficient than a local condensing boiler with a gross efficiency of 92%-93% at point of delivery.

It can be summarised, an a medium scale scheme with limited DEN potential connection potential, the installation of a centralised LTHW system would be counterproductive, with year on year heat losses outweighing the less then certain potential connection to a low carbon DEN.

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6.0 Renewable Energy Options

The final element of the Mayor's 'Energy Hierarchy' requires development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible – Be Green.

Renewable energy can be defined as energy taken from naturally occurring or renewable sources, such as sunlight, wind, wave's tides, geothermal etc. Harnessing these energy sources can involve a direct use of natural energy, such as solar water heating panels, or it can be a more indirect process, such as the use of Biofuels produced from plants, which have harnessed and embodied the suns energy through photosynthesis.

The energy efficiency measures outlined above have the most significant impact on the heating and hot water energy requirements for the development, and the associated reduction in gas consumption.

This section then sets out the feasibility of implementing different energy technologies in consideration of: -

- Potential for Carbon savings
- Capital costs
- Running costs
- Payback period as a result of energy saved/Government incentives
- Maturity/availability of technology
- Reliability of the technology and need for back up or alternative systems.

6.1 Government incentives

6.1.1 Renewable Heat Incentive

New applications for the Renewable Heat Incentive (RHI) for commercial development were withdrawn on 31st March 2021.

6.2 Wind turbines

Wind turbines come in two main types'- horizontal axis and vertical axis. The more traditional horizontal axis systems rotate around the central pivot to face into the wind, whilst vertical axis systems work with wind from all directions.

The potential application of wind energy technologies at a particular site is dependent upon a variety of factors. But mainly these are: -

Wind speed

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Wind turbulence

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- Visual impact
- Noise impact
- Impact upon ecology

The availability and consistency of wind in urban environments is largely dependent upon the proximity, scale and orientation of surrounding obstructions. To receive practical amounts of non-turbulent wind, the blades of a wind turbine would need to be placed significantly above the roof level of the proposed project at Watford Road itself, standing some 30m + above ground floor level.

It is inconceivable that any wind turbines of this size would be considered acceptable in this location.

6.3 Solar Energy

The proposed development has areas of low pitched roof that could accommodate solar panels orientated to the south.

In general, the roofs will have an unrestricted aspect, so there is scope therefore to site solar photovoltaic (PV) or water heating equipment at roof level.

6.3.1 Solar water heating

Solar water heating panels come in two main types; flat plate collectors and evacuated tubes. Flat plate collectors feed water, or other types of fluid used specifically to carry heat, through a roof mounted collector and into a hot water storage tank. Evacuated tube collectors are slightly more advanced as they employ sealed vacuum tubes, which capture and harness the heat more effectively.

Both collector types can capture heat whether the sky is overcast or clear. Depending on location, approximately 900-1100 kWh of solar energy falls on each m^2 of unshaded UK roof surface annually. The usable energy output per m^2 of solar panel as a result of this amount of insolation ranges from between 380-550 kWh/yr.

Solar hot water systems are of course, displacing gas for DHW provision (as noted above), and due to the low cost of gas as a source of energy, solar thermal systems tend to have a very poor pay back model unless there is a reliable and consultant demand for hot water; a medium size residential scheme simply does not provide this

Accordingly, given the limited roof space available and the strategy to off-set the electrical use, solar PV may be a stronger candidate (see below) and offer a greater return in terms of a return on investment.

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6.3.2 Photovoltaics (PV)

A 1kWp (1 kilowatt peak) system in the UK could be expected to produce between 790-800kWh of electricity per year based upon a south east orientation according to SAP2005 methodology used by the Microgeneration Certification Scheme (MCS). The figure given in the London Renewables Toolkit is 783 kWh per year for a development in London.

Despite the withdrawal of the Feed in Tariff, the returns on PV installations are still able to achieve 3-4% returns via the reduction in electricity consumption.

Accordingly, the design team are proposing to utilise the significant roof space to accommodate 106 x 330W PV panels – a total array at 34.98kWp.

The array will produce some 39,000kWh/annum, off-setting a further 9.13 tonnes of $CO_2/annum$ (SAP10 emission levels).

6.4 Biomass heating

Biomass is a term given to fuel derived directly from biological sources for example rapeseed oil, wood chip/pellets or gas from anaerobic digestion. It can only be considered as a renewable energy source if the carbon dioxide emitted from burning the fuel is later recaptured in reproducing the fuel source (i.e. trees that are grown to become wood fuel, capture carbon as they grow).

Biomass heating systems require space to site a boiler and fuel hopper along with a supply of fuel – which can be very bulky items. There also needs to be a local source of biomass fuel that can be delivered on a regular basis. There are also issues with fuel storage and delivery which mitigate against this technology.

Additionally, a boiler of this type would replace the need for a conventional gas boiler and therefore offset all the gas energy typically used for space and water heating. However, biomass releases high levels of NO_x emissions and particulate matters, as well as other pollutants and would therefore have to be considered carefully against the high standard of air quality requirements within Brent's Borough wide AQMA. Accordingly, the use of biomass is not considered appropriate for this project.

6.6 Ground source heat pump

All heat pump technologies utilise electricity as the primary fuel source – in this case displacing gas, as such, the overall reduction in emissions when using this technology can be less effective when opposed to a technology that is actually displacing electricity.

Ground source heating or cooling requires a source of consistent ground temperature, which could be a vertical borehole or a spread of pipework loops and a 'heat pump'. The system uses a loop of fluid to collect the more constant temperature in the ground and

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transport it to a heat pump. In a cooling system this principle works in reverse and the heat is distributed into the ground.

The heat pump then generates increased temperatures by 'condensing' the heat taken from the ground, producing hot water temperatures in the region of 45°C. This water can then be used as pre-heated water for a conventional boiler or to provide space heating with an under-floor heating system.

The use of a ground source heating/cooling system will therefore require:

- Vertical borehole or ground loop
- Use of under floor heating
- Space for heat pump unit

Clearly, there is insufficient land area to install low level collector loops, leaving deep bore GSHP as the only potential option.

Normally the boreholes would need to be 6 to 8 metres apart and a 100-metre-deep borehole will only provide about 5kw of heat. The borehole should also be formed around 3m away from the perimeter of the building and most specialists don't recommend using the structural boreholes.

Clearly, in the case of the proposed development, there is little scope for the locating of the ground collector devices and as such, ground source heating cannot be considered.

6.7 Air source heat pump

Air source heating or cooling also employs the principle of a heat pump. This time either, upgrading the ambient external air temperature to provide higher temperatures for water and space heating, or taking warmth from within the building and dissipating it to the outdoor air.

It must be remembered that heat pumps utilise grid based electricity and the associated emissions, so that actual the reduction in emissions can be limited. Assuming a seasonal system efficiency of 320% (Coefficient of Performance of 3.2) and that the air source heat pump will replace 100% of the space heating/hot water demand, then the system would reduce the overall CO₂ emissions by approximately 60%. The table below demonstrates, on the assumption of a demand of 1000kWh/year for heating and hot water.

Table 9 – Air Source Heat Pump Performance

Type of Array	Energy Consumption (kWh/yr.)	Emission factor (SAP10) (kgCO ₂ /h)	Total CO ₂ emissions (kg/annum)
90% efficient gas boiler	11111	0.210	2333
320% efficient ASHP	2813	0.233	655
100% efficient immersion (back-up)	1000	0.233	233

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A theoretical carbon saving of 62%

Accordingly, the design team are proposing to utilise NIBE Fighter heat pump systems, providing heating and how water to individual flats, via a heat exchange process with the exhausted internal air, with fresh external make-up air drawn in via wall mounted vents.

Because of the enhanced ventilation systems, the flats are able to air test down to levels below that normally associated with naturally ventilated units.

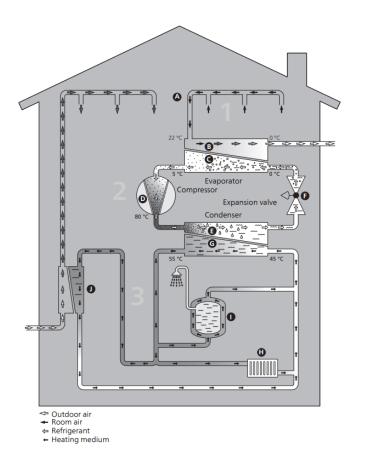
NIBE F730

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All-in-one exhaust and supply air source heat pump which provides heating, ventilation, heat recovery and hot water efficiently. With built-in hot water tank, immersion heater, circulation pump, fans and control system, the heat pump provides source of heat. The ventilation air's energy is converted to residential heating in three different circuits. From the outgoing ventilation air (1), heating energy is recovered from the dwelling and transported to the heat pump. The heat pump increases the recovered heat's low temperature to a high temperature in the refrigerant circuit (2). The heat is distributed around the house in the heating medium circuit (3).

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Ventilation air

- A. The hot air is transferred from the rooms to the heat pump via the house ventilation system.
- B. The fan then routes the air to the heat pump's evaporator. Here, the air releases the heating energy and the air's temperature drops significantly. The cold air is then blown out of the house.

Refrigerant circuit

- C. A liquid, a refrigerant, circulates in a closed system in the heat pump which also passes the evaporator. The refrigerant has a very low boiling point. In the evaporator the refrigerant receives the heat energy from the ventilation air and starts to boil.
- D. The gas that is produced during boiling is routed into an electrically powered compressor. When the gas is compressed, the pressure increases and the gas's temperature increases considerably, from approx. 5°C to approx. 80°C.

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- E. From the compressor, the gas is forced into a heat exchanger, condenser, where it releases heat energy to the heat pump's heating section, whereupon the gas is cooled and condenses to liquid form again.
- F. As the pressure is still high, the refrigerant can pass an expansion valve, where the pressure drops so that the refrigerant returns to its original temperature. The refrigerant has now completed a full cycle. It is routed to the evaporator again and the process is repeated.

Heat medium circuit

- G. The heat energy that the refrigerant produces in the condenser is retrieved by the climate system's water, heating medium, which is heated to 35 °C (supply temperature).
- H. The hot water circulates in a closed system and is pumped out to the radiators/heating coils of the house.
- I. The heat pump's integrated water heater is in the heating section. The heating medium heats the hot water.

Pre-heated supply air

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J. The hot water also circulates to the heat pump's supply air coil. The supply air coil heats up the air that is blown out into the rooms that have supply air inlets.

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6.8 Final Emissions Calculation

Given the outcome of the feasibility study above, the developer is proposing the above noted NIBE heat pump system to generate the heating and hot water systems for the flats and a 106 panel roof mounted PV array to utilise the available roof space.

The final table – Table 6 – summarises the final outputs from the SAP models; attached at **Appendix C.** The SAP 10 emission calculations are attached at **Appendix D.**

Table 10 - "Be Green" emission levels

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Unit	Emission Rate (regulated energy use)	Unregulated Energy Use	Total baseline emissions	Total baseline emissions
	Kg/sqm	Kg/sqm	Kg/sqm	Kg
Sample 1	4.7	6.78	11.46	1149.67
Sample 2	3.5	7.02	10.57	559.76
Sample 3	5.6	6.81	12.45	1151.13
Sample 4	3.5	7.02	10.57	559.76
Sample 5	3.6	6.89	10.51	783.87
Sample 6	4.7	6.81	11.51	1063.59
Sample 7	3.5	7.02	10.57	559.76
Sample 8	3.6	6.89	10.51	783.87
Sample 9	4.7	7.06	11.73	562.94
Sample 10	5.2	7.04	12.21	614.92
Development Total				32246

The data at Table 5 confirms that overall emissions – including unregulated energy use - have been reduced by **51.09%** over and above the baseline model, with a **42.91%** reduction in emissions directly from the use of energy generating and renewable technologies, i.e. over and above the energy efficient model.

Excluding the un-regulated use, i.e. considering emissions controlled under AD Part L, then the final reduction in DER/TER equates to **72.97%**.

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7.0 Sustainable Design & Construction

The Sustainability credentials of the proposed residential development are set out below; based on the assessment criteria developed by the Building Research Establishment

Materials

New build construction techniques will be considered against the BRE Green Guide to ensure that, where practical, the most environmentally friendly construction techniques are deployed.

Construction materials will be sourced from suppliers capable of demonstrating a culture of responsible sourcing via environmental management certification, such as BES6001

Insulation materials will be selected that demonstrate the use of blowing agents with a low global warming potential, specifically, a rating of 5 or less. Additionally, all insulants used will demonstrate responsible sourcing of material and key processes.

The principle contractor with be required to produce a site waste management plan and sustainable procure plan, in line with BREEAM requirements – this will include a predemolition audit to identify demolition materials to reuse on-site or salvage appropriate materials to enable their reuse or recycling off-site. The procurement plan will follow the waste hierarchy Reduce; Reuse & Recycle.

A Site Waste Management Plan (SWMP) will be developed prior to commencement of development stage to inform the adoption of good practice waste minimisation in design. This will set targets to minimise the generation of non-hazardous construction waste using the sustainable procurement plan to avoid over-ordering and to use just-in-time delivery policies.

Operational waste and recycling – appropriate internal and external storage space will be provided to ensure that residents can sort, store and dispose of waste and recyclable materials in line with Brent's collection policies.

Pollution

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The contractor will also monitor the use of energy and water use during the construction phase and incorporate best site practices to reduce the potential for air (dust) and ground water pollution.

The completed dwellings will use zero emission heat pump systems for heating and hot water.

The main contractor will be required to register the site with the Considerate Constructors Scheme and achieve a best practice score of 25 or more.

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To void the issue of noise pollution, the development will comply with Building Regulations Part E, providing a good level of sound insulation between the proposed development and surrounding buildings.

Energy

The dwelling will incorporate renewables technologies as noted in the main report above.

The new homes will also be supplied with a Home User Guide offering practical advice on how to use the home economically and efficiently, including specific advise on how to reduce unregulated energy uses.

This will be further enhanced by the installation of smart energy metering, enabling occupants to accurately assess their energy usage and thereby, manage it.

Water

The development minimise water use as far as practicable by incorporating appropriate water efficiency and water recycling measures. The applicants will ensure that all dwellings meet the required level of 105 litres maximum daily allowable usage per person in accordance with Level 4 of the Code for Sustainable Homes.

Sustainable Urban Drainage (SuDs)

The existing site is currently made up entirely of building and hard surfaces. Accordingly, the introduction of new planted areas and green roof areas will help to reduce the levels of surface water run-off.

A formal flood risk assessment and SuDs strategy is submitted under separate cover.

Ecology and Biodiversity

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Clearly, the existing site is 100% previously developed, so any improvement on this situation would increase biodiversity.

The development would employ an ecologist to consider the planting regime for the communal landscaped areas and an overall improvement in the levels of fauna and flora utilising indigenous species where possible and appropriate.

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8.0 Conclusions

This report has detailed the baseline energy requirements for the proposed development, the reduction in energy demand as a result of energy efficiency measures and the potential to achieve further CO₂ reductions using renewable energy technologies.

The baseline results have shown that if the development was built to a standard to meet only the minimum requirements of current building regulations, the total amount of CO₂ emissions would be **65933Kg/year**.

Following the introduction of passive energy efficiency measures into the development, as detailed in section 4, the total amount of CO₂ emissions would be reduced to **56481Kg/year**

There is also a requirement to reduce CO₂ emissions across the development using renewable or low-carbon energy sources. Therefore, the report has considered the feasibility of the following technologies:

- Wind turbines
- Solar hot water
- Photovoltaic systems
- Biomass heating
- CHP (Combined heat and power)
- Ground & Air source heating

The results of the assessment of suitable technologies relative to the nature, locations and type of development suggest that the most suitable solution to meeting reduction in CO₂ emissions would be via the generation of electricity on site via an 44.81kWp PV array, with the development's heat generated via exhaust air source heat pump technology.

This has been used in the SAP models (reproduced at **Appendix C**) for the development. The SAP 10 emission calculations are attached at **Appendix D**, which have also been detailed above in Table 6, which show a final gross emission level of **32246Kg/year**, representing a total reduction in emission over the baseline model, taking into account unregulated energy, of **51.09%**.

In addition, the final SAP outputs at Appendix C demonstrate that the building achieves an overall improvement in regulated emissions over the Building Regulations Part L standards for regulated emissions of minimum of 72.97%.

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Tables 11 & 12 Demonstrate how the Watford Road project complies with the London Plan requirements and the GLA guidance relating to zero carbon development.

Table 11 – Carbon Emission Reductions – Domestic Buildings

	Carbon Dioxid (tonnes CO ₂ po	
	Regulated	Unregulated
Base Line: (1) Building Regulations 2013 Part L2A Compliant Development (Notional Building)	46.16	19.76
CO2 emissions after energy demand reduction (be lean)	36.71	19.76
CO2 emissions after energy demand reduction (be lean) AND heat network (be clean)	36.71	19.76
CO2 emissions after energy demand reduction (be lean) AND heat network (be clean) AND renewable energy (be green)	12.48	19.76

Table 12 – Regulated Emissions Savings – domestic Buildings

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	Regulated Carbo	n Dioxide Savings
	(Tonnes CO2 per annum)	%
Savings from energy	9.45	20.47
demand reduction		
Savings from heat network	0.00	0.00
Savings from renewable	24.24	52.50
energy		
Total Cumulative Savings	33.69	72.97
	(Tonne	es CO ₂)
Carbon Shortfall	12	.48
Cumulative savings for off-	37	4.4
set payment		
Cash-in-lieu Contribution	£35	,568



Figure 1 below sets out how the Proposed Development energy efficiency measures and LZC systems reduce CO₂ emissions in line with the London Plan Energy Hierarchy.

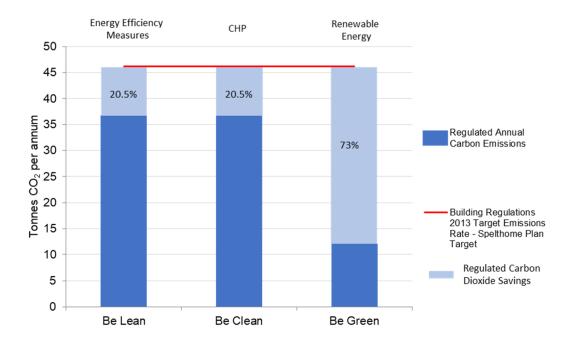


Figure 1: The Site Wide Energy Hierarchy and target



Appendix A

Baseline/Un-regulated Energy Use:-

SAP Outputs & Target Emission Rates

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 11:01:12

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:** Flat

Total Floor Area: 100.28m²

Dwelling Details:

Site Reference:

NEW DWELLING DESIGN STAGE

231 Watford Road - BASE **Plot Reference:** Sample 1

Address:

Client Details:

Name: Address:

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas

Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 17.55 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 16.85 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 53.5 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 44.2 kWh/m²

OK 2 Fabric U-values

Element Average

Highest External wall 0.16 (max. 0.30) 0.16 (max. 0.70) OK Party wall 0.00 (max. 0.20) **OK**

Floor 0.14 (max. 0.25) 0.14 (max. 0.70)

Roof (no roof)

Openings 1.10 (max. 2.00) 1.10 (max. 3.30) OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 5.00 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas

Data from manufacturer

Combi boiler

Efficiency 89.5 % SEDBUK2009

Minimum 88.0 % OK

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

OK

6 Controls

Space heating controls TTZC by plumbing and electrical services

Hot water controls: No cylinder thermostat

No cylinder

Boiler interlock: Yes OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings 100.0%

Minimum 75.0% **OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames valley): Slight

Based on:

Overshading: Average or unknown

Windows facing: South East

Windows facing: South West

Ventilation rate:

15.34m²

1.28m²

3.00

10 Key features

Windows U-value 1.1 W/m²K
Party Walls U-value 0 W/m²K

OK

OK

		Hear I	Details:						
Access Name	Neilleabam	User I		. Nivos	hau.		CTDO	010012	
Assessor Name: Software Name:	Neil Ingham Stroma FSAP 2012		Stroma Softwa					010943 on: 1.0.5.41	
		Property	Address:						
Address :									
1. Overall dwelling dime	ensions:								
Ground floor			ea(m²)	(1a) x		ight(m) 75	(2a) =	Volume(m ³	(3a)
	a) . (1b) . (1a) . (1d) . (1a) .					75	(2a) -	275.77	(34)
Total floor area TFA = (1	a)+(10)+(10)+(10)+(10)+	(111)	100.28	(4)) . (2-) . (2-	4) . (2 -) .	(2-)		_
Dwelling volume				(3a)+(3b))+(3C)+(3C	d)+(3e)+	.(3h) =	275.77	(5)
2. Ventilation rate:	main sec	ondary	other		total			m³ per hou	ır
Number of chimneys	heating hea	iting		1 = [40 =		_
•		<u> </u>	0]	0		20 =	0	(6a)
Number of open flues		0 +	0] ⁻	0			0	(6b)
Number of intermittent fa				Ļ	4		10 =	40	(7a)
Number of passive vents				Ļ	0		10 =	0	(7b)
Number of flueless gas fi	res				0	X 4	40 =	0	(7c)
							Air ch	nanges per ho	our
Infiltration due to chimne	ys, flues and fans = (6a)+	·(6b)+(7a)+(7b)+	(7c) =	Г	40		÷ (5) =	0.15	(8)
If a pressurisation test has b	peen carried out or is intended,	proceed to (17),	otherwise c	ontinue fr			` ′		`` <i>`</i>
Number of storeys in the	he dwelling (ns)							0	(9)
Additional infiltration	.25 for steel or timber fra	me or 0 35 fo	r maconn	v conetr	uction	[(9)	-1]x0.1 =	0	(10)
	resent, use the value correspor			*	uction			0	(11)
deducting areas of openin	• /) 0 4 / 1	ماد داد				ı		
If suspended wooden to the sus	floor, enter 0.2 (unsealed) or 0.1 (seal	ea), eise (enter U				0	(12)
• ,	s and doors draught strip	ned						0	(13)
Window infiltration	s and doors draught strip	pou	0.25 - [0.2	x (14) ÷ 1	00] =			0	(15)
Infiltration rate			(8) + (10) +	+ (11) + (1	2) + (13)	+ (15) =		0	(16)
Air permeability value,	q50, expressed in cubic	metres per h	our per so	uare m	etre of e	envelope	area	5	(17)
If based on air permeabil	lity value, then (18) = [(17)	÷ 20]+(8), otherw	vise (18) = (16)				0.4	(18)
Air permeability value applie	es if a pressurisation test has be	een done or a de	gree air per	meability	is being u	sed			
Number of sides sheltere	ed		(20) 4 [0 07E v (4	10)1			0	(19)
Shelter factor	ling aboltor footor		(20) = 1 - [(21) = (18)		[9)] =			1	(20)
Infiltration rate incorporat Infiltration rate modified f			(21) = (10)	X (20) =				0.4	(21)
Jan Feb	Mar Apr May	Jun Jul	Aug	Sep	Oct	Nov	Dec]	
Monthly average wind sp		our our	j /wg j	ОСР	1 000	1 1404	D00	l	
(22)m= 5.1 5	4.9 4.4 4.3	3.8 3.8	3.7	4	4.3	4.5	4.7]	
`		1			<u> </u>	<u> </u>	1	1	
Wind Factor $(22a)m = (22a)m $		0.05 0.05	1 000 1			1 , , -		1	
(22a)m= 1.27 1.25	1.23 1.1 1.08	0.95 0.95	0.92	1	1.08	1.12	1.18]	

Adjusted infiltration rate (allowing for shelf	ter and wind	speed) =	(21a) x	(22a)m					
	0.42 0.38	0.38	0.37	0.4	0.42	0.44	0.46		
Calculate effective air change rate for the If mechanical ventilation:	аррисаріе са	ase						0	(2
If exhaust air heat pump using Appendix N, (23b)	= (23a) × Fmv (equation (I	N5)) , othe	rwise (23b) = (23a)			0	—\`
If balanced with heat recovery: efficiency in % alle	owing for in-use	factor (fron	n Table 4h) =				0	= _(2
a) If balanced mechanical ventilation wi	th heat recov	ery (MVI	HR) (24a	a)m = (22)	2b)m + (23b) × [1 – (23c)		`
24a)m= 0 0 0 0	0 0	0	0	0	0	0	0	_	(2
b) If balanced mechanical ventilation wi	thout heat re	covery (N	ЛV) (24b)m = (22	2b)m + (2	23b)	•	•	
24b)m= 0 0 0 0	0 0	0	0	0	0	0	0		(2
c) If whole house extract ventilation or p	ositive input	ventilatio	n from o	outside	-	-	-		
if $(22b)m < 0.5 \times (23b)$, then $(24c) =$	= (23b); other	wise (24	c) = (22k	o) m + 0.	5 × (23b)	ī	1	
24c)m= 0 0 0 0	0 0	0	0	0	0	0	0		(2
d) If natural ventilation or whole house properties if (22b)m = 1, then (24d)m = (22b)n					0.51				
	0.59 0.57	0.57	0.5 + [(2	0.58	0.59	0.6	0.61		(2
Effective air change rate - enter (24a) o	ļ		<u> </u>	<u> </u>	0.00	1 0.0	0.01		`
	0.59 0.57	0.57	0.57	0.58	0.59	0.6	0.61		(2
						l			
3. Heat losses and heat loss parameter:									
ELEMENT Gross Openings area (m²) m²	Net Aı A ,ı		U-valı W/m2		A X U (W/I		k-value kJ/m²-l		X k J/K
Vindows Type 1	15.3		/[1/(1.4)+		20.34	$\stackrel{\prime}{\Box}$			(2
Vindows Type 2	1.28	x1,	/[1/(1.4)+	0.04] =	1.7	一			(2
loor	100.2	28 X	0.13		13.0364	<u> </u>			(2
Valls Type1 68.22 16.62	51.6	_	0.18	=	9.29	=		7 =	
Valls Type2 43.24 0	43.2	=	0.18	<u>-</u>	7.78	=		-	— `(2
otal area of elements, m ²	211.7	=	00						` (;
earty wall	15.2	=	0		0				
arty ceiling	100.2	=							
nternal wall **	175.1	_							
for windows and roof windows, use effective windo			ı formula 1	/[(1/U-valu	ıe)+0.04] a	L as given in	paragraph		(
* include the areas on both sides of internal walls a		J			, ,	Ü	, , ,		
abric heat loss, $W/K = S(A \times U)$			(26)(30)) + (32) =				52.14	(3
leat capacity Cm = S(A x k)				((28)	(30) + (32	2) + (32a).	(32e) =	21990.67	(3
hermal mass parameter (TMP = Cm ÷ T	FA) in kJ/m²k			Indica	tive Value	: Medium		250	(3
or design assessments where the details of the col an be used instead of a detailed calculation.	nstruction are no	t known pr	ecisely the	indicative	values of	TMP in T	able 1f		
hermal bridges : S (L x Y) calculated usi	na Appendix	K						13.5	(;
details of thermal bridging are not known (36) = 0.	•							10.0	(
otal fabric heat loss	, ,			(33) +	(36) =			65.64	(3
entilation heat loss calculated monthly				(38)m	= 0.33 × (25)m x (5)		
Jan Feb Mar Apr	May Jun	Jul	Aug	Sep	Oct	Nov	Dec		
88)m= 57.05 56.6 56.16 54.09 5	3.71 51.91	51.91	51.58	52.6	53.71	54.49	55.31		(;
leat transfer coefficient, W/K				(39)m	= (37) + (38)m			
9)m= 122.68 122.23 121.8 119.73 1	19.35 117.55	117.55	117.22	118.24	119.35	120.13	120.94		
roma FSAP 2012 Version: 1.0.5.41 (SAP 9.92) - h	ttn://www.etrome				Average =	Sum(39)	12 /12=	119.753 _{age}	_ (

at loss parai	meter (H	HLP), W/	m²K					(40)m	= (39)m ÷	· (4)			
)m= 1.22	1.22	1.21	1.19	1.19	1.17	1.17	1.17	1.18	1.19	1.2	1.21		
mber of day	s in mor	nth (Tahl	e 1a)						Average =	Sum(40) ₁ .	12 /12=	1.19	(40
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
)m= 31	28	31	30	31	30	31	31	30	31	30	31		(4
Water heat	ing ener	gy requi	rement:								kWh/yea	ar:	
sumed occu f TFA > 13.9 f TFA £ 13.9), N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9))2)] + 0.0	0013 x (⁻	TFA -13		74		(42
nual average duce the annua more that 125	l average	hot water	usage by	5% if the a	lwelling is	designed t			se target o		0.32		(4
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
water usage in	litres per	day for ea	ch month	Vd,m = fa	ctor from T	Table 1c x	(43)	_	_				
)m= 109.26	105.28	101.31	97.34	93.37	89.39	89.39	93.37	97.34	101.31	105.28	109.26		_
ergy content of	hot water	used - cal	culated mo	onthly = 4 .	190 x Vd.r	n x nm x D	Tm / 3600			m(44) ₁₁₂ = ables 1b. 1		1191.9	(4
)m= 162.03	141.71	146.23	127.49	122.33	105.56	97.82	112.25	113.59	132.37	144.5	156.91		
,			1-1112	1==100		*****		l	l	m(45) ₁₁₂ =	ь н	1562.77	(4
stantaneous wa	ater heatii	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46 ₎			, ,			
)m= 24.3	21.26	21.93	19.12	18.35	15.83	14.67	16.84	17.04	19.86	21.67	23.54		(4
ater storage orage volum		inaludin	a ony o	olor or M	WHDC	otorogo	within oc	ama vaa	ool				,
community h	` ,					ŭ		airie ves	361		0		(4
nerwise if no	_			_			` '	ers) ente	er '0' in (47)			
ater storage	loss:												
If manufactu	urer's de	eclared lo	oss facto	or is kno	wn (kWh	n/day):					0		(-
mperature fa	actor fro	m Table	2b								0		(4
ergy lost froi		_	-				(48) x (49)) =			0		(
If manufactors water stora			•										(!
community h	-			C Z (KVV)	11/11116/06	(y)					0		(
lume factor t	•										0		(:
mperature fa	actor fro	m Table	2b								0		(
ergy lost froi	m water	storage	, kWh/ye	ear			(47) x (51)) x (52) x (53) =		0		(
nter (50) or (54) in (5	55)									0		(
ater storage	loss cal	culated f	or each	month			((56)m = (55) × (41)	m				
)m= 0	0	0	0	0	0	0	0	0	0	0	0		(!
linder contains	dedicated	d solar sto	rage, (57)r	m = (56)m	x [(50) – (H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Appendix	Н	
)m= 0	0	0	0	0	0	0	0	0	0	0	0		(
mary circuit	loss (an	nual) fro	m Table	3							0		(!
mary circuit	•	•			50\m - ('58\ · 36	E v (11)	m					
mary circuit	ioss cai	culated i	oi eacii	IIIOIIII (<i>58)</i> 111 – ($(30) \pm 30$	D X (41)	1111					
modified by				•	•	. ,	, ,		r thermo	stat)			

Carebilean salaulatad f			(04)	(00) - (NOE - /44	\							
Combi loss calculated f	or each 50.96	montn (61)M = 47.58	(60) ÷ 3	45.55)m 47.	₅₀ T	48	50.96	49.32	50.96	1	(61)
` '						<u> </u>				<u> </u>		(50) (04)	(01)
Total heat required for v (62)m= 212.98 187.74						`	_			`	`´	(59)m + (61)m 1	(62)
` '	197.19	175.49	169.91	149.64		159.		161.59	183.33	193.81	207.87	J	(62)
Solar DHW input calculated under the control of the									r contribu	tion to wate	er neating)		
(63)m= 0 0	0	0	0	0	0 0	0		0	0	0	0	1	(63)
` '			0	<u> </u>	<u> </u>			0	· ·			J	(00)
Output from water heat (64)m= 212.98 187.74	197.19	175.49	169.91	149.64	143.37	159.	82	161.59	183.33	193.81	207.87	1	
(04)/11- 212.00 107.74	107.10	170.40	100.01	140.04	140.07	L				er (annual)		2142.74	(64)
Heat gains from water h	noating	k\\/h/m/	onth 0.2	5 ′ [O 8/	5 × (45)m								J (
(65)m= 66.61 58.62	61.36	54.39	52.57	46.12	43.91	49.2		49.77	56.75	60.37	64.91	'	(65)
include (57)m in calc					<u> </u>					ļ			(00)
		· , ,		yiii idei	is in the t	uweii	ii ig (OI HOLW	alei is i	TOTTI COTT	illiullity i	leating	
5. Internal gains (see		·):										
Metabolic gains (Table Jan Feb	5), Watt Mar		Mov	מעו	Jul	۱ ۸.	ا ما	Con	Oot	Nov	Doo	1	
Jan Feb 137.11 137.11	137.11	Apr 137.11	May 137.11	Jun 137.11	+	137	ug 11	Sep 137.11	Oct 137.11	137.11	Dec 137.11	-	(66)
` '	I			l		I			107.11	137.11	107.11	J	(00)
Lighting gains (calculate (67)m= 23.72 21.07	17.13	12.97	L, equat	8.19	8.85	11.	_	15.43	19.59	22.87	24.38	1	(67)
· · · <u> </u>				<u> </u>	ļ	<u> </u>				22.01	24.30	J	(07)
Appliances gains (calcu						r ´				T 200 40	045.45	1	(68)
(68)m= 256.78 259.44	252.73	238.43	220.39	203.43		189.		196.15	210.45	228.49	245.45	J	(00)
Cooking gains (calculat	i	-	<u> </u>			_				00.74	20.74	1	(60)
(69)m= 36.71 36.71	36.71	36.71	36.71	36.71	36.71	36.	/ 1	36.71	36.71	36.71	36.71	J	(69)
Pumps and fans gains	`				1 0	<u> </u>	. 1	0		Ι.,	Ι ,	1	(70)
(70)m= 3 3	3		3	3	3	3	·	3	3	3	3	J	(70)
Losses e.g. evaporation					T 400.00	100		100.00	400.00	T 400 00	100.00	1	(71)
` '		-109.68	-109.68	-109.68	-109.68	-109	.68	-109.68	-109.68	-109.68	-109.68	J	(71)
Water heating gains (Ta	 _	75.54	70.00	04.05	1 50.00		45 1	00.40	70.00	1 00 05	1 07.05	1	(70)
(72)m= 89.53 87.24	82.48	75.54	70.66	64.05	59.02	66.		69.12	76.28	83.85	87.25		(72)
Total internal gains =	440.47	004.00	007.07		6)m + (67)m	<u> </u>	'	. ,	, , ,	· · ·	•	1	(72)
(73)m= 437.17 434.88	419.47	394.08	367.87	342.8	327.1	334	.22	347.84	373.45	402.34	424.21		(73)
6. Solar gains: Solar gains are calculated u	ısina solar	flux from	Table 6a	and asso	ciated equa	ations t	to co	nvert to th	e applica	ble orienta	tion		
Orientation: Access Fa	_	Area			ux		.0 00.	g_	о арриоа	FF F		Gains	
Table 6d	40101	m ²			able 6a		Ta	able 6b	Т	able 6c		(W)	
Southeast 0.9x 0.77	x	15.3	34	x	36.79	x		0.63	x [0.7		172.49	(77)
Southeast 0.9x 0.77	X	15.3		x	62.67) x		0.63	-	0.7	= =	293.82] (77)
Southeast 0.9x 0.77	X	15.3		x	85.75] x		0.63	x [0.7	= =	402.02](77)
Southeast 0.9x 0.77	X	15.3			106.25]		0.63		0.7	-	498.12](77)
Southeast 0.9x 0.77	X	15.3		-	119.01	X		0.63	x	0.7	= =	557.93](77)
3.77						J		0.00		0.7			J` '

F					_		1		– 1				_
Southeast 0.9x	0.77	X	15.	34	X	118.15	X	0.63	×	0.7	=	553.9	(77)
Southeast 0.9x	0.77	X	15.	34	x	113.91	X	0.63	X	0.7	=	534.02	(77)
Southeast _{0.9x}	0.77	X	15.3	34	X	104.39	X	0.63	X	0.7	=	489.39	(77)
Southeast _{0.9x}	0.77	X	15.3	34	X	92.85	X	0.63	X	0.7	=	435.3	(77)
Southeast 0.9x	0.77	X	15.	34	x	69.27	X	0.63	X	0.7	=	324.73	(77)
Southeast 0.9x	0.77	X	15.3	34	X	44.07	X	0.63	X	0.7	=	206.61	(77)
Southeast 0.9x	0.77	X	15.	34	x	31.49	X	0.63	x	0.7	=	147.62	(77)
Southwest _{0.9x}	0.77	Х	1.2	28	x	36.79		0.63	x	0.7	=	14.39	(79)
Southwest _{0.9x}	0.77	Х	1.2	28	x	62.67		0.63	x	0.7	=	24.52	(79)
Southwest _{0.9x}	0.77	X	1.2	28	x	85.75		0.63	X	0.7	=	33.55	(79)
Southwest _{0.9x}	0.77	x	1.2	28	x	106.25	1	0.63	x	0.7		41.56	(79)
Southwest _{0.9x}	0.77	x	1.2	28	x	119.01	1	0.63	x	0.7	_	46.56	(79)
Southwest _{0.9x}	0.77	x	1.2	28	х	118.15	Ī	0.63	X	0.7		46.22	(79)
Southwest _{0.9x}	0.77	x	1.2	28	х	113.91	Ī	0.63	x	0.7		44.56	(79)
Southwest _{0.9x}	0.77	x	1.2	28	х	104.39	j	0.63	x	0.7	=	40.84	(79)
Southwest _{0.9x}	0.77	x	1.2	28	х	92.85	j	0.63	×	0.7		36.32	(79)
Southwest _{0.9x}	0.77	x	1.2	28	х	69.27	j	0.63	x	0.7		27.1	(79)
Southwest _{0.9x}	0.77	x	1.2	28	х	44.07	j	0.63	x	0.7		17.24	(79)
Southwest _{0.9x}	0.77	x	1.2	28	х	31.49	j	0.63	x	0.7		12.32	(79)
Solar gains in	watts, cal	lculated	for eacl	h month	l		(83)m	n = Sum(74)m .	(82)m				
(83)m= 186.89	318.34	435.56	539.68	604.49	600	0.12 578.58	530	.23 471.62	351.83	3 223.85	159.94]	(83)
									0000				()
Total gains – i	nternal ar	nd solar	(84)m =	= (73)m	+ (83	B)m , watts	!		0000	1		I	()
Total gains – ii (84)m= 624.05		nd solar 855.03	(84)m = 933.76	972.36	+ (83	'	864		725.28	-	584.15]	(84)
(84)m= 624.05	753.22	855.03	933.76	972.36	942	'				-	I		
(84)m= 624.05 7. Mean inter	753.22 nal tempe	855.03 erature (933.76 (heating	972.36 season	942	2.92 905.68	864	.45 819.46		-	I	21	
(84)m= 624.05	753.22 nal tempe during he	855.03 erature (933.76 (heating	972.36 season	942 ng ar	2.92 905.68 rea from Tal	864	.45 819.46		-	I	21	(84)
(84)m= 624.05 7. Mean inter Temperature	753.22 nal tempe during he	855.03 erature (933.76 (heating	972.36 season	942 ng ar	2.92 905.68 rea from Tal	864 ble 9	.45 819.46		626.19	I	21	(84)
7. Mean inter Temperature Utilisation fac	nal tempe during he ctor for ga	erature (eating points for li	933.76 (heating eriods in ving are	972.36 season the livi	942 ng ar	rea from Tal e Table 9a) un Jul	864 ble 9	.45 819.46 , Th1 (°C) ug Sep	725.28	626.19	584.15	21	(84)
(84)m= 624.05 7. Mean inter Temperature Utilisation fact Jan (86)m= 1	nal tempe during he etor for ga Feb	erature (eating poins for limited Mar 0.98	933.76 (heating eriods in ving are Apr 0.95	972.36 season the livi ea, h1,m May 0.88	942 ng ar (see	rea from Tal e Table 9a) un Jul 73 0.56	864 ble 9	.45 819.46 , Th1 (°C) ug Sep 6 0.83	725.28 Oct	8 626.19 Nov	584.15 Dec	21	(84)
(84)m= 624.05 7. Mean inter Temperature Utilisation fact Jan	nal tempe during he etor for ga Feb	erature (eating poins for limited Mar 0.98	933.76 (heating eriods in ving are Apr 0.95	972.36 season the livi ea, h1,m May 0.88	942 ng ar (see	rea from Talle Table 9a) un Jul 73 0.56	864 ble 9	.45 819.46 , Th1 (°C) ug Sep 6 0.83 Table 9c)	725.28 Oct	8 626.19 Nov	584.15 Dec	21	(84)
7. Mean inter Temperature Utilisation fact Jan (86)m= 1 Mean interna (87)m= 19.68	nal tempera during heater for ga Feb 0.99 I tempera	erature (eating poins for lime Mar 0.98 atture in leading point 10.98 atture in leading 10.98 atture in leading 10.94 atture 10.94 atture in leading 10.94 atture	933.76 (heating eriods in ving are 0.95) iving are 20.48	972.36 season the livi ea, h1,m May 0.88 ea T1 (fo	942 ng ar (see 0.7 ollow 20.	rea from Talle Table 9a) un Jul 73 0.56 v steps 3 to 7 94 20.99	864 ble 9 A 0.7 in T 20.	.45 819.46 , Th1 (°C) ug Sep 6 0.83 Table 9c) 98 20.87	725.28 Oct 0.97	Nov 0.99	584.15 Dec 1	21	(84)
(84)m= 624.05 7. Mean inter Temperature Utilisation fact Jan (86)m= 1 Mean interna (87)m= 19.68 Temperature	nal tempe during he stor for ga Feb 0.99 I tempera 19.87 during he	erature (eating poins for line Mar 0.98 liture in lace 20.14 leating poins eating eatin	933.76 (heating eriods in Apr 0.95 iving are 20.48 eriods ir	972.36 season the livi ea, h1,m May 0.88 ea T1 (for 20.76	942 ng ar (see 0.7 0.7 ollow 20.	rea from Tal e Table 9a) un Jul 73 0.56 r steps 3 to 7 94 20.99 Iling from Ta	864 ble 9 A 0.7 in T 20.	.45 819.46 , Th1 (°C) ug Sep 6 0.83 Table 9c) 98 20.87 9, Th2 (°C)	725.28 Oct 0.97	Nov 0.99	Dec 1 19.66	21	(84) (85) (86) (87)
(84)m= 624.05 7. Mean inter Temperature Utilisation fact Jan (86)m= 1 Mean interna (87)m= 19.68 Temperature (88)m= 19.9	nal temper during heater for ga Feb 0.99 I tempera 19.87 during heater 19.9	erature (eating poins for line Mar 0.98 atture in lace 20.14 eating poins 19.91	933.76 (heating eriods in Apr 0.95 iving are 20.48 eriods in 19.92	972.36 season the livi ea, h1,m May 0.88 ea T1 (for 20.76 n rest of	942 ng ar n (see	rea from Tal e Table 9a) un Jul 73 0.56 r steps 3 to 7 94 20.99 Illing from Ta 94 19.94	864 ble 9 A 0.7 in T 20. able 9	.45 819.46 , Th1 (°C) ug Sep 6 0.83 Table 9c) 98 20.87 9, Th2 (°C)	725.28 Oct 0.97	Nov 0.99	584.15 Dec 1	21	(84)
(84)m= 624.05 7. Mean inter Temperature Utilisation fact Jan (86)m= 1 Mean interna (87)m= 19.68 Temperature (88)m= 19.9 Utilisation fact	nal tempera during heater for ga Feb 0.99 I tempera 19.87 during heater for ga	erature (eating poins for limits for limits for limits for limits for limits for response limits for respo	933.76 (heating eriods in Apr 0.95 iving are 20.48 eriods in 19.92 est of decrease of the second sec	972.36 season the livi ea, h1,m May 0.88 ea T1 (for 20.76 n rest of 19.93 welling,	942 ng ar n (see 0.7 ollow 20. dwel 19. h2,m	2.92 905.68 rea from Tale Table 9a) un Jul 73 0.56 r steps 3 to 7 94 20.99 Illing from Ta 94 19.94 n (see Table	864 ble 9 A 0.7 in T 20. able 9 19.	.45 819.46 , Th1 (°C) ug Sep 6 0.83 Table 9c) 98 20.87 9, Th2 (°C) 94 19.94	725.28 Oct 0.97 20.5	Nov 0.99 20.03	Dec 1 19.66 19.92	21	(84) (85) (86) (87) (88)
(84)m= 624.05 7. Mean inter Temperature Utilisation fact Jan (86)m= 1 Mean interna (87)m= 19.68 Temperature (88)m= 19.9 Utilisation fact (89)m= 1	nal tempera during heater for ga Feb 0.99 I tempera 19.87 during heater for ga 0.99	erature (eating poins for limits for rough limits for rou	933.76 (heating eriods in Apr 0.95 iving are 20.48 eriods in 19.92 est of do 0.94	972.36 season the livi ea, h1,m May 0.88 ea T1 (for 20.76 n rest of 19.93 welling, 0.83	942 ng ar n (see 0.7 ollow 20. dwel 19. h2,m 0.6	rea from Tale Table 9a) un Jul 73 0.56 7 steps 3 to 7 94 20.99 Illing from Ta 94 19.94 n (see Table 63 0.43	864 ble 9 A 0.7 in T 20. able 9 19. 9a) 0.4	.45 819.46 , Th1 (°C) ug Sep 6 0.83 Table 9c) 98 20.87 9, Th2 (°C) 94 19.94	725.28 Oct 0.97 20.5	Nov 0.99	Dec 1 19.66	21	(84) (85) (86) (87)
(84)m= 624.05 7. Mean inter Temperature Utilisation face Jan (86)m= 1 Mean interna (87)m= 19.68 Temperature (88)m= 19.9 Utilisation face (89)m= 1 Mean interna	nal temper during heater for ga Feb 0.99 I tempera 19.87 during heater for ga 19.9 ctor for ga 0.99 I tempera	erature (eating poins for line of line	933.76 (heating eriods in ving are 20.48 eriods in 19.92 est of do 0.94 he rest	972.36 season the livi ea, h1,m May 0.88 ea T1 (for 20.76 n rest of 19.93 welling, 0.83 of dwell	942 n) ng ar n (see	rea from Tal e Table 9a) un Jul 73 0.56 r steps 3 to 7 94 20.99 Illing from Ta 94 19.94 n (see Table 63 0.43	864 ble 9 A 0.7 in T 20. able 9 19. 9a) 0.4 eps 3	.45 819.46 , Th1 (°C) ug Sep 6 0.83 Table 9c) 98 20.87 9, Th2 (°C) 94 19.94 17 0.75 1 to 7 in Table	725.28 Oct 0.97 20.5 19.93 0.95 e 9c)	Nov 0.99 20.03 19.92	Dec 1 19.66 19.92	21	(84) (85) (86) (87) (88) (89)
(84)m= 624.05 7. Mean inter Temperature Utilisation fact Jan (86)m= 1 Mean interna (87)m= 19.68 Temperature (88)m= 19.9 Utilisation fact (89)m= 1	nal tempera during heater for ga Feb 0.99 I tempera 19.87 during heater for ga 0.99	erature (eating poins for limits for rough limits for rou	933.76 (heating eriods in Apr 0.95 iving are 20.48 eriods in 19.92 est of do 0.94	972.36 season the livi ea, h1,m May 0.88 ea T1 (for 20.76 n rest of 19.93 welling, 0.83	942 ng ar n (see 0.7 ollow 20. dwel 19. h2,m 0.6	rea from Tal e Table 9a) un Jul 73 0.56 r steps 3 to 7 94 20.99 Illing from Ta 94 19.94 n (see Table 63 0.43	864 ble 9 A 0.7 in T 20. able 9 19. 9a) 0.4	.45 819.46 , Th1 (°C) ug Sep 6 0.83 Table 9c) 98 20.87 9, Th2 (°C) 94 19.94 47 0.75 4 to 7 in Tabl 94 19.84	725.28 Oct 0.97 20.5 19.93 0.95 e 9c) 19.35	Nov 0.99 20.03 19.92 0.99	Dec 1 19.66 19.92 1		(84) (85) (86) (87) (88) (89)
(84)m= 624.05 7. Mean inter Temperature Utilisation face Jan (86)m= 1 Mean interna (87)m= 19.68 Temperature (88)m= 19.9 Utilisation face (89)m= 1 Mean interna	nal temper during heater for ga Feb 0.99 I tempera 19.87 during heater for ga 19.9 ctor for ga 0.99 I tempera	erature (eating poins for line of line	933.76 (heating eriods in ving are 20.48 eriods in 19.92 est of do 0.94 he rest	972.36 season the livi ea, h1,m May 0.88 ea T1 (for 20.76 n rest of 19.93 welling, 0.83 of dwell	942 n) ng ar n (see	rea from Tal e Table 9a) un Jul 73 0.56 r steps 3 to 7 94 20.99 Illing from Ta 94 19.94 n (see Table 63 0.43	864 ble 9 A 0.7 in T 20. able 9 19. 9a) 0.4 eps 3	.45 819.46 , Th1 (°C) ug Sep 6 0.83 Table 9c) 98 20.87 9, Th2 (°C) 94 19.94 47 0.75 4 to 7 in Tabl 94 19.84	725.28 Oct 0.97 20.5 19.93 0.95 e 9c) 19.35	Nov 0.99 20.03 19.92	Dec 1 19.66 19.92 1	0.23	(84) (85) (86) (87) (88) (89)
(84)m= 624.05 7. Mean inter Temperature Utilisation face Jan (86)m= 1 Mean interna (87)m= 19.68 Temperature (88)m= 19.9 Utilisation face (89)m= 1 Mean interna	nal tempera during he ctor for ga during he 19.9 ctor for ga 0.99 l tempera 19.87 l tempera 19.9 ctor for ga 18.43	erature (eating poins for line for rough) ins for rough) eating poins for rough) ins for rough) iture in to 18.83	933.76 (heating eriods in ving are Apr 0.95) iving are 20.48 eriods in 19.92 est of do 0.94 he rest 19.32	972.36 season the livi ea, h1,m May 0.88 ea T1 (for 20.76 n rest of 19.93 welling, 0.83 of dwell 19.7	942 ng ar n (see	rea from Tal e Table 9a) un Jul 73 0.56 r steps 3 to 7 94 20.99 Illing from Ta 94 19.94 n (see Table 63 0.43 T2 (follow ste 99 19.94	864 ble 9 A 0.4 7 in T 20. able 9 19. 9a) 0.4 eps 3 19.	.45 819.46 , Th1 (°C) ug Sep 6 0.83 Table 9c) 98 20.87 9, Th2 (°C) 94 19.94 47 0.75 4 to 7 in Table 94 19.84	725.28 Oct 0.97 20.5 19.93 0.95 e 9c) 19.35	Nov 0.99 20.03 19.92 0.99	Dec 1 19.66 19.92 1		(84) (85) (86) (87) (88) (89)
(84)m= 624.05 7. Mean intermant Temperature Utilisation fact Jan (86)m= 1 Mean internal (87)m= 19.68 Temperature (88)m= 19.9 Utilisation fact (89)m= 1 Mean internal (90)m= 18.15	nal temper during he ctor for ga Feb 0.99 I tempera 19.87 during he 19.9 ctor for ga 0.99 I tempera 18.43 I tempera	erature (eating poins for line 19.91 ins for rough)	933.76 (heating eriods in ving are 20.48 eriods in 19.92 est of do 0.94 he rest 19.32 or the wh	972.36 season the livi ea, h1,m May 0.88 ea T1 (for 20.76 n rest of 19.93 welling, 0.83 of dwell 19.7	942 ng ar n (see	rea from Tal e Table 9a) un Jul 73 0.56 r steps 3 to 7 94 20.99 Illing from Ta 94 19.94 n (see Table 63 0.43 T2 (follow ste .9 19.94 0 = fLA × T1 14 20.18	864 ble 9 A 0.4 7 in T 20. able 9 19. 9a) 0.4 eps 3 19. + (1 20.	.45 819.46 y, Th1 (°C) ug Sep 6 0.83 Table 9c) 98 20.87 9, Th2 (°C) 94 19.94 47 0.75 4 to 7 in Tabl 94 19.84 f - fLA) × T2 18 20.08	725.28 Oct 0.97 20.5 19.93 0.95 e 9c) 19.35 LA = Liv	Nov 0.99 20.03 19.92 0.99 18.67 ring area ÷ (4	Dec 1 19.66 19.92 1		(84) (85) (86) (87) (88) (89)

				.	-	.	T			T	T		ı	
(93)m=	18.51	18.77	19.13	19.59	19.94	20.14	20.18	20.18	20.08	19.62	18.99	18.48		(93)
			uirement							. —				
			ternal ter or gains	•		ied at ste	ep 11 of	l able 9	b, so tha	t II,m=(/6)m an	d re-calc	culate	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisa			ains, hm	<u> </u>	· · ·	<u> </u>	<u> </u>		'	<u> </u>	<u> </u>			
(94)m=	1	0.99	0.97	0.93	0.84	0.65	0.46	0.5	0.76	0.95	0.99	1		(94)
Usefu	ıl gains,	hmGm	, W = (94	4)m x (8	4)m								•	
(95)m=	621.1	744.6	831.79	869.44	811.97	615.04	415.8	435.01	626.46	687.25	619.77	582.11		(95)
		_	rnal tem	perature	from Ta	r	·	1	1	·	·		ı	
(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)
							-``	- ` 	– (96)m		<u> </u>		1	
(97)m=		1694.96		l .	983.81	651.33	420.94	443	706.78	1076.44	1427.95	1727.22		(97)
-		<u> </u>	1	1	1	I	i e)m – (95 I	i	r -	054.00		
(98)m=	834.71	638.64	525.97	295.55	127.85	0	0	0	0	289.55	581.9	851.96		7,000
								Tota	al per year	(kWh/yeai	r) = Sum(9	8) _{15,912} =	4146.15	(98)
Space	e heatin	g require	ement in	kWh/m²	² /year								41.35	(99)
9a. En	ergy red	quiremer	nts – Indi	ividual h	eating sy	ystems i	ncluding	micro-C	CHP)					
Spac	e heatir	ng:										,		_
Fracti	ion of sp	ace hea	at from s	econdar	y/supple	mentary	system						0	(201)
Fracti	ion of sp	ace hea	at from m	nain syst	em(s)			(202) = 1	- (201) =				1	(202)
Fracti	ion of to	tal heati	ng from	main sys	stem 1			(204) = (2	02) x [1 –	(203)] =			1	(204)
Efficie	ency of i	main spa	ace heat	ing syste	em 1								93.4	(206)
Efficie	ency of	seconda	ry/suppl	ementar	y heating	g system	າ, %						0	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	⊐ ar
Space	e heatin	g require	ement (c	alculate	d above)								
	834.71	638.64	525.97	295.55	127.85	0	0	0	0	289.55	581.9	851.96		
(211)m	n = {[(98)m x (20)4)] } x 1	00 ÷ (20	06)									(211)
	893.7	683.77	563.14	316.44	136.89	0	0	0	0	310.01	623.01	912.16		
			-	-	-	-	-	Tota	l (kWh/yea	ar) =Sum(2	211),15,1012	_	4439.13	(211)
Space	e heatin	g fuel (s	econdar	y), kWh/	month							'		
= {[(98)m x (20)1)]}x1	00 ÷ (20	8)										
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		_
								Tota	al (kWh/yea	ar) =Sum(2	215) _{15,1012}	Į=	0	(215)
	heating													
Output			ter (calc			440.04	440.07	1.50.00	104.50	400.00	400.04	007.07	1	
Гиза	212.98	187.74	197.19	175.49	169.91	149.64	143.37	159.82	161.59	183.33	193.81	207.87		7(040)
		ater hea		00.05	04.05						07.05		80.3	(216)
(217)m=		87.89	87.4	86.35	84.35	80.3	80.3	80.3	80.3	86.2	87.65	88.22		(217)
		•	kWh/ma) ÷ (217)											
	241.63	213.61	225.61	203.22	201.44	186.35	178.54	199.03	201.23	212.69	221.13	235.62		
•			!				<u> </u>		l = Sum(2:	19a) ₁₁₂ =	<u> </u>	I .	2520.11	(219)
Annua	al totals									k'	Wh/year	•	kWh/year	」 `
		fuel use	ed, main	system	1						•		4439.13	7
													•	_

Water heating fuel used				2520.11	7
Electricity for pumps, fans and electric keep-hot					_
central heating pump:			30]	(230c)
boiler with a fan-assisted flue			45		(230e)
Total electricity for the above, kWh/year	sum of (230a	a)(230g) =		75	(231)
Electricity for lighting				418.92	(232)
Total delivered energy for all uses (211)(221) +	(231) + (232)(237b) =			7453.16	(338)
12a. CO2 emissions – Individual heating systems	s including micro-CHP				
	Energy	Emission fac	etor	Emissions	
	kWh/year	kg CO2/kWh	,101	kg CO2/yea	
Space heating (main system 1)			=		
Space heating (main system 1) Space heating (secondary)	kWh/year	kg CO2/kWh		kg CO2/yea	ar -
	kWh/year (211) x	kg CO2/kWh	=	kg CO2/yea	ar](261)
Space heating (secondary)	kWh/year (211) x (215) x	kg CO2/kWh 0.216 0.519	=	kg CO2/yea	(261) (263)
Space heating (secondary) Water heating	kWh/year (211) x (215) x (219) x	kg CO2/kWh 0.216 0.519	=	kg CO2/yea 958.85 0 544.34	(261) (263) (264)
Space heating (secondary) Water heating Space and water heating	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (264) =	0.216 0.519 0.216	= = =	958.85 0 544.34 1503.19	(261) (263) (264) (265)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-hot	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (264) = (231) x (232) x	0.216 0.519 0.216	= = =	kg CO2/yea 958.85 0 544.34 1503.19 38.93	(261) (263) (264) (265) (267)

TER =

(273)

17.55

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 11:01:10

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:** Flat

Total Floor Area: 52.98m²

Dwelling Details:

NEW DWELLING DESIGN STAGE

Site Reference: 231 Watford Road - BASE **Plot Reference:** Sample 2

Address:

Client Details:

Name: Address:

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas

Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 17.47 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 17.07 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 35.9 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 29.5 kWh/m²

OK

2 Fabric U-values

Element Average Highest External wall 0.15 (max. 0.30) 0.16 (max. 0.70) OK Party wall 0.00 (max. 0.20) **OK**

Floor (no floor) Roof (no roof)

Openings 1.10 (max. 2.00) OK 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 5.00 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas

Data from manufacturer

Combi boiler

Efficiency 89.5 % SEDBUK2009

Minimum 88.0 %

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

OK

6 Controls			
Space heating controls	TTZC by plumbing an		ок
Hot water controls:	No cylinder thermosta No cylinder	at .	
Boiler interlock:	Yes		OK
7 Low energy lights			
Percentage of fixed lights with lo	ow-energy fittings	100.0%	
Minimum		75.0%	OK
8 Mechanical ventilation			
Not applicable			
9 Summertime temperature			
Overheating risk (Thames valled	y):	Slight	ОК
Based on:	,	· ·	
Overshading:		Average or unknown	
Windows facing: South East		6.39m²	
Ventilation rate:		6.00	
10 Key features			

1.1 W/m²K

 $0 \text{ W/m}^2\text{K}$

Windows U-value Party Walls U-value

		l lser I	Details:						
Assessor Name: Software Name:	Neil Ingham Stroma FSAP 2012		Strom Softwa	are Ve	rsion:			010943 on: 1.0.5.41	
Address :	F	Property	Address	Sample	e 2				
1. Overall dwelling dime	ensions:								
		Are	a(m²)		Av. He	ight(m)	_	Volume(m	3)
Ground floor			52.98	(1a) x	2	2.75	(2a) =	145.69	(3a)
Total floor area TFA = (1	a)+(1b)+(1c)+(1d)+(1e)+(1	n) [52.98	(4)					
Dwelling volume				(3a)+(3b)+(3c)+(3c	d)+(3e)+	.(3n) =	145.69	(5)
2. Ventilation rate:									
	main seconda heating heating	ry	other		total			m³ per hou	ır
Number of chimneys	0 + 0	_ + [0] = [0	X 4	40 =	0	(6a)
Number of open flues	0 + 0	T + [0	=	0	x 2	20 =	0	(6b)
Number of intermittent fa	ins				2	x '	10 =	20	(7a)
Number of passive vents	;			Ē	0	x '	10 =	0	(7b)
Number of flueless gas fi	ires			F	0	X 4	40 =	0	(7c)
				L					
							Air ch	nanges per ho	our
	ys, flues and fans = $(6a)+(6b)+(6b)+(6b)$			Ę	20		÷ (5) =	0.14	(8)
Number of storeys in the	peen carried out or is intended, proced he dwelling (ns)	ed to (17),	otherwise (continue tr	om (9) to	(16)		0	(9)
Additional infiltration	no awaning (115)					[(9)	-1]x0.1 =	0	(10)
Structural infiltration: 0	.25 for steel or timber frame o	r 0.35 fo	r masoni	y constr	ruction			0	(11)
• • • • • • • • • • • • • • • • • • • •	resent, use the value corresponding t	o the grea	ter wall are	a (after					
deducting areas of openia	ngs);	.1 (seal	ed), else	enter 0				0	(12)
If no draught lobby, en		(,,					0	(13)
Percentage of window	s and doors draught stripped							0	(14)
Window infiltration			0.25 - [0.2	x (14) ÷ 1	00] =			0	(15)
Infiltration rate			(8) + (10)	+ (11) + (1	12) + (13)	+ (15) =		0	(16)
•	q50, expressed in cubic metro	•		•	etre of e	envelope	area	5	(17)
•	lity value, then $(18) = [(17) \div 20] +$ es if a pressurisation test has been do				io hoina u	and		0.39	(18)
Number of sides sheltere		ne or a de	gree air pe	пеаышу	is being u	seu		0	(19)
Shelter factor			(20) = 1 -	[0.0 75 x (1	19)] =			1	(20)
Infiltration rate incorporate	ting shelter factor		(21) = (18) x (20) =				0.39	(21)
Infiltration rate modified f	or monthly wind speed								
Jan Feb	Mar Apr May Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	peed from Table 7								
(22)m= 5.1 5	4.9 4.4 4.3 3.8	3.8	3.7	4	4.3	4.5	4.7		
Wind Factor (22a)m = (2	2)m ÷ 4								
<u> </u>	1.23 1.1 1.08 0.95	0.95	0.92	1	1.08	1.12	1.18		
		-						ı	

Adjusted infiltr	ation rat	e (allowi	ng for sh	nelter an	d wind s	speed) =	(21a) x	(22a)m					
0.49 Calculate effec	0.48	0.47 Change i	0.43	0.42 he appli	0.37 Cable ca	0.37 Se	0.36	0.39	0.42	0.44	0.46]	
If mechanica		_		по струпп	00.070 00.							0	(23
If exhaust air h	eat pump (using Appe	endix N, (2	3b) = (23a	a) × Fmv (e	equation (N	N5)) , othe	rwise (23b) = (23a)			0	(23
If balanced with	heat reco	overy: effic	iency in %	allowing f	or in-use f	actor (fron	n Table 4h) =				0	(23
a) If balance	d mech	anical ve	ntilation	with he	at recove	ery (MVI	HR) (24a	n)m = (22	2b)m + (23b) × [1 – (23c)	÷ 100]	
(24a)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
b) If balance	d mech	anical ve	ntilation	without	heat red	overy (N	ЛV) (24b	m = (22)	2b)m + (23b)			
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
c) If whole h if (22b)n				•					5 × (23b	o)			
(24c)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
d) If natural if (22b)n									0.5]			•	
(24d)m= 0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6]	(24
Effective air	change	rate - er	iter (24a) or (24b	o) or (24	c) or (24	d) in box	(25)		-			
(25)m= 0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6		(25
3. Heat losse	s and he	eat loss r	paramete	er:									
ELEMENT	Gros	•	Openin		Net Ar	ea	U-valı	ле	AXU		k-value	9	ΑΧk
	area	(m²)	· m	2	A ,r	n²	W/m2	K .	(W/I	K)	kJ/m²-l	K	kJ/K
Windows					6.39	х1,	/[1/(1.4)+ 	0.04] =	8.47	╝.			(27
Walls Type1	22.1	7	6.39		15.78	3 X	0.18	=	2.84				(29
Walls Type2	17.2	22	0		17.22	<u>x</u>	0.18	=	3.1				(29
Total area of e	lements	, m²			39.39)							(31
Party wall					46.48	3 X	0	= [0				(32
Party floor					52.98	3							(32
Party ceiling					52.98	3							(32
Internal wall **					97.63	3							(32
* for windows and						ated using	formula 1	/[(1/U-valu	ie)+0.04] a	as given in	paragraph	1 3.2	
** include the area Fabric heat los				is anu pan	uuoris		(26)(30)	+ (32) =				14.4	11 (33
Heat capacity		•	0)				, , , , ,		.(30) + (32	2) + (32a).	(32e) =	8658	
Thermal mass		,	P = Cm ÷	- TFA) ir	n kJ/m²K				tive Value	, , ,	(0=0)	250	
For design assess	•	`		,			ecisely the	indicative	values of	TMP in Ta	able 1f	200	,(00
can be used inste													
Thermal bridge					-	<						5.7	1 (36
if details of therma Total fabric he		are not kn	own (36) =	= 0.05 x (3	1)			(33) +	(36) =			20.1	13 (37
Ventilation hea	at loss ca	alculated	monthly	/				(38)m	= 0.33 × (25)m x (5))	_	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(38)m= 29.9	29.67	29.45	28.4	28.21	27.29	27.29	27.12	27.65	28.21	28.6	29.02		(38
Heat transfer of	coefficier	nt, W/K						(39)m	= (37) + (38)m			
(39)m= 50.03	49.8	49.58	48.53	48.33	47.42	47.42	47.25	47.77	48.33	48.73	49.14		
									Average =	Sum(39) ₁	12 /12=	48.5	53 (39

Heat loss para	meter (ł	HLP), W/	m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 0.94	0.94	0.94	0.92	0.91	0.9	0.9	0.89	0.9	0.91	0.92	0.93		
N			- 4-)						Average =	Sum(40) _{1.}	12 /12=	0.92	(40)
Number of day Jan	Feb	Mar	e Ta) 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 heat	ing ene	rgy requi	rement:								kWh/ye	ear:	
Assumed occu			F4	/ o oooo	.40 (T	- 40.0	\0\1 · 0 (2040 /	TEA 40		78		(42)
if TFA > 13.9 if TFA £ 13.9		+ 1./6 x	[1 - exp	(-0.0003	349 x (11	-A -13.9))2)] + 0.0)013 x (IFA -13	.9)			
Annual averag	e hot wa										.43		(43)
Reduce the annua not more that 125	_				-	•	to achieve	a water us	se target o	of			
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in								ОСР	000	1404	Dec		
(44)m= 84.07	81.01	77.96	74.9	71.84	68.78	68.78	71.84	74.9	77.96	81.01	84.07		
		ļ							Total = Su	ım(44) ₁₁₂ =		917.12	(44)
Energy content of	hot water	used - cal	culated mo	onthly $= 4$.	190 x Vd,r	n x nm x D	77m / 3600) kWh/mor	nth (see Ta	ables 1b, 1	c, 1d)		
(45)m= 124.67	109.04	112.52	98.1	94.13	81.22	75.27	86.37	87.4	101.86	111.18	120.74		_
If instantaneous w	ater heati	na at noint	of use (no	hot water	· storage)	enter∩in	hoves (46		Total = Su	ım(45) ₁₁₂ =	- L	1202.49	(45)
(46)m= 18.7	16.36	16.88	14.71	14.12	12.18	11.29	12.96	13.11	15.28	16.68	18.11		(46)
Water storage		10.00	14.71	14.12	12.10	11.29	12.90	13.11	13.20	10.00	10.11		(40)
Storage volum	e (litres)) includin	g any so	olar or W	/WHRS	storage	within sa	ame ves	sel		0		(47)
If community h	eating a	and no ta	nk in dw	elling, e	nter 110	litres in	(47)						
Otherwise if no		hot wate	er (this in	icludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in ((47)			
Water storage a) If manufact		eclared l	nss facto	nr is kno	wn (k\/\/h	n/day).					0		(48)
Temperature fa				JI 10 KI10	WII (ICVVI	i, ady).					0		(49)
Energy lost fro				ear			(48) x (49)) =			0		(50)
b) If manufact		_	-		or is not		() ()				0		(00)
Hot water stora	_			e 2 (kWl	h/litre/da	ıy)					0		(51)
If community h Volume factor	•		on 4.3										(50)
Temperature fa			2b							_	0		(52) (53)
Energy lost fro				ear			(47) x (51)) x (52) x (53) =		0		(54)
Enter (50) or (•	, 1	Jul			() ()	, (, (,	-	0		(55)
Water storage	loss cal	culated f	or 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	dedicate	d solar sto	rage, (57)ı	<u>l</u> m = (56)m	x [(50) – (<u>I</u> H11)] ÷ (5	0), else (5	<u>I</u> 7)m = (56)	m where (L (H11) is fro	m Appendi	хН	
(57)m= 0	0	0	0	0	0	0	0	0	0	0	0		(57)
Primary circuit	loss (ar	nual) fro	m Table	e 3							0		(58)
Primary circuit	•	•			59)m = ((58) ÷ 36	65 × (41)	m					
(modified by	factor f	rom Tabl	e H5 if t	here is s	olar wat	er heatir	ng and a	cylinde	r thermo	stat)			
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

Combi loss calcul			i			- ` ` `	_				ı	ı	1	(0.1)
` '	7.29 39.7		36.94	36.61	33.92	35.05	36.6			39.73	39.95	42.84	J	(61)
Total heat require		_					`		-		` 	<u>`</u>	(59)m + (61)m	(22)
` '	6.33 152.		135.03	130.74	115.14	110.32	122.9			141.58	151.14	163.58]	(62)
Solar DHW input calc	_								olar c	contribut	ion to wate	er heating)		
(add additional lin		$\overline{}$. 		_		Γ.	Ι .	1	(00)
(63)m= 0	0 0		0	0	0	0	0	0		0	0	0	J	(63)
Output from wate						1						l	1	
(64)m= 167.51 14	6.33 152.	24	135.03	130.74	115.14	110.32	122.9			141.58	151.14	163.58	4000.00	1(64)
											r (annual)₁		1660.93	(64)
Heat gains from v						1			$\overline{}$		1		1] 1	4
(65)m= 52.16 4	5.58 47.3	34	41.85	40.45	35.49	33.79	37.8	7 38.2	9	43.8	46.96	50.86	J	(65)
include (57)m i	n calculation	on of	(65)m	only if c	ylinder	is in the o	dwelli	ng or ho	t wat	ter is fr	om com	munity h	neating	
5. Internal gains	(see Tab	le 5 a	and 5a)	:										
Metabolic gains (Table 5), V	<u>Vatts</u>	S										,	
Jan	Feb Ma	ar	Apr	May	Jun	Jul	Au	g Se	р	Oct	Nov	Dec		
(66)m= 88.9 8	88.9	9	88.9	88.9	88.9	88.9	88.9	88.9	9	88.9	88.9	88.9		(66)
Lighting gains (ca	lculated in	Арр	endix L	_, equat	ion L9 c	r L9a), a	lso se	e Table	5				_	
(67)m= 15.32 1	3.6 11.0)6	8.38	6.26	5.29	5.71	7.42	9.96	6	12.65	14.77	15.74		(67)
Appliances gains	(calculate	d in A	Append	lix L, eq	uation L	.13 or L1	3a), a	lso see	Table	e 5				
(68)m= 154.97 15	66.57 152.	52	143.9	133.01	122.77	115.93	114.3	32 118.3	38	127	137.89	148.13]	(68)
Cooking gains (ca	alculated in	n App	pendix	L, equat	ion L15	or L15a), alsc	see Ta	ble 5	;			-	
(69)m= 31.89 3	1.89 31.8	39	31.89	31.89	31.89	31.89	31.8	9 31.8	9	31.89	31.89	31.89]	(69)
Pumps and fans	gains (Tab	le 5a	 a)					•					•	
(70)m= 3	3 3		3	3	3	3	3	3		3	3	3]	(70)
Losses e.g. evap	oration (ne	gativ	ve valu∉	es) (Tab	le 5)	•	•	'			•	•	•	
(71)m= -71.12 -7	1.12 -71.	12	-71.12	-71.12	-71.12	-71.12	-71.1	2 -71.1	2	-71.12	-71.12	-71.12]	(71)
Water heating gain	ns (Table	<u>_</u>				!							•	
	7.82 63.6	-	58.13	54.37	49.29	45.42	50.9	53.1	9	58.87	65.22	68.35]	(72)
Total internal ga	 ins =	!_	!		(66)m + (67)m	1 + (68)	m + (69)m	1 + (70	0)m + (7	1)m + (72))m	J	
	0.67 279.	89	263.07	246.3	230.01	219.73	225.3	32 234.	2	251.2	270.55	284.9	1	(73)
6. Solar gains:														
Solar gains are calcu	ulated using	solar f	flux from	Table 6a	and assoc	ciated equa	itions to	convert t	o the	applicat	ole orientat	tion.		
Orientation: Acc	ess Facto	r	Area		Flu			g_			FF		Gains	
Tab	le 6d		m²		Ta	ble 6a		Table	6b	Т	able 6c		(W)	
Southeast _{0.9x}	0.77	x	6.3	9	X	36.79	x	0.63		х	0.7	=	71.85	(77)
Southeast _{0.9x}	0.77	x	6.3	9	x	62.67	x	0.63		x	0.7	_ =	122.39	(77)
Southeast _{0.9x}	0.77	x	6.3	9	x	85.75	x	0.63		×	0.7	=	167.46	(77)
Southeast _{0.9x}	0.77	x	6.3	9	x 1	06.25	x	0.63		×	0.7	=	207.5	(77)
Southeast _{0.9x}	0.77	x	6.3	9	x 1	19.01	x	0.63		×	0.7	-	232.41	(77)
		-		•									-	-

Southeast _{0.9x}	0.77	X	6.3	9	x	1	18.15	x		0.63	x	0.7	=	230.73	(77)
Southeast _{0.9x}	0.77	Х	6.3	9	x	1	13.91	x		0.63	x	0.7	=	222.45	(77)
Southeast _{0.9x}	0.77	X	6.3	9	x	10	04.39	x		0.63	x	0.7	=	203.86	(77)
Southeast _{0.9x}	0.77	X	6.3	9	x	9	2.85	x		0.63	x	0.7	=	181.33	(77)
Southeast _{0.9x}	0.77	x	6.3	9	x	6	9.27	x		0.63	×	0.7	_ =	135.27	(77)
Southeast _{0.9x}	0.77	Х	6.3	9	x	4	4.07	х		0.63	x	0.7	=	86.06	(77)
Southeast 0.9x	0.77	х	6.3	9	x	3	1.49	x		0.63	_ x [0.7	=	61.49	(77)
_								•			_				_
Solar gains in	watts, ca	alculated	for eacl	n month				(83)m	n = Si	um(74)m .	(82)m				
(83)m= 71.85	122.39	167.46	207.5	232.41	23	30.73	222.45	203	3.86	181.33	135.27	86.06	61.49		(83)
Total gains – i	nternal a	nd solar	(84)m =	(73)m	+ (8	33)m	, watts								
(84)m= 364.92	413.07	447.35	470.56	478.72	46	60.74	442.18	429	9.18	415.53	386.47	356.61	346.39		(84)
7. Mean inter	nal temp	erature	(heating	season)										
Temperature						area f	from Tal	ole 9	, Th	1 (°C)				21	(85)
Utilisation fac	•	•			-					` ,					_
Jan	Feb	Mar	Apr	May	È	Jun	Jul	A	ug	Sep	Oct	Nov	Dec		
(86)m= 1	0.99	0.98	0.93	0.83	(0.64	0.47	0.	.5	0.74	0.94	0.99	1		(86)
Mean interna	l tampar	atura in l	living ar	 22 T1 (f	مالد	w sta	ns 3 to 7	7 in T	Fahla	2 9c)		_	ļ.		
(87)m= 20.13	20.28	20.48	20.73	20.9	_	0.98	21	2		20.96	20.75	20.4	20.11		(87)
` ′	<u> </u>						<u> </u>								` '
Temperature					$\overline{}$			T		· · ·	20.46	20.45	20.14	Ī	(88)
(88)m= 20.13	20.13	20.14	20.15	20.16		0.17	20.17	20.	.17	20.17	20.16	20.15	20.14		(00)
Utilisation fac	,	ains for r		welling,	т —		1	9a)	-					Ī	
(89)m= 0.99	0.99	0.97	0.91	0.78).57	0.38	0.4	41	0.67	0.92	0.99	1		(89)
Mean interna	l temper	ature in	the rest	of dwell	ing	T2 (f	ollow ste	eps 3	3 to 7	7 in Tabl	e 9c)	_			
(90)m= 18.97	19.19	19.48	19.84	20.06	2	0.16	20.17	20.	.17	20.14	19.87	19.38	18.96		(90)
										f	LA = Livi	ng area ÷ (4) =	0.4	(91)
Mean interna	l temper	ature (fo	r the wh	ole dwe	lling	g) = fl	LA × T1	+ (1	– fL	A) × T2					
(92)m= 19.44	19.63	19.89	20.2	20.4	2	0.49	20.51	20.	.51	20.47	20.22	19.79	19.42		(92)
Apply adjustr	nent to t	he mean	internal	temper	atu	re fro	m Table	4e,	whe	re appro	priate	•			
(93)m= 19.44	19.63	19.89	20.2	20.4	2	0.49	20.51	20.	.51	20.47	20.22	19.79	19.42		(93)
8. Space hea	ting requ	uirement													
Set Ti to the					ned	at ste	ep 11 of	Tab	le 9b	o, so tha	t Ti,m=	(76)m an	d re-calc	culate	
the utilisation												1	_	1	
Jan	Feb	Mar	Apr	May		Jun	Jul	A	ug	Sep	Oct	Nov	Dec		
Utilisation fac	0.99	0.97	0.91	0.8		0.6	0.42	0.4	15	0.7	0.92	0.98	0.99		(94)
Useful gains,						0.0	0.42	0.5	+5	0.7	0.92	0.90	0.99		(01)
(95)m= 362.36		432.42	430.5	381.87	27	74.35	184.7	193	3.26	290.84	357.44	351.05	344.53		(95)
Monthly aver					_						-	1			` '
(96)m= 4.3	4.9	6.5	8.9	11.7		14.6	16.6	16	5.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate	e for mea	an intern	al tempe	erature,	Lm	, W =	=[(39)m	x [(9	3)m-	– (96)m]	1	I	1	
(97)m= 757.47	733.43	663.62	548.28	420.7	_	79.52	185.2	194		304.37	465.2	618.52	748.2		(97)
Space heatin	g require	ement fo	r each n	nonth, k	Wh	/mont	th = 0.02	24 x	[(97)	m – (95)m] x (4	11)m		•	
(98)m= 293.96	219.4	172.01	84.8	28.89		0	0)	0	80.17	192.58	300.33		
														-	

					Tota	ıl per year	(kWh/yea	r) = Sum(9	08) _{15,912} =	1372.14	(98)
Space heating requirement in	kWh/m²	²/year								25.9	(99)
9a. Energy requirements – Ind	ividual h	eating s	ystems i	ncluding	micro-C	CHP)					
Space heating:		, .							Г		_
Fraction of space heat from s			mentary	-		(224)				0	(201)
Fraction of space heat from m	•	, ,			(202) = 1	,	,		ļ	1	(202)
Fraction of total heating from	•				(204) = (2	02) x [1 –	(203)] =		ļ	1	(204)
Efficiency of main space heat	0 ,								ļ	93.4	(206)
Efficiency of secondary/supple	ementar	y heating	g system	า, %		,		,		0	(208)
Jan Feb Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ar
Space heating requirement (c	alculate	d above)	0	0	0	0	80.17	192.58	300.33		
	1	l .	U	0	U	0	00.17	192.56	300.33		(044)
$(211)m = \{[(98)m \times (204)] \} \times 1$ $314.73 234.9 184.17$	90.8	30.93	0	0	0	0	85.83	206.19	321.55		(211)
20.00 10.000		00.00				l (kWh/yea				1469.1	(211)
Space heating fuel (secondar	y), kWh/	month							L		
$= \{[(98)\text{m x } (201)]\} \times 100 \div (201)$	• /	_	_	_	_	_	_	_			
(215)m= 0 0 0	0	0	0	0	0	0	0	0	0		_
					Tota	ıl (kWh/yea	ar) =Sum(2	215) _{15,101}	2=	0	(215)
Water heating	lata dad	l \									
Output from water heater (calc	ulated a	130.74	115.14	110.32	122.98	124.34	141.58	151.14	163.58		
Efficiency of water heater										80.3	(216)
(217)m= 86.45 86.07 85.36	83.92	81.96	80.3	80.3	80.3	80.3	83.68	85.66	86.56		 (217)
Fuel for water heating, kWh/mo											
(219) m = (64) m x $100 \div (217)$ (219)m = 193.76 170.01 178.36	m 160.91	159.52	143.39	137.38	153.15	154.84	169.19	176.43	188.98		
(219)111- 193.70 170.01 170.30	100.91	109.02	143.33	137.30		I = Sum(2		170.43	100.90	1985.93	(219)
Annual totals								Wh/yeaı	լ r	kWh/yea	
Space heating fuel used, main	system	1						.,		1469.1	
Water heating fuel used									Ī	1985.93	7
Electricity for pumps, fans and	electric	keep-ho	t						L		
central heating pump:									30		(2300
boiler with a fan-assisted flue									45		(230€
Total electricity for the above, I		ır			sum	of (230a).	(230g) =			75	(231)
Electricity for lighting	., 50								l T	270.51	(232)
, ,	000 (244	\ (004\	. (224)	. (222)	(227h)	_			[[=
Total delivered energy for all us	`	, , ,	` ′	` ′	` ′				L	3800.53	(338)
12a. CO2 emissions – Individ	ual heat	ing syste	ems inclu	uding mi	cro-CHF)					
				ergy /h/year			Emiss kg CO	ion fac 2/kWh	tor	Emissions kg CO2/ye	

Space heating (main system 1)	(211) x	0.216 =	317.32 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	428.96 (264)
Space and water heating	(261) + (262) + (263) + (264) =		746.29 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	140.39 (268)
Total CO2, kg/year	sum	of (265)(271) =	925.6 (272)

 $TER = 17.47 \tag{273}$

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 11:01:08

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 92.44m² Site Reference: 231 Watford Road - BASE

Plot Reference: Sample 3

Address:

Client Details:

Name: Address:

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas

Fuel factor: 1.00 (mains gas)

19.96 kg/m² Target Carbon Dioxide Emission Rate (TER)

Dwelling Carbon Dioxide Emission Rate (DER) 19.36 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 61.4 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 50.5 kWh/m²

OK

2 Fabric U-values

Element Average Highest External wall 0.15 (max. 0.30) 0.16 (max. 0.70) OK Party wall 0.00 (max. 0.20) **OK** Floor 0.14 (max. 0.25) 0.14 (max. 0.70) OK Roof (no roof) OK

Openings 1.10 (max. 2.00) 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 5.00 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas

Data from manufacturer

Combi boiler

Efficiency 89.5 % SEDBUK2009

Minimum 88.0 %

OK

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

6 Controls

Space heating controls TTZC by plumbing and electrical services

Hot water controls: No cylinder thermostat

No cylinder

Boiler interlock: Yes OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings 100.0%

Minimum 75.0% **OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames valley): Not significant

Based on:

Overshading: Average or unknown

Windows facing: North East
Windows facing: North West
Ventilation rate:

3.85m²
5.11m²
6.00

10 Key features

Windows U-value 1.1 W/m²K
Party Walls U-value 0 W/m²K

OK

OK

		l lser I	Details:						
Assessor Name: Software Name:	Neil Ingham Stroma FSAP 2012		Strom Softwa	are Ve	rsion:			0010943 on: 1.0.5.41	
Address :	F	Property	Address	Sample	e 3				
1. Overall dwelling dime	ensions:								
		Are	a(m²)		Av. He	ight(m)	_	Volume(m	³)
Ground floor			92.44	(1a) x	2	2.75	(2a) =	254.21	(3a)
Total floor area TFA = (1	a)+(1b)+(1c)+(1d)+(1e)+(1	n) :	92.44	(4)					
Dwelling volume				(3a)+(3b)+(3c)+(3c	d)+(3e)+	.(3n) =	254.21	(5)
2. Ventilation rate:									
	main seconda heating heating	ry	other		total			m³ per hou	ır
Number of chimneys	0 + 0	+	0] = [0	X 4	40 =	0	(6a)
Number of open flues	0 + 0	+	0] = [0	x 2	20 =	0	(6b)
Number of intermittent fa	ns			Ī	3	x '	10 =	30	(7a)
Number of passive vents	;			Ē	0	x '	10 =	0	(7b)
Number of flueless gas fi	res			F	0	X 4	40 =	0	(7c)
				_					
							Air ch	nanges per he	our
	ys, flues and fans = $(6a)+(6b)+(6b)+(6a)+(6b)+(6a)+(6b)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a$				30		÷ (5) =	0.12	(8)
Number of storeys in the	een carried out or is intended, procee he dwelling (ns)	ea to (17),	otnerwise	continue ir	om (9) to	(16)		0	(9)
Additional infiltration	a					[(9)	-1]x0.1 =	0	(10)
Structural infiltration: 0	.25 for steel or timber frame o	r 0.35 fo	r masoni	y constr	ruction			0	(11)
if both types of wall are padeducting areas of openia	resent, use the value corresponding t	o the grea	ter wall are	a (after					
,	floor, enter 0.2 (unsealed) or 0	.1 (seal	ed), else	enter 0				0	(12)
If no draught lobby, en	,	`	,,					0	(13)
Percentage of windows	s and doors draught stripped							0	(14)
Window infiltration			0.25 - [0.2	x (14) ÷ 1	00] =			0	(15)
Infiltration rate			(8) + (10)					0	(16)
•	q50, expressed in cubic metro	•	•	•	etre of e	envelope	area	5	(17)
•	lity value, then $(18) = [(17) \div 20] + (18)$ if a pressurisation test has been do				is haina u	sad		0.37	(18)
Number of sides sheltere		ne or a de	gree an pe	THEADIIITY	is being u	seu		0	(19)
Shelter factor			(20) = 1 -	[0.0 75 x (1	19)] =			1	(20)
Infiltration rate incorporat	ting shelter factor		(21) = (18) x (20) =				0.37	(21)
Infiltration rate modified f	or monthly wind speed								
Jan Feb	Mar Apr May Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	eed from Table 7								
(22)m= 5.1 5	4.9 4.4 4.3 3.8	3.8	3.7	4	4.3	4.5	4.7		
Wind Factor (22a)m = (2	2)m ÷ 4								
	1.23 1.1 1.08 0.95	0.95	0.92	1	1.08	1.12	1.18]	
		•	•		•	•	•	•	

djusted infiltration rate (allowing for shelter	and wind s	speed) =	(21a) x	(22a)m			_	_	
0.47 0.46 0.45 0.4 0.4	1	0.35	0.34	0.37	0.4	0.41	0.43		
alculate effective air change rate for the ap If mechanical ventilation:	oplicable ca	ise						0	
If exhaust air heat pump using Appendix N, (23b) =	(23a) × Fmv (eguation (I	N5)) . othe	rwise (23b) = (23a)			0	(
If balanced with heat recovery: efficiency in % allowing the state of					(200)				— — `
a) If balanced mechanical ventilation with	_				2h\m + (23P) ^ [1 _ (23c)	0 : 1001	(
4a)m= 0 0 0 0 0 0	0	0	0	0	0	0	0]	(
b) If balanced mechanical ventilation with								J	`
4b)m= 0 0 0 0 0 0	0	0	0	0	0	0	0	1	(
c) If whole house extract ventilation or pos								J	
if $(22b)m < 0.5 \times (23b)$, then $(24c) = (25c)$	•				.5 × (23b	o)			
c)m= 0 0 0 0 0	0	0	0	0	0	0	0		
d) If natural ventilation or whole house point (22b)m = 1, then (24d)m = (22b)m c	•				0.51		-	•	
ld)m= 0.61 0.61 0.6 0.58 0.5		0.56	0.56	0.57	0.58	0.59	0.59]	(
Effective air change rate - enter (24a) or (24b) or (24	c) or (24	d) in bo	((25)	<u> </u>	<u> </u>		ı	
i)m= 0.61 0.61 0.6 0.58 0.5	<u> </u>	0.56	0.56	0.57	0.58	0.59	0.59]	
					L	L		ı	
. Heat losses and heat loss parameter: LEMENT Gross Openings area (m²) m²	Net Ar A ,r		U-valı W/m2		A X U (W/		k-value kJ/m²·l		A X k kJ/K
ndows Type 1	3.85		/[1/(1.4)+	0.04] =	5.1	<u></u>			
indows Type 2	5.11	=	/[1/(1.4)+	0.04] =	6.77	=			
oor	92.44	=	0.13		12.017	<u> </u>		\neg	
alls Type1 35.28 8.96	26.32	=	0.13		4.74			╡	
alls Type2 82.44 0		=			14.84	 		\dashv \vdash	_
tall area of elements, m ²	82.44	_	0.18	=	14.04				
·	210.1	=		_					
rty wall	15.98	=	0	=	0			┥	ᆜ
rty ceiling	92.44	_						╡	
ernal wall **	154.4					. [
or windows and roof windows, use effective window include the areas on both sides of internal walls and		lated using	g formula 1	/[(1/U-valt	ie)+0.04] a	as given in	paragraph	1 3.2	
bric heat loss, $W/K = S (A \times U)$	•		(26)(30)	+ (32) =				43.47	
eat capacity Cm = S(A x k)				((28).	(30) + (32	2) + (32a).	(32e) =	18340.86	_
ermal mass parameter (TMP = Cm ÷ TFA	a) in kJ/m²K	, L		Indica	itive Value	: Medium		250	
r design assessments where the details of the const	ruction are no	t known pr	recisely the	indicative	e values of	TMP in T	able 1f		
ermal bridges : S (L x Y) calculated using	Appendix I	K						13.4	
letails of thermal bridging are not known (36) = 0.05	x (31)								
tal fabric heat loss				(33) +	(36) =			56.87	
entilation heat loss calculated monthly				(38)m	= 0.33 × ((25)m x (5))	1	
Jan Feb Mar Apr Ma	ay Jun	Jul	Aug	Sep	Oct	Nov	Dec		
8)m= 51.18 50.82 50.47 48.82 48.5	47.07	47.07	46.81	47.63	48.51	49.13	49.79		
eat transfer coefficient, W/K				(39)m	= (37) + (38)m			
m= 108.05 107.69 107.34 105.69 105.	38 103.94	103.94	103.68	104.5	105.38	106.01	106.66		
	://www.stroma	-	-	-	Average -	Sum(39) ₁	/12_	105.692	

Heat loss para	meter (l	-II P) \///	m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 1.17	1.16	1.16	1.14	1.14	1.12	1.12	1.12	1.13	1.14	1.15	1.15		
(10)										Sum(40) ₁ .		1.14	(40)
Number of day	s in mo	nth (Tabl	e 1a)						worago	G a(10)1.	27—		(-/
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)
				<u> </u>	<u> </u>	<u> </u>							
4 10/2/2012 201	•										130/1/		
4. Water heat	ing ene	rgy requi	rement:								kWh/ye	ear:	
Assumed occu if TFA > 13.9 if TFA £ 13.9	0, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9)2)] + 0.0	0013 x (⁻	ΓFA -13		66		(42)
Annual averag Reduce the annua not more that 125	l average	hot water	usage by	5% if the α	lwelling is	designed t			se target o		.32		(43)
								_					
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage ir	i litres pei	r day for ea	icn montn	va,m = ra	ctor from 1	able 1c x	(43)		1				
(44)m= 107.05	103.16	99.27	95.37	91.48	87.59	87.59	91.48	95.37	99.27	103.16	107.05		_
Energy content of	hot water	used - cal	culated mo	onthly = 4 .	190 x Vd,r	n x nm x D	0Tm / 3600			ım(44) ₁₁₂ = ables 1b, 1	L	1167.84	(44)
(45)m= 158.75	138.85	143.28	124.91	119.86	103.43	95.84	109.98	111.29	129.7	141.58	153.75		
								-	Total = Su	ım(45) ₁₁₂ =	=	1531.22	(45)
If instantaneous w	ater heati	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46 ₎) to (61)			•		
(46)m= 23.81	20.83	21.49	18.74	17.98	15.51	14.38	16.5	16.69	19.46	21.24	23.06		(46)
Water storage	loss:												
Storage volume	e (litres)) includin	g any so	olar or W	/WHRS	storage	within sa	ame ves	sel		0		(47)
If community h	eating a	and no ta	nk in dw	velling, e	nter 110	litres in	(47)						
Otherwise if no		hot wate	er (this in	ıcludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in ((47)			
Water storage					(1.54/1	<i>(</i> 1					1		
a) If manufacti				or is kno	wn (kvvr	n/day):					0		(48)
Temperature fa	actor fro	m Table	2b								0		(49)
Energy lost fro		_	-				(48) x (49)) =			0		(50)
b) If manufact			-								1		(54)
Hot water stora If community h	•			ez (KVV	ii/iitie/ua	iy <i>)</i>					0		(51)
Volume factor	_		311 4.0								0		(52)
Temperature fa			2b							_	0		(53)
Energy lost fro	m watei	storage	kWh/ve	ear			(47) x (51)) x (52) x (53) =		0		(54)
Enter (50) or (•	,				() (-)	(=) (,		0		(55)
Water storage	, ,	,	or each	month			((56)m = (55) × (41)ı	m				, ,
													(56)
(56)m= 0 If cylinder contains	0 dedicate	0 d solar sto	0 rage, (57)ı	0 m = (56)m	0 x [(50) – (0 H11)] ÷ (5	0 0), else (5	0 7)m = (56)	0 m where (0 (H11) is fro	0 m Appendi	ix H	(30)
(57)m= 0	0	0	0	0	0	0	0	0	0	0	0		(57)
Primary circuit	loss (ar	nual) fro	m Table	3							0		(58)
Primary circuit	•	•			59)m = ((58) ÷ 36	55 × (41)	m					
(modified by	factor f	rom Tabl	e H5 if t	here is s	solar wat	er heatii	ng and a	cylinde	r thermo	stat)			
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

Combi loss calcula			ì	`	- ` ` `				1		1	
(61)m= 50.96 46.		47.03	46.62	43.19	44.63	46.62		50.58	49.32	50.96]	(61)
Total heat required					h month	(62)m	= 0.85 × ((45)m +	` ´ 	(57)m +	(59)m + (61)m	
(62)m= 209.71 184	87 193.86	171.95	166.47	146.62	140.47	156.6	158.33	180.29	190.89	204.7		(62)
Solar DHW input calcul								r contribu	tion to wate	er heating)		
(add additional line	s if FGHRS	and/or \	WWHRS	applies	, see Ap	pendix	(G)				1	
(63)m= 0	0	0	0	0	0	0	0	0	0	0]	(63)
Output from water	neater	_									-	
(64)m= 209.71 184	87 193.86	171.95	166.47	146.62	140.47	156.6	158.33	180.29	190.89	204.7		,
						Ot	utput from wa	ater heate	er (annual)	112	2104.78	(64)
Heat gains from wa	ter heating	g, kWh/m	onth 0.2	5 ´ [0.85	× (45)m	+ (61)	m] + 0.8 x	د [(46)m	+ (57)m	+ (59)m	<u>.</u>]	
(65)m= 65.53 57.	60.29	53.29	51.51	45.19	43.03	48.22	48.76	55.77	59.4	63.86		(65)
include (57)m in	calculation	of (65)m	only if c	ylinder i	s in the o	dwellin	g or hot w	ater is f	rom com	munity h	neating	
5. Internal gains	see Table	5 and 5a):									
Metabolic gains (T	able 5). Wa	ıtts										
	eb Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec]	
(66)m= 132.88 132	88 132.88	132.88	132.88	132.88	132.88	132.88	3 132.88	132.88	132.88	132.88	1	(66)
Lighting gains (cald	ulated in A	ppendix	L, equat	ion L9 o	r L9a), a	lso see	Table 5				1	
(67)m= 25.23 22.		13.8	10.31	8.71	9.41	12.23		20.84	24.33	25.93]	(67)
Appliances gains (alculated i	n Appen	dix L. ea	uation L	13 or L1		so see Ta	ble 5	1	!	1	
(68)m= 243.5 246		- 	208.99	192.91	182.16	179.64		199.56	216.67	232.75]	(68)
Cooking gains (cal	culated in A	Appendix	L. eguat	ion L15	or L15a	Lalso:	 see Table	5	Į.	<u>. </u>	ı	
(69)m= 36.29 36.		36.29	36.29	36.29	36.29	36.29		36.29	36.29	36.29	1	(69)
Pumps and fans ga	ins (Tahle					<u> </u>		l	ı		1	
(70)m= 3 3		3	3	3	3	3	3	3	3	3	1	(70)
Losses e.g. evapor			ļ	ļ		L					I	(- /
(71)m= -106.31 -106		1	-106.31	-106.31	-106.31	-106.3	1 -106.31	-106.31	-106.31	-106.31	1	(71)
` '			1-100.51	-100.51	1-100.51	-100.3	1 -100.51	-100.51	-100.51	-100.51	J	(, ,)
Water heating gain (72)m= 88.07 85.		74.02	69.23	62.76	57.83	64.82	67.73	74.96	82.51	85.83	1	(72)
` '		74.02	09.23	l	l	<u> </u>				<u> </u>	J	(12)
Total internal gair	-	070.70	1 254.4				n + (69)m + (336.01		389.37		1	(73)
(73)m= 422.66 420	12 404.77	379.78	354.4	330.24	315.27	322.55	336.01	361.23	389.37	410.38		(13)
6. Solar gains: Solar gains are calculated	ted using sol	ar flux from	Table 6a	and assoc	rina hateir	itions to	convert to th	a annlical	hle orientat	tion		
Orientation: Acce	_	Area		Flu		1110113 10	g_	іс арріісаі	FF	uori.	Gains	
Table		m²			ble 6a		Table 6b	Т	able 6c		(W)	
Northeast _{0.9x}).77	3.8	25	x 1	11.28	1 x [0.63	x [0.7		13.28	(75)
).77			-	22.97	」 ^	0.63	^ x	0.7	_	27.02](75)
NI).77			-	41.38	」^∟ 1 × □	0.63	_	0.7		48.69	(75) (75)
						╎├		╡╞		=		_
).77			-	67.96]	0.63		0.7	╡ -	79.96	(75)
Northeast U.9X).77	3.8	35	x (91.35	X	0.63	X	0.7	=	107.48	(75)

ъ		_			_		- 1						_
Northeast _{0.9x}	0.77	×	3.8	5	×	97.38	X	0.63	×	0.7	=	114.58	(75)
Northeast _{0.9x}	0.77	X	3.8	5	x	91.1	X	0.63	X	0.7	=	107.19	(75)
Northeast _{0.9x}	0.77	X	3.8	5	x	72.63	x	0.63	X	0.7	=	85.45	(75)
Northeast _{0.9x}	0.77	X	3.8	5	x	50.42	X	0.63	X	0.7	=	59.33	(75)
Northeast _{0.9x}	0.77	X	3.8	5	x	28.07	X	0.63	Х	0.7	=	33.02	(75)
Northeast _{0.9x}	0.77	X	3.8	5	x	14.2	x	0.63	X	0.7	=	16.7	(75)
Northeast 0.9x	0.77	X	3.8	5	x	9.21	x	0.63	X	0.7	=	10.84	(75)
Northwest 0.9x	0.77	x	5.1	1	x	11.28	x	0.63	x	0.7	=	17.62	(81)
Northwest 0.9x	0.77	X	5.1	1	x	22.97	x	0.63	х	0.7	=	35.87	(81)
Northwest 0.9x	0.77	x	5.1	1	x	41.38	x	0.63	X	0.7	=	64.62	(81)
Northwest 0.9x	0.77	x	5.1	1	x	67.96	x	0.63	X	0.7	=	106.13	(81)
Northwest 0.9x	0.77	x	5.1	1	x	91.35	x	0.63	X	0.7	=	142.65	(81)
Northwest 0.9x	0.77	x	5.1	1	x	97.38	x	0.63	x	0.7	=	152.08	(81)
Northwest 0.9x	0.77	X	5.1	1	x	91.1	x	0.63	X	0.7	=	142.27	(81)
Northwest _{0.9x}	0.77	x	5.1	1	x	72.63	x	0.63	x	0.7	=	113.42	(81)
Northwest _{0.9x}	0.77	×	5.1	1	x	50.42	x	0.63	x	0.7	=	78.74	(81)
Northwest _{0.9x}	0.77	×	5.1	1	x	28.07	x	0.63	x	0.7	=	43.83	(81)
Northwest _{0.9x}	0.77	x	5.1	1	x	14.2	x	0.63	x	0.7	=	22.17	(81)
Northwest 0.9x	0.77	×	5.1	1	x =	9.21	x	0.63	x	0.7	=	14.39	(81)
Solar gains in	watts calcu	ılated	for eacl	n month			(83)m	= Sum(74)m .	(82)m				
(83)m= 30.9		13.31	186.08	250.13	266.6	7 249.46	198.	- 	76.86	38.88	25.23		(83)
Total gains – i	nternal and	solar	(84)m =	(73)m -	+ (83)	m , watts	!						
(84)m= 453.56	483.01 5	18.08	565.86	604.53	596.9	1 564.73	521	.42 474.08	438.08	3 428.24	435.61		(84)
7. Mean inter	nal tempera	ature	(heating	season)	_							
Temperature			`		,	a from Ta	ble 9,	Th1 (°C)				21	(85)
Utilisation fac	•	•			•			,					
Jan		Mar	Apr	May	Jui		Τ.			T			
(86)m= 1	1	1	0.00				A	ug Sep	Oct	Nov	Dec		
		'	0.99	0.96	0.88	0.74	0.8		Oct 0.99	Nov 1	Dec 1		(86)
Mean interna	l temperatu				<u> </u>	<u> </u>	0.8	3 0.96	-				(86)
Mean interna (87)m= 19.63	l temperatu				<u> </u>	steps 3 to	0.8	0.96 able 9c)	-	1		1	(86) (87)
(87)m= 19.63	19.73 1	re in 1 9.95	iving are	ea T1 (fo	20.8	steps 3 to 20.96	0.8 7 in T 20.9	3 0.96 Table 9c)	0.99	1	1		
(87)m= 19.63 Temperature	19.73 1 during hea	e in l 9.95 ting p	iving are 20.27 eriods ir	ea T1 (fo 20.6 n rest of	20.80	steps 3 to 20.96	0.8 7 in T 20.9 able 9	0.96 (able 9c) 94 20.73 9, Th2 (°C)	0.99	19.94	19.62		(87)
(87)m= 19.63 Temperature (88)m= 19.94	19.73 1 during hea 19.95 1	9.95 ting p	iving are 20.27 eriods ir 19.97	ea T1 (fo 20.6 n rest of 19.97	20.80 dwelli	steps 3 to 20.96 ng from Ta 3 19.98	0.8 7 in T 20.9 able 9	0.96 (able 9c) 94 20.73 9, Th2 (°C)	0.99	19.94	1		
(87)m= 19.63 Temperature (88)m= 19.94 Utilisation factors	19.73 1 during hea 19.95 1 ctor for gain	9.95 ting p 9.95 s for r	iving are 20.27 eriods ir 19.97 est of d	ea T1 (fo 20.6 n rest of 19.97 welling,	20.80 dwelli 19.90 h2,m	steps 3 to 20.96 ng from Ta 19.98 (see Table	0.8 7 in T 20.9 able 9 19.9	0.96 Table 9c) 94 20.73 0, Th2 (°C) 98 19.98	0.99 20.33 19.97	19.94	19.62		(87)
(87)m= 19.63 Temperature (88)m= 19.94	19.73 1 during hea 19.95 1	9.95 ting p	iving are 20.27 eriods ir 19.97	ea T1 (fo 20.6 n rest of 19.97	20.80 dwelli	steps 3 to 20.96 ng from Ta 19.98 (see Table	0.8 7 in T 20.9 able 9	0.96 Table 9c) 94 20.73 0, Th2 (°C) 98 19.98	0.99	19.94	19.62		(87)
(87)m= 19.63 Temperature (88)m= 19.94 Utilisation fact (89)m= 1 Mean internal	during hea 19.95 1 ctor for gain 1 temperatu	ting p 9.95 s for r	iving are 20.27 eriods ir 19.97 est of do 0.99	ea T1 (for 20.6 n rest of 19.97 welling, 0.95 of dwelling	20.80 dwellii 19.90 h2,m 0.81	steps 3 to 20.96 ng from Ta 19.98 (see Table 0.6	0.8 7 in T 20.9 able 9 19.9 9a) 0.6 eps 3	0.96 able 9c) 94 20.73 0, Th2 (°C) 98 19.98 7 0.92 to 7 in Table	0.99 20.33 19.97 0.99 e 9c)	19.94	1 19.62 19.96		(87) (88) (89)
(87)m= 19.63 Temperature (88)m= 19.94 Utilisation fact (89)m= 1	during hea 19.95 1 ctor for gain 1 temperatu	ere in l 9.95 ting p 9.95 s for r	iving are 20.27 eriods ir 19.97 est of do 0.99	ea T1 (fo 20.6 n rest of 19.97 welling, 0.95	20.80 dwelli 19.90 h2,m	steps 3 to 20.96 ng from Ta 19.98 (see Table 0.6	0.8 7 in T 20.9 able 9 19.9 9a) 0.6	0.96 Sable 9c) 94 20.73 0, Th2 (°C) 98 19.98 7 0.92 to 7 in Table 95 19.71	0.99 20.33 19.97 0.99 e 9c)	19.94 19.96 1 18.57	1 19.62 19.96 1		(87) (88) (89) (90)
(87)m= 19.63 Temperature (88)m= 19.94 Utilisation fact (89)m= 1 Mean internal	during hea 19.95 1 ctor for gain 1 temperatu	ting p 9.95 s for r	iving are 20.27 eriods ir 19.97 est of do 0.99	ea T1 (for 20.6 n rest of 19.97 welling, 0.95 of dwelling	20.80 dwellii 19.90 h2,m 0.81	steps 3 to 20.96 ng from Ta 19.98 (see Table 0.6	0.8 7 in T 20.9 able 9 19.9 9a) 0.6 eps 3	0.96 Sable 9c) 94 20.73 0, Th2 (°C) 98 19.98 7 0.92 to 7 in Table 95 19.71	0.99 20.33 19.97 0.99 e 9c)	19.94	1 19.62 19.96 1	0.3	(87) (88) (89)
(87)m= 19.63 Temperature (88)m= 19.94 Utilisation fact (89)m= 1 Mean internal	19.73 1 during hea 19.95 1 ctor for gain 1 ltemperatu 18.26 1	s for r 1 109.95	eriods in 19.97 est of do 0.99 the rest 19.05	ea T1 (fo 20.6 n rest of 19.97 welling, 0.95 of dwelli	20.80 dwelli 19.90 h2,m 0.81 ng T2	steps 3 to 20.96 ng from Ta 3 19.98 (see Table 0.6 (follow step 7 19.96	0.8 7 in T 20.9 able 9 19.9 9a) 0.6 eps 3	0.96 Table 9c) 94 20.73 0, Th2 (°C) 98 19.98 7 0.92 to 7 in Table 95 19.71	0.99 20.33 19.97 0.99 e 9c)	19.94 19.96 1 18.57	1 19.62 19.96 1	0.3	(87) (88) (89) (90)
(87)m= 19.63 Temperature (88)m= 19.94 Utilisation fact (89)m= 1 Mean internation intern	19.73 1 during hea 19.95 1 ctor for gain 1 ltemperatu 18.26 1	s for r 1 s.57 sre (fo	eriods in 19.97 est of do 0.99 the rest 19.05 r the wh	ea T1 (for 20.6 no rest of 19.97 welling, 0.95 of dwelling, 19.52 ole dwe 19.84	20.80 dwelli 19.90 h2,m 0.81 ng T2 19.8	steps 3 to 20.96 ng from Ta 3	0.8 7 in T 20.9 able 9 19.9 9a) 0.6 eps 3 19.9 + (1 20.2	0.96 Table 9c) 94 20.73 0, Th2 (°C) 98 19.98 7 0.92 to 7 in Table 95 19.71 f	0.99 20.33 19.97 0.99 e 9c) 19.14 Liv	19.94 19.96 1 18.57 ring area ÷ (-	1 19.62 19.96 1	0.3	(87) (88) (89) (90)

(00) 40.57	107	40.00	40.40	40.04	00.40	00.00	00.05	00.00	40.5	10.00	40.50		(93)
(93)m= 18.57	18.7	18.99	19.42	19.84	20.16	20.26	20.25	20.02	19.5	18.98	18.56		(93)
8. Space hea				ro obtain	and at at	on 11 of	Table 0	h so tha	t Ti m_/	76)m an	d ro colo	ulato	
the utilisation			•		eu ai sii	с р 11 01	Table 3	U, 30 IIIa	(11,111–(rojili ali	u re-caic	uiate	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation fac	tor for g	ains, hm	:										
(94)m= 1	1	0.99	0.98	0.94	0.82	0.64	0.71	0.92	0.99	1	1		(94)
Useful gains,	1	· ` `	<u> </u>				1	1					(05)
(95)m= 452.82	481.79	515.29	556.53	570.08	491.24	362.5	369.45	438.45	433.08	427	435.04		(95)
Monthly aver		1				40.0	1 40 4	444	40.0	7.4	4.0		(06)
(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 (97)m= 1541.56	1486.28	an intern	1111.82	858.27	Lm , vv =	380.58	398.88	- (96)m	J 937.81	1259.32	1531.72		(97)
Space heatin	<u> </u>	l .				l	l .			<u> </u>	1331.72		(37)
(98)m= 810.02	675.01	613.73	399.81	214.41	0	0.02	0	0	375.52	599.26	815.93		
(00)111-	1 07 0.01	010.70	000.01	214.41	Ů			l per year			<u> </u>	4503.7	(98)
				.,			Tota	ii pei yeai	(KVVII/yeai) = Sum(9	O)15,912 —		╡``
Space heatin	ig require	ement in	kVVh/m²	/year								48.72	(99)
9a. Energy red	quiremer	nts – Indi	vidual h	eating sy	ystems i	ncluding	micro-C	CHP)					
Space heatii	_										1		_
Fraction of sp	pace hea	at from so	econdar	y/supple	mentary	•						0	(201)
Fraction of sp	pace hea	at from m	nain syst	em(s)			(202) = 1	- (201) =				1	(202)
Fraction of to	tal heati	ng from	main sys	stem 1			(204) = (2	02) × [1 –	(203)] =			1	(204)
Efficiency of	main spa	ace heat	ing syste	em 1								93.4	(206)
Efficiency of	seconda	ry/suppl	ementar	y heating	g system	ո, %						0	(208)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ar
Space heatin	g require	ement (c		d above))		,	1		1	1		
810.02	675.01	613.73	399.81	214.41	0	0	0	0	375.52	599.26	815.93		
(211)m = {[(98)m x (20	(4)] } x 1	00 ÷ (20	06)			_			_			(211)
867.26	722.71	657.1	428.06	229.56	0	0	0	0	402.05	641.61	873.58		_
							Tota	ıl (kWh/yea	ır) =Sum(2	211) _{15,1012}	F	4821.95	(211)
Space heatin	•		• •	month									
$= \{[(98)m \times (20)]\}$	T						1			1	1		
(215)m= 0	0	0	0	0	0	0	0	0	0	0	0		7
							Tota	I (kWh/yea	ar) =Sum(2	215) _{15,1012}	F	0	(215)
Water heating													
Output from w	ater hea	193.86	ulated al 171.95	166.47	146.62	140.47	156.6	158.33	180.29	190.89	204.7		
Efficiency of w			171.95	100.47	140.02	140.47	130.0	130.33	100.29	190.09	204.7	80.3	(216)
			87.11	9E 60	80.3	90.2	002	90.2	06.06	07.72	00 10	00.3	(217)
(217)m= 88.12	88.02	87.75		85.69	00.3	80.3	80.3	80.3	86.86	87.73	88.18		(211)
Fuel for water $(219)m = (64)$	•												
(219)m= 237.98	210.04	220.93	197.4	194.28	182.59	174.94	195.01	197.17	207.57	217.58	232.15		
	•	•				•	Tota	I = Sum(2	19a) ₁₁₂ =		•	2467.64	(219)
Annual totals	;								k'	Wh/year	•	kWh/year	-
Space heating	fuel use	ed, main	system	1						=		4821.95	
											!		_

Water heating fuel used				2467.64	٦
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	a)(230g) =		75	(231)
Electricity for lighting				445.58	(232)
Total delivered energy for all uses (211)(221) +	(231) + (232)(237b) =			7810.17	(338)
12a. CO2 emissions – Individual heating system	s including micro-CHP				
	Energy	Emission fac	tor	Emissions	
	kWh/year	kg CO2/kWh	, lOi	kg CO2/yea	
Space heating (main system 1)			=		
Space heating (main system 1) Space heating (secondary)	kWh/year	kg CO2/kWh		kg CO2/yea	ar ¬
	kWh/year (211) x	kg CO2/kWh	=	kg CO2/yea	ar](261)
Space heating (secondary)	kWh/year (211) x (215) x	kg CO2/kWh 0.216 0.519	=	kg CO2/yea	(261) (263)
Space heating (secondary) Water heating	kWh/year (211) x (215) x (219) x	kg CO2/kWh 0.216 0.519	=	kg CO2/yea 1041.54 0 533.01	(261) (263) (264)
Space heating (secondary) Water heating Space and water heating	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (264) =	0.216 0.519 0.216	= = =	kg CO2/yea 1041.54 0 533.01 1574.55	(261) (263) (264) (265)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-hot	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (264) = (231) x (232) x	0.216 0.519 0.519	= = =	kg CO2/yea 1041.54 0 533.01 1574.55 38.93	(261) (263) (264) (265) (267)

TER =

(273)

19.96

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 11:01:07

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:** Flat

Total Floor Area: 52.98m²

Dwelling Details:

NEW DWELLING DESIGN STAGE

Site Reference: 231 Watford Road - BASE **Plot Reference:** Sample 4

Address:

Client Details:

Name: Address:

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas

Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 17.47 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 17.07 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 35.9 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 29.5 kWh/m²

OK

2 Fabric U-values

Element Average Highest External wall 0.15 (max. 0.30) 0.16 (max. 0.70) OK Party wall 0.00 (max. 0.20) **OK**

Floor (no floor) Roof (no roof)

Openings 1.10 (max. 2.00) OK 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 5.00 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas

Data from manufacturer

Combi boiler

Efficiency 89.5 % SEDBUK2009

Minimum 88.0 %

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

OK

6 Controls			
Space heating controls	ОК		
Hot water controls:	No cylinder thermosta No cylinder	11	
Boiler interlock:	Yes		OK
7 Low energy lights			
Percentage of fixed lights with I	ow-energy fittings	100.0%	
Minimum		75.0%	OK
8 Mechanical ventilation			
Not applicable			
9 Summertime temperature			
Overheating risk (Thames valle	y):	Slight	ОК
Based on:	•	· ·	
Overshading:		Average or unknown	
Windows facing: South East		6.39m²	
Ventilation rate:		6.00	
10 Key features			

1.1 W/m²K

 $0 \text{ W/m}^2\text{K}$

Windows U-value Party Walls U-value

		l lser I	Details:							
Assessor Name: Software Name:	Neil Ingham Stroma FSAP 2012		Stroma Number: STR Software Version: Vers					RO010943 sion: 1.0.5.41		
Address :	F	roperty	Address	: Sample	e 4					
1. Overall dwelling dime	ensions:									
		Are	a(m²)		Av. He	ight(m)	_	Volume(m	3)	
Ground floor			52.98	(1a) x	2	2.75	(2a) =	145.69	(3a)	
Total floor area TFA = (1	a)+(1b)+(1c)+(1d)+(1e)+(1	n) [52.98	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3c	d)+(3e)+	.(3n) =	145.69	(5)	
2. Ventilation rate:										
	main seconda heating heating	ry	other		total			m³ per hou	ır	
Number of chimneys	0 + 0	_ + [0	=	0	X 4	40 =	0	(6a)	
Number of open flues	0 + 0	_ + [0	= [0	x 2	20 =	0	(6b)	
Number of intermittent fa	ins			Ī	2	x '	10 =	20	(7a)	
Number of passive vents	3			Ī	0	x -	10 =	0	(7b)	
Number of flueless gas f	ires			Ē	0	X 4	40 =	0	(7c)	
				<u>L</u>						
				_			Air ch	nanges per he	our 	
	ys, flues and fans = $(6a)+(6b)+(6b)+(6a)+(6b)+(6a)+(6b)+(6a)+(6a)+(6a)+(6a)+(6b)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a$				20		÷ (5) =	0.14	(8)	
Number of storeys in t	peen carried out or is intended, procee he dwelling (ns)	ea to (17),	otnerwise	continue ti	om (9) to	(16)		0	(9)	
Additional infiltration	g ()					[(9)	-1]x0.1 =	0	(10)	
Structural infiltration: 0	.25 for steel or timber frame o	r 0.35 fo	r masoni	ry consti	ruction			0	(11)	
if both types of wall are p deducting areas of openi	resent, use the value corresponding t	o the grea	ter wall are	ea (after						
,	floor, enter 0.2 (unsealed) or 0	.1 (seal	ed), else	enter 0				0	(12)	
If no draught lobby, en	ter 0.05, else enter 0							0	(13)	
Percentage of window	s and doors draught stripped							0	(14)	
Window infiltration			0.25 - [0.2	2 x (14) ÷ 1	100] =			0	(15)	
Infiltration rate			(8) + (10)					0	(16)	
,	q50, expressed in cubic metro	-	•	•	etre of e	envelope	area	5	(17)	
•	lity value, then $(18) = [(17) \div 20] + (18)$ es if a pressurisation test has been do				is beina u	sed		0.39	(18)	
Number of sides sheltere		10 01 G G0	groo an po	modelinty	io boilig a	oou		0	(19)	
Shelter factor			(20) = 1 -	[0.075 x (19)] =			1	(20)	
Infiltration rate incorpora	ting shelter factor		(21) = (18) x (20) =				0.39	(21)	
Infiltration rate modified f	for monthly wind speed		,					1		
Jan Feb	Mar Apr May Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Monthly average wind sp			1	1			1	1		
(22)m= 5.1 5	4.9 4.4 4.3 3.8	3.8	3.7	4	4.3	4.5	4.7			
Wind Factor (22a)m = (2	2)m ÷ 4									
(22a)m= 1.27 1.25	1.23 1.1 1.08 0.95	0.95	0.92	1	1.08	1.12	1.18]		
_								_		

Adjusted infiltr	ation rat	e (allowi	ng for sh	nelter an	d wind s	peed) =	(21a) x	(22a)m					
0.49 Calculate effec	0.48	0.47 Change	0.43	0.42 he appli	0.37 Cable ca	0.37 Se	0.36	0.39	0.42	0.44	0.46		
If mechanica		-		по струпп	00.070 00.							0	(23a)
If exhaust air h	eat pump (using Appe	endix N, (2	3b) = (23a	a) × Fmv (e	equation (N	N5)) , othe	rwise (23b) = (23a)			0	(23b)
If balanced with	heat reco	overy: effic	iency in %	allowing f	or in-use f	actor (fron	n Table 4h) =				0	(23c)
a) If balance	d mech	anical ve	ntilation	with he	at recove	ery (MVI	HR) (24a	a)m = (22)	2b)m + (23b) × [1 – (23c)	÷ 100]	
(24a)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24a)
b) If balance	d mech	anical ve	ntilation	without	heat red	overy (N	ЛV) (24b	m = (22)	2b)m + (23b)			
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If whole h if (22b)n				•					5 × (23b	o)			
(24c)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) If natural if (22b)n									0.5]			•	
(24d)m= 0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6		(24d)
Effective air	change	rate - er	iter (24a) or (24b	o) or (24	c) or (24	d) in box	(25)				_	
(25)m= 0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6		(25)
3. Heat losse	s and he	eat loss r	paramete	er:									
ELEMENT	Gros	·	Openin		Net Ar	ea	U-val	ue	AXU		k-value	9	ΑΧk
	area	(m²)	· m	2	A ,r	n²	W/m2	ιK	(W/I	<u>()</u>	kJ/m²-l	K	kJ/K
Windows					6.39	х1.	/[1/(1.4)+	0.04] =	8.47	╛.			(27)
Walls Type1	22.1	7	6.39		15.78	3 X	0.18	=	2.84				(29)
Walls Type2	17.2	22	0		17.22	<u>x</u>	0.18	=	3.1				(29)
Total area of e	lements	, m²			39.39)							(31)
Party wall					46.48	3 X	0	= [0				(32)
Party floor					52.98	3							(32a)
Party ceiling					52.98	3							(32b)
Internal wall **					97.63	3							(32c)
* for windows and						ated using	formula 1	/[(1/U-valu	ie)+0.04] a	s given in	paragraph	1 3.2	
** include the area Fabric heat los				is anu pan	uuoris		(26)(30)) + (32) =				14.41	(33)
Heat capacity		•	0)						.(30) + (32	2) + (32a).	(32e) =	8658.87	
Thermal mass		,	P = Cm ÷	- TFA) ir	n kJ/m²K				tive Value	, , ,	(/	250	(35)
For design assess	•	`		,			ecisely the	indicative	values of	TMP in Ta	able 1f		(22)
can be used inste					P 1	,							
Thermal bridge					-	\						5.71	(36)
if details of therma Total fabric he		are not kn	OWII (36) =	= 0.05 X (3	1)			(33) +	(36) =			20.13	(37)
Ventilation hea	at loss ca	alculated	l monthly	/				(38)m	= 0.33 × (25)m x (5))		
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec]	
(38)m= 29.9	29.67	29.45	28.4	28.21	27.29	27.29	27.12	27.65	28.21	28.6	29.02		(38)
Heat transfer of	coefficier	nt, W/K						(39)m	= (37) + (37)	38)m		-	
(39)m= 50.03	49.8	49.58	48.53	48.33	47.42	47.42	47.25	47.77	48.33	48.73	49.14]	
		-			•		-	-					

Heat loss para	meter (I	HLP), W/	m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 0.94	0.94	0.94	0.92	0.91	0.9	0.9	0.89	0.9	0.91	0.92	0.93		
N			- 4-)						Average =	Sum(40) _{1.}	12 /12=	0.92	(40)
Number of day Jan	Feb	Mar	e Ta) Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m= 31	28	31	30	31	30	31	31	30	31	30	31		(41)
` '						<u> </u>							
4. Water heat	ing ene	rgy requi	rement:								kWh/ye	ear:	
Assumed occu			F4	/ o oooo	.40 (T	- 40.0	\0\1 · 0 (2040 /	TEA 40		78		(42)
if TFA > 13.9 if TFA £ 13.9		+ 1./6 x	[1 - exp	(-0.0003	349 x (11	-A -13.9)2)] + 0.0)013 x (IFA -13	.9)			
Annual averag	e hot wa										.43		(43)
Reduce the annua not more that 125	_				_	_	to achieve	a water us	se target o	of			
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in								ОСР	000	1404	Dec		
(44)m= 84.07	81.01	77.96	74.9	71.84	68.78	68.78	71.84	74.9	77.96	81.01	84.07		
		ļ				ļ.			Total = Su	ım(44) ₁₁₂ =		917.12	(44)
Energy content of	hot water	used - cal	culated mo	onthly $= 4$.	190 x Vd,r	n x nm x C	Tm / 3600) kWh/mor	nth (see Ta	ables 1b, 1	c, 1d)		
(45)m= 124.67	109.04	112.52	98.1	94.13	81.22	75.27	86.37	87.4	101.86	111.18	120.74		_
If instantaneous w	ater heati	na at noint	of use (no	hot water	· storage)	enter∩in	hoves (46		Total = Su	ım(45) ₁₁₂ =	- L	1202.49	(45)
(46)m= 18.7	16.36	16.88	14.71	14.12	12.18	11.29	12.96	13.11	15.28	16.68	18.11		(46)
Water storage		10.00	14.71	14.12	12.10	11.29	12.90	13.11	13.20	10.00	10.11		(40)
Storage volum	e (litres)) includin	g any so	olar or W	/WHRS	storage	within sa	ame ves	sel		0		(47)
If community h	eating a	and no ta	nk in dw	elling, e	nter 110	litres in	(47)						
Otherwise if no		hot wate	er (this in	icludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in ((47)			
Water storage a) If manufact		eclared l	nss facto	nr is kno	wn (k\//h	n/day).					0		(48)
Temperature fa				JI 13 KI10	vvii (icvvi	ı, day).					0 0		(49)
Energy lost fro				ear			(48) x (49)) =			0		(50)
b) If manufact		_	-		or is not		() ()				0		(00)
Hot water stora	_			e 2 (kWl	h/litre/da	ay)					0		(51)
If community h Volume factor	•		on 4.3										(50)
Temperature fa			2b							_	0		(52) (53)
Energy lost fro				ear			(47) x (51)) x (52) x (53) =		0		(54)
Enter (50) or (•	, 1	Jul			() ()	, (, (,	-	0		(55)
Water storage	loss cal	culated f	or 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	dedicate	d solar sto	rage, (57)ı	<u>l</u> m = (56)m	x [(50) – (<u>I</u> H11)] ÷ (5	0), else (5	<u>I</u> 7)m = (56)	m where (L (H11) is fro	m Appendi	хН	
(57)m= 0	0	0	0	0	0	0	0	0	0	0	0		(57)
Primary circuit	loss (ar	nual) fro	m Table	e 3							0		(58)
Primary circuit	•	•			59)m = ((58) ÷ 36	65 × (41)	m					
(modified by	factor f	rom Tabl	e H5 if t	here is s	olar wat	ter heatii	ng and a	cylinde	r thermo	stat)			
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

Combi loss calculated for each month $(61)m = (60) \div 365 \times (41)m$														
			i			- ` ` `	_				1	ı	1	(0.1)
` '	7.29 39.7		36.94	36.61	33.92	35.05	36.6			39.73	39.95	42.84	J	(61)
Total heat require		_					`		-		` 	<u>`</u>	(59)m + (61)m	(22)
` '	6.33 152.		135.03	130.74	115.14	110.32	122.9			141.58	151.14	163.58]	(62)
Solar DHW input calc	_								olar c	contribut	ion to wate	er heating)		
(add additional lin		$\overline{}$							_			Ι .	1	(00)
(63)m= 0	0 0		0	0	0	0	0	0		0	0	0	J	(63)
Output from wate						1						l	1	
(64)m= 167.51 14	6.33 152.	24	135.03	130.74	115.14	110.32	122.9			141.58	151.14	163.58	4000.00	1(64)
											r (annual)₁		1660.93	(64)
Heat gains from v		_				1			$\overline{}$		1		1] 1	4
(65)m= 52.16 4	5.58 47.3	34	41.85	40.45	35.49	33.79	37.8	7 38.2	9	43.8	46.96	50.86]	(65)
include (57)m i	n calculation	on of	(65)m	only if c	ylinder	is in the o	dwelli	ng or ho	t wat	ter is fr	om com	munity h	neating	
5. Internal gains	(see Tab	le 5 a	and 5a)	:										
Metabolic gains (Table 5), V	<u>Vatts</u>	S										,	
Jan	Feb Ma	ar	Apr	May	Jun	Jul	Au	g Se	р	Oct	Nov	Dec		
(66)m= 88.9 8	88.9	9	88.9	88.9	88.9	88.9	88.9	88.9	9	88.9	88.9	88.9		(66)
Lighting gains (ca	lculated in	Арр	endix L	_, equat	ion L9 c	r L9a), a	lso se	e Table	5				_	
(67)m= 15.32 1	3.6 11.0)6	8.38	6.26	5.29	5.71	7.42	9.96	6	12.65	14.77	15.74		(67)
Appliances gains	(calculate	d in A	Append	lix L, eq	uation L	.13 or L1	3a), a	lso see	Table	e 5				
(68)m= 154.97 15	66.57 152.	52	143.9	133.01	122.77	115.93	114.3	32 118.3	38	127	137.89	148.13]	(68)
Cooking gains (ca	alculated in	n App	pendix	L, equat	ion L15	or L15a), alsc	see Ta	ble 5	;			-	
(69)m= 31.89 3	1.89 31.8	39	31.89	31.89	31.89	31.89	31.8	9 31.8	9	31.89	31.89	31.89]	(69)
Pumps and fans	gains (Tab	le 5a	 a)					•					•	
(70)m= 3	3 3		3	3	3	3	3	3		3	3	3]	(70)
Losses e.g. evap	oration (ne	gativ	ve valu∉	es) (Tab	le 5)	•	•	'			•	•	•	
(71)m= -71.12 -7	1.12 -71.	12	-71.12	-71.12	-71.12	-71.12	-71.1	2 -71.1	2	-71.12	-71.12	-71.12]	(71)
Water heating gain	ns (Table	<u>_</u>				!							•	
	7.82 63.6	-	58.13	54.37	49.29	45.42	50.9	53.1	9	58.87	65.22	68.35]	(72)
Total internal ga	 ins =	!_	!		(66)m + (67)m	1 + (68)	m + (69)m	1 + (70	0)m + (7	1)m + (72))m	J	
	0.67 279.	89	263.07	246.3	230.01	219.73	225.3	32 234.	2	251.2	270.55	284.9	1	(73)
6. Solar gains:														
Solar gains are calcu	ulated using	solar f	flux from	Table 6a	and assoc	ciated equa	itions to	convert t	o the	applicat	ole orientat	tion.		
Orientation: Acc	ess Facto	r	Area		Flu			g_			FF		Gains	
Tab	le 6d		m²		Ta	ble 6a		Table	6b	Т	able 6c		(W)	
Southeast _{0.9x}	0.77	x	6.3	9	X	36.79	x	0.63		х	0.7	=	71.85	(77)
Southeast _{0.9x}	0.77	x	6.3	9	x	62.67	x	0.63		x	0.7	_ =	122.39	(77)
Southeast _{0.9x}	0.77	x	6.3	9	x	85.75	x	0.63		×	0.7	=	167.46	(77)
Southeast _{0.9x}	0.77	x	6.3	9	x 1	06.25	x	0.63		×	0.7	=	207.5	(77)
Southeast _{0.9x}	0.77	x	6.3	9	x 1	19.01	x	0.63		×	0.7	-	232.41	(77)
		-		•									-	-

Southeast _{0.9x}	0.77	X	6.3	9	x	1	18.15	x		0.63	x	0.7	=	230.73	(77)
Southeast _{0.9x}	0.77	Х	6.3	9	x	1	13.91	x		0.63	x	0.7	=	222.45	(77)
Southeast _{0.9x}	0.77	X	6.3	9	x	10	04.39	x		0.63	x	0.7	=	203.86	(77)
Southeast _{0.9x}	0.77	X	6.3	9	x	9	2.85	x		0.63	x	0.7	=	181.33	(77)
Southeast _{0.9x}	0.77	x	6.3	9	x	6	9.27	x		0.63	×	0.7	_ =	135.27	(77)
Southeast _{0.9x}	0.77	Х	6.3	9	x	4	4.07	х		0.63	x	0.7	=	86.06	(77)
Southeast 0.9x	0.77	х	6.3	9	x	3	1.49	x		0.63	_ x [0.7	=	61.49	(77)
_								•			_				_
Solar gains in	watts, ca	alculated	for eacl	n month				(83)m	n = Si	um(74)m .	(82)m				
(83)m= 71.85	122.39	167.46	207.5	232.41	23	30.73	222.45	203	3.86	181.33	135.27	86.06	61.49		(83)
Total gains – i	nternal a	nd solar	(84)m =	(73)m	+ (8	33)m	, watts								
(84)m= 364.92	413.07	447.35	470.56	478.72	46	60.74	442.18	429	9.18	415.53	386.47	356.61	346.39		(84)
7. Mean inter	nal temp	erature	(heating	season)										
Temperature						area f	from Tal	ole 9	, Th	1 (°C)				21	(85)
Utilisation fac	•	•			-					` ,					_
Jan	Feb	Mar	Apr	May	È	Jun	Jul	A	ug	Sep	Oct	Nov	Dec		
(86)m= 1	0.99	0.98	0.93	0.83	(0.64	0.47	0.	.5	0.74	0.94	0.99	1		(86)
Mean interna	l tampar	atura in l	living ar	 22 T1 (f	مالد	w sta	ns 3 to 7	7 in T	Fahla	2 9c)		_	ļ.		
(87)m= 20.13	20.28	20.48	20.73	20.9	_	0.98	21	2		20.96	20.75	20.4	20.11		(87)
` ′	ļ						<u> </u>								` '
Temperature					$\overline{}$			T		· · ·	20.46	20.45	20.14	Ī	(88)
(88)m= 20.13	20.13	20.14	20.15	20.16		0.17	20.17	20.	.17	20.17	20.16	20.15	20.14		(00)
Utilisation fac	,	ains for r		welling,	т —		1	9a)	-					Ī	
(89)m= 0.99	0.99	0.97	0.91	0.78).57	0.38	0.4	41	0.67	0.92	0.99	1		(89)
Mean interna	l temper	ature in	the rest	of dwell	ing	T2 (f	ollow ste	eps 3	3 to 7	7 in Tabl	e 9c)	_			
(90)m= 18.97	19.19	19.48	19.84	20.06	2	0.16	20.17	20.	.17	20.14	19.87	19.38	18.96		(90)
										f	LA = Livi	ng area ÷ (4) =	0.4	(91)
Mean interna	l temper	ature (fo	r the wh	ole dwe	lling	g) = fl	LA × T1	+ (1	– fL	A) × T2					
(92)m= 19.44	19.63	19.89	20.2	20.4	2	0.49	20.51	20.	.51	20.47	20.22	19.79	19.42		(92)
Apply adjustr	nent to t	he mean	internal	temper	atu	re fro	m Table	4e,	whe	re appro	priate	•			
(93)m= 19.44	19.63	19.89	20.2	20.4	2	0.49	20.51	20.	.51	20.47	20.22	19.79	19.42		(93)
8. Space hea	ting requ	uirement													
Set Ti to the					ned	at ste	ep 11 of	Tab	le 9b	o, so tha	t Ti,m=	(76)m an	d re-calc	culate	
the utilisation												1	_	1	
Jan	Feb	Mar	Apr	May		Jun	Jul	A	ug	Sep	Oct	Nov	Dec		
Utilisation fac	0.99	0.97	0.91	0.8		0.6	0.42	0.4	15	0.7	0.92	0.98	0.99		(94)
Useful gains,						0.0	0.42	0.5	+5	0.7	0.92	0.90	0.99		(01)
(95)m= 362.36		432.42	430.5	381.87	27	74.35	184.7	193	3.26	290.84	357.44	351.05	344.53		(95)
Monthly aver					_						-	1			` '
(96)m= 4.3	4.9	6.5	8.9	11.7		14.6	16.6	16	5.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate	e for mea	an intern	al tempe	erature,	Lm	, W =	=[(39)m	x [(9	3)m-	– (96)m]	1	I	1	
(97)m= 757.47	733.43	663.62	548.28	420.7	_	79.52	185.2	194		304.37	465.2	618.52	748.2		(97)
Space heatin	g require	ement fo	r each n	nonth, k	Wh	/mont	th = 0.02	24 x	[(97)	m – (95)m] x (4	11)m		•	
(98)m= 293.96	219.4	172.01	84.8	28.89		0	0)	0	80.17	192.58	300.33		
														-	

					Tota	ıl per year	(kWh/yea	r) = Sum(9	08) _{15,912} =	1372.14	(98)
Space heating requirement in	kWh/m²	²/year								25.9	(99)
9a. Energy requirements – Ind	ividual h	eating sy	ystems i	ncluding	micro-C	CHP)					
Space heating:		, .							Г		_
Fraction of space heat from s			mentary	-		(224)				0	(201)
Fraction of space heat from m	•	, ,			(202) = 1	,	,		ļ	1	(202)
Fraction of total heating from	•				(204) = (2	02) x [1 –	(203)] =		ļ	1	(204)
Efficiency of main space heat	0 ,								ļ	93.4	(206)
Efficiency of secondary/supple	ementar	y heating	g system	า, %		,		,		0	(208)
Jan Feb Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ar
Space heating requirement (c	alculate	d above)	0	0	0	0	80.17	192.58	300.33		
	1	l .	U	0	U	0	00.17	192.56	300.33		(044)
$(211)m = \{[(98)m \times (204)] \} \times 1$ $314.73 234.9 184.17$	90.8	30.93	0	0	0	0	85.83	206.19	321.55		(211)
20.00 10.000		00.00				l (kWh/yea				1469.1	(211)
Space heating fuel (secondar	y), kWh/	month							L		
$= \{[(98)\text{m x } (201)]\} \times 100 \div (201)$	• /	_	_	_	_	_	_	_			
(215)m= 0 0 0	0	0	0	0	0	0	0	0	0		_
					Tota	ıl (kWh/yea	ar) =Sum(2	215) _{15,101}	2=	0	(215)
Water heating	lata dad	l \									
Output from water heater (calc	ulated a	130.74	115.14	110.32	122.98	124.34	141.58	151.14	163.58		
Efficiency of water heater										80.3	(216)
(217)m= 86.45 86.07 85.36	83.92	81.96	80.3	80.3	80.3	80.3	83.68	85.66	86.56		(217)
Fuel for water heating, kWh/mo											
(219) m = (64) m x $100 \div (217)$ (219)m = 193.76 170.01 178.36	m 160.91	159.52	143.39	137.38	153.15	154.84	169.19	176.43	188.98		
(219)111- 193.70 170.01 170.30	100.91	109.02	143.33	137.30		I = Sum(2		170.43	100.90	1985.93	(219)
Annual totals								Wh/yeaı	լ r	kWh/yea	
Space heating fuel used, main	system	1						.,		1469.1	
Water heating fuel used									Ī	1985.93	7
Electricity for pumps, fans and	electric	keep-ho	t						L		
central heating pump:									30		(2300
boiler with a fan-assisted flue									45		(230€
Total electricity for the above, I		ır			sum	of (230a).	(230g) =			75	(231)
Electricity for lighting	., 50								l T	270.51	(232)
, ,	000 (244	\ (004\	. (224)	. (222)	(227h)	_			[[=
Total delivered energy for all us	`	, , ,	` ′	` ′	` ′				L	3800.53	(338)
12a. CO2 emissions – Individ	ual heat	ing syste	ems inclu	uding mi	cro-CHF)					
				ergy /h/year			Emiss kg CO	ion fac 2/kWh	tor	Emissions kg CO2/ye	

Space heating (main system 1)	(211) x	0.216	317.32 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	428.96 (264)
Space and water heating	(261) + (262) + (263) + (264) =		746.29 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	140.39 (268)
Total CO2, kg/year	sum	of (265)(271) =	925.6 (272)

 $TER = 17.47 \tag{273}$

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Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 74.55m²

Site Reference: 231 Watford Road - BASE **Plot Reference:** Sample 5

Address:

Client Details:

Name: Address:

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas

Fuel factor: 1.00 (mains gas)

16.23 kg/m² Target Carbon Dioxide Emission Rate (TER)

Dwelling Carbon Dioxide Emission Rate (DER) 15.76 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 39.5 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 32.4 kWh/m²

OK

2 Fabric U-values

Element Average Highest External wall 0.16 (max. 0.30) 0.16 (max. 0.70) OK Party wall 0.00 (max. 0.20) **OK**

Floor (no floor) Roof (no roof)

Openings 1.10 (max. 2.00) OK 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 5.00 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas

Data from manufacturer

Combi boiler

Efficiency 89.5 % SEDBUK2009

Minimum 88.0 %

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

OK

6 Controls

Space heating controls TTZC by plumbing and electrical services

No cylinder thermostat

No cylinder

Boiler interlock: Yes OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings 100.0%

Minimum 75.0% **OK**

8 Mechanical ventilation

Hot water controls:

Not applicable

9 Summertime temperature

Overheating risk (Thames valley): Slight

Based on:

Overshading: Average or unknown

Windows facing: South East 12.79m² Windows facing: South 1.28m² Ventilation rate: 6.00

10 Key features

Windows U-value 1.1 W/m²K
Party Walls U-value 0 W/m²K

OK

OK

		He	er Details:								
Access at Name.	Noillagham	USE		a Mirros	b a v .		CTDO	010012			
Assessor Name: Software Name:	Neil Ingham Stroma FSAP 2012	2	Stroma Softwa					010943 on: 1.0.5.41			
			rty Address:								
Address :											
1. Overall dwelling dime	ensions:										
Ground floor		<i>,</i>	Area(m²)	(1a) x		ight(m) 75	(2a) =	Volume(m ³	(3a)		
	a) . (1b) . (1a) . (1d) . (1a)					75	(2a) -	205.01	(Ja)		
Total floor area TFA = (1	a)+(10)+(10)+(10)+(10)	+(111)	74.55	(4)) . (2-) . (2-	4) . (2 -) .	(2-)		_		
Dwelling volume				(3a)+(3b))+(3c)+(3c	d)+(3e)+	.(3h) =	205.01	(5)		
2. Ventilation rate:	main se	condary	other		total			m³ per hou	ır		
Number of chimneys	heating he	eating		1 ₌ [40 =		_		
Number of chimneys		-	0	」 ⁻	0		20 =	0	(6a)		
Number of open flues		0 +	0	」 ⁻ └	0			0	(6b)		
Number of intermittent fa				Ļ	3		10 =	30	(7a)		
Number of passive vents				Ļ	0		10 =	0	(7b)		
Number of flueless gas fires $0 x 40 = 0 (7c)$											
							Air ch	anges per ho	our		
Infiltration due to chimne	ys, flues and fans = (6a))+(6b)+(7a)+(7	b)+(7c) =	Г	30		÷ (5) =	0.15	(8)		
If a pressurisation test has b	peen carried out or is intended	d, proceed to (1	7), otherwise o	ontinue fr			` ′		`` <i>`</i>		
Number of storeys in the	he dwelling (ns)							0	(9)		
Additional infiltration	OF for atoal antimber for		· for mooon			[(9)	-1]x0.1 =	0	(10)		
	.25 for steel or timber fr resent, use the value corresp			•	uction			0	(11)		
deducting areas of opening	ngs); if equal user 0.35						,				
•	floor, enter 0.2 (unseale	ed) or 0.1 (se	ealed), else	enter 0				0	(12)		
If no draught lobby, en								0	(13)		
· ·	s and doors draught stri	ipped	0.05 10.0	(4.4) 4	001			0	(14)		
Window infiltration			0.25 - [0.2		_	. (45)		0	(15)		
Infiltration rate	-50		(8) + (10)	, , ,	, , ,	, ,		0	(16)		
If based on air permeabil	q50, expressed in cubic	•	•	•	etre of e	envelope	area	5	(17)		
	es if a pressurisation test has				is heina u	sed		0.4	(18)		
Number of sides sheltere		00011 00110 01 0	a dogree an per	modeliny	io boilig a			0	(19)		
Shelter factor			(20) = 1 -	0.075 x (1	19)] =			1	(20)		
Infiltration rate incorporate	ting shelter factor		(21) = (18)	x (20) =				0.4	(21)		
Infiltration rate modified f	or monthly wind speed						'				
Jan Feb	Mar Apr May	Jun Ju	ıl Aug	Sep	Oct	Nov	Dec				
Monthly average wind sp	eed from Table 7										
(22)m= 5.1 5	4.9 4.4 4.3	3.8 3.8	3.7	4	4.3	4.5	4.7				
Wind Factor (22a)m = (2.	2)m ∸ 4										
<u> </u>	1.23 1.1 1.08	0.95 0.9	0.92	1	1.08	1.12	1.18				
` '		1 3.0	1		L			J			

<i>'</i> ———	rate (allow				<u> </u>	<u>` </u>	` 	l	<u> </u>	T	1	
0.51 0.5 alculate effective a		0.44	0.43	0.38	0.38	0.37	0.4	0.43	0.45	0.47]	
If mechanical ven	•	1010 101 1	по арри	oabio oa	00						0	
If exhaust air heat pur	np using App	endix N, (2	23b) = (23a	a) × Fmv (e	equation (N	N5)) , othe	rwise (23b) = (23a)			0	
If balanced with heat	ecovery: effic	ciency in %	allowing f	or in-use fa	actor (fron	n Table 4h) =				0	
a) If balanced me	chanical ve	entilation	with he	at recove	ery (MVI	HR) (24a	a)m = (22)	2b)m + (23b) × [1 – (23c)	÷ 100]	
la)m= 0 0	0	0	0	0	0	0	0	0	0	0]	
b) If balanced me	chanical ve	entilation	without	heat rec	overy (N	ЛV) (24b)m = (22	2b)m + (2	23b)	-	-	
b)m = 0 0	0	0	0	0	0	0	0	0	0	0		
c) If whole house if (22b)m < 0.				•				.5 × (23b	o)			
c)m= 0 0	0	0	0	0	0	0	0	0	0	0		
d) If natural ventil if (22b)m = 1,			•					0.5]				
d)m= 0.63 0.63	0.62	0.6	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61		
Effective air chan	ge rate - e	nter (24a) or (24b	o) or (24d	c) or (24	d) in box	(25)					
)m= 0.63 0.63	0.62	0.6	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61		
. Heat losses and	heat loss	paramet	er:									
_EMENT G	ross ea (m²)	Openin m	ıgs	Net Ar A ,r		U-valı W/m2		A X U (W/I	K)	k-value kJ/m²-		A X I kJ/K
ndows Type 1				12.79	x1.	/[1/(1.4)+	0.04] =	16.96				
ndows Type 2				1.28	x1.	/[1/(1.4)+	0.04] =	1.7				
alls Type1	1.85	14.0	7	27.78	x	0.18	=	5				
alls Type2	24.37	0		24.37	×	0.18	=	4.39				
tal area of eleme	nts, m²			66.22	2							
rty wall				41.82	<u>x</u>	0	=	0				
rty floor				74.55	5							
rty ceiling				74.55	5				Ī		7 6	
ernal wall **				131.12	2				Ī		7 6	
or windows and roof w Include the areas on b					ated using	ı formula 1	/[(1/U-valu	ıe)+0.04] a	as given in	paragrapl	1 3.2	
bric heat loss, W	K = S (A x	(U)				(26)(30)	+ (32) =				28.0	4
at capacity Cm =	S(A x k)						((28).	(30) + (32	2) + (32a).	(32e) =	11409	.48
ermal mass para	neter (TM	P = Cm -	: TFA) ir	n kJ/m²K			Indica	tive Value	: Medium		250)
r design assessments n be used instead of a			construct	ion are not	t known pr	ecisely the	e indicative	e values of	TMP in T	able 1f		
ermal bridges : S	` '		• .	•	<						7.7	6
etails of thermal bridg tal fabric heat los	_	nown (36) =	= 0.05 x (3	11)			(33) +	(36) =			35.	3
ntilation heat loss	1	1	<u> </u>	ı			- ` ´	= 0.33 × (25)m x (5)	1	1	
Jan Fe	+	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
	3 41.8	40.26	39.97	38.62	38.62	38.37	39.14	39.97	40.55	41.16		
)m= 42.46 42.1			<u> </u>	L		<u> </u>				1	J	
eat transfer coefficient			!			!	(39)m	= (37) + (3	38)m		J 1	

Heat loss para	meter (l	HLP), W/	m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 1.05	1.05	1.04	1.02	1.02	1	1	0.99	1.01	1.02	1.02	1.03		
		· · · / - · · · ·	4 \					,	Average =	Sum(40) ₁ .	12 /12=	1.02	(40)
Number of day Jan	s in mo	nth (Tabl	e 1a) Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m= 31	28	31	30	31	30	31	31	30	31	30	31		(41)
(41)=			00	01			01	00			01		(,
4. Water heat	ing ene	rgy requi	rement:								kWh/ye	ear:	
Assumed seen	nono.	NI											(40)
Assumed occu if TFA > 13.9 if TFA £ 13.9	0, N = 1		[1 - exp	(-0.0003	49 x (TF	FA -13.9)2)] + 0.0	0013 x (¯	ΓFA -13		35		(42)
Annual average									a taraat a		.04		(43)
Reduce the annua not more that 125	-		• .		-	-	o acnieve	a water us	se target o	OΓ			
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in	n litres per	r day for ea	-	Vd,m = fa	ctor from T	Table 1c x							
(44)m= 99.05	95.45	91.85	88.24	84.64	81.04	81.04	84.64	88.24	91.85	95.45	99.05		
Energy content of	hot water	used - cal	culated ma	onthly – 1	100 v Vd r	n v nm v F	Tm / 3600			im(44) ₁₁₂ =	L	1080.53	(44)
	128.47	132.57	115.58	110.9	95.7	88.68	101.76	102.97	120	130.99	142.25		
(45)m= 146.89	120.47	132.37	115.56	110.9	95.7	00.00	101.76			im(45) ₁₁₂ =	<u> </u>	1416.75	(45)
If instantaneous w	ater heati	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46		rotar – ou	(10)112 =	L	1110.70	(- 7
(46)m= 22.03	19.27	19.89	17.34	16.63	14.35	13.3	15.26	15.45	18	19.65	21.34		(46)
Water storage		الماليطانم	a 001/0	olor or M	WHDC	otorogo	within or		مما				(47)
Storage volume	` '		•			•		airie ves	9 C I		0		(47)
Otherwise if no	•			•			` '	ers) ente	er '0' in ((47)			
Water storage	loss:		`					,					
a) If manufactor				or is kno	wn (kWh	n/day):					0		(48)
Temperature fa											0		(49)
Energy lost from b) If manufactor		_	-		or ic not		(48) x (49)) =			0		(50)
Hot water stora			-								0		(51)
If community h	_		on 4.3										
Volume factor			01								0		(52)
Temperature fa									,		0		(53)
Energy lost fro Enter (50) or (•	, kWh/ye	ear			(47) x (51)	x (52) x (53) =	-	0		(54) (55)
Water storage	, ,	,	or each	month			((56)m = (55) × (41)ı	m		0		(55)
(56)m= 0	0	0	0	0	0	0	0	0	0	0	0		(56)
If cylinder contains			-	-					_		_	хH	(30)
(57)m= 0	0	0	0	0	0	0	0	0	0	0	0		(57)
Primary circuit	loss (ar	nual) fro	m Table	3							0		(58)
Primary circuit	•	•			59)m = ((58) ÷ 36	55 × (41)	m					. ,
(modified by				•	•	. ,	, ,		r thermo	stat)			
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

Combi loss calculated for each month $(61)m = (60) \div 365 \times (41)m$													
					<u> </u>	- ` `		1	ı	1	1	1	(0.1)
` '		5.8	43.52	43.13	39.96	41.3	43.13	<u> </u>	46.8	47.07	50.47		(61)
Total heat require		_				1	`		` 	ì ´	`	(59)m + (61)m	
` '	72.4 179		159.09	154.03	135.66	129.97	144.8		166.81	178.06	192.73		(62)
Solar DHW input calc	_								r contribu	tion to wate	er heating)		
(add additional lin									1	1	1	1	(22)
(63)m= 0)	0	0	0	0	0	0	0	0	0		(63)
Output from wate												1	
(64)m= 197.36 1	72.4 179	9.37	159.09	154.03	135.66	129.97	144.8		166.81	178.06	192.73		٦
							0	utput from w	ater heate	er (annual) ₁	l12	1956.87	(64)
Heat gains from v	ater hea	ting,	kWh/mo	onth 0.2	5 ´ [0.85	× (45)m	+ (61)m] + 0.8 x	([(46)m	+ (57)m	+ (59)m]	
(65)m= 61.46 5	3.7 55.	.78	49.31	47.66	41.81	39.81	44.62	45.12	51.6	55.32	59.92		(65)
include (57)m i	n calculat	ion o	f (65)m	only if c	ylinder i	s in the o	dwellir	g or hot w	ater is f	rom com	munity h	neating	
5. Internal gains	(see Tal	ole 5	and 5a)):									
Metabolic gains (Γable 5),	Watt	S										
		1ar	Apr	May	Jun	Jul	Aug	g Sep	Oct	Nov	Dec		
(66)m= 117.57 11	7.57 117	7.57	117.57	117.57	117.57	117.57	117.5	7 117.57	117.57	117.57	117.57		(66)
Lighting gains (ca	lculated i	n Ap	pendix l	L, equat	ion L9 o	r L9a), a	lso se	e Table 5	ı	•	•	•	
		.56	10.27	7.68	6.48	7	9.1	12.22	15.51	18.1	19.3]	(67)
Appliances gains	(calculate	ed in	Append	dix L. ea	uation L	13 or L1	 3а), al	so see Ta	ble 5	1		ı	
·· — —	9.83 204		192.84	178.25	164.53	155.37	153.2		170.2	184.8	198.51]	(68)
Cooking gains (ca	lculated	in Ar	nendix	l equat	ion I 15	or I 15a\	L also	see Table	5	ļ.		J	
	4.76 34.		34.76	34.76	34.76	34.76	34.76		34.76	34.76	34.76]	(69)
Pumps and fans g	L I	 bla 5	<u>a)</u>			1				<u> </u>	<u> </u>	I	, ,
(70)m= 3	<u> </u>	3	3	3	3	3	3	3	3	3	3	1	(70)
Losses e.g. evapo												l	(- /
	4.05 -94	Ť	-94.05	-94.05	-94.05	-94.05	-94.0	5 -94.05	-94.05	-94.05	-94.05	1	(71)
			-94.03	-94.03	-94.03	1 -94.03	-94.0	3 -94.03	-94.03	-94.03	-94.03	I	(11)
Water heating gai	` —		00.40	04.05	F0.07	T 50.54	50.0	, , , , , , ,	60.00	70.04	1 00 50	1	(72)
` '	9.91 74.	.97	68.48	64.05	58.07	53.51	59.97		69.36	76.84	80.53	l	(72)
Total internal ga					,	· · · ·		m + (69)m +		•		1	(70)
` '	7.69 354	1.21	332.86	311.25	290.35	277.14	283.5	5 294.79	316.34	341.01	359.62		(73)
6. Solar gains:	ulated wains		flux from	Toble Co.	and accor	iotod ogua	tiona to	convert to th	a annliad	ble erienter	tion		
Solar gains are calcu	•				and assoc Flu	•	ilions to		е аррпса	FF	uon.	Gains	
Orientation: Acc Tab	ess Facic le 6d	ונ	Area m²			ble 6a		g_ Table 6b	Т	able 6c		(W)	
Southeast 0.9x		1	40:	70			1 F					` '	1(77)
<u></u>	0.77	X	12.		-	36.79	X	0.63	X	0.7	=	143.82	(77)
Southeast 0.9x	0.77	X	12.		-	62.67	X	0.63	×	0.7	=	244.98	(77)
Southeast 0.9x	0.77	X	12.			35.75	X	0.63	╣ ^ϫ ╞	0.7	=	335.19	(77)
Southeast 0.9x	0.77	X	12.	==	-	06.25	X	0.63	_ ×	0.7	=	415.32	(77)
Southeast _{0.9x}	0.77	X	12.	79	x 1	19.01	X	0.63	Х	0.7	=	465.19	(77)

		_			_		, ,		_				_
Southeast 0.9x	0.77	X	12.	79	X	118.15	X	0.63	X	0.7	=	461.82	(77)
Southeast _{0.9x}	0.77	X	12.	79	X	113.91	X	0.63	X	0.7	=	445.25	(77)
Southeast 0.9x	0.77	X	12.	79	X	104.39	X	0.63	X	0.7	=	408.04	(77)
Southeast _{0.9x}	0.77	X	12.	79	X	92.85	X	0.63	X	0.7	=	362.94	(77)
Southeast 0.9x	0.77	X	12.	79	X	69.27	x	0.63	X	0.7	=	270.75	(77)
Southeast _{0.9x}	0.77	X	12.	79	X	44.07	x	0.63	X	0.7	=	172.26	(77)
Southeast 0.9x	0.77	X	12.	79	X	31.49	x	0.63	X	0.7	=	123.08	(77)
South 0.9x	0.77	X	1.2	28	x	46.75	X	0.63	X	0.7	=	18.29	(78)
South 0.9x	0.77	X	1.2	28	x	76.57	x	0.63	X	0.7	=	29.95	(78)
South 0.9x	0.77	X	1.2	28	x	97.53	x	0.63	X	0.7	=	38.15	(78)
South 0.9x	0.77	x	1.2	28	x	110.23	x	0.63	X	0.7	=	43.12	(78)
South 0.9x	0.77	x	1.2	28	x	114.87	x	0.63	X	0.7	=	44.94	(78)
South 0.9x	0.77	X	1.2	28	x	110.55	x	0.63	x	0.7	=	43.24	(78)
South 0.9x	0.77	X	1.2	28	x	108.01	x	0.63	x	0.7	=	42.25	(78)
South _{0.9x}	0.77	×	1.2	28	x	104.89	x	0.63	x	0.7	=	41.03	(78)
South _{0.9x}	0.77	×	1.2	28	x	101.89	x	0.63	x	0.7	=	39.86	(78)
South _{0.9x}	0.77	×	1.2	28	x	82.59	x	0.63	x	0.7	_ =	32.31	(78)
South _{0.9x}	0.77	×	1.2	28	x	55.42	x	0.63	x	0.7	=	21.68	(78)
South _{0.9x}	0.77	×	1.2	28	x	40.4	, x	0.63	×	0.7		15.8	(78)
Solar gains in (83)m= 162.11	 	ulated 73.34	for eac 458.44	h month 510.12	505.0	7 487.5	(83)m 449.	= Sum(74)m . .07 402.79	<mark>(82)m</mark> 303.0		138.88	1	(83)
Total gains – i	nternal and	solar	(84)m =	= (73)m	+ (83)r	n , watts			<u> </u>		ļ	J	
(84)m= 532.44	642.62 72	27.55	791.3	821.37	795.4	2 764.64	732.	.63 697.59	619.4	534.95	498.5]	(84)
7. Mean inte	rnal tempera	ature ((heating	season)							•	
Temperature	•		`		′	a from Ta	ble 9.	Th1 (°C)				21	(85)
Utilisation fac	•	•			_		,						`
Jan		Mar	Apr	May	Jur		Aı	ug Sep	Oct	Nov	Dec]	
(86)m= 1	0.99	0.97	0.9	0.78	0.58	0.43	0.4		0.93	0.99	1		(86)
Mean interna	ıl temperatu	ıre in I	iving ar	ea T1 (fo	ollow s	tens 3 to	7 in T	able 9c)				4	
(87)m= 20	 	0.46	20.73	20.91	20.99	i i	21		20.73	20.31	19.98]	(87)
Temperature	during hea	tina n	oriode ir	rost of	dwellii	na from Tr	abla C				<u> </u>	ı	
(88)m= 20.04		0.05	20.07	20.07	20.08	-	20.0	` 	20.07	20.06	20.06]	(88)
` ′	<u> </u>			<u> </u>		_		1		1		J	, ,
Utilisation fac	 -	- 1		,	1	1	T	7 0.60	0.0	1 0 00		1	(89)
(89)m= 0.99	<u> </u>	0.95	0.88	0.72	0.51	0.34	0.3		0.9	0.98	1		(09)
Mean interna	 	- 1		i	·	<u>`</u>	T .				ı	1	(0.0)
(90)m= 18.72	19.01 1	9.38	19.77	19.99	20.08	20.08	20.0		19.77		18.69		(90)
								Ť	LA = LI\	ving area ÷ (+) =	0.4	(91)
Mean interna	l temperatu	re (fo	r the wh	ole dwe	lling) =	fLA × T1	+ (1	– fLA) × T2				1	
Mean interna (92)m= 19.23 Apply adjusti	19.49	19.8	20.15	20.36	20.44	20.45	20.4	45 20.41	20.15		19.2]	(92)

(02)	40.00	10.40	40.0	20.45	20.20	20.44	20.45	20.45	20.44	20.45	40.00	40.0	1	(93)
(93)m=	19.23	19.49	19.8	20.15	20.36	20.44	20.45	20.45	20.41	20.15	19.63	19.2		(93)
			uirement				44 -4	Table O	41	4 T: /	70)	- -	late	
			or gains	•		ed at ste	ер ттог	rable 9	o, so tha	t 11,m=(rojin an	d re-calc	culate	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
			ains, hm					,				,		
(94)m=	0.99	0.98	0.95	0.88	0.74	0.54	0.37	0.41	0.65	0.9	0.98	0.99		(94)
Usefu			W = (94)				ı	,			1	,	1	
(95)m=	528.28	629.65	691.89	694.91	606.74	427.73	285.54	299.04	454.38	560.53	525.22	495.65		(95)
	<u> </u>	age exte	rnal tem	perature			•	,				,		
(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)
							-``	- ` 	– (96)m					
	1168.39			L	655.82	434.35	286.24	300.19	473.08	723.46	957	1154.42		(97)
Space		g require	ement fo		nonth, k\	Wh/mon	th = 0.02	24 x [(97)m – (95)m] x (4	1)m	,		
(98)m=	476.24	340.65	253.36	115.85	36.51	0	0	0	0	121.22	310.88	490.12		_
								Tota	l per year	(kWh/year	r) = Sum(9	8) _{15,912} =	2144.83	(98)
Space	e heatin	g require	ement in	kWh/m²	² /year								28.77	(99)
9a En	erav rea	uiremer	nts – Indi	ividual h	eating sy	vstems i	ncluding	micro-C	'HPI					_
	e heatir		ito iriai	ividual II	cating sy	y Storris r	ricidaling	inicio c	<i>/</i>					
•		•	at from s	econdar	v/supple	mentarv	svstem						0	(201)
			at from m				•	(202) = 1	- (201) =				1	(202)
				-	. ,				02) × [1 –	(203)] =				(204)
			ng from a ace heat	-				(204) - (2	02) X [1	(200)] =			93.4	(206)
	•	-				a ovetom	. 0/							╣ .
EIIICIE			ry/suppl			-		ī				1	0	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ar
Space		<u> </u>	ement (c					<u> </u>		101.00		100.10	1	
	476.24	340.65	253.36	115.85	36.51	0	0	0	0	121.22	310.88	490.12		
(211)m)m x (20	(4)] } x 1	00 ÷ (20	06)	•	•			•			•	(211)
	509.89	364.73	271.26	124.03	39.09	0	0	0	0	129.78	332.85	524.75		_
								Tota	ıl (kWh/yea	ar) =Sum(2	211) _{15,1012}	2=	2296.39	(211)
Space	e heatin	g fuel (s	econdar	y), kWh/	month									
= {[(98)m x (20	1)] } x 1	00 ÷ (20	8)									•	
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		_
								Tota	ıl (kWh/yea	ar) =Sum(2	215) _{15,1012}	2=	0	(215)
Water	heating	ı												_
Output			ter (calc				1				1		1	
	197.36	172.4	179.37	159.09	154.03	135.66	129.97	144.89	146.49	166.81	178.06	192.73		_
Efficier	ncy of w	ater hea	ıter										80.3	(216)
(217)m=	87.19	86.73	85.92	84.27	82.06	80.3	80.3	80.3	80.3	84.26	86.44	87.3		(217)
		•	kWh/mo											
. ,) ÷ (217)					l					ı	
(219) m =	226.36	198.77	208.76	188.8	187.71	168.94	161.86	180.44	182.43	197.96	206	220.76		٦
_								I ota	I = Sum(21				2328.79	(219)
	I totals	fuol ···s :	ad masi	overte re-	4					k\	Wh/year	r 	kWh/year	7
space	neaung	iuei use	ed, main	system	I								2296.39	J

				_
Water heating fuel used			2328.79	
Electricity for pumps, fans and electric keep-hot				
central heating pump:			30	(230c)
boiler with a fan-assisted flue			45	(230e)
Total electricity for the above, kWh/year	sum of (230a	a)(230g) =	75	(231)
Electricity for lighting			331.6	(232)
Total delivered energy for all uses (211)(221) +	(231) + (232)(237b) =		5031.79	(338)
12a. CO2 emissions – Individual heating systems	s including micro-CHP			
	Enorgy	Emississ factor	Emissions	
	Energy kWh/year	Emission factor kg CO2/kWh	kg CO2/yea	
Space heating (main system 1)	3		kg CO2/yea	
Space heating (main system 1) Space heating (secondary)	kWh/year	kg CO2/kWh	kg CO2/yea	ar
	kWh/year	kg CO2/kWh	kg CO2/yea	ar](261)
Space heating (secondary)	kWh/year (211) x (215) x	kg CO2/kWh 0.216 = 0.519 =	kg CO2/yea	(261) (263)
Space heating (secondary) Water heating	kWh/year (211) x (215) x (219) x	kg CO2/kWh 0.216 = 0.519 =	kg CO2/yea 496.02 0 503.02	(261) (263) (264)
Space heating (secondary) Water heating Space and water heating	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (264) =	kg CO2/kWh 0.216 = 0.519 = 0.216 =	kg CO2/yea 496.02 0 503.02 999.04 38.93	(261) (263) (264) (265)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-hot	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (264) = (231) x (232) x	kg CO2/kWh 0.216 = 0.519 = 0.519 =	kg CO2/yea 496.02 0 503.02 999.04 38.93	(261) (263) (264) (265) (267)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-hot Electricity for lighting	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (264) = (231) x (232) x	kg CO2/kWh 0.216 = 0.519 = 0.519 = 0.519 =	kg CO2/yea 496.02 0 503.02 999.04 38.93 172.1	(261) (263) (264) (265) (267) (268)

TER =

(273)

16.23

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 11:01:04

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:** Flat

Dwelling Details:

Site Reference:

NEW DWELLING DESIGN STAGE

Total Floor Area: 92.44m² 231 Watford Road - BASE **Plot Reference:** Sample 6

Address:

Client Details:

Name:

Address:

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas

Fuel factor: 1.00 (mains gas)

17.63 kg/m² Target Carbon Dioxide Emission Rate (TER)

Dwelling Carbon Dioxide Emission Rate (DER) 16.80 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 49.2 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 39.2 kWh/m²

OK

2 Fabric U-values

Element Average Highest External wall 0.15 (max. 0.30) 0.16 (max. 0.70) OK Party wall 0.00 (max. 0.20) **OK**

Floor (no floor) Roof (no roof)

Openings 1.10 (max. 2.00) OK 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 5.00 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas

Data from manufacturer

Combi boiler

Efficiency 89.5 % SEDBUK2009

Minimum 88.0 %

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

OK

6 Controls

Space heating controls TTZC by plumbing and electrical services

Hot water controls: No cylinder thermostat

No cylinder

Boiler interlock: Yes OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings 100.0%

Minimum 75.0% **OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames valley): Not significant

Based on:

Overshading: Average or unknown

Windows facing: North East
Windows facing: North West
Ventilation rate:

3.85m²
5.11m²
6.00

10 Key features

Windows U-value 1.1 W/m²K
Party Walls U-value 0 W/m²K

OK

OK

		Hearl	Details:								
Access Name	NoiLlagham	USELI		- Muses	hau.		CTDO	010042			
Assessor Name: Software Name:	Neil Ingham Stroma FSAP 2012		Stroma Softwa					010943 n: 1.0.5.41			
		Property	Address:								
Address :											
1. Overall dwelling dime	ensions:										
Ground floor			ea(m²) 92.44	(1a) x		ight(m) 75	(2a) =	Volume(m ³	(3a)		
	a) ((1b) ((1a) ((1d) ((1a) (75	[(Σα) -	234.21	(34)		
Total floor area TFA = (1	a)+(10)+(10)+(10)+(10)+	(111)	92.44	(4)) . (2-) . (2-	4) . (2 -) .	(0-)		_		
Dwelling volume				(3a)+(3b))+(3C)+(3C	d)+(3e)+	.(3n) =	254.21	(5)		
2. Ventilation rate:	main seco	ondary	other		total			m³ per hou	r		
Number of chimneys	heating hea	ting		1 = [40 =		_		
Number of chimneys		<u> </u>	0]	0		20 =	0	(6a)		
Number of open flues		0 +	0	」 ⁻ └	0			0	(6b)		
Number of intermittent fa				L	3		10 =	30	(7a)		
Number of passive vents				L	0		10 =	0	(7b)		
Number of flueless gas fires $0 x 40 = 0 (7c)$											
							Air ch	anges per ho	our		
Infiltration due to chimne	ys, flues and fans = (6a)+	(6b)+(7a)+(7b)+	·(7c) =	Г	30		÷ (5) =	0.12	(8)		
If a pressurisation test has b	een carried out or is intended,	proceed to (17),	otherwise c	ontinue fr			` ′		`` <i>`</i>		
Number of storeys in the	ne dwelling (ns)							0	(9)		
Additional infiltration	.25 for steel or timber fra	ma or 0 35 fa	or maconr	v conetr	uction	[(9)	-1]x0.1 =	0	(10)		
	resent, use the value correspor			•	uction			0	(11)		
deducting areas of openin	• / .	\	I\ -I				ı		_		
If suspended wooden to the sus	floor, enter 0.2 (unsealed) or 0.1 (seal	ea), eise	enter U				0	(12)		
• •	s and doors draught strip	ned						0	(13)		
Window infiltration	s and doors draught strip	pou	0.25 - [0.2	x (14) ÷ 1	00] =			0	(15)		
Infiltration rate			(8) + (10) -	+ (11) + (1	2) + (13)	+ (15) =		0	(16)		
Air permeability value,	q50, expressed in cubic	metres per h	our per so	quare m	etre of e	envelope	area	5	(17)		
If based on air permeabil	ity value, then (18) = [(17) -	÷ 20]+(8), otherv	vise (18) = (16)				0.37	(18)		
	es if a pressurisation test has be	een done or a de	egree air pei	meability	is being u	sed					
Number of sides sheltere	ed		(20) – 1	0 075 v /4	10)1 —			0	(19)		
Shelter factor	ing chalter factor		(20) = 1 - [(21) = (18)		9)] =			1	(20)		
Infiltration rate incorporat Infiltration rate modified f	-		(21) = (10)	X (20) -				0.37	(21)		
Jan Feb		Jun Jul	Aug	Sep	Oct	Nov	Dec				
Monthly average wind sp		our our	//ug	ОСР	1 000	1 1404	_ D00				
(22)m= 5.1 5		3.8 3.8	3.7	4	4.3	4.5	4.7				
`		1	1		<u> </u>	<u> </u>		I			
Wind Factor $(22a)m = (22a)m $		0.05 0.05		ı.		1 , , -	4.6				
(22a)m= 1.27 1.25	1.23 1.1 1.08	0.95	0.92	1	1.08	1.12	1.18				

Adjusted infiltr	ation rat	e (allowi	ng for st	nelter an	ıd wind s	speed) =	(21a) x	(22a)m					
0.47	0.46	0.45	0.4	0.4	0.35	0.35	0.34	0.37	0.4	0.41	0.43		
Calculate effe		_	rate for t	he appli	cable ca	se	•					<u>.</u>	
If mechanicate If exhaust air h			andiv N. (S	13h) - (23c	a) v Emy (e	auation (N	VSV) other	nvice (23h	n) = (23a)			0	(23a
If balanced with		0		, ,	,	. `	,, .	,) = (23a)			0	(23b
		•	•	· ·		`	•	•	Ola)	(00L) F	4 (00)	0	(230
a) If balance	ea mecha 0	anicai ve	entilation 0	with nea	at recove		1R) (24a	0 = (22)	2b)m + (. 0	23b) × [1	1 – (23c) 1 0	i ÷ 100j 1	(24a
												j	(270
b) If balance (24b)m= 0	ea mecha 0	anicai ve	entilation 0	without	neat rec	overy (N	0 (24b	0 m = (22)	26)m + (2 0	23b) ₀	0	1	(24)
]	(24)
c) If whole h		(23b), t		•	•				.5 × (23t	p)		-	
(24c)m= 0	0	0	0	0	0	0	0	0	0	0	0		(240
d) If natural if (22b)r		on or who		•	•				0.5]				
(24d)m= 0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59]	(240
Effective air	change	rate - er	nter (24a) or (24k	o) or (24	c) or (24	d) in box	(25)		-	-	•	
(25)m= 0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59]	(25)
3. Heat losse	s and he	at loss r	narameti	≏r·									
ELEMENT	Gros area	SS	Openin m	ıgs	Net Ar A ,r		U-valı W/m2		A X U (W/I		k-value kJ/m²-l		A X k kJ/K
Nindows Type		()			3.85		/[1/(1.4)+	0.04] =	5.1	$\stackrel{\prime}{\Box}$			(27)
Vindows Type					5.11		/[1/(1.4)+	0.04] =	6.77	=			(27)
Nalls Type1	35.2	28	8.96		26.32	_	0.18		4.74	╡ ┌			(29)
Walls Type2	82.4		0.50	=	82.44	=	0.18	=	14.84	륵 ¦		╡	(29)
Total area of e					117.7	=	0.10		14.04				(31)
Party wall	nomonio	,				=				— г			(31)
Party floor					15.98		0		0			╡	
•					92.44	=				L		┥	(328
Party ceiling					92.44	_				Ĺ		╡╠	(32)
nternal wall **					154.4			/F/4/11	1004	. L			(320
for windows and * include the area						atea using	i tormuia 1.	/[(1/U-vail	ie)+0.04] a	is given in	paragrapr	1 3.2	
abric heat los	ss, W/K :	= S (A x	U)	·			(26)(30)	+ (32) =				31.46	(33)
leat capacity	Cm = S((Axk)						((28)	(30) + (32	2) + (32a).	(32e) =	15105.4	16 (34)
Thermal mass	parame	ter (TMF	o = Cm -	- TFA) ir	n kJ/m²K			Indica	tive Value	: Medium		250	(35)
For design assess can be used inste				constructi	ion are not	t known pr	ecisely the	indicative	values of	TMP in Ta	able 1f		
hermal bridge	es : S (L	x Y) cal	culated (using Ap	pendix ł	<						9.02	(36)
details of thermatoric he		are not kn	own (36) =	= 0.05 x (3	11)			(33) +	· (36) =			40.48	(37)
entilation hea	at loss ca	alculated	d monthly	y				(38)m	= 0.33 × ((25)m x (5))		
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec]	
38)m= 51.18	50.82	50.47	48.82	48.51	47.07	47.07	46.81	47.63	48.51	49.13	49.79	1	(38)
	coefficier	nt. W/K				•	•	(39)m	= (37) + (37)	38)m	•		
teat transfer (V - / **	. , , (
Heat transfer (39)m= 91.66	91.3	90.95	89.3	88.99	87.55	87.55	87.28	88.1	88.99	89.61	90.27]	

Heat loss para	meter (H	HLP), W/	m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 0.99	0.99	0.98	0.97	0.96	0.95	0.95	0.94	0.95	0.96	0.97	0.98		
Number of day	re in mo	oth (Tabl	0 10)					,	Average =	Sum(40) _{1.}	12 /12=	0.97	(40)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m= 31	28	31	30	31	30	31	31	30	31	30	31		(41)
									-				
4. Water heat	ing ene	rgy requi	rement:								kWh/ye	ar:	
Assumed occu if TFA > 13.9 if TFA £ 13.9	0, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9))2)] + 0.0	0013 x (⁻	ΓFA -13		66		(42)
Annual averag Reduce the annua not more that 125	l average	hot water	usage by	5% if the a	welling is	designed t			se target c		.32		(43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in	n litres per	day for ea	ch month	Vd,m = fa	ctor from T	Table 1c x	(43)			•			
(44)m= 107.05	103.16	99.27	95.37	91.48	87.59	87.59	91.48	95.37	99.27	103.16	107.05		_
Energy content of	hot water	used - calo	culated mo	onthly = 4 .	190 x Vd,r	n x nm x D	OTm / 3600			ım(44) ₁₁₂ = ables 1b, 1	L	1167.84	(44)
(45)m= 158.75	138.85	143.28	124.91	119.86	103.43	95.84	109.98	111.29	129.7	141.58	153.75		
` /								_	L Total = Su	I ım(45) ₁₁₂ =		1531.22	(45)
If instantaneous w	ater heati	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46,) to (61)					
(46)m= 23.81	20.83	21.49	18.74	17.98	15.51	14.38	16.5	16.69	19.46	21.24	23.06		(46)
Water storage Storage volum		includin	a anv so	olar or W	/WHRS	storage	within sa	ame ves	sel		0		(47)
If community h	, ,		•			_					<u> </u>		()
Otherwise if no		hot wate	er (this in	icludes i	nstantar	eous co	mbi boil	ers) ente	er '0' in ((47)			
Water storage		ا امسمام	ft-	معامات	/1.\\/h	/da./\							(40)
a) If manufact				or is kno	wn (Kvvr	i/day):					0		(48)
Temperature fa Energy lost fro				oor			(48) x (49)	١ _			0		(49)
b) If manufact		_	-		or is not		(40) X (49)	, =			0		(50)
Hot water stora	age loss	factor fr	om Tabl								0		(51)
If community h	_		on 4.3										
Volume factor Temperature fa			2h							_	0		(52)
·							(47) v (E4)	\ v (EQ) v (I	E0)		0		(53)
Energy lost fro Enter (50) or (•	, KVVII/y€	ai			(47) x (51)) X (32) X (55) =		0		(54) (55)
Water storage	, ,	,	or each	month			((56)m = (55) × (41)ı	m		0		(00)
(56)m= 0	0	0	0	0	0	0	0	0	0	0	0		(56)
If cylinder contains		-	-	-			-	_	_		_	x H	(00)
(57)m= 0	0	0	0	0	0	0	0	0	0	0	0		(57)
Primary circuit	loss (ar	nual) fro	m Table	· 3					•		0		(58)
Primary circuit	•	•			59)m = ((58) ÷ 36	65 × (41)	m					
(modified by	factor f	rom Tabl	e H5 if t	here is s	olar wat	er heatir	ng and a	cylinde	r thermo	stat)			
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

Combi loss calcula			ì	`	- ` ` `				1		1	
(61)m= 50.96 46.		47.03	46.62	43.19	44.63	46.62		50.58	49.32	50.96]	(61)
Total heat required					h month	(62)m	$= 0.85 \times ($	(45)m +	` ´ 	(57)m +	(59)m + (61)m	
(62)m= 209.71 184	87 193.86	171.95	166.47	146.62	140.47	156.6	158.33	180.29	190.89	204.7		(62)
Solar DHW input calcul								r contribu	tion to wate	er heating)		
(add additional line	s if FGHRS	and/or \	WWHRS	applies	, see Ap	pendix	(G)				1	
(63)m= 0	0	0	0	0	0	0	0	0	0	0]	(63)
Output from water	neater	_									-	
(64)m= 209.71 184	87 193.86	171.95	166.47	146.62	140.47	156.6	158.33	180.29	190.89	204.7		,
						Ot	utput from wa	ater heate	er (annual)	112	2104.78	(64)
Heat gains from wa	ter heating	g, kWh/m	onth 0.2	5 ´ [0.85	× (45)m	+ (61)	m] + 0.8 x	د [(46)m	+ (57)m	+ (59)m	<u>.</u>]	
(65)m= 65.53 57.	60.29	53.29	51.51	45.19	43.03	48.22	48.76	55.77	59.4	63.86		(65)
include (57)m in	calculation	of (65)m	only if c	ylinder i	s in the o	dwellin	g or hot w	ater is f	rom com	munity h	neating	
5. Internal gains	see Table	5 and 5a):									
Metabolic gains (T	able 5). Wa	ıtts										
	eb Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec]	
(66)m= 132.88 132	88 132.88	132.88	132.88	132.88	132.88	132.88	3 132.88	132.88	132.88	132.88	1	(66)
Lighting gains (cald	ulated in A	ppendix	L, equat	ion L9 o	r L9a), a	lso see	Table 5				1	
(67)m= 25.23 22.		13.8	10.31	8.71	9.41	12.23		20.84	24.33	25.93]	(67)
Appliances gains (alculated i	n Appen	dix L. ea	uation L	13 or L1		so see Ta	ble 5	1	!	1	
(68)m= 243.5 246		- 	208.99	192.91	182.16	179.64		199.56	216.67	232.75]	(68)
Cooking gains (cal	culated in A	Appendix	L. eguat	ion L15	or L15a	Lalso:	 see Table	5	Į.	<u>. </u>	ı	
(69)m= 36.29 36.		36.29	36.29	36.29	36.29	36.29		36.29	36.29	36.29	1	(69)
Pumps and fans ga	ins (Tahle					<u> </u>		l	ı		1	
(70)m= 3 3		3	3	3	3	3	3	3	3	3	1	(70)
Losses e.g. evapor			ļ	ļ		L					I	(- /
(71)m= -106.31 -106		1	-106.31	-106.31	-106.31	-106.3	1 -106.31	-106.31	-106.31	-106.31	1	(71)
` '			1-100.51	-100.51	1-100.51	-100.3	1 -100.51	-100.51	-100.51	-100.51	J	(, ,)
Water heating gain (72)m= 88.07 85.		74.02	69.23	62.76	57.83	64.82	67.73	74.96	82.51	85.83	1	(72)
` '		74.02	09.23	l	l	l				<u> </u>	J	(12)
Total internal gair		070.70	1 254.4				n + (69)m + (336.01		389.37		1	(73)
(73)m= 422.66 420	12 404.77	379.78	354.4	330.24	315.27	322.55	336.01	361.23	389.37	410.38		(13)
6. Solar gains: Solar gains are calculated	ted using sol	ar flux from	Table 6a	and assoc	rina hateir	itions to	convert to th	a annlical	hle orientat	tion		
Orientation: Acce	_	Area		Flu		1110113 10	g_	іс арріісаі	FF	uori.	Gains	
Table		m²			ble 6a		Table 6b	Т	able 6c		(W)	
Northeast _{0.9x}).77	3.8	25	x 1	11.28	1 x [0.63	x [0.7		13.28	(75)
).77			-	22.97	」 ^	0.63	^ x	0.7	_	27.02](75)
NI).77			-	41.38	」^∟ 1 × □	0.63	_	0.7		48.69	(75) (75)
						╎├		╡╞		=		_
).77			-	67.96]	0.63		0.7	╡ -	79.96	(75)
Northeast U.9X).77	3.8	35	x (91.35	X	0.63	X	0.7	=	107.48	(75)

r		_			_		,		_				_
Northeast _{0.9x}	0.77	X	3.8	35	X	97.38	X	0.63	X	0.7	=	114.58	(75)
Northeast _{0.9x}	0.77	X	3.8	35	X	91.1	X	0.63	X	0.7	=	107.19	(75)
Northeast _{0.9x}	0.77	X	3.8	35	X	72.63	X	0.63	X	0.7	=	85.45	(75)
Northeast _{0.9x}	0.77	X	3.8	35	х	50.42	X	0.63	X	0.7	=	59.33	(75)
Northeast _{0.9x}	0.77	X	3.8	35	x	28.07	X	0.63	X	0.7	=	33.02	(75)
Northeast _{0.9x}	0.77	X	3.8	35	X	14.2	X	0.63	X	0.7	=	16.7	(75)
Northeast 0.9x	0.77	X	3.8	35	x	9.21	X	0.63	X	0.7	=	10.84	(75)
Northwest 0.9x	0.77	X	5.1	1	x	11.28	X	0.63	X	0.7	=	17.62	(81)
Northwest 0.9x	0.77	x	5.1	1	x	22.97	X	0.63	X	0.7	=	35.87	(81)
Northwest 0.9x	0.77	X	5.1	1	x	41.38	X	0.63	X	0.7	=	64.62	(81)
Northwest 0.9x	0.77	X	5.1	1	x	67.96	X	0.63	X	0.7	=	106.13	(81)
Northwest 0.9x	0.77	X	5.1	1	x	91.35	X	0.63	X	0.7	=	142.65	(81)
Northwest 0.9x	0.77	x	5.1	1	x	97.38	X	0.63	x	0.7	=	152.08	(81)
Northwest _{0.9x}	0.77	X	5.1	1	X	91.1	X	0.63	x	0.7	=	142.27	(81)
Northwest _{0.9x}	0.77	X	5.1	1	x	72.63	X	0.63	X	0.7	=	113.42	(81)
Northwest _{0.9x}	0.77	X	5.1	1	x	50.42	X	0.63	x	0.7	=	78.74	(81)
Northwest _{0.9x}	0.77	×	5.1	1	x	28.07	X	0.63	x	0.7		43.83	(81)
Northwest _{0.9x}	0.77	×	5.1	1	x	14.2	X	0.63	x	0.7		22.17	(81)
Northwest _{0.9x}	0.77	X	5.1	1	х	9.21	X	0.63	x	0.7	=	14.39	(81)
Solar gains in	watts, calcu	ulated	for eac	h month			(83)m	ı = Sum(74)m .	(82)m			,	
(83)m= 30.9		13.31	186.08	250.13	266.6		198	.87 138.07	76.86	38.88	25.23		(83)
Total gains – i			. ,		<u>`</u>						•	1	
(84)m= 453.56	483.01 51	8.08	565.86	604.53	596.9	564.73	521	.42 474.08	438.08	3 428.24	435.61		(84)
7. Mean inter	nal tempera	ature	(heating	season)								
Temperature	during hear	ting p	eriods ir	the livi	ng area	a from Tal	ble 9	, Th1 (°C)				21	(85)
Utilisation fac	tor for gain	s for I	iving are	ea, h1,m	(see	able 9a)				_	,	•	
Jan	Feb	Mar	Apr	May	Jun	Jul	А	ug Sep	Oct	Nov	Dec		
(86)m= 1	1	1	0.99	0.95	0.83	0.66	0.7	2 0.94	0.99	1	1		(86)
Mean_interna	l temperatu	re in l	iving are	ea T1 (fo	ollow s	teps 3 to 7	7 in T	able 9c)				_	
(87)m= 19.87	19.97 2	0.16	20.45	20.73	20.93	20.99	20.	98 20.83	20.48	20.14	19.87		(87)
Temperature	during hear	ting p	eriods ir	rest of	dwellir	ng from Ta	able 9	9, Th2 (°C)					
(88)m= 20.09	20.09 2	20.1	20.11	20.11	20.13	20.13	20.	13 20.12	20.11	20.11	20.1		(88)
Utilisation fac	ctor for gain:	s for r	est of d	welling.	h2.m (see Table	. 9a)	•	•	•	•	•	
(89)m= 1	1	1	0.98	0.93	0.75	0.54	0.6	0.9	0.99	1	1]	(89)
Mean interna	l tomporatu	ro in i	the rest	of dwall	ina T2	/follow.st/	nc 2	to 7 in Tabl	lo ()c)	_!		ı	
(90)m= 18.57	 	8.99	19.43	19.82	20.07	`	20.		19.48	18.97	18.57]	(90)
(00)	'•'' ''		. 5. 70	1 .0.02	1	20.12	1			ving area ÷ (0.3	(91)
		,,			\	:	,,			- (*	L	
Mean interna (92)m= 18.96	 	`				1	`		10.70	10.22	10.00	1	(02)
(92)m= 18.96 Apply adjustr		9.34 moon	19.74	20.1	20.33		20.		19.78		18.96		(92)
ADDIV AUIUSII	HELL TO THE	mean	miremal	remper	atule l	וטווו ו מטופ	, 4 0,	where appro	philaie				

_							.						ı	
` ′	8.96	19.08	19.34	19.74	20.1	20.33	20.38	20.38	20.22	19.78	19.32	18.96		(93)
8. Space														
Set Ti to the utilisa				•		ed at ste	ep 11 of	Table 9	b, so tha	t Ti,m=(76)m an	d re-calc	culate	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
ک Utilisatio					iviay	Odii	<u> </u>	_ / tug	СОР	001	1101	200		
(94)m=	1	1	0.99	0.98	0.93	0.77	0.58	0.64	0.9	0.99	1	1		(94)
Useful g	ains, h	mGm ,	W = (94)	4)m x (84	4)m	<u> </u>	ļ						l	
(95)m= 45	52.92	481.9	515.28	555.07	560.41	460.5	324.96	335.82	428.15	432.56	427.09	435.13		(95)
Monthly	avera	ge exte	rnal tem	perature	from Ta	able 8								
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat los	s rate	for mea	an intern	al tempe	erature,	Lm , W =	=[(39)m :	x [(93)m	– (96)m]				
(97)m= 13					747.31	501.72	331.01	346.98	539.27	816.91		1331.99		(97)
Space h						Wh/mon	th = 0.02	24 x [(97)m – (95		r e		ı	
(98)m= 66	62.68	546.42	485.58	296.97	139.05	0	0	0	0	285.96	481.17	667.26		,
								Tota	l per year	(kWh/year	r) = Sum(9	8) _{15,912} =	3565.09	(98)
Space h	eating	require	ement in	kWh/m²	?/year								38.57	(99)
9a. Energ	y requ	ıiremen	nts – Indi	vidual h	eating sy	ystems i	ncluding	micro-C	CHP)					-
Space h	eating	g:					J							
Fraction	of spa	ice hea	t from s	econdar	y/supple	mentary	system						0	(201)
Fraction	of spa	ce hea	it from m	nain syst	em(s)			(202) = 1	- (201) =				1	(202)
Fraction	of tota	al heatir	ng from	main sys	stem 1			(204) = (2	02) x [1 –	(203)] =			1	(204)
Efficienc	y of m	ain spa	ace heat	ing syste	em 1								93.4	(206)
Efficienc	•	•				a system	າ, %						0	(208)
Γ.	Jan T	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ır L
Space h				•					Сор		1.01	200	1000	•
	Ť	546.42	485.58	296.97	139.05	0	0	0	0	285.96	481.17	667.26		
(211)m =	(98)1}	n x (20	4)1 } x 1	00 ÷ (20)6)			ı			ı		l	(211)
· / —	''' 	585.03	519.89	317.96	148.87	0	0	0	0	306.16	515.17	714.41		,
								Tota	ı ıl (kWh/yea	ar) =Sum(2	1 211) _{15,1012}		3817.01	(211)
Space h	eating	fuel (se	econdar	v). kWh/	month									J
= {[(98)m	-	•		• •										
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
	·							Tota	l (kWh/yea	ar) =Sum(2	215),,,,5,10,12	F	0	(215)
Water he	ating													_
Output fro	om wa	ter hea	ter (calc		bove)		•						ı	
		184.87	193.86	171.95	166.47	146.62	140.47	156.6	158.33	180.29	190.89	204.7		_
Efficiency	of wa	ter hea	ter				•						80.3	(216)
(217)m= 8	7.75	87.61	87.27	86.41	84.6	80.3	80.3	80.3	80.3	86.21	87.28	87.81		(217)
Fuel for w		•												
(219)m = $(219)m = $ $(219$		1 X 100 211.01	222.15	m 198.98	196.77	182.59	174.94	195.01	197.17	209.13	218.71	233.13		
(= : 0)				. 55.55		1 . 52.00	Lo-		I = Sum(2:		L		2478.59	(219)
Annual to	otale								,-		Wh/year		kWh/year	رد، ع)
Space he		uel use	ed, main	system	1					r.	y cai		3817.01	1
	-												l	J

					٦
Water heating fuel used				2478.59	
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				445.58	(232)
Total delivered energy for all uses (211)(221) +	6816.18	(338)			
12a. CO2 emissions – Individual heating systems	s including micro-CHP				
	Energy	Emission fa	ctor	Emissions	
	kWh/year	kg CO2/kWh		kg CO2/yea	ar
Space heating (main system 1)	kWh/year (211) x	kg CO2/kWh	=	kg CO2/yea	ar](261)
Space heating (main system 1) Space heating (secondary)	·				_
	(211) x	0.216	=	824.47	(261)
Space heating (secondary)	(211) x (215) x	0.216	=	824.47	(261)
Space heating (secondary) Water heating	(211) x (215) x (219) x	0.216	=	824.47 0 535.38	(261) (263) (264)
Space heating (secondary) Water heating Space and water heating	(211) x (215) x (219) x (261) + (262) + (263) + (264) =	0.216 0.519 0.216	= = =	824.47 0 535.38 1359.85	(261) (263) (264) (265)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-hot	(211) x (215) x (219) x (261) + (262) + (263) + (264) = (231) x (232) x	0.216 0.519 0.216	= = =	824.47 0 535.38 1359.85 38.93	(261) (263) (264) (265) (267)

TER =

(273)

17.63

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 11:01:03

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 52.98m²

Site Reference: 231 Watford Road - BASE **Plot Reference:** Sample 7

Address:

Client Details:

Name: Address:

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas

Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 17.47 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 17.07 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 35.9 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 29.5 kWh/m²

OK

2 Fabric U-values

Element Average Highest External wall 0.15 (max. 0.30) 0.16 (max. 0.70) OK Party wall 0.00 (max. 0.20) **OK**

Floor (no floor) Roof (no roof)

Openings 1.10 (max. 2.00) OK 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 5.00 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas

Data from manufacturer

Combi boiler

Efficiency 89.5 % SEDBUK2009

Minimum 88.0 %

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

OK

6 Controls			
Space heating controls	TTZC by plumbing an		ок
Hot water controls:	No cylinder thermosta No cylinder	at .	
Boiler interlock:	Yes		OK
7 Low energy lights			
Percentage of fixed lights with lo	ow-energy fittings	100.0%	
Minimum		75.0%	OK
8 Mechanical ventilation			
Not applicable			
9 Summertime temperature			
Overheating risk (Thames valled	y):	Slight	ОК
Based on:	,	· ·	
Overshading:		Average or unknown	
Windows facing: South East		6.39m²	
Ventilation rate:		6.00	
10 Key features			

1.1 W/m²K

 $0 \text{ W/m}^2\text{K}$

Windows U-value Party Walls U-value

		l lser I	Details:						
Assessor Name: Software Name:	Neil Ingham Stroma FSAP 2012		Strom Softwa	are Vei	rsion:			010943 on: 1.0.5.41	
Address :	F	Property	Address	Sample	e 7				
1. Overall dwelling dime	nsions:								
		Are	a(m²)		Av. He	ight(m)	_	Volume(m	3)
Ground floor			52.98	(1a) x	2	.75	(2a) =	145.69	(3a)
Total floor area TFA = (1a	a)+(1b)+(1c)+(1d)+(1e)+(1	n) [52.98	(4)					
Dwelling volume				(3a)+(3b)+(3c)+(3c	d)+(3e)+	.(3n) =	145.69	(5)
2. Ventilation rate:									
	main seconda heating heating	ry	other		total			m³ per hou	ır
Number of chimneys	0 + 0	_ + _	0] = [0	X 4	40 =	0	(6a)
Number of open flues	0 + 0	_ + [0] = [0	x 2	20 =	0	(6b)
Number of intermittent fa	ns			Ī	2	x ′	10 =	20	(7a)
Number of passive vents				Ē	0	x ′	10 =	0	(7b)
Number of flueless gas fi	res			Ė	0	X 4	40 =	0	(7c)
				_					
							Air ch	nanges per ho	our
•	ys, flues and fans = $(6a)+(6b)+(6b)+(6a)+(6b)+(6a)+(6b)+(6a)+(6a)+(6a)+(6a)+(6b)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a$				20		÷ (5) =	0.14	(8)
Number of storeys in the	een carried out or is intended, procee ne dwelling (ns)	ea to (17),	otnerwise (continue ir	om (9) to	(16)		0	(9)
Additional infiltration	g ()					[(9)-	-1]x0.1 =	0	(10)
Structural infiltration: 0.	.25 for steel or timber frame o	r 0.35 fo	r masoni	y constr	uction			0	(11)
if both types of wall are prededucting areas of openir	resent, use the value corresponding t	o the grea	ter wall are	a (after					
,	loor, enter 0.2 (unsealed) or 0	.1 (seal	ed), else	enter 0				0	(12)
If no draught lobby, ent	ter 0.05, else enter 0							0	(13)
Percentage of windows	s and doors draught stripped							0	(14)
Window infiltration			0.25 - [0.2	. ,	-			0	(15)
Infiltration rate			(8) + (10)					0	(16)
•	q50, expressed in cubic metro ity value, then $(18) = [(17) \div 20] + (18)$	•	•	•	etre of e	envelope	area	5	(17)
•	s if a pressurisation test has been do				is being u	sed		0.39	(18)
Number of sides sheltere			,	,	J			0	(19)
Shelter factor			(20) = 1 -	0.075 x (1	19)] =			1	(20)
Infiltration rate incorporat	_		(21) = (18	x (20) =				0.39	(21)
Infiltration rate modified for		1	1		1		1	1	
Jan Feb	Mar Apr May Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	 	1	T		T	T		1	
(22)m= 5.1 5	4.9 4.4 4.3 3.8	3.8	3.7	4	4.3	4.5	4.7		
Wind Factor (22a)m = (22	2)m ÷ 4								
(22a)m= 1.27 1.25	1.23 1.1 1.08 0.95	0.95	0.92	1	1.08	1.12	1.18		

Adjusted infiltr	ation rat	e (allowi	ng for sh	nelter an	d wind s	speed) =	(21a) x	(22a)m					
0.49 Calculate effec	0.48	0.47 Change i	0.43	0.42 he appli	0.37 Cable ca	0.37 Se	0.36	0.39	0.42	0.44	0.46]	
If mechanica		_		по струпп	00.070 00.							0	(23
If exhaust air h	eat pump (using Appe	endix N, (2	3b) = (23a	a) × Fmv (e	equation (N	N5)) , othe	rwise (23b) = (23a)			0	(23
If balanced with	heat reco	overy: effic	iency in %	allowing f	or in-use f	actor (fron	n Table 4h) =				0	(23
a) If balance	d mech	anical ve	ntilation	with he	at recove	ery (MVI	HR) (24a	n)m = (22	2b)m + (23b) × [1 – (23c)	÷ 100]	
(24a)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
b) If balance	d mech	anical ve	ntilation	without	heat red	overy (N	ЛV) (24b	m = (22)	2b)m + (23b)			
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
c) If whole h if (22b)n				•					5 × (23b	o)			
(24c)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
d) If natural if (22b)n									0.5]			•	
(24d)m= 0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6]	(24
Effective air	change	rate - er	iter (24a) or (24b	o) or (24	c) or (24	d) in box	(25)		-			
(25)m= 0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6		(25
3. Heat losse	s and he	eat loss r	paramete	er:									
ELEMENT	Gros	•	Openin		Net Ar	ea	U-valı	ле	AXU		k-value	9	ΑΧk
	area	(m²)	· m	2	A ,r	n²	W/m2	K .	(W/I	K)	kJ/m²-l	K	kJ/K
Windows					6.39	х1,	/[1/(1.4)+ 	0.04] =	8.47	╝.			(27
Walls Type1	22.1	7	6.39		15.78	3 X	0.18	=	2.84				(29
Walls Type2	17.2	22	0		17.22	<u>x</u>	0.18	=	3.1				(29
Total area of e	lements	, m²			39.39)							(31
Party wall					46.48	3 X	0	= [0				(32
Party floor					52.98	3							(32
Party ceiling					52.98	3							(32
Internal wall **					97.63	3							(32
* for windows and						ated using	formula 1	/[(1/U-valu	ie)+0.04] a	as given in	paragraph	1 3.2	
** include the area Fabric heat los				is anu pan	uuoris		(26)(30)	+ (32) =				14.4	11 (33
Heat capacity		•	0)				, , , , ,		.(30) + (32	2) + (32a).	(32e) =	8658	
Thermal mass		,	P = Cm ÷	- TFA) ir	n kJ/m²K				tive Value	, , ,	(0=0)	250	
For design assess	•	`		,			ecisely the	indicative	values of	TMP in Ta	able 1f	200	,(00
can be used inste													
Thermal bridge					-	<						5.7	1 (36
if details of therma Total fabric he		are not kn	own (36) =	= 0.05 x (3	1)			(33) +	(36) =			20.1	13 (37
Ventilation hea	at loss ca	alculated	monthly	/				(38)m	= 0.33 × (25)m x (5))	_	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(38)m= 29.9	29.67	29.45	28.4	28.21	27.29	27.29	27.12	27.65	28.21	28.6	29.02		(38
Heat transfer of	coefficier	nt, W/K						(39)m	= (37) + (38)m			
(39)m= 50.03	49.8	49.58	48.53	48.33	47.42	47.42	47.25	47.77	48.33	48.73	49.14		
									Average =	Sum(39) ₁	12 /12=	48.5	53 (39

Heat loss para	meter (ł	HLP), W/	m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 0.94	0.94	0.94	0.92	0.91	0.9	0.9	0.89	0.9	0.91	0.92	0.93		
N			- 4-)						Average =	Sum(40) _{1.}	12 /12=	0.92	(40)
Number of day Jan	Feb	Mar	e Ta) 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 heat	ing ene	rgy requi	rement:								kWh/ye	ear:	
Assumed occu			F4	/ o oooo	.40 (T	- 40.0	\0\1 · 0 (2040 /	TEA 40		78		(42)
if TFA > 13.9 if TFA £ 13.9		+ 1./6 x	[1 - exp	(-0.0003	349 x (11	-A -13.9))2)] + 0.0)013 x (IFA -13	.9)			
Annual averag	e hot wa										.43		(43)
Reduce the annua not more that 125	_				-	•	to achieve	a water us	se target o	of			
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in								ОСР	000	1404	Dec		
(44)m= 84.07	81.01	77.96	74.9	71.84	68.78	68.78	71.84	74.9	77.96	81.01	84.07		
		ļ							Total = Su	ım(44) ₁₁₂ =		917.12	(44)
Energy content of	hot water	used - cal	culated mo	onthly $= 4$.	190 x Vd,r	n x nm x D	Tm / 3600) kWh/mor	nth (see Ta	ables 1b, 1	c, 1d)		
(45)m= 124.67	109.04	112.52	98.1	94.13	81.22	75.27	86.37	87.4	101.86	111.18	120.74		_
If instantaneous w	ater heati	na at noint	of use (no	hot water	· storage)	enter∩in	hoves (46		Total = Su	ım(45) ₁₁₂ =	- L	1202.49	(45)
(46)m= 18.7	16.36	16.88	14.71	14.12	12.18	11.29	12.96	13.11	15.28	16.68	18.11		(46)
Water storage		10.00	14.71	14.12	12.10	11.29	12.90	13.11	13.20	10.00	10.11		(40)
Storage volum	e (litres)) includin	g any so	olar or W	/WHRS	storage	within sa	ame ves	sel		0		(47)
If community h	eating a	and no ta	nk in dw	elling, e	nter 110	litres in	(47)						
Otherwise if no		hot wate	er (this in	icludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in ((47)			
Water storage a) If manufact		eclared l	nss facto	nr is kno	wn (k\/\/h	n/dav).					0		(48)
Temperature fa				JI 10 KI10	WII (ICVVI	i, ady).					0		(49)
Energy lost fro				ear			(48) x (49)) =			0		(50)
b) If manufact		_	-		or is not		() ()				0		(00)
Hot water stora	_			e 2 (kWl	h/litre/da	ıy)					0		(51)
If community h Volume factor	•		on 4.3										(50)
Temperature fa			2b							_	0		(52) (53)
Energy lost fro				ear			(47) x (51)) x (52) x (53) =		0		(54)
Enter (50) or (•	, 1	Jul			() ()	, (, (,	-	0		(55)
Water storage	loss cal	culated f	or 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	dedicate	d solar sto	rage, (57)ı	<u>l</u> m = (56)m	x [(50) – (<u>I</u> H11)] ÷ (5	0), else (5	<u>I</u> 7)m = (56)	m where (L (H11) is fro	m Appendi	хН	
(57)m= 0	0	0	0	0	0	0	0	0	0	0	0		(57)
Primary circuit	loss (ar	nual) fro	m Table	e 3							0		(58)
Primary circuit	•	•			59)m = ((58) ÷ 36	65 × (41)	m					
(modified by	factor f	rom Tabl	e H5 if t	here is s	olar wat	er heatir	ng and a	cylinde	r thermo	stat)			
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

Combi loss calcul			i			- ` ` `	_				1	1	1	(0.1)
` '	7.29 39.7		36.94	36.61	33.92	35.05	36.6			39.73	39.95	42.84	J	(61)
Total heat require		_					`		-		` 	<u>`</u>	(59)m + (61)m	(22)
` '	6.33 152.		135.03	130.74	115.14	110.32	122.9			141.58	151.14	163.58]	(62)
Solar DHW input calc	_								olar c	contribut	ion to wate	er heating)		
(add additional lin		$\overline{}$							_			Ι .	1	(00)
(63)m= 0	0 0		0	0	0	0	0	0		0	0	0	J	(63)
Output from wate						1						l	1	
(64)m= 167.51 14	6.33 152.	24	135.03	130.74	115.14	110.32	122.9			141.58	151.14	163.58	4000.00	1(64)
											r (annual)₁		1660.93	(64)
Heat gains from v		_				1	r		$\overline{}$		1		1] 1	4
(65)m= 52.16 4	5.58 47.3	34	41.85	40.45	35.49	33.79	37.8	7 38.2	9	43.8	46.96	50.86	J	(65)
include (57)m i	n calculation	on of	(65)m	only if c	ylinder	is in the o	dwelli	ng or ho	t wat	ter is fr	om com	munity h	neating	
5. Internal gains	(see Tab	le 5 a	and 5a)	:										
Metabolic gains (Table 5), V	<u>Vatts</u>	S										,	
Jan	Feb Ma	ar	Apr	May	Jun	Jul	Au	g Se	р	Oct	Nov	Dec		
(66)m= 88.9 8	88.9	9	88.9	88.9	88.9	88.9	88.9	88.9	9	88.9	88.9	88.9		(66)
Lighting gains (ca	lculated in	Арр	endix L	_, equat	ion L9 c	r L9a), a	lso se	e Table	5				_	
(67)m= 15.32 1	3.6 11.0)6	8.38	6.26	5.29	5.71	7.42	9.96	6	12.65	14.77	15.74		(67)
Appliances gains	(calculate	d in A	Append	lix L, eq	uation L	.13 or L1	3a), a	lso see	Table	e 5				
(68)m= 154.97 15	66.57 152.	52	143.9	133.01	122.77	115.93	114.3	32 118.3	38	127	137.89	148.13]	(68)
Cooking gains (ca	alculated in	n App	pendix	L, equat	ion L15	or L15a), alsc	see Ta	ble 5	;			-	
(69)m= 31.89 3	1.89 31.8	39	31.89	31.89	31.89	31.89	31.8	9 31.8	9	31.89	31.89	31.89]	(69)
Pumps and fans	gains (Tab	le 5a	 a)					•					•	
(70)m= 3	3 3		3	3	3	3	3	3		3	3	3]	(70)
Losses e.g. evap	oration (ne	gativ	ve value	es) (Tab	le 5)	•	•	'			•	•	•	
(71)m= -71.12 -7	1.12 -71.	12	-71.12	-71.12	-71.12	-71.12	-71.1	2 -71.1	2	-71.12	-71.12	-71.12]	(71)
Water heating gain	ns (Table	<u>_</u>				!							•	
	7.82 63.6	-	58.13	54.37	49.29	45.42	50.9	53.1	9	58.87	65.22	68.35]	(72)
Total internal ga	 ins =	!	!		(66)m + (67)m	1 + (68)	m + (69)m	1 + (70	0)m + (7	1)m + (72))m	J	
	0.67 279.	89	263.07	246.3	230.01	219.73	225.3	32 234.	2	251.2	270.55	284.9	1	(73)
6. Solar gains:														
Solar gains are calcu	ulated using	solar f	flux from	Table 6a	and assoc	ciated equa	itions to	convert t	o the	applicat	ole orientat	tion.		
Orientation: Acc	ess Facto	r	Area		Flu			g_			FF		Gains	
Tab	le 6d		m²		Ta	ble 6a		Table	6b	Т	able 6c		(W)	
Southeast _{0.9x}	0.77	x	6.3	9	X	36.79	x	0.63		х	0.7	=	71.85	(77)
Southeast _{0.9x}	0.77	x	6.3	9	x	62.67	x	0.63		x	0.7	_ =	122.39	(77)
Southeast _{0.9x}	0.77	x	6.3	9	x	85.75	x	0.63		×	0.7	=	167.46	(77)
Southeast _{0.9x}	0.77	x	6.3	9	x 1	06.25	x	0.63		×	0.7	=	207.5	(77)
Southeast _{0.9x}	0.77	x	6.3	9	x 1	19.01	x	0.63		×	0.7	-	232.41	(77)
		-		•									-	-

Southeast _{0.9x}	0.77	X	6.3	9	x	1	18.15	x		0.63	x	0.7	=	230.73	(77)
Southeast _{0.9x}	0.77	Х	6.3	9	x	1	13.91	x		0.63	x	0.7	=	222.45	(77)
Southeast _{0.9x}	0.77	X	6.3	9	x	10	04.39	x		0.63	x	0.7	=	203.86	(77)
Southeast _{0.9x}	0.77	X	6.3	9	x	9	2.85	x		0.63	x	0.7	=	181.33	(77)
Southeast _{0.9x}	0.77	x	6.3	9	x	6	9.27	x		0.63	×	0.7	_ =	135.27	(77)
Southeast _{0.9x}	0.77	Х	6.3	9	x	4	4.07	х		0.63	x	0.7	=	86.06	(77)
Southeast 0.9x	0.77	х	6.3	9	x	3	1.49	x		0.63	_ x [0.7	=	61.49	(77)
_								•			_				_
Solar gains in	watts, ca	alculated	for eacl	n month				(83)m	n = Si	um(74)m .	(82)m				
(83)m= 71.85	122.39	167.46	207.5	232.41	23	30.73	222.45	203	3.86	181.33	135.27	86.06	61.49		(83)
Total gains – i	nternal a	nd solar	(84)m =	(73)m	+ (8	33)m	, watts								
(84)m= 364.92	413.07	447.35	470.56	478.72	46	60.74	442.18	429	9.18	415.53	386.47	356.61	346.39		(84)
7. Mean inter	nal temp	erature	(heating	season)										
Temperature						area f	from Tal	ole 9	, Th	1 (°C)				21	(85)
Utilisation fac	•	•			-					` ,					_
Jan	Feb	Mar	Apr	May	È	Jun	Jul	A	ug	Sep	Oct	Nov	Dec		
(86)m= 1	0.99	0.98	0.93	0.83	(0.64	0.47	0.	.5	0.74	0.94	0.99	1		(86)
Mean interna	l tampar	atura in l	living ar	 22 T1 (f	مالد	w sta	ns 3 to 7	7 in T	Fahla	2 9c)		_	ļ.		
(87)m= 20.13	20.28	20.48	20.73	20.9	_	0.98	21	2		20.96	20.75	20.4	20.11		(87)
` ′	ļ						<u> </u>								` '
Temperature					$\overline{}$			T		· · ·	20.46	20.45	20.14	Ī	(88)
(88)m= 20.13	20.13	20.14	20.15	20.16		0.17	20.17	20.	.17	20.17	20.16	20.15	20.14		(00)
Utilisation fac	,	ains for r		welling,	т —		1	9a)	-					Ī	
(89)m= 0.99	0.99	0.97	0.91	0.78).57	0.38	0.4	41	0.67	0.92	0.99	1		(89)
Mean interna	l temper	ature in	the rest	of dwell	ing	T2 (f	ollow ste	eps 3	3 to 7	7 in Tabl	e 9c)	_			
(90)m= 18.97	19.19	19.48	19.84	20.06	2	0.16	20.17	20.	.17	20.14	19.87	19.38	18.96		(90)
										f	LA = Livi	ng area ÷ (4) =	0.4	(91)
Mean interna	l temper	ature (fo	r the wh	ole dwe	lling	g) = fl	LA × T1	+ (1	– fL	A) × T2					
(92)m= 19.44	19.63	19.89	20.2	20.4	2	0.49	20.51	20.	.51	20.47	20.22	19.79	19.42		(92)
Apply adjustr	nent to t	he mean	internal	temper	atu	re fro	m Table	4e,	whe	re appro	priate	•			
(93)m= 19.44	19.63	19.89	20.2	20.4	2	0.49	20.51	20.	.51	20.47	20.22	19.79	19.42		(93)
8. Space hea	ting requ	uirement													
Set Ti to the					ned	at ste	ep 11 of	Tab	le 9b	o, so tha	t Ti,m=	(76)m an	d re-calc	culate	
the utilisation												1	_	1	
Jan	Feb	Mar	Apr	May		Jun	Jul	A	ug	Sep	Oct	Nov	Dec		
Utilisation fac	0.99	0.97	0.91	0.8		0.6	0.42	0.4	15	0.7	0.92	0.98	0.99		(94)
Useful gains,						0.0	0.42	0.5	+5	0.7	0.92	0.90	0.99		(01)
(95)m= 362.36		432.42	430.5	381.87	27	74.35	184.7	193	3.26	290.84	357.44	351.05	344.53		(95)
Monthly aver											-	1			` '
(96)m= 4.3	4.9	6.5	8.9	11.7		14.6	16.6	16	5.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate	e for mea	an intern	al tempe	erature,	Lm	, W =	=[(39)m	x [(9	3)m-	– (96)m]	1	I	1	
(97)m= 757.47	733.43	663.62	548.28	420.7	_	79.52	185.2	194		304.37	465.2	618.52	748.2		(97)
Space heatin	g require	ement fo	r each n	nonth, k	Wh	/mont	th = 0.02	24 x	[(97)	m – (95)m] x (4	11)m		•	
(98)m= 293.96	219.4	172.01	84.8	28.89		0	0)	0	80.17	192.58	300.33		
														-	

			Tota	l per year	(kWh/yea	r) = Sum (9	8)15,912 =	1372.14	(98)
Space heating requirement in kWh/m²/year	25.9	(99)							
9a. Energy requirements – Individual heating s	systems i	including	micro-C	CHP)					
Space heating:							Г		¬
Fraction of space heat from secondary/supple	ementary	-	(202) = 1 -	(224)			ļ	0	(201)
Fraction of space heat from main system(s)	1	(202)							
Fraction of total heating from main system 1	1	(204)							
Efficiency of main space heating system 1	93.4	(206)							
Efficiency of secondary/supplementary heating	ng systen	n, %	,			,	<u> </u>	0	(208)
Jan Feb Mar Apr May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ar
Space heating requirement (calculated above 293.96 219.4 172.01 84.8 28.89	e) 0	0	0	0	80.17	192.58	300.33		
	1 0		0	U	00.17	192.56	300.33		(044)
$(211) m = \{ [(98) m x (204)] \} x 100 \div (206) $ $314.73 234.9 184.17 90.8 30.93$	0	0	0	0	85.83	206.19	321.55		(211)
00 20 10 00.0 00.00	1 -			l (kWh/yea				1469.1	(211)
Space heating fuel (secondary), kWh/month							L		」 `
$= \{[(98)m \times (201)]\} \times 100 \div (208)$			_		_				
(215)m= 0 0 0 0 0	0	0	0	0	0	0	0		_
			Tota	l (kWh/yea	ar) =Sum(2	215) _{15,1012}	F	0	(215)
Water heating									
Output from water heater (calculated above) 167.51 146.33 152.24 135.03 130.74	115.14	110.32	122.98	124.34	141.58	151.14	163.58		
Efficiency of water heater							<u> </u>	80.3	(216)
(217)m= 86.45 86.07 85.36 83.92 81.96	80.3	80.3	80.3	80.3	83.68	85.66	86.56		(217)
Fuel for water heating, kWh/month	•					!			
(219) m = (64) m x $100 \div (217)$ m (219)m = 193.76 170.01 178.36 160.91 159.52	143.39	137.38	153.15	154.84	169.19	176.43	188.98		
(213)111= 193.76 170.01 170.30 100.91 139.32	143.39	137.36		I = Sum(2:		170.43	100.90	1985.93	(219)
Annual totals				`		Wh/yeaı	·	kWh/yea	
Space heating fuel used, main system 1						,		1469.1	
Water heating fuel used							Ī	1985.93	1
Electricity for pumps, fans and electric keep-ho	ot						L		
central heating pump:							30		(2300
boiler with a fan-assisted flue							45		(230€
Total electricity for the above, kWh/year			sum	of (230a).	(230g) =		4 5[75	(231)
									=
Electricity for lighting	\ . (004\	. (000)	(00 7 1.)				[r	270.51	(232)
Total delivered energy for all uses (211)(221		` ′	` ′				l	3800.53	(338)
12a. CO2 emissions – Individual heating syst	ems incl	uding mi	cro-CHF						
		nergy Vh/year			Emiss kg CO	ion fac 2/kWh	tor	Emissions kg CO2/ye	

Space heating (main system 1)	(211) x	0.216	317.32 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	428.96 (264)
Space and water heating	(261) + (262) + (263) + (264) =		746.29 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	140.39 (268)
Total CO2, kg/year	sum	of (265)(271) =	925.6 (272)

 $TER = 17.47 \tag{273}$

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 11:01:02

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:** Flat

Total Floor Area: 74.55m²

Dwelling Details:

NEW DWELLING DESIGN STAGE

Site Reference: 231 Watford Road - BASE **Plot Reference:** Sample 8

Address:

Client Details:

Name:

Address:

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas

Fuel factor: 1.00 (mains gas)

16.23 kg/m² Target Carbon Dioxide Emission Rate (TER)

Dwelling Carbon Dioxide Emission Rate (DER) 15.76 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 39.5 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 32.4 kWh/m²

OK

2 Fabric U-values

Element Average Highest External wall 0.16 (max. 0.30) 0.16 (max. 0.70) OK Party wall 0.00 (max. 0.20) **OK**

Floor (no floor) Roof (no roof)

Openings 1.10 (max. 2.00) OK 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 5.00 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas

Data from manufacturer

Combi boiler

Efficiency 89.5 % SEDBUK2009

Minimum 88.0 %

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

OK

6 Controls

Space heating controls TTZC by plumbing and electrical services

No cylinder thermostat

No cylinder

Boiler interlock: Yes OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings 100.0%

Minimum 75.0% **OK**

8 Mechanical ventilation

Hot water controls:

Not applicable

9 Summertime temperature

Overheating risk (Thames valley): Slight

Based on:

Overshading: Average or unknown

Windows facing: South East 12.79m² Windows facing: South 1.28m² Ventilation rate: 6.00

10 Key features

Windows U-value 1.1 W/m²K
Party Walls U-value 0 W/m²K

OK

OK

		l Iser I	Details:						
Assessor Name: Software Name:	Neil Ingham Stroma FSAP 2012		Strom Softwa	are Ve		0010943 on: 1.0.5.41			
Address :	F	Property	Address	: Sample	e 8				
1. Overall dwelling dime	ensions:								
		Are	a(m²)		Av. He	ight(m)	_	Volume(m	3)
Ground floor		-	74.55	(1a) x	2	2.75	(2a) =	205.01	(3a)
Total floor area TFA = (1	a)+(1b)+(1c)+(1d)+(1e)+(1	n)	74.55	(4)					
Dwelling volume				(3a)+(3b)+(3c)+(3c	d)+(3e)+	.(3n) =	205.01	(5)
2. Ventilation rate:									
	main seconda heating heating	ry	other		total			m³ per hou	ır
Number of chimneys	0 + 0	+ [0	=	0	X 4	40 =	0	(6a)
Number of open flues	0 + 0	+ [0	= [0	x 2	20 =	0	(6b)
Number of intermittent fa	ins				3	x ′	10 =	30	(7a)
Number of passive vents	;			Ē	0	x '	10 =	0	(7b)
Number of flueless gas fi	ires				0	X 4	40 =	0	(7c)
				<u>L</u>					
				_			Air ch	nanges per he	our
	ys, flues and fans = $(6a)+(6b)+(6b)+(6a)+(6b)+(6a)+(6b)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a$				30		÷ (5) =	0.15	(8)
Number of storeys in the	peen carried out or is intended, proced he dwelling (ns)	ea to (17),	otnerwise (continue ti	om (9) to	(16)		0	(9)
Additional infiltration	ino arronning (ino)					[(9)-	-1]x0.1 =	0	(10)
Structural infiltration: 0	.25 for steel or timber frame o	r 0.35 fo	r masoni	ry consti	ruction			0	(11)
if both types of wall are p deducting areas of openi	resent, use the value corresponding t	o the grea	ter wall are	ea (after					
,	floor, enter 0.2 (unsealed) or (.1 (seale	ed), else	enter 0				0	(12)
If no draught lobby, en	,	`	,,					0	(13)
Percentage of windows	s and doors draught stripped							0	(14)
Window infiltration			0.25 - [0.2	2 x (14) ÷ 1	100] =			0	(15)
Infiltration rate			(8) + (10)					0	(16)
•	q50, expressed in cubic metro	•	•	•	etre of e	envelope	area	5	(17)
•	lity value, then $(18) = [(17) \div 20] +$ es if a pressurisation test has been do				is boing u	sod		0.4	(18)
Number of sides sheltere		ne or a de	gree air pe	ппеаышу	is being u	seu		0	(19)
Shelter factor			(20) = 1 -	[0.075 x (19)] =			1	(20)
Infiltration rate incorporate	ting shelter factor		(21) = (18) x (20) =				0.4	(21)
Infiltration rate modified f	or monthly wind speed							_	
Jan Feb	Mar Apr May Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	peed from Table 7							_	
(22)m= 5.1 5	4.9 4.4 4.3 3.8	3.8	3.7	4	4.3	4.5	4.7		
Wind Factor (22a)m = (2.	2)m ÷ 4								
<u> </u>	1.23 1.1 1.08 0.95	0.95	0.92	1	1.08	1.12	1.18]	
								ı	

<i>'</i>	rate (allow				<u> </u>	<u>` </u>	` 	l		T	1	
0.51 0.5 alculate effective	1 -	0.44	0.43	0.38	0.38	0.37	0.4	0.43	0.45	0.47	J	
If mechanical ver	•	1010 101 1	по арри	oabio oa	00						0	
If exhaust air heat pu	np using App	endix N, (2	(23a) = (23a	a) × Fmv (e	equation (N	N5)) , othe	rwise (23b) = (23a)			0	
If balanced with heat	ecovery: effic	ciency in %	allowing f	or in-use f	actor (fron	n Table 4h) =				0	
a) If balanced me	chanical v	entilation	with he	at recove	ery (MVI	HR) (24a	a)m = (22)	2b)m + (23b) × [1 – (23c)	÷ 100]	
ea)m= 0 0	0	0	0	0	0	0	0	0	0	0		
b) If balanced me	chanical v	entilation	without	heat rec	overy (N	ЛV) (24b)m = (22	2b)m + (2	23b)		_	
b)m= 0 0	0	0	0	0	0	0	0	0	0	0]	
c) If whole house if (22b)m < 0			•	•				.5 × (23b	o)			
c)m= 0 0	0	0	0	0	0	0	0	0	0	0]	
d) If natural venti if (22b)m = 1			•					0.5]				
d)m= 0.63 0.6	2 0.62	0.6	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61		
Effective air char	ge rate - e	nter (24a) or (24b	o) or (24	c) or (24	d) in box	(25)				-	
)m= 0.63 0.6	0.62	0.6	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61		
. Heat losses and	heat loss	paramet	er:									
	ross ea (m²)	Openin m		Net Ar A ,r		U-valı W/m2		A X U (W/I	K)	k-value kJ/m²-		A X kJ/k
ndows Type 1				12.79	x1.	/[1/(1.4)+	0.04] =	16.96				
ndows Type 2				1.28	x1.	/[1/(1.4)+	0.04] =	1.7				
alls Type1	11.85	14.0	7	27.78	x	0.18	=	5				
alls Type2	24.37	0		24.37	, x	0.18	<u> </u>	4.39	$\overline{}$		$\overline{}$	
tal area of eleme	nts, m²			66.22	2							
rty wall				41.82	<u>x</u>	0	=	0				
rty floor				74.55	5						=	
rty ceiling				74.55	<u></u>				Ī		7 7	
ernal wall **				131.1	2				Ī		Ħ F	
or windows and roof v					ated using	ı formula 1	/[(1/U-valu	ıe)+0.04] a	as given in	paragraph	n 3.2	
bric heat loss, W	'K = S (A x)	: U)				(26)(30)) + (32) =				28.	04
at capacity Cm =	S(Axk)						((28).	(30) + (32	2) + (32a).	(32e) =	1140	9.48
ermal mass para	meter (TM	P = Cm -	: TFA) ir	n kJ/m²K			Indica	tive Value	: Medium		25	0
design assessments be used instead of a			construct	ion are not	t known pr	ecisely the	e indicative	e values of	TMP in Ta	able 1f		
ermal bridges : S	, ,			•	<						7.7	6
etails of thermal bridg tal fabric heat los	_	nown (36) =	= 0.05 x (3	11)			(33) +	(36) =			35	8
ntilation heat los	calculate	d monthly	y				- ` ´	= 0.33 × (25)m x (5)) 	1	
Jan Fe		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
\ 40 40	3 41.8	40.26	39.97	38.62	38.62	38.37	39.14	39.97	40.55	41.16		
)m= 42.46 42.			l						•			
eat transfer coeffi	zient, W/K						(39)m	= (37) + (3	38)m	•		

Heat loss para	meter (l	HLP), W/	m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 1.05	1.05	1.04	1.02	1.02	1	1	0.99	1.01	1.02	1.02	1.03		
.		· · · / - · · · ·	4 \					,	Average =	Sum(40) ₁ .	12 /12=	1.02	(40)
Number of day Jan	s in mo	nth (Tabl	e 1a) Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m= 31	28	31	30	31	30	31	31	30 30	31	30	31		(41)
(41)	20		00	01			01	00			01		(,
4. Water heat	ing ene	rgy requi	rement:								kWh/ye	ear:	
Assumed seem	nanav	NI											(40)
Assumed occu if TFA > 13.9 if TFA £ 13.9	9, N = 1		[1 - exp	(-0.0003	49 x (TF	FA -13.9)2)] + 0.0	0013 x (¯	ΓFA -13		35		(42)
Annual averag											.04		(43)
Reduce the annua not more that 125	_		• .		-	-	o acnieve	a water us	se target d)T			
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in	n litres per	r day for ea	-	Vd,m = fa	ctor from	Table 1c x							
(44)m= 99.05	95.45	91.85	88.24	84.64	81.04	81.04	84.64	88.24	91.85	95.45	99.05		
Energy content of	hot water	used - cal	culated ma	onthly – 1	100 v Vd r	n v nm v F	Tm / 3600			im(44) ₁₁₂ =	L	1080.53	(44)
	128.47	132.57	115.58	110.9	95.7	88.68	101.76	102.97	120	130.99	142.25		
(45)m= 146.89	120.47	132.37	115.56	110.9	95.7	00.00	101.76			im(45) ₁₁₂ =	<u> </u>	1416.75	(45)
If instantaneous w	ater heati	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46		rotar – ou	1111(40)112	L	1410.70	(```
(46)m= 22.03	19.27	19.89	17.34	16.63	14.35	13.3	15.26	15.45	18	19.65	21.34		(46)
Water storage		الماليطانم	a 001/0	olor or M	WHDC	otorogo	within or		001				(47)
Storage volum If community h	` '		•			•		airie ves	9 C I		0		(47)
Otherwise if no	•			•			` '	ers) ente	er '0' in ((47)			
Water storage	loss:									`			
a) If manufact				or is kno	wn (kWh	n/day):					0		(48)
Temperature fa											0		(49)
Energy lost fro b) If manufact		_	-		or ic not		(48) x (49)) =			0		(50)
Hot water stora			-								0		(51)
If community h	•		on 4.3										
Volume factor			01								0		(52)
Temperature fa									,		0		(53)
Energy lost fro Enter (50) or (•	, kWh/ye	ear			(47) x (51)	x (52) x (53) =	-	0		(54) (55)
Water storage		,	or each	month			((56)m = (55) × (41)ı	m		0		(55)
(56)m= 0	0	0	0	0	0	0	0	0	0	Ιο	0		(56)
If cylinder contains	_		-						_		_	хН	(00)
(57)m= 0	0	0	0	0	0	0	0	0	0	0	0		(57)
Primary circuit	loss (ar	nual) fro	m Table	3		•			•		0		(58)
Primary circuit	•	•			59)m = ((58) ÷ 36	55 × (41)	m					
(modified by	factor f	rom Tabl	e H5 if t	here is s	olar wat	ter heatii	ng and a	cylinde	r thermo	stat)			
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

Combi loss calcul					<u> </u>	- ` `		1	ı	1	1	1	(0.1)
` '		5.8	43.52	43.13	39.96	41.3	43.13	<u> </u>	46.8	47.07	50.47		(61)
Total heat require		_				1	`		` 	ì ´	`	(59)m + (61)m	
` '	72.4 179		159.09	154.03	135.66	129.97	144.8		166.81	178.06	192.73		(62)
Solar DHW input calc	_								r contribu	tion to wate	er heating)		
(add additional lin									1	1	1	1	(22)
(63)m= 0)	0	0	0	0	0	0	0	0	0		(63)
Output from wate												1	
(64)m= 197.36 1	72.4 179	9.37	159.09	154.03	135.66	129.97	144.8		166.81	178.06	192.73		٦
							0	utput from w	ater heate	er (annual) ₁	l12	1956.87	(64)
Heat gains from v	ater hea	ting,	kWh/mo	onth 0.2	5 ´ [0.85	× (45)m	+ (61)m] + 0.8 x	([(46)m	+ (57)m	+ (59)m]	
(65)m= 61.46 5	3.7 55.	.78	49.31	47.66	41.81	39.81	44.62	45.12	51.6	55.32	59.92		(65)
include (57)m i	n calculat	ion o	f (65)m	only if c	ylinder i	s in the o	dwellir	g or hot w	ater is f	rom com	munity h	neating	
5. Internal gains	(see Tal	ole 5	and 5a)):									
Metabolic gains (Γable 5),	Watt	S										
		1ar	Apr	May	Jun	Jul	Aug	g Sep	Oct	Nov	Dec		
(66)m= 117.57 11	7.57 117	7.57	117.57	117.57	117.57	117.57	117.5	7 117.57	117.57	117.57	117.57		(66)
Lighting gains (ca	lculated i	n Ap	pendix l	L, equat	ion L9 o	r L9a), a	lso se	e Table 5	ı	•	•	•	
		.56	10.27	7.68	6.48	7	9.1	12.22	15.51	18.1	19.3]	(67)
Appliances gains	(calculate	ed in	Append	dix L. ea	uation L	13 or L1	 3а), al	so see Ta	ble 5	1		ı	
·· — —	9.83 204		192.84	178.25	164.53	155.37	153.2		170.2	184.8	198.51]	(68)
Cooking gains (ca	lculated	in Ar	nendix	l equat	ion I 15	or I 15a\	L also	see Table	5	ļ.		J	
	4.76 34.		34.76	34.76	34.76	34.76	34.76		34.76	34.76	34.76]	(69)
Pumps and fans (L I	 bla 5	<u>a)</u>			1				<u> </u>	<u> </u>	I	, ,
(70)m= 3	<u> </u>	3	3	3	3	3	3	3	3	3	3	1	(70)
Losses e.g. evapo												l	(- /
	4.05 -94	Ť	-94.05	-94.05	-94.05	-94.05	-94.0	5 -94.05	-94.05	-94.05	-94.05	1	(71)
			-94.03	-94.03	-94.03	1 -94.03	-94.0	3 -94.03	-94.03	-94.03	-94.03	I	(11)
Water heating gai	-		00.40	04.05	F0.07	T 50.54	50.0	, , , , , , ,	60.00	70.04	1 00 50	1	(72)
` '	9.91 74.	.97	68.48	64.05	58.07	53.51	59.97		69.36	76.84	80.53	l	(72)
Total internal ga					,	· · · ·		m + (69)m +		•		1	(70)
` '	7.69 354	1.21	332.86	311.25	290.35	277.14	283.5	5 294.79	316.34	341.01	359.62		(73)
6. Solar gains:	ulated wains		flux from	Toble Co.	and accor	iotod ogua	tiona to	convert to th	a annliad	blo orientos	tion		
Solar gains are calcu	•				and assoc Flu	•	ilions to		е аррпса	FF	uon.	Gains	
Orientation: Acc Tab	ess Facic le 6d	ונ	Area m²			ble 6a		g_ Table 6b	Т	able 6c		(W)	
Southeast 0.9x		1	40:	70			1 F					` '	1(77)
<u></u>	0.77	X	12.		-	36.79	X	0.63	X	0.7	=	143.82	(77)
Southeast 0.9x	0.77	X	12.		-	62.67	X	0.63	×	0.7	=	244.98	(77)
Southeast 0.9x	0.77	X	12.			35.75	X	0.63	╣ ^ϫ ╞	0.7	=	335.19	(77)
Southeast 0.9x	0.77	X	12.	==	-	06.25	X	0.63	_ ×	0.7	=	415.32	(77)
Southeast _{0.9x}	0.77	X	12.	79	x 1	19.01	X	0.63	Х	0.7	=	465.19	(77)

		_			_		, ,		_				_
Southeast 0.9x	0.77	X	12.	79	X	118.15	X	0.63	X	0.7	=	461.82	(77)
Southeast _{0.9x}	0.77	X	12.	79	X	113.91	X	0.63	X	0.7	=	445.25	(77)
Southeast 0.9x	0.77	X	12.	79	X	104.39	X	0.63	X	0.7	=	408.04	(77)
Southeast _{0.9x}	0.77	X	12.	79	X	92.85	X	0.63	X	0.7	=	362.94	(77)
Southeast 0.9x	0.77	X	12.	79	X	69.27	x	0.63	X	0.7	=	270.75	(77)
Southeast _{0.9x}	0.77	X	12.	79	X	44.07	x	0.63	X	0.7	=	172.26	(77)
Southeast 0.9x	0.77	X	12.	79	X	31.49	x	0.63	X	0.7	=	123.08	(77)
South 0.9x	0.77	X	1.2	28	x	46.75	X	0.63	X	0.7	=	18.29	(78)
South 0.9x	0.77	X	1.2	28	x	76.57	x	0.63	X	0.7	=	29.95	(78)
South 0.9x	0.77	X	1.2	28	x	97.53	x	0.63	X	0.7	=	38.15	(78)
South 0.9x	0.77	x	1.2	28	x	110.23	x	0.63	X	0.7	=	43.12	(78)
South 0.9x	0.77	x	1.2	28	x	114.87	x	0.63	X	0.7	=	44.94	(78)
South 0.9x	0.77	X	1.2	28	x	110.55	x	0.63	x	0.7	=	43.24	(78)
South 0.9x	0.77	X	1.2	28	x	108.01	x	0.63	x	0.7	=	42.25	(78)
South _{0.9x}	0.77	×	1.2	28	x	104.89	x	0.63	x	0.7	=	41.03	(78)
South _{0.9x}	0.77	×	1.2	28	x	101.89	x	0.63	x	0.7	=	39.86	(78)
South _{0.9x}	0.77	×	1.2	28	x	82.59	x	0.63	x	0.7	_ =	32.31	(78)
South _{0.9x}	0.77	×	1.2	28	x	55.42	x	0.63	x	0.7	=	21.68	(78)
South _{0.9x}	0.77	×	1.2	28	x	40.4	, x	0.63	x	0.7		15.8	(78)
Solar gains in (83)m= 162.11	 	ulated 73.34	for eac 458.44	h month 510.12	505.0	7 487.5	(83)m 449.	= Sum(74)m . .07 402.79	<mark>(82)m</mark> 303.0		138.88	1	(83)
Total gains – i	nternal and	solar	(84)m =	= (73)m	+ (83)r	n , watts			<u> </u>		ļ	J	
(84)m= 532.44	642.62 72	27.55	791.3	821.37	795.4	2 764.64	732.	.63 697.59	619.4	534.95	498.5]	(84)
7. Mean inte	rnal tempera	ature ((heating	season)							•	
Temperature	•		`		′	a from Ta	ble 9.	Th1 (°C)				21	(85)
Utilisation fac	•	•			_		,						`
Jan		Mar	Apr	May	Jur		Aı	ug Sep	Oct	Nov	Dec]	
(86)m= 1	0.99	0.97	0.9	0.78	0.58	0.43	0.4		0.93	0.99	1		(86)
Mean interna	ıl temperatu	ıre in I	iving ar	ea T1 (fo	ollow s	tens 3 to	7 in T	able 9c)				4	
(87)m= 20	 	0.46	20.73	20.91	20.99	i i	21		20.73	20.31	19.98]	(87)
Temperature	during hea	tina n	oriode ir	rost of	dwellii	na from T	abla C				<u> </u>	ı	
(88)m= 20.04		0.05	20.07	20.07	20.08	-	20.0	` 	20.07	20.06	20.06]	(88)
` ′	<u> </u>			<u> </u>		_		1		1		J	, ,
Utilisation fac	 -	- 1		,	1	1	T	7 0.60	0.0	1 0 00		1	(89)
(89)m= 0.99	<u> </u>	0.95	0.88	0.72	0.51	0.34	0.3		0.9	0.98	1		(09)
Mean interna	 	- 1		i	·	<u>`</u>	T .				ı	1	(0.0)
(90)m= 18.72	19.01 1	9.38	19.77	19.99	20.08	20.08	20.0		19.77		18.69		(90)
								Ť	LA = LI\	ving area ÷ (+) =	0.4	(91)
Mean interna	l temperatu	re (fo	r the wh	ole dwe	lling) =	fLA × T1	+ (1	– fLA) × T2				1	
Mean interna (92)m= 19.23 Apply adjusti	19.49	19.8	20.15	20.36	20.44	20.45	20.4	45 20.41	20.15		19.2]	(92)

(02)	40.00	10.40	40.0	20.45	20.20	20.44	20.45	20.45	20.44	20.45	40.00	40.0	1	(93)
(93)m=	19.23	19.49	19.8	20.15	20.36	20.44	20.45	20.45	20.41	20.15	19.63	19.2		(93)
			uirement				44 -4	Table O	41	4 T: /	70)	- -	late	
			or gains	•		ed at ste	ер ттог	rable 9	o, so tha	t 11,m=(rojm an	d re-calc	culate	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
			ains, hm					,				,		
(94)m=	0.99	0.98	0.95	0.88	0.74	0.54	0.37	0.41	0.65	0.9	0.98	0.99		(94)
Usefu			W = (94)				ı	,			1	,	1	
(95)m=	528.28	629.65	691.89	694.91	606.74	427.73	285.54	299.04	454.38	560.53	525.22	495.65		(95)
	<u> </u>	age exte	rnal tem	perature			•	,				,		
(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)
							-``	- ` 	– (96)m					
	1168.39			L	655.82	434.35	286.24	300.19	473.08	723.46	957	1154.42		(97)
Space		g require	ement fo		nonth, k\	Wh/mon	th = 0.02	24 x [(97)m – (95)m] x (4 ⁻	1)m	,		
(98)m=	476.24	340.65	253.36	115.85	36.51	0	0	0	0	121.22	310.88	490.12		_
								Tota	l per year	(kWh/year	r) = Sum(9	8) _{15,912} =	2144.83	(98)
Space	e heatin	g require	ement in	kWh/m²	² /year								28.77	(99)
9a En	erav rea	uiremer	nts – Indi	ividual h	eating sy	vstems i	ncluding	micro-C	'HPI					_
	e heatir		ito iriai	ividual II	cating sy	y Storris r	ricidaling	inicio c	<i>/</i>					
•		•	at from s	econdar	v/supple	mentarv	svstem						0	(201)
			at from m				•	(202) = 1	- (201) =				1	(202)
				-	. ,				02) × [1 –	(203)] =				(204)
			ng from a ace heat	-				(204) - (2	02) X [1	(200)] =			93.4	(206)
	•	-				a oveton	. 0/							╣ .
EIIICIE			ry/suppl			-		ī				1	0	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ar
Space		<u> </u>	ement (c					<u> </u>		101.00		100.10	1	
	476.24	340.65	253.36	115.85	36.51	0	0	0	0	121.22	310.88	490.12		
(211)m)m x (20	(4)] } x 1	00 ÷ (20	06)		•			•			•	(211)
	509.89	364.73	271.26	124.03	39.09	0	0	0	0	129.78	332.85	524.75		_
								Tota	ıl (kWh/yea	ar) =Sum(2	211) _{15,1012}	2=	2296.39	(211)
Space	e heatin	g fuel (s	econdar	y), kWh/	month									
= {[(98)m x (20	1)] } x 1	00 ÷ (20	8)									•	
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		_
								Tota	ıl (kWh/yea	ar) =Sum(2	215) _{15,1012}	2=	0	(215)
Water	heating	ı												_
Output			ter (calc				1				1		1	
	197.36	172.4	179.37	159.09	154.03	135.66	129.97	144.89	146.49	166.81	178.06	192.73		_
Efficier	ncy of w	ater hea	ıter										80.3	(216)
(217)m=	87.19	86.73	85.92	84.27	82.06	80.3	80.3	80.3	80.3	84.26	86.44	87.3		(217)
		•	kWh/mo											
. ,) ÷ (217)					l					ı	
(219) m =	226.36	198.77	208.76	188.8	187.71	168.94	161.86	180.44	182.43	197.96	206	220.76		٦
_								I ota	I = Sum(21				2328.79	(219)
	I totals	fuol ···s :	ad masi	overte re-	4					k\	Wh/year	r 	kWh/year	7
space	neaung	iuei use	ed, main	system	I								2296.39	J

				_
Water heating fuel used			2328.79	
Electricity for pumps, fans and electric keep-hot				
central heating pump:			30	(230c)
boiler with a fan-assisted flue			45	(230e)
Total electricity for the above, kWh/year	sum of (230a	a)(230g) =	75	(231)
Electricity for lighting			331.6	(232)
Total delivered energy for all uses (211)(221) +	(231) + (232)(237b) =		5031.79	(338)
12a. CO2 emissions – Individual heating systems	s including micro-CHP			
	Enorgy	Emississ factor	Emissions	
	Energy kWh/year	Emission factor kg CO2/kWh	kg CO2/yea	
Space heating (main system 1)	3		kg CO2/yea	
Space heating (main system 1) Space heating (secondary)	kWh/year	kg CO2/kWh	kg CO2/yea	ar
	kWh/year	kg CO2/kWh	kg CO2/yea	ar](261)
Space heating (secondary)	kWh/year (211) x (215) x	kg CO2/kWh 0.216 = 0.519 =	kg CO2/yea	(261) (263)
Space heating (secondary) Water heating	kWh/year (211) x (215) x (219) x	kg CO2/kWh 0.216 = 0.519 =	kg CO2/yea 496.02 0 503.02	(261) (263) (264)
Space heating (secondary) Water heating Space and water heating	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (264) =	kg CO2/kWh 0.216 = 0.519 = 0.216 =	kg CO2/yea 496.02 0 503.02 999.04 38.93	(261) (263) (264) (265)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-hot	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (264) = (231) x (232) x	kg CO2/kWh 0.216 = 0.519 = 0.519 =	kg CO2/yea 496.02 0 503.02 999.04 38.93	(261) (263) (264) (265) (267)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-hot Electricity for lighting	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (264) = (231) x (232) x	kg CO2/kWh 0.216 = 0.519 = 0.519 = 0.519 =	kg CO2/yea 496.02 0 503.02 999.04 38.93 172.1	(261) (263) (264) (265) (267) (268)

TER =

(273)

16.23

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 11:01:02

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:**

Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 48m²

Site Reference: 231 Watford Road - BASE **Plot Reference:** Sample 9

Address:

Client Details:

Name: Address:

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas

Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 21.48 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 21.05 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 55.2 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 44.0 kWh/m²

OK

2 Fabric U-values

Element Average Highest External wall 0.15 (max. 0.30) 0.16 (max. 0.70) OK Party wall 0.00 (max. 0.20) OK Floor (no floor) Roof 0.12 (max. 0.20) 0.12 (max. 0.35) OK

Openings 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

1.10 (max. 2.00)

Air permeability at 50 pascals 5.00 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas

Data from manufacturer

Combi boiler

Efficiency 89.5 % SEDBUK2009

Minimum 88.0 % OK

1.10 (max. 3.30)

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

OK

6 Controls

Space heating controls TTZC by plumbing and electrical services

No cylinder thermostat

No cylinder

Boiler interlock: Yes OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings 100.0%
Minimum 75.0%

8 Mechanical ventilation

Not applicable

Hot water controls:

9 Summertime temperature

Overheating risk (Thames valley): Slight

Based on:

Overshading: Average or unknown

Windows facing: South West 7.68m²
Ventilation rate: 6.00

10 Key features

Windows U-value 1.1 W/m²K
Roofs U-value 0.12 W/m²K
Party Walls U-value 0 W/m²K

OK

OK

OK

		Hear	Details:											
A No	Noil leaban	USEI		- M	L		CTDO	040040						
Assessor Name: Software Name:	Neil Ingham Stroma FSAP 2012		Stroma Softwa					010943 on: 1.0.5.41						
Contware Hame.	Stroma 1 67 tr 2012		y Address:				7 01010	71.0.0.77						
Address :		·		·										
1. Overall dwelling dime	ensions:													
Ground floor		Ar	ea(m²)	(10) ×		ight(m)	(2a) =	Volume(m ³	(3a)					
	-) . (4 -) . (4 -) . (4 -) . (4 -)	. (4.5)		(1a) x	2	.75	(2a) =	132	(3a)					
Total floor area TFA = (1	a)+(1b)+(1c)+(1d)+(1e)+	+(1n)	48	(4)		n (5)	<i>(</i> 2.)		_					
Dwelling volume				(3a)+(3b))+(3c)+(3c	d)+(3e)+	.(3n) =	132	(5)					
2. Ventilation rate:	main sec	condary	other		total			m³ per hou	ır					
Number of altimospess	heating he	ating		1			40 =		_					
Number of chimneys			0] = [0			0	(6a)					
Number of open flues	0 +	0 +	0] = [0		20 =	0	(6b)					
Number of intermittent fa				L	2		10 =	20	(7a)					
Number of passive vents	ì				0	X '	10 =	0	(7b)					
Number of flueless gas fi	res				0	X 4	40 =	0	(7c)					
	Air changes per hour													
Infiltration due to chimne	vs_flues and fans = (6a)	+(6b)+(7a)+(7b)	+(7c) =	Г	20		÷ (5) =	0.15	(8)					
•	peen carried out or is intended,			ontinue fr			. (0) –	0.13						
Number of storeys in the	he dwelling (ns)							0	(9)					
Additional infiltration						[(9)	-1]x0.1 =	0	(10)					
	0.25 for steel or timber fra resent, use the value correspo			•	uction			0	(11)					
deducting areas of opening		maing to the gre	aler wall area	a (anter										
If suspended wooden f	floor, enter 0.2 (unseale	d) or 0.1 (sea	aled), else	enter 0				0	(12)					
If no draught lobby, en	ter 0.05, else enter 0							0	(13)					
ŭ	s and doors draught strip	pped						0	(14)					
Window infiltration			0.25 - [0.2		_			0	(15)					
Infiltration rate			(8) + (10) -	, , ,	, , ,	, ,		0	(16)					
	q50, expressed in cubic	•	•	•	etre of e	envelope	area	5	(17)					
If based on air permeabil	es if a pressurisation test has b				is boing u	sod		0.4	(18)					
Number of sides sheltere		dell'uone or a c	legice ali pei	теаышу	is being u	seu		0	(19)					
Shelter factor	· -		(20) = 1 - [0.075 x (1	9)] =			1	(20)					
Infiltration rate incorporat	ting shelter factor		(21) = (18)	x (20) =				0.4	(21)					
Infiltration rate modified f	or monthly wind speed						!							
Jan Feb	Mar Apr May	Jun Jul	Aug	Sep	Oct	Nov	Dec							
Monthly average wind sp	eed from Table 7													
(22)m= 5.1 5	4.9 4.4 4.3	3.8 3.8	3.7	4	4.3	4.5	4.7							
Wind Factor (22a)m = (2	2)m ∸ 4													
	1.23 1.1 1.08	0.95 0.95	0.92	1	1.08	1.12	1.18							
, ,,		3.30		-		L <u>-</u>		J						

0.51	0.5	0.49	0.44	0.43	0.38	0.38	0.37	0.4	0.43	0.45	0.47		
Calculate effe		U	rate for t	he appli	cable ca	se	l						
If mechanic							.=					0	(2
If exhaust air h		0		, ,	,	. `	,, .	•) = (23a)			0	(2
If balanced wit		-	-	_								0	(2
a) If balance	1					- ` ` 	- ^ ` `	<u> </u>	 		<u>`</u>	÷ 100] I	(0
24a)m= 0	0		0	0	0	0	0	0	0	0	0		(2
b) If balance			ntilation		neat red		<u> </u>	<u>`</u>	 		Ι ,	1	(2
24b)m= 0	0	0		0		0	0	0	0	0	0		(2
c) If whole h	n < 0.5 ×			•	•				5 x (23h	۸			
$\frac{11(225)1}{24c)m} = 0$	0.07	0	0	0	0	0	0	0	0	0	0]	(2
d) If natural	ventilatio	on or wh	ole hous	e positiv	/e input	L ventilatio	n from l	oft			ļ	ļ	
,	n = 1, the			•	•				0.5]				
24d)m= 0.63	0.63	0.62	0.6	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61		(2
Effective air	change	rate - en	iter (24a	or (24b	o) or (24	c) or (24	d) in box	(25)					
25)m= 0.63	0.63	0.62	0.6	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61		(2
3. Heat losse	s and he	at lose r	aramete	ar.									
	Gros	·	Openin		Net Ar	00	U-valı	10	AXU		k-value	·	Χk
LEMENT	area		m		A,r		W/m2		(W/I	<)	kJ/m²·l		J/K
indows/					7.68	x1,	/[1/(1.4)+	0.04] =	10.18				(
/alls Type1	28.9	95	7.68		21.27	, x	0.18		3.83	= [(
/alls Type2	40.2	29	0		40.29) x	0.18	<u> </u>	7.25				(;
oof	48		0	一	48	x	0.13	=	6.24	₹ i			(;
otal area of e	elements	, m²			117.2	4							(;
arty wall					22.38	3 X	0	=	0				(
•					22.38	3 X	0	= [0				= '
arty wall arty floor nternal wall **	ŧ				48		0	= [0] []]			
arty floor iternal wall *		ows, use e	ffective wi	ndow U-ve	48 97.35	5				[[s given in	paragraph	3.2	(:
arty floor ternal wall ** for windows and	l roof wind				48 97.35 alue calcul	5				[[s given in	paragraph	13.2	(:
arty floor ternal wall ** for windows and include the are	l roof windo as on both	sides of in	ternal wall		48 97.35 alue calcul	ated using		/[(1/U-valu		[[s given in	paragraph	3.2	(1)
arty floor Iternal wall ** for windows and include the are abric heat los	l roof winde as on both ss, W/K =	sides of in	ternal wall		48 97.35 alue calcul	ated using	ı formula 1	/[(1/U-valu + (32) =					(;
arty floor Iternal wall ** for windows and include the are abric heat lose eat capacity	I roof windons on both ss, W/K = Cm = S(sides of in = S (A x (A x k)	ternal wali U)	s and part	97.35 alue calculitions	ated using	ı formula 1	/[(1/U-valu + (32) = ((28)	re)+0.04] a	2) + (32a).		27.5	
arty floor Iternal wall ** for windows and include the area abric heat lose eat capacity hermal mass or design asses.	I roof windon as on both as, W/K = Cm = S(aparame aments wh	sides of in = S (A x (A x k) eter (TMF) ere the dec	ternal wall U) P = Cm ÷ tails of the	s and part	48 97.35 alue calcul titions	ated using	1 formula 1.	/[(1/U-valu + (32) = ((28) Indica	.(30) + (32) tive Value:	2) + (32a). Medium	(32e) =	27.5 7928.85	
arty floor Iternal wall ** for windows and include the area abric heat lose eat capacity hermal mass or design assess on be used inste	I roof windo as on both ss, W/K = Cm = S(parame sments wh and of a dec	sides of in = S (A x (A x k) ter (TMF ere the detailed calcu	ternal wall U) P = Cm ÷ tails of the	s and part - TFA) in	48 97.35 alue calculations a kJ/m²K	ated using	1 formula 1.	/[(1/U-valu + (32) = ((28) Indica	.(30) + (32) tive Value:	2) + (32a). Medium	(32e) =	27.5 7928.85 250	
arty floor ternal wall ** for windows and include the are abric heat lose eat capacity hermal mass or design asses an be used inste	I roof winder as on both as, W/K = Cm = S(aparame aments whe and of a decession is S (L	sides of in = S (A x (A x k) ster (TMF) ere the destailed calcumates x Y) calcumates	ternal wall U) P = Cm ÷ tails of the lation. culated t	s and part - TFA) in constructi	48 97.35 alue calculatitions a kJ/m²K ion are not	ated using	1 formula 1.	/[(1/U-valu + (32) = ((28) Indica	.(30) + (32) tive Value:	2) + (32a). Medium	(32e) =	27.5 7928.85	
arty floor ternal wall ** for windows and include the are abric heat los eat capacity hermal mass or design asses in be used inste hermal bridg details of thermal	I roof windo as on both ss, W/K = Cm = S(a parame sments wh had of a dea es : S (L al bridging	sides of in = S (A x (A x k) ster (TMF) ere the destailed calcumates x Y) calcumates	ternal wall U) P = Cm ÷ tails of the lation. culated t	s and part - TFA) in constructi	48 97.35 alue calculatitions a kJ/m²K ion are not	ated using	1 formula 1.	/[(1/U-valu + (32) = ((28) Indica e indicative	.(30) + (32) tive Value:	2) + (32a). Medium	(32e) =	27.5 7928.85 250	
arty floor Iternal wall ** For windows and include the areabric heat lose eat capacity hermal mass or design assess in be used instead hermal bridg details of thermal total fabric hermal fabric he	I roof winder as on both as, W/K = Cm = S(aparame aments whe and of a decession and bridging at loss	sides of in = S (A x (A x k) ter (TMF ere the dec tailed calco x Y) calco are not known	ternal wall U) P = Cm ÷ tails of the llation. culated to	s and part TFA) in constructi using Ap	48 97.35 alue calculatitions a kJ/m²K ion are not	ated using	1 formula 1.	/[(1/U-valu + (32) = ((28) Indica e indicative	.(30) + (32 tive Values	2) + (32a). Medium TMP in Ta	(32e) = able 1f	27.5 7928.85 250 6.81	
arty floor	I roof winder as on both as, W/K = Cm = S(aparame aments whe and of a decession and bridging at loss	sides of in S (A x k) Ster (TMF) There the destailed calculation (x Y) calculate (x Y) calculate (x Y)	ternal wall U) P = Cm ÷ tails of the llation. culated to	s and part TFA) in constructi using Ap	48 97.35 alue calculatitions a kJ/m²K ion are not	ated using	1 formula 1.	/[(1/U-valu + (32) = ((28) Indica e indicative	.(30) + (32) tive Values e values of (36) =	2) + (32a). Medium TMP in Ta	(32e) = able 1f	27.5 7928.85 250 6.81	= '
arty floor aternal wall ** for windows and include the are abric heat lose eat capacity hermal mass or design assess an be used instead hermal bridg details of therm otal fabric he entilation hea	I roof windon as on both as, W/K = Cm = S(a parame asments who had of a decrease : S (Leal bridging that loss at loss cat	sides of in S (A x k) Ster (TMF) There the destailed calculated are not known alculated	ternal wall U) P = Cm ÷ tails of the ulation. culated u own (36) =	TFA) in constructions and part	48 97.35 alue calculations a kJ/m²K ion are not	ated using	(26)(30)	/[(1/U-value) + (32) = ((28) Indicative) (33) + (38)m	.(30) + (32) tive Values of (36) = = 0.33 × (2) + (32a). Medium TMP in Ta	(32e) = able 1f	27.5 7928.85 250 6.81	
arty floor ternal wall ** for windows and include the are abric heat los eat capacity hermal mass or design asses in be used inste hermal bridg details of therma otal fabric he entilation hes	roof winder as on both ss, W/K = Cm = S(as parame as ments who had of a decrease is S (La al bridging that loss cat los	sides of in S (A x k) Ster (TMF) Here the declared calculated are not known alculated Mar 27.05	ternal wall U) P = Cm ÷ tails of the ulation. culated u own (36) =	TFA) in constructiusing Ap 0.05 x (3	48 97.35 alue calculatitions a kJ/m²K fon are not spendix h 1) Jun	ated using t known pr	(26)(30) recisely the	/[(1/U-value) + (32) = ((28) Indicative) (33) + (38)m Sep 25.29	.(30) + (32) tive Values e values of (36) = = 0.33 × (Oct	2) + (32a). Medium TMP in Ta 25)m x (5) Nov 26.22	(32e) = able 1f Dec	27.5 7928.85 250 6.81	

Heat loss para	meter (l	HP) W/	m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 1.29	1.28	1.28	1.26	1.25	1.23	1.23	1.23	1.24	1.25	1.26	1.27		
(10)				0	20		0		<u> </u>	: Sum(40) ₁ .		1.26	(40)
Number of day	s in mo	nth (Tab	le 1a)						worago	Sum(10)	27 . —	20	(-/
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)
		<u> </u>				<u>I</u>							
4 10/2/2012 201	•										130/1./		
4. Water heat	ing ene	rgy requi	rement:								kWh/ye	ear:	
Assumed occu if TFA > 13.9 if TFA £ 13.9	9, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9)2)] + 0.0	0013 x (⁻	ΓFA -13		63		(42)
Annual averag Reduce the annua not more that 125	al average	hot water	usage by	5% if the a	lwelling is	designed t			se target o		.95		(43)
		· ·				1		_		1			
Jan	Feb	Mar	Apr	May	Jun	Jul Table 10 V	Aug	Sep	Oct	Nov	Dec		
Hot water usage in	ı iitres pei	r day for ea	cn montn	va,m = 1a	ctor from	i abie 1c x	(43)	1				l	
(44)m= 80.24	77.32	74.4	71.49	68.57	65.65	65.65	68.57	71.49	74.4	77.32	80.24		_
Energy content of	hot water	used - cal	culated mo	onthly = 4.	190 x Vd,r	n x nm x D	OTm / 3600			ım(44) ₁₁₂ = ables 1b, 1		875.35	(44)
(45)m= 118.99	104.07	107.39	93.63	89.84	77.52	71.84	82.44	83.42	97.22	106.12	115.24		
		•				•		_	Total = Su	ım(45) ₁₁₂ =		1147.73	(45)
If instantaneous w	ater heati	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46)) to (61)			•		
(46)m= 17.85	15.61	16.11	14.04	13.48	11.63	10.78	12.37	12.51	14.58	15.92	17.29		(46)
Water storage		•				•			•	·			
Storage volum	e (litres)) includin	g any so	olar or W	/WHRS	storage	within sa	ame ves	sel		0		(47)
If community h	•			•			` '						
Otherwise if no		hot wate	er (this in	icludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in ((47)			
Water storage				!	(1.) (1.)	. /-						1	(10)
a) If manufact				or is kno	wn (Kvvr	n/day):					0		(48)
Temperature fa											0		(49)
Energy lost fro		-	-				(48) x (49)) =			0		(50)
b) If manufact Hot water stora			-										(E4)
If community h	•			C Z (KVVI	ii/iiti c /ua	iy <i>)</i>					0		(51)
Volume factor	_		311 4.0								0		(52)
Temperature fa			2b							_	0		(53)
Energy lost fro				-ar			(47) x (51)) x (52) x (53) =		0		(54)
Enter (50) or (•	, 10 VIII/ y C	Jui			(, (0.)	,		-	0		(55)
Water storage	. , .	•	or each	month			((56)m = (55) × (41):	m		<u> </u>		()
										1 _			(50)
(56)m= 0 If cylinder contains	0 s dedicate	0 d solar sto	0 rage, (57)	0 m = (56)m	0 x [(50) – (0 H11)] ÷ (5	0 0), else (5	0 7)m = (56)	0 m where (0 (H11) is fro	0 m Append	ix H	(56)
(57)m= 0	0	0	0	0	0	0	0	0	0	0	0		(57)
Primary circuit	loss (ar	nnual) fro	m Table	e 3							0		(58)
Primary circuit				•	•	. ,	, ,						
(modified by	factor f	rom Tabl	le H5 if t	here is s	olar wat	ter heatii	ng and a	cylinde	r thermo	stat)	-	ı	
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

Combi loss o						- `						1	
(61)m= 40.89	35.59	37.92	35.25	34.94	32.38	33.46	34.94	35.25	37.92	38.13	40.89]	(61)
	-	water he	eating ca	alculated		h month	(62)m	= 0.85 ×	(45)m +	(46)m +	(57)m +	(59)m + (61)m	
(62)m= 159.8	8 139.66	145.31	128.88	124.78	109.9	105.29	117.38	118.67	135.13	144.25	156.13		(62)
Solar DHW inpu									r contribut	ion to wate	er heating)		
(add addition	nal lines if	FGHRS	and/or \	WWHRS	applies	s, see Ap	pendix	G)				1	
(63)m = 0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output from	water hea	ter				_							
(64)m= 159.8	8 139.66	145.31	128.88	124.78	109.9	105.29	117.38	118.67	135.13	144.25	156.13		,
							O	utput from w	ater heate	r (annual)	12	1585.28	(64)
Heat gains fr	om water	heating,	kWh/m	onth 0.2	5 ´ [0.85	× (45)m	ı + (61)	m] + 0.8 x	k [(46)m	+ (57)m	+ (59)m]	
(65)m= 49.79	43.5	45.19	39.95	38.61	33.87	32.25	36.15	36.55	41.8	44.82	48.54		(65)
include (57	7)m in cal	culation of	of (65)m	only if c	ylinder	is in the	dwellin	g or hot w	ater is f	rom com	munity h	neating	
5. Internal	gains (see	Table 5	and 5a):									
Metabolic ga	ins (Table	5). Wat	ts										
Jan		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec]	
(66)m= 81.57	81.57	81.57	81.57	81.57	81.57	81.57	81.57	81.57	81.57	81.57	81.57	1	(66)
Lighting gain	ıs (calcula	ted in Ap	pendix	L, equat	ion L9 c	r L9a), a	lso se	Table 5					
(67)m= 13.21	<u> </u>	9.54	7.22	5.4	4.56	4.93	6.4	8.59	10.91	12.74	13.58	1	(67)
Appliances g	ains (calc	ulated in	Append	dix L. ea	uation L	.13 or L1	3a). al:	so see Ta	ble 5	!	!	J	
(68)m= 142.0	<u> </u>	139.8	131.89	121.91	112.53	106.26	104.79		116.41	126.39	135.77	1	(68)
Cooking gair	ns (calcula	ıted in Aı	opendix	L. eguat	ion L15	or L15a), also	see Table	5	<u>. </u>		J	
(69)m= 31.16	_`	31.16	31.16	31.16	31.16	31.16	31.16		31.16	31.16	31.16	1	(69)
Pumps and f	_	(Table f	[[a]	<u> </u>			<u> </u>		<u> </u>			ı	
(70)m= 3	3	3	3	3	3	3	3	3	3	3	3	1	(70)
Losses e.g. e				<u> </u>			L					J	(- /
(71)m= -65.26		-65.26	-65.26	-65.26	-65.26	-65.26	-65.26	-65.26	-65.26	-65.26	-65.26	1	(71)
` ′		<u> </u>	-03.20	-03.20	-03.20	-03.20	-00.20	-03.20	-03.20	-00.20	-03.20	J	(, ,)
Water heatin (72)m= 66.92	``	60.74	55.48	51.89	47.04	43.35	48.58	50.76	56.19	62.25	65.24	1	(72)
` '		l	33.46	31.09			<u> </u>		l	<u> </u>	<u> </u>	J	(12)
Total interna	_ `		0.45.07	000 00		· · · ·		n + (69)m +	· · · · · · · · · · · · · · · · · · ·		i	1	(72)
(73)m= 272.6		260.55	245.07	229.68	214.6	205.01	210.25	218.33	233.98	251.85	265.07		(73)
6. Solar gains are		ucina colo	r flux from	Table 6a	and acco	siated equa	ations to	convert to th	o applicat	alo orientas	tion		
Orientation:		•	Area		Flu	•	ations to		ie applicai	FF	iioii.	Gains	
Onemation.	Table 6d		m ²			ble 6a		g_ Table 6b	Т	able 6c		(W)	
Southwest _{0.9x}	0.77	x	7.0		x	26.70	1 -	0.63	⊣ , г	0.7	<u> </u>	. ,	(79)
Southwest _{0.9} x			7.6			36.79		0.63	×	0.7	=	86.36	╡
Southwest _{0.9} x	0	X	7.6			62.67	, <u> </u>	0.63		0.7	_ =	147.1	∫(79) ¬(70)
	<u> </u>	X	7.6		-	85.75	ļ	0.63	x	0.7	_ =	201.27	 (79) (70)
Southwesto.9x		X	7.6		—	06.25	ļ	0.63	╡ [×] ╞	0.7	=	249.38	[(79)
Southwest _{0.9} x	0.77	X	7.6	88	X 1	19.01		0.63	X	0.7	=	279.33	(79)

Southw	est _{0.9x}	0.77	Х	7.6	88	X	1	18.15]		0.63	x	0.7	=	277.31	(79)
Southw	est _{0.9x}	0.77	x	7.6	i8	x	1	13.91	Ī İ		0.63	x [0.7	<u> </u>	267.36	(79)
Southw	est _{0.9x}	0.77	x	7.6	i8	x	1	04.39	Ī İ		0.63	x	0.7		245.02	(79)
Southw	est _{0.9x}	0.77	х	7.6	i8	x	9	92.85	i i		0.63	x	0.7		217.93	(79)
Southw	est _{0.9x}	0.77	×	7.6	i8	X		69.27	i i		0.63		0.7	_	162.58	(79)
Southw	est _{0.9x}	0.77	×	7.6	i8	X		14.07	i i		0.63	x [0.7		103.44	(79)
Southw	est _{0.9x}	0.77	X	7.6	i8	X	3	31.49	i		0.63	- x	0.7		73.91	(79)
	L								J 1				-			 ` ′
Solar	ains in	watts. ca	alculated	for eacl	n month	1			(83)m	ı = Sı	um(74)m .	(82)m				
(83)m=	86.36	147.1	201.27	249.38	279.33	1	77.31	267.36	245.	.02	217.93	162.58	103.44	73.91		(83)
Total g	jains – i	nternal a	and solar	(84)m =	(73)m	+ (83)m	, watts	•					l	l	
(84)m=	359	417.56	461.82	494.45	509.01	4	91.92	472.37	455.	.26	436.27	396.56	355.29	338.97		(84)
7. Me	an inter	nal temr	perature	(heating	seasor	n)		•	•							
			neating p				area	from Tal	ble 9.	. Th	1 (°C)				21	(85)
-		_	ains for I						,	,	. (•)					
O timo	Jan	Feb	Mar	Apr	May	T	Jun	Jul	ΙAι	ug	Sep	Oct	Nov	Dec		
(86)m=	0.99	0.99	0.98	0.94	0.86	t	0.7	0.54	0.5	- 	0.8	0.95	0.99	1		(86)
, ,				l	T4 /5	- " -	4-	0 4 2 -		اــــــــــــــــــــــــــــــــــــ	- 0-\	<u> </u>		ļ		
(87)m=	19.71	1 temper	ature in	20.49	20.77	_	ow ste 20.94	20.99	7 in i 20.9		20.88	20.52	20.06	19.69]	(87)
			<u> </u>						<u> </u>	!		20.32	20.00	19.09		(07)
-			neating p			_		1	T		` ,	I	T	<u> </u>	1	(2.2)
(88)m=	19.85	19.85	19.86	19.87	19.88		9.89	19.89	19.	.9	19.89	19.88	19.87	19.86		(88)
Utilisa	ation fac	tor for g	ains for i	est of d	welling,	h2	,m (se	ee Table	9a)				_		<u>.</u>	
(89)m=	0.99	0.99	0.97	0.92	0.81		0.61	0.41	0.4	15	0.72	0.93	0.99	0.99		(89)
Mean	interna	l temper	ature in	the rest	of dwell	ing	T2 (f	ollow ste	eps 3	to 7	7 in Tabl	e 9c)				
(90)m=	18.16	18.43	18.81	19.29	19.65	1	9.85	19.89	19.8	89	19.8	19.35	18.68	18.13		(90)
		•				•		•		•	1	LA = Livi	ng area ÷ (4) =	0.42	(91)
Mean	interna	l temper	ature (fo	r the wh	ole dwe	llin	a) = f	LA x T1	+ (1 -	– fL	A) x T2					
(92)m=	18.82	19.05	19.39	19.8	20.13	_	20.31	20.35	20.3		20.26	19.85	19.27	18.79		(92)
Apply	∟—— ⁄ adjustr	nent to t	he mean	internal	temper	atu	ire fro	m Table	4e, v	whe	re appro	priate	-1	<u> </u>		
(93)m=	18.82	19.05	19.39	19.8	20.13	2	20.31	20.35	20.3	35	20.26	19.85	19.27	18.79		(93)
8. Sp	ace hea	ting requ	uirement			•				•			·			
						nec	l at st	ep 11 of	Tabl	e 9b	o, so tha	t Ti,m=	(76)m an	d re-cald	culate	
the u		1	or gains						.	_	_		1		1	
Lier.	Jan	Feb	Mar	Apr	May		Jun	Jul	Αι	ug	Sep	Oct	Nov	Dec		
	0.99	0.98	ains, hm		0.00		0.65	0.46	0.5	_	0.75	0.02	1 0 00	0.00		(94)
(94)m=			0.96	0.92	0.82		0.65	0.46	0.0	5	0.75	0.93	0.98	0.99		(34)
(95)m=	355.79	410.11	, W = (94 445	454.26	418.72	T 3	18.26	219.11	228.	67	326.03	369.34	349.08	336.59		(95)
			ernal tem			_		210.11	220.	.07	320.03	303.54	343.00	330.33		(00)
(96)m=	4.3	4.9	6.5	8.9	11.7	_	14.6	16.6	16.	.4	14.1	10.6	7.1	4.2		(96)
			an intern			1		Į						I	1	
(97)m=	897.27	871.41	790.68	657.81	506.84	_	38.51	222.44	233.	- -	366.93	556.22	736.59	889.24		(97)
Spac	e heatin	g require	ement fo	r each m	nonth, k	Wh	/mon	th = 0.02	24 x [<u>(</u> 97)	m – (95)m] x (4	11)m		1	
(98)m=	402.86	309.99	257.19	146.55	65.56	Γ	0	0	0		0	139.03	T	411.18		
															-	

				Tota	l per year	(kWh/year	r) = Sum(9	8) _{15,912} =	2011.38	(98)
Space heating requirement in kW	Vh/m²/year								41.9	(99)
9a. Energy requirements – Individo	lual heating sy	/stems i	ncluding	micro-C	HP)					
Space heating:								г		7,000
Fraction of space heat from seco		mentary	-	(000) 4	(004)			Ĺ	0	(201)
Fraction of space heat from main	. , ,			(202) = 1 -	` '	(0.00)		Ļ	1	(202)
Fraction of total heating from mai	•			(204) = (204)	02) × [1 –	(203)] =		ļ	1	(204)
Efficiency of main space heating	•							Ĺ	93.4	(206)
Efficiency of secondary/supplement	entary heating	g system	า, %					<u> </u>	0	(208)
	Apr May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ar
Space heating requirement (calculated 402.86 309.99 257.19 14	 		_	0	0	120.02	270	444 40		
	46.55 65.56	0	0	0	U	139.03	279	411.18		(044)
$(211)m = \{[(98)m \times (204)] \} \times 100$ $431.33 331.9 275.36 15$	÷ (206) 56.91 70.19	0	0	0	0	148.86	298.72	440.23		(211)
10.100 00.10 2.0.00 10	70.01				l (kWh/yea				2153.51	(211)
Space heating fuel (secondary), I	kWh/month							L		」 `
$= \{[(98)\text{m x } (201)]\} \times 100 \div (208)$							_			
(215)m= 0 0 0	0 0	0	0	0	0	0	0	0		_
				Tota	I (kWh/yea	ar) =Sum(2	215) _{15,1012}	F	0	(215)
Water heating	(l - l									
Output from water heater (calculat	ted above) 28.88 124.78	109.9	105.29	117.38	118.67	135.13	144.25	156.13		
Efficiency of water heater			<u> </u>					<u> </u>	80.3	(216)
	5.38 83.51	80.3	80.3	80.3	80.3	85.12	86.68	87.38		(217)
Fuel for water heating, kWh/month	h									
$(219)m = (64)m \times 100 \div (217)m$ (219)m = 183.18	50.96 149.41	136.86	131.12	146.17	147.79	158.75	166.41	178.69		
(219)111= 163.16 160.03 166.04 13	00.96 149.41	130.00	131.12		I = Sum(2°		100.41	170.09	1877.93	(219)
Annual totals					`		Wh/year	. L	kWh/yea	
Space heating fuel used, main sys	stem 1						,	ſ	2153.51	
Water heating fuel used								Ī	1877.93	7
Electricity for pumps, fans and ele	ectric keep-hot	t						L		_
central heating pump:	·							30		(2300
boiler with a fan-assisted flue								45		(230€
Total electricity for the above, kWh	h/vear			sum	of (230a).	(230a) =			75	(231)
Electricity for lighting	,				(/-	· - 3/		L T		(232)
, ,	(044) (004)	. (004)	. (000)	(0071-)				Ĺ	233.31	=
Total delivered energy for all uses	, , , ,	` ′	` ′	` ,				L	4339.75	(338)
12a. CO2 emissions – Individual	heating syste	ms inclu	uding mi	cro-CHP						
			ergy /h/year			Emiss kg CO	ion fac 2/kWh	tor	Emissions kg CO2/ye	

Space heating (main system 1)	(211) x	0.216	=	465.16	(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) =			870.79	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	121.09	(268)
Total CO2, kg/year	sum (of (265)(271) =		1030.8	(272)

TER = 21.48 (273)

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 11:01:01

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:** Flat

Dwelling Details:

Site Reference:

NEW DWELLING DESIGN STAGE

231 Watford Road - BASE

Plot Reference: Sample 10

Total Floor Area: 50.38m²

Address:

Client Details:

Name: Address:

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas

Fuel factor: 1.00 (mains gas)

22.37 kg/m² Target Carbon Dioxide Emission Rate (TER)

Dwelling Carbon Dioxide Emission Rate (DER) 21.30 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 61.6 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 49.0 kWh/m²

OK

2 Fabric U-values

Element Average Highest External wall 0.16 (max. 0.30) 0.16 (max. 0.70) OK Party wall 0.00 (max. 0.20) OK

Floor (no floor)

Roof 0.12 (max. 0.20) 0.12 (max. 0.35) OK Openings 1.10 (max. 2.00) OK 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 5.00 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas

Data from manufacturer

Combi boiler

Efficiency 89.5 % SEDBUK2009

Minimum 88.0 %

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

OK

6 Controls

Space heating controls TTZC by plumbing and electrical services

No cylinder thermostat

No cylinder

Boiler interlock: Yes OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings 100.0%
Minimum 75.0%

8 Mechanical ventilation

Hot water controls:

Not applicable

9 Summertime temperature

Overheating risk (Thames valley): Slight

Based on:

Overshading: Average or unknown

Windows facing: North West

Windows facing: North East

Ventilation rate:

6.39m²

3.85m²

6.00

10 Key features

Windows U-value 1.1 W/m²K
Roofs U-value 0.12 W/m²K
Party Walls U-value 0 W/m²K

OK

OK

OK

		Llee	r Details:						
Access on Names	No: Usahan	USE		- M	L		CTDO	010010	
Assessor Name: Software Name:	Neil Ingham Stroma FSAP 2012)	Strom Softwa					010943 on: 1.0.5.41	
Continui o Humo.			ty Address				7 0 10 10		
Address :		·		·					
1. Overall dwelling dime	ensions:								
Ground floor		A	rea(m²)	(10) ×		ight(m)	(2a) =	Volume(m³	(3a)
	-) . (4 -) . (4 -) . (4 -) . (4 -)	. (4.5)		(1a) x	2	.75	(2a) =	138.55	(Sa)
Total floor area TFA = (1	a)+(1b)+(1c)+(1d)+(1e)	+(1n)	50.38	(4)) (O.) (O.)	I) (O)	(0.)		_
Dwelling volume				(3a)+(3b))+(3c)+(3c	d)+(3e)+	.(3n) =	138.55	(5)
2. Ventilation rate:	main se	condary	other		total			m³ per hou	r
Number of allipsychia	heating	eating		,			40 =		_
Number of chimneys			0] = [0			0	(6a)
Number of open flues	0 +	0 +	0] = [0		20 =	0	(6b)
Number of intermittent fa				L	2		10 =	20	(7a)
Number of passive vents	;				0	X '	10 =	0	(7b)
Number of flueless gas fi	ires				0	X 4	40 =	0	(7c)
							Air ch	nanges per ho	our
Infiltration due to chimne	vs_flues and fans = (6a)+(6b)+(7a)+(7b	o)+(7c) =	Г	20		÷ (5) =	0.14	(8)
	peen carried out or is intended			continue fr			. (0) –	0.14	
Number of storeys in the	he dwelling (ns)							0	(9)
Additional infiltration						[(9)	-1]x0.1 =	0	(10)
	.25 for steel or timber fr resent, use the value corresp			•	uction			0	(11)
deducting areas of openii		oriding to the g	realer wall are	a (aner					
If suspended wooden t	floor, enter 0.2 (unseale	ed) or 0.1 (se	aled), else	enter 0				0	(12)
If no draught lobby, en	ter 0.05, else enter 0							0	(13)
· ·	s and doors draught str	ipped						0	(14)
Window infiltration			0.25 - [0.2					0	(15)
Infiltration rate			(8) + (10)					0	(16)
,	q50, expressed in cubi	•	•	•	etre of e	envelope	area	5	(17)
If based on air permeabil	es if a pressurisation test has				is heina u	sad		0.39	(18)
Number of sides sheltere		boon done or d	aogree an po	modelinty	io boiling a	50 u		0	(19)
Shelter factor			(20) = 1 -	0.075 x (1	9)] =			1	(20)
Infiltration rate incorporat	ting shelter factor		(21) = (18	x (20) =				0.39	(21)
Infiltration rate modified f	or monthly wind speed						,		_
Jan Feb	Mar Apr May	Jun Ju	l Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	eed from Table 7								
(22)m= 5.1 5	4.9 4.4 4.3	3.8 3.8	3.7	4	4.3	4.5	4.7		
Wind Factor (22a)m = (2	2)m ∸ 4								
	1.23 1.1 1.08	0.95 0.9	5 0.92	1	1.08	1.12	1.18		
` '					L			J	

ljusted infiltration ra	te (allowi	ing for sh	nelter an	d wind s	peed) =	(21a) x	(22a)m		_			
0.5 0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46		
a <i>lculate effective ail If mechanical ventil</i>	_	rate for t	пе арріі	саріе са	se					ı	0	
If exhaust air heat pump		endix N, (2	(3b) = (23a	a) × Fmv (e	equation (N5)) , othe	wise (23b) = (23a)			0	(
If balanced with heat red	covery: effic	eiency in %	allowing f	or in-use f	actor (fror	n Table 4h) =				0	
a) If balanced mecl	-	-	_					2h)m + (23b) x [ا (23c) – 1		
la)m= 0 0	0	0	0	0	0	0	0	0	0	0		
b) If balanced mecl	nanical ve	entilation	without	heat rec	overv (I	л ИV) (24b	m = (2)	2b)m + (23b)			
b)m= 0 0	0	0	0	0	0	0	0	0	0	0		
c) If whole house e	xtract ver	ntilation o	or positiv	re input v	rentilatio	on from o	utside			Į.		
if (22b)m < 0.5				•				.5 × (23b	o)			
c)m= 0 0	0	0	0	0	0	0	0	0	0	0		
d) If natural ventilat	ion or wh	ole hous	se positiv	e input	ventilati	on from I	oft	!			l	
if (22b)m = 1, tl	nen (24d)	m = (221)	o)m othe	erwise (2	4d)m =	0.5 + [(2	2b)m² x	0.5]			i	
d)m= 0.63 0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61		
Effective air change	rate - er	nter (24a) or (24k	o) or (24	c) or (24	ld) in box	(25)					
)m= 0.63 0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61		
. Heat losses and h	eat loss i	paramete	er:									
_EMENT Gro		Openin		Net Ar	ea	U-valı	ıe	ΑXU		k-value)	ΑΧk
	a (m²)	'n		A ,r	n²	W/m2	K	(W/	K)	kJ/m²-ł	<	kJ/K
ndows Type 1				6.39	x1	/[1/(1.4)+	0.04] =	8.47				
ndows Type 2				3.85	x1	/[1/(1.4)+	0.04] =	5.1				
alls Type1 39	98	10.2	4	29.74	x	0.18	_ =	5.35	$\overline{}$ [
alls Type2 20	07	0		20.07	, x	0.18	=	3.61	₹ i			
oof 50	38	0		50.38	x	0.13	=	6.55	Ħ i			
tal area of element	 s, m²			110.4	3							
rty wall				25.9	x	0		0	— [
rty floor				50.38	=							_
ernal wall **				108.6	=				L T		-	
or windows and roof win	dows use a	affective wi	ndow I I-va			n formula 1	/[(1/ ₌ va	ء 0.41 مراها] as aiven in	naragranh		
nclude the areas on bot					aleu usiriç	j iorriula i	/[(1/O-vait	1 0 /+0.0+j 6	is given in	paragrapri	3.2	
bric heat loss, W/K	= S (A x	U)				(26)(30)	+ (32) =				29.09	
eat capacity Cm = S	S(Axk)						((28).	(30) + (32	2) + (32a).	(32e) =	7600.84	
ermal mass param	eter (TMF	= Cm +	: TFA) ir	n kJ/m²K			Indica	itive Value	: Medium		250	
r design assessments w	here the de	tails of the	construct	ion are not	t known p	recisely the	indicative	e values of	TMP in T	able 1f		
n be used instead of a d					_					,		
ermal bridges : S (,		• .	•	<						6.72	
letails of thermal bridging Ital fabric heat loss	g are not kr	10wn (36) =	= 0.05 x (3	11)			(33) +	· (36) =		ı	25.04	
ntilation heat loss	alculated	1 monthly	./					$= 0.33 \times ($	25)m v (5))	35.81	
Jan Feb	Mar		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
3an Feb 3)m= 28.64 28.41	28.19	Apr 27.16	26.97	26.07	26.07	25.9	26.42	26.97	27.36	27.77		
/ 20.07 20.41	20.19	1 27.10	20.31	1 20.01	20.07	20.3	20.72	1 20.37	1 27.50	21.11		
-1.1							10-1	(6-)	00)			
eat transfer coefficients)m= 64.45 64.23	ent, W/K 64.01	62.97	62.78	61.88	61.88	61.71	(39)m 62.23	62.78	38)m 63.17	63.58	I	

Heat loss para	meter (l	HLP). W/	m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 1.28	1.27	1.27	1.25	1.25	1.23	1.23	1.22	1.24	1.25	1.25	1.26		
()				-					<u> </u>	Sum(40) ₁ .		1.25	(40)
Number of day	s in mo	nth (Tabl	e 1a)							(-,	L		`
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)
									<u> </u>				
1 Mater beet	ina ono	rav roqui	romont:								kWh/ye	or:	
4. Water heat	ing ene	rgy requi	rement.								KVVII/ye	al.	
Assumed occur if TFA > 13.9 if TFA £ 13.9	9, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9))2)] + 0.0	0013 x (⁻	ΓFA -13		.7		(42)
Annual averag Reduce the annua not more that 125	ıl average	hot water	usage by	5% if the a	lwelling is	designed t			se target c		.61		(43)
							_	_	_				
Jan Hot water usage in	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
	,	r day lor ea	CH MONUI	vu,iii = ia	Clor Ironii i	able ICX	` ′		ı		1		
(44)m= 82.07	79.08	76.1	73.11	70.13	67.15	67.15	70.13	73.11	76.1	79.08	82.07		
Energy content of	hot water	used - cal	culated mo	onthly = 4 .	190 x Vd,r	m x nm x D	0Tm / 3600			m(44) ₁₁₂ = ables 1b, 1	L	895.27	(44)
(45)m= 121.7	106.44	109.84	95.76	91.88	79.29	73.47	84.31	85.32	99.43	108.53	117.86		
									Total = Su	m(45) ₁₁₂ =	=	1173.84	(45)
If instantaneous w	ater heati	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46,) to (61)	_				
(46)m= 18.26	15.97	16.48	14.36	13.78	11.89	11.02	12.65	12.8	14.91	16.28	17.68		(46)
Water storage													
Storage volum	` '		•			_		ame ves	sel		0		(47)
If community h	•			•			` '	\4-	(O! ! /	(47)			
Otherwise if no Water storage		not wate	er (triis ir	iciudes i	nstantar	ieous co	illod idin	ers) ente	er O in ((47)			
a) If manufact		eclared lo	oss facto	or is kno	wn (kWł	n/day).					0		(48)
Temperature fa				51 10 Ki10	**** (1.000)	"day).					0		(49)
Energy lost fro				ar			(48) x (49)						` '
b) If manufact		_	-		or is not		(40) X (49)	-			0		(50)
Hot water stora			-								0		(51)
If community h	eating s	ee sectio	on 4.3										
Volume factor	from Ta	ble 2a									0		(52)
Temperature fa	actor fro	m Table	2b								0		(53)
Energy lost fro	m watei	storage	, kWh/ye	ear			(47) x (51)	x (52) x (53) =		0		(54)
Enter (50) or (54) in (5	55)									0		(55)
Water storage	loss cal	culated f	or each	month			((56)m = (55) × (41)ı	m				
(56)m= 0	0	0	0	0	0	0	0	0	0	0	0		(56)
If cylinder contains	dedicate	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Appendi	хН	
(57)m= 0	0	0	0	0	0	0	0	0	0	0	0		(57)
Primary circuit	loss (ar	nnual) fro	m Table	e 3							0		(58)
Primary circuit	•	•			59)m = ((58) ÷ 36	55 × (41)	m					
(modified by	factor f	rom Tabl	e H5 if t	here is s	olar wat	er heatir	ng and a	cylinde	r thermo	stat)			
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

Combi loss ca	alculated	for each	month ((61)m =	(60) ÷ 30	65 × (41))m				•	•	
(61)m= 41.82	36.4	38.78	36.06	35.74	33.11	34.22	35.74	36.06	38.78	39	41.82]	(61)
Total heat req	uired for	water he	eating ca	alculated	for eac	h month	(62)m =	0.85 ×	(45)m +	(46)m +	(57)m +	(59)m + (61)m	
(62)m= 163.52	142.84	148.62	131.82	127.62	112.4	107.69	120.05	121.37	138.21	147.53	159.68		(62)
Solar DHW input	calculated	using App	endix G oı	Appendix	H (negati	ve quantity	y) (enter 'C)' if no sola	r contribut	ion to wate	er heating)		
(add additiona	al lines if	FGHRS	and/or \	WWHRS	applies	, see Ap	pendix (G)				•	
(63)m= 0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output from w	ater hea	ter										_	
(64)m= 163.52	142.84	148.62	131.82	127.62	112.4	107.69	120.05	121.37	138.21	147.53	159.68		_
							Out	put from w	ater heate	r (annual) ₁	12	1621.35	(64)
Heat gains fro	m water	heating,	kWh/m	onth 0.2	5 ´ [0.85	× (45)m	+ (61)n	n] + 0.8	k [(46)m	+ (57)m	+ (59)m]	
(65)m= 50.92	44.49	46.22	40.85	39.49	34.64	32.98	36.97	37.38	42.75	45.84	49.64		(65)
include (57)	m in cal	culation of	of (65)m	only if c	ylinder i	s in the	dwelling	or hot w	ater is f	om com	munity h	neating	
5. Internal g	ains (see	e Table 5	and 5a):									
Metabolic gair	ns (Table	e 5). Wat	ts										
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1	
(66)m= 85.06	85.06	85.06	85.06	85.06	85.06	85.06	85.06	85.06	85.06	85.06	85.06		(66)
Lighting gains	(calcula	ted in Ar	pendix	L, equat	ion L9 o	r L9a), a	lso see	Table 5				ı	
(67)m= 13.29	11.8	9.6	7.27	5.43	4.58	4.95	6.44	8.64	10.97	12.81	13.66	1	(67)
Appliances ga	ains (calc	ulated in	Append	L. ea	uation L	13 or L1		see Ta	ble 5	<u>!</u>	ļ	ı	
(68)m= 148.22	- `	145.88	137.63	127.22	117.43	110.89	109.35	113.22	121.48	131.89	141.68]	(68)
Cooking gains	s (calcula	ted in A	nnendix	I equat	ion I 15	or I 15a') also s	ee Table	5			ı	
(69)m= 31.51	31.51	31.51	31.51	31.51	31.51	31.51	31.51	31.51	31.51	31.51	31.51	1	(69)
Pumps and fa	ne gaine	(Table F	[[a]			<u> </u>	<u> </u>	<u> </u>		<u> </u>		I	
(70)m= 3	3	3	3	3	3	3	3	3	3	3	3	1	(70)
Losses e.g. e	vanoratio	n (nega		ļ	ļ						·	I	` '
(71)m= -68.05	-68.05	-68.05	-68.05	-68.05	-68.05	-68.05	-68.05	-68.05	-68.05	-68.05	-68.05	1	(71)
Water heating			00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	l	(* -)
(72)m= 68.44	66.21	62.12	56.74	53.07	48.11	44.33	49.69	51.92	57.47	63.66	66.73	1	(72)
` '	ļ		30.74	33.07				+ (69)m +		ļ		l	(12)
Total interna (73)m= 281.47	. 	269.12	253.16	227.24	221.64	. ,	217	· '	·	, , ,	273.58	1	(73)
		269.12	253.16	237.24	221.04	211.69	217	225.31	241.44	259.88	273.36		(73)
6. Solar gain Solar gains are		usina sola	r flux from	Table 6a	and assoc	iated equa	itions to co	onvert to th	ne annlicat	ole orientat	ion		
Orientation:		•	Area		Flu	•		g_	о арриоак	FF		Gains	
	Table 6d		m ²			ble 6a	Т	able 6b	Т	able 6c		(W)	
Northeast 0.9x	0.77	x	3.8	35	x 1	1.28	1 x 🗀	0.63	x	0.7		13.28	(75)
Northeast 0.9x	0.77	x	3.8		-	22.97] ^ <u> </u>	0.63	^	0.7		27.02](75)
Northeast 0.9x	0.77	×	3.8			11.38] ^ <u> </u>	0.63		0.7	= -	48.69](75)](75)
Northeast 0.9x		×	3.8			67.96] ^	0.63	^ x	0.7	= -	79.96](75)](75)
Northeast 0.9x					-		¦ ⊨		≓		=		
. 1011110031 (1.9)	0.77	Х	3.8	55	X 6	91.35	X	0.63	x	0.7	=	107.48	(75)

		_			_					_				_
Northeast _{0.9x}	0.77	X	3.8	5	X	9	7.38	X	0.63	×	0.7	=	114.58	(75)
Northeast _{0.9x}	0.77	X	3.8	5	X	9	1.1	X	0.63	X	0.7	=	107.19	(75)
Northeast _{0.9x}	0.77	X	3.8	5	X	7:	2.63	X	0.63	X	0.7	=	85.45	(75)
Northeast _{0.9x}	0.77	X	3.8	5	X	5	0.42	X	0.63	X	0.7	=	59.33	(75)
Northeast _{0.9x}	0.77	X	3.8	5	X	2	8.07	X	0.63	X	0.7	=	33.02	(75)
Northeast _{0.9x}	0.77	X	3.8	5	X	1	4.2	X	0.63	X	0.7	=	16.7	(75)
Northeast 0.9x	0.77	X	3.8	5	x	9	.21	X	0.63	X	0.7	=	10.84	(75)
Northwest 0.9x	0.77	X	6.3	9	x	1	1.28	x	0.63	X	0.7	=	22.03	(81)
Northwest 0.9x	0.77	X	6.3	9	x	2:	2.97	X	0.63	X	0.7	=	44.85	(81)
Northwest 0.9x	0.77	X	6.3	9	x	4	1.38	X	0.63	X	0.7	=	80.81	(81)
Northwest 0.9x	0.77	X	6.3	9	x	6	7.96	X	0.63	X	0.7	=	132.71	(81)
Northwest _{0.9x}	0.77	X	6.3	9	x	9	1.35	X	0.63	X	0.7	=	178.39	(81)
Northwest _{0.9x}	0.77	x	6.3	9	x	9	7.38	x	0.63	X	0.7	=	190.18	(81)
Northwest _{0.9x}	0.77	X	6.3	9	x	9	1.1	X	0.63	X	0.7	=	177.91	(81)
Northwest _{0.9x}	0.77	X	6.3	9	x	7:	2.63	x	0.63	X	0.7	=	141.83	(81)
Northwest _{0.9x}	0.77	X	6.3	9	x	5(0.42	x	0.63	x	0.7	=	98.46	(81)
Northwest _{0.9x}	0.77	X	6.3	9	x	28	8.07	x	0.63	x	0.7		54.81	(81)
Northwest _{0.9x}	0.77	×	6.3	9	x	1	4.2	x	0.63	x	0.7		27.72	(81)
Northwest _{0.9x}	0.77	X	6.3	9	x	9	.21	x	0.63	x	0.7	-	17.99	(81)
Solar gains in	 	9.49	for eac 212.67	n month 285.87	1	4.76	285.1	r –	= Sum(74)m	(<mark>82)m</mark> 87.84	44.43	00.04	7	(83)
(83)m= 35.31 Total gains – i								227	.28 157.79	07.04	44.43	28.84	_	(00)
(84)m= 316.78		8.61	465.82	523.1	·	6.41	496.79	444	.28 383.1	329.2	7 304.31	302.42	1	(84)
` '					<u> </u>	J. 1 1	100.70		1 000.1	020.2	00 1.01	1 002.12		()
7. Mean inter	•		`				T	- I - O	Th4 (00)					7(05)
Temperature	ŭ	٠.			•			oie 9	ini (°C)				21	(85)
Utilisation fac					Ť			Ι		0.4	Nov	Dag	7	
(86)m= 1		Mar .99	Apr 0.96	May 0.87	╁	un 69	Jul 0.53	0.6	ug Sep s1 0.87	Oct	Nov 1	Dec 1		(86)
` ′	<u> </u>				<u> </u>	!		<u> </u>	<u> </u>	0.90				(00)
Mean interna	 	1		`	ı	— i				T 00 00	10.05	1 400	7	(07)
(87)m= 19.62	19.75 20	0.03	20.42	20.76	20	.94	20.99	20.	98 20.82	20.39	19.95	19.6		(87)
Temperature					1	Ť				1			7	
(88)m= 19.86	19.86	9.86	19.88	19.88	19	9.9	19.9	19	.9 19.89	19.88	19.88	19.87		(88)
Utilisation fac	tor for gains	s for r	est of d	welling,	h2,n	n (se	e Table	9a)		_		_	_	
(89)m= 1	0.99 0	.98	0.94	0.82	0	.6	0.41	0.4	8.0	0.97	0.99	1		(89)
Mean interna	l temperatui	re in t	he rest	of dwell	ing 1	Γ2 (fc	ollow ste	ps 3	to 7 in Tab	le 9c)				
(90)m= 18.02	18.23 18	3.63	19.2	19.65	19	.86	19.89	19.	89 19.75	19.18	18.52	18.01		(90)
	•				•			•	•	fLA = Li	ving area ÷ (∙	4) =	0.48	(91)
Mean interna	l temperatu	re (fo	r the wh	ole dwe	llina) = fl	A x T1	+ (1	– fLA) × T2				_	_
(92)m= 18.78		9.29	19.79	20.18	~~	.38	20.41	20.		19.76	19.2	18.77]	(92)
		mean	internal	temper	atur	e froi	m Table	4e,	where appr			I	_	
, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,										-				

_							1	,		1		1	ı	
(93)m=	18.78	18.95	19.29	19.79	20.18	20.38	20.41	20.41	20.26	19.76	19.2	18.77		(93)
			uirement											
			ernal ter or gains	•		ed at ste	ep 11 of	Table 9	b, so tha	t Ti,m=(76)m an	d re-calc	ulate	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
L Utilisat			ains, hm		iviay	Juli	Jui	L	Сер	Oct	INOV	Dec		
(94)m=	1	0.99	0.98	0.94	0.83	0.64	0.47	0.54	0.83	0.97	0.99	1		(94)
	aains.	hmGm .	, W = (94	1)m x (84	L 4)m	l	<u> </u>			<u> </u>	<u> </u>			
	315.35	348.44	391.26	438.56	435.35	337.16	232.43	240.44	316.55	318.67	301.87	301.32		(95)
∟ Monthl	y avera	ige exte	rnal tem	perature	from Ta	able 8		<u> </u>	ļ		<u> </u>	!		
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat lo	ss rate	for mea	an intern	al tempe	erature,	Lm , W =	=[(39)m	x [(93)m	– (96)m]				
(97)m=	933.46	902.68	818.91	685.49	532.45	357.44	236.04	247.35	383.33	574.89	764.58	926.31		(97)
Space	heating	g require	ement fo	r each n	nonth, k\	Wh/mon	th = 0.02	24 x [(97)m – (95)m] x (4	1)m			
(98)m=	459.87	372.45	318.17	177.79	72.24	0	0	0	0	190.63	333.15	464.99		
			-			-	-	Tota	l per year	(kWh/yeaı	r) = Sum(9	8) _{15,912} =	2389.3	(98)
Space	heating	require	ement in	kWh/m²	/year								47.43	(99)
		•	nts – Indi			vetame i	ncluding	ı micro-C	'HDI					
Space Space			its — iridi	Mudai II	calling s	y Sterris r	ricidaling	i illicio-c) II)					
•		•	at from se	econdar	v/supple	mentarv	svstem						0	(201)
	•		at from m			,	-	(202) = 1	- (201) =				1	(202)
	•		ng from	-	` ,				02) × [1 –	(203)] =				(204)
			•	-				(201) – (2	02) X [!	(200)] -			1	╡゛
	•	•	ace heati										93.4	(206)
Efficier	ncy of s	econda	ry/supple	ementar	y heating	g systen	າ, %						0	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ar
	- i	•	ement (c		· ·		1			1	ı	1	l	
Ŀ	459.87	372.45	318.17	177.79	72.24	0	0	0	0	190.63	333.15	464.99		
(211)m :	= {[(98)	m x (20	4)] } x 1	00 ÷ (20	06)		Г			Г	ı		1	(211)
L	492.37	398.77	340.66	190.35	77.34	0	0	0	0	204.1	356.69	497.85		_
								Tota	al (kWh/yea	ar) =Sum(2	211) _{15,1012}	₂ =	2558.13	(211)
•		•	econdar	• •	month									
			00 ÷ (20				Ι			ı	Г	•	l	
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		٦
								Lota	ıl (kWh/yea	ar) =Sum(2	215) _{15,1012}	<i>_</i> =	0	(215)
Water h	_													
	rom wa 163.52	ater hea 142.84	ter (calc 148.62	ulated al 131.82	127.62	112.4	107.69	120.05	121.37	138.21	147.53	159.68		
Efficiend				131.02	127.02	112.4	107.09	120.03	121.37	130.21	147.55	139.00	90.2	(216)
_	-			05.04	00.00	00.0	00.0	000	00.0	05.00	07.04	07.50	80.3	
_	87.51	87.35	86.92	85.81	83.68	80.3	80.3	80.3	80.3	85.86	87.04	87.58		(217)
		•	kWh/mo (217) ÷ (
(219)m=		163.52	170.98	153.62	152.51	139.98	134.11	149.5	151.15	160.97	169.5	182.32		
L	!				·		<u> </u>	Tota	ıl = Sum(2	19a) ₁₁₂ =			1915.01	(219)
Annual	totals									k'	Wh/year	, ,	kWh/year	
		fuel use	ed, main	system	1						•		2558.13	1
													<u> </u>	_

					_
Water heating fuel used				1915.01	
Electricity for pumps, fans and electric keep-hot					
central heating pump:			30		(230c)
boiler with a fan-assisted flue			45		(230e)
Total electricity for the above, kWh/year	sum of (230a)(230g) =		75	(231)
Electricity for lighting				234.63	(232)
Total delivered energy for all uses (211)(221) +	(231) + (232)(237b) =			4782.78	(338)
12a. CO2 emissions – Individual heating systems	s including micro-CHP				
	_				
	Energy kWh/year	Emission factoring Kg CO2/kWh	ctor	Emissions kg CO2/yea	ar
Space heating (main system 1)			etor =		ar](261)
Space heating (main system 1) Space heating (secondary)	kWh/year	kg CO2/kWh		kg CO2/yea	_
	kWh/year	kg CO2/kWh	=	kg CO2/yea	(261)
Space heating (secondary)	kWh/year (211) x (215) x	kg CO2/kWh 0.216 0.519	=	kg CO2/yea	(261)
Space heating (secondary) Water heating	kWh/year (211) x (215) x (219) x	kg CO2/kWh 0.216 0.519	=	kg CO2/yea 552.56 0 413.64	(261) (263) (264)
Space heating (secondary) Water heating Space and water heating	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (264) =	kg CO2/kWh 0.216 0.519 0.216	= = =	kg CO2/yea 552.56 0 413.64 966.2	(261) (263) (264) (265)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-hot	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (264) = (231) x (232) x	kg CO2/kWh 0.216 0.519 0.519	= = =	kg CO2/yea 552.56 0 413.64 966.2 38.93	(261) (263) (264) (265) (267)

TER =

(273)

22.37



Appendix B

Energy Efficient Design:-

SAP Outputs & Dwelling Emission Rates

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 10:57:56

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:** Flat

Dwelling Details:

Site Reference:

NEW DWELLING DESIGN STAGE

Total Floor Area: 100.28m² **Plot Reference:** Sample 1

Address:

Client Details:

Name: Address:

This report covers items included within the SAP calculations.

231 Watford Road - LEAN

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas

Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 17.55 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 15.78 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 53.5 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 42.3 kWh/m²

OK 2 Fabric U-values

Element Average Highest

External wall 0.16 (max. 0.30) 0.16 (max. 0.70) OK Party wall 0.00 (max. 0.20) **OK** OK

Floor 0.14 (max. 0.25) 0.14 (max. 0.70) Roof (no roof)

Openings 1.10 (max. 2.00) 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 3.50 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas

Data from manufacturer

Combi boiler

Efficiency 89.5 % SEDBUK2009

Minimum 88.0 %

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

OK

OK

Controlo			
Controls			
Space heating controls Hot water controls:	TTZC by plumbing and e No cylinder thermostat No cylinder	lectrical services	ок
Boiler interlock:	Yes		ок
Low energy lights			
Percentage of fixed lights wi	th low-energy fittings	100.0%	
Minimum		75.0%	OK
Mechanical ventilation			
Continuous extract system			
Specific fan power:		1.05	
Maximum		0.7	Fail
Summertime temperature			
Overheating risk (Thames va	alley):	Slight	OK
sed on:			
Overshading:		Average or unknown	
Windows facing: South East		15.34m²	
Windows facing: South Wes	t	1.28m²	
Ventilation rate:		3.00	
) Key features			
Air permeablility		3.5 m³/m²h	
Windows U-value		1.1 W/m²K	
Party Walls U-value		0 W/m²K	

		User D	Notaile:						
Access Name	Noil Inghom	USELL		o Nium	hor.		STD()	010042	
Assessor Name: Software Name:	Neil Ingham Stroma FSAP 2012		Strom Softwa					010943 on: 1.0.5.41	
		Property	Address						
Address :									
1. Overall dwelling dime	ensions:	_							
Ground floor			a(m²)	(1a) x		ight(m) 2.75	(2a) =	Volume(m³) (3a)
	a)+(1b)+(1c)+(1d)+(1e)+(1					75	(2a) -	213.11	
	a)+(1b)+(1c)+(1d)+(1e)+(1	11)1	00.28	(4)) . (20) . (26	4) . (2.5) .	(2n)		-
Dwelling volume				(3a)+(3b)+(30)+(30	d)+(3e)+	(311) =	275.77	(5)
2. Ventilation rate:	main seconda	rv	other		total			m³ per hou	r
Number of chimneys	heating heating	-, □ + □		7 = [40 =		_
•		_ `	0	」	0		20 =	0	(6a)
Number of open flues		」	0	」	0		10 =	0	(6b)
Number of intermittent fa				Ļ	0			0	(7a)
Number of passive vents				Ļ	0		10 =	0	(7b)
Number of flueless gas fi	res				0	X 4	40 =	0	(7c)
							Air ch	anges per ho	ur
Infiltration due to chimne	ys, flues and fans = $(6a)+(6b)+(6b)$	7a)+(7b)+((7c) =	Γ	0		÷ (5) =	0	(8)
If a pressurisation test has b	een carried out or is intended, proce	ed to (17),	otherwise o	continue fr	rom (9) to		, ,	-	``
Number of storeys in the	he dwelling (ns)							0	(9)
Additional infiltration	.25 for steel or timber frame o	r 0 35 fo	r maenni	v consti	ruction	[(9)	-1]x0.1 =	0	(10)
	resent, use the value corresponding t			•	uction			0	(11)
deducting areas of openii		1 (222)	مطا مامم	ontor O			ı	_	7,40
If no draught lobby, en	floor, enter 0.2 (unsealed) or (ter 0.05, else enter 0	o. i (Seai	ea), eise	enter 0				0	(12)
• ,	s and doors draught stripped							0	(14)
Window infiltration	0 11		0.25 - [0.2	x (14) ÷ 1	00] =			0	(15)
Infiltration rate			(8) + (10)	+ (11) + (1	12) + (13)	+ (15) =		0	(16)
•	q50, expressed in cubic metr	•	•	•	etre of e	envelope	area	3.5	(17)
	ity value, then $(18) = [(17) \div 20] +$							0.18	(18)
Air permeability value applie Number of sides sheltere	es if a pressurisation test has been do ad	ne or a de	gree air pe	rmeability	is being u	sed		0	(19)
Shelter factor	eu .		(20) = 1 -	[0.075 x (19)] =			0	(20)
Infiltration rate incorporat	ting shelter factor		(21) = (18) x (20) =				0.18	(21)
Infiltration rate modified f	or monthly wind speed						!		
Jan Feb	Mar Apr May Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	eed from Table 7								
(22)m= 5.1 5	4.9 4.4 4.3 3.8	3.8	3.7	4	4.3	4.5	4.7		
Wind Factor (22a)m = (2	2)m ÷ 4								
	1.23 1.1 1.08 0.95	0.95	0.92	1	1.08	1.12	1.18		
			•			•		•	

Adjusted infiltration rate (allowing for shel	ter and wind	speed) =	(21a) x	(22a)m		ı		1	
0.22 0.22 0.21 0.19 Calculate effective air change rate for the	0.19 0.17	0.17	0.16	0.18	0.19	0.2	0.21		
If mechanical ventilation:	аррисавіе са	1S C						0.5	(2
If exhaust air heat pump using Appendix N, (23b)	= (23a) × Fmv (equation (I	N5)) , othe	rwise (23b) = (23a)			0.5	— \(\)
If balanced with heat recovery: efficiency in % all	owing for in-use	factor (fron	n Table 4h) =				0.0	
a) If balanced mechanical ventilation w	_				2h)m + (23b) x [1 – (23c)		(
24a)m= 0 0 0 0	0 0	0	0	0	0	0	0		(2
b) If balanced mechanical ventilation w	thout heat re	coverv (N	л ИV) (24b	m = (22)	2b)m + (23b)	ļ	l	
24b)m= 0 0 0 0	0 0	0	0	0	0	0	0		(2
c) If whole house extract ventilation or p	ositive input	ventilatio	on from o	utside	!	<u> </u>	!		
if $(22b)m < 0.5 \times (23b)$, then $(24c) =$	•				.5 × (23b)			
24c)m= 0.5 0.5 0.5 0.5	0.5 0.5	0.5	0.5	0.5	0.5	0.5	0.5		(2
d) If natural ventilation or whole house	oositive input	ventilation	on from I	oft	!	!	•	•	
if (22b)m = 1, then (24d)m = (22b)n	otherwise (2	24d)m =	0.5 + [(2	2b)m² x	0.5]			1	
24d)m= 0 0 0 0	0 0	0	0	0	0	0	0		(2
Effective air change rate - enter (24a) o	r (24b) or (24	c) or (24	ld) in box	(25)				1	
25)m= 0.5 0.5 0.5 0.5	0.5 0.5	0.5	0.5	0.5	0.5	0.5	0.5		(2
3. Heat losses and heat loss parameter:									
LEMENT Gross Openings	Net A	rea	U-val	ue	ΑXU		k-value		Χk
area (m²) m²	Α,	m²	W/m2	K .	(W/I	K)	kJ/m²·ł	K kJ	l/K
/indows Type 1	15.3	4 x1	/[1/(1.1)+	0.04] =	16.16				(
/indows Type 2	1.28	x1	/[1/(1.1)+	0.04] =	1.35				(:
loor	100.2	28 x	0.14	=	14.0392	2	110	11030	.8 (
Valls Type1 68.22 16.62	51.6	X	0.16	=	8.26		60	3096	(
/alls Type2 43.24 0	43.2	4 x	0.15	_ = [6.47		60	2594.	4 (
otal area of elements, m²	211.7	' 4							 (
arty wall	15.2	1 X	0	=	0	\neg	45	684.4	5 (
arty ceiling	100.2	28					30	3008.	(
iternal wall **	175.1	8					9	1576.6	=
for windows and roof windows, use effective windo			g formula 1	/[(1/U-valu	ıe)+0.04] a	L as given in			`الـــــُــُ
include the areas on both sides of internal walls a	nd partitions				, -	-			
abric heat loss, $W/K = S (A \times U)$			(26)(30)	+ (32) =				46.28	(
eat capacity Cm = S(A x k)				((28).	(30) + (32	2) + (32a)	(32e) =	21990.67	(
hermal mass parameter (TMP = $Cm \div T$	FA) in kJ/m²k	(= (34)	÷ (4) =			219.29	(
or design assessments where the details of the co on be used instead of a detailed calculation.	nstruction are no	t known pi	recisely the	indicative	e values of	TMP in T	able 1f		
nermal bridges : S (L x Y) calculated usi	ng Appendix	K						15.42	
details of thermal bridging are not known (36) = 0 .	05 x (31)						'		
otal fabric heat loss				(33) +	(36) =			61.7	
entilation heat loss calculated monthly				(38)m	= 0.33 × (25)m x (5)	•	
Jan Feb Mar Apr	May Jun	Jul	Aug	Sep	Oct	Nov	Dec		
8)m= 45.5 45.5 45.5 45.5	45.5 45.5	45.5	45.5	45.5	45.5	45.5	45.5		(
eat transfer coefficient, W/K				(39)m	= (37) + (37)	38)m			
9)m= 107.2 107.2 107.2 107.2 1	07.2 107.2	107.2	107.2	107.2	107.2	107.2	107.2		

Heat loss para	ımeter (I	HLP), W/	m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07		
									Average =	Sum(40) ₁ .	12 /12=	1.07	(40)
Number of day		nth (Tab	le 1a)		i	i	i	i		 			
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 hea	ting ene	rgy requi	rement:								kWh/ye	ar:	
Assumed occu			[1 - exp	(-0.0003	349 x (TF	FA -13.9)2)] + 0.0	0013 x (⁻	TFA -13.		74		(42)
if TFA £ 13.9	•												
Annual average Reduce the annual	,		,	•	•	_	` ,		se target o		.32		(43)
not more that 125	-				-	-		a mater at	or target s				
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage i							_						
(44)m= 109.26	105.28	101.31	97.34	93.37	89.39	89.39	93.37	97.34	101.31	105.28	109.26		
		<u> </u>		ļ					Total = Su	m(44) ₁₁₂ =	=	1191.9	(44)
Energy content of	hot water	used - cal	culated m	onthly $= 4$.	190 x Vd,r	n x nm x C	Tm / 3600) kWh/mor	nth (see Ta	ables 1b, 1	c, 1d)		
(45)m= 162.03	141.71	146.23	127.49	122.33	105.56	97.82	112.25	113.59	132.37	144.5	156.91		
		•							Total = Su	m(45) ₁₁₂ =	=	1562.77	(45)
If instantaneous w	vater heati	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46	to (61)	_				
(46)m= 24.3	21.26	21.93	19.12	18.35	15.83	14.67	16.84	17.04	19.86	21.67	23.54		(46)
Water storage		مال مال مال		-l \ \	/\// IDC	_4			1		1		
Storage volum	` '		•			_		ame ves	Sei		0		(47)
If community hotherwise if no	-			_			' '	are) anto	or 'O' in <i>(</i>	47)			
Water storage		not wate	ii (uno n	iciuues i	nstantai	ieous co	ilibi boli	ers) erite	51 0 111 (77)			
a) If manufact		eclared l	oss facto	or is kno	wn (kWł	n/day):					0		(48)
Temperature f	actor fro	m Table	2b								0		(49)
Energy lost fro				ear			(48) x (49)) =			0		(50)
b) If manufact		_	-		or is not	known:							,
Hot water stor	•			le 2 (kW	h/litre/da	ıy)					0		(51)
If community had Volume factor	_		on 4.3								1		(==)
Temperature f			2h							—	0		(52) (53)
·							(47) ~ (54)) v (F2) v (E0)		0		, ,
Energy lost fro Enter (50) or		_	, KVVII/ye	ear			(47) X (31)) x (52) x (53) =		0		(54) (55)
Water storage	` , `	,	or each	month			((56)m - (55) × (41)	m		0		(55)
										Ι.			(50)
(56)m= 0 If cylinder contains	0 a dadicata	0	0	0 m = (56)m	0	0	0	0 7\m - (56)	0 m whore (0	0 m Appendi	v Ll	(56)
						1	1	1				X 1 1	
(57)m= 0	0	0	0	0	0	0	0	0	0	0	0		(57)
Primary circuit	loss (ar	nnual) fro	m Table	e 3							0		(58)
Primary circuit					•	. ,	, ,						
(modified by		rom Tab		here is s	i	i		cylinde	r thermo	stat)			
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

Combi	loco col	loulotod	for each	month ((61)m –	(60) · 3(SE (41)	\m						
(61)m=	50.96	46.03	50.96	48	47.58	44.08	45.55	47.5	8 48	50.96	49.32	50.96	1	(61)
						<u> </u>		ļ		_!		ļ.	(E0)m + (61)m	,
(62)m=	212.98	187.74	197.19	175.49	169.91	149.64	143.37	159.8		``	`	207.87	· (59)m + (61)m]	(62)
		_									ution to wat		1	(02)
			FGHRS							nai contrib	ation to wat	ci ricating)		
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	1	(63)
FHRS	130.55	118.76	119.02	108.25	54.61	12.92	12.03	13.6	6 13.8	110.41	119.46	128.96	J	(63) (G2)
Output	from wa	ater hea	ter											
(64)m=	80.19	66.95	75.93	65.12	113.2	134.78	129.33	144.0	07 145.6	7 70.68	72.18	76.67]	
, ,								C	Output from	water heat	er (annual)	112	1174.76	(64)
Heat o	ains froi	m water	heating,	kWh/mo	onth 0.2	5 ′ [0.85	× (45)m	ı + (61	I)m] + 0.	3 x [(46)n	n + (57)m	+ (59)m		_
(65)m=	66.61	58.62	61.36	54.39	52.57	46.12	43.91	49.2		-``	60.37	64.91	اً	(65)
inclu	ıde (57)ı	m in cald	culation o	of (65)m	only if c	vlinder i	s in the	dwellir	na or hot	water is	from com	ımunitv h	ı neating	
			e Table 5	, ,	•	,			J			. ,		
		·	5), Wat		, .									
Metab	Jan	Feb	Mar	Apr	May	Jun	Jul	Au	g Se	Oct	Nov	Dec	1	
(66)m=	137.11	137.11	137.11	137.11	137.11	137.11	137.11	137.1	` 	+	+	137.11	1	(66)
Liahtin	u gains	(calcula	ted in Ar	pendix	L. eguat	ion L9 o	r L9a). a	lso se	ee Table	 5		Ţ	ı	
(67)m=	23.72	21.07	17.13	12.97	9.7	8.19	8.85	11.5			22.87	24.38]	(67)
Applia	nces gai	ins (calc	ulated in	Append	dix L. ea	uation L	L 13 or L1	ı 3а). а	lso see	able 5	-1]	
(68)m=	256.78	259.44	252.73	238.43	220.39	203.43	192.1	189.4			228.49	245.45]	(68)
Cookir	na aains	(calcula	ıted in Aı	opendix	L. eguat	ion L15	or L15a). also	see Tal	 le 5	-	ļ	ı	
(69)m=	36.71	36.71	36.71	36.71	36.71	36.71	36.71	36.7			36.71	36.71]	(69)
Pumps	and far	ns gains	(Table 5	 āa)		<u> </u>		<u>!</u>	<u> </u>		-	ļ	1	
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	1	(70)
Losses	E.a. ev	aporatio	n (negat	ive valu	es) (Tab	le 5)						Į.	1	
	-109.68		-109.68	-109.68	-109.68	-109.68	-109.68	-109.6	68 -109.6	8 -109.68	3 -109.68	-109.68	1	(71)
Water	Leating	gains (T	able 5)			ļ		<u> </u>		-1	1	ļ	ı	
(72)m=	89.53	87.24	82.48	75.54	70.66	64.05	59.02	66.1	5 69.12	76.28	83.85	87.25	1	(72)
Total i	nternal	gains =				(66)	m + (67)m	1 + (68)	m + (69)m	+ (70)m + ((71)m + (72)m	J	
(73)m=	437.17	434.88	419.47	394.08	367.87	342.8	327.1	334.2	22 347.8	4 373.45	402.34	424.21	1	(73)
6. So	lar gains	S:												
Solar g	ains are c	alculated	using sola	r flux from	Table 6a	and assoc	ated equa	ations to	convert to	the applica	able orienta	tion.		
Orienta		Access F		Area		Flu			g_		FF		Gains	
	T	able 6d		m²		Tal	ole 6a		Table 6	b ·	Table 6c		(W)	
Southe	ast _{0.9x}	0.77	X	15.	34	x 3	6.79	x	0.63	×	0.7	=	172.49	(77)
Southe	ast _{0.9x}	0.77	X	15.	34	x 6	2.67	x	0.63	x	0.7	=	293.82	(77)
Southe	ast _{0.9x}	0.77	X	15.	34	x 8	5.75	x	0.63	x	0.7	=	402.02	(77)
Southe	ast _{0.9x}	0.77	X	15.	34	X 1	06.25	x	0.63	x	0.7	=	498.12	(77)

F										_				_
Southeast 0.9x	0.77	X	15.3	34	X	1	19.01	X	0.63	X	0.7	=	557.93	(77)
Southeast 0.9x	0.77	X	15.3	34	X	1	18.15	X	0.63	X	0.7	=	553.9	(77)
Southeast _{0.9x}	0.77	X	15.3	34	X	1	13.91	X	0.63	X	0.7	=	534.02	(77)
Southeast _{0.9x}	0.77	X	15.3	34	X	10	04.39	X	0.63	X	0.7	=	489.39	(77)
Southeast _{0.9x}	0.77	X	15.3	34	X	9	2.85	X	0.63	X	0.7	=	435.3	(77)
Southeast 0.9x	0.77	X	15.3	34	X	6	9.27	x	0.63	X	0.7	=	324.73	(77)
Southeast 0.9x	0.77	X	15.3	34	X	4	4.07	x	0.63	X	0.7	=	206.61	(77)
Southeast 0.9x	0.77	X	15.3	34	X	3	1.49	x	0.63	x	0.7	=	147.62	(77)
Southwest _{0.9x}	0.77	X	1.2	8	X	3	6.79]	0.63	x	0.7	=	14.39	(79)
Southwest _{0.9x}	0.77	X	1.2	8	X	6	2.67]	0.63	X	0.7	=	24.52	(79)
Southwest _{0.9x}	0.77	X	1.2	8	X	8	5.75]	0.63	x	0.7	=	33.55	(79)
Southwest _{0.9x}	0.77	X	1.2	8	X	10	06.25]	0.63	x	0.7	=	41.56	(79)
Southwest _{0.9x}	0.77	X	1.2	8	X	1	19.01]	0.63	x	0.7	=	46.56	(79)
Southwest _{0.9x}	0.77	X	1.2	8	X	1	18.15]	0.63	x	0.7	=	46.22	(79)
Southwest _{0.9x}	0.77	X	1.2	8	X	1	13.91]	0.63	x	0.7	=	44.56	(79)
Southwest _{0.9x}	0.77	X	1.2	8	X	10	04.39]	0.63	x	0.7	=	40.84	(79)
Southwest _{0.9x}	0.77	x	1.2	8	X	9	2.85]	0.63	x	0.7	=	36.32	(79)
Southwest _{0.9x}	0.77	X	1.2	8	X	6	9.27]	0.63	x	0.7	=	27.1	(79)
Southwest _{0.9x}	0.77	X	1.2	8	X	4	4.07]	0.63	x	0.7	=	17.24	(79)
Southwest _{0.9x}	0.77	X	1.2	8	X	3	1.49]	0.63	x	0.7	=	12.32	(79)
Calar maina in	مامم ملاميي			a manth										
Solar gains in	 		for each	1 monu	1			(83)m	n = Sum(74)m.	(82)m			1	
(83)m= 186.89	318.34	435.56	539.68	604.49	60	00.12	578.58	(<mark>83</mark>)m 530		(82)m 351.8		159.94]	(83)
(83)m= 186.89 Total gains – i	318.34 4	435.56 d solar	539.68 (84)m =	604.49 : (73)m	+ (8	83)m	, watts	530	.23 471.62	351.8	3 223.85	l .]	` '
(83)m= 186.89	318.34 4	435.56	539.68	604.49	+ (8		l	È	.23 471.62		3 223.85	159.94 584.15]	(83) (84)
(83)m= 186.89 Total gains – i	318.34 4 nternal and 753.22 8	435.56 d solar 355.03	539.68 (84)m = 933.76	604.49 : (73)m 972.36	+ (8 94	83)m	, watts	530	.23 471.62	351.8	3 223.85	l .		` '
(83)m= 186.89 Total gains – i (84)m= 624.05	318.34 4 nternal and 753.22 8	435.56 d solar 855.03 rature (539.68 (84)m = 933.76 (heating	604.49 : (73)m 972.36	60 + (8 94	83)m 42.92	905.68	530 864	.23 471.62 .45 819.46	351.8	3 223.85	l .	21	` '
(83)m= 186.89 Total gains – i (84)m= 624.05 7. Mean inter	318.34 4 nternal and 753.22 8 nal temper during hea	d solar 355.03 rature (539.68 (84)m = 933.76 (heating eriods in	604.49 (73)m 972.36 seasor	94 1)	83)m 42.92 area 1	, watts 905.68 from Tab	530 864	.23 471.62 .45 819.46	351.8	3 223.85	l .	21	(84)
(83)m= 186.89 Total gains – i (84)m= 624.05 7. Mean inter Temperature	318.34 4 nternal and 753.22 8 nal temper during hea	d solar 355.03 rature (539.68 (84)m = 933.76 (heating eriods in	604.49 (73)m 972.36 seasor	94 10) 10)	83)m 42.92 area 1	, watts 905.68 from Tab	530 864 ole 9	.23 471.62 .45 819.46	351.8	3 223.85	l .	21	(84)
(83)m= 186.89 Total gains – i (84)m= 624.05 7. Mean inter Temperature Utilisation fac	318.34 4 nternal and 753.22 8 rnal temper during hea	d solar 355.03 rature (ating pens for li	539.68 (84)m = 933.76 heating eriods in	604.49 (73)m 972.36 season the livea, h1,n	+ (8 9, n) ing	83)m 42.92 area 1 ee Ta	, watts 905.68 from Tab ble 9a)	530 864 ole 9	.23 471.62 .45 819.46 , Th1 (°C)	351.8 725.2	3 223.85	584.15	21	(84)
(83)m= 186.89 Total gains – i (84)m= 624.05 7. Mean inter Temperature Utilisation fac	318.34 4 nternal and 753.22 8 mal tempel during hea etor for gain Feb 0.99	d solar rature (ating pens for li Mar 0.97	539.68 (84)m = 933.76 (heating eriods in Apr 0.93	604.49 : (73)m 972.36 season the livea, h1,n May 0.84	94 n) ing n (se	83)m 42.92 area f ee Ta Jun 0.68	, watts 905.68 from Tab ble 9a) Jul 0.51	530 864 ole 9 A	.23 471.62 .45 819.46 , Th1 (°C) ug Sep .55 0.78	351.8 725.2	3 223.85 8 626.19	584.15 Dec	21	(84)
(83)m= 186.89 Total gains – i (84)m= 624.05 7. Mean inter Temperature Utilisation fact Jan (86)m= 1	318.34 4 nternal and 753.22 8 nal tempel during hea ctor for gain Feb 0.99	d solar rature (ating pens for li Mar 0.97	539.68 (84)m = 933.76 (heating eriods in Apr 0.93	604.49 : (73)m 972.36 season the livea, h1,n May 0.84	66 + (8 9. 1) 1) 1) 1) 1)	83)m 42.92 area f ee Ta Jun 0.68	, watts 905.68 from Tab ble 9a) Jul 0.51	530 864 ole 9 A	.23 471.62 .45 819.46 . Th1 (°C) .ug Sep .55 0.78	351.8 725.2	3 223.85 8 626.19 . Nov 0.99	584.15 Dec	21	(84)
(83)m= 186.89 Total gains – i (84)m= 624.05 7. Mean inter Temperature Utilisation fact Jan (86)m= 1 Mean interna	318.34 4 nternal and 753.22 8 nal temper during head ctor for gain Feb 0.99 ltemperate 19.97	d solar ass5.03 rature (ating pens for li Mar 0.97 ure in l 20.24	539.68 (84)m = 933.76 (heating eriods in ving are	604.49 (73)m 972.36 seasor the lives, h1,n May 0.84 ea T1 (f	66	83)m 42.92 area f ee Ta Jun 0.68 w ste	, watts 905.68 from Tabble 9a) Jul 0.51 ps 3 to 7	530 864 ole 9 A 0.5 7 in T 20.	.23 471.62 .45 819.46 .Th1 (°C) ug Sep .55 0.78 .Table 9c) .98 20.9	351.8 725.2 Oct 0.95	3 223.85 8 626.19 . Nov 0.99	584.15 Dec 1	21	(84)
(83)m= 186.89 Total gains – i (84)m= 624.05 7. Mean inter Temperature Utilisation fact Jan (86)m= 1 Mean interna (87)m= 19.77	318.34 4 nternal and 753.22 8 mal temper during head ctor for gain Feb 0.99 1 temperate 19.97 during head	d solar ass5.03 rature (ating pens for li Mar 0.97 ure in l 20.24	539.68 (84)m = 933.76 (heating eriods in ving are	604.49 (73)m 972.36 seasor the lives, h1,n May 0.84 ea T1 (f	66	83)m 42.92 area f ee Ta Jun 0.68 w ste	, watts 905.68 from Tabble 9a) Jul 0.51 ps 3 to 7	530 864 ole 9 A 0.5 7 in T 20.	.23 471.62 .45 819.46 ., Th1 (°C) ug Sep .55 0.78 Table 9c) 98 20.9 9, Th2 (°C)	351.8 725.2 Oct 0.95	3 223.85 8 626.19 Nov 0.99	584.15 Dec 1	21	(84)
(83)m= 186.89 Total gains – i (84)m= 624.05 7. Mean inter Temperature Utilisation fact Jan (86)m= 1 Mean interna (87)m= 19.77 Temperature (88)m= 20.03	318.34 4 nternal and 753.22 8 mal temper during head ctor for gain Feb 0.99 Il temperate 19.97 during head 20.03	d solar rature (ating pens for li Mar 0.97 ure in l 20.24 ating pe	539.68 (84)m = 933.76 (heating eriods in Apr 0.93 iving are 20.55 eriods in 20.03	604.49 (73)m 972.36 seasor the liver ea, h1,n May 0.84 ea T1 (f 20.81 n rest of 20.03	+ (\(\) 9- 1) ing n (see) (continue of the continue of the c	area frage area frage	yos.68 from Tabble 9a) Jul 0.51 ps 3 to 7 20.99 from Tabble 9a)	5300 864 864 A 0.5 7 in T 20.	.23 471.62 .45 819.46 ., Th1 (°C) ug Sep .55 0.78 Table 9c) 98 20.9 9, Th2 (°C)	351.8 725.2 Oct 0.95	3 223.85 8 626.19 Nov 0.99	Dec 1 19.71	21	(84) (85) (86) (87)
(83)m= 186.89 Total gains – i (84)m= 624.05 7. Mean inter Temperature Utilisation fact [86)m= 1 Mean internal (87)m= 19.77 Temperature	318.34 2 nternal and 753.22 8 rnal temper during hea ctor for gain Feb 0.99 lt temperat 19.97 during hea 20.03	d solar rature (ating pens for li Mar 0.97 ure in l 20.24 ating pe	539.68 (84)m = 933.76 (heating eriods in Apr 0.93 iving are 20.55 eriods in 20.03	604.49 (73)m 972.36 seasor the liver ea, h1,n May 0.84 ea T1 (f 20.81 n rest of 20.03	+ (8 9,0 1) sing (sing following following (sing following followi	area frage area frage	yos.68 from Tabble 9a) Jul 0.51 ps 3 to 7 20.99 from Tabble 9a)	5300 864 864 A 0.5 7 in T 20.	.23 471.62 .45 819.46 .Th1 (°C) ug Sep .55 0.78 .58 20.9 .79, Th2 (°C) .70 03 20.03	351.8 725.2 Oct 0.95	3 223.85 8 626.19 Nov 0.99	Dec 1 19.71	21	(84) (85) (86) (87)
(83)m= 186.89 Total gains – i (84)m= 624.05 7. Mean inter Temperature Utilisation fac [86)m= 1 Mean interna (87)m= 19.77 Temperature (88)m= 20.03 Utilisation fac (89)m= 0.99	318.34 2 nternal and 753.22 8 rnal temper during hea ctor for gair Feb 0.99 Il temperate 19.97 during hea 20.03 ctor for gair	d solar rature (ating pens for li Mar 0.97 ure in l 20.24 ating pe	539.68 (84)m = 933.76 (heating eriods in ving are 20.55 eriods in 20.03 est of do 0.91	604.49 (73)m 972.36 Seasor the liv ea, h1,n May 0.84 ea T1 (ff 20.81 n rest of 20.03 welling, 0.79	60	83)m 42.92 area f ee Ta Jun 0.68 w ste 20.95 relling 20.03 ,m (se	ywatts 905.68 from Table 9a) Jul 0.51 ps 3 to 7 20.99 from Table 20.03 ee Table 0.4	5300 8644 8644 864 A 0.557 in T 20. able (9 20. 9a) 0.4	.23 471.62 .45 819.46 .Th1 (°C) .ug Sep .55 0.78 .able 9c) .98 20.9 .9, Th2 (°C) .03 20.03	351.8 725.2 Oct 0.95 20.55	3 223.85 8 626.19 Nov 0.99 20.08	Dec 1 19.71 20.03	21	(84) (85) (86) (87) (88)
(83)m= 186.89 Total gains – i (84)m= 624.05 7. Mean inter Temperature Utilisation fact (86)m= 1 Mean interna (87)m= 19.77 Temperature (88)m= 20.03 Utilisation fact (89)m= 0.99 Mean interna	318.34 2 nternal and 753.22 8 mal temper during head tor for gain Feb 0.99 Il temperate 20.03 2 ctor for gain 0.99 Il temperate 20.03 2 temperate 19.99	d solar rature (ating pens for li Mar 0.97 ure in l 20.24 ating pe	539.68 (84)m = 933.76 (heating eriods in Apr 0.93 iving are 20.55 eriods in 20.03 est of do 0.91 he rest	604.49 (73)m 972.36 Seasor the livea, h1,n May 0.84 ea T1 (f 20.81 rest of 20.03 welling, 0.79 of dwel	+ (8 9. 1) 9. 1) 10 10 10 10 10 10 10	83)m 42.92 area f ee Ta Jun 0.68 w ste 20.95 relling 20.03 m (se 0.59	ywatts 905.68 from Tabble 9a) Jul 0.51 ps 3 to 7 20.99 from Tabble 20.03 ee Table 0.4 ollow ste	5300 864 864 A 0.5 7 in T 20. 9a) 0.4	.23 471.62 .45 819.46 ., Th1 (°C) .ug Sep .55 0.78 .able 9c) .98 20.9 ., Th2 (°C) .03 20.03 .44 0.71 .to 7 in Table	351.8 725.2 Oct 0.95 20.55 20.03 0.93 e 9c)	3 223.85 8 626.19 Nov 0.99 20.08 0.99	Dec 1 19.71 20.03	21]	(84) (85) (86) (87) (88)
(83)m= 186.89 Total gains – i (84)m= 624.05 7. Mean inter Temperature Utilisation fac [86)m= 1 Mean interna (87)m= 19.77 Temperature (88)m= 20.03 Utilisation fac (89)m= 0.99	318.34 2 nternal and 753.22 8 mal temper during head tor for gain Feb 0.99 Il temperate 20.03 2 ctor for gain 0.99 Il temperate 20.03 2 temperate 19.99	d solar rature (ating pens for li Mar 0.97 ure in l 20.24 ating pe	539.68 (84)m = 933.76 (heating eriods in ving are 20.55 eriods in 20.03 est of do 0.91	604.49 (73)m 972.36 Seasor the liv ea, h1,n May 0.84 ea T1 (ff 20.81 n rest of 20.03 welling, 0.79	+ (8 9. 1) 9. 1) 10 10 10 10 10 10 10	83)m 42.92 area f ee Ta Jun 0.68 w ste 20.95 relling 20.03 ,m (se	ywatts 905.68 from Table 9a) Jul 0.51 ps 3 to 7 20.99 from Table 20.03 ee Table 0.4	5300 8644 8644 864 A 0.557 in T 20. able (9 20. 9a) 0.4	.23 471.62 .45 819.46 .Th1 (°C) .ug Sep .55 0.78 .able 9c) .98 20.9 .9, Th2 (°C) .03 20.03 .44 0.71 .to 7 in Table .02 19.94	351.8 725.2 Oct 0.95 20.55 20.03 0.93 e 9c) 19.51	3 223.85 8 626.19 Nov 0.99 20.08 0.99	Dec 1 19.71 20.03 1 1 18.3		(84) (85) (86) (87) (88) (89)
Total gains – i (84)m= 624.05 7. Mean inter Temperature Utilisation fact (86)m= 1 Mean interna (87)m= 19.77 Temperature (88)m= 20.03 Utilisation fact (89)m= 0.99 Mean interna (90)m= 18.38	318.34 4 nternal and 753.22 8 nal temper during heater for gain Feb 0.99 It temperate 20.03 20.03 20.09 20.00 20.0	d solar rature (ating pens for li Mar 0.97 ure in l 20.24 ating pens for r 0.97 ure in t 19.06	539.68 (84)m = 933.76 (heating eriods in a seriods in 20.55) eriods in 20.03 est of du 0.91 he rest (19.5)	604.49 (73)m 972.36 Seasor the livea, h1,n May 0.84 ea T1 (f 20.81 n rest of 20.03 welling, 0.79 of dwel 19.83	60	area free Ta Jun 0.68 w ste 20.95 velling 20.03 m (se 0.59 T2 (fo 9.99	, watts 905.68 from Table 9a) Jul 0.51 ps 3 to 7 20.99 from Table 20.03 ee Table 0.4 ollow stern 20.02	5300 8644 864 864 0.5 0.5 7 in T 20. 9a) 0.2 eps 3	.23 471.62 .45 819.46 .Th1 (°C) ug Sep .55 0.78 .65 20.9 .7 Th2 (°C) .7 Th2 (°C) .7 Th3 10 10 10 10 10 10 10 10 10 10 10 10 10	351.8 725.2 Oct 0.95 20.55 20.03 0.93 e 9c) 19.51	3 223.85 8 626.19 Nov 0.99 20.08 0.99 18.84	Dec 1 19.71 20.03 1 1 18.3	21	(84) (85) (86) (87) (88)
Total gains – i (84)m= 624.05 7. Mean inter Temperature Utilisation fact (86)m= 1 Mean interna (87)m= 19.77 Temperature (88)m= 20.03 Utilisation fact (89)m= 0.99 Mean interna (90)m= 18.38	318.34 2 nternal and 753.22 8 rnal temper during head and temper at 19.97 and 20.03 and temperate 19.99 and temperate 19.99 and temperate 18.67 and temperate 18.67 and temperate 18.67	d solar rature (ating pens for li Mar 0.97 ure in l 20.24 ating pens for r 0.97 ure in t 19.06	539.68 (84)m = 933.76 (heating eriods in Apr 0.93 iving are 20.55 eriods in 20.03 est of do 0.91 he rest of 19.5	604.49 (73)m 972.36 seasor the livea, h1,n May 0.84 ea T1 (f 20.81 rest of 20.03 welling, 0.79 of dwel 19.83	60	83)m 42.92 area f ee Ta Jun 0.68 ew ste 20.95 relling 20.03 m (se 0.59 T2 (fo 9.99	ywatts 905.68 from Table 9a) Jul 0.51 ps 3 to 7 20.99 from Table 20.03 ee Table 0.4 collow stee 20.02	5300 864 864 A 0.5 7 in T 20. 9a) 0.4 eps 3 20.	.23 471.62 .45 819.46 .Th1 (°C) ug Sep .5 0.78 .6able 9c) .98 20.9 .9, Th2 (°C) .03 20.03 .44 0.71 .to 7 in Table .02 19.94	351.8 725.2 Oct 0.95 20.55 20.03 0.93 e 9c) 19.51 fLA = Liv	3 223.85 8 626.19 Nov 0.99 20.08 20.03 18.84 ving area ÷ (-	Dec 1 19.71 20.03 1 1 18.3 4) =		(84) (85) (86) (87) (88) (89) (90) (91)
Total gains – i (84)m= 624.05 7. Mean inter Temperature Utilisation fact (86)m= 1 Mean interna (87)m= 19.77 Temperature (88)m= 20.03 Utilisation fact (89)m= 0.99 Mean interna (90)m= 18.38	318.34 2 nternal and 753.22 8 rnal temper during hea ctor for gair Feb 0.99 Il temperati 19.97 during hea 20.03 ctor for gair 0.99 Il temperati 18.67	d solar rature (ating pens for li Mar 0.97 ure in l 20.24 ating pe 20.03 ure in t 19.06 ure (for	539.68 (84)m = 933.76 (heating eriods in ving are 20.55 eriods in 20.03 est of do 0.91 he rest of 19.5 r the who 19.74	604.49 (73)m 972.36 seasor the liv ea, h1,n May 0.84 ea T1 (ff 20.03 welling, 0.79 of dwel 19.83 ole dwe 20.06	60	83)m 42.92 area f ee Ta Jun 0.68 w ste 20.95 relling 20.03 m (se 0.59 T2 (fo 9.99	ywatts 905.68 from Table 9a) Jul 0.51 ps 3 to 7 20.99 from Table 20.03 ee Table 0.4 ollow stee 20.02 LA × T1 20.25	5300 864 A	.23 471.62 .45 819.46 .Th1 (°C) .ug Sep .55 0.78 .able 9c) .98 20.9 .9, Th2 (°C) .03 20.03 .44 0.71 .to 7 in Table .02 19.94	351.8 725.2 0.05 0.95 20.03 0.93 e 9c) 19.51 19.75	3 223.85 8 626.19 Nov 0.99 20.08 20.03 18.84 ving area ÷ (Dec 1 19.71 20.03 1 1 18.3		(84) (85) (86) (87) (88) (89)

(00) TABEE AD SO AD AD AD SO AD AD AD AD AD AD AD AD AD AD AD AD AD	20 10 40	1 ,0	93)
(93)m= 18.55 18.82 19.19 19.59 19.91 20.06 20.1 20.09 20.01 19.6 18.9	98 18.48	[9	13)
8. Space heating requirement			
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m the utilisation factor for gains using Table 9a	and re-car	culate	
Jan Feb Mar Apr May Jun Jul Aug Sep Oct No	ov Dec		
Utilisation factor for gains, hm:		1	
(94)m= 0.99 0.98 0.96 0.9 0.78 0.6 0.41 0.45 0.71 0.92 0.9	8 0.99	(9	94)
Useful gains, hmGm , W = (94)m x (84)m		1	
(95)m= 619 738.93 818.3 840.72 762.26 561.53 371.62 390.8 579.86 668.73 615.	46 580.59	(9	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	(9	96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m- (96)m]		,	
(97)m= 1527.97 1492.29 1359.91 1146.29 880.19 585.63 374.82 395.91 633.95 965.06 1273	.53 1531.08	(9	97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m			
(98)m= 676.27 506.26 402.96 220.01 87.74 0 0 0 0 220.47 473.	81 707.16		
Total per year (kWh/year) = Su	m(98) _{15,912} =	3294.69 (9	98)
Space heating requirement in kWh/m²/year		32.85 (9	99)
		,	
9a. Energy requirements – Individual heating systems including micro-CHP)			
Space heating: Fraction of space heat from secondary/supplementary system		0 (2	201)
Fraction of space heat from main system(s) $(202) = 1 - (201) =$			202)
Fraction of total heating from main system 1 $(204) = (202) \times [1 - (203)] =$		`	204)
Efficiency of main space heating system 1			206)
Efficiency of secondary/supplementary heating system, %			208)
			.00)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct No Space heating requirement (calculated above)	ov Dec	kWh/year	
676.27 506.26 402.96 220.01 87.74 0 0 0 0 220.47 473.	81 707.16	1	
	01 707.10]	
$(211)m = \{[(98)m \times (204)] \} \times 100 \div (206)$	74 700 40	(2 1	211)
748.91 560.65 446.25 243.65 97.16 0 0 0 244.15 524.		,,	
Total (kWh/year) =Sum(211),s	1012=	3648.6	211)
Space heating fuel (secondary), kWh/month			
= {[(98)m x (201)]} x 100 ÷ (208)		1	
(215)m= 0 0 0 0 0 0 0 0 0 0 0 0 0			
Total (kWh/year) =Sum(215) ₁₅	1012	0 (2	215)
Water heating			
Output from water heater (calculated above)	.	1	
80.19 66.95 75.93 65.12 113.2 134.78 129.33 144.07 145.67 70.68 72.7	76.67		
Efficiency of water heater			216)
(217)m= 89.21 89.11 88.69 87.99 84.81 81 81 81 81 87.85 88.9	95 89.3	(2	217)
Fuel for water heating, kWh/month			
$ (219)m = (64)m \times 100 \div (217)m $ $ (219)m = 89.89 75.13 85.61 74.01 133.47 166.4 159.67 177.86 179.83 80.45 81.79 $	14 85.86	1	
Total = Sum(219a) ₁₁₂ =	1 33.00	1389.32 (2	219)
	oor		.19)
Annual totals Space heating fuel used, main system 1	c ai	kWh/year 3648.6	
,			

					7
Water heating fuel used				1389.32	
Electricity for pumps, fans and electric keep-hot					
mechanical ventilation - balanced, extract or pos	itive input from outsid	le	459.24]	(230a)
central heating pump:			30]	(230c)
boiler with a fan-assisted flue			45]	(230e)
Total electricity for the above, kWh/year	sum	n of (230a)(230g) =		534.24	(231)
Electricity for lighting				418.92	(232)
Total delivered energy for all uses (211)(221) +	(231) + (232)(237b)) =		5991.09	(338)
12a. CO2 emissions – Individual heating systems	s including micro-CHF	P			
	Energy kWh/year	Emission fac kg CO2/kWh		Emissions kg CO2/yea	ır
Space heating (main system 1)	• • • • • • • • • • • • • • • • • • • •				ır](261)
Space heating (main system 1) Space heating (secondary)	kWh/year	kg CO2/kWh		kg CO2/yea	_
	kWh/year (211) x	kg CO2/kWh	=	kg CO2/yea	(261)
Space heating (secondary)	kWh/year (211) x (215) x	0.216 0.519 0.216	=	kg CO2/yea	(261)
Space heating (secondary) Water heating	kWh/year (211) x (215) x (219) x	0.216 0.519 0.216	=	kg CO2/yea 788.1 0 300.09	(261) (263) (264)
Space heating (secondary) Water heating Space and water heating	kWh/year (211) x (215) x (219) x (261) + (262) + (263) +	kg CO2/kWh 0.216 0.519 0.216 (264) =	= =	kg CO2/yea 788.1 0 300.09	(261) (263) (264) (265)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-hot	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (231) x	kg CO2/kWh 0.216 0.519 0.216 (264) =	= = =	kg CO2/yea 788.1 0 300.09 1088.19 277.27	(261) (263) (264) (265) (267)

El rating (section 14)

85

(274)

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 10:57:54

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:**

Flat

Total Floor Area: 52.98m²

Dwelling Details:

Site Reference:

NEW DWELLING DESIGN STAGE

231 Watford Road - LEAN **Plot Reference:** Sample 2

Address:

Client Details:

Name: Address:

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas

Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 17.47 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 15.62 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 35.9 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 27.6 kWh/m²

OK

2 Fabric U-values

Element Average Highest External wall 0.15 (max. 0.30) 0.16 (max. 0.70) OK Party wall 0.00 (max. 0.20) **OK**

Floor (no floor) Roof (no roof)

Openings 1.10 (max. 2.00) OK 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 3.50 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas

Data from manufacturer

Combi boiler

Efficiency 89.5 % SEDBUK2009

Minimum 88.0 %

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

OK

6 Controls			
Space heating controls Hot water controls:	TTZC by plumbing and e No cylinder thermostat No cylinder	ок	
Boiler interlock:	Yes	ок	
7 Low energy lights			
Percentage of fixed lights with	n low-energy fittings	100.0%	
Minimum		75.0%	OK
8 Mechanical ventilation			
Continuous extract system			
Specific fan power:		1.05	
Maximum		0.7	Fail
9 Summertime temperature			
Overheating risk (Thames va	lley):	Slight	OK
Based on:			
Overshading:		Average or unknown	
Windows facing: South East		6.39m²	
Ventilation rate:		6.00	
10 Key features			
Air permeablility		3.5 m³/m²h	
Windows U-value		1.1 W/m²K	
Party Walls U-value		0 W/m²K	

		l lser I	Details: _						
Assessor Name: Software Name:						010943 on: 1.0.5.41			
Address :	F	Property	Address	: Sample	e 2				
1. Overall dwelling dime	ensions:								
		Are	a(m²)		Av. He	ight(m)	_	Volume(m	3)
Ground floor			52.98	(1a) x	2	2.75	(2a) =	145.69	(3a)
Total floor area TFA = (1	a)+(1b)+(1c)+(1d)+(1e)+(1	n) [52.98	(4)					
Dwelling volume				(3a)+(3b)+(3c)+(3c	d)+(3e)+	.(3n) =	145.69	(5)
2. Ventilation rate:									
	main seconda heating heating	ry	other		total			m³ per hou	ır
Number of chimneys	0 + 0] + [0	= [0	X 4	40 =	0	(6a)
Number of open flues	0 + 0	7 + [0	=	0	x 2	20 =	0	(6b)
Number of intermittent fa	ins				0	x ′	10 =	0	(7a)
Number of passive vents	;			Ē	0	x '	10 =	0	(7b)
Number of flueless gas fi	ires			F	0	X 4	40 =	0	(7c)
				L					
							Air ch	nanges per ho	our
	ys, flues and fans = (6a)+(6b)+(Ţ	0		÷ (5) =	0	(8)
Number of storeys in the	peen carried out or is intended, procee he dwelling (ns)	ed to (17),	otherwise (continue fr	rom (9) to	(16)		0	(9)
Additional infiltration	no awaning (115)					[(9)	-1]x0.1 =	0	(10)
Structural infiltration: 0	.25 for steel or timber frame o	r 0.35 fo	r masoni	ry consti	ruction			0	(11)
• • • • • • • • • • • • • • • • • • • •	resent, use the value corresponding t	o the grea	ter wall are	ea (after			'		
deducting areas of openia	ngs);	.1 (seal	ed), else	enter 0				0	(12)
If no draught lobby, en	,	(000	,,					0	(13)
Percentage of window	s and doors draught stripped							0	(14)
Window infiltration			0.25 - [0.2	2 x (14) ÷ 1	100] =			0	(15)
Infiltration rate			(8) + (10)	+ (11) + (1	12) + (13)	+ (15) =		0	(16)
•	q50, expressed in cubic metro	•	•	•	etre of e	envelope	area	3.5	(17)
•	lity value, then $(18) = [(17) \div 20] + (18)$ if a pressurisation test has been do				is boing u	sod		0.18	(18)
Number of sides sheltere		ne or a de	gree air pe	ппеаышу	is being u	seu		0	(19)
Shelter factor			(20) = 1 -	[0.075 x (19)] =			1	(20)
Infiltration rate incorporate	ting shelter factor		(21) = (18) x (20) =				0.18	(21)
Infiltration rate modified f	or monthly wind speed								
Jan Feb	Mar Apr May Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	peed from Table 7								
(22)m= 5.1 5	4.9 4.4 4.3 3.8	3.8	3.7	4	4.3	4.5	4.7		
Wind Factor (22a)m = (2	2)m ÷ 4								
	1.23 1.1 1.08 0.95	0.95	0.92	1	1.08	1.12	1.18		
								ı	

						peed) =	`	<u> </u>			<u> </u>	1	
0.22 Calculate effect	0.22 Ctive air	0.21 Change i	0.19 rate for t	0.19 he appli	0.17 Cable ca	0.17 S e	0.16	0.18	0.19	0.2	0.21		
If mechanica		_	410 707 1	по арри	ouble ou							0.5	(23
If exhaust air h	eat pump ı	using Appe	endix N, (2	3b) = (23a	a) × Fmv (e	equation (N	N5)) , othe	rwise (23b) = (23a)			0.5	(23
If balanced with	n heat reco	very: effic	iency in %	allowing f	or in-use f	actor (from	n Table 4h) =				0	(23
a) If balance	ed mecha	anical ve	ntilation	with hea	at recove	ery (MVI	HR) (24a)m = (22	2b)m + (23b) × [1 – (23c)	÷ 100]	
(24a)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
b) If balance	ed mecha	anical ve	ntilation	without	heat rec	overy (N	ЛV) (24b)m = (22	2b)m + (2	23b)			
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
c) If whole h if (22b)n	ouse ex n < 0.5 ×				-				5 × (23b)			
(24c)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(24
d) If natural if (22b)n	ventilation								0.5]				
(24d)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
Effective air	change	rate - er	iter (24a) or (24b	o) or (24	c) or (24	d) in box	(25)				_	
(25)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(25
3. Heat losse	s and he	eat loss p	paramete	er:									
ELEMENT	Gros	S	Openin	gs	Net Ar		U-valu		AXU	^	k-value		Χk
Mindows	area	(m²)	m	l ²	A ,r		W/m2	-	(W/I	⟨)	kJ/m²-l	K K	J/K
Walla Tura 1				_	6.39	=	/[1/(1.1)+	—, ¦	6.73	ᆿ ,			(27
Walls Type1	22.1	_	6.39	_	15.78	=	0.16	=	2.52	닠 ¦	60	946.	= `
Nalls Type2	17.2		0		17.22	=	0.15	=	2.58		60	1033	
Total area of e	elements	, m²			39.39								(3
Party wall					46.48	X	0	= [0		45	2091	= `
Party floor					52.98					[40	2119	.2 (32
Party ceiling					52.98					اِ	30	1589	.4 (32
nternal wall **					97.63						9	878.6	32
for windows and it include the area						ated using	formula 1	/[(1/U-valu	re)+0.04] a	is given in	paragraph	1 3.2	
Fabric heat los							(26)(30)	+ (32) =				11.84	(33
Heat canacity	Cm = S(Axk)	•					((28)	.(30) + (32	2) + (32a).	(32e) =	8658.87	(34
ical capacity		tor /TN/E		TE 41 :								163.44	(35
	parame	tei (Tivir	= Cm ÷	- I FA) Ir	n kJ/m²K			= (34)	\div (4) =				(3)
Thermal mass For design assess	sments wh	ere the de	tails of the	•			ecisely the	• • •	. ,	TMP in T	able 1f		(3.
Thermal mass For design assess can be used inste	sments wh ad of a dea	ere the de tailed calcu	tails of the ulation.	constructi	ion are not	known pr	recisely the	• • •	. ,	TMP in T	able 1f	6.45	<u></u>
Thermal mass For design assess can be used inste Thermal bridge f details of therma	sments whead of a decent set : S (L	ere the de tailed calcu x Y) calc	tails of the ulation. culated u	constructius	ion are not pendix l	known pr	recisely the	• • •	. ,	TMP in T	able 1f		
Fhermal mass For design assess can be used inste Thermal bridge of details of therma Total fabric he	sments whead of a decent of a	ere the de tailed calcu x Y) calcu are not kn	tails of the ulation. culated u	constructiusing Ap	ion are not pendix l	known pr	ecisely the	indicative	values of (36) =				(36
Thermal mass For design assess can be used inste Thermal bridge of details of therma Total fabric he	sments wh ad of a der es: S (L al bridging at loss at loss ca	ere the de tailed calcu x Y) calcu are not kn	tails of the ulation. culated u	constructions and constructions are constructed using Ap = 0.05 x (3	ion are not pendix l	known pr		(33) + (38)m	(36) = = 0.33 × (25)m x (5) •	6.45	(36
Thermal mass For design assess can be used inste Thermal bridge if details of therma Total fabric he Ventilation hea	es : S (L al bridging at loss at loss ca	ere the de tailed calcu x Y) calcu are not kn alculated Mar	tails of the ulation. culated u own (36) = I monthly	constructions are constructed using Ap = 0.05 x (3)	ppendix ł 1) Jun	known pr	Aug	(33) + (38)m Sep	(36) = = 0.33 × (25)m x (5 Nov	Dec	6.45	(36
Thermal mass For design assess can be used inste Thermal bridge if details of therma Total fabric he Ventilation hea Jan 38)m= 24.04	es : S (L al bridging at loss at loss ca Feb	ere the de tailed calculated are not known alculated Mar	tails of the ulation. culated u own (36) =	constructions and constructions are constructed using Ap = 0.05 x (3	opendix h	known pr		(33) + (38)m	(36) = = 0.33 × (25)m x (5) •	6.45	(36
Thermal mass For design assess can be used inste Thermal bridge If details of therma Total fabric he Ventilation hea	es : S (L al bridging at loss at loss ca Feb	ere the de tailed calculated are not known alculated Mar	tails of the ulation. culated u own (36) = I monthly	constructions are constructed using Ap = 0.05 x (3)	ppendix ł 1) Jun	known pr	Aug	(33) + (38)m Sep 24.04	(36) = = 0.33 × (25)m x (5 Nov 24.04	Dec	6.45	(36

Heat loss para	meter (l	HLP). W/	m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8		
()										Sum(40) ₁ .		0.8	(40)
Number of day	s in mo	nth (Tabl	e 1a)							, ,	L		
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 heat	ing ene	ray requi	rement:								kWh/ye	ear:	
Assumed occu if TFA > 13.9 if TFA £ 13.9	0, N = 1		[1 - exp	(-0.0003	49 x (TF	FA -13.9))2)] + 0.0	0013 x (⁻	TFA -13		78		(42)
Annual average Reduce the annua									se target o		.43		(43)
not more that 125	litres per	person per	day (all w	ater use, l	not and co	ld)							
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in	litres pe	day for ea	ch month	Vd,m = fa	ctor from	Table 1c x	(43)		•	•			
(44)m= 84.07	81.01	77.96	74.9	71.84	68.78	68.78	71.84	74.9	77.96	81.01	84.07		
									Total = Su	m(44) ₁₁₂ =	=	917.12	(44)
Energy content of	hot water	used - cald	culated mo	onthly = 4.	190 x Vd,r	n x nm x D	Tm / 3600) kWh/mor	nth (see Ta	ables 1b, 1	c, 1d)		
(45)m= 124.67	109.04	112.52	98.1	94.13	81.22	75.27	86.37	87.4	101.86	111.18	120.74		_
									Total = Su	m(45) ₁₁₂ =	=	1202.49	(45)
If instantaneous w	ater heati	ng at point	of use (no) hot water	storage),	enter 0 in	boxes (46)) to (61)	i				
(46)m= 18.7	16.36	16.88	14.71	14.12	12.18	11.29	12.96	13.11	15.28	16.68	18.11		(46)
Water storage Storage volume		includin	a any c	olar or M	/\/\LDC	ctorogo	within co	amo voc	col				(47)
•	` '		•			_		airie ves	361		0		(47)
If community he Otherwise if no	•			•			` '	ers) ente	er 'O' in <i>(</i>	(47)			
Water storage			. (o. o, o		,			
a) If manufacto	urer's d	eclared lo	oss facto	or is kno	wn (kWł	n/day):					0		(48)
Temperature fa	actor fro	m Table	2b								0		(49)
Energy lost from	m watei	storage	, kWh/ye	ear			(48) x (49)) =			0		(50)
b) If manufacti			-										
Hot water stora	-			e 2 (kWl	n/litre/da	ıy)					0		(51)
If community he Volume factor	_		on 4.3										(50)
Temperature fa			2h								0		(52) (53)
Energy lost from				aar			(47) x (51)) v (52) v (53) -				` '
Enter (50) or (•	, KVVII/yt	zai			(4 7) X (31)) X (32) X (55) =		0		(54) (55)
Water storage	, ,	,	or each	month			((56)m = (55) × (41):	m		<u> </u>		(00)
	0				0				1				(56)
(56)m= 0 If cylinder contains		0 d solar stor	0 age, (57)	0 m = (56)m	0 x [(50) – (0 H11)] ÷ (5	0 0), else (5	0 7)m = (56)	m where (0 (H11) is fro	0 m Appendi	ix H	(30)
(57)m= 0	0	0	0	0	0	0	0	0	0	0	0		(57)
Primary circuit	loss (ar	nual) fro	m Table	3							0		(58)
Primary circuit				•	•	. ,	, ,						
(modified by		rom Tabl		here is s				cylinde	r thermo	stat)			
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

Combi loss calculated for each month (6	$(1)m = (60) \div 365 \times (4)$	1)m				
(61)m= 42.84 37.29 39.73 36.94	36.61 33.92 35.05	36.61 36.94	39.73 39.95	42.84		(61)
Total heat required for water heating cale	culated for each mont	$n (62)m = 0.85 \times$	(45)m + (46)m +	(57)m +	(59)m + (61)m	
(62)m= 167.51 146.33 152.24 135.03	130.74 115.14 110.32	122.98 124.34	141.58 151.14	163.58		(62)
Solar DHW input calculated using Appendix G or A	Appendix H (negative quant	ty) (enter '0' if no sola	ar contribution to wat	er heating)	I	
(add additional lines if FGHRS and/or W	WHRS applies, see A	ppendix G)				
(63)m= 0 0 0 0	0 0 0	0 0	0 0	0		(63)
FHRS 106.82 78.54 64.44 36.06	20.17 10.02 9.28	10.66 10.79	35.87 73.71	105.11		(63) (G2)
Output from water heater						
(64)m= 58.81 66.15 86.05 97.35	108.95 103.64 99.5	110.71 111.92	103.96 75.66	56.59		
<u> </u>	•	Output from w	vater heater (annual)	112	1079.28	(64)
Heat gains from water heating, kWh/mor	nth 0.25 ´ [0.85 × (45)r	m + (61)m] + 0.8	x [(46)m + (57)m	+ (59)m]	
(65)m= 52.16 45.58 47.34 41.85	40.45 35.49 33.79	37.87 38.29	43.8 46.96	50.86		(65)
include (57)m in calculation of (65)m c	only if cylinder is in the	dwelling or hot w	vater is from com	munity h	eating	
5. Internal gains (see Table 5 and 5a):						
Metabolic gains (Table 5), Watts						
Jan Feb Mar Apr	May Jun Jul	Aug Sep	Oct Nov	Dec		
(66)m= 88.9 88.9 88.9 88.9	88.9 88.9 88.9	88.9 88.9	88.9 88.9	88.9		(66)
Lighting gains (calculated in Appendix L,	equation L9 or L9a),	also see Table 5	'	•	I	
(67)m= 15.32 13.6 11.06 8.38	6.26 5.29 5.71	7.42 9.96	12.65 14.77	15.74		(67)
Appliances gains (calculated in Appendix	x L, equation L13 or L	13a), also see Ta	able 5		I	
(68)m= 154.97 156.57 152.52 143.9	133.01 122.77 115.93	114.32 118.38	127 137.89	148.13		(68)
Cooking gains (calculated in Appendix L	, equation L15 or L15	a), also see Table	e 5		J	
(69)m= 31.89 31.89 31.89 31.89	31.89 31.89 31.89	31.89 31.89	31.89 31.89	31.89		(69)
Pumps and fans gains (Table 5a)	! !	!			I	
(70)m= 3 3 3 3 3	3 3 3	3 3	3 3	3		(70)
Losses e.g. evaporation (negative values	s) (Table 5)	•			I	
	-71.12 -71.12 -71.12	-71.12 -71.12	-71.12 -71.12	-71.12		(71)
Water heating gains (Table 5)	! !				I	
(72)m= 70.11 67.82 63.63 58.13	54.37 49.29 45.42	50.9 53.19	58.87 65.22	68.35		(72)
Total internal gains =	(66)m + (67)	m + (68)m + (69)m +	(70)m + (71)m + (72)m	ı	
(73)m= 293.07 290.67 279.89 263.07	246.3 230.01 219.73	225.32 234.2	251.2 270.55	284.9		(73)
6. Solar gains:						
Solar gains are calculated using solar flux from T	able 6a and associated equ	ations to convert to the	he applicable orienta	tion.		
Orientation: Access Factor Area	Flux	g_	FF		Gains	
Table 6d m²	Table 6a	Table 6b	Table 6c		(W)	
Southeast 0.9x 0.77 x 6.39	x 36.79	x 0.63	x 0.7	=	71.85	(77)
Southeast 0.9x 0.77 x 6.39	x 62.67	× 0.63	x 0.7		122.39	(77)
		_				
Southeast 0.9x 0.77 x 6.39	x 85.75	× 0.63	× 0.7	=	167.46	(77)

Southeas	t _{0.9x}	0.77	X	6.3	39	X	1	19.01	x		0.63	x	0.7	=	232.41	(77)
Southeas	t _{0.9x}	0.77	X	6.3	39	X	1	18.15	X		0.63	x	0.7	=	230.73	(77)
Southeas	t _{0.9x}	0.77	X	6.3	39	X	1	13.91	X		0.63	x	0.7	=	222.45	(77)
Southeas	t _{0.9x}	0.77	X	6.3	39	X	10	04.39	x		0.63	x	0.7	=	203.86	(77)
Southeas	t _{0.9x}	0.77	X	6.3	39	X	9	2.85	X		0.63	x	0.7	=	181.33	(77)
Southeas	t _{0.9x}	0.77	X	6.3	39	X	6	9.27	X		0.63	x	0.7	=	135.27	(77)
Southeas	t 0.9x	0.77	X	6.3	39	X	4	4.07	X		0.63	x	0.7	=	86.06	(77)
Southeas	t _{0.9x}	0.77	x	6.3	39	X	3	1.49	x		0.63	x	0.7		61.49	(77)
									•							
Solar gai	ins in v	vatts, ca	alculated	d for eac	h month	1			(83)m	ı = Sı	um(74)m .	(82)m				
—	71.85	122.39	167.46	207.5	232.41	$\overline{}$	30.73	222.45	203	.86	181.33	135.27	86.06	61.49		(83)
Total gai	ns – in	iternal a	nd sola	r (84)m =	= (73)m	+ (8	83)m	, watts					•	•	•	
(84)m= 3	864.92	413.07	447.35	470.56	478.72	4	60.74	442.18	429	.18	415.53	386.47	356.61	346.39		(84)
7. Mear	n interr	nal temn	erature	(heating	seasor	n)									•	
		· ·		eriods in			area f	from Tab	ole 9.	. Th	1 (°C)				21	(85)
•		Ū	٠.	living are		·			J.O 0	,	. ()					(55)
	Jan	Feb	Mar	Apr	May	Ť	Jun	Jul	Α	ug	Sep	Oct	Nov	Dec]	
<u> </u>	0.98	0.96	0.93	0.86	0.74	+	0.57	0.42	0.4	_	0.66	0.88	0.96	0.98		(86)
` ′				<u> </u>	ļ			ļ	<u> </u>	!		0.00	1 0.00	1 0.00		, ,
	- 1			living ar	· `	_		i –	ı —				1	T	1	(07)
(87)m= 2	20.06	20.24	20.47	20.71	20.89	2	20.98	21	20.	99	20.95	20.73	20.34	20.01		(87)
Temper	rature o	during h	eating p	eriods ir	rest of	dw	elling	from Ta	ble 9	9, Tr	n2 (°C)				,	
(88)m= 2	20.25	20.25	20.25	20.25	20.25	2	20.25	20.25	20.	25	20.25	20.25	20.25	20.25		(88)
Utilisatio	on fact	or for g	ains for	rest of d	welling,	h2,	m (se	e Table	9a)							
(89)m=	0.98	0.96	0.92	0.84	0.7		0.51	0.35	0.3	88	0.6	0.85	0.95	0.98		(89)
Mean in	nternal	temper	ature in	the rest	of dwell	lina	T2 (f	ollow ste	ns 3	to 7	7 in Tahl	e 9c)	•	•	•	
													19.41	18.92]	(90)
						1			<u> </u>	!			ing area ÷ (0.4	(91)
									,,							` ′
			<u> </u>	r the wh	ole dwe	_	-	r	`	$\overline{}$		00.00	10.70	1000	1	(02)
` ′	19.43	19.65	19.94	20.24			20.53	20.55	20.		20.51	20.26	19.78	19.36		(92)
· · · · · ·	19.28	19.5	ne mear 19.79	interna 20.09	20.29	_	0.38	20.4	4e, 20		20.36	20.11	19.63	19.21	1	(93)
` '				L	20.29		.0.36	20.4	20	.4	20.30	20.11	19.03	19.21		(55)
8. Spac					ro obtoi	n o d	ot ot	on 11 of	Tobl	0 Oh	oo tha	t Ti m-	-(76)m on	d ro cold	nulata	
				using Ta		nea	al Si	ғр п о	ıabı	e ar), 50 ilia	t 11,111=	:(76)m an	u re-caic	Julate	
	Jan	Feb	Mar	Apr	May	Γ	Jun	Jul	Α	ug	Sep	Oct	Nov	Dec		
Utilisatio						-			<u> </u>	<u> </u>	•				J	
(94)m=	0.97	0.95	0.91	0.83	0.7	1	0.52	0.36	0.3	39	0.61	0.84	0.95	0.97		(94)
Useful g	gains, l	hmGm ,	W = (9	4)m x (8	4)m	-		•					•	•	1	
(95)m= 3	353.46	391.04	405.71	390.47	334.32	2	39.13	160.15	168	.16	252.96	326.02	337.22	337.5		(95)
Monthly	/ avera	ige exte	rnal tem	perature	from T	abl	e 8								-	
(96)m=	4.3	4.9	6.5	8.9	11.7		14.6	16.6	16	.4	14.1	10.6	7.1	4.2		(96)
Heat los	ss rate	for mea	an interr	al temp	erature,	Lm	, W =	=[(39)m	x [(9:	3)m-	- (96)m]			-	
(97)m= 6	34.17	618.1	562.51	473.49	363.81	2	44.84	160.96	169	.36	264.98	402.48	530.59	635.41		(97)

Space heating requir	ement fo	or each n	nonth, k\	Wh/mon	th = 0.02	24 x [(97])m – (95)m] x (4	1)m					
(98)m= 208.84 152.59	116.66	59.78	21.93	0	0	0	0	56.89	139.22	221.64				
			•			Tota	l per year	(kWh/yeaı	r) = Sum(9	8) _{15,912} =	977.56	(98)		
Space heating requir	Space heating requirement in kWh/m²/year													
9a. Energy requireme	nts – Ind	ividual h	eating s	ystems i	ncluding	micro-C	CHP)							
Space heating:			, .							г		7 ,		
Fraction of space he				mentary	•		(004)				0	(201)		
Fraction of space he		•	. ,			(202) = 1 -		(000)1			1	(202)		
Fraction of total heat	•	•				(204) = (204)	02) x [1 –	(203)] =			1	(204)		
Efficiency of main sp					0.4						90.3	(206)		
Efficiency of seconda	ary/suppl	ementar ı	y heatin	g systen	า, % เ						0	(208)		
Jan Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ar		
Space heating requir	116.66	59.78	21.93	0	0	0	0	56.89	139.22	221.64				
$(211)m = \{[(98)m \times (200)]\}$			<u> </u>				Ŭ	00.00	100.22	221.04		(211)		
231.28 168.98	129.19	66.2	24.29	0	0	0	0	63	154.18	245.45		(211)		
						Tota	l (kWh/yea	ar) =Sum(2	L 211) _{15,1012}	<u> </u>	1082.57	(211)		
Space heating fuel (s	secondar	y), kWh/	month							L		_		
$= \{[(98)m \times (201)]\} \times (201)$	100 ÷ (20	(8)												
(215)m= 0 0	0	0	0	0	0	0	0	0	0	0		_		
						lota	I (kWh/yea	ar) =Sum(2	215) _{15,1012}	-	0	(215)		
Water heating Output from water hea	ater (calc	ulated a	hove)											
58.81 66.15	86.05	97.35	108.95	103.64	99.5	110.71	111.92	103.96	75.66	56.59				
Efficiency of water hea	ater	•		•	•	•	•		•		81	(216)		
(217)m= 88.08 87.27	86.1	84.3	82.42	81	81	81	81	84.06	86.79	88.24		(217)		
Fuel for water heating														
(219)m = (64) m x 10 (219)m = 66.77 75.79	99.94	115.47	132.19	127.95	122.84	136.67	138.18	123.67	87.18	64.13				
`	1		<u> </u>	Į		Tota	I = Sum(2	19a) ₁₁₂ =	<u> </u>		1290.78	(219)		
Annual totals								k'	Wh/year	_	kWh/year			
Space heating fuel us	ed, main	system	1								1082.57			
Water heating fuel use	ed									[1290.78			
Electricity for pumps,	fans and	electric	keep-ho	t										
mechanical ventilation	n - balan	nced, ext	ract or p	ositive ii	nput fron	n outside	Э			261.29		(230a)		
central heating pump):									30		(230c)		
boiler with a fan-assi	sted flue									45		(230e)		
Total electricity for the	abovo I						of (220a)	(220a) -				(231)		
												(231)		
Electricity for lighting	above, i	kWh/yea	l i			Sum	01 (230a).	(230g) =		L T	336.29 270.51	(232)		
Electricity for lighting Total delivered energy		·		+ (231)	+ (232)			(230g) =		[[╡		

12a. CO2 emissions – Individual heating systems	s including micro-CHP		
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	233.83 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216	278.81 (264)
Space and water heating	(261) + (262) + (263) + (264) =		512.64 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	174.53 (267)
Electricity for lighting	(232) x	0.519	140.39 (268)
Total CO2, kg/year	sum	n of (265)(271) =	827.57 (272)
Dwelling CO2 Emission Rate	(272	2) ÷ (4) =	15.62 (273)
EI rating (section 14)			89 (274)

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 10:57:53

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:**

Flat

Dwelling Details:

Site Reference:

NEW DWELLING DESIGN STAGE Total Floor Area: 92.44m²

Plot Reference: Sample 3

Address:

Client Details:

Name: Address:

This report covers items included within the SAP calculations.

231 Watford Road - LEAN

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas

Fuel factor: 1.00 (mains gas)

19.96 kg/m² Target Carbon Dioxide Emission Rate (TER)

Dwelling Carbon Dioxide Emission Rate (DER) 18.12 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 61.4 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 48.7 kWh/m²

OK

2 Fabric U-values

Element Average Highest External wall 0.15 (max. 0.30) 0.16 (max. 0.70) OK Party wall 0.00 (max. 0.20) **OK** Floor 0.14 (max. 0.25) 0.14 (max. 0.70) OK

Roof (no roof)

Openings 1.10 (max. 2.00) 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 3.50 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas

Data from manufacturer

Combi boiler

Efficiency 89.5 % SEDBUK2009

Minimum 88.0 %

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

OK

OK

6 Controls										
			ОК							
Space heating controls										
Hot water controls:	No cylinder thermostat									
	No cylinder									
Boiler interlock:	Yes		OK							
7 Low energy lights										
Percentage of fixed lights with	th low-energy fittings	100.0%								
Minimum		75.0%	OK							
8 Mechanical ventilation										
Continuous extract system										
Specific fan power:		1.05								
Maximum		0.7	Fail							
9 Summertime temperature										
Overheating risk (Thames va	alley):	Not significant	ок							
Based on:										
Overshading:		Average or unknown								
Windows facing: North East		3.85m²								
Windows facing: North West		5.11m²								
Ventilation rate:		6.00								
10 Key features										
Air permeablility		3.5 m³/m²h								
Windows U-value		1.1 W/m²K								
Party Walls U-value		0 W/m²K								

		l Iser I	Details:										
Assessor Name: Software Name:	Neil Ingham Stroma FSAP 2012		Strom Softwa	are Ve		0010943 on: 1.0.5.41							
Address: Sample 3 Address:													
Overall dwelling dimensions: Area(m²) Av. Height(m) Vol													
		Are	a(m²)		Av. He	ight(m)	_	Volume(m	³)				
Ground floor		9	92.44	(1a) x	2	.75	(2a) =	254.21	(3a)				
Total floor area TFA = (1a	a)+(1b)+(1c)+(1d)+(1e)+(1	n) 🤇	92.44	(4)									
Dwelling volume				(3a)+(3b)+(3c)+(3c	d)+(3e)+	.(3n) =	254.21	(5)				
2. Ventilation rate:													
	main seconda heating heating	ry	other		total			m³ per hou	ır				
Number of chimneys	0 + 0	+	0] = [0	X 4	40 =	0	(6a)				
Number of open flues	0 + 0	+ [0] = [0	x 2	20 =	0	(6b)				
Number of intermittent fa	ns			Ī	0	x ′	10 =	0	(7a)				
Number of passive vents				Ī	0	x ²	10 =	0	(7b)				
Number of flueless gas fi	res			Ē	0	x 4	40 =	0	(7c)				
				_									
							Air ch	nanges per ho	our 				
•	ys, flues and fans = $(6a)+(6b)+(6b)+(6a)+(6b)+(6a)+(6b)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a$				0		÷ (5) =	0	(8)				
Number of storeys in the	een carried out or is intended, proceence	ea to (17),	otnerwise (continue ir	om (9) to ((16)		0	(9)				
Additional infiltration	3 (2)					[(9)-	-1]x0.1 =	0	(10)				
Structural infiltration: 0	.25 for steel or timber frame o	r 0.35 fo	r masoni	y constr	uction			0	(11)				
if both types of wall are po deducting areas of openir	resent, use the value corresponding t	o the grea	ter wall are	a (after									
,	floor, enter 0.2 (unsealed) or 0	.1 (seale	ed), else	enter 0				0	(12)				
If no draught lobby, en	ter 0.05, else enter 0							0	(13)				
-	s and doors draught stripped							0	(14)				
Window infiltration			0.25 - [0.2	. ,	-			0	(15)				
Infiltration rate	.50		(8) + (10)					0	(16)				
•	q50, expressed in cubic metro ity value, then $(18) = [(17) \div 20] + (18)$	•		•	etre of e	envelope	area	3.5	(17)				
•	es if a pressurisation test has been do				is being u	sed		0.18	(18)				
Number of sides sheltere	ed							0	(19)				
Shelter factor			(20) = 1 -		19)] =			1	(20)				
Infiltration rate incorporat	•		(21) = (18) x (20) =				0.18	(21)				
Infiltration rate modified for	- 1 	1	1 .			<u> </u>		1					
Jan Feb	Mar Apr May Jun	Jul	Aug	Sep	Oct	Nov	Dec	J					
Monthly average wind sp (22)m= 5.1 5	eed from Table 7 4.9 4.4 4.3 3.8	3.8	3.7	4	4.3	4.5	4.7	1					
(22)m= 5.1 5	4.3 4.4 4.3 3.6] 3.0	3.1	4	4.3	4.5	4.7	J					
Wind Factor (22a)m = (22	2)m ÷ 4												
(22a)m= 1.27 1.25	1.23 1.1 1.08 0.95	0.95	0.92	1	1.08	1.12	1.18						

djusted infilt	tration rat	e (allowi	ng for sh	nelter an	d wind s	peed) =	(21a) x	(22a)m	_		_		
0.22	0.22	0.21	0.19	0.19	0.17	0.17	0.16	0.18	0.19	0.2	0.21		
<i>alculate effe</i> If mechanic		•	rate for t	пе арріі	саріе са	se						0.5	(2
If exhaust air I			endix N. (2	3b) = (23a	a) × Fmv (e	equation (N5)) . othe	wise (23b) = (23a)			0.5	
If balanced wi		0		, ,	,	. ,	,, .	`	, , ,			0.5	(2
a) If balanc		•	-	_					2h\m + (23h) v I	1 _ (23c)	_	(4
4a)m= 0		0	0	0	0	0	0	0	0	0	0]	(:
b) If balanc	ed mech:	L anical ve	L entilation	without	heat red	:overv (I	⊥ MV) (24h)m = (2)	2b)m + (23b)	1	l	
4b)m= 0	0	0	0	0	0	0	0	0	0	0	T 0		(
c) If whole	house ex	tract ver	tilation o	r positiv	l /e input v	/entilatio	on from o	LLLL outside				l	
,	m < 0.5 ×				•				.5 × (23b	o)			
1c)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(
d) If natural	l ventilatio	on or wh	ole hous	e positiv	e input	ventilati	on from I	oft			•	•	
if (22b)	m = 1, the	en (24d)	m = (22l	o)m othe	erwise (2	4d)m =	0.5 + [(2	2b)m² x	0.5]			1	
1d)m= 0	0	0	0	0	0	0	0	0	0	0	0		(
Effective ai	r change	rate - er	nter (24a) or (24b	o) or (24	c) or (24	d) in box	(25)				1	
5)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(
. Heat loss	es and he	eat loss p	paramete	er:									
LEMENT	Gros area		Openin m		Net Ar A ,r		U-valı W/m2	-	A X U (W/		k-value kJ/m²-l		A X k ⟨J/K
indows Typ		()			3.85		/[1/(1.1)+		4.06	$\stackrel{\prime}{\Box}$			
indows Typ					5.11	_	/[1/(1.1)+		5.38				
oor	_				92.44	=	0.14		12.941		75	693	
alls Type1	05.6		0.00			=		=		<u></u>		= =	=
	35.2		8.96		26.32	=	0.16	_	4.21		60	1579	=
alls Type2	82.4		0		82.44	_	0.15	=	12.34		60	494	
otal area of	eiements	, m²			210.1	6							(
arty wall					15.98	×	0	=	0		45	719	0.1
arty ceiling					92.44						30	277	3.2
ternal wall *					154.4						9	1389	.96
or windows an include the are						ated using	g formula 1	/[(1/U-valu	ıe)+0.04] á	as given ir	n paragraph	n 3.2	
abric heat lo				is anu pan	uuons		(26)(30)	+ (32) =				38.93	
eat capacity		,	0)						(30) + (32	2) + (32a)	(32e) =	18340.86	
nermal mas		,	P = Cm -	- TFA) ir	n k.l/m²K			,	÷ (4) =	_, . (0_ 0,	(020)	198.41	==(
r design asses	•	,		•			recisely the	` '		TMP in T	able 1f	190.41	'
n be used inst						,							
nermal bridg	ges : S (L	x Y) cal	culated (using Ap	pendix l	<						14.76	
letails of therm		are not kn	own (36) =	= 0.05 x (3	1)			(0.0)	(0.0)			<u> </u>	
otal fabric h									(36) =			53.69	
entilation he		i –					1 .	<u> </u>	= 0.33 × (·	<u> </u>	1	
	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec 41.94		
Jan	44 ~ 4				41.94	41.94	41.94	41.94	41.94	41.94	4104	I	(
3)m= 41.94	41.94	41.94	41.94	41.94	41.54	41.94	41.94	41.94	11.04	1	41.94	l	,
	coefficie		95.64	41.94	95.64	95.64	95.64		= (37) + (<u> </u>	95.64	1	

Heat loss para	ameter (I	HLP), W	/m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03		
						ı	ı	,	Average =	Sum(40) ₁	12 /12=	1.03	(40)
Number of day	ys in mo	nth (Tab	le 1a)					1	1	•			
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m= 31	28	31	30	31	30	31	31	30	31	30	31		(41)
4. Water hea	ting ene	rgy requi	irement:								kWh/ye	ear:	
Assumed occu if TFA > 13.9 if TFA £ 13.9	9, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9)2)] + 0.0	0013 x (¯	TFA -13		66		(42)
Annual average Reduce the annual not more that 125	al average	hot water	usage by	5% if the c	lwelling is	designed i			se target c		7.32		(43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage i	n litres pe	r day for ea	ach month	Vd,m = fa	ctor from	Table 1c x	(43)		•	•			
(44)m= 107.05	103.16	99.27	95.37	91.48	87.59	87.59	91.48	95.37	99.27	103.16	107.05		
						_				m(44) ₁₁₂ =	L	1167.84	(44)
Energy content of													
(45)m= 158.75	138.85	143.28	124.91	119.86	103.43	95.84	109.98	111.29	129.7	141.58	153.75		
If instantaneous w	vater heati	ing at point	of use (no	o hot water	r storage).	enter 0 in	boxes (46		Total = Su	m(45) ₁₁₂ =	• [1531.22	(45)
(46)m= 23.81	20.83	21.49	18.74	17.98	15.51	14.38	16.5	16.69	19.46	21.24	23.06		(46)
Water storage		21.40	10.74	17.50	10.01	14.50	10.0	10.03	13.40	21.24	20.00		()
Storage volum	ne (litres) includir	ng any so	olar or W	/WHRS	storage	within sa	ame ves	sel		0		(47)
If community h	neating a	and no ta	ınk in dw	velling, e	nter 110	litres in	(47)						
Otherwise if no		hot wate	er (this in	ncludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in ((47)			
Water storage		adorad I	ana fant	or io kno	/Id\A/k	2/dox/).							(40)
a) If manufact				OI IS KIIO	WII (KVVI	i/uay).					0		(48)
Temperature f							(40) (40)				0		(49)
Energy lost from b) If manufact		_	-		or is not		(48) x (49)) =			0		(50)
Hot water stor			-								0		(51)
If community h	_		on 4.3										
Volume factor			01								0		(52)
Temperature f											0		(53)
Energy lost fro		_	, kWh/ye	ear			(47) x (51)) x (52) x (53) =		0		(54)
Enter (50) or	` , ` `	,	for ooob	manth			//EC\m /	'EE\ (44).			0		(55)
Water storage		1			Ι			(55) × (41)	1	ı	1		(==)
(56)m= 0	0	0	0	0 (50) ==	0	0	0	7) (50)	0	0	0	Sec. 1.1	(56)
If cylinder contains	s dedicate	u solal slo	rage, (57)	ın = (56)iii I	x [(50) – (п I I)] - (3	u), eise (s r	<i>r</i>)iii = (56)	ını where (<u>п I I) IS IIO</u>	THE Appendi	ΙΧΠ	
(57)m= 0	0	0	0	0	0	0	0	0	0	0	0		(57)
Primary circuit	•	•									0		(58)
Primary circuit					•	. ,	, ,		(1.	-1-1			
(modified by	1	1	i		i				·	'			(EO)
(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
(62)m= 209.71 184.87 193.86 171.95 166.47 146.62 140.47 156.6 158.33 180.29 190.89 204.7 (62) Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)
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 ECHDS and/or WWHDS applies ass Appendix C)
(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 0 (63)
FHRS 129.02 118.22 119.35 108.38 89.44 12.68 11.8 13.41 13.56 110.41 118.62 127.16 (63) (G2)
Output from water heater
(64)m= 78.45 64.63 72.29 61.5 74.98 132.04 126.71 141.13 142.7 67.65 70.11 75.3
Output from water heater (annual) ₁₁₂ 1107.5 (64)
Heat gains from water heating, kWh/month 0.25 ´ [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]
(65)m= 65.53 57.67 60.29 53.29 51.51 45.19 43.03 48.22 48.76 55.77 59.4 63.86 (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= 132.88 132.88 132.88 132.88 132.88 132.88 132.88 132.88 132.88 132.88 132.88 132.88 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
(67)m= 25.23 22.41 18.22 13.8 10.31 8.71 9.41 12.23 16.41 20.84 24.33 25.93 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
(68)m= 243.5 246.02 239.66 226.1 208.99 192.91 182.16 179.64 186 199.56 216.67 232.75 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
(69)m= 36.29 36.29 36.29 36.29 36.29 36.29 36.29 36.29 36.29 36.29 (69)
Pumps and fans gains (Table 5a)
(70)m= 3 3 3 3 3 3 3 3 3 3 3 (70)
Losses e.g. evaporation (negative values) (Table 5)
(71)m= -106.31
Water heating gains (Table 5)
(72)m= 88.07 85.82 81.03 74.02 69.23 62.76 57.83 64.82 67.73 74.96 82.51 85.83 (72)
Total internal gains = $(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$
(73)m= 422.66 420.12 404.77 379.78 354.4 330.24 315.27 322.55 336.01 361.23 389.37 410.38 (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 Area Flux g_ FF Gains
Table 6d m² Table 6a Table 6b Table 6c (W)
Northeast 0.9x 0.77 x 3.85 x 11.28 x 0.63 x 0.7 = 13.28 (75)
Northeast 0.9x 0.77 x 3.85 x 22.97 x 0.63 x 0.7 = 27.02 (75)
Northeast 0.9x 0.77 x 3.85 x 41.38 x 0.63 x 0.7 = 48.69 (75)
Northeast 0.9x 0.77 x 3.85 x 67.96 x 0.63 x 0.7 = 79.96 (75)

Northeast 0.9x		7(75)
NOTHERS (1981 0.77 X 3.85 X 97.38 X 0.63 X 0.7 = 1	107.48	(75)
Nethors	114.58	[(75)
Northeast 0.9x	107.19	[(75)
Northeast 0.9x	85.45	<u> </u> (75)
Northeast 0.9x	59.33	[(75)
Northeast 0.9x 0.77 x 3.85 x 28.07 x 0.63 x 0.7 =	33.02	<u> </u> (75)
Northeast 0.9x 0.77 x 3.85 x 14.2 x 0.63 x 0.7 =	16.7	<u> </u> (75)
Northeast 0.9x 0.77 x 3.85 x 9.21 x 0.63 x 0.7 =	10.84	(75)
Northwest 0.9x 0.77 x 5.11 x 11.28 x 0.63 x 0.7 =	17.62	(81)
Northwest 0.9x 0.77 x 5.11 x 22.97 x 0.63 x 0.7 =	35.87	(81)
Northwest 0.9x 0.77 x 5.11 x 41.38 x 0.63 x 0.77 =	64.62	(81)
Northwest 0.9x 0.77 x 5.11 x 67.96 x 0.63 x 0.77 =	106.13	(81)
Northwest 0.9x 0.77 x 5.11 x 91.35 x 0.63 x 0.7 =	142.65	(81)
Northwest 0.9x 0.77 x 5.11 x 97.38 x 0.63 x 0.7 =	152.08	(81)
Northwest 0.9x 0.77 x 5.11 x 91.1 x 0.63 x 0.7 =	142.27	(81)
Northwest 0.9x 0.77 x 5.11 x 72.63 x 0.63 x 0.7 =	113.42	(81)
Northwest 0.9x 0.77 x 5.11 x 50.42 x 0.63 x 0.7 =	78.74	(81)
Northwest 0.9x 0.77 x 5.11 x 28.07 x 0.63 x 0.7 =	43.83	(81)
Northwest 0.9x 0.77 x 5.11 x 14.2 x 0.63 x 0.7 =	22.17	(81)
Northwest 0.9x 0.77 x 5.11 x 9.21 x 0.63 x 0.7 =	14.39	(81)
		_
Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m		
(83)m= 30.9 62.89 113.31 186.08 250.13 266.67 249.46 198.87 138.07 76.86 38.88 25.23		(83)
Total gains – internal and solar (84)m = (73)m + (83)m, watts		
(84)m= 453.56 483.01 518.08 565.86 604.53 596.91 564.73 521.42 474.08 438.08 428.24 435.61		(84)
7. Mean internal temperature (heating season)		
Temperature during heating periods in the living area from Table 9, Th1 (°C)	21	(85)
Utilisation factor for gains for living area, h1,m (see Table 9a)		•
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec		
(86)m= 1 1 0.99 0.98 0.94 0.83 0.68 0.74 0.93 0.99 1 1		(86)
Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)		
(87)m= 19.57 19.68 19.91 20.25 20.6 20.85 20.96 20.94 20.72 20.3 19.88 19.54		(87)
Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)		
(88)m= 20.05 20.05 20.05 20.05 20.05 20.05 20.05 20.05 20.05 20.05 20.05 20.05 20.05		(88)
Litilisation factor for dains for rest of dwelling n/m (see Table 9a)		(89)
Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)		(00)
(89)m= 1 1 0.99 0.97 0.91 0.76 0.56 0.63 0.89 0.98 0.99 1		
(89)m= 1 1 0.99 0.97 0.91 0.76 0.56 0.63 0.89 0.98 0.99 1 Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)		
(89)m= 1 1 0.99 0.97 0.91 0.76 0.56 0.63 0.89 0.98 0.99 1 Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 18.13 18.29 18.63 19.11 19.6 19.93 20.03 20.02 19.78 19.19 18.57 18.08		(90)
(89)m= 1 1 0.99 0.97 0.91 0.76 0.56 0.63 0.89 0.98 0.99 1 Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	0.3	(90)](91)
(89)m= 1 1 0.99 0.97 0.91 0.76 0.56 0.63 0.89 0.98 0.99 1 Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 18.13 18.29 18.63 19.11 19.6 19.93 20.03 20.02 19.78 19.19 18.57 18.08	0.3	-
(89)m= 1 1 0.99 0.97 0.91 0.76 0.56 0.63 0.89 0.98 0.99 1 Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 18.13 18.29 18.63 19.11 19.6 19.93 20.03 20.02 19.78 19.19 18.57 18.08 fLA = Living area ÷ (4) =	0.3	-

(02)m	10.44	10.56	10.06	10.2	10.75	20.06	20.16	20.14	40.02	10.27	10.01	40.27		(93)
(93)m=	18.41	18.56	18.86	19.3	19.75	20.06	20.16	20.14	19.92	19.37	18.81	18.37		(93)
			uirement				44 -4	Table O	41	4 T: /	70)	-11-	lata	
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-cal the utilisation factor for gains using Table 9a													uiate	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
	ation fac		ains, hm					,					ı	
(94)m=	1	0.99	0.99	0.97	0.9	0.76	0.58	0.64	0.88	0.97	0.99	1		(94)
Usefu			W = (94)				T	,	1		1		ı	
(95)m=	451.45	479.71	511.2	546.31	546.11	454.25	326.04	334.8	416.54	426.9	424.9	433.92		(95)
	nly avera	age exte	rnal tem	perature			•	,					ı	
(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)
							- ` 	- ` 	– (96)m				ı	
			1182.36		770.13	522.05	340.41	357.91	556.15	838.98	1120.24	1355.16		(97)
Space			ı	i	nonth, k\	Wh/mon	th = 0.02	24 x [(97)m – (95)m] x (4 ⁻	1)m		ı	
(98)m=	668.44	555.33	499.34	323.09	166.68	0	0	0	0	306.58	500.65	685.4		_
								Tota	l per year	(kWh/year	r) = Sum(9	8)15,912 =	3705.51	(98)
Space	e heatin	g require	ement in	kWh/m²	² /year								40.09	(99)
9a En	erav rea	ujremer	nts — Indi	ividual h	eating sy	vstems i	ncluding	micro-C	'HPI					
	e heatir		ito iria	ividual II	caming 5	y Storris r	ricidaling	inicio c	<i>/</i>					
•		•	at from s	econdar	v/supple	mentarv	svstem						0	(201)
	•		at from m				•	(202) = 1	- (201) =				1	(202)
	•		ng from	-	. ,			(204) = (2	02) × [1 –	(203)] =			1	(204)
			•	-									90.3] (206)
Efficiency of main space heating system 1 Efficiency of secondary/supplementary heating system, %														(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ar J`´
Space			ement (c	<u> </u>				19	000				, 55	~ .
	668.44	555.33	499.34	323.09	166.68	0	0	0	0	306.58	500.65	685.4		
(211)m) – {[(98)m x (20	 (4)] } x 1	00 ÷ (20	16)		ļ				!		l	(211)
(211)11	740.25	614.98	552.98	357.79	184.58	0	0	0	0	339.51	554.43	759.03		(=::)
									l (kWh/yea				4103.55	(211)
Cnaa	o bootin	a fuel (e		\\A/b/	manth					(/15,1012		4100.00	_(=::/
•		•	econdar 00 ÷ (20	• •	monun									
(215)m=		0	0 . (20	0	0	0	0	0	0	0	0	0		
(- /			<u> </u>						l (kWh/yea	ar) =Sum(2	1 215), _{540 4} ,	=	0	(215)
Motor	hooting									, (715,1012		-	
	heating		ter (calc	ulated al	hove)									
Output	78.45	64.63	72.29	61.5	74.98	132.04	126.71	141.13	142.7	67.65	70.11	75.3		
Efficier	ncv of w	ater hea	ıter						l		l	l	81	(216)
(217)m=		89.23	89.01	88.67	87.19	81	81	81	81	88.46	89.04	89.29	-	(217)
. ,			kWh/mo		_			<u> </u>	I		<u> </u>			•
		•) ÷ (217)											
(219)m=		72.43	81.22	69.36	86	163.01	156.43	174.24	176.17	76.47	78.73	84.34		
			•					Tota	I = Sum(2	19a) ₁₁₂ =	-		1306.32	(219)
Annua	Annual totals kWh/year												kWh/year	_
Space	heating	fuel use	ed, main	system	1						=		4103.55	1
												1		_

					7
Water heating fuel used				1306.32	
Electricity for pumps, fans and electric keep-hot					
mechanical ventilation - balanced, extract or pos	itive input from outsi	de	455.9]	(230a)
central heating pump:			30]	(230c)
boiler with a fan-assisted flue			45]	(230e)
Total electricity for the above, kWh/year	su	ım of (230a)(230g) =		530.9	(231)
Electricity for lighting				445.58	(232)
Total delivered energy for all uses (211)(221) +	(231) + (232)(237b	o) =		6386.35	(338)
12a. CO2 emissions – Individual heating systems	s including micro-CH	l P			
	Energy kWh/year	Emission fac kg CO2/kWh	ctor	Emissions kg CO2/yea	ır
Space heating (main system 1)	•		ctor =		ır](261)
Space heating (main system 1) Space heating (secondary)	kWh/year	kg CO2/kWh		kg CO2/yea	_
	kWh/year	kg CO2/kWh	=	kg CO2/yea	(261)
Space heating (secondary)	kWh/year (211) x (215) x	0.216 0.519 0.216	=	kg CO2/yea	(261)
Space heating (secondary) Water heating	kWh/year (211) x (215) x (219) x	0.216 0.519 0.216	=	kg CO2/yea 886.37 0 282.17	(261) (263) (264)
Space heating (secondary) Water heating Space and water heating	kWh/year (211) x (215) x (219) x (261) + (262) + (263)	kg CO2/kWh 0.216 0.519 0.216 + (264) =	= =	kg CO2/yea 886.37 0 282.17 1168.53	(261) (263) (264) (265)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-hot	kWh/year (211) x (215) x (219) x (261) + (262) + (263) - (231) x	kg CO2/kWh 0.216 0.519 0.216 + (264) =	= = =	kg CO2/yea 886.37 0 282.17 1168.53 275.54	(261) (263) (264) (265) (267)

El rating (section 14)

84

(274)

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 10:57:51

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:**

Flat

Total Floor Area: 52.98m²

Dwelling Details:

NEW DWELLING DESIGN STAGE

Site Reference: 231 Watford Road - LEAN **Plot Reference:** Sample 4

Address:

Client Details:

Name: Address:

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas

Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 17.47 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 15.62 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 35.9 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 27.6 kWh/m²

OK

2 Fabric U-values

Element Average Highest External wall 0.15 (max. 0.30) 0.16 (max. 0.70) OK Party wall 0.00 (max. 0.20) **OK**

Floor (no floor) Roof (no roof)

Openings 1.10 (max. 2.00) OK 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 3.50 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas

Data from manufacturer

Combi boiler

Efficiency 89.5 % SEDBUK2009

Minimum 88.0 %

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

OK

6 Controls			
Space heating controls Hot water controls:	TTZC by plumbing and e No cylinder thermostat No cylinder	electrical services	ок
Boiler interlock:	Yes		ок
7 Low energy lights			
Percentage of fixed lights with	n low-energy fittings	100.0%	
Minimum		75.0%	OK
8 Mechanical ventilation			
Continuous extract system			
Specific fan power:		1.05	
Maximum		0.7	Fail
9 Summertime temperature			
Overheating risk (Thames va	lley):	Slight	OK
Based on:			
Overshading:		Average or unknown	
Windows facing: South East		6.39m²	
Ventilation rate:		6.00	
10 Key features			
Air permeablility		3.5 m³/m²h	
Windows U-value		1.1 W/m²K	
Party Walls U-value		0 W/m²K	

Assessor Name: Neil Ingham Stroma Number: STRO010943 Software Name: Stroma FSAP 2012 Software Version: Version: 1.0.5.41
Software Name: Stroma FSAP 2012 Software Version: Version: 1.0.5.41 Property Address: Sample 4 Address: 1. Overall dwelling dimensions: Area(m²) Av. Height(m) Volume(m³) Ground floor 52.98 (1a) X 2.75 (2a) 145.69 (5) Dwelling volume (3a)+(3b)+(3c)+(3d)+(3e)+(3n) 145.69 (5) 2. Ventilation rate: main heating heating heating heating may per hour heating Number of open flues 0 + 0 = 0 x 40 = 0 (6a) Number of intermittent fans 0 x 10 = 0 (7a) Number of passive vents 0 x 10 = 0 (7b)
Address: 1. Overall dwelling dimensions: Area(m²)
Area(m²)
Area(m²)
Ground floor 52.98 (1a) x 2.75 (2a) = 145.69 (3a) Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+(1n) 52.98 (4) Dwelling volume $(3a)+(3b)+(3c)+(3d)+(3e)+(3n) = 145.69$ (5) 2. Ventilation rate: Main heating 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 0 x 10 = 0 (7a) Number of passive vents 0 x 10 = 0 (7b)
Total floor area TFA = $(1a)+(1b)+(1c)+(1d)+(1e)+(1n)$ Dwelling volume $(3a)+(3b)+(3c)+(3d)+(3e)+(3n) = 145.69 $ (5) 2. Ventilation rate: $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$
Dwelling volume $ (3a)+(3b)+(3c)+(3d)+(3e)+(3n) = 145.69 $ (5) $ \hline $
2. Ventilation rate: main heating heating 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 Number of passive vents 0 x 10 = 0 (7a)
Number of chimneys 0 + 0 + 0 + 0 = 0 x 40 = 0 (6a) Number of open flues 0 + 0 + 0 = 0 x 20 = 0 (6b) Number of intermittent fans 0 x 10 = 0 (7a) Number of passive vents 0 x 10 = 0 (7b)
Number of chimneys 0 + 0 + 0 + 0 + 0 + 0 - 0 (6a) Number of open flues 0 + 0 + 0 + 0 - 0 (6b) Number of intermittent fans 0 x 10 = 0 (7a) Number of passive vents 0 x 10 = 0 (7b)
Number of open flues 0 + 0 + 0 = 0
Number of intermittent fans $ \begin{array}{c ccccc} 0 & x & 10 & = & 0 & (7a) \\ \hline Number of passive vents & 0 & x & 10 & = & 0 & (7b) \end{array} $
Number of passive vents 0 x 10 = 0 (7b)
Air changes per hour
Infiltration due to chimneys, flues and fans = $(6a)+(6b)+(7a)+(7b)+(7c) = 0$ $\div (5) = 0$ (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16) Number of storeys in the dwelling (ns) 0 (9)
Number of storeys in the dwelling (ns) Additional infiltration [(9)-1]x0.1 = 0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)
If no draught lobby, enter 0.05, else enter 0
Percentage of windows and doors draught stripped 0 (14)
Window infiltration $0.25 - [0.2 \times (14) \div 100] = 0 \tag{15}$
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 3.5 (17) If based on air permeability value, then $(18) = [(17) \div 20] + (8)$, otherwise $(18) = (16)$ 0.18
If based on air permeability value, then $(18) = [(17) \div 20] + (8)$, otherwise $(18) = (16)$ Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used
Number of sides sheltered 0 (19)
Shelter factor $(20) = 1 - [0.075 \times (19)] = 1$ (20)
Infiltration rate incorporating shelter factor $(21) = (18) \times (20) = 0.18$ (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 $(22a)m = (22)m \div 4$
(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 infiltra	ation rat	e (allowi	ng for sh	nelter an	d wind s	speed) =	(21a) x	(22a)m					
0.22	0.22	0.21	0.19	0.19	0.17	0.17	0.16	0.18	0.19	0.2	0.21]	
Calculate effect		_	rate for t	he appli	cable ca	se	-	-	-			0.5	(23a)
If exhaust air he			endix N, (2	3b) = (23a	a) × Fmv (e	equation (I	N5)) , othe	rwise (23b) = (23a)			0.5	(23b)
If balanced with		0 11		, ,	, ,	. ,	,, .	`	, , ,			0.5	(23c)
a) If balance	d mecha	anical ve	ntilation	with he	at recove	erv (MVI	HR) (24a	a)m = (2)	2b)m + (23b) x [1 – (23c)		(200)
(24a)m= 0	0	0	0	0	0	0	0	0	0	0	0]	(24a)
b) If balance	d mech	anical ve	ntilation	without	heat red	overy (N	лV) (24t	m = (22)	2b)m + (23b)	·	•	
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0]	(24b)
c) If whole h if (22b)n				•					.5 × (23b	D)	•	•	
(24c)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5]	(24c)
d) If natural if (22b)n									0.5]	•	•	•	
(24d)m= 0	0	0	0	0	0	0	0	0	0	0	0]	(24d)
Effective air	change	rate - er	iter (24a) or (24b	o) or (24	c) or (24	d) in box	(25)				_	
(25)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(25)
3. Heat losse	s and he	eat loss p	paramete	er:									
ELEMENT	Gros	·	Openin		Net Ar	ea	U-val	ıe	AXU		k-value		ΑΧk
	area	(m²)	m	²	A ,r		W/m2		(W/	K)	kJ/m²-	K	kJ/K
Windows					6.39	x1	/[1/(1.1)+	0.04] =	6.73	ᆜ .			(27)
Walls Type1	22.1	7	6.39		15.78	3 X	0.16	=	2.52		60	94	6.8 (29)
Walls Type2	17.2	22	0		17.22	2 x	0.15	=	2.58		60	103	33.2 (29)
Total area of e	lements	, m²			39.39								(31)
Party wall					46.48	3 X	0	=	0		45	209	1.6 (32)
Party floor					52.98	3					40	211	9.2 (32a)
Party ceiling					52.98	3					30	158	(32b)
Internal wall **					97.63	3					9	878	3.67 (32c)
* for windows and ** include the area						ated using	formula 1	/[(1/U-valu	ıe)+0.04] a	as given in	paragraph	1 3.2	
Fabric heat los				is anu pan	uuoris		(26)(30)	+ (32) =				11.84	(33)
Heat capacity		•	0)				, , , ,		(30) + (32	2) + (32a).	(32e) =	8658.87	
Thermal mass		,	P = Cm -	- TFA) ir	n kJ/m²K			,,,,,	÷ (4) =	_,	()	163.44	(35)
For design assess	•	`		,			ecisely the	` '	. ,	TMP in T	able 1f	100.44	(00)
can be used inste													
Thermal bridge	•	,			•	<						6.45	(36)
if details of therma Total fabric he		are not kn	own (36) =	= 0.05 x (3	1)			(33) +	(36) =			18.29	(37)
Ventilation hea	at loss ca	alculated	l monthly	/				(38)m	= 0.33 × ((25)m x (5))	10.20	`` ′
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec]	
(38)m= 24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	1	(38)
Heat transfer of	coefficier	nt, W/K					•	(39)m	= (37) + (38)m	•	•	
(39)m= 42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33]	
							•		- Δverage –	Sum(39) ₁	/12-	42.33	(39)

Heat loss para	meter (l	HLP). W/	m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8		
()										Sum(40) ₁ .		0.8	(40)
Number of day	s in mo	nth (Tabl	e 1a)							, ,	L		
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 heat	ing ene	ray requi	rement:								kWh/ye	ear:	
Assumed occu if TFA > 13.9 if TFA £ 13.9	0, N = 1		[1 - exp	(-0.0003	49 x (TF	FA -13.9))2)] + 0.0	0013 x (⁻	TFA -13		78		(42)
Annual average Reduce the annua									se target o		.43		(43)
not more that 125	litres per	person per	day (all w	ater use, l	not and co	ld)							
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in	litres pe	day for ea	ch month	Vd,m = fa	ctor from	Table 1c x	(43)		•	•			
(44)m= 84.07	81.01	77.96	74.9	71.84	68.78	68.78	71.84	74.9	77.96	81.01	84.07		
									Total = Su	m(44) ₁₁₂ =	=	917.12	(44)
Energy content of	hot water	used - cald	culated mo	onthly = 4.	190 x Vd,r	n x nm x D	Tm / 3600) kWh/mor	nth (see Ta	ables 1b, 1	c, 1d)		
(45)m= 124.67	109.04	112.52	98.1	94.13	81.22	75.27	86.37	87.4	101.86	111.18	120.74		_
									Total = Su	m(45) ₁₁₂ =	=	1202.49	(45)
If instantaneous w	ater heati	ng at point	of use (no) hot water	storage),	enter 0 in	boxes (46)) to (61)	i				
(46)m= 18.7	16.36	16.88	14.71	14.12	12.18	11.29	12.96	13.11	15.28	16.68	18.11		(46)
Water storage Storage volume		includin	a any c	olar or M	/\/\LDC	ctorogo	within co	amo voc	col				(47)
•	` '		•			_		airie ves	361		0		(47)
If community he Otherwise if no	•			•			` '	ers) ente	er 'O' in <i>(</i>	(47)			
Water storage			. (o. o, o		,			
a) If manufacto	urer's d	eclared lo	oss facto	or is kno	wn (kWł	n/day):					0		(48)
Temperature fa	actor fro	m Table	2b								0		(49)
Energy lost from	m watei	storage	, kWh/ye	ear			(48) x (49)) =			0		(50)
b) If manufacti			-										
Hot water stora	-			e 2 (kWl	n/litre/da	ıy)					0		(51)
If community he Volume factor	_		on 4.3										(50)
Temperature fa			2h								0		(52) (53)
Energy lost from				aar			(47) x (51)) v (52) v (53) -				` '
Enter (50) or (•	, KVVII/yt	zai			(4 7) X (31)) X (32) X (55) =		0		(54) (55)
Water storage	, ,	,	or each	month			((56)m = (55) × (41):	m		<u> </u>		(00)
	0				0				1				(56)
(56)m= 0 If cylinder contains		0 d solar stor	0 age, (57)	0 m = (56)m	0 x [(50) – (0 H11)] ÷ (5	0 0), else (5	0 7)m = (56)	m where (0 (H11) is fro	0 m Appendi	ix H	(30)
(57)m= 0	0	0	0	0	0	0	0	0	0	0	0		(57)
Primary circuit	loss (ar	nual) fro	m Table	3							0		(58)
Primary circuit				•	•	. ,	, ,						
(modified by		rom Tabl		here is s				cylinde	r thermo	stat)			
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

Combi loss calculated for each month (6	$(1)m = (60) \div 365 \times (4)$	1)m				
(61)m= 42.84 37.29 39.73 36.94	36.61 33.92 35.05	36.61 36.94	39.73 39.95	42.84		(61)
Total heat required for water heating cale	culated for each mont	$n (62)m = 0.85 \times$	(45)m + (46)m +	(57)m +	(59)m + (61)m	
(62)m= 167.51 146.33 152.24 135.03	130.74 115.14 110.32	122.98 124.34	141.58 151.14	163.58		(62)
Solar DHW input calculated using Appendix G or A	Appendix H (negative quant	ty) (enter '0' if no sola	ar contribution to wat	er heating)	I	
(add additional lines if FGHRS and/or W	WHRS applies, see A	ppendix G)				
(63)m= 0 0 0 0	0 0 0	0 0	0 0	0		(63)
FHRS 106.82 78.54 64.44 36.06	20.17 10.02 9.28	10.66 10.79	35.87 73.71	105.11		(63) (G2)
Output from water heater						
(64)m= 58.81 66.15 86.05 97.35	108.95 103.64 99.5	110.71 111.92	103.96 75.66	56.59		
<u> </u>	•	Output from w	vater heater (annual)	112	1079.28	(64)
Heat gains from water heating, kWh/mor	nth 0.25 ´ [0.85 × (45)r	m + (61)m] + 0.8	x [(46)m + (57)m	+ (59)m]	
(65)m= 52.16 45.58 47.34 41.85	40.45 35.49 33.79	37.87 38.29	43.8 46.96	50.86		(65)
include (57)m in calculation of (65)m c	only if cylinder is in the	dwelling or hot w	vater is from com	munity h	eating	
5. Internal gains (see Table 5 and 5a):						
Metabolic gains (Table 5), Watts						
Jan Feb Mar Apr	May Jun Jul	Aug Sep	Oct Nov	Dec		
(66)m= 88.9 88.9 88.9 88.9	88.9 88.9 88.9	88.9 88.9	88.9 88.9	88.9		(66)
Lighting gains (calculated in Appendix L,	equation L9 or L9a),	also see Table 5	'	•	I	
(67)m= 15.32 13.6 11.06 8.38	6.26 5.29 5.71	7.42 9.96	12.65 14.77	15.74		(67)
Appliances gains (calculated in Appendix	x L, equation L13 or L	13a), also see Ta	able 5		I	
(68)m= 154.97 156.57 152.52 143.9	133.01 122.77 115.93	114.32 118.38	127 137.89	148.13		(68)
Cooking gains (calculated in Appendix L	, equation L15 or L15	a), also see Table	e 5		J	
(69)m= 31.89 31.89 31.89 31.89	31.89 31.89 31.89	31.89 31.89	31.89 31.89	31.89		(69)
Pumps and fans gains (Table 5a)	! !	!			I	
(70)m= 3 3 3 3 3	3 3 3	3 3	3 3	3		(70)
Losses e.g. evaporation (negative values	s) (Table 5)	•			I	
	-71.12 -71.12 -71.12	-71.12 -71.12	-71.12 -71.12	-71.12		(71)
Water heating gains (Table 5)	! !				I	
(72)m= 70.11 67.82 63.63 58.13	54.37 49.29 45.42	50.9 53.19	58.87 65.22	68.35		(72)
Total internal gains =	(66)m + (67)	m + (68)m + (69)m +	(70)m + (71)m + (72)m	ı	
(73)m= 293.07 290.67 279.89 263.07	246.3 230.01 219.73	225.32 234.2	251.2 270.55	284.9		(73)
6. Solar gains:						
Solar gains are calculated using solar flux from T	able 6a and associated equ	ations to convert to the	he applicable orienta	tion.		
Orientation: Access Factor Area	Flux	g_	FF		Gains	
Table 6d m²	Table 6a	Table 6b	Table 6c		(W)	
Southeast 0.9x 0.77 x 6.39	x 36.79	x 0.63	x 0.7	=	71.85	(77)
Southeast 0.9x 0.77 x 6.39	x 62.67	× 0.63	x 0.7		122.39	(77)
		_				
Southeast 0.9x 0.77 x 6.39	x 85.75	× 0.63	× 0.7	=	167.46	(77)

Southeas	t _{0.9x}	0.77	X	6.3	39	X	1	19.01	x		0.63	x	0.7	=	232.41	(77)
Southeas	t _{0.9x}	0.77	X	6.3	39	X	1	18.15	X		0.63	x	0.7	=	230.73	(77)
Southeas	t _{0.9x}	0.77	X	6.3	39	X	1	13.91	X		0.63	x	0.7	=	222.45	(77)
Southeas	t _{0.9x}	0.77	X	6.3	39	X	10	04.39	x		0.63	x	0.7	=	203.86	(77)
Southeas	t _{0.9x}	0.77	X	6.3	39	X	9	2.85	X		0.63	x	0.7	=	181.33	(77)
Southeas	t _{0.9x}	0.77	X	6.3	39	X	6	9.27	X		0.63	x	0.7	=	135.27	(77)
Southeas	t 0.9x	0.77	X	6.3	39	X	4	4.07	X		0.63	x	0.7	=	86.06	(77)
Southeas	t _{0.9x}	0.77	x	6.3	39	X	3	1.49	x		0.63	x	0.7		61.49	(77)
									•							
Solar gai	ins in v	vatts, ca	alculated	d for eac	h month	1			(83)m	ı = Sı	um(74)m .	(82)m				
—	71.85	122.39	167.46	207.5	232.41	$\overline{}$	30.73	222.45	203	.86	181.33	135.27	86.06	61.49		(83)
Total gai	ns – in	iternal a	nd sola	r (84)m =	= (73)m	+ (8	83)m	, watts					•	•	•	
(84)m= 3	864.92	413.07	447.35	470.56	478.72	4	60.74	442.18	429	.18	415.53	386.47	356.61	346.39		(84)
7. Mear	n interr	nal temn	erature	(heating	seasor	n)									•	
		· ·		eriods in			area f	from Tab	ole 9.	. Th	1 (°C)				21	(85)
•		Ū	٠.	living are		·			J.O 0	,	. ()					(55)
	Jan	Feb	Mar	Apr	May	Ť	Jun	Jul	Α	ug	Sep	Oct	Nov	Dec]	
<u> </u>	0.98	0.96	0.93	0.86	0.74	+	0.57	0.42	0.4	_	0.66	0.88	0.96	0.98		(86)
` ′				<u> </u>	ļ			ļ	<u> </u>	!		0.00	1 0.00	1 0.00		, ,
	- 1			living ar	· `	_		i –	ı —				1	T	1	(07)
(87)m= 2	20.06	20.24	20.47	20.71	20.89	2	20.98	21	20.	99	20.95	20.73	20.34	20.01		(87)
Temper	rature o	during h	eating p	eriods ir	rest of	dw	elling	from Ta	ble 9	9, Tr	n2 (°C)				,	
(88)m= 2	20.25	20.25	20.25	20.25	20.25	2	20.25	20.25	20.	25	20.25	20.25	20.25	20.25		(88)
Utilisatio	on fact	or for g	ains for	rest of d	welling,	h2,	m (se	e Table	9a)							
(89)m=	0.98	0.96	0.92	0.84	0.7		0.51	0.35	0.3	88	0.6	0.85	0.95	0.98		(89)
Mean in	nternal	temper	ature in	the rest	of dwell	lina	T2 (f	ollow ste	ns 3	to 7	7 in Tahl	e 9c)	•	•	•	
													19.41	18.92]	(90)
						1			<u> </u>	!			ing area ÷ (0.4	(91)
									,,							` ′
			<u> </u>	r the wh	ole dwe	_	-	r	`	$\overline{}$		00.00	10.70	1000	1	(02)
` ′	19.43	19.65	19.94	20.24			20.53	20.55	20.		20.51	20.26	19.78	19.36		(92)
· · · · · ·	19.28	19.5	ne mear 19.79	interna 20.09	20.29	_	0.38	20.4	4e, 20		20.36	20.11	19.63	19.21	1	(93)
` '				L	20.29		.0.36	20.4	20	.4	20.30	20.11	19.03	19.21		(55)
8. Spac					ro obtoi	200	ot ot	on 11 of	Tobl	0 Oh	oo tha	t Ti m-	-(76)m on	d ro cold	nulata	
				using Ta		nea	al Si	ғр п о	ıabı	e ar), 50 ilia	L 11,111=	:(76)m an	u re-caic	Julate	
	Jan	Feb	Mar	Apr	May	Γ	Jun	Jul	Α	ug	Sep	Oct	Nov	Dec		
Utilisatio						-			<u> </u>	<u> </u>	•				J	
(94)m=	0.97	0.95	0.91	0.83	0.7	1	0.52	0.36	0.3	39	0.61	0.84	0.95	0.97		(94)
Useful g	gains, l	hmGm ,	W = (9	4)m x (8	4)m	-		•					•	•	1	
(95)m= 3	353.46	391.04	405.71	390.47	334.32	2	39.13	160.15	168	.16	252.96	326.02	337.22	337.5		(95)
Monthly	/ avera	ige exte	rnal tem	perature	from T	abl	e 8								-	
(96)m=	4.3	4.9	6.5	8.9	11.7		14.6	16.6	16	.4	14.1	10.6	7.1	4.2		(96)
Heat los	ss rate	for mea	an interr	al temp	erature,	Lm	, W =	=[(39)m	x [(9:	3)m-	- (96)m]			-	
(97)m= 6	34.17	618.1	562.51	473.49	363.81	2	44.84	160.96	169	.36	264.98	402.48	530.59	635.41		(97)

Space heating requir	ement fo	or each n	nonth, k\	Wh/mon	th = 0.02	24 x [(97])m – (95)m] x (4	1)m			
(98)m= 208.84 152.59	116.66	59.78	21.93	0	0	0	0	56.89	139.22	221.64		
			•			Tota	l per year	(kWh/yeaı	r) = Sum(9	8) _{15,912} =	977.56	(98)
Space heating requir	ement in	kWh/m²	²/year								18.45	(99)
9a. Energy requireme	nts – Ind	ividual h	eating s	ystems i	ncluding	micro-C	CHP)					
Space heating:			, .							г		7 ,
Fraction of space he				mentary	•		(004)				0	(201)
Fraction of space he		•	. ,			(202) = 1 -		(000)1			1	(202)
Fraction of total heat	•	•				(204) = (204)	02) x [1 –	(203)] =			1	(204)
Efficiency of main sp					0.4						90.3	(206)
Efficiency of seconda	ary/suppl	ementar ı	y heatin	g systen	า, % เ						0	(208)
Jan Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ar
Space heating requir	116.66	59.78	21.93	0	0	0	0	56.89	139.22	221.64		
$(211)m = \{[(98)m \times (200)]\}$			<u> </u>				Ŭ	00.00	100.22	221.04		(211)
231.28 168.98	129.19	66.2	24.29	0	0	0	0	63	154.18	245.45		(211)
						Tota	l (kWh/yea	ar) =Sum(2	L 211) _{15,1012}	<u> </u>	1082.57	(211)
Space heating fuel (s	secondar	y), kWh/	month							L		_
$= \{[(98)m \times (201)]\} \times (201)$	100 ÷ (20	(8)										
(215)m= 0 0	0	0	0	0	0	0	0	0	0	0		_
						lota	I (kWh/yea	ar) =Sum(2	215) _{15,1012}	-	0	(215)
Water heating Output from water hea	ater (calc	ulated a	hove)									
58.81 66.15	86.05	97.35	108.95	103.64	99.5	110.71	111.92	103.96	75.66	56.59		
Efficiency of water hea	ater	•		•	•	•	•		•		81	(216)
(217)m= 88.08 87.27	86.1	84.3	82.42	81	81	81	81	84.06	86.79	88.24		(217)
Fuel for water heating												
(219)m = (64) m x 10 (219)m = 66.77 75.79	99.94	115.47	132.19	127.95	122.84	136.67	138.18	123.67	87.18	64.13		
`	1		<u> </u>	Į		Tota	I = Sum(2	19a) ₁₁₂ =	<u> </u>		1290.78	(219)
Annual totals								k'	Wh/year	_	kWh/year	
Space heating fuel us	ed, main	system	1								1082.57	
Water heating fuel use	ed									[1290.78	
Electricity for pumps,	fans and	electric	keep-ho	t								
mechanical ventilation	n - balan	nced, ext	ract or p	ositive ii	nput fron	n outside	Э			261.29		(230a)
central heating pump):									30		(230c)
boiler with a fan-assi	sted flue									45		(230e)
Total electricity for the	abovo I						of (220a)	(220a) -				(231)
•	above, i	kWh/yea	l I			Sum	UI (230a).	(230g) =		l	336.29	(231)
Electricity for lighting	above, i	kWh/yea	l i			Sum	01 (230a).	(230g) =		L T	270.51	(232)
Electricity for lighting Total delivered energy		·		+ (231)	+ (232)			(230g) =		[[╡

12a. CO2 emissions – Individual heating systems	s including micro-CHP		
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	233.83 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216	278.81 (264)
Space and water heating	(261) + (262) + (263) + (264) =		512.64 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	174.53 (267)
Electricity for lighting	(232) x	0.519	140.39 (268)
Total CO2, kg/year	sum	n of (265)(271) =	827.57 (272)
Dwelling CO2 Emission Rate	(272	2) ÷ (4) =	15.62 (273)
EI rating (section 14)			89 (274)

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 10:57:50

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:** Flat

Dwelling Details:

Site Reference:

NEW DWELLING DESIGN STAGE

Total Floor Area: 74.55m² **Plot Reference:** Sample 5

Address:

Client Details:

Name: Address:

This report covers items included within the SAP calculations.

231 Watford Road - LEAN

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas

Fuel factor: 1.00 (mains gas)

16.23 kg/m² Target Carbon Dioxide Emission Rate (TER)

Dwelling Carbon Dioxide Emission Rate (DER) 14.53 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 39.5 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 30.6 kWh/m²

2 Fabric U-values

Element Average Highest

External wall 0.16 (max. 0.30) 0.16 (max. 0.70) OK Party wall 0.00 (max. 0.20) **OK**

Floor (no floor) Roof (no roof)

Openings 1.10 (max. 2.00) OK 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 3.50 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas

Data from manufacturer

Combi boiler

Efficiency 89.5 % SEDBUK2009

Minimum 88.0 % OK

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

OK

6 Controls			
Space heating controls Hot water controls:	TTZC by plumbing and e No cylinder thermostat No cylinder	electrical services	ок
Boiler interlock:	Yes		ОК
7 Low energy lights			
Percentage of fixed lights wi	th low-energy fittings	100.0%	
Minimum		75.0%	OK
8 Mechanical ventilation			
Continuous extract system			
Specific fan power:		1.05	
Maximum		0.7	Fail
9 Summertime temperature			
Overheating risk (Thames va	alley):	Slight	OK
Based on:			
Overshading:		Average or unknown	
Windows facing: South East		12.79m²	
Windows facing: South		1.28m²	
Ventilation rate:		6.00	
10 Key features			
Air permeablility		3.5 m³/m²h	
Windows U-value		1.1 W/m²K	
Party Walls U-value		0 W/m²K	

		l Iser I	Details:						
Assessor Name: Software Name:	Neil Ingham Stroma FSAP 2012		Strom Softwa	are Ve	rsion:			010943 on: 1.0.5.41	
Address :	F	Property	Address	Sample	e 5				
1. Overall dwelling dime	nsions:								
		Are	a(m²)		Av. He	ight(m)	_	Volume(m ³	3)
Ground floor		7	74.55	(1a) x	2	2.75	(2a) =	205.01	(3a)
Total floor area TFA = (1a	a)+(1b)+(1c)+(1d)+(1e)+(1	n)	74.55	(4)					
Dwelling volume				(3a)+(3b)+(3c)+(3c	d)+(3e)+	.(3n) =	205.01	(5)
2. Ventilation rate:									
	main seconda heating heating	ry	other		total			m³ per hou	ır
Number of chimneys	0 + 0	+	0] = [0	X 4	40 =	0	(6a)
Number of open flues	0 + 0	+	0] = [0	x 2	20 =	0	(6b)
Number of intermittent far	ns			Ī	0	x '	10 =	0	(7a)
Number of passive vents				Ē	0	x '	10 =	0	(7b)
Number of flueless gas fin	res			Ē	0	X 4	40 =	0	(7c)
				_					
							Air ch	nanges per ho	our
•	/s, flues and fans = $(6a)+(6b)+(6b)+(6a)$				0		÷ (5) =	0	(8)
Number of storeys in the	een carried out or is intended, procee ne dwelling (ns)	ea to (17),	otnerwise (continue ir	om (9) to	(16)		0	(9)
Additional infiltration						[(9)	-1]x0.1 =	0	(10)
Structural infiltration: 0.	25 for steel or timber frame o	r 0.35 fo	r masonı	y constr	ruction			0	(11)
if both types of wall are pr deducting areas of openin	resent, use the value corresponding t	o the grea	ter wall are	a (after					
,	loor, enter 0.2 (unsealed) or 0	.1 (seale	ed), else	enter 0				0	(12)
If no draught lobby, ent	ter 0.05, else enter 0							0	(13)
Percentage of windows	s and doors draught stripped							0	(14)
Window infiltration			0.25 - [0.2	. ,	-			0	(15)
Infiltration rate			(8) + (10)					0	(16)
•	q50, expressed in cubic metro ity value, then $(18) = [(17) \div 20] + (18)$	•		•	etre of e	envelope	area	3.5	(17)
•	s if a pressurisation test has been do				is being u	sed		0.18	(18)
Number of sides sheltere		·	,	,	J			0	(19)
Shelter factor			(20) = 1 -	[0.0 75 x (1	19)] =			1	(20)
Infiltration rate incorporat			(21) = (18) x (20) =				0.18	(21)
Infiltration rate modified for	- 		1				1	1	
Jan Feb	Mar Apr May Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	- 1 1 - 1	T	T		T	1		1	
(22)m= 5.1 5	4.9 4.4 4.3 3.8	3.8	3.7	4	4.3	4.5	4.7		
Wind Factor (22a)m = (22	2)m ÷ 4								
(22a)m= 1.27 1.25	1.23 1.1 1.08 0.95	0.95	0.92	1	1.08	1.12	1.18		

Adjusted infiltra	ation rate	e (allowi	ng for sh	elter an	d wind s	speed) =	(21a) x	(22a)m				_	
0.22	0.22	0.21	0.19	0.19	0.17	0.17	0.16	0.18	0.19	0.2	0.21		
<i>Calcul<mark>ate effec</mark></i> If mechanica		_	rate for t	he appli	cable ca	se	-		-	-			
If exhaust air he			endix N (2	3b) = (23a	a) × Fmv (e	equation (N	N5)) other	wise (23h) = (23a)			0.5	(23
If balanced with		0 11		, ,	, ,	. ,	,, .	`) = (20a)			0.5	(23
		-	-	_					26\m . /	22h) [1 (226)	0	(23
a) If balance (24a)m= 0	0	o 0	0	0	0	0	1K) (24a	0	0	23b) x [0	- 100] 	(24
b) If balance						<u> </u>						J	(-
24b)m= 0	0	0	0	0	0	0	0	0	0	0	0	1	(24
c) If whole ho				-	ļ							J	•
if (22b)m				•					.5 × (23b	o)			
24c)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5]	(2
d) If natural v	/entilatio	on or wh	ole hous	e positiv	/e input	ventilatio	on from I	oft				ı	
if (22b)m				•	•				0.5]			_	
24d)m= 0	0	0	0	0	0	0	0	0	0	0	0		(2
Effective air	change	rate - er	iter (24a	or (24b	o) or (24	c) or (24	d) in box	(25)				-	
25)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(2
3. Heat losses	and he	eat loss r	paramete	er:									
LEMENT	Gros		Openin		Net Ar	ea	U-valı	ıe	ΑXU		k-value	e A	Χk
	area	(m²)	· m		A ,r	m²	W/m2	K .	(W/	K)	kJ/m²-l	K k	J/K
Vindows Type	1				12.79	x1.	/[1/(1.1)+	0.04] =	13.48				(2
Vindows Type	2				1.28	x1.	/[1/(1.1)+	0.04] =	1.35				(2
Valls Type1	41.8	5	14.0	7	27.78	3 x	0.16	=	4.44		60	1666.	8 (2
Valls Type2	24.3	7	0		24.37	7 X	0.15	=	3.65		60	1462.	2 (2
otal area of el	ements	, m²			66.22	2							— (3
Party wall					41.82	<u>x</u>	0		0	\neg [45	1881.	9 (3
Party floor					74.55	5					40	2982	(3
Party ceiling					74.55					Ì	30	2236.	5 (3
nternal wall **					131.1	_					9	1180.0	=
for windows and	roof windo	ows, use e	ffective wi	ndow U-va			formula 1	/[(1/U-valu	ıe)+0.04] á	L as given in			30 (0
* include the area								- 1	, -		, , ,		
abric heat los	s, W/K =	= S (A x	U)				(26)(30)	+ (32) =				22.92	(3
leat capacity (Cm = S(Axk)						((28).	.(30) + (32	2) + (32a).	(32e) =	11409.48	(3
hermal mass	parame	ter (TMF	P = Cm ÷	- TFA) ir	n kJ/m²K			= (34)	÷ (4) =			153.04	(3
or design assess an be used instea				constructi	ion are no	t known pr	ecisely the	indicative	values of	TMP in T	able 1f		
hermal bridge	s : S (L	x Y) cal	culated i	using Ap	pendix l	<						9.46	(3
details of therma	l bridging	are not kn	own (36) =	= 0.05 x (3	1)								
otal fabric hea	at loss							(33) +	(36) =			32.38	(3
entilation hea	t loss ca	alculated	monthly	/				(38)m	= 0.33 × (25)m x (5)	1	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83		(3
leat transfer c	oefficier	nt, W/K						(39)m	= (37) + (38)m			
39)m= 66.21	66.21	66.21	66.21	66.21	66.21	66.21	66.21	66.21	66.21	66.21	66.21		
					ww.stroma	•	•		Average =	0(00)	- 440	66.2 ≱ age	— 1.

Heat loss para	meter (H	HLP), W/	m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89		
L!								,	Average =	: Sum(40) _{1.}	12 /12=	0.89	(40)
Number of day		`	le 1a)										
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m= 31	28	31	30	31	30	31	31	30	31	30	31		(41)
4. Water heat	ing ene	rgy requi	rement:								kWh/ye	ar:	
Assumed occu	nancy	N									25		(42)
if TFA > 13.9 if TFA £ 13.9	N = 1		[1 - exp	(-0.0003	49 x (TF	FA -13.9))2)] + 0.0	0013 x (ΓFA -13		35		(42)
Annual average											.04		(43)
Reduce the annua not more that 125							o achieve	a water us	se target o	of Total			
								_		1			
Jan Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in							, ,		1				
(44)m= 99.05	95.45	91.85	88.24	84.64	81.04	81.04	84.64	88.24	91.85	95.45	99.05		_
Energy content of	hot water	used - cali	culated mo	onthly – 4	190 x Vd r	n x nm x F	Tm / 3600			ım(44) ₁₁₂ = ables 1b. 1	L	1080.53	(44)
										1			
(45)m= 146.89	128.47	132.57	115.58	110.9	95.7	88.68	101.76	102.97	120	130.99	142.25	4.440.75	(45)
If instantaneous w	ater heati	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46)		i otai = Su	ım(45) ₁₁₂ =	· L	1416.75	(45)
(46)m= 22.03	19.27	19.89	17.34	16.63	14.35	13.3	15.26	15.45	18	19.65	21.34		(46)
Water storage		15.05	17.54	10.00	14.00	10.0	13.20	10.40	10	13.03	21.04		(1.0)
Storage volume	e (litres)	includin	g any so	olar or W	/WHRS	storage	within sa	ame ves	sel		0		(47)
If community h	eating a	ınd no ta	nk in dw	elling, e	nter 110	litres in	(47)						
Otherwise if no	stored	hot wate	er (this in	icludes i	nstantar	eous co	mbi boil	ers) ente	er '0' in ((47)			
Water storage													
a) If manufacti	urer's de	eclared l	oss facto	or is kno	wn (kWł	n/day):					0		(48)
Temperature fa	actor fro	m Table	2b								0		(49)
Energy lost from		_	-				(48) x (49)) =			0		(50)
b) If manufactors Hot water stora			-										(54)
If community h	_			e z (KVVI	i/iiti e/ua	iy <i>)</i>					0		(51)
Volume factor	•		511 4.0								0		(52)
Temperature fa	actor fro	m Table	2b							_	0		(53)
Energy lost fro	m water	storage	, kWh/ye	ear			(47) x (51)) x (52) x (53) =		0		(54)
Enter (50) or (•	,							-	0		(55)
Water storage	loss cal	culated f	or each	month			((56)m = (55) × (41)ı	m				
(56)m= 0	0	0	0	0	0	0	0	0	0	0	0		(56)
If cylinder contains		-		-				-	_		_	хН	` '
(57)m= 0	0	0	0	0	0	0	0	0	0	0	0		(57)
Primary circuit	loss (ar	nual) fro	m Table	3							0		(58)
Primary circuit	•	•			59)m = ((58) ÷ 36	55 × (41)	m					
(modified by				,	•	. ,	, ,		r thermo	stat)			
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

Combi	loss ca	lculated	for each	month ((61)m =	(60) ÷ 36	65 × (41)m						
(61)m=	50.47	43.93	46.8	43.52	43.13	39.96	41.3	43.13	43.52	46.8	47.07	50.47		(61)
Total h	eat requ	uired for	water h	eating ca	alculated	for eacl	h month	(62)m =	0.85 × ((45)m +	(46)m +	(57)m +	ı (59)m + (61)m	
(62)m=	197.36	172.4	179.37	159.09	154.03	135.66	129.97	144.89	146.49	166.81	178.06	192.73		(62)
Solar DH	lW input	calculated	using App	endix G or	· Appendix	H (negati	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)	ı	
(add ad	dditiona	l lines if	FGHRS	and/or V	WWHRS	applies	, see Ap	pendix (G)					
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
FHRS	118.26	108.96	98.96	52.46	27.3	11.79	10.94	12.49	12.63	55.12	109.91	116.74	1	(63) (G2)
Output	from w	ater hea	ter										_	
(64)m=	76.88	61.51	78.35	104.72	124.83	122.12	117.21	130.5	131.95	109.63	66.08	73.77		_
		-	-	-	-	-	-	Outp	out from wa	ater heate	r (annual)₁	12	1197.54	(64)
Heat g	ains fro	m water	heating,	kWh/mo	onth 0.2	5 ´ [0.85	× (45)m	+ (61)m	n] + 0.8 x	د [(46)m	+ (57)m	+ (59)m]	
(65)m=	61.46	53.7	55.78	49.31	47.66	41.81	39.81	44.62	45.12	51.6	55.32	59.92		(65)
inclu	de (57)	m in cald	culation (of (65)m	only if c	ylinder i	s in the	dwelling	or hot w	ater is fr	om com	munity h	eating	
5. Int	ernal ga	ains (see	Table 5	and 5a):			-				·		
Metabo	olic gain	ıs (Table	5). Wat	ts										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m=	117.57	117.57	117.57	117.57	117.57	117.57	117.57	117.57	117.57	117.57	117.57	117.57		(66)
Lighting	g gains	(calcula	ted in Ar	pendix	L, equat	ion L9 o	r L9a), a	lso see	Table 5				J	
(67)m=	18.78	16.68	13.56	10.27	7.68	6.48	7	9.1	12.22	15.51	18.1	19.3		(67)
Appliar	nces ga	ins (calc	ulated ir	n Append	dix L, eq	uation L	13 or L1	3a), also	see Ta	ble 5	l			
(68)m=	207.68	209.83	204.4	192.84	178.25	164.53	155.37	153.21	158.64	170.2	184.8	198.51		(68)
Cookin	g gains	(calcula	ted in A	ppendix	L, equat	tion L15	or L15a), also se	ee Table	5			I	
(69)m=	34.76	34.76	34.76	34.76	34.76	34.76	34.76	34.76	34.76	34.76	34.76	34.76		(69)
Pumps	and fai	ns gains	(Table 5	.——— 5а)			!	!					J	
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3		(70)
Losses	e.g. ev	aporatio	n (nega	tive valu	es) (Tab	le 5)							I	
(71)m=	-94.05	-94.05	-94.05	-94.05	-94.05	-94.05	-94.05	-94.05	-94.05	-94.05	-94.05	-94.05		(71)
Water	heating	gains (T	able 5)		•	•			•				ı	
(72)m=	82.61	79.91	74.97	68.48	64.05	58.07	53.51	59.97	62.66	69.36	76.84	80.53		(72)
Total i	nternal	gains =				(66)	m + (67)m	n + (68)m -	- (69)m + ((70)m + (7	1)m + (72)	m	J	
(73)m=	370.33	367.69	354.21	332.86	311.25	290.35	277.14	283.55	294.79	316.34	341.01	359.62		(73)
6. Sol	ar gains	S:												
Solar g	ains are o	calculated	using sola	r flux from	Table 6a	and assoc	iated equa	itions to co	nvert to th	e applicat	le orientat	ion.		
Orienta	ation: A	Access F	actor	Area		Flu			g_		FF		Gains	
	7	Table 6d		m²		Tal	ble 6a	T	able 6b	T	able 6c		(W)	
Southea	ast _{0.9x}	0.77	X	12.	79	x 3	86.79	X	0.63	x	0.7	=	143.82	(77)
Southea	ast _{0.9x}	0.77	X	12.	79	x 6	32.67	x	0.63	_ x [0.7		244.98	(77)
Southea	ast _{0.9x}	0.77	х	12.	79	x 8	35.75	x	0.63	_ x _	0.7		335.19	(77)
Southea	ast _{0.9x}	0.77	x	12.	79	x 1	06.25	x	0.63	x	0.7		415.32	[(77)

Southeast 0.9x 0.77												
	X	12.7	' 9	X	119.01	X	0.63	X	0.7	=	465.19	(77)
Southeast 0.9x 0.77	X	12.7	' 9	x	118.15	X	0.63	X	0.7	=	461.82	(77)
Southeast 0.9x 0.77	X	12.7	' 9	x	113.91	X	0.63	x	0.7	=	445.25	(77)
Southeast 0.9x 0.77	X	12.7	' 9	x	104.39	×	0.63	x	0.7	=	408.04	(77)
Southeast 0.9x 0.77	x	12.7	'9	x	92.85	X	0.63	x	0.7	=	362.94	(77)
Southeast 0.9x 0.77	x	12.7	79	x	69.27	×	0.63	x	0.7	=	270.75	(77)
Southeast 0.9x 0.77	x	12.7	79	x	44.07	×	0.63	x	0.7	=	172.26	(77)
Southeast 0.9x 0.77	x	12.7	79	х	31.49	×	0.63	×	0.7		123.08	(77)
South 0.9x 0.77	x	1.28	8	x	46.75	×	0.63	x	0.7	=	18.29	(78)
South 0.9x 0.77	х	1.28	8	x	76.57	×	0.63	x	0.7	=	29.95	(78)
South 0.9x 0.77	x	1.28	8	х	97.53	×	0.63	×	0.7		38.15	(78)
South 0.9x 0.77	x	1.28	8	х	110.23	×	0.63	×	0.7		43.12	(78)
South 0.9x 0.77	x	1.28	8	х	114.87	×	0.63	×	0.7	=	44.94	(78)
South 0.9x 0.77	x	1.28	8	х	110.55	×	0.63	×	0.7	=	43.24	(78)
South 0.9x 0.77	x	1.28	8	х	108.01	×	0.63	×	0.7	=	42.25	(78)
South 0.9x 0.77	x	1.28	8	x	104.89	×	0.63	×	0.7	=	41.03	(78)
South 0.9x 0.77	x	1.28	8	x	101.89	×	0.63	×	0.7	=	39.86	(78)
South 0.9x 0.77	x	1.28	8	х	82.59	X	0.63	×	0.7	=	32.31	(78)
South 0.9x 0.77	x	1.28	8	х	55.42	×	0.63	×	0.7	=	21.68	(78)
South 0.9x 0.77	x	1.28	8	х	40.4	×	0.63	×	0.7	=	15.8	(78)
				٠				_				
Solar gains in watts, c	alculated	for each	n month	1		(83)m	n = Sum(74)m	.(82)m				
Solar gains in watts, c (83)m= 162.11 274.93	alculated 373.34	for each 458.44	month 510.12	$\overline{}$	05.07 487.5	(83)m 449		303.0	1	138.88	1	(83)
	373.34	458.44	510.12	50		ì		<u> </u>	1	138.88]	(83)
(83)m= 162.11 274.93	373.34	458.44	510.12	50 + (8		449	.07 402.79	<u> </u>	6 193.94	138.88]	(83) (84)
(83)m= 162.11 274.93 Total gains – internal	373.34 and solar 727.55	458.44 (84)m = 791.3	510.12 (73)m 821.37	50 + (8	33)m , watts	449	.07 402.79	303.0	6 193.94]	, ,
(83)m= 162.11 274.93 Total gains – internal 3 (84)m= 532.44 642.62	373.34 and solar 727.55 perature	458.44 (84)m = 791.3 (heating	510.12 (73)m 821.37 season	50 + (8 79	33)m , watts 95.42 764.64	732	.63 697.59	303.0	6 193.94		21	, ,
(83)m= 162.11 274.93 Total gains – internal (84)m= 532.44 642.62 7. Mean internal tem	373.34 and solar 727.55 perature neating p	458.44 (84)m = 791.3 (heating eriods in	510.12 (73)m 821.37 season the livit	50 + (8 79 ng a	33)m , watts 95.42	732 able 9	.63 697.59	303.0	6 193.94		21	(84)
(83)m= 162.11 274.93 Total gains – internal (84)m= 532.44 642.62 7. Mean internal tem Temperature during	373.34 and solar 727.55 perature neating p	458.44 (84)m = 791.3 (heating eriods in	510.12 (73)m 821.37 season the livit	50 + (8 79 ng an (se	33)m , watts 95.42	732 able 9	.63 697.59	303.0	534.95		21	(84)
(83)m= 162.11 274.93 Total gains – internal (84)m= 532.44 642.62 7. Mean internal tem Temperature during Utilisation factor for g	373.34 and solar 727.55 perature neating plains for I	458.44 (84)m = 791.3 (heating eriods in iving are	510.12 (73)m - 821.37 season the living a, h1,m	50 + (8 79 n) ng a	33)m , watts 95.42 764.64 area from Ta	732 able 9	.63 697.59 , Th1 (°C)	303.0	534.95	498.5	21	(84)
(83)m= 162.11 274.93 Total gains – internal (84)m= 532.44 642.62 7. Mean internal tem Temperature during Utilisation factor for gain Jan Feb (86)m= 0.98 0.95	373.34 and solar 727.55 Derature the eating plains for I Mar 0.9	458.44 (84)m = 791.3 (heating eriods in iving are Apr 0.81	510.12 (73)m - 821.37 season the living a, h1,m May 0.68	50 + (8 79))) mg a (se	33)m , watts 95.42 764.64 area from Ta ee Table 9a) Jun Jul 0.51 0.38	732 able 9	.07 402.79 .63 697.59 , Th1 (°C) ug Sep	303.00 619.4	534.95 Nov	498.5 Dec	21	(84)
(83)m= 162.11 274.93 Total gains – internal (84)m= 532.44 642.62 7. Mean internal tem Temperature during Utilisation factor for g	373.34 and solar 727.55 Derature the eating plains for I Mar 0.9	458.44 (84)m = 791.3 (heating eriods in iving are Apr 0.81	510.12 (73)m - 821.37 season the living a, h1,m May 0.68	50 + (8 79)) nng a (se ollow) collow	33)m , watts 95.42 764.64 area from Ta ee Table 9a) Jun Jul 0.51 0.38	732 able 9	.07 402.79 .63 697.59 , Th1 (°C) ug Sep 11 0.61 Table 9c)	303.00 619.4	534.95 Nov 0.95	498.5 Dec	21	(84)
(83)m= 162.11 274.93 Total gains – internal (84)m= 532.44 642.62 7. Mean internal tem Temperature during Utilisation factor for Quality Jan Feb (86)m= 0.98 0.95 Mean internal tempe (87)m= 19.86 20.11	and solar 727.55 perature neating plains for I Mar 0.9 rature in I 20.41	458.44 (84)m = 791.3 (heating eriods in iving are 0.81 iving are 20.69	510.12 (73)m - 821.37 season the living a, h1,m May 0.68 ea T1 (for 20.88	500 + (86 79 79 79 79 79 79 79 79 79 79 79 79 79	33)m , watts 95.42	732 able 9 A 0.4 7 in 1 20.	.07 402.79 .63 697.59 , Th1 (°C) ug Sep 10.61 Table 9c) 99 20.94	303.0 619.4 Oct 0.85	534.95 Nov 0.95	498.5 Dec 0.98	21	(84)
(83)m= 162.11 274.93 Total gains – internal (84)m= 532.44 642.62 7. Mean internal tem Temperature during Utilisation factor for gains – internal tem Utilisation factor for gains – internal tempe (86)m= 0.98 0.95 Mean internal tempe (87)m= 19.86 20.11 Temperature during 19.86 20.11	and solar reature the eating plains for I Mar 0.9 reature in I 20.41	458.44 (84)m = 791.3 (heating eriods in iving are 0.81 iving are 20.69 eriods in	510.12 (73)m - 821.37 season the livina, h1,m May 0.68 ea T1 (for 20.88 rest of	500 + (86 79 0))	33)m , watts 95.42	732 able 9 A 0.4 7 in 1 20.	.07 402.79 .63 697.59 , Th1 (°C) ug Sep 11 0.61 Table 9c) 99 20.94 9, Th2 (°C)	303.0 619.4 Oct 0.85	193.94 534.95 Nov 0.95	Dec 0.98	21	(84) (85) (86) (87)
(83)m= 162.11 274.93 Total gains – internal (84)m= 532.44 642.62 7. Mean internal tem Temperature during Utilisation factor for gain (86)m= 0.98 0.95 Mean internal tempe (87)m= 19.86 20.11 Temperature during (88)m= 20.18 20.18	and solar reating p ains for I Mar 0.9 reature in I 20.41 neating p	458.44 (84)m = 791.3 (heating eriods in iving are 20.69 eriods in 20.18	510.12 (73)m - 821.37 season the living a, h1,m May 0.68 ea T1 (for 20.88 rest of 20.18	50	33)m , watts 95.42	732 able 9 A 0.4 7 in T 20. Table 9	.07 402.79 .63 697.59 , Th1 (°C) ug Sep 11 0.61 Table 9c) 99 20.94 9, Th2 (°C)	303.0 619.4 Oct 0.85	193.94 534.95 Nov 0.95	498.5 Dec 0.98	21	(84)
(83)m= 162.11 274.93 Total gains – internal (84)m= 532.44 642.62 7. Mean internal tem Temperature during Utilisation factor for Q Jan Feb (86)m= 0.98 0.95 Mean internal tempe (87)m= 19.86 20.11 Temperature during (88)m= 20.18 20.18 Utilisation factor for Q	and solar reature neating p ains for I Mar 0.9 rature in I 20.41 neating p	458.44 (84)m = 791.3 (heating eriods in iving are Apr 0.81 iving are 20.69 eriods in 20.18	510.12 (73)m = 821.37 season the living a, h1,m	50 + (8 79 79 79 79 79 79 79 79 79 79 79 79 79	33)m , watts 95.42	732 able 9 A 0.4 7 in T 20. able 9 20. e 9a)	.07 402.79 .63 697.59 , Th1 (°C) ug Sep 10.61 Table 9c) 99 20.94 9, Th2 (°C) 18 20.18	303.0 619.4 Oct 0.85 20.68	193.94 534.95 Nov 0.95 20.2	Dec 0.98 19.78	21	(84) (85) (86) (87) (88)
(83)m= 162.11 274.93 Total gains – internal (84)m= 532.44 642.62 7. Mean internal tem Temperature during Utilisation factor for Quality Jan Feb (86)m= 0.98 0.95 Mean internal tempe (87)m= 19.86 20.11 Temperature during (88)m= 20.18 20.18 Utilisation factor for Quality 0.97 0.94	and solar reature meating plains for I Mar 0.9 rature in I 20.41 neating p 20.18 anins for r 0.88	458.44 (84)m = 791.3 (heating eriods in iving are	510.12 (73)m = 821.37 season the living a, h1,m	50	33)m , watts 95.42	732 able 9 A 0.2 7 in T 20. able 9 0.3	.07 402.79 .63 697.59 , Th1 (°C) ug Sep 1 0.61 Table 9c) 99 20.94 9, Th2 (°C) 18 20.18	303.0 619.4 Oct 0.85 20.68	193.94 534.95 Nov 0.95	Dec 0.98	21	(84) (85) (86) (87)
(83)m= 162.11 274.93 Total gains – internal (84)m= 532.44 642.62 7. Mean internal tem Temperature during Utilisation factor for gain Jan Feb (86)m= 0.98 0.95 Mean internal tempe (87)m= 19.86 20.11 Temperature during (88)m= 20.18 20.18 Utilisation factor for gain (89)m= 0.97 0.94 Mean internal tempe	and solar reature in eating p ains for I Mar 0.9 reature in I 20.41 neating p 20.18 ains for r 0.88	458.44 (84)m = 791.3 (heating eriods in iving are Apr 0.81 iving are 20.69 eriods in 20.18 est of dw 0.78 the rest of	510.12 (73)m = 821.37 season the livina, h1,m May 0.68 ea T1 (for 20.88 rest of 20.18 velling, 0.63 of dwelling	50	33)m , watts 95.42	732 able 9 A 0.4 7 in T 20. cable 9 0.3 teps 3	.07 402.79 .63 697.59 .63 Sep .7 0.61 .64 0.61 .65 .65 0.65 .66 0.55 .66 7 10 Table	303.0 619.4 Oct 0.85 20.68 20.18 0.82 e 9c)	193.94 534.95 Nov 0.95 20.2	Dec 0.98 19.78 20.18	21	(84) (85) (86) (87) (88) (89)
(83)m= 162.11 274.93 Total gains – internal (84)m= 532.44 642.62 7. Mean internal tem Temperature during Utilisation factor for Quality Jan Feb (86)m= 0.98 0.95 Mean internal tempe (87)m= 19.86 20.11 Temperature during (88)m= 20.18 20.18 Utilisation factor for Quality 0.97 0.94	and solar reature meating plains for I Mar 0.9 rature in I 20.41 neating p 20.18 anins for r 0.88	458.44 (84)m = 791.3 (heating eriods in iving are	510.12 (73)m = 821.37 season the living a, h1,m	50	33)m , watts 95.42	732 able 9 A 0.2 7 in T 20. able 9 0.3	.07 402.79 .63 697.59 .63 697.59 .7	303.0 619.4 Oct 0.85 20.68 20.18 0.82 e 9c)	193.94 534.95 Nov 0.95 20.2 3 20.18	19.78 20.18 0.98		(84) (85) (86) (87) (88) (89)
(83)m= 162.11 274.93 Total gains – internal (84)m= 532.44 642.62 7. Mean internal tem Temperature during Utilisation factor for gain Jan Feb (86)m= 0.98 0.95 Mean internal tempe (87)m= 19.86 20.11 Temperature during (88)m= 20.18 20.18 Utilisation factor for gain (89)m= 0.97 0.94 Mean internal tempe	and solar reature in eating p ains for I Mar 0.9 reature in I 20.41 neating p 20.18 ains for r 0.88	458.44 (84)m = 791.3 (heating eriods in iving are Apr 0.81 iving are 20.69 eriods in 20.18 est of dw 0.78 the rest of	510.12 (73)m = 821.37 season the livina, h1,m May 0.68 ea T1 (for 20.88 rest of 20.18 velling, 0.63 of dwelling	50	33)m , watts 95.42	732 able 9 A 0.4 7 in T 20. cable 9 0.3 teps 3	.07 402.79 .63 697.59 .63 697.59 .7	303.0 619.4 Oct 0.85 20.68 20.18 0.82 e 9c)	193.94 534.95 Nov 0.95 20.2	19.78 20.18 0.98	21	(84) (85) (86) (87) (88) (89)
(83)m= 162.11 274.93 Total gains – internal (84)m= 532.44 642.62 7. Mean internal tem Temperature during Utilisation factor for gain Jan Feb (86)m= 0.98 0.95 Mean internal tempe (87)m= 19.86 20.11 Temperature during (88)m= 20.18 20.18 Utilisation factor for gain (89)m= 0.97 0.94 Mean internal tempe	and solar reature neating p ains for I 0.9 rature in I 20.41 neating p 20.18 ains for r 0.88	458.44 (84)m = 791.3 (heating eriods in iving are 20.69 eriods in 20.18 est of dw 0.78 the rest of 19.82	510.12 (73)m + 821.37 season the living a, h1,m May 0.68 ea T1 (for 20.88 rest of 20.18 velling, 0.63 of dwelling 20.06	+ (8 79 1)) ng a 1 (see 1) cut dw. 20 1 h2, 1 1 cut dw. 20 1 cut dw	33)m , watts 95.42	732 able 9 A 0.4 7 in T 20. 5 able 9 0.3 teps 3	.07 402.79 .63 697.59 , Th1 (°C) ug Sep 1 0.61 Table 9c) 99 20.94 9, Th2 (°C) 18 20.18 34 0.55 10 7 in Table 17 20.13	303.0 619.4 Oct 0.85 20.68 20.18 0.82 e 9c)	193.94 534.95 Nov 0.95 20.2 3 20.18	19.78 20.18 0.98		(84) (85) (86) (87) (88) (89)
(83)m= 162.11 274.93 Total gains – internal (84)m= 532.44 642.62 7. Mean internal tem Temperature during (12) Utilisation factor for (2) Jan Feb (86)m= 0.98 0.95 Mean internal tempe (87)m= 19.86 20.11 Temperature during (88)m= 20.18 20.18 Utilisation factor for (89)m= 0.97 0.94 Mean internal tempe (90)m= 18.65 19.01	and solar reature neating p ains for I 0.9 rature in I 20.41 neating p 20.18 ains for r 0.88	458.44 (84)m = 791.3 (heating eriods in iving are 20.69 eriods in 20.18 est of dw 0.78 the rest of 19.82	510.12 (73)m + 821.37 season the living a, h1,m May 0.68 ea T1 (for 20.88 rest of 20.18 velling, 0.63 of dwelling 20.06	+ (86 / 79 / 79 / 79 / 79 / 79 / 79 / 79 / 7	33)m , watts 95.42	732 able 9 A 0.4 7 in T 20. 5 able 9 0.3 teps 3	.07 402.79 .63 697.59 .63 697.59 .7 h1 (°C) .63 Sep .7 h2 (°C) 303.0 619.4 Oct 0.85 20.68 20.18 0.82 e 9c)	193.94 534.95 Nov 0.95 20.2 20.18 0.94 19.15	19.78 20.18 0.98		(84) (85) (86) (87) (88) (89)	

(00)	40.00	40.0	40.07	00.04	00.04	00.00	00.05	00.05	00.0	00.04	10.44	40.00	1	(93)
(93)m=	18.98	19.3	19.67	20.01	20.24	20.33	20.35	20.35	20.3	20.01	19.41	18.89		(93)
			uirement				44 -4	Table O	41	4 T: /	70)	-11-	late	
			or gains	•		ed at ste	ер ттог	rable 9	o, so tha	t 11,m=(rojm an	d re-calc	culate	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
	ation fac	tor for g	ains, hm	1:									•	
(94)m=	0.96	0.93	0.87	0.78	0.64	0.47	0.32	0.35	0.56	0.81	0.93	0.97		(94)
Usefu			, W = (9 ²				T	,	1		1	1	ı	
(95)m=	512.21	596.56	634.89	614.75	522.18	370.16	246.71	259.07	390.9	501.43	499.52	483.26		(95)
	_	age exte	rnal tem	perature			•	,						
(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			i				-``	- ` 	– (96)m					
(97)m=	971.82	953.24	871.67	735.72	565.12	379.26	248.22	261.32	410.44	622.74	815.34	972.38		(97)
Space		<u> </u>	ı	r each n	nonth, k\	Wh/mont	th = 0.02	24 x [(97)m – (95	<u> </u>	r		ı	
(98)m=	341.94	239.69	176.17	87.1	31.95	0	0	0	0	90.26	227.39	363.91		_
								Tota	l per year	(kWh/yeaı	r) = Sum(9	8)15,912 =	1558.4	(98)
Space	e heatin	g require	ement in	kWh/m²	² /year								20.9	(99)
9a En	erav rea	uiremer	nts – Indi	ividual h	eating sy	vstems i	ncluding	micro-C	'HPI					
	e heatir		ito iriai	ividuai 11	caming 5	y Sterris II	ricidaling	inicio c	<i>/</i>					
-		•	at from s	econdar	v/supple	mentarv	svstem						0	(201)
			at from m			,	•	(202) = 1	- (201) =				1] (202)
			ng from	-	. ,				02) × [1 –	(203)] =			1	(204)
			ace heat	-				(-) (- / [(/1			90.3	(206)
	•	-	ry/suppl			a evetom	0/-						0](208)
LIIICIE				·				Ι	0	0.1	NI.			」` ′
Space	Jan	Feb	Mar ement (c	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ar
Space	341.94	239.69	176.17	87.1	31.95	0	0	0	0	90.26	227.39	363.91	1	
(0.1.1)				<u> </u>		U				90.20	221.55	303.91		
(211)m		•	(4)] } x 1	· `				Ι.					1	(211)
	378.68	265.44	195.09	96.45	35.38	0	0	0	0	99.96	251.81	403		7,
								Tota	ıl (kWh/yea	ar) =Sum(2	211) _{15,1012}	=	1725.81	(211)
•		`	econdar	• / ·	month									
			00 ÷ (20	r	_	_	T _	T _	I -		I -	I -	I	
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		7,
								Tota	I (kWh/yea	ar) =Sum(2	215) _{15,1012}	=	0	(215)
	heating													
Output			ter (calc			400.40	447.04	120.5	424.05	400.00	66.00	70.77		
⊏ #::	76.88	61.51	78.35	104.72	124.83	122.12	117.21	130.5	131.95	109.63	66.08	73.77		7(040)
İ		ater hea		1			1						81	(216)
(217)m=	88.44	88.23	87.22	84.97	82.74	81	81	81	81	84.95	88.02	88.59		(217)
		•	kWh/m(
(219)m=		69.71) ÷ (217) 89.83	123.23	150.87	150.76	144.71	161.12	162.9	129.05	75.07	83.27		
(= : •)			L	L			L	<u> </u>	I = Sum(2		L	L	1427.46	(219)
Δηημο	ıl totals								= _=		Wh/year		kWh/year	J(213)
		fuel use	ed, main	system	1					ĸ	• • i ii y c ai		1725.81	7
1	9		,	•										

					٦
Water heating fuel used				1427.46	
Electricity for pumps, fans and electric keep-hot					
mechanical ventilation - balanced, extract or pos	itive input from outside		367.67		(230a)
central heating pump:			30		(230c)
boiler with a fan-assisted flue			45		(230e)
Total electricity for the above, kWh/year	sum of (2	230a)(230g) =		442.67	(231)
Electricity for lighting				331.6	(232)
Total delivered energy for all uses (211)(221) +	(231) + (232)(237b) =			3927.54	(338)
12a. CO2 emissions – Individual heating system	s including micro-CHP				
	Energy kWh/year	Emission factor kg CO2/kWh	or	Emissions kg CO2/yea	ır
Space heating (main system 1)	3 7		or =		ır](261)
Space heating (main system 1) Space heating (secondary)	kWh/year	kg CO2/kWh		kg CO2/yea	7
	kWh/year (211) x	kg CO2/kWh	=	kg CO2/yea	(261)
Space heating (secondary)	kWh/year (211) x (215) x	0.216 0.519 0.216	=	kg CO2/yea	(261)
Space heating (secondary) Water heating	kWh/year (211) x (215) x (219) x	0.216 0.519 0.216	=	kg CO2/yea 372.77 0 308.33	(261) (263) (264)
Space heating (secondary) Water heating Space and water heating	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (264)	kg CO2/kWh 0.216 0.519 0.216	= = =	kg CO2/yea 372.77 0 308.33 681.11	(261) (263) (264) (265)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-hot	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (264) (231) x (232) x	kg CO2/kWh 0.216 0.519 0.216	= = =	kg CO2/yea 372.77 0 308.33 681.11 229.75	(261) (263) (264) (265) (267)

El rating (section 14)

88

(274)

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 10:57:49

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:**

Flat

Total Floor Area: 92.44m²

Dwelling Details:

Site Reference:

NEW DWELLING DESIGN STAGE

231 Watford Road - LEAN **Plot Reference:** Sample 6

Address:

Client Details:

Name: Address:

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas

Fuel factor: 1.00 (mains gas)

17.63 kg/m² Target Carbon Dioxide Emission Rate (TER)

Dwelling Carbon Dioxide Emission Rate (DER) 15.66 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 49.2 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 37.4 kWh/m²

OK

2 Fabric U-values

Element Average Highest External wall 0.15 (max. 0.30) 0.16 (max. 0.70) OK Party wall 0.00 (max. 0.20) **OK**

Floor (no floor) Roof (no roof)

Openings 1.10 (max. 2.00) OK 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 3.50 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas

Data from manufacturer

Combi boiler

Efficiency 89.5 % SEDBUK2009

Minimum 88.0 %

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

OK

6 Controls					
Space heating controls	TTZC by plumbing and e	lectrical services	OK		
Hot water controls:	No cylinder thermostat				
	No cylinder				
Boiler interlock:					
7 Low energy lights					
Percentage of fixed lights with	th low-energy fittings	100.0%			
Minimum		75.0%	OK		
8 Mechanical ventilation					
Continuous extract system					
Specific fan power:		1.05			
Maximum		0.7	Fail		
9 Summertime temperature					
Overheating risk (Thames va	alley):	Not significant	ок		
Based on:					
Overshading:		Average or unknown			
Windows facing: North East		3.85m²			
Windows facing: North West		5.11m²			
Ventilation rate:		6.00			
10 Key features					
Air permeablility		3.5 m³/m²h			
Windows U-value		1.1 W/m²K			
Party Walls U-value		0 W/m²K			

		Lloor F	Details:						
Assessor Name:	Neil Ingham	USELL	Strom	a Num	bor:		STRO	010943	
Software Name:	Stroma FSAP 2012		Softwa					n: 1.0.5.41	
	· ·	Property	Address	Sample	e 6				
Address :									
Overall dwelling dime	ensions:	A = 0	o(m²\		Av. Ua	iaht/m)		Valuma/m³	\
Ground floor			a(m²) 92.44	(1a) x		ight(m) 2.75	(2a) =	Volume(m³)) (3a)
Total floor area TFA = (1	a)+(1b)+(1c)+(1d)+(1e)+(1		92.44	(4)			」 ` ′		`′
Dwelling volume		′ 🖳	2)+(3c)+(3c	d)+(3e)+	(3n) =	254.21	(5)
							` '	234.21	(0)
2. Ventilation rate:	main seconda	ry	other		total			m³ per hou	r
Number of chimneys	heating heating + 0	- + -	0] = [0	×	40 =	0	(6a)
Number of open flues	0 + 0	╡ + 片	0] ₌ [0	x	20 =	0	 (6b)
Number of intermittent fa	ins				0	x	10 =	0	(7a)
Number of passive vents	;			F	0	x	10 =	0	(7b)
Number of flueless gas fi				Ľ	0	x	40 =	0	一 (7c)
· ·				L				<u>-</u>	` ′
							Air ch	anges per ho	ur
'	ys, flues and fans = $(6a)+(6b)+(6b)+(6b)$				0		÷ (5) =	0	(8)
If a pressurisation test has be Number of storeys in the	peen carried out or is intended, proced he dwelling (ns)	ed to (17),	otherwise (continue fr	om (9) to	(16)		0	(9)
Additional infiltration	no awoming (no)					[(9)	-1]x0.1 =	0	(10)
Structural infiltration: 0	.25 for steel or timber frame of	r 0.35 fo	r masoni	y consti	ruction			0	(11)
if both types of wall are padeducting areas of openia	resent, use the value corresponding t	to the grea	ter wall are	a (after			•		_
•	floor, enter 0.2 (unsealed) or ().1 (seale	ed), else	enter 0				0	(12)
If no draught lobby, en	ter 0.05, else enter 0	,	,					0	(13)
Percentage of windows	s and doors draught stripped							0	(14)
Window infiltration			0.25 - [0.2	x (14) ÷ 1	00] =			0	(15)
Infiltration rate			(8) + (10)	+ (11) + (1	12) + (13)	+ (15) =		0	(16)
•	q50, expressed in cubic metr	-	•	•	etre of e	envelope	area	3.5	(17)
	lity value, then $(18) = [(17) \div 20] +$							0.18	(18)
Air permeability value applie Number of sides sheltere	es if a pressurisation test has been do	ne or a de	gree air pe	rmeability	is being u	sed	ĺ		7(40)
Shelter factor	eu		(20) = 1 -	[0.075 x ([*]	19)] =			0	(19)
Infiltration rate incorporat	ting shelter factor		(21) = (18) x (20) =				0.18	(21)
Infiltration rate modified f	-							0.10	
Jan Feb	Mar Apr May Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	peed from Table 7								
(22)m= 5.1 5	4.9 4.4 4.3 3.8	3.8	3.7	4	4.3	4.5	4.7		
Wind Factor (22a)m = (2	2)m ∸ 4								
	1.23 1.1 1.08 0.95	0.95	0.92	1	1.08	1.12	1.18		
		•						l	

Adjusted infiltra	tion rate	e (allowi	ng for sh	elter an	d wind s	peed) =	(21a) x	(22a)m				_	
0.22	0.22	0.21	0.19	0.19	0.17	0.17	0.16	0.18	0.19	0.2	0.21		
Calculate effect If mechanical		-	rate for t	he appli	cable ca	se						0.5	(2:
If exhaust air hea			endix N. (2	3b) = (23a	a) × Fmv (e	eguation (I	N5)) . othe	rwise (23b) = (23a)			0.5	(2:
If balanced with		0 11		, ,	, ,	. ,	,, .	`	, (200)			0.5	=
a) If balanced		-		_					2h\m + (23P) ^ [-	1 _ (23c)	. 1001	(2:
24a)m= 0	0	0	0	0	0	0	0	0	0	0	0	- 100]	(2
b) If balanced						<u> </u>		<u> </u>			, ,		•
24b)m= 0	0	0	0	0	0	0	0	0	0	0	0		(2
c) If whole ho				-	ļ			<u> </u>					·
if (22b)m				•					.5 × (23b	o)			
24c)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(2
d) If natural v	entilatio	on or wh	ole hous	e positiv	/e input	ventilatio	on from I	oft	!				
if (22b)m				•	•				0.5]				
24d)m= 0	0	0	0	0	0	0	0	0	0	0	0		(2
Effective air o	hange	rate - er	iter (24a) or (24b	o) or (24	c) or (24	d) in box	(25)				-	
25)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(2
3. Heat losses	and he	eat loss r	paramete	er:									
LEMENT	Gros		Openin		Net Ar	ea	U-valı	re	AXU		k-value	e A	Χk
	area	(m²)	· m		A ,r	n²	W/m2	K	(W/	K)	kJ/m²-l	K kJ	/K
Vindows Type	1				3.85	х1	/[1/(1.1)+	0.04] =	4.06				(2
Vindows Type	2				5.11	x1	/[1/(1.1)+	0.04] =	5.38				(2
Valls Type1	35.2	8	8.96		26.32	<u>x</u>	0.16	=	4.21		60	1579.:	2 (2
Valls Type2	82.4	4	0		82.44	X	0.15	=	12.34		60	4946.	4 (2
otal area of ele	ements	, m²			117.7	2							(3
arty wall					15.98	3 x	0	=	0	\neg	45	719.1	(3
arty floor					92.44	二					40	3697.	6 (3
arty ceiling					92.44	一				Ī	30	2773.:	2 (3
nternal wall **					154.4	4				Ī	9	1389.9	6 (3
for windows and r	oof windo	ows, use e	ffective wi	ndow U-va			formula 1	/[(1/U-valu	ıe)+0.04] á	ו as given in			,
* include the areas	on both	sides of in	ternal wal	s and part	titions								
abric heat loss	s, W/K =	= S (A x	U)				(26)(30)	+ (32) =				25.99	(3
leat capacity C	cm = S(Axk)						((28)	(30) + (32	2) + (32a).	(32e) =	15105.46	(3
hermal mass p		,		•				` '	÷ (4) =			163.41	(3
or design assessr an be used instea				constructi	ion are no	t known pr	ecisely the	indicative	values of	TMP in T	able 1f		
hermal bridge:				ısina An	nendix k	<						10.38	(3
details of thermal	•	•		• .	•	•						10.30	'`
otal fabric hea			()	()	,			(33) +	(36) =			36.38	(3
entilation heat	loss ca	alculated	l monthly	/				(38)m	= 0.33 × ([25)m x (5])	_	_
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
38)m= 41.94	41.94	41.94	41.94	41.94	41.94	41.94	41.94	41.94	41.94	41.94	41.94		(3
leat transfer co	efficier	nt, W/K						(39)m	= (37) + (38)m		-	
39)m= 78.32	78.32	78.32	78.32	78.32	78.32	78.32	78.32	78.32	78.32	78.32	78.32		

Heat loss para	ameter (I	HLP), W/	m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85		
		!						,	Average =	Sum(40) ₁ .	12 /12=	0.85	(40)
Number of day	<u> </u>	<u> </u>						_					
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 hea	ting ene	rgy requi	rement:								kWh/ye	ar:	
Assumed occu if TFA > 13. if TFA £ 13.9	9, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9)2)] + 0.0	0013 x (⁻	TFA -13		66		(42)
Annual average Reduce the annual not more that 125	al average	hot water	usage by	5% if the a	lwelling is	designed t			se target o		7.32		(43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage i	in litres pe	r day for ea		Vd,m = fa	ctor from	Table 1c x							
(44)m= 107.05	103.16	99.27	95.37	91.48	87.59	87.59	91.48	95.37	99.27	103.16	107.05		
		•								m(44) ₁₁₂ =	L	1167.84	(44)
Energy content of	f hot water	used - cal	culated mo	onthly = 4 .	190 x Vd,r	n x nm x C	Tm / 3600) kWh/mor	nth (see Ta	ables 1b, 1	c, 1d)		
(45)m= 158.75	138.85	143.28	124.91	119.86	103.43	95.84	109.98	111.29	129.7	141.58	153.75		_
If instantaneous v	vətor hoati	na at noint	of use (no	hot water	· storaga)	enter∩in	hoves (46		Total = Su	m(45) ₁₁₂ =	= [1531.22	(45)
	ı		,	1	,.	·	` '	,	10.40		00.00		(46)
(46)m= 23.81 Water storage	20.83 loss:	21.49	18.74	17.98	15.51	14.38	16.5	16.69	19.46	21.24	23.06		(46)
Storage volum) includin	g any so	olar or W	/WHRS	storage	within sa	ame ves	sel		0		(47)
If community h	neating a	and no ta	nk in dw	elling, e	nter 110	litres in	(47)						
Otherwise if no	o stored	hot wate	er (this in	icludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in (47)			
Water storage					4.144	/ I \							
a) If manufact				or is kno	wn (kVVI	n/day):					0		(48)
Temperature f											0		(49)
Energy lost from b) If manufact		_	-		or io not		(48) x (49)) =			0		(50)
Hot water stor			-								0		(51)
If community h	•			`		,							` ,
Volume factor	from Ta	ble 2a									0		(52)
Temperature f	actor fro	m Table	2b								0		(53)
Energy lost fro		_	, kWh/ye	ear			(47) x (51)) x (52) x (53) =		0		(54)
Enter (50) or	` , ` `	,									0		(55)
Water storage	loss cal	culated f	or each	month		_	((56)m = (55) × (41)ı	m	_			
(56)m= 0	0	0	0	0	0	0	0	0	0	0	0		(56)
If cylinder contain	s dedicate	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Appendi	хH	
(57)m= 0	0	0	0	0	0	0	0	0	0	0	0		(57)
Primary circuit	t loss (ar	nnual) fro	m Table	<u></u>							0		(58)
Primary circuit	,	•			59)m = ((58) ÷ 36	65 × (41)	m					
(modified by	/ factor f	rom Tab	le H5 if t	here is s	olar wat	er heatii	ng and a	cylinde	r thermo	stat)			
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

(61)ms 60.98 46.03 50.58 47.03 46.62 43.19 44.63 46.62 47.03 50.58 49.23 50.96 (61) Total heat required for water heating calculated for each month (62)ms = 0.85 x (45)ms + (46)ms + (57)ms + (59)ms + (61)ms (62)ms (62)ms 200.71 194.87 193.86 171.96 166.47 146.62 140.47 156.6 158.33 190.29 190.98 204.7 (62) (62) Sabri DHW imput calculated using subpressive. Ge or Appendix H (negative quantity) tenter 10 if no solar contribution to water heating (340 d additional lines if FGHRS and/or WWHRS applies, see Appendix H (193.81 171.96 170.70 59.97 12.68 11.8 13.41 13.56 193.16 116.70 124.13 142.70 183.9 124.81	Combi loss calculated for ea	ch month (61)m =	= (60) ÷ 365 ×	(41)m						
(62) (62) (62) (63)			``	` í —	47.03	50.58	49.32	50.96		(61)
Solar DHW injust calculated using Appendix H (negative quantity) (enter 0" if no solar contribution to water heating) (add additional lines if FGHRS and/or WWHRS applies, see Appendix C) (63)ms 0	Total heat required for water	heating calculate	ed for each mo	onth (62)m =	= 0.85 ×	(45)m +	(46)m +	(57)m +	(59)m + (61)m	
California Section S	(62)m= 209.71 184.87 193.8	6 171.95 166.47	146.62 140	0.47 156.6	158.33	180.29	190.89	204.7		(62)
(63)me	Solar DHW input calculated using A	ppendix G or Append	ix Η (negative qu	antity) (enter '0)' if no sola	r contribut	ion to wate	er heating)	•	
Output from water heater (64)me	(add additional lines if FGHF	S and/or WWHR	S applies, see	e Appendix	G)					
Output from water heater (64)me 81.64 66.81 74.53 62.81 104.46 132.04 126.71 141.13 142.7 68.3 72.16 78.34 Output from water heater (annual)	(63)m= 0 0 0	0 0	0	0 0	0	0	0	0		(63)
C4-	FHRS 125.84 116.04 117.1	1 107.07 59.97	12.68 1	1.8 13.41	13.56	109.16	116.57	124.13	•	(63) (G2)
Computation Computation	Output from water heater									
Heat gains from water heating, kWh/month 0.25 ' [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] (65)me	(64)m= 81.64 66.81 74.53	62.81 104.46	132.04 126	5.71 141.13	142.7	68.9	72.16	78.34		_
(65)me 65.53 57.67 60.29 53.29 51.51 45.19 43.03 48.22 48.76 55.77 59.4 63.86 (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				Out	put from w	ater heate	r (annual)₁	12	1152.21	(64)
include (67)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 May	Heat gains from water heatir	ig, kWh/month 0.2	25 ´ [0.85 × (4	l5)m + (61)r	n] + 0.8 x	x [(46)m	+ (57)m	+ (59)m]	
Metabolic gains (Table 5), Watts Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	(65)m= 65.53 57.67 60.29	53.29 51.51	45.19 43	.03 48.22	48.76	55.77	59.4	63.86		(65)
Metabolic qains (Table 5), Watts Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	include (57)m in calculatio	n of (65)m only if	cylinder is in	the dwelling	or hot w	ater is fr	om com	munity h	leating	
Sepant S	5. Internal gains (see Table	e 5 and 5a):		_					-	
Sepant S	Metabolic gains (Table 5). W	'atts								
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 (67)m= 25.23			Jun J	ul Aug	Sep	Oct	Nov	Dec		
(67)me	(66)m= 132.88 132.88 132.8	8 132.88 132.88	132.88 132	2.88 132.88	132.88	132.88	132.88	132.88		(66)
(67)me	Lighting gains (calculated in	Appendix L, equa	ation L9 or L9	a), also see	Table 5					
(68)m= 243.5					1	20.84	24.33	25.93		(67)
(68)m= 243.5	Appliances gains (calculated	in Appendix L, e	guation L13 c	r L13a), als	o see Ta	ble 5	<u> </u>	ı	ı	
(69)m= 36.29	· · · · · · · · · · · · · · · · · · ·		`		1	1	216.67	232.75		(68)
(69)m= 36.29	Cooking gains (calculated in	Appendix L, equa	ation L15 or L	15a), also s	ee Table	5		Į.		
Company of the state of the sta		 				1	36.29	36.29		(69)
Company of the state of the sta	Pumps and fans gains (Table	 e 5a)			.!	!	!	ļ.	•	
(71)m=	·	 	3	3 3	3	3	3	3		(70)
(71)m=	Losses e.g. evaporation (neg	ative values) (Ta	ıble 5)							
(72)m= 88.07 85.82 81.03 74.02 69.23 62.76 57.83 64.82 67.73 74.96 82.51 85.83 (72) Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m (73)m= 422.66 420.12 404.77 379.78 354.4 330.24 315.27 322.55 336.01 361.23 389.37 410.38 (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 Table 6a Flux Table 6b FF Gains Table 6c (W) Northeast 0.9x 0.77 x 3.85 x 11.28 x 0.63 x 0.7 = 13.28 (75) Northeast 0.9x 0.77 x 3.85 x 41.38 x 0.63 x 0.7 = 48.69 (75)		<u> </u>		6.31 -106.31	-106.31	-106.31	-106.31	-106.31		(71)
(72)m= 88.07 85.82 81.03 74.02 69.23 62.76 57.83 64.82 67.73 74.96 82.51 85.83 (72) Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m (73)m= 422.66 420.12 404.77 379.78 354.4 330.24 315.27 322.55 336.01 361.23 389.37 410.38 (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 Table 6a Flux Table 6b Table 6c (W) Northeast 0.9x 0.77 x 3.85 x 11.28 x 0.63 x 0.7 = 13.28 (75) Northeast 0.9x 0.77 x 3.85 x 41.38 x 0.63 x 0.7 = 48.69 (75)	Water heating gains (Table 5	5)	-!	I	1					
(73)m= 422.66 420.12 404.77 379.78 354.4 330.24 315.27 322.55 336.01 361.23 389.37 410.38 (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 m² Table 6a Table 6b Table 6c (W) Northeast 0.9x 0.77 x 3.85 x 11.28 x 0.63 x 0.7 = 13.28 (75) Northeast 0.9x 0.77 x 3.85 x 22.97 x 0.63 x 0.7 = 27.02 (75) Northeast 0.9x 0.77 x 3.85 x 41.38 x 0.63 x 0.7 = 48.69 (75)			62.76 57	.83 64.82	67.73	74.96	82.51	85.83		(72)
(73)m= 422.66 420.12 404.77 379.78 354.4 330.24 315.27 322.55 336.01 361.23 389.37 410.38 (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 Mark Table 6a Flux Table 6b Table 6b Table 6c (W) Northeast 0.9x 0.77 x 3.85 x 11.28 x 0.63 x 0.7 = 13.28 (75) Northeast 0.9x 0.77 x 3.85 x 22.97 x 0.63 x 0.7 = 27.02 (75) Northeast 0.9x 0.77 x 3.85 x 41.38 x 0.63 x 0.7 = 48.69 (75)	Total internal gains =	!	(66)m +	(67)m + (68)m	+ (69)m +	(70)m + (7	1)m + (72)	m	ı	
Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Table 6d m^2 Flux g_{-} FF Gains Table 6c (W) Northeast $0.9x$ 0.77 x 3.85 x 11.28 x 0.63 x 0.7 $= 13.28$ (75) Northeast $0.9x$ 0.77 x 3.85 x 22.97 x 0.63 x 0.7 $= 27.02$ (75) Northeast $0.9x$ 0.77 x 3.85 x 41.38 x 0.63 x 0.7 $= 48.69$ (75)		7 379.78 354.4	330.24 315	5.27 322.55	336.01	361.23	389.37	410.38		(73)
Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Table 6d m^2 Flux g_{-} FF Gains Table 6c (W) Northeast $0.9x$ 0.77 x 3.85 x 11.28 x 0.63 x 0.7 $= 13.28$ (75) Northeast $0.9x$ 0.77 x 3.85 x 22.97 x 0.63 x 0.7 $= 27.02$ (75) Northeast $0.9x$ 0.77 x 3.85 x 41.38 x 0.63 x 0.7 $= 48.69$ (75)	6. Solar gains:									
Table 6d m ² Table 6a Table 6b Table 6c (W) Northeast 0.9x 0.77 x 3.85 x 11.28 x 0.63 x 0.7 = 13.28 (75) Northeast 0.9x 0.77 x 3.85 x 22.97 x 0.63 x 0.7 = 27.02 (75) Northeast 0.9x 0.77 x 3.85 x 41.38 x 0.63 x 0.7 = 48.69 (75)		olar flux from Table 6a	a and associated	equations to c	onvert to th	ne applicat	ole orientat	ion.		
Northeast 0.9x	Orientation: Access Factor	Area	Flux				FF		Gains	
Northeast 0.9x	Table 6d	m²	Table 6	Sa -	Γable 6b	T	able 6c		(W)	
Northeast 0.9x 0.77 x 3.85 x 41.38 x 0.63 x 0.7 = 48.69 (75)	Northeast _{0.9x} 0.77	x 3.85	X 11.28	х	0.63	x	0.7	=	13.28	(75)
	Northeast 0.9x 0.77	x 3.85	x 22.97	x	0.63	_ x [0.7		27.02	(75)
	Northeast 0.9x 0.77	x 3.85	x 41.38	x	0.63	x	0.7		48.69	(75)
Northeast 0.9x 0.77 x 3.85 x 67.96 x 0.63 x 0.7 = 79.96 (75)	Northeast 0.9x 0.77	x 3.85	x 67.96	x	0.63	x	0.7	=	79.96	(75)

Northeast 0.9s										_						
Northeast 0.9x	Northea	st 0.9x	0.77	X	3.	35	X	9	1.35	X	0.63	X	0.7	=	107.48	(75)
Northeast 0.0%	Northea	st _{0.9x}	0.77	X	3.	35	X	9	7.38	x	0.63	X	0.7	=	114.58	(75)
Northeast 0.sk	Northea	st 0.9x	0.77	X	3.	35	x	,	91.1	x	0.63	X	0.7	=	107.19	(75)
Northeast 0.5%	Northea	st 0.9x	0.77	x	3.	35	x	7	2.63	x	0.63	X	0.7	=	85.45	(75)
Northeast 0.sk	Northea	st _{0.9x}	0.77	x	3.	35	x	5	0.42	x	0.63	x	0.7		59.33	(75)
Northwest 0, 9x	Northea	st 0.9x	0.77	×	3.	35	x	2	8.07	x	0.63	x	0.7		33.02	(75)
Northwest 0, 9x	Northea	st 0.9x	0.77	x	3.	35	x		14.2	x	0.63	×	0.7		16.7	(75)
Northwest 0, 9x	Northea	st 0.9x	0.77	x	3.	35	x	9	9.21	x	0.63	×	0.7		10.84	(75)
Northwest 0.9x	Northwe	est _{0.9x}	0.77	x	5.	11	x	1	1.28	x	0.63	x	0.7	=	17.62	(81)
Northwest 0.9x	Northwe	est 0.9x	0.77	x	5.	11	x	2	2.97	x	0.63	×	0.7		35.87	(81)
Northwest 0.9x	Northwe	est _{0.9x}	0.77	x	5.	11	x	4	1.38	x	0.63	x	0.7		64.62	(81)
Northwest 0.9x	Northwe	est _{0.9x}	0.77	x	5.	11	x	6	7.96	x	0.63	x	0.7	=	106.13	(81)
Northwest 0.9x	Northwe	est _{0.9x}	0.77	x	5.	11	х	9	1.35	х	0.63	x	0.7	=	142.65	(81)
Northwest 0.9x	Northwe	est _{0.9x}	0.77	x	5.	11	х	9	7.38	х	0.63	x	0.7	=	152.08	(81)
Northwest 0.9x	Northwe	est _{0.9x}	0.77	x	5.	11	х	,	91.1	x	0.63	x	0.7	=	142.27	(81)
Northwest 0.9x	Northwe	est _{0.9x}	0.77	×	5.	11	x	7	2.63	x	0.63	×	0.7		113.42	(81)
Northwest 0.9x	Northwe	est _{0.9x}	0.77	x	5.	11	x	5	0.42	x	0.63	x	0.7		78.74	(81)
Solar gains in watts, calculated for each month (83)m = Sum(74)m (82)m	Northwe	est _{0.9x}	0.77	×	5.	11	х	2	8.07	x	0.63	x	0.7		43.83	(81)
Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m (83)m= 30.9 62.89 113.31 186.08 250.13 266.67 249.46 198.87 138.07 76.86 38.88 25.23 (83) Total gains – internal and solar (84)m = (73)m + (83)m , watts (84)m= 453.56 483.01 518.08 565.86 604.53 596.91 564.73 521.42 474.08 438.08 428.24 435.61 (84) 7. Mean internal temperature (heating season) Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m= 0.99 0.99 0.99 0.98 0.96 0.89 0.74 0.58 0.65 0.87 0.97 0.99 1 (86) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 19.7 19.82 20.05 20.39 20.71 20.91 20.98 20.96 20.81 20.41 19.99 19.66 (87) Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 (88) Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) (89)m= 0.99 0.99 0.98 0.98 0.95 0.86 0.68 0.49 0.55 0.82 0.96 0.99 0.99 0.99 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 18.45 18.61 18.96 19.44 19.88 20.14 20.2 20.19 20.02 19.48 18.87 18.39 (90) FLA = Living area + (4) = 0.3 (91) Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 - fLA) x T2 (92)m= 18.83 18.98 19.29 19.72 20.13 20.37 20.43 20.42 20.25 19.76 19.21 18.77	Northwe	est _{0.9x}	0.77	×	5.	11	x	_	14.2	x	0.63	×	0.7		22.17	(81)
(83)m= 30.9 62.89 113.31 186.08 250.13 266.67 249.46 198.87 138.07 76.86 38.88 25.23 (83) Total gains – internal and solar (84)m = (73)m + (83)m , watts (84)m= 453.56 483.01 518.08 565.86 604.53 596.91 564.73 521.42 474.08 438.08 428.24 435.61 (84) 7. Mean internal temperature (heating season) Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m= 0.99 0.99 0.98 0.96 0.89 0.74 0.58 0.65 0.87 0.97 0.99 1 0.99 1 0.96 (86) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 19.7 19.82 20.05 20.39 20.71 20.91 20.98 20.96 20.81 20.41 19.99 19.66 (87) Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 (88) Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) Wean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (89)m= 0.99 0.99 0.98 0.95 0.86 0.68 0.49 0.55 0.82 0.96 0.99 0.99 0.99 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 18.45 18.61 18.96 19.44 19.88 20.14 20.2 20.19 20.02 19.48 18.87 18.39 (90) Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 - fLA) x T2 (92)m= 18.83 18.98 19.29 19.72 20.13 20.37 20.43 20.42 20.25 19.76 19.21 18.77	Northwe	est _{0.9x}	0.77	x	5.	11	х		9.21	x	0.63	×	0.7	=	14.39	(81)
(83)m= 30.9 62.89 113.31 186.08 250.13 266.67 249.46 198.87 138.07 76.86 38.88 25.23 (83) Total gains – internal and solar (84)m = (73)m + (83)m , watts (84)m= 453.56 483.01 518.08 565.86 604.53 596.91 564.73 521.42 474.08 438.08 428.24 435.61 (84) 7. Mean internal temperature (heating season) Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m= 0.99 0.99 0.98 0.96 0.89 0.74 0.58 0.65 0.87 0.97 0.99 1 0.99 1 0.96 (86) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 19.7 19.82 20.05 20.39 20.71 20.91 20.98 20.96 20.81 20.41 19.99 19.66 (87) Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 (88) Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) Wean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (89)m= 0.99 0.99 0.98 0.95 0.86 0.68 0.49 0.55 0.82 0.96 0.99 0.99 0.99 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 18.45 18.61 18.96 19.44 19.88 20.14 20.2 20.19 20.02 19.48 18.87 18.39 (90) Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 - fLA) x T2 (92)m= 18.83 18.98 19.29 19.72 20.13 20.37 20.43 20.42 20.25 19.76 19.21 18.77		_								1						
(83)m= 30.9 62.89 113.31 186.08 250.13 266.67 249.46 198.87 138.07 76.86 38.88 25.23 (83) Total gains – internal and solar (84)m = (73)m + (83)m , watts (84)m= 453.56 483.01 518.08 565.86 604.53 596.91 564.73 521.42 474.08 438.08 428.24 435.61 (84) 7. Mean internal temperature (heating season) Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m= 0.99 0.99 0.98 0.96 0.89 0.74 0.58 0.65 0.87 0.97 0.99 1 0.99 1 0.96 (86) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 19.7 19.82 20.05 20.39 20.71 20.91 20.98 20.96 20.81 20.41 19.99 19.66 (87) Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 (88) Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) Wean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (89)m= 0.99 0.99 0.98 0.95 0.86 0.68 0.49 0.55 0.82 0.96 0.99 0.99 0.99 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 18.45 18.61 18.96 19.44 19.88 20.14 20.2 20.19 20.02 19.48 18.87 18.39 (90) Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 - fLA) x T2 (92)m= 18.83 18.98 19.29 19.72 20.13 20.37 20.43 20.42 20.25 19.76 19.21 18.77	Solar o	ains in v	watts ca	lculated	d for eac	h mont	h			(83)m	n = Sum(74)m	(82)m				
(84)m= 453.56	ĭ	1					\neg	66.67		È		- 		25.23	1	(83)
7. Mean internal temperature (heating season) Temperature during heating periods in the living area from Table 9, Th1 (°C) 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 0.98 0.96 0.89 0.74 0.58 0.65 0.87 0.97 0.99 1 (86) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 19.7 19.82 20.05 20.39 20.71 20.91 20.98 20.96 20.81 20.41 19.99 19.66 (87) Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 (88) Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) (89)m= 0.99 0.99 0.99 0.98 0.95 0.86 0.68 0.49 0.55 0.82 0.96 0.99 0.99 0.99 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 18.45 18.61 18.96 19.44 19.88 20.14 20.2 20.19 20.02 19.48 18.87 18.39 (90) Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 - fLA) x T2 (92)m= 18.83 18.98 19.29 19.72 20.13 20.37 20.43 20.42 20.25 19.76 19.21 18.77 (92)	Total ga	ains – ir	nternal ar	nd sola	r (84)m :	= (73)n	1 + (83)m	, watts	<u> </u>	I	l			_	
Temperature during heating periods in the living area from Table 9, Th1 (°C) 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 0.98 0.96 0.89 0.74 0.58 0.65 0.87 0.97 0.99 1 (86) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 19.7 19.82 20.05 20.39 20.71 20.91 20.98 20.96 20.81 20.41 19.99 19.66 (87) Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 (88) Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) (89)m= 0.99 0.99 0.98 0.98 0.95 0.86 0.68 0.49 0.55 0.82 0.96 0.99 0.99 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 18.45 18.61 18.96 19.44 19.88 20.14 20.2 20.19 20.02 19.48 18.87 18.39 (90) Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2 (92)m= 18.83 18.98 19.29 19.72 20.13 20.37 20.43 20.42 20.25 19.76 19.21 18.77 (92)	(84)m=	453.56	483.01	518.08	565.86	604.53	3 5	96.91	564.73	521	.42 474.08	438.0	8 428.24	435.61		(84)
Temperature during heating periods in the living area from Table 9, Th1 (°C) 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 0.98 0.96 0.89 0.74 0.58 0.65 0.87 0.97 0.99 1 (86) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 19.7 19.82 20.05 20.39 20.71 20.91 20.98 20.96 20.81 20.41 19.99 19.66 (87) Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 (88) Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) (89)m= 0.99 0.99 0.98 0.98 0.95 0.86 0.68 0.49 0.55 0.82 0.96 0.99 0.99 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 18.45 18.61 18.96 19.44 19.88 20.14 20.2 20.19 20.02 19.48 18.87 18.39 (90) Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2 (92)m= 18.83 18.98 19.29 19.72 20.13 20.37 20.43 20.42 20.25 19.76 19.21 18.77 (92)	7 Mea	an inter	nal tempe	erature	(heating	seaso	n)							•		
Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec			•		,			area i	from Tab	ole 9	. Th1 (°C)				21	(85)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	•		•	٠.			•				, (-)					``
(86)m= 0.99 0.99 0.98 0.96 0.89 0.74 0.58 0.65 0.87 0.97 0.99 1 (86) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 19.7 19.82 20.05 20.39 20.71 20.91 20.98 20.96 20.81 20.41 19.99 19.66 (87) Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 20.21 <t< td=""><td>[</td><td></td><td></td><td></td><td>T</td><td>ı</td><td>T</td><td></td><td></td><td>Α</td><td>ua Sep</td><td>Oc</td><td>t Nov</td><td>Dec</td><td></td><td></td></t<>	[T	ı	T			Α	ua Sep	Oc	t Nov	Dec		
(87)m= 19.7 19.82 20.05 20.39 20.71 20.91 20.98 20.96 20.81 20.41 19.99 19.66 (87) Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 20.21 20.2	(86)m=		-				_					 	+	1		(86)
(87)m= 19.7 19.82 20.05 20.39 20.71 20.91 20.98 20.96 20.81 20.41 19.99 19.66 (87) Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 (88) Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) (89)m= 0.99 0.99 0.98 0.95 0.86 0.68 0.49 0.55 0.82 0.96 0.99 0.99 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 18.45 18.61 18.96 19.44 19.88 20.14 20.2 20.19 20.02 19.48 18.87 18.39 (90) Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 - fLA) x T2 (92)m= 18.83 18.98 19.29 19.72 20.13 20.37 20.43 20.42 20.25 19.76 19.21 18.77 (92)	Mean	internal	tempera	turo in	livina ar	02 T1 /	(follo	w sto	ns 3 to 7	I 7 in T	able 9c)	ļ.		!	<u></u>	
Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 20.21 (88) Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) (89)m= 0.99	Г	1			~~	i —	` 				- '	20.4	19.99	19.66	7	(87)
(88)m= 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 20.21 (88) Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) (89)m= 0.99 0.99 0.98 0.95 0.86 0.68 0.49 0.55 0.82 0.96 0.99 0.99 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 18.45 18.61 18.96 19.44 19.88 20.14 20.2 20.19 20.02 19.48 18.87 18.39 (90) ### Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 - fLA) × T2 (92)m= 18.83 18.98 19.29 19.72 20.13 20.37 20.43 20.42 20.25 19.76 19.21 18.77 (92)	L					L				<u> </u>			1 13133	1	_	` '
Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) (89)m= 0.99 0.99 0.98 0.95 0.86 0.68 0.49 0.55 0.82 0.96 0.99 0.99 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 18.45 18.61 18.96 19.44 19.88 20.14 20.2 20.19 20.02 19.48 18.87 18.39 (90) Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 - fLA) x T2 (92)m= 18.83 18.98 19.29 19.72 20.13 20.37 20.43 20.42 20.25 19.76 19.21 18.77 (92)	· r					1	$\overline{}$					20.22	20.21	20.21	7	(88)
(89)m= 0.99 0.99 0.98 0.95 0.86 0.68 0.49 0.55 0.82 0.96 0.99 0.99 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 18.45 18.61 18.96 19.44 19.88 20.14 20.2 20.19 20.02 19.48 18.87 18.39 (90) ### Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 - fLA) x T2 (92)m= 18.83 18.98 19.29 19.72 20.13 20.37 20.43 20.42 20.25 19.76 19.21 18.77 (92)	L					<u> </u>					20.21	20.2	20.21	20.21		(00)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 18.45	г				1			•		_		T	1		7	(20)
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	(89)m=	0.99	0.99	0.98	0.95	0.86		0.68	0.49	0.5	0.82	0.96	0.99	0.99		(89)
Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$ (92)m= 18.83 18.98 19.29 19.72 20.13 20.37 20.43 20.42 20.25 19.76 19.21 18.77 (92)	Mean		tempera	ture in	the rest	of dwe	lling	T2 (f	ollow ste	ps 3	to 7 in Tab	le 9c)	_	,	-	
Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$ (92)m= 18.83 18.98 19.29 19.72 20.13 20.37 20.43 20.42 20.25 19.76 19.21 18.77 (92)	(90)m=	18.45	18.61	18.96	19.44	19.88	2	20.14	20.2	20.			l	I		— ` ´
(92)m= 18.83 18.98 19.29 19.72 20.13 20.37 20.43 20.42 20.25 19.76 19.21 18.77 (92)												fLA = Li	ving area ÷ (4) =	0.3	(91)
(92)m= 18.83 18.98 19.29 19.72 20.13 20.37 20.43 20.42 20.25 19.76 19.21 18.77 (92)	Mean	internal	tempera	iture (fo	or the wh	ole dw	ellin	g) = fl	_A × T1	+ (1	– fLA) × T2					
Apply adjustment to the mean internal temperature from Table 4e, where appropriate	Г			<u> </u>	1		\neg			`			3 19.21	18.77		(92)
	Apply	adjustn	nent to th	e meai	n interna	l tempe	eratu	re fro	m Table	4e,	where appr	opriate)		_	

		(02)
(93)m= 18.68 18.83 19.14 19.57 19.98 20.22 20.28 20.27 20.1 19.61 19.06 18.62		(93)
8. Space heating requirement	lata	
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calcu the utilisation factor for gains using Table 9a	iate	
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 0.94 0.85 0.68 0.5 0.56 0.82 0.95 0.98 0.99		(94)
Useful gains, hmGm , W = (94)m x (84)m		()
(95)m= 449.29 476.44 504.92 531.22 512.75 404.92 281.73 292.07 387.41 417.87 421.67 432.16		(95)
Monthly average external temperature from Table 8		(00)
(96)m= 4.3 4.9 6.5 8.9 11.7 14.6 16.6 16.4 14.1 10.6 7.1 4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m- (96)m] (97)m= 1125.86 1090.63 989.74 835.98 648.68 440.03 288.43 303.27 470.27 705.57 936.79 1129.73		(97)
		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m (98)m=		
	2701.3	(98)
Total per year (kWh/year) = Sum(98) _{15,912} =	2701.3]
Space heating requirement in kWh/m²/year	29.22	(99)
9a. Energy requirements – Individual heating systems including micro-CHP)		
Space heating:		
Fraction of space heat from secondary/supplementary system	0	(201)
Fraction of space heat from main system(s) (202) = 1 - (201) =	1	(202)
Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1	90.3	(206)
Efficiency of secondary/supplementary heating system, %	0	(208)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	kWh/year	r
Space heating requirement (calculated above)		
503.37 412.73 360.7 219.43 101.13 0 0 0 0 214.05 370.89 518.99		
$(211)m = \{[(98)m \times (204)] \} \times 100 \div (206)$		(211)
557.44 457.07 399.45 243 112 0 0 0 0 237.04 410.73 574.74		
Total (kWh/year) =Sum(211) _{15,1012} =	2991.47	(211)
Space heating fuel (secondary), kWh/month		1
$= \{[(98)m \times (201)]\} \times 100 \div (208)$		
(215)m= 0 0 0 0 0 0 0 0 0 0 0 0		
Total (kWh/year) =Sum(215) _{15,1012} =	0	(215)
Water heating		1
Output from water heater (calculated above)		
81.64 66.81 74.53 62.81 104.46 132.04 126.71 141.13 142.7 68.9 72.16 78.34		-
Efficiency of water heater	81	(216)
(217)m= 88.88 88.88 88.56 88.05 85.32 81 81 81 81 87.84 88.64 88.96		(217)
Fuel for water heating, kWh/month		
(219)m = (64)m x 100 ÷ (217)m		
(219)m= 91.85 75.17 84.15 71.33 122.43 163.01 156.43 174.24 176.17 78.43 81.4 88.06	1000 05	l (0.5)
Total = Sum(219a) ₁₁₂ =		(219)
	kWh/year	
Annual totals Space heating fuel used, main system 1	2991.47	1

Water heating fuel used				1362.68]
Electricity for pumps, fans and electric keep-hot					
mechanical ventilation - balanced, extract or pos	itive input from outsid	е	455.9		(230a)
central heating pump:			30		(230c)
boiler with a fan-assisted flue			45		(230e)
Total electricity for the above, kWh/year	sum	n of (230a)(230g) =		530.9	(231)
Electricity for lighting				445.58	(232)
Total delivered energy for all uses (211)(221) +	(231) + (232)(237b)	=		5330.62	(338)
12a. CO2 emissions – Individual heating system	s including micro-CHF				
3 .					
	Energy kWh/year	Emission fa		Emissions kg CO2/yea	ır
Space heating (main system 1)	•				ır](261)
Space heating (main system 1) Space heating (secondary)	kWh/year	kg CO2/kWh		kg CO2/yea	,
	kWh/year	kg CO2/kWh	=	kg CO2/yea	(261)
Space heating (secondary)	kWh/year (211) x (215) x	0.216 0.519 0.216	=	kg CO2/yea	(261) (263)
Space heating (secondary) Water heating	kWh/year (211) x (215) x (219) x	0.216 0.519 0.216	=	kg CO2/yea 646.16 0 294.34	(261) (263) (264)
Space heating (secondary) Water heating Space and water heating	kWh/year (211) x (215) x (219) x (261) + (262) + (263) +	kg CO2/kWh 0.216 0.519 0.216 (264) =	= = =	kg CO2/yea 646.16 0 294.34 940.5	(261) (263) (264) (265)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-hot	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (231) x	kg CO2/kWh 0.216 0.519 0.216 0.519	= = =	kg CO2/yea 646.16 0 294.34 940.5 275.54	(261) (263) (264) (265) (267)

El rating (section 14)

(274)

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Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:**

Flat

Total Floor Area: 52.98m²

Dwelling Details:

NEW DWELLING DESIGN STAGE

Site Reference: 231 Watford Road - LEAN **Plot Reference:** Sample 7

Address:

Client Details:

Name: Address:

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas

Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 17.47 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 15.62 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 35.9 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 27.6 kWh/m²

OK 2 Fabric U-values

Element Average

Highest External wall 0.15 (max. 0.30) 0.16 (max. 0.70) OK Party wall 0.00 (max. 0.20) **OK**

Floor (no floor) Roof (no roof)

Openings 1.10 (max. 2.00) OK 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 3.50 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas

Data from manufacturer

Combi boiler

Efficiency 89.5 % SEDBUK2009

Minimum 88.0 %

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

OK

6 Controls			
Space heating controls Hot water controls:	TTZC by plumbing and e No cylinder thermostat No cylinder	electrical services	ок
Boiler interlock:	Yes		ок
7 Low energy lights			
Percentage of fixed lights with	n low-energy fittings	100.0%	
Minimum		75.0%	OK
8 Mechanical ventilation			
Continuous extract system			
Specific fan power:		1.05	
Maximum		0.7	Fail
9 Summertime temperature			
Overheating risk (Thames va	lley):	Slight	OK
Based on:			
Overshading:		Average or unknown	
Windows facing: South East		6.39m²	
Ventilation rate:		6.00	
10 Key features			
Air permeablility		3.5 m³/m²h	
Windows U-value		1.1 W/m ² K	
Party Walls U-value		0 W/m²K	

		Hear F	Details:						
Assessor Name:	Neil Ingham	USEI L	Strom	a Num	ber:		STRO	010943	
Software Name:	Stroma FSAP 2012		Softwa					on: 1.0.5.41	
		Property	Address	: Sample	e 7				
Address :									
1. Overall dwelling dime	ensions:	Δre	a(m²)		Δν Ηρ	ight(m)		Volume(m³	١
Ground floor				(1a) x		2.75	(2a) =	145.69	(3a)
Total floor area TFA = (1	a)+(1b)+(1c)+(1d)+(1e)+(1	n)	52.98	(4)					_
Dwelling volume				(3a)+(3b)+(3c)+(3c	d)+(3e)+	(3n) =	145.69	(5)
2. Ventilation rate:									
	main seconda heating heating		other		total			m³ per hou	r
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 fa	ins			- -	0	X	10 =	0	(7a)
Number of passive vents	;			Ī	0	x	10 =	0	(7b)
Number of flueless gas fi	ires			Ī	0	x	40 =	0	(7c)
				_					
				_			Air ch	nanges per ho	_
	ys, flues and fans = (6a)+(6b)+ neen carried out or is intended, proce			continue f	0		÷ (5) =	0	(8)
Number of storeys in the		cu to (11),	ourorwise (sonunae n	0111 (3) 10	(10)		0	(9)
Additional infiltration						[(9)	-1]x0.1 =	0	(10)
Structural infiltration: 0	.25 for steel or timber frame of	or 0.35 fo	r masoni	ry consti	ruction			0	(11)
if both types of wall are p deducting areas of openi	resent, use the value corresponding	to the grea	ter wall are	a (after					
•	floor, enter 0.2 (unsealed) or).1 (seale	ed), else	enter 0				0	(12)
If no draught lobby, en	,	(2222	- · / ,					0	(13)
• •	s and doors draught stripped							0	(14)
Window infiltration			0.25 - [0.2	2 x (14) ÷ 1	100] =			0	(15)
Infiltration rate			(8) + (10)	+ (11) + (12) + (13)	+ (15) =		0	(16)
Air permeability value,	q50, expressed in cubic metr	es per ho	our per s	quare m	etre of e	envelope	area	3.5	(17)
If based on air permeabil	lity value, then $(18) = [(17) \div 20] +$	(8), otherw	rise (18) = ((16)				0.18	(18)
	es if a pressurisation test has been de	one or a de	gree air pe	rmeability	is being u	sed	1		¬
Number of sides sheltere Shelter factor	ea		(20) = 1 -	[0.075 x (⁻	19)1 =			0	(19)
Infiltration rate incorporate	ting shelter factor		(21) = (18		-71			0.18	(21)
Infiltration rate modified f	•		` , `	, , ,				0.16	(21)
Jan Feb	Mar Apr May Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	peed from Table 7								
(22)m= 5.1 5	4.9 4.4 4.3 3.8	3.8	3.7	4	4.3	4.5	4.7]	
Wind Factor (22a)m = (2.	2)m ÷ 4								
	1.23 1.1 1.08 0.95	0.95	0.92	1	1.08	1.12	1.18]	
` '	1 32 3.00	1		<u> </u>	L		<u> </u>	J	

Adjusted infiltra	ation rat	e (allowi	ng for sh	nelter an	d wind s	speed) =	(21a) x	(22a)m					
0.22	0.22	0.21	0.19	0.19	0.17	0.17	0.16	0.18	0.19	0.2	0.21]	
Calculate effect		_	rate for t	he appli	cable ca	se	-	-	-			0.5	(23a)
If exhaust air he			endix N, (2	3b) = (23a	a) × Fmv (e	equation (I	N5)) , othe	rwise (23b) = (23a)			0.5	(23b)
If balanced with		0 11		, ,	, ,	. ,	,, .	`	, , ,			0.5	(23c)
a) If balance	d mecha	anical ve	ntilation	with he	at recove	erv (MVI	HR) (24a	a)m = (2)	2b)m + (23b) x [1 – (23c)		(200)
(24a)m= 0	0	0	0	0	0	0	0	0	0	0	0]	(24a)
b) If balance	d mech	anical ve	ntilation	without	heat red	overy (N	лV) (24b	m = (22)	2b)m + (23b)	·	•	
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0]	(24b)
c) If whole h if (22b)n				•					.5 × (23b	D)	•	•	
(24c)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5]	(24c)
d) If natural if (22b)n									0.5]	•	•	•	
(24d)m= 0	0	0	0	0	0	0	0	0	0	0	0]	(24d)
Effective air	change	rate - er	iter (24a) or (24b	o) or (24	c) or (24	d) in box	(25)				_	
(25)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(25)
3. Heat losse	s and he	eat loss p	paramete	er:									
ELEMENT	Gros	·	Openin		Net Ar	ea	U-val	ıe	AXU		k-value		ΑΧk
	area	(m²)	m	²	A ,r		W/m2		(W/	K)	kJ/m²-	K	kJ/K
Windows					6.39	x1	/[1/(1.1)+	0.04] =	6.73	ᆜ .			(27)
Walls Type1	22.1	7	6.39		15.78	3 X	0.16	=	2.52		60	94	6.8 (29)
Walls Type2	17.2	22	0		17.22	2 x	0.15	=	2.58		60	103	33.2 (29)
Total area of e	lements	, m²			39.39								(31)
Party wall					46.48	3 X	0	=	0		45	209	1.6 (32)
Party floor					52.98	3					40	211	9.2 (32a)
Party ceiling					52.98	3					30	158	(32b)
Internal wall **					97.63	3					9	878	3.67 (32c)
* for windows and ** include the area						ated using	formula 1	/[(1/U-valu	ıe)+0.04] a	as given in	paragraph	1 3.2	
Fabric heat los				is anu pan	uuoris		(26)(30)	+ (32) =				11.84	(33)
Heat capacity		•	0)				, , , ,		(30) + (32	2) + (32a).	(32e) =	8658.87	
Thermal mass		,	P = Cm -	- TFA) ir	n kJ/m²K			,,,,,	÷ (4) =	_,	()	163.44	(35)
For design assess	•	`		,			ecisely the	` '	. ,	TMP in T	able 1f	100.44	(00)
can be used inste													
Thermal bridge	•	,			•	<						6.45	(36)
if details of therma Total fabric he		are not kn	own (36) =	= 0.05 x (3	1)			(33) +	(36) =			18.29	(37)
Ventilation hea	at loss ca	alculated	l monthly	/				(38)m	= 0.33 × ((25)m x (5))	10.20	`` ′
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec]	
(38)m= 24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	1	(38)
Heat transfer of	coefficier	nt, W/K					•	(39)m	= (37) + (38)m	•	•	
(39)m= 42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33]	
							•		- Δverage –	Sum(39) ₁	/12-	42.33	(39)

Heat loss para	meter (l	HLP). W/	m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8		
()										Sum(40) ₁ .		0.8	(40)
Number of day	s in mo	nth (Tabl	e 1a)							, ,	L		
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 heat	ing ene	ray requi	rement:								kWh/ye	ear:	
Assumed occu if TFA > 13.9 if TFA £ 13.9	0, N = 1		[1 - exp	(-0.0003	49 x (TF	FA -13.9))2)] + 0.0	0013 x (⁻	TFA -13		78		(42)
Annual average Reduce the annua									se target o		.43		(43)
not more that 125	litres per	person per	day (all w	ater use, l	not and co	ld)							
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in	litres pe	day for ea	ch month	Vd,m = fa	ctor from	Table 1c x	(43)		•	•			
(44)m= 84.07	81.01	77.96	74.9	71.84	68.78	68.78	71.84	74.9	77.96	81.01	84.07		
									Total = Su	m(44) ₁₁₂ =	=	917.12	(44)
Energy content of	hot water	used - cald	culated mo	onthly = 4.	190 x Vd,r	n x nm x D	Tm / 3600) kWh/mor	nth (see Ta	ables 1b, 1	c, 1d)		
(45)m= 124.67	109.04	112.52	98.1	94.13	81.22	75.27	86.37	87.4	101.86	111.18	120.74		_
									Total = Su	m(45) ₁₁₂ =	=	1202.49	(45)
If instantaneous w	ater heati	ng at point	of use (no) hot water	storage),	enter 0 in	boxes (46)) to (61)	i				
(46)m= 18.7	16.36	16.88	14.71	14.12	12.18	11.29	12.96	13.11	15.28	16.68	18.11		(46)
Water storage Storage volume		includin	a any c	olar or M	/\/\LDC	ctorogo	within co	amo voc	col				(47)
•	` '		•			_		airie ves	361		0		(47)
If community he Otherwise if no	•			•			` '	ers) ente	er 'O' in <i>(</i>	(47)			
Water storage			. (o. o, o		,			
a) If manufacti	urer's d	eclared lo	oss facto	or is kno	wn (kWł	n/day):					0		(48)
Temperature fa	actor fro	m Table	2b								0		(49)
Energy lost from	m watei	storage	, kWh/ye	ear			(48) x (49)) =			0		(50)
b) If manufacti			-										
Hot water stora	-			e 2 (kWl	n/litre/da	ıy)					0		(51)
If community he Volume factor	_		on 4.3										(50)
Temperature fa			2h								0		(52) (53)
Energy lost from				aar			(47) x (51)) v (52) v (53) -				` '
Enter (50) or (•	, KVVII/yt	zai			(4 7) X (31)) X (32) X (55) =		0		(54) (55)
Water storage	, ,	,	or each	month			((56)m = (55) × (41):	m		<u> </u>		(00)
	0				0				1				(56)
(56)m= 0 If cylinder contains		0 d solar stor	0 age, (57)	0 m = (56)m	0 x [(50) – (0 H11)] ÷ (5	0 0), else (5	0 7)m = (56)	m where (0 (H11) is fro	0 m Appendi	ix H	(30)
(57)m= 0	0	0	0	0	0	0	0	0	0	0	0		(57)
Primary circuit	loss (ar	nual) fro	m Table	3							0		(58)
Primary circuit				•	•	. ,	, ,						
(modified by		rom Tabl		here is s				cylinde	r thermo	stat)			
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

Combi loss calculated for each month (6	$(1)m = (60) \div 365 \times (4)$	1)m				
(61)m= 42.84 37.29 39.73 36.94	36.61 33.92 35.05	36.61 36.94	39.73 39.95	42.84		(61)
Total heat required for water heating cale	culated for each mont	$n (62)m = 0.85 \times$	(45)m + (46)m +	(57)m +	(59)m + (61)m	
(62)m= 167.51 146.33 152.24 135.03	130.74 115.14 110.32	122.98 124.34	141.58 151.14	163.58		(62)
Solar DHW input calculated using Appendix G or A	Appendix H (negative quant	ty) (enter '0' if no sola	ar contribution to wat	er heating)	I	
(add additional lines if FGHRS and/or W	WHRS applies, see A	ppendix G)				
(63)m= 0 0 0 0	0 0 0	0 0	0 0	0		(63)
FHRS 106.82 78.54 64.44 36.06	20.17 10.02 9.28	10.66 10.79	35.87 73.71	105.11		(63) (G2)
Output from water heater						
(64)m= 58.81 66.15 86.05 97.35	108.95 103.64 99.5	110.71 111.92	103.96 75.66	56.59		
	•	Output from w	vater heater (annual)	112	1079.28	(64)
Heat gains from water heating, kWh/mor	nth 0.25 ´ [0.85 × (45)r	m + (61)m] + 0.8	x [(46)m + (57)m	+ (59)m]	
(65)m= 52.16 45.58 47.34 41.85	40.45 35.49 33.79	37.87 38.29	43.8 46.96	50.86		(65)
include (57)m in calculation of (65)m c	only if cylinder is in the	dwelling or hot w	vater is from com	munity h	eating	
5. Internal gains (see Table 5 and 5a):						
Metabolic gains (Table 5), Watts						
Jan Feb Mar Apr	May Jun Jul	Aug Sep	Oct Nov	Dec		
(66)m= 88.9 88.9 88.9 88.9	88.9 88.9 88.9	88.9 88.9	88.9 88.9	88.9		(66)
Lighting gains (calculated in Appendix L,	equation L9 or L9a),	also see Table 5	'	•	I	
(67)m= 15.32 13.6 11.06 8.38	6.26 5.29 5.71	7.42 9.96	12.65 14.77	15.74		(67)
Appliances gains (calculated in Appendix	x L, equation L13 or L	13a), also see Ta	able 5		I	
(68)m= 154.97 156.57 152.52 143.9	133.01 122.77 115.93	114.32 118.38	127 137.89	148.13		(68)
Cooking gains (calculated in Appendix L	, equation L15 or L15	a), also see Table	e 5		J	
(69)m= 31.89 31.89 31.89 31.89	31.89 31.89 31.89	31.89 31.89	31.89 31.89	31.89		(69)
Pumps and fans gains (Table 5a)	! !	!			I	
(70)m= 3 3 3 3 3	3 3 3	3 3	3 3	3		(70)
Losses e.g. evaporation (negative values	s) (Table 5)	•			I	
	-71.12 -71.12 -71.12	-71.12 -71.12	-71.12 -71.12	-71.12		(71)
Water heating gains (Table 5)	! !				I	
(72)m= 70.11 67.82 63.63 58.13	54.37 49.29 45.42	50.9 53.19	58.87 65.22	68.35		(72)
Total internal gains =	(66)m + (67)	m + (68)m + (69)m +	(70)m + (71)m + (72)m	ı	
(73)m= 293.07 290.67 279.89 263.07	246.3 230.01 219.73	225.32 234.2	251.2 270.55	284.9		(73)
6. Solar gains:						
Solar gains are calculated using solar flux from T	able 6a and associated equ	ations to convert to the	he applicable orienta	tion.		
Orientation: Access Factor Area	Flux	g_	FF		Gains	
Table 6d m²	Table 6a	Table 6b	Table 6c		(W)	
Southeast 0.9x 0.77 x 6.39	x 36.79	x 0.63	x 0.7	=	71.85	(77)
Southeast 0.9x 0.77 x 6.39	x 62.67	× 0.63	x 0.7		122.39	(77)
		_				
Southeast 0.9x 0.77 x 6.39	x 85.75	× 0.63	× 0.7	=	167.46	(77)

Southeast 0.9v 0.77 v 6.20 v 140.04 v 0.62 v 0.77 - 222.44 (77)																
Southeast 0.9x 0.77 x 6.39 x 119.01 x 0.63 x 0.7 = 232.41 (77) Southeast 0.9x 0.77 x 6.39 x 118.15 x 0.63 x 0.7 = 230.73 (77)														(77)		
Southeas	t _{0.9x}	0.77	х	6.3	39	X	1	18.15	X		0.63	x	0.7	=	230.73	(77)
Southeas	t _{0.9x}	0.77	X	6.3	39	X	1	13.91	X		0.63	x	0.7	=	222.45	(77)
Southeas	t _{0.9x}	0.77	X	6.3	39	X	10	04.39	x		0.63	x	0.7	=	203.86	(77)
Southeas	t _{0.9x}	0.77	X	6.3	39	X	9	2.85	X		0.63	x	0.7	=	181.33	(77)
Southeas	t _{0.9x}	0.77	X	6.3	39	X	6	9.27	X		0.63	x	0.7	=	135.27	(77)
Southeas	t 0.9x	0.77	X	6.3	39	X	4	4.07	X		0.63	x	0.7	=	86.06	(77)
Southeas	t _{0.9x}	0.77	x	6.3	39	X	3	1.49	x		0.63	x	0.7		61.49	(77)
									•							
Solar gai	ins in v	vatts, ca	alculated	d for eac	h month	1			(83)m	ı = Sı	um(74)m .	(82)m				
—	71.85	122.39	167.46	207.5	232.41	$\overline{}$	30.73	222.45	203	.86	181.33	135.27	86.06	61.49		(83)
Total gai	ns – in	iternal a	nd sola	r (84)m =	= (73)m	+ (8	83)m	, watts					•	•	•	
(84)m= 3	864.92	413.07	447.35	470.56	478.72	4	60.74	442.18	429	.18	415.53	386.47	356.61	346.39		(84)
7. Mear	n interr	nal temn	erature	(heating	seasor	n)									•	
		· ·		eriods in			area f	from Tab	ole 9.	. Th	1 (°C)				21	(85)
•		Ū	٠.	living are		·			J.O 0	,	. ()					(55)
	Jan	Feb	Mar	Apr	May	Ť	Jun	Jul	Α	ug	Sep	Oct	Nov	Dec]	
<u> </u>	0.98	0.96	0.93	0.86	0.74	+	0.57	0.42	0.4	_	0.66	0.88	0.96	0.98		(86)
` ′				<u> </u>	ļ			ļ	<u> </u>	!		0.00	1 0.00	1 0.00		, ,
	- 1			living ar	· `	_		i –	ı —				1	T	1	(07)
(87)m= 2	20.06	20.24	20.47	20.71	20.89	2	20.98	21	20.	99	20.95	20.73	20.34	20.01		(87)
Temper	rature o	during h	eating p	eriods ir	rest of	dw	elling	from Ta	ble 9	9, Tr	n2 (°C)				,	
(88)m= 2	20.25	20.25	20.25	20.25	20.25	2	20.25	20.25	20.	25	20.25	20.25	20.25	20.25		(88)
Utilisatio	on fact	or for g	ains for	rest of d	welling,	h2,	m (se	e Table	9a)							
(89)m=	0.98	0.96	0.92	0.84	0.7		0.51	0.35	0.3	88	0.6	0.85	0.95	0.98		(89)
Mean in	nternal	temper	ature in	the rest	of dwell	lina	T2 (f	ollow ste	ns 3	to 7	7 in Tahl	e 9c)	•	•	•	
													19.41	18.92]	(90)
						1			<u> </u>	!			ing area ÷ (0.4	(91)
									,,							` ′
			<u> </u>	r the wh	ole dwe	_	-	r	`	$\overline{}$		00.00	10.70	1000	1	(02)
` ′	19.43	19.65	19.94	20.24			20.53	20.55	20.		20.51	20.26	19.78	19.36		(92)
· · · · · ·	ajustm 19.28	19.5	ne mear 19.79	interna 20.09	20.29	_	0.38	20.4	4e, 20		20.36	20.11	19.63	19.21	1	(93)
` '				L	20.29		.0.36	20.4	20	.4	20.30	20.11	19.03	19.21		(55)
8. Spac					ro obtoi	200	ot ot	on 11 of	Tobl	0 Oh	oo tha	t Ti m-	-(76)m on	d ro cold	nulata	
				using Ta		nea	al Si	ғр п о	ıabı	e ar), 50 ilia	t 11,111=	:(76)m an	u re-caic	Julate	
	Jan	Feb	Mar	Apr	May	Γ	Jun	Jul	Α	ug	Sep	Oct	Nov	Dec		
Utilisatio						-			<u> </u>	<u> </u>	•				J	
(94)m=	0.97	0.95	0.91	0.83	0.7	1	0.52	0.36	0.3	39	0.61	0.84	0.95	0.97		(94)
Useful g	gains, l	hmGm ,	W = (9	4)m x (8	4)m	-		•					•	•	1	
(95)m= 3	353.46	391.04	405.71	390.47	334.32	2	39.13	160.15	168	.16	252.96	326.02	337.22	337.5		(95)
Monthly	/ avera	ige exte	rnal tem	perature	from T	abl	e 8			'					-	
(96)m=	4.3	4.9	6.5	8.9	11.7		14.6	16.6	16	.4	14.1	10.6	7.1	4.2		(96)
Heat los	ss rate	for mea	an interr	al temp	erature,	Lm	, W =	=[(39)m	x [(9:	3)m-	- (96)m]			-	
(97)m= 6	34.17	618.1	562.51	473.49	363.81	2	44.84	160.96	169	.36	264.98	402.48	530.59	635.41		(97)

Space heating requir	ement fo	or each n	nonth, k\	Wh/mon	th = 0.02	24 x [(97])m – (95)m] x (4	1)m			
(98)m= 208.84 152.59	116.66	59.78	21.93	0	0	0	0	56.89	139.22	221.64		
			•			Tota	l per year	(kWh/yeaı	r) = Sum(9	8) _{15,912} =	977.56	(98)
Space heating requir	ement in	kWh/m²	²/year								18.45	(99)
9a. Energy requireme	nts – Ind	ividual h	eating s	ystems i	ncluding	micro-C	CHP)					
Space heating:			, .							г		7
Fraction of space he				mentary	•		(004)				0	(201)
Fraction of space he		•	. ,			(202) = 1 -		(000)1			1	(202)
Fraction of total heat	•	•				(204) = (204)	02) x [1 –	(203)] =			1	(204)
Efficiency of main sp		•			0.4						90.3	(206)
Efficiency of seconda	ary/suppl	ementar ı	y heatin	g systen	า, % เ			·			0	(208)
Jan Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ar
Space heating requir	116.66	59.78	21.93	0	0	0	0	56.89	139.22	221.64		
$(211)m = \{[(98)m \times (200)]\}$			<u> </u>				Ů	00.00	100.22	221.04		(211)
231.28 168.98	129.19	66.2	24.29	0	0	0	0	63	154.18	245.45		(211)
						Tota	l (kWh/yea	ar) =Sum(2	L 211) _{15,1012}	<u> </u>	1082.57	(211)
Space heating fuel (s	secondar	y), kWh/	month							L		_
$= \{[(98)m \times (201)]\} \times (201)$	100 ÷ (20	(8)										
(215)m= 0 0	0	0	0	0	0	0	0	0	0	0		_
						lota	I (kWh/yea	ar) =Sum(2	215) _{15,1012}	-	0	(215)
Water heating Output from water hea	ater (calc	ulated a	hove)									
58.81 66.15	86.05	97.35	108.95	103.64	99.5	110.71	111.92	103.96	75.66	56.59		
Efficiency of water hea	ater	•		•	•	•	•		•		81	(216)
(217)m= 88.08 87.27	86.1	84.3	82.42	81	81	81	81	84.06	86.79	88.24		(217)
Fuel for water heating												
(219)m = (64) m x 10 (219)m = 66.77 75.79	99.94	115.47	132.19	127.95	122.84	136.67	138.18	123.67	87.18	64.13		
`	1		<u> </u>	Į		Tota	I = Sum(2	19a) ₁₁₂ =	<u> </u>		1290.78	(219)
Annual totals								k'	Wh/year	_	kWh/year	
Space heating fuel us	ed, main	system	1								1082.57	
Water heating fuel use	ed									[1290.78	
Electricity for pumps,	fans and	electric	keep-ho	t								
mechanical ventilation	n - balan	nced, ext	ract or p	ositive ii	nput fron	n outside	Э			261.29		(230a)
central heating pump):									30		(230c)
boiler with a fan-assi	sted flue									45		(230e)
Total electricity for the	abovo I						of (220a)	(220a) -				(231)
•	above, i	kWh/yea	l I			Sum	UI (230a).	(230g) =		l	336.29	(231)
Electricity for lighting	above, i	kWh/yea	l i			Sum	01 (230a).	(230g) =		L T	270.51	(232)
Electricity for lighting Total delivered energy		·		+ (231)	+ (232)			(230g) =		[[╡

12a. CO2 emissions – Individual heating systems	s including micro-CHP		
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	233.83 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216	278.81 (264)
Space and water heating	(261) + (262) + (263) + (264) =		512.64 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	174.53 (267)
Electricity for lighting	(232) x	0.519	140.39 (268)
Total CO2, kg/year	sum	n of (265)(271) =	827.57 (272)
Dwelling CO2 Emission Rate	(272	2) ÷ (4) =	15.62 (273)
EI rating (section 14)			89 (274)

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 10:57:47

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:**

Flat

Total Floor Area: 74.55m²

Dwelling Details:

Site Reference:

NEW DWELLING DESIGN STAGE

231 Watford Road - LEAN **Plot Reference:** Sample 8

Address:

Client Details:

Name:

Address:

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas

Fuel factor: 1.00 (mains gas)

16.23 kg/m² Target Carbon Dioxide Emission Rate (TER)

Dwelling Carbon Dioxide Emission Rate (DER) 14.53 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 39.5 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 30.6 kWh/m²

OK

2 Fabric U-values

Element Average Highest External wall 0.16 (max. 0.30) 0.16 (max. 0.70) OK Party wall 0.00 (max. 0.20) **OK**

Floor (no floor) Roof (no roof)

Openings 1.10 (max. 2.00) OK 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 3.50 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas

Data from manufacturer

Combi boiler

Efficiency 89.5 % SEDBUK2009

Minimum 88.0 %

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

OK

6 Controls			
Space heating controls Hot water controls:	TTZC by plumbing and e No cylinder thermostat No cylinder	electrical services	ок
Boiler interlock:	Yes		ОК
7 Low energy lights			
Percentage of fixed lights wi	th low-energy fittings	100.0%	
Minimum		75.0%	OK
8 Mechanical ventilation			
Continuous extract system			
Specific fan power:		1.05	
Maximum		0.7	Fail
9 Summertime temperature			
Overheating risk (Thames va	alley):	Slight	OK
Based on:			
Overshading:		Average or unknown	
Windows facing: South East		12.79m²	
Windows facing: South		1.28m²	
Ventilation rate:		6.00	
10 Key features			
Air permeablility		3.5 m³/m²h	
Windows U-value		1.1 W/m²K	
Party Walls U-value		0 W/m²K	

		l lser I	Details:						
Assessor Name: Software Name:	Neil Ingham Stroma FSAP 2012		Strom Softwa	are Ve	rsion:			0010943 on: 1.0.5.41	
Address :	F	Property	Address	: Sample	e 8				
1. Overall dwelling dime	ensions:								
		Are	a(m²)		Av. He	ight(m)	_	Volume(m	3)
Ground floor			74.55	(1a) x	2	2.75	(2a) =	205.01	(3a)
Total floor area TFA = (1	a)+(1b)+(1c)+(1d)+(1e)+(1	n)	74.55	(4)					
Dwelling volume				(3a)+(3b)+(3c)+(3c	d)+(3e)+	.(3n) =	205.01	(5)
2. Ventilation rate:									
	main seconda heating heating	ry	other		total			m³ per hou	ır
Number of chimneys	0 + 0	+ [0	_ = [0	X 4	40 =	0	(6a)
Number of open flues	0 + 0	+	0] = [0	x 2	20 =	0	(6b)
Number of intermittent fa	ns			Ī	0	x '	10 =	0	(7a)
Number of passive vents				Ī	0	x -	10 =	0	(7b)
Number of flueless gas fi	res			Ē	0	X 4	40 =	0	(7c)
				L					
				_			Air ch	nanges per ho	our
•	ys, flues and fans = $(6a)+(6b)+(6b)+(6a)+(6b)+(6a)+(6b)+(6a)+(6b)+(6a)+(6a)+(6b)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a$				0		÷ (5) =	0	(8)
Number of storeys in the	een carried out or is intended, proced ne dwelling (ns)	ea to (17),	otnerwise	continue ti	om (9) to	(16)		0	(9)
Additional infiltration	3 (=)					[(9)	-1]x0.1 =	0	(10)
Structural infiltration: 0	.25 for steel or timber frame o	r 0.35 fo	r masoni	ry consti	ruction			0	(11)
if both types of wall are pa deducting areas of openia	resent, use the value corresponding t	o the grea	ter wall are	ea (after					
,	floor, enter 0.2 (unsealed) or (.1 (seal	ed), else	enter 0				0	(12)
If no draught lobby, en	ter 0.05, else enter 0							0	(13)
-	s and doors draught stripped							0	(14)
Window infiltration			0.25 - [0.2	. ,	-	. (45)		0	(15)
Infiltration rate	aEO expressed in cubic metr	oe por b	(8) + (10)				oroo	0	(16)
•	q50, expressed in cubic metro ity value, then $(18) = [(17) \div 20] +$	•	•	•	ietre or e	rivelope	alea	3.5 0.18	(17)
· ·	es if a pressurisation test has been do				is being u	sed		0.10	()
Number of sides sheltere	ed		(22)		. = \ 7			0	(19)
Shelter factor	Carachaltan fastan		(20) = 1 -		19)] =			1	(20)
Infiltration rate incorporat	•		(21) = (18	6) X (20) =				0.18	(21)
Infiltration rate modified f	Mar Apr May Jun	Jul	Aug	Sep	Oct	Nov	Dec	1	
Monthly average wind sp		Jui	Aug	Тоер	1 001	1407	Dec	J	
(22)m= 5.1 5	4.9 4.4 4.3 3.8	3.8	3.7	4	4.3	4.5	4.7	1	
		ı	1	1	1	ı	I	J	
Wind Factor $(22a)m = (22a)m $	' 		T					1	
(22a)m= 1.27 1.25	1.23 1.1 1.08 0.95	0.95	0.92	1	1.08	1.12	1.18	J	

Adjusted infiltra	ation rate	e (allowi	ng for sh	elter an	d wind s	speed) =	(21a) x	(22a)m				_	
0.22	0.22	0.21	0.19	0.19	0.17	0.17	0.16	0.18	0.19	0.2	0.21		
<i>Calcul<mark>ate effec</mark></i> If mechanica		_	rate for t	he appli	cable ca	se	-		-	-			
If exhaust air he			endix N (2	3b) = (23a	a) × Fmv (e	equation (N	N5)) other	wise (23h) = (23a)			0.5	(23
If balanced with		0 11		, ,	, ,	. ,	,, .	`) = (20a)			0.5	(23
		-	-	_					26\m . /	22h) [1 (225)	0	(23
a) If balance (24a)m= 0	0	o 0	0	0	0	0	1K) (24a	0	0	23b) x [0	- 100] 	(24
b) If balance						<u> </u>						J	(-
24b)m= 0	0	0	0	0	0	0	0	0	0	0	0	1	(24
c) If whole ho				-	ļ							J	•
if (22b)m				•					.5 × (23b	o)			
24c)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5]	(2
d) If natural v	/entilatio	on or wh	ole hous	e positiv	/e input	ventilatio	on from I	oft				ı	
if (22b)m				•	•				0.5]			_	
24d)m= 0	0	0	0	0	0	0	0	0	0	0	0		(2
Effective air	change	rate - er	iter (24a	or (24b	o) or (24	c) or (24	d) in box	(25)				-	
25)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(2
3. Heat losses	and he	eat loss r	paramete	er:									
LEMENT	Gros		Openin		Net Ar	ea	U-valı	ıe	ΑXU		k-value	e A	Χk
	area	(m²)	· m		A ,r	m²	W/m2	K .	(W/	K)	kJ/m²-l	K k	J/K
Vindows Type	1				12.79	x1.	/[1/(1.1)+	0.04] =	13.48				(2
Vindows Type	2				1.28	x1.	/[1/(1.1)+	0.04] =	1.35				(2
Valls Type1	41.8	5	14.0	7	27.78	3 x	0.16	=	4.44		60	1666.	8 (2
Valls Type2	24.3	7	0		24.37	7 X	0.15	=	3.65		60	1462.	2 (2
otal area of el	ements	, m²			66.22	2							— (3
Party wall					41.82	<u>x</u>	0		0		45	1881.	9 (3
Party floor					74.55	5					40	2982	(3
Party ceiling					74.55					Ì	30	2236.	5 (3
nternal wall **					131.1	_					9	1180.0	=
for windows and	roof windo	ows, use e	ffective wi	ndow U-va			formula 1	/[(1/U-valu	ıe)+0.04] á	L as given in			30 (0
* include the area								- 1	, -		, , ,		
abric heat los	s, W/K =	= S (A x	U)				(26)(30)	+ (32) =				22.92	(3
leat capacity (Cm = S(Axk)						((28).	.(30) + (32	2) + (32a).	(32e) =	11409.48	(3
hermal mass	parame	ter (TMF	P = Cm ÷	- TFA) ir	n kJ/m²K			= (34)	÷ (4) =			153.04	(3
or design assess an be used instea				constructi	ion are no	t known pr	ecisely the	indicative	values of	TMP in T	able 1f		
hermal bridge	s : S (L	x Y) cal	culated i	using Ap	pendix l	<						9.46	(3
details of therma	l bridging	are not kn	own (36) =	= 0.05 x (3	1)								
otal fabric hea	at loss							(33) +	(36) =			32.38	(3
entilation hea	t loss ca	alculated	monthly	/				(38)m	= 0.33 × (25)m x (5)	1	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83		(3
leat transfer c	oefficier	nt, W/K						(39)m	= (37) + (38)m			
39)m= 66.21	66.21	66.21	66.21	66.21	66.21	66.21	66.21	66.21	66.21	66.21	66.21		
					ww.stroma	•	•		Average =	0(00)	- /40	66.2 ≱ age	— 1.

Heat loss para	meter (l	HLP), W/	m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89		
								,	Average =	: Sum(40) _{1.}	12 /12=	0.89	(40)
Number of day		`	le 1a)						1				
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m= 31	28	31	30	31	30	31	31	30	31	30	31		(41)
4. Water heat	ing ene	rgy requi	rement:								kWh/ye	ar:	
Assumed occu	inancv	NI									05		(42)
if TFA > 13.9	9, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9)2)] + 0.0	0013 x (ΓFA -13		35		(42)
Annual averag											.04		(43)
Reduce the annua not more that 125							o achieve	a water us	se target o	of Total			
		· ·								1			
Jan Hot water usage ii	Feb	Mar Mar	Apr	May	Jun	Jul Table 10 x	Aug	Sep	Oct	Nov	Dec		
							, ,						
(44)m= 99.05	95.45	91.85	88.24	84.64	81.04	81.04	84.64	88.24	91.85	95.45	99.05		7,,,,
Energy content of	hot water	used - cal	culated mo	onthly = 4 .	190 x Vd.r	n x nm x D)Tm / 3600			ım(44) ₁₁₂ = ables 1b. 1	L	1080.53	(44)
(45)m= 146.89	128.47	132.57	115.58	110.9	95.7	88.68	101.76	102.97	120	130.99	142.25		
(43)111= 140.03	120.47	132.37	110.00	110.9	33.1	00.00	101.70			im(45) ₁₁₂ =	<u> </u>	1416.75	(45)
If instantaneous w	ater heati	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46)		rotar – Su	1111(43)112 -	- L	1410.73	()
(46)m= 22.03	19.27	19.89	17.34	16.63	14.35	13.3	15.26	15.45	18	19.65	21.34		(46)
Water storage	loss:	<u> </u>								<u> </u>			
Storage volum	e (litres)) includin	g any so	olar or W	/WHRS	storage	within sa	ame ves	sel		0		(47)
If community h	eating a	and no ta	nk in dw	elling, e	nter 110	litres in	(47)						
Otherwise if no		hot wate	er (this in	ıcludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in ((47)			
Water storage		الممسمال	ft-		/1.\^/L	·/do./\							(40)
a) If manufact				or is kno	wn (kvvr	n/day):					0		(48)
Temperature fa											0		(49)
Energy lost fro b) If manufact		_	-		or is not		(48) x (49)) =			0		(50)
Hot water stora			-								0		(51)
If community h	•			`		,							` ,
Volume factor	from Ta	ble 2a									0		(52)
Temperature fa	actor fro	m Table	2b								0		(53)
Energy lost fro	m watei	rstorage	, kWh/ye	ear			(47) x (51)	x (52) x (53) =		0		(54)
Enter (50) or ((54) in (5	55)									0		(55)
Water storage	loss cal	culated f	or each	month			((56)m = (55) × (41)ı	m				
(56)m= 0	0	0	0	0	0	0	0	0	0	0	0		(56)
If cylinder contains	dedicate	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (H11)] ÷ (5	0), else (5	7)m = (56)	m where ((H11) is fro	m Appendi	хH	
(57)m= 0	0	0	0	0	0	0	0	0	0	0	0		(57)
Primary circuit	•	•									0		(58)
Primary circuit				•	•	. ,	, ,						
(modified by						i			i	- 			/==·
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

Combi loss calculated for each month (61) m = $(60) \div 365 \times (41)$ m (61) m= $\begin{bmatrix} 50.47 & 43.93 & 46.8 & 43.52 & 43.13 & 39.96 & 41.3 & 43.13 & 43.52 & 46.8 & 47.07 & 50.47 \end{bmatrix}$ (61)
Total heat required for water heating calculated for each month $(62)m = 0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$
(62)m= 197.36 172.4 179.37 159.09 154.03 135.66 129.97 144.89 146.49 166.81 178.06 192.73 (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 0 (63)
FHRS 118.26 108.96 98.96 52.46 27.3 11.79 10.94 12.49 12.63 55.12 109.91 116.74 (63) (G2)
Output from water heater
(64)m= 76.88 61.51 78.35 104.72 124.83 122.12 117.21 130.5 131.95 109.63 66.08 73.77
Output from water heater (annual) ₁₁₂ 1197.54 (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= 61.46 53.7 55.78 49.31 47.66 41.81 39.81 44.62 45.12 51.6 55.32 59.92 (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= 117.57 117.57 117.57 117.57 117.57 117.57 117.57 117.57 117.57 117.57 117.57 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
(67)m= 18.78 16.68 13.56 10.27 7.68 6.48 7 9.1 12.22 15.51 18.1 19.3 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
(68)m= 207.68 209.83 204.4 192.84 178.25 164.53 155.37 153.21 158.64 170.2 184.8 198.51 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
(69)m= 34.76 34.76 34.76 34.76 34.76 34.76 34.76 34.76 34.76 34.76 34.76 34.76 (69)
Pumps and fans gains (Table 5a)
(70)m= 3 3 3 3 3 3 3 3 3 3 3 (70)
Losses e.g. evaporation (negative values) (Table 5)
(71)m=
Water heating gains (Table 5)
(72)m= 82.61 79.91 74.97 68.48 64.05 58.07 53.51 59.97 62.66 69.36 76.84 80.53 (72)
Total internal gains = $(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$
(73)m= 370.33 367.69 354.21 332.86 311.25 290.35 277.14 283.55 294.79 316.34 341.01 359.62 (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 Area Flux g_ FF Gains
Table 6d m² Table 6a Table 6b Table 6c (W)
Southeast $0.9x$ 0.77 x 12.79 x 36.79 x 0.63 x 0.77 = 143.82 (77)
Southeast 0.9x 0.77 x 12.79 x 62.67 x 0.63 x 0.77 = 244.98 (77)
Southeast 0.9x 0.77 x 12.79 x 85.75 x 0.63 x 0.7 = 335.19 (77)
Southeast 0.9x 0.77 x 12.79 x 106.25 x 0.63 x 0.7 = 415.32 (77)

Southeast 0.9x	Southeast 0.9x			Southea	_						_			_						
Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 South 0.9x 0.77 x	Southeast 0.9x	Southeast $0.9x$ 0.77 x 12.79 x 119.01 x 0.63 x 0.7 = 465.19 (77)	Southeast $0.9x$ 0.77 x 12.79 x 119.01 x 0.63 x 0.7 = 465.19 (77)		ıst <mark>0.9</mark> x	0.77		x [12.7	79	X	1	19.01	x	0.63	X	0.7	=	465.19	(77)
Southeast 0.9x	Southeast 0.9x	Southeast $0.9x$ 0.77 x 12.79 x 118.15 x 0.63 x 0.7 = 461.82 (77)		Southea	st 0.9x	0.77		x [12.7	79	X	1	18.15	_ x [0.63	X	0.7	=	461.82	(77)
Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 172.26 South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7 = 18.29 South 0.9x 0.77 x 1.28 x 97.53 x 0.63 x 0.7 = 38.15 South 0.9x 0.77 x 1.28<	Southeast 0.9x		Southeast $0.9x$ 0.77 x 12.79 x 118.15 x 0.63 x 0.7 = 461.82 (77)	Southea	st _{0.9x}	0.77		x [12.7	79	x	1	13.91	_ x [0.63	X	0.7	=	445.25	(77)
Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7 = 18.29 South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7 = 29.95 South 0.9x 0.77 x 1.28 x 110.23 x 0.63 x 0.7 = 43.12 South 0.9x 0.77 x 1.28	Southeast 0.9x	Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77)		Southea	ıst _{0.9x} [0.77		x [12.7	79	x	1	04.39	x [0.63	x	0.7	=	408.04	(77)
Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7 = 29.95 South 0.9x 0.77 x 1.28 x 97.53 x 0.63 x 0.7 = 38.15 South 0.9x 0.77 x 1.28 x 110.23 x 0.63 x 0.7 = 43.12 31.12 South 0.9x 0.77 x 1.28 x 110.23 x 0.63 x 0.7 = 44.94 <td>Southeast 0.9x</td> <td>Cavith and the second s</td> <td>Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77)</td> <td>Southea</td> <td>st 0.9x</td> <td>0.77</td> <td></td> <td>x</td> <td>12.7</td> <td>79</td> <td>x</td> <td>9</td> <td>2.85</td> <td>x [</td> <td>0.63</td> <td>x</td> <td>0.7</td> <td>=</td> <td>362.94</td> <td>(77)</td>	Southeast 0.9x	Cavith and the second s	Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77)	Southea	st 0.9x	0.77		x	12.7	79	x	9	2.85	x [0.63	x	0.7	=	362.94	(77)
Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7 = 29.95 South 0.9x 0.77 x 1.28 x 97.53 x 0.63 x 0.7 = 38.15 South 0.9x 0.77 x 1.28 x 110.23 x 0.63 x 0.7 = 43.12 South 0.9x 0.77 x 1.28 x 110.23 x 0.63 x 0.7 = 44.94 South 0.9x 0.77 x 1.28 x 110.55 x 0.63 x 0.7 = 42.25	Southeast 0.9x	Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77)	Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77)	Southea	st 0.9x	0.77		x [12.7	79	x	6	9.27	x	0.63	x	0.7	=	270.75	(77)
South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7 = 29.95 South 0.9x 0.77 x 1.28 x 97.53 x 0.63 x 0.7 = 38.15 South 0.9x 0.77 x 1.28 x 110.23 x 0.63 x 0.7 = 43.12 South 0.9x 0.77 x 1.28 x 110.23 x 0.63 x 0.7 = 43.12 South 0.9x 0.77 x 1.28 x 110.55 x 0.63 x 0.7 = 43.24 South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 41.03 </td <td>South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 (78) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7 = 29.95 (78) South 0.9x 0.77 x 1.28 x 97.53 x 0.63 x 0.7 = 38.15 (78) South 0.9x 0.77 x 1.28 x 110.23 x 0.63 x 0.7 = 43.12 (78) South 0.9x 0.77 x 1.28 x 114.87 x 0.63 x 0.7 = 44.94 (78) South 0.9x 0.77 x 1.28 x 110.55 x 0.63 x 0.7 = 43.24 (78) South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 (78) South<td>Southeast 0.9x</td><td>Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77)</td><td>Southea</td><td>st 0.9x</td><td>0.77</td><td></td><td>x [</td><td>12.7</td><td>79</td><td>x</td><td>4</td><td>4.07</td><td>x</td><td>0.63</td><td>x</td><td>0.7</td><td></td><td>172.26</td><td>(77)</td></td>	South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 (78) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7 = 29.95 (78) South 0.9x 0.77 x 1.28 x 97.53 x 0.63 x 0.7 = 38.15 (78) South 0.9x 0.77 x 1.28 x 110.23 x 0.63 x 0.7 = 43.12 (78) South 0.9x 0.77 x 1.28 x 114.87 x 0.63 x 0.7 = 44.94 (78) South 0.9x 0.77 x 1.28 x 110.55 x 0.63 x 0.7 = 43.24 (78) South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 (78) South <td>Southeast 0.9x</td> <td>Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77)</td> <td>Southea</td> <td>st 0.9x</td> <td>0.77</td> <td></td> <td>x [</td> <td>12.7</td> <td>79</td> <td>x</td> <td>4</td> <td>4.07</td> <td>x</td> <td>0.63</td> <td>x</td> <td>0.7</td> <td></td> <td>172.26</td> <td>(77)</td>	Southeast 0.9x	Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77)	Southea	st 0.9x	0.77		x [12.7	79	x	4	4.07	x	0.63	x	0.7		172.26	(77)
South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7 = 29.95 South 0.9x 0.77 x 1.28 x 97.53 x 0.63 x 0.7 = 38.15 South 0.9x 0.77 x 1.28 x 110.23 x 0.63 x 0.7 = 43.12 South 0.9x 0.77 x 1.28 x 110.55 x 0.63 x 0.7 = 43.24 South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 43.24 South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 42.25 South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 South 0.9x 0.77 x 1.28 x 82.59 x	South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7 = 29.95 (78) South 0.9x 0.77 x 1.28 x 97.53 x 0.63 x 0.7 = 38.15 (78) South 0.9x 0.77 x 1.28 x 110.23 x 0.63 x 0.7 = 43.12 (78) South 0.9x 0.77 x 1.28 x 114.87 x 0.63 x 0.7 = 44.94 (78) South 0.9x 0.77 x 1.28 x 110.55 x 0.63 x 0.7 = 43.24 (78) South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 42.25 (78) South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 (78) South <td>Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77)</td> <td>Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77)</td> <td>Southea</td> <td>st _{0.9x}</td> <td>0.77</td> <td></td> <td>x [</td> <td>12.7</td> <td>79</td> <td>x</td> <td>3</td> <td>31.49</td> <td>x</td> <td>0.63</td> <td>x</td> <td>0.7</td> <td></td> <td>123.08</td> <td>(77)</td>	Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77)	Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77)	Southea	st _{0.9x}	0.77		x [12.7	79	x	3	31.49	x	0.63	x	0.7		123.08	(77)
South 0.9x 0.77 x 1.28 x 97.53 x 0.63 x 0.7 = 38.15 South 0.9x 0.77 x 1.28 x 110.23 x 0.63 x 0.7 = 43.12 South 0.9x 0.77 x 1.28 x 114.87 x 0.63 x 0.7 = 44.94 South 0.9x 0.77 x 1.28 x 110.55 x 0.63 x 0.7 = 43.24 South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 42.25 South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 South 0.9x 0.77 x 1.28 x 82.59 x	South 0.9x 0.77 x 1.28 x 97.53 x 0.63 x 0.7 = 38.15 (78) South 0.9x 0.77 x 1.28 x 110.23 x 0.63 x 0.7 = 43.12 (78) South 0.9x 0.77 x 1.28 x 110.55 x 0.63 x 0.7 = 44.94 (78) South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 43.24 (78) South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 42.25 (78) South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 (78) South 0.9x 0.77 x 1.28 x 101.89 x 0.63 x 0.7 = 39.86 (78) South </td <td>Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77)</td> <td>Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77)</td> <td>South</td> <td>0.9x</td> <td>0.77</td> <td>一</td> <td>x [</td> <td>1.28</td> <td>8</td> <td>x</td> <td>4</td> <td>6.75</td> <td>x</td> <td>0.63</td> <td>x</td> <td>0.7</td> <td></td> <td>18.29</td> <td>(78)</td>	Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77)	Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77)	South	0.9x	0.77	一	x [1.28	8	x	4	6.75	x	0.63	x	0.7		18.29	(78)
South 0.9x 0.77 x 1.28 x 110.23 x 0.63 x 0.7 = 43.12 South 0.9x 0.77 x 1.28 x 114.87 x 0.63 x 0.7 = 44.94 South 0.9x 0.77 x 1.28 x 110.55 x 0.63 x 0.7 = 43.24 South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 42.25 South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 South 0.9x 0.77 x 1.28 x 101.89 x 0.63 x 0.7 = 32.31 South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 South 0.9x 0.77 x 1.28 x 55.42 x	South 0.9x 0.77 x 1.28 x 110.23 x 0.63 x 0.7 = 43.12 (78) South 0.9x 0.77 x 1.28 x 114.87 x 0.63 x 0.7 = 44.94 (78) South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 43.24 (78) South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 42.25 (78) South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 (78) South 0.9x 0.77 x 1.28 x 101.89 x 0.63 x 0.7 = 32.31 (78) South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 (78)	Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77)	Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77)	South	0.9x	0.77		x [1.28	8	x	7	6.57	x	0.63	x	0.7	=	29.95	(78)
South 0.9x 0.77 x 1.28 x 114.87 x 0.63 x 0.7 = 44.94 South 0.9x 0.77 x 1.28 x 110.55 x 0.63 x 0.7 = 43.24 South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 42.25 South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 South 0.9x 0.77 x 1.28 x 101.89 x 0.63 x 0.7 = 39.86 South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 South 0.9x 0.77 x 1.28 x 55.42 x 0.63 x 0.7 = 21.68	South 0.9x 0.77 x 1.28 x 114.87 x 0.63 x 0.7 = 44.94 (78) South 0.9x 0.77 x 1.28 x 110.55 x 0.63 x 0.7 = 43.24 (78) South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 42.25 (78) South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 (78) South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 (78) South 0.9x 0.77 x 1.28 x 101.89 x 0.63 x 0.7 = 39.86 (78) South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 (78)	Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 (78)	Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 123.08 (77)	South	0.9x	0.77		x [1.28	8	x	9	7.53	x	0.63	x	0.7		38.15	(78)
South 0.9x 0.77 x 1.28 x 110.55 x 0.63 x 0.7 = 43.24 South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 42.25 South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 South 0.9x 0.77 x 1.28 x 101.89 x 0.63 x 0.7 = 39.86 South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 South 0.9x 0.77 x 1.28 x 55.42 x 0.63 x 0.7 = 21.68	South 0.9x 0.77 x 1.28 x 110.55 x 0.63 x 0.7 = 43.24 (78) South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 42.25 (78) South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 (78) South 0.9x 0.77 x 1.28 x 101.89 x 0.63 x 0.7 = 39.86 (78) South 0.9x 0.77 x 1.28 x 101.89 x 0.63 x 0.7 = 39.86 (78) South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 (78)	Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 (78) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7 = 29.95 (78)	Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7	South	0.9x	0.77		x [1.28	8	x	1	10.23	x	0.63	x	0.7	=	43.12	(78)
South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 42.25 South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 South 0.9x 0.77 x 1.28 x 101.89 x 0.63 x 0.7 = 39.86 South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 South 0.9x 0.77 x 1.28 x 55.42 x 0.63 x 0.7 = 21.68	South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 42.25 (78) South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 (78) South 0.9x 0.77 x 1.28 x 101.89 x 0.63 x 0.7 = 39.86 (78) South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 (78)	Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 (78) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7 = 29.95 (78) South 0.9x 0.77 x 1.28 x <td>Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 (78) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7 = 18.29 (78) South 0.9x 0.77 x 1.28 x<!--</td--><td>South</td><td>0.9x</td><td>0.77</td><td></td><td>x [</td><td>1.28</td><td>8</td><td>x</td><td>1</td><td>14.87</td><td>x</td><td>0.63</td><td>×</td><td>0.7</td><td>=</td><td>44.94</td><td>(78)</td></td>	Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 (78) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7 = 18.29 (78) South 0.9x 0.77 x 1.28 x </td <td>South</td> <td>0.9x</td> <td>0.77</td> <td></td> <td>x [</td> <td>1.28</td> <td>8</td> <td>x</td> <td>1</td> <td>14.87</td> <td>x</td> <td>0.63</td> <td>×</td> <td>0.7</td> <td>=</td> <td>44.94</td> <td>(78)</td>	South	0.9x	0.77		x [1.28	8	x	1	14.87	x	0.63	×	0.7	=	44.94	(78)
South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 South 0.9x 0.77 x 1.28 x 101.89 x 0.63 x 0.7 = 39.86 South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 South 0.9x 0.77 x 1.28 x 55.42 x 0.63 x 0.7 = 21.68	South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 (78) South 0.9x 0.77 x 1.28 x 101.89 x 0.63 x 0.7 = 39.86 (78) South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 (78)	Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 (78) South 0.9x 0.77 x 1.28 x 97.53 x 0.63 x 0.7 = 38.15 (78) South 0.9x 0.77 x 1.28 x <td>Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7</td> <td>South</td> <td>0.9x</td> <td>0.77</td> <td></td> <td>x [</td> <td>1.28</td> <td>8</td> <td>x</td> <td>1</td> <td>10.55</td> <td>x</td> <td>0.63</td> <td>x</td> <td>0.7</td> <td>=</td> <td>43.24</td> <td>(78)</td>	Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7	South	0.9x	0.77		x [1.28	8	x	1	10.55	x	0.63	x	0.7	=	43.24	(78)
South 0.9x 0.77 x 1.28 x 101.89 x 0.63 x 0.7 = 39.86 South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 South 0.9x 0.77 x 1.28 x 55.42 x 0.63 x 0.7 = 21.68	South 0.9x 0.77 x 1.28 x 101.89 x 0.63 x 0.7 = 39.86 (78) South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 (78)	Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 (78) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7	Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7	South	0.9x	0.77		x [1.28	8	x	1	08.01	x	0.63	x	0.7	=	42.25	(78)
South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 South 0.9x 0.77 x 1.28 x 55.42 x 0.63 x 0.7 = 21.68	South 0.9x 0.77 × 1.28 × 82.59 × 0.63 × 0.7 = 32.31 (78)	Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x	Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7	South	0.9x	0.77		× [1.28	8	x	1	04.89	х	0.63	×	0.7	=	41.03	(78)
South 0.9x 0.77 x 1.28 x 55.42 x 0.63 x 0.7 = 21.68	0.17	Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 (78) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7	Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7	South	0.9x	0.77		x [1.28	8	x	1	01.89	x	0.63	×	0.7	=	39.86	(78)
0.4	South $0.9x$ 0.77 x 1.28 x 55.42 x 0.63 x 0.7 = 21.68 (78)	Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 (78) South 0.9x 0.77 x 1.28 x 97.53 x 0.63 x 0.7	Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7	South	0.9x	0.77		x [1.28	8	x	8	32.59	x	0.63	x	0.7	=	32.31	(78)
South	0.00	Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 182.9 (78) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7	Southeast 0.9x	South	0.9x	0.77		x [1.28	8	x	5	55.42	x	0.63	×	0.7	_	21.68	(78)
South $0.9X$ 0.77 X 1.28 X 40.4 X 0.63 X 0.7 = 15.8	South 0.9x 0.77 x 1.28 x 40.4 x 0.63 x 0.7 = 15.8 (78)	Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7	Southeast 0.9x	South	0.9x	0.77		x [1.28	8	x		40.4	x	0.63	×	0.7	_ =	15.8	(78)
		Southeast 0.9x	Southeast 0.9x		_			_			•					_				_
Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m		Southeast 0.9x	Southeast 0.9x	Solar q	ains in	watts, ca	lculate	ed f	for each	n mont	th			(83)m	= Sum(74)m	(82)m				
		Southeast 0.9x	Southeast 0.9x	ĭ				$\overline{}$			\neg	505.07	487.5	È			6 193.94	138.88		(83)
Total gains – internal and solar (84)m = (73)m + (83)m , watts	Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m	Southeast 0.9x	Southeast 0.9x	Total g	ains – i	nternal a	nd sol	ar ((84)m =	(73)n	า + ((83)m	, watts				•	I	1	
(84)m= 532.44 642.62 727.55 791.3 821.37 795.42 764.64 732.63 697.59 619.4 534.95 498.5	Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m (83)m= 162.11 274.93 373.34 458.44 510.12 505.07 487.5 449.07 402.79 303.06 193.94 138.88 (83)	Southeast 0.9x	Southeast 0.9x	(84)m=	532.44	642.62	727.55	,	791.3	821.3	7 7	95.42	764.64	732.	63 697.59	619.4	534.95	498.5		(84)
7. Mean internal temperature (heating season)	Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m (83)m= 162.11 274.93 373.34 458.44 510.12 505.07 487.5 449.07 402.79 303.06 193.94 138.88 (83) Total gains – internal and solar (84)m = (73)m + (83)m , watts	Southeast 0.9x	Southeast 0.9x	7. Me:	an inter	nal temp	eratur	e (h	neating	seaso	on)			-						
	Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m (83)m= 162.11 274.93 373.34 458.44 510.12 505.07 487.5 449.07 402.79 303.06 193.94 138.88 (83) Total gains – internal and solar (84)m = (73)m + (83)m , watts (84)m= 532.44 642.62 727.55 791.3 821.37 795.42 764.64 732.63 697.59 619.4 534.95 498.5 (84)	Southeast 0.9x	Southeast 0.9x						Ĭ			area	from Tal	ole 9,	Th1 (°C)				21	(85)
	Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m (83)m = 162.11 274.93 373.34 458.44 510.12 505.07 487.5 449.07 402.79 303.06 193.94 138.88 Total gains – internal and solar (84)m = (73)m + (83)m , watts (84)m = 532.44 642.62 727.55 791.3 821.37 795.42 764.64 732.63 697.59 619.4 534.95 498.5 7. Mean internal temperature (heating season)	Southeast 0.9x	Southeast 0.9x	•		_	_	•			_				` '					
	Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m (83)m= 162.11 274.93 373.34 458.44 510.12 505.07 487.5 449.07 402.79 303.06 193.94 138.88 Total gains – internal and solar (84)m = (73)m + (83)m , watts (84)m= 532.44 642.62 727.55 791.3 821.37 795.42 764.64 732.63 697.59 619.4 534.95 498.5 7. Mean internal temperature (heating season) Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)	Southeast 0.9x	Southeast 0.9x		Jan	Feb	Mar		Apr	May	y	Jun	Jul	Αι	ug Sep	Oct	Nov	Dec		
Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 Utilisation factor for gains for living area, h1,m (see Table 9a)	Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m (83)m = 162.11 274.93 373.34 458.44 510.12 505.07 487.5 449.07 402.79 303.06 193.94 138.88 (83) Total gains – internal and solar (84)m = (73)m + (83)m , watts (84)m = 532.44 642.62 727.55 791.3 821.37 795.42 764.64 732.63 697.59 619.4 534.95 498.5 (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)	Southeast 0.9x	Southeast 0.9x	(86)m=	0.98	0.95	0.9	T	0.81	0.68		0.51	0.38	0.4	1 0.61	0.85	0.95	0.98		(86)
Temperature during heating periods in the living area from Table 9, Th1 (°C) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m (83)m = 162.11 274.93 373.34 458.44 510.12 505.07 487.5 449.07 402.79 303.06 193.94 138.88 Total gains – internal and solar (84)m = (73)m + (83)m , watts (84)m = 532.44 642.62 727.55 791.3 821.37 795.42 764.64 732.63 697.59 619.4 534.95 498.5 7. Mean internal temperature (heating season) Temperature during heating periods in the living area from Table 9, Th1 (°C) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	Southeast 0.9x	Southeast 0.9x	Mean	interna	l tempera	ature ii	ı liv	ving are	a T1	(follo	ow ste	ns 3 to 7	in T	able 9c)		•		•	
Temperature during heating periods in the living area from Table 9, Th1 (°C) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m= 0.98 0.95 0.9 0.81 0.68 0.51 0.38 0.41 0.61 0.85 0.95 0.98	Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m (83)m= 162.11 274.93 373.34 458.44 510.12 505.07 487.5 449.07 402.79 303.06 193.94 138.88 (70 a)m = Sum(74)m(82)m (84)m = Size (10 a)m	Southeast 0.9x	Southeast 0.9x	Г	19.86	20.11	20.41	T	20.69		Ì		20.99		- 	20.68	20.2	19.78		(87)
Temperature during heating periods in the living area from Table 9, Th1 (°C) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m= 0.98 0.95 0.9 0.81 0.68 0.51 0.38 0.41 0.61 0.85 0.95 0.98 Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)	Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m (83)m = 162.11 274.93 373.34 458.44 510.12 505.07 487.5 449.07 402.79 303.06 193.94 138.88 (83) Total gains – internal and solar (84)m = (73)m + (83)m , watts (84)m = 532.44 642.62 727.55 791.3 821.37 795.42 764.64 732.63 697.59 619.4 534.95 498.5 (84)m = Temperature during heating periods in the living area from Table 9, Th1 (°C) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m = 0.98 0.95 0.9 0.81 0.68 0.51 0.38 0.41 0.61 0.85 0.95 0.98 Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)	Southeast 0.9x	Southeast 0.9x						!	root			<u> </u>		!				l	
Temperature during heating periods in the living area from Table 9, Th1 (°C) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m= 0.98 0.95 0.9 0.81 0.68 0.51 0.38 0.41 0.61 0.85 0.95 0.98 Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 19.86 20.11 20.41 20.69 20.88 20.97 20.99 20.99 20.94 20.68 20.2 19.78	Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m (83)m= 162.11 274.93 373.34 458.44 510.12 505.07 487.5 449.07 402.79 303.06 193.94 138.88 (83) Total gains – internal and solar (84)m = (73)m + (83)m , watts (84)m= 532.44 642.62 727.55 791.3 821.37 795.42 764.64 732.63 697.59 619.4 534.95 498.5 (84) 7. Mean internal temperature (heating season) Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m= 0.98 0.95 0.9 0.81 0.68 0.51 0.38 0.41 0.61 0.85 0.95 0.98 (86) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 19.86 20.11 20.41 20.69 20.88 20.97 20.99 20.99 20.94 20.68 20.2 19.78 (87)	Southeast 0.9x	Southeast 0.9x	· r		 		- -			$\overline{}$		i		- 	20.18	20.18	20.18		(88)
Temperature during heating periods in the living area from Table 9, Th1 (°C) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m= 0.98 0.95 0.9 0.81 0.68 0.51 0.38 0.41 0.61 0.85 0.95 0.98 Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 19.86 20.11 20.41 20.69 20.88 20.97 20.99 20.99 20.94 20.68 20.2 19.78 Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)	Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m (83)m = 162.11 274.93 373.34 458.44 510.12 505.07 487.5 449.07 402.79 303.06 193.94 138.88 (83) Total gains – internal and solar (84)m = (73)m + (83)m , watts (84)m = 532.44 642.62 727.55 791.3 821.37 795.42 764.64 732.63 697.59 619.4 534.95 498.5 (84) 7. Mean internal temperature (heating season) Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m = 0.98 0.95 0.9 0.81 0.68 0.51 0.38 0.41 0.61 0.85 0.95 0.98 (86) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m = 19.86 20.11 20.41 20.69 20.88 20.97 20.99 20.99 20.94 20.68 20.2 19.78 (87) Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)	Southeast 0.9x	Southeast 0.9x						J				<u> </u>	<u> </u>	20.10	20.10	20.10	20.10		()
Temperature during heating periods in the living area from Table 9, Th1 (°C) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m= 0.98 0.95 0.9 0.81 0.68 0.51 0.38 0.41 0.61 0.85 0.95 0.98 Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 19.86 20.11 20.41 20.69 20.88 20.97 20.99 20.99 20.94 20.68 20.2 19.78 Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18	Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m (83)m = 162.11 274.93 373.34 458.44 510.12 505.07 487.5 449.07 402.79 303.06 193.94 138.88 (83) Total gains – internal and solar (84)m = (73)m + (83)m , watts (84)m = 532.44 642.62 727.55 791.3 821.37 795.42 764.64 732.63 697.59 619.4 534.95 498.5 (84) 7. Mean internal temperature (heating season) Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m = 0.98 0.95 0.9 0.81 0.68 0.51 0.38 0.41 0.61 0.85 0.95 0.98 (86) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) [87]m	Southeast 0.9x	Southeast 0, sk 0.77	r		`		r re					i	–			1		1	(00)
Temperature during heating periods in the living area from Table 9, Th1 (°C) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m= 0.98 0.95 0.9 0.81 0.68 0.51 0.38 0.41 0.61 0.85 0.95 0.98 Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 19.86 20.11 20.41 20.69 20.88 20.97 20.99 20.99 20.94 20.68 20.2 19.78 Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 20.18 2	Solar gains in watts, calculated for each month (83)m= 162.11 274.93 373.34 458.44 510.12 505.07 487.5 449.07 402.79 303.06 193.94 138.88 (83) Total gains – internal and solar (84)m = (73)m + (83)m , watts (84)m= 532.44 642.62 727.55 791.3 821.37 795.42 764.64 732.63 697.59 619.4 534.95 498.5 (84) 7. Mean internal temperature (heating season) Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m= 0.98 0.95 0.9 0.81 0.68 0.51 0.38 0.41 0.61 0.85 0.95 0.98 (86) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 19.86 20.11 20.41 20.69 20.88 20.97 20.99 20.99 20.94 20.68 20.2 19.78 (87) Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 20.18 20	Southeast 0 9x 0.77	Southeast 0.9x	(89)m=	0.97	0.94	0.88		0.78	0.63		0.45	0.31	0.3	4 0.55	0.82	0.94	0.98		(89)
Temperature during heating periods in the living area from Table 9, Th1 (°C) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m= 0.98 0.95 0.9 0.81 0.68 0.51 0.38 0.41 0.61 0.85 0.95 0.98 Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 19.86 20.11 20.41 20.69 20.88 20.97 20.99 20.99 20.94 20.68 20.2 19.78 Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 20.18 2	Solar gains in watts, calculated for each month (83)m= 162.11 274.93 373.34 458.44 510.12 505.07 487.5 449.07 402.79 303.06 193.94 138.88 (83) Total gains – internal and solar (84)m = (73)m + (83)m , watts (84)m= 532.44 642.62 727.55 791.3 821.37 795.42 764.64 732.63 697.59 619.4 534.95 498.5 (84) 7. Mean internal temperature (heating season) Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m= 0.98 0.95 0.9 0.81 0.68 0.51 0.38 0.41 0.61 0.85 0.95 0.98 (86) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 19.86 20.11 20.41 20.69 20.88 20.97 20.99 20.99 20.94 20.68 20.2 19.78 (87) Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 20.18 20	Southeast 0 9x	Southeast 0.9x	-	interna	l tempera		_			一一	•		i 		e 9c)	_		1	
Temperature during heating periods in the living area from Table 9, Th1 (°C) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m= 0.98 0.95 0.9 0.81 0.68 0.51 0.38 0.41 0.61 0.85 0.95 0.98 Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 19.86 20.11 20.41 20.69 20.88 20.97 20.99 20.99 20.94 20.68 20.2 19.78 Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) (89)m= 0.97 0.94 0.88 0.78 0.63 0.45 0.31 0.34 0.55 0.82 0.94 0.98 Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m (83)m= 162.11 274.93 373.34 458.44 510.12 505.07 487.5 449.07 402.79 303.06 193.94 138.88 (83) Total gains – internal and solar (84)m = (73)m + (83)m , watts (84)m= 532.44 642.62 727.55 791.3 821.37 795.42 764.64 732.63 697.59 619.4 534.95 498.5 (84) 7. Mean internal temperature (heating season) Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m= 0.98 0.95 0.9 0.81 0.68 0.51 0.38 0.41 0.61 0.85 0.95 0.98 (86) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 19.86 20.11 20.41 20.69 20.88 20.97 20.99 20.99 20.99 20.94 20.68 20.2 19.78 (87) Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 (88) Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	Southeast 0, sk 0.77	Southeast 0, 9x	Mean				- 1	19.82	20.06	. 1 :	20 15	20 17	1 00 4	47 00 40	19 81	10 15	10 55		(00)
Temperature during heating periods in the living area from Table 9, Th1 (°C) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m= 0.98 0.95 0.9 0.81 0.68 0.51 0.38 0.41 0.61 0.85 0.95 0.98 Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 19.86 20.11 20.41 20.69 20.88 20.97 20.99 20.99 20.94 20.68 20.2 19.78 Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) (89)m= 0.97 0.94 0.88 0.78 0.63 0.45 0.31 0.34 0.55 0.82 0.94 0.98 Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 18.65 19.01 19.43 19.82 20.06 20.15 20.17 20.17 20.17 19.81 19.81 19.15 18.55	Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m [83)m = 162.11 274.93 373.34 458.44 510.12 505.07 487.5 449.07 402.79 303.06 193.94 138.88 (83) Total gains – internal and solar (84)m = (73)m + (83)m , watts [84)m = 532.44 642.62 727.55 791.3 821.37 795.42 764.64 732.63 697.59 619.4 534.95 498.5 (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) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (86)m = 19.86 20.11 20.41 20.69 20.88 20.97 20.99 20.99 20.94 20.68 20.2 19.78 (87) Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m = 20.18 20.	Southeast 0, 9x	Southeast 0.9x	r		19.01	19.43					20.10	20.17	20.1				<u> </u>		
Temperature during heating periods in the living area from Table 9, Th1 (°C) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m= 0.98 0.95 0.9 0.81 0.68 0.51 0.38 0.41 0.61 0.85 0.95 0.98 Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 19.86 20.11 20.41 20.69 20.88 20.97 20.99 20.99 20.94 20.68 20.2 19.78 Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) (89)m= 0.97 0.94 0.88 0.78 0.63 0.45 0.31 0.34 0.55 0.82 0.94 0.98 Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 18.65 19.01 19.43 19.82 20.06 20.15 20.17 20.17 20.17 19.81 19.81 19.15 18.55	Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m [83)m = 162.11 274,93 373.34 458.44 510.12 505.07 487.5 449.07 402.79 303.06 193.94 138.88 (83) Total gains – internal and solar (84)m = (73)m + (83)m, watts [84)m = 532.44 642.62 727.55 791.3 821.37 795.42 764.64 732.63 697.59 619.4 534.95 498.5 (84) 7. Mean internal temperature (heating season) Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85) Utilisation factor for gains for living area, h1,m (see Table 9a) [86)m = 0.98 0.95 0.9 0.81 0.68 0.51 0.38 0.41 0.61 0.85 0.95 0.98 (86) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) [87)m = 19.86 20.11 20.41 20.69 20.88 20.97 20.99 20.99 20.99 20.94 20.68 20.2 19.78 (87) Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) [88)m = 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 (88) Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) [89)m = 0.97 0.94 0.88 0.78 0.63 0.45 0.31 0.34 0.55 0.82 0.94 0.98 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) [89)m = 18.65 19.01 19.43 19.82 20.06 20.15 20.17 20.17 20.13 19.81 19.15 18.55 (90)	Southeast 0, 9x	Southeast 0.9x	r		19.01	19.43		1332		1 -	20.10	20.17	20.1				<u> </u>	0.4	
Temperature during heating periods in the living area from Table 9, Th1 (°C) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m= 0.98 0.95 0.9 0.81 0.68 0.51 0.38 0.41 0.61 0.85 0.95 0.98 Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 19.86 20.11 20.41 20.69 20.88 20.97 20.99 20.99 20.94 20.68 20.2 19.78 Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) (89)m= 0.97 0.94 0.88 0.78 0.63 0.45 0.31 0.34 0.55 0.82 0.94 0.98 Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 18.65 19.01 19.43 19.82 20.06 20.15 20.17 20.17 20.17 19.81 19.81 19.15 18.55	Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m [83)m = 162.11 274.93 373.34 458.44 510.12 505.07 487.5 449.07 402.79 303.06 193.94 138.88 (83) [84)m = 532.44 642.62 727.55 791.3 821.37 795.42 764.64 732.63 697.59 619.4 534.95 498.5 (84) [7. Mean internal temperature (heating season) Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85) Utilisation factor for gains for living area, h1,m (see Table 9a) [86)m = 0.98 0.95 0.9 0.81 0.68 0.51 0.38 0.41 0.61 0.85 0.95 0.98 (86) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) [87)m = 19.86 20.11 20.41 20.69 20.88 20.97 20.99 20.99 20.94 20.68 20.2 19.78 (87) Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) [88)m = 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 (88) Utilisation factor for gains for rest of dwelling T2 (follow steps 3 to 7 in Table 9c) [89)m = 0.97 0.94 0.88 0.78 0.63 0.45 0.31 0.34 0.55 0.82 0.94 0.98 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) [89]m = 18.65 19.01 19.43 19.82 20.06 20.15 20.17 20.17 20.13 19.81 19.15 18.55 (90) [10.4	Southeast 0.3x	Southeast 0.9x	(90)m=	18.65									l	f			<u> </u>	0.4	
Temperature during heating periods in the living area from Table 9, Th1 (°C) Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (86)m= 0.98 0.95 0.9 0.81 0.68 0.51 0.38 0.41 0.61 0.85 0.95 0.98 Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 19.86 20.11 20.41 20.69 20.88 20.97 20.99 20.99 20.94 20.68 20.2 19.78 Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 20.18	Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m (83)m = 162.11 274.93 373.34 458.44 510.12 505.07 487.5 449.07 402.79 303.06 193.94 138.88 (83) (84)m = 532.44 642.62 727.55 791.3 821.37 795.42 764.64 732.63 697.59 619.4 534.95 498.5 (84) (84)m = 532.44 642.62 727.55 791.3 821.37 795.42 764.64 732.63 697.59 619.4 534.95 498.5 (84) (85) (84) (86) (86) (86) (86) (86) (86) (86) (86	Southeast 0.3x	Southeast 0 sk	(90)m=	18.65 interna	l tempera	ature (for	the who	ole dw	vellir	ng) = f	LA × T1	+ (1 -	- fLA) × T2	LA = Liv	ving area ÷ (4	4) =	0.4	(91)
South and an order of the state	1.20	Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 182.9 (78) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7	Southeast 0.9x	South	0.9x	0.77		x	1.28	8	X	5	55.42	x	0.63	X	0.7	=	21.68	(78)
0.4		Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 182.9 (78) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7	Southeast 0.9x		L		_	H			! !] L] [╡		=		╡` ′
0.41	South $0.9 \times 1 + 0.77 \times 1 + 1.28 \times 1 + 55.42 \times 1 + 0.63 \times 1 + 0.77 \times 1 = 1 + 21.68 \times 1.78$	Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 182.9 (78) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7	Southeast 0.9x		0.9x	0.77		×	1.28	8	X	8	32.59	×	0.63	X	0.7	=	32.31	(78)
South 0.9x 0.77 x 1.28 x 55.42 x 0.63 x 0.7 = 21.68		Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 (78) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7	Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7	South	0.9x	0.77		x [1.28	8	X		32.59] _X	0.63	×	0.7		32.31	(78)
South 0.9x 0.77 x 1.28 x 55.42 x 0.63 x 0.7 = 21.68	0.17	Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 (78) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7	Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7	South	0.9x	0.77		x	1.28	8	X	1	01.89	X	0.63	X	0.7	=	39.86	(78)
South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 South 0.9x 0.77 x 1.28 x 55.42 x 0.63 x 0.7 = 21.68	South 0.9x 0.77 × 1.28 × 82.59 × 0.63 × 0.7 = 32.31 (78)	Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 (78) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7	Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7		Ļ		=	ŀ			 	—] [] [╡		=		= ' '
South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 South 0.9x 0.77 x 1.28 x 55.42 x 0.63 x 0.7 = 21.68	South 0.9x 0.77 × 1.28 × 82.59 × 0.63 × 0.7 = 32.31 (78)	Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x	Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7	South	0.9x	0.77	$\overline{}$	x [1.28	8	x	1	04.89	x	0.63	x	0.7		41.03	(78)
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South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 South 0.9x 0.77 x 1.28 x 101.89 x 0.63 x 0.7 = 39.86 South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 South 0.9x 0.77 x 1.28 x 55.42 x 0.63 x 0.7 = 21.68	South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 (78) South 0.9x 0.77 x 1.28 x 101.89 x 0.63 x 0.7 = 39.86 (78) South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 (78)	Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 (78) South 0.9x 0.77 x 1.28 x 97.53 x 0.63 x 0.7 = 38.15 (78) South 0.9x 0.77 x 1.28 x <td>Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7</td> <td>South</td> <td>0.9x</td> <td>0.77</td> <td></td> <td>x [</td> <td>1.28</td> <td>8</td> <td>x</td> <td>1</td> <td>10.55</td> <td>x</td> <td>0.63</td> <td>×</td> <td>0.7</td> <td></td> <td>43.24</td> <td>(78)</td>	Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) South 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7	South	0.9x	0.77		x [1.28	8	x	1	10.55	x	0.63	×	0.7		43.24	(78)
South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 42.25 South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 South 0.9x 0.77 x 1.28 x 101.89 x 0.63 x 0.7 = 39.86 South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 South 0.9x 0.77 x 1.28 x 55.42 x 0.63 x 0.7 = 21.68	South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 42.25 (78) South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 (78) South 0.9x 0.77 x 1.28 x 101.89 x 0.63 x 0.7 = 39.86 (78) South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 (78)	Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 (78) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7 = 29.95 (78) South 0.9x 0.77 x 1.28 x <td>Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 (78) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7 = 18.29 (78) South 0.9x 0.77 x 1.28 x<!--</td--><td>South</td><td>0.9x</td><td>0.77</td><td></td><td>x [</td><td>1.28</td><td>8</td><td>x</td><td>1</td><td>14.87</td><td>x</td><td>0.63</td><td>x</td><td>0.7</td><td></td><td>44.94</td><td>(78)</td></td>	Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 (78) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7 = 18.29 (78) South 0.9x 0.77 x 1.28 x </td <td>South</td> <td>0.9x</td> <td>0.77</td> <td></td> <td>x [</td> <td>1.28</td> <td>8</td> <td>x</td> <td>1</td> <td>14.87</td> <td>x</td> <td>0.63</td> <td>x</td> <td>0.7</td> <td></td> <td>44.94</td> <td>(78)</td>	South	0.9x	0.77		x [1.28	8	x	1	14.87	x	0.63	x	0.7		44.94	(78)
South 0.9x 0.77 x 1.28 x 110.55 x 0.63 x 0.7 = 43.24 South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 42.25 South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 South 0.9x 0.77 x 1.28 x 101.89 x 0.63 x 0.7 = 39.86 South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 South 0.9x 0.77 x 1.28 x 55.42 x 0.63 x 0.7 = 21.68	South 0.9x 0.77 x 1.28 x 110.55 x 0.63 x 0.7 = 43.24 (78) South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 42.25 (78) South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 (78) South 0.9x 0.77 x 1.28 x 101.89 x 0.63 x 0.7 = 39.86 (78) South 0.9x 0.77 x 1.28 x 101.89 x 0.63 x 0.7 = 39.86 (78) South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 (78)	Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 (78) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7 = 29.95 (78)	Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7	South	0.9x	0.77		x [1.28	8	x	1	10.23	x	0.63	x	0.7	=	43.12	(78)
South 0.9x 0.77 x 1.28 x 114.87 x 0.63 x 0.7 = 44.94 South 0.9x 0.77 x 1.28 x 110.55 x 0.63 x 0.7 = 43.24 South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 42.25 South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 South 0.9x 0.77 x 1.28 x 101.89 x 0.63 x 0.7 = 39.86 South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 South 0.9x 0.77 x 1.28 x 55.42 x 0.63 x 0.7 = 21.68	South 0.9x 0.77 x 1.28 x 114.87 x 0.63 x 0.7 = 44.94 (78) South 0.9x 0.77 x 1.28 x 110.55 x 0.63 x 0.7 = 43.24 (78) South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 42.25 (78) South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 (78) South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 (78) South 0.9x 0.77 x 1.28 x 101.89 x 0.63 x 0.7 = 39.86 (78) South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 (78)	Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7 = 18.29 (78) South 0.9x 0.77 x 1.28 x 76.57 x 0.63 x 0.7 = 29.95 (78)	Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77) South 0.9x 0.77 x 1.28 x 46.75 x 0.63 x 0.7	South	0.9x	0.77		x [1.28	8	X	9	7.53	x	0.63	X	0.7	=	38.15	(78)
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South 0.9x 0.77 x 1.28 x 97.53 x 0.63 x 0.7 = 38.15 South 0.9x 0.77 x 1.28 x 110.23 x 0.63 x 0.7 = 43.12 South 0.9x 0.77 x 1.28 x 114.87 x 0.63 x 0.7 = 44.94 South 0.9x 0.77 x 1.28 x 110.55 x 0.63 x 0.7 = 43.24 South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 42.25 South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 South 0.9x 0.77 x 1.28 x 82.59 x 0.63 x 0.7 = 32.31 South 0.9x 0.77 x 1.28 x 82.59 x	South 0.9x 0.77 x 1.28 x 97.53 x 0.63 x 0.7 = 38.15 (78) South 0.9x 0.77 x 1.28 x 110.23 x 0.63 x 0.7 = 43.12 (78) South 0.9x 0.77 x 1.28 x 110.55 x 0.63 x 0.7 = 44.94 (78) South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 43.24 (78) South 0.9x 0.77 x 1.28 x 108.01 x 0.63 x 0.7 = 42.25 (78) South 0.9x 0.77 x 1.28 x 104.89 x 0.63 x 0.7 = 41.03 (78) South 0.9x 0.77 x 1.28 x 101.89 x 0.63 x 0.7 = 39.86 (78) South </td <td>Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77)</td> <td>Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77)</td> <td></td> <td>Ļ</td> <td>0.77</td> <td></td> <td>×</td> <td>1.28</td> <td>8</td> <td>X</td> <td>4</td> <td>6.75</td> <td>X</td> <td>0.63</td> <td>×</td> <td>0.7</td> <td> =</td> <td>18.29</td> <td>= ' '</td>	Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77)	Southeast 0.9x 0.77 x 12.79 x 113.91 x 0.63 x 0.7 = 445.25 (77) Southeast 0.9x 0.77 x 12.79 x 104.39 x 0.63 x 0.7 = 408.04 (77) Southeast 0.9x 0.77 x 12.79 x 92.85 x 0.63 x 0.7 = 362.94 (77) Southeast 0.9x 0.77 x 12.79 x 69.27 x 0.63 x 0.7 = 270.75 (77) Southeast 0.9x 0.77 x 12.79 x 44.07 x 0.63 x 0.7 = 172.26 (77) Southeast 0.9x 0.77 x 12.79 x 31.49 x 0.63 x 0.7 = 123.08 (77)		Ļ	0.77		×	1.28	8	X	4	6.75	X	0.63	×	0.7	=	18.29	= ' '
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Southeast 0.9x	Southeast 0.9x		Southeast $0.9x$ 0.77 x 12.79 x 118.15 x 0.63 x 0.7 $=$ 461.82 (77)	Southea	L ا st n gx		==	ŀ			!]] L] [╡				= ' '
Southeast 0.9x	Southeast 0.9x	Southeast $0.9x$ 0.77 x 12.79 x 118.15 x 0.63 x 0.7 = 461.82 (77)		Southea	st _{0.9x}	0.77		x	12.7	79	X	1	18.15] x	0.63	x	0.7		461.82	(77)
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(00)	40.00	40.0	40.07	00.04	00.04	00.00	00.05	00.05	00.0	00.04	10.44	40.00		(93)
(93)m=	18.98	19.3	19.67	20.01	20.24	20.33	20.35	20.35	20.3	20.01	19.41	18.89		(93)
			uirement				44 -4	Table 0	41	4 T: /	70)	-11-	lata	
			or gains	•		ed at ste	ер ттог	rable 9	o, so tha	t 11,m=(rojin an	d re-calc	culate	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
	ation fac	tor for g	ains, hm	1:			,						•	
(94)m=	0.96	0.93	0.87	0.78	0.64	0.47	0.32	0.35	0.56	0.81	0.93	0.97		(94)
Usefu			, W = (9 ²				T	,	1		1	1	ı	
(95)m=	512.21	596.56	634.89	614.75	522.18	370.16	246.71	259.07	390.9	501.43	499.52	483.26		(95)
		age exte	rnal tem	perature			•	,						
(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			i				-``	- ` 	– (96)m					
(97)m=	971.82	953.24	871.67	735.72	565.12	379.26	248.22	261.32	410.44	622.74	815.34	972.38		(97)
Space			ı	r each n	nonth, k\	Wh/mon	th = 0.02	24 x [(97)m – (95	<u> </u>	r		1	
(98)m=	341.94	239.69	176.17	87.1	31.95	0	0	0	0	90.26	227.39	363.91		_
								Tota	l per year	(kWh/yeaı	r) = Sum(9	8) _{15,912} =	1558.4	(98)
Space	e heatin	g require	ement in	kWh/m²	?/year								20.9	(99)
9a En	erav rea	wiremer	nts — Indi	ividual h	eating sy	vstems i	ncluding	micro-C	:HP)					
	e heatir		no ma	Madain	oainig oʻ	y otorno r	rioraanig	, moro c)					
-		•	at from s	econdar	v/supple	mentary	system						0	(201)
			at from m			,	•	(202) = 1	- (201) =				1	(202)
			ng from	-	. ,			(204) = (2	02) x [1 –	(203)] =			1	(204)
			ace heat	-									90.3	(206)
	•	-	ry/supple			g system	າ, %						0	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ar
Space	e heatin	g require	ement (c	<u> </u>)							,	
-	341.94	239.69	176.17	87.1	31.95	0	0	0	0	90.26	227.39	363.91		
(211)m	n = {[(98)m x (20	(4)] } x 1	00 ÷ (20	06)		Į.				ļ.	!	l	(211)
(= 1 1)	378.68	265.44	195.09	96.45	35.38	0	0	0	0	99.96	251.81	403		` ,
			ļ				<u> </u>	Tota	l (kWh/yea	ar) =Sum(2	L 211) _{15.1012}	<u>. </u>	1725.81	(211)
Snace	e heatin	a fual (s	econdar	v) k\//h/	month									J` ′
•		•	00 ÷ (20	• / ·	month									
(215)m=		0	0	0	0	0	0	0	0	0	0	0		
, ,			<u> </u>	<u> </u>			<u> </u>	Tota	l II (kWh/yea	ar) =Sum(2	1	<u> </u> =	0	(215)
Water	heating													」` ′
	_		ter (calc	ulated a	hove)									
o anpan	76.88	61.51	78.35	104.72	124.83	122.12	117.21	130.5	131.95	109.63	66.08	73.77		
Efficier	ncy of w	ater hea	ıter						!		Į.	Į.	81	(216)
(217)m=	88.44	88.23	87.22	84.97	82.74	81	81	81	81	84.95	88.02	88.59		(217)
Fuel fo			kWh/mo	onth			Į	!	!		I .	Į	I	
		•) ÷ (217)											
(219)m=	86.93	69.71	89.83	123.23	150.87	150.76	144.71	161.12	162.9	129.05	75.07	83.27		_
·								Tota	I = Sum(2	19a) ₁₁₂ =			1427.46	(219)
	al totals									k'	Wh/year		kWh/year	_
Space	heating	fuel use	ed, main	system	1								1725.81	
												'		

					٦
Water heating fuel used				1427.46	
Electricity for pumps, fans and electric keep-hot					
mechanical ventilation - balanced, extract or pos	itive input from outside		367.67		(230a)
central heating pump:			30		(230c)
boiler with a fan-assisted flue			45		(230e)
Total electricity for the above, kWh/year	sum of (2	230a)(230g) =		442.67	(231)
Electricity for lighting				331.6	(232)
Total delivered energy for all uses (211)(221) +	(231) + (232)(237b) =			3927.54	(338)
12a. CO2 emissions – Individual heating system	s including micro-CHP				
	Energy kWh/year	Emission factor kg CO2/kWh	or	Emissions kg CO2/yea	ır
Space heating (main system 1)	3 7		or =		ır](261)
Space heating (main system 1) Space heating (secondary)	kWh/year	kg CO2/kWh		kg CO2/yea	7
	kWh/year (211) x	kg CO2/kWh	=	kg CO2/yea	(261)
Space heating (secondary)	kWh/year (211) x (215) x	0.216 0.519 0.216	=	kg CO2/yea	(261)
Space heating (secondary) Water heating	kWh/year (211) x (215) x (219) x	0.216 0.519 0.216	=	kg CO2/yea 372.77 0 308.33	(261) (263) (264)
Space heating (secondary) Water heating Space and water heating	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (264)	kg CO2/kWh 0.216 0.519 0.216	= = =	kg CO2/yea 372.77 0 308.33 681.11	(261) (263) (264) (265)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-hot	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (264) (231) x (232) x	kg CO2/kWh 0.216 0.519 0.216	= = =	kg CO2/yea 372.77 0 308.33 681.11 229.75	(261) (263) (264) (265) (267)

El rating (section 14)

88

(274)

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 *Printed on 12 July 2021 at 10:57:46*

Project Information:

Assessed By: Neil Ingham (STRO010943) Building Type: Flat

Dwelling Details:

NEW DWELLING DESIGN STAGETotal Floor Area: 48m²

Site Reference: 231 Watford Road - LEAN Plot Reference: Sample 9

Address:

Client Details:

Name: Address :

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas

Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 21.48 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER)

18.22 kg/m²

OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 55.2 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 42.1 kWh/m²

OK
2 Fabric U-values

Element Average Highest

External wall 0.15 (max. 0.30) 0.16 (max. 0.70) OK

Party wall 0.00 (max. 0.20) - OK

Floor (no floor)

 Roof
 0.12 (max. 0.20)
 0.12 (max. 0.35)
 OK

 Openings
 1.10 (max. 2.00)
 1.10 (max. 3.30)
 OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals 3.50 (design value)

Maximum 10.0 OK

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas

Data from manufacturer

Combi boiler

Efficiency 89.5 % SEDBUK2009

Minimum 88.0 %

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

OK

6 Controls			
Space heating controls Hot water controls:	TTZC by plumbing and e	lectrical services	ок
Boiler interlock:	No cylinder Yes		ок
7 Low energy lights	103		OK .
Percentage of fixed lights wi Minimum	th low-energy fittings	100.0% 75.0%	ок
8 Mechanical ventilation			
Continuous extract system Specific fan power: Maximum		1.05 0.7	Fail
9 Summertime temperature			
Overheating risk (Thames va	alley):	Slight	ок
Overshading: Windows facing: South Wes Ventilation rate:	t	Average or unknown 7.68m ² 6.00	
10 Key features			
Air permeablility Windows U-value Roofs U-value Party Walls U-value		3.5 m³/m²h 1.1 W/m²K 0.12 W/m²K 0 W/m²K	

		l Iser I	Details:						
Assessor Name: Software Name:	Neil Ingham Stroma FSAP 2012		Strom Softwa					010943 on: 1.0.5.41	
Address :	F	Property	Address	Sample	e 9				
1. Overall dwelling dime	ensions:								
3		Are	a(m²)		Av. He	ight(m)		Volume(m	³)
Ground floor			48	(1a) x	2	2.75	(2a) =	132	(3a)
Total floor area TFA = (1	a)+(1b)+(1c)+(1d)+(1e)+(1	n)	48	(4)					<u> </u>
Dwelling volume				(3a)+(3b)+(3c)+(3c	d)+(3e)+	.(3n) =	132	(5)
2. Ventilation rate:									
	main seconda heating heating	ry	other		total			m³ per hou	ır
Number of chimneys	0 + 0	+ [0] = [0	X 4	40 =	0	(6a)
Number of open flues	0 + 0	- + -	0	Ī - [0	x	20 =	0	(6b)
Number of intermittent fa	ns				0	x -	10 =	0	(7a)
Number of passive vents				Ē	0	x -	10 =	0	(7b)
Number of flueless gas fi	res			F	0	X 4	40 =	0	(7c)
				L					
				_			Air ch	nanges per h	our —
•	ys, flues and fans = $(6a)+(6b)+(6b)+(6a)+(6b)+(6a)+(6b)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a$				0		÷ (5) =	0	(8)
Number of storeys in the	een carried out or is intended, proceence	ea 10 (17),	otrierwise	onunue ir	om (9) to	(10)		0	(9)
Additional infiltration	3 ()					[(9)	-1]x0.1 =	0	(10)
	.25 for steel or timber frame o			•	ruction			0	(11)
if both types of wall are pudeducting areas of openia	resent, use the value corresponding t nas): if equal user 0.35	o the grea	ter wall are	a (after					
,	floor, enter 0.2 (unsealed) or 0	.1 (seal	ed), else	enter 0				0	(12)
If no draught lobby, en	ter 0.05, else enter 0							0	(13)
-	s and doors draught stripped							0	(14)
Window infiltration			0.25 - [0.2	. ,	-			0	(15)
Infiltration rate	250 averaged in autic mate		(8) + (10)					0	(16)
•	q50, expressed in cubic metro ity value, then $(18) = [(17) \div 20] + (18)$	•	•	•	etre or e	envelope	area	3.5	(17)
· ·	es if a pressurisation test has been do				is being u	sed		0.18	(10)
Number of sides sheltere	ed							0	(19)
Shelter factor			(20) = 1 -		19)] =			1	(20)
Infiltration rate incorporat	•		(21) = (18) x (20) =				0.18	(21)
Infiltration rate modified f	- 1 	11	1 4	0.5.7	0-4	Nan	Data	1	
Jan Feb	Mar Apr May Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp (22)m= 5.1 5	4.9 4.4 4.3 3.8	3.8	3.7	4	4.3	4.5	4.7]	
(1	1	<u>'</u>	I	1	l	I	
Wind Factor (22a)m = (22	' 							1	
(22a)m= 1.27 1.25	1.23 1.1 1.08 0.95	0.95	0.92	1	1.08	1.12	1.18		

1 000	ation rate						r `	` ´ 	0.40	0.0			
0.22 Calculate effe	0.22 Ctive air o	0.21 Change i	0.19 rate for t	0.19 he appli	0.17 Cable ca	0.17 se	0.16	0.18	0.19	0.2	0.21		
If mechanica		•										0.5	(23
If exhaust air h	eat pump ι	ısing Appe	endix N, (2	3b) = (23a	ı) × Fmv (e	equation (N	N5)) , othe	rwise (23b) = (23a)		Ī	0.5	(23
If balanced with	n heat reco	very: effic	iency in %	allowing f	or in-use f	actor (from	n Table 4h) =				0	(23
a) If balance	d mecha	anical ve	ntilation	with hea	at recove	ery (MVI	HR) (24a	a)m = (22)	2b)m + (23b) × [1 – (23c)	÷ 100]	
(24a)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
b) If balance	d mecha	anical ve	ntilation	without	heat rec	overy (N	ЛV) (24b)m = (22	2b)m + (2	23b)			
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
c) If whole h if (22b)r	ouse ext n < 0.5 ×			•	•				5 × (23b)			
(24c)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(24
d) If natural if (22b)r	ventilation $r = 1$, the			•	•				0.5]				
(24d)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
Effective air	change	rate - er	iter (24a	or (24b	o) or (24	c) or (24	d) in box	(25)					
(25)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(25
3. Heat losse	s and he	at loss r	aramete	or.									
ELEMENT	Gros	•	Openin		Net Ar	ea	U-valı	ie	AXU		k-value	e A 2	(k
	area		m		A ,r		W/m2		(W/I	<)	kJ/m²-k		
Vindows					7.68	x1,	/[1/(1.1)+	0.04] =	8.09				(27
Walls Type1	28.9	5	7.68		21.27	<u>′</u> х	0.16	= [3.4		60	1276.2	(29
Walls Type2	40.2	9	0		40.29) X	0.15	= [6.03		60	2417.4	(29
Roof	48		0		48	X	0.12	= [5.76		9	432	(30
Total area of e	lements	, m²			117.2	4							(31
Party wall					22.38	x	0		0	\neg	45	1007.1	(32
Party floor					48						40	1920	(32
nternal wall **	ı				97.35	<u>=</u>					9	876.15	= (32
for windows and it include the area						ated using	ı formula 1	/[(1/U-valu	ie)+0.04] a	s given in	paragraph	3.2	_
abric heat los	ss, W/K =	= S (A x	U)				(26)(30)) + (32) =				23.29	(3:
Heat capacity	Cm = S(Axk)						((28)	.(30) + (32	2) + (32a).	(32e) =	7928.85	(34
	parame	ter (TMF	P = Cm ÷	- TFA) ir	kJ/m²K			= (34)	÷ (4) =		i	165.18	(3
Thermal mass		ere the de	tails of the	constructi	ion are not	t known pr	ecisely the	indicative	values of	TMP in T	able 1f		_
or design asses													\neg
For design assess an be used inste	ad of a det	ailed calcu	ulation.	using Ap	pendix ł	<						7.78	(3
For design assess an be used inste Thermal bridg f details of therma	ad of a det es : S (L al bridging a	ailed calcu x Y) calc	<i>ulation.</i> culated (•	<		(33) +	(36) =		[31.06	_
For design assess an be used inste Thermal bridge details of therma Total fabric he	ad of a det es:S(L al bridging a at loss	ailed calcu x Y) calcu are not kn	ulation. culated (own (36) =	= 0.05 x (3	•	<			(36) = = 0.33 × (25)m x (5	[]		_
For design assess can be used inste Thermal bridg f details of therma Total fabric he	ad of a det es:S(L al bridging a at loss	ailed calcu x Y) calcu are not kn	ulation. culated (own (36) =	= 0.05 x (3	•	Jul	Aug			25)m x (5 Nov) Dec		_
For design assess can be used inste Thermal bridge If details of thermal Total fabric he Ventilation hea Jan 38)m= 21.78	ad of a detention and of a detention and the second	ailed calcu x Y) calcu are not kn	ulation. culated to	= 0.05 x (3	1)		Aug 21.78	(38)m	= 0.33 × ((36
For design assess can be used inste Fhermal bridge of details of therma Fotal fabric he Fentilation hea	es : S (L al bridging a at loss at loss ca Feb 21.78	x Y) calc x Y) calc are not kn alculated Mar 21.78	ulation. culated to own (36) = I monthly	= 0.05 x (3 / May	Jun	Jul	⊢ <u> </u>	(38)m Sep 21.78	= 0.33 × (Nov 21.78	Dec		(37
For design assess an be used insternal bridger details of thermal fotal fabric here. Jan Jan 38)m= 21.78	es : S (L al bridging a at loss at loss ca Feb 21.78	x Y) calc x Y) calc are not kn alculated Mar 21.78	ulation. culated to own (36) = I monthly	= 0.05 x (3 / May	Jun	Jul	⊢ <u> </u>	(38)m Sep 21.78	= 0.33 × (Oct 21.78	Nov 21.78	Dec		(3

Heat loss para	ameter (I	HLP), W/	′m²K					(40)m	= (39)m ÷	· (4)			
(40)m= 1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1		
	1					ı	ı		Average =	Sum(40) ₁ .	12 /12=	1.1	(40)
Number of day	·	nth (Tab	le 1a)	1	ı			1	1	i			
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 hea	ting ene	rgy requi	rement:								kWh/ye	ar:	
Assumed occi if TFA > 13. if TFA £ 13.	9, N = 1		[1 - exp	0.0003	349 x (TF	FA -13.9)2)] + 0.0	0013 x (⁻	TFA -13.		63		(42)
Annual average Reduce the annual not more that 125	al average	hot water	usage by	5% if the c	lwelling is	designed t			se target o		95		(43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage	in litres pe	r day for ea			ctor from	Table 1c x		!	ļ.	ļ.			
(44)m= 80.24	77.32	74.4	71.49	68.57	65.65	65.65	68.57	71.49	74.4	77.32	80.24		
		•				!	!			m(44) ₁₁₂ =	L	875.35	(44)
Energy content of	f hot water	used - cal	culated m	onthly = 4.	190 x Vd,r	n x nm x C	OTm / 3600) kWh/mor	nth (see Ta	ables 1b, 1	c, 1d)		
(45)m= 118.99	104.07	107.39	93.63	89.84	77.52	71.84	82.44	83.42	97.22	106.12	115.24		_
If instantaneous v	water heati	ina at noint	of use (no	n hot water	r storaga)	enter () in	hoves (46		Total = Su	m(45) ₁₁₂ =	= [1147.73	(45)
	1		,		, , , , , , , , , , , , , , , , , , ,		· · ·	,	14.50	45.00	47.00		(46)
(46)m= 17.85 Water storage	15.61 loss:	16.11	14.04	13.48	11.63	10.78	12.37	12.51	14.58	15.92	17.29		(46)
Storage volum) includin	ig any s	olar or W	/WHRS	storage	within sa	ame ves	sel		0		(47)
If community h	neating a	and no ta	nk in dv	velling, e	nter 110	litres in	(47)						
Otherwise if n	o stored	hot wate	er (this ir	ncludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in (47)			
Water storage					4.144	<i>,</i> , , ,							
a) If manufac				or is kno	wn (kVVI	n/day):					0		(48)
Temperature f											0		(49)
Energy lost from b) If manufact		_	-		or ic not		(48) x (49)) =			0		(50)
Hot water stor			-								0		(51)
If community h	•			`		• /							, ,
Volume factor											0		(52)
Temperature f	factor fro	m Table	2b								0		(53)
Energy lost fro		_	, kWh/y	ear			(47) x (51)) x (52) x (53) =		0		(54)
Enter (50) or	` , `	,									0		(55)
Water storage	loss cal	culated f	or each	month			((56)m = ((55) × (41)	m				
(56)m= 0	0	0	0	0	0	0	0	0	0	0	0		(56)
If cylinder contain	s dedicate	d solar sto	rage, (57)	m = (56)m	x [(50) – (H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Appendi	хH	
(57)m= 0	0	0	0	0	0	0	0	0	0	0	0		(57)
Primary circuit	t loss (ar	nnual) fro	m Table	e 3							0		(58)
Primary circuit	•	•			59)m = ((58) ÷ 36	65 × (41)	m		_			
(modified by	factor f	rom Tab	le H5 if t	here is s	olar wat	ter heatii	ng and a	cylinde	r thermo	stat)			
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

Camb:	lana ani	ام عاملات ما	for ooolo		(C4)	(00) - 20	CE /44	١						
(61)m=	40.89	35.59	for each 37.92	35.25	34.94	32.38	33.46	34.94	4 35.25	37.92	38.13	40.89	l	(61)
			<u> </u>			<u> </u>	<u> </u>	ļ	!	ļ.	ļ	Ļ	(F0)m + (61)m	(01)
(62)m=	159.88	139.66	145.31	128.88	124.78	109.9	105.29	117.3		135.13	(46)III + 144.25	(57)m + 156.13	(59)m + (61)m]	(62)
						l	<u> </u>				ļ		i	(02)
			FGHRS						r '0' if no sola v G)	ar contribu	ion to wate	er nealing)		
(63)m=	0	0	0	0	0	0	0	0		0	0	0	I	(63)
FHRS	105.19	96.26	92.9	54.25	30.29	9.55	8.85	10.17		53.61	97.29	103.39	i	(63) (G2)
		ater hea		020	00.20	0.00	0.00			00.0.	01.120			, , , ,
(64)m=	52.9	41.84	50.75	73.08	92.96	98.92	94.97	105.6	7 106.83	79.85	45.29	50.94		
, ,							<u> </u>	0	Utput from w	ater heate	r (annual)	l12	894	(64)
Heat g	ains fror	m water	heating,	kWh/mo	onth 0.2	5 ´ [0.85	× (45)m	n + (61)m] + 0.8	x [(46)m	+ (57)m	+ (59)m	1	-
(65)m=	49.79	43.5	45.19	39.95	38.61	33.87	32.25	36.1		41.8	44.82	48.54	ĺ	(65)
inclu	ıde (57)ı	m in cald	culation o	of (65)m	only if c	vlinder i	s in the	dwellir	ng or hot v	vater is f	rom com	munity h	ı ıeating	
	` ,		e Table 5	` ,		,			<u> </u>			,		
		`	e 5), Wat											
Wictab	Jan	Feb	Mar	Apr	May	Jun	Jul	Au	g Sep	Oct	Nov	Dec		
(66)m=	81.57	81.57	81.57	81.57	81.57	81.57	81.57	81.5	- 	81.57	81.57	81.57		(66)
Lightin	g gains	(calcula	ted in Ap	pendix	L, equat	ion L9 o	r L9a), a	ılso se	e Table 5				I	
(67)m=	13.21	11.73	9.54	7.22	5.4	4.56	4.93	6.4	8.59	10.91	12.74	13.58		(67)
Applia	nces gai	ins (calc	ulated in	Append	dix L, eq	uation L	13 or L1	3a), a	lso see Ta	ıble 5	•	•	I	
(68)m=	142.04	143.52	139.8	131.89	121.91	112.53	106.26	104.7	9 108.5	116.41	126.39	135.77		(68)
Cookir	ng gains	(calcula	ted in A	pendix	L, equat	ion L15	or L15a), also	see Table	÷ 5			I	
(69)m=	31.16	31.16	31.16	31.16	31.16	31.16	31.16	31.16	6 31.16	31.16	31.16	31.16		(69)
Pumps	and far	ns gains	(Table 5	5a)		•	•	•	•	•	•	•	ı	
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3		(70)
Losses	s e.g. ev	aporatio	n (negat	ive valu	es) (Tab	le 5)		•	•		•	•	ı	
(71)m=	-65.26	-65.26	-65.26	-65.26	-65.26	-65.26	-65.26	-65.2	6 -65.26	-65.26	-65.26	-65.26		(71)
Water	heating	gains (T	able 5)					•	•			•	•	
(72)m=	66.92	64.73	60.74	55.48	51.89	47.04	43.35	48.58	8 50.76	56.19	62.25	65.24		(72)
Total i	nternal	gains =	:			(66)	m + (67)m	n + (68)	m + (69)m +	(70)m + (7	'1)m + (72))m	I	
(73)m=	272.64	270.46	260.55	245.07	229.68	214.6	205.01	210.2	25 218.33	233.98	251.85	265.07		(73)
6. So	lar gains	s:												
Solar g	ains are c	alculated	using sola	r flux from	Table 6a	and assoc	iated equa	ations to	convert to the	ne applical	ole orienta	tion.		
Orienta		Access F		Area		Flu			g_ T-51- C5	-	FF		Gains	
	_	Table 6d		m²			ble 6a		Table 6b	_ I	able 6c		(W)	_
	est _{0.9x}	0.77	X	7.6	8	x 3	86.79	ļ	0.63	x	0.7	=	86.36	(79)
Southw	<u> </u>	0.77	X	7.6	8	x 6	62.67	Ţ	0.63	x	0.7	=	147.1	(79)
	est _{0.9x}	0.77	Х	7.6	8	x 8	35.75	<u> </u>	0.63	X	0.7	=	201.27	(79)
Southw	est _{0.9x}	0.77	X	7.6	8	X 1	06.25	J L	0.63	X	0.7	=	249.38	(79)

Southwest _{0.}	9x 0.77	х	7.6	88	x	119.01	1		0.63	х	0.7	=	279.33	(79)
Southwest _{0.}	9x 0.77	×	7.6	88	x	118.15	5		0.63	x	0.7		277.31	(79)
Southwest _{0.}	9x 0.77	х	7.6	88	x	113.91	1		0.63	x	0.7	=	267.36	(79)
Southwest _{0.}	9x 0.77	Х	7.6	88	x	104.39	9		0.63	x	0.7	=	245.02	(79)
Southwest _{0.}	9x 0.77	х	7.6	88	x	92.85	5		0.63	x	0.7	=	217.93	(79)
Southwest _{0.}	9x 0.77	x	7.6	68	x	69.27	,		0.63	_ x [0.7	_ =	162.58	(79)
Southwesto.	9x 0.77	X	7.6	68	x $\overline{\ }$	44.07	,		0.63	_ x [0.7	-	103.44	(79)
Southwest _{0.}	9x 0.77	х	7.6	68	x	31.49)		0.63	_ x [0.7	=	73.91	(79)
					_									
Solar gains	in watts, ca	alculated	for eac	h month				(83)m = S	Sum(74)m .	(82)m				
(83)m= 86.3	36 147.1	201.27	249.38	279.33	277	.31 26	7.36	245.02	217.93	162.58	103.44	73.91		(83)
Total gains	– internal a	and solar	(84)m =	= (73)m ·	+ (83)m , wa	atts		•		•		l	
(84)m= 35	9 417.56	461.82	494.45	509.01	491	.92 472	2.37	455.26	436.27	396.56	355.29	338.97		(84)
7. Mean ir	nternal temp	perature	(heating	season)									
	ure during h		`		<i>'</i>	ea from	n Tab	ole 9. Th	1 (°C)				21	(85)
•	factor for g	•			•			0,	()					(11)
Ja		Mar	Apr	May	r		Jul	Aug	Sep	Oct	Nov	Dec		
(86)m= 0.9	_	0.94	0.88	0.78	0.6	_	.47	0.51	0.71	0.9	0.97	0.98		(86)
` ′	!	<u> </u>			<u> </u>	!			<u>l</u>	0.0	0.07	0.00		()
	rnal temper			· `	1	i			· ·		T	l		(07)
(87)m= 19.5	56 19.79	20.1	20.45	20.74	20.	92 20	0.98	20.97	20.86	20.48	19.94	19.5		(87)
Temperati	ure during h	neating p	eriods ir	rest of	dwe	ling fro	m Ta	ble 9, T	h2 (°C)				i	
(88)m= 20	20	20	20	20	2) 2	20	20	20	20	20	20		(88)
Utilisation	factor for g	ains for i	est of d	welling,	h2,m	(see T	able	9a)						
(89)m= 0.9	8 0.96	0.92	0.85	0.73	0.5	5 0.	.37	0.41	0.64	0.87	0.96	0.98		(89)
Mean inte	rnal temper	ature in t	the rest	of dwelli	ina T	2 (follo	w sta	ne 3 to	7 in Tahl	a 0c)			l	
(90)m= 18.		18.86	19.35	19.73	19.		9.99	19.98	19.88	19.4	18.65	18.01		(90)
(00)	1 .02	1 .0.00	.0.00					. 0.00	L	<u> </u>	g area ÷ (4		0.42	(91)
											•	,	0.42	(0.)
	rnal temper	 							'				1	(00)
(92)m= 18.		19.38	19.81	20.16	20.		0.41	20.4	20.29	19.85	19.2	18.64		(92)
	istment to t	1		· ·						·	1 40 05	10.40	l	(02)
(93)m= 18.5		19.23	19.66	20.01	20	2 20	0.26	20.25	20.14	19.7	19.05	18.49		(93)
•	neating requ					4		T-1.1- 0		. T' /	70)		la (a	
	ne mean int ion factor fo		•		ied a	t step 1	11 01	rable 9	b, so tha	t 11,m=(76)m an	a re-caic	culate	
Ja		Mar	Apr	May	Jı,	ın J	Jul	Aug	Sep	Oct	Nov	Dec		
	factor for g			way		-	<u>, a.</u>	7.09	Cop		1101			
(94)m= 0.9		0.91	0.84	0.73	0.5	6 0	0.4	0.44	0.65	0.86	0.95	0.97		(94)
Useful gai	ns, hmGm	. W = (94	1)m x (84	4)m					1		1	ı		
(95)m= 347.	1	419.96	416.41	370.94	277	.02 189	9.34	198.06	285.33	340.88	336.37	329.71		(95)
Monthly a	verage exte	rnal tem	perature	from T	able	 B				ļ	!	I.	ı	
(96)m= 4.3	<u>_</u>	6.5	8.9	11.7	14		6.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss	rate for me	an intern	al tempe	erature,	Lm ,	W =[(3	9)m >	k [(93)m	– (96)m]	•		1	
(97)m= 754.	12 737.19	672.93	568.72	439.08	295	.99 19	93.3	203.55	319.3	481.14	631.23	755.15		(97)
	•				•				-	•	-		1	

	g require	ement fo	r each n	nonth, k\	Wh/mon	th = 0.02	24 x [(97))m – (95)m] x (4 ⁻	1)m			
(98)m= 302.69	230	188.21	109.66	50.7	0	0	0	0	104.36	212.3	316.53		
		-	-		-	-	Tota	l per year	(kWh/year) = Sum(9	8) _{15,912} =	1514.44	(98)
Space heating	g require	ement in	kWh/m²	/year							[31.55	(99)
9a. Energy req	uiremer	nts – Indi	ividual h	eating s	ystems i	ncluding	micro-C	HP)					
Space heatin	_										-		_
Fraction of spa					mentary	-					Į	0	(201)
Fraction of spa			•	` '			(202) = 1 -				Į	1	(202)
Fraction of tot	al heati	ng from	main sys	stem 1			(204) = (204)	02) × [1 –	(203)] =		Į	1	(204)
Efficiency of n	nain spa	ace heat	ing syste	em 1								90.3	(206)
Efficiency of s	econda	ry/suppl	ementar	y heatin	g system	າ, %						0	(208)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ear
Space heating	•	· `	1	d above)								
302.69	230	188.21	109.66	50.7	0	0	0	0	104.36	212.3	316.53		
(211)m = {[(98)					1								(211)
335.21	254.71	208.42	121.44	56.14	0	0	O Tota	0	115.57	235.11	350.53		7(044)
0			\ 1\A#				rota	I (kWh/yea	ar) =Sum(2	211) _{15,1012}		1677.12	(211)
Space heating = {[(98)m x (20	•		• •	month									
$= \{[(90) \text{III X } (20) \text{(215)m} = 0 \}$	0	00 + (20	0	0	0	0	0	0	0	0	0		
` '		<u> </u>	ļ		ļ		Tota	l (kWh/yea	ar) =Sum(2	L 215) _{15,1012}		0	(215)
Water heating											L		
Output from wa		ter (calc	ulated a	oove)		•	•						
52.9	41.84	50.75	73.08	92.96	98.92	94.97	105.67	106.83	79.85	45.29	50.94		_
Efficiency of wa	ater hea	ıter											
						·						81	(216)
(217)m= 88.78	88.73	88.15	86.34	84.05	81	81	81	81	86.02	88.51	88.89	81	(216)
Fuel for water h	neating,	kWh/mo	onth	84.05	81	81	81	81	86.02	88.51	88.89	81	
` '	neating,	kWh/mo	onth	84.05 110.59	81	81	130.46	81	92.83	88.51 51.17	88.89 57.31	81	
Fuel for water h (219)m = (64)r	neating, n x 100	kWh/mo) ÷ (217)	onth m				130.46		92.83			1062.57	
Fuel for water h (219)m = (64)r	neating, n x 100	kWh/mo) ÷ (217)	onth m				130.46	131.89	92.83 19a) ₁₁₂ =		57.31		(217)
Fuel for water h (219)m = (64)r (219)m= 59.58	neating, m x 100 47.15	kWh/mo) ÷ (217) 57.57	onth om 84.65	110.59			130.46	131.89	92.83 19a) ₁₁₂ =	51.17	57.31	1062.57	(217)
Fuel for water (219)m = (64)r (219)m = 59.58 Annual totals	neating, m x 100 47.15	kWh/mo) ÷ (217) 57.57	onth om 84.65	110.59			130.46	131.89	92.83 19a) ₁₁₂ =	51.17	57.31	1062.57 kWh/yea l	(217)
Fuel for water (219)m = (64)r (219)m = 59.58 Annual totals Space heating	neating, n x 100 47.15 fuel use	kWh/mo) ÷ (217) 57.57	system	110.59	122.13		130.46	131.89	92.83 19a) ₁₁₂ =	51.17	57.31	1062.57 kWh/yea 1677.12	(217)
Fuel for water is (219)m = (64)r (219)m = 59.58 Annual totals Space heating Water heating is	neating, n x 100 47.15 fuel use fuel use umps, f	kWh/mo) ÷ (217) 57.57 ed, main ed	system	110.59 1 keep-ho	122.13	117.24	130.46 Tota	131.89 I = Sum(2	92.83 19a) ₁₁₂ =	51.17	57.31	1062.57 kWh/yea 1677.12	(217)
Fuel for water in (219)m = (64)r (219)m = 59.58 Annual totals Space heating Water heating in Electricity for p	neating, n x 100 47.15 fuel use fuel use umps, fo	kWh/mo ÷ (217) 57.57 ed, main ed ans and n - balan	system	110.59 1 keep-ho	122.13	117.24	130.46 Tota	131.89 I = Sum(2	92.83 19a) ₁₁₂ =	51.17	57.31	1062.57 kWh/yea 1677.12	(217) (219)
Fuel for water in (219)m = (64)r (219)m = 59.58 Annual totals Space heating Water heating in Electricity for pomechanical versions	fuel use umps, fantilation	kWh/mo) ÷ (217) 57.57 ed, main ed ans and n - balan	system	110.59 1 keep-ho	122.13	117.24	130.46 Tota	131.89 I = Sum(2	92.83 19a) ₁₁₂ =	51.17	57.31	1062.57 kWh/yea 1677.12	(217) (219) r (230a)
Fuel for water in (219)m = (64)r (219)m = 59.58 Annual totals Space heating Water heating in the second se	fuel use umps, for the tilation g pump an-assis	kWh/mo ÷ (217) 57.57 ed, main ed ans and n - balan :	system electric	110.59 1 keep-ho ract or p	122.13	117.24	130.46 Tota	131.89 I = Sum(2	92.83 19a) ₁₁₂ = k \	51.17 Wh/year	236.73	1062.57 kWh/yea 1677.12	(217) (219) r (230a) (230c)
Fuel for water in (219)m = (64)r (219)m = 59.58 Annual totals Space heating Water heating in the second se	fuel use umps, for the for the	kWh/mo ÷ (217) 57.57 ed, main ed ans and n - balan :	system electric	110.59 1 keep-ho ract or p	122.13	117.24	130.46 Tota	131.89 I = Sum(2:	92.83 19a) ₁₁₂ = k \	51.17 Wh/year	236.73	1062.57 kWh/yea 1677.12 1062.57	(217) (219) r (230a) (230c) (230e)

12a. CO2 emissions – Individual heating systems	s including micro-CHP				
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year		
Space heating (main system 1)	(211) x	0.216 =	362.26 (261)		
Space heating (secondary)	(215) x	0.519 =	0 (263)		
Water heating	(219) x	0.216 =	229.51 (264)		
Space and water heating	(261) + (262) + (263) + (264) =		591.77 (265)		
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	161.79 (267)		

 $(272) \div (4) =$

121.09

874.65

(268)

(272)

Electricity for lighting (232) x

0.519 Total CO2, kg/year sum of (265)...(271) =

Dwelling CO2 Emission Rate 18.22 (273)El rating (section 14) (274)87

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 10:57:45

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:**

Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 50.38m²

Site Reference: 231 Watford Road - LEAN **Plot Reference:** Sample 10

Address:

Client Details:

Name: Address:

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas

Fuel factor: 1.00 (mains gas)

22.37 kg/m² Target Carbon Dioxide Emission Rate (TER)

Dwelling Carbon Dioxide Emission Rate (DER) 18.95 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 61.6 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 47.1 kWh/m²

OK

2 Fabric U-values **Element**

Average Highest External wall 0.16 (max. 0.30) 0.16 (max. 0.70) OK Party wall 0.00 (max. 0.20) OK

Floor (no floor)

Roof 0.12 (max. 0.20) 0.12 (max. 0.35) OK Openings 1.10 (max. 2.00) OK 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 3.50 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas

Data from manufacturer

Combi boiler

Efficiency 89.5 % SEDBUK2009

Minimum 88.0 %

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

OK

ontrols			
Space heating controls	TTZC by plumbing and e	lectrical services	ОК
Hot water controls:	No cylinder thermostat		
	No cylinder		
Boiler interlock:	Yes		ОК
ow energy lights			
Percentage of fixed lights with	h low-energy fittings	100.0%	
Minimum		75.0%	ОК
echanical ventilation			
Continuous extract system			
Specific fan power:		1.05	
Maximum		0.7	Fail
ummertime temperature			
Overheating risk (Thames va	alley):	Slight	ок
ed on:	•	•	
Overshading:		Average or unknown	
Windows facing: North West		6.39m²	
Windows facing: North East		3.85m²	
Ventilation rate:		6.00	
Key features			
Air permeablility		3.5 m³/m²h	
Windows U-value		1.1 W/m²K	
		0.12 W/m ² K	
Roofs U-value		U. 12 VV/111-K	

		Hear F	Details:						
Accesser Name	Noil Inghom	USELL		o Muum	hor.		STD()	010943	
Assessor Name: Software Name:	Neil Ingham Stroma FSAP 2012		Strom Softwa					n: 1.0.5.41	
		Property							
Address :									
1. Overall dwelling dime	ensions:	_							
Ground floor			a(m²) 50.38	(1a) x		ight(m) 2.75	(2a) =	Volume(m³)) (3a)
	a) ((1b) ((1a) ((1d) ((1a) (75	(2a) -	130.33	(Ja)
•	a)+(1b)+(1c)+(1d)+(1e)+(1	(11)	50.38	(4)) . (2-) . (2-	4) . (2 -) .	(2-)		_
Dwelling volume				(3a)+(3b)+(30)+(30	d)+(3e)+	(311) =	138.55	(5)
2. Ventilation rate:	main seconda	arv	other		total			m³ per hou	r
Number of chimneys	heating heating			7 = [40 =	-	_
•		_ `	0]	0		20 =	0	(6a)
Number of open flues			0	」 ⁻	0		10 =	0	(6b)
Number of intermittent fa				Ļ	0			0	(7a)
Number of passive vents				Ļ	0		10 =	0	(7b)
Number of flueless gas fi	res				0	X 4	40 =	0	(7c)
							Air ch	anges per ho	ur
Infiltration due to chimne	ys, flues and fans = $(6a)+(6b)+$	(7a)+(7b)+((7c) =	Г	0		÷ (5) =	0	(8)
If a pressurisation test has b	een carried out or is intended, proce	ed to (17),	otherwise o	continue fr	rom (9) to		, ,	-	_ ` ′
Number of storeys in the	ne dwelling (ns)							0	(9)
Additional infiltration	OF for atoal or timber frame	r 0 25 fo	r maaan	, constr	u otion	[(9)	-1]x0.1 =	0	(10)
	.25 for steel or timber frame of the contract			•	uction			0	(11)
deducting areas of openir	ngs); if equal user 0.35						,		_
•	floor, enter 0.2 (unsealed) or	0.1 (seale	ed), else	enter 0				0	(12)
If no draught lobby, en								0	(13)
Window infiltration	s and doors draught stripped		0.25 - [0.2	x (14) ÷ 1	1001 =			0	(14)
Infiltration rate			(8) + (10)			+ (15) =		0	(15)
	q50, expressed in cubic meta	es per ho					area	3.5	(17)
•	ity value, then $(18) = [(17) \div 20] + (18)$	•	•	•				0.18	(18)
•	es if a pressurisation test has been d				is being u	sed			」 ` ′
Number of sides sheltere	ed							0	(19)
Shelter factor			(20) = 1 -		19)] =			1	(20)
Infiltration rate incorporat	_		(21) = (18) x (20) =				0.18	(21)
Infiltration rate modified f		1	Ι.		<u> </u>	1			
Jan Feb	Mar Apr May Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp		1 00	0.7	4	1 40	4.5	4 -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 = $(22a)$ m =	2)m ÷ 4								
(22a)m= 1.27 1.25	1.23 1.1 1.08 0.95	0.95	0.92	1	1.08	1.12	1.18		

Adjusted infiltr	ation rat	e (allowi	ng for sh	nelter an	d wind s	peed) =	: (21a) x	(22a)m						
0.22	0.22	0.21	0.19	0.19	0.17	0.17	0.16	0.18	0.19	0.2	0.21			
Calculate effect If mechanica		_	rate for t	he appli	cable ca	se	-		-	-	-			٦٫٫٫
If exhaust air h			endix N (2	3h) = (23a	a) × Fmv (e	equation (N5)) othe	wise (23h	n) = (23a)			0.5		_](23 □ ₍₂₃
If balanced with) = (20 0)			0.5](23], ₍₂₂
		-	-	_					Oh\m ı (22h) v [1 (220)	. 1001		(23
a) If balance			0	0	0	0	1 (24a	0	0	230) x [0	- 100]		(24
b) If balance									<u> </u>		_			(-
24b)m= 0			0	0	0	0	0 0	0	20)III + (0	0			(24
c) If whole h														(-
•				•	-		c) = (22k		.5 × (23k	o)				
24c)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5			(24
d) If natural											Į.			
		`	· · ·		· `		0.5 + [(2							
24d)m= 0	0	0	0	0	0	0	0	0	0	0	0			(24
Effective air	change		<u> </u>) or (24k	ŕ	c) or (24	ld) in box	(25)		•				
25)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5			(2
3. Heat losse	s and he	eat loss p	paramet	er:										
LEMENT	Gros	_	Openin		Net Ar		U-val		AXU		k-value		ΑX	
Vindovio Tvro	area	(m²)	m) '	A ,r		W/m2		(W/	K)	kJ/m²-l	(kJ/k	
Vindows Type					6.39		/[1/(1.1)+		6.73	=				(2
Vindows Type	2				3.85	x ¹	/[1/(1.1)+	0.04] =	4.06	ᆗ ,				(2 [:]
Valls Type1	39.9	98	10.2	4	29.74	X	0.16	=	4.76	!	60		784.4	(29
Valls Type2	20.0)7	0		20.07	<u> </u>	0.15	=	3	[60		204.2	(29
Roof	50.3	38	0		50.38	X	0.12	=	6.05		9	4	53.42	(3
otal area of e	lements	, m²			110.4	3								(3
Party wall					25.9	X	0	=	0		45		165.5	(3
arty floor					50.38	3					40		015.2	(3
nternal wall **					108.6	8					9		78.12	(3
for windows and						ated using	g formula 1	/[(1/U-valu	ue)+0.04] a	as given in	paragraph	3.2		_
* include the area				ls and par	titions		(00) (00)	(00)						_
abric heat los		•	U)				(26)(30)					24.6	S](3
leat capacity		,			,			., ,	(30) + (3	2) + (32a)	(32e) =	7600.	84](3
hermal mass	•	•		,				` ') ÷ (4) =			150.8	37	(3
or design assess an be used inste				construct	ion are not	known pi	recisely the	: indicative	e values of	'IMP IN I	able 1f			
hermal bridge				using Ap	pendix ł	<						8.15	;	(3
details of therma	al bridging	are not kn	own (36) =	= 0.05 x (3	11)						!			
otal fabric he	at loss							(33) +	- (36) =			32.7	4	(3
entilation hea	at loss ca	alculated	monthly	/				(38)m	= 0.33 × ((25)m x (5)			
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
38)m= 22.86	22.86	22.86	22.86	22.86	22.86	22.86	22.86	22.86	22.86	22.86	22.86			(3
leat transfer o	coefficie	nt, W/K						(39)m	i = (37) + (38)m				
39)m= 55.6	55.6	55.6	55.6	55.6	55.6	55.6	55.6	55.6	55.6	55.6	55.6			
							•		•					_

Heat loss para	ımeter (I	HLP), W	′m²K					(40)m	= (39)m ÷	· (4)			
(40)m= 1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1		
				!	<u>. </u>	!	!		Average =	Sum(40) ₁ .	12 /12=	1.1	(40)
Number of day	1	<u> </u>							<u> </u>				
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		(44)
(41)m= 31	28	31	30	31	30	31	31	30	31	30	31		(41)
4. Water hea	ting ene	rgy requi	rement:								kWh/ye	ear:	
Assumed occu if TFA > 13.9 if TFA £ 13.9	9, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9)2)] + 0.0	0013 x (¯	TFA -13.		.7		(42)
Annual average Reduce the annual not more that 125	, al average	hot water	usage by	5% if the c	lwelling is	designed t			se target o		.61		(43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage i	n litres pe	r day for ea		Vd,m = fa	ctor from	Table 1c x							
(44)m= 82.07	79.08	76.1	73.11	70.13	67.15	67.15	70.13	73.11	76.1	79.08	82.07		
Francisco de la contracto de l					400 \/-/		T / 200			m(44) ₁₁₂ =		895.27	(44)
Energy content of													
(45)m= 121.7	106.44	109.84	95.76	91.88	79.29	73.47	84.31	85.32	99.43	108.53	117.86	4470.04	
If instantaneous w	vater heati	ng at point	of use (no	o hot water	storage),	enter 0 in	boxes (46		lotal = Su	m(45) ₁₁₂ =		1173.84	(45)
(46)m= 18.26	15.97	16.48	14.36	13.78	11.89	11.02	12.65	12.8	14.91	16.28	17.68		(46)
Water storage	loss:			<u> </u>				ļ	l .	ļ.			
Storage volum	ne (litres) includir	ig any s	olar or W	/WHRS	storage	within sa	ame ves	sel		0		(47)
If community h	_			_			, ,		(0): (
Otherwise if no Water storage		not wate	er (this ir	iciuaes i	nstantar	neous co	ilod idmo	ers) ente	er o in (47)			
a) If manufact		eclared I	oss facto	or is kno	wn (kWł	n/day):					0		(48)
Temperature f					,	• ,					0		(49)
Energy lost fro	m wate	r storage	, kWh/ye	ear			(48) x (49)) =			0		(50)
b) If manufact			-										
Hot water store If community h	•			le 2 (kW	h/litre/da	ay)					0		(51)
Volume factor	_		JII 4.3								0		(52)
Temperature f			2b							—	0		(53)
Energy lost fro	m wate	r storage	, kWh/ye	ear			(47) x (51)) x (52) x (53) =		0		(54)
Enter (50) or	(54) in (55)									0		(55)
Water storage	loss cal	culated f	or 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	s dedicate	d solar sto	rage, (57)	m = (56)m	x [(50) – (H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Append	ix H	
(57)m= 0	0	0	0	0	0	0	0	0	0	0	0		(57)
Primary circuit	loss (ar	nnual) fro	m Table	 ∋ 3							0		(58)
Primary circuit	•	•			59)m = ((58) ÷ 36	65 × (41)	m					
(modified by	factor f	rom Tab	le H5 if t	here is s	solar wat	ter heatii	ng and a	cylinde	r thermo	stat)			
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

(61) 61 62 63 64 63 63 63 63 63 63	Combi I	loss cal	lculated	for each	month (61)m =	(60) ÷ 36	65 × (41))m						
(62)min	г					,	`	· · ·		36.06	38.78	39	41.82		(61)
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 0 0 0 0 0 0 0	Total he	eat requ	uired for	water h	eating ca	alculated	l for eac	n month	(62)m =	0.85 × ((45)m +	(46)m +	(57)m +	(59)m + (61)m	
Companies Fehres Fehres Survivers (62)m=	163.52	142.84	148.62	131.82	127.62	112.4	107.69	120.05	121.37	138.21	147.53	159.68		(62)	
(63) me	Solar DH\	W input o	calculated	using App	endix G or	Appendix	H (negati	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)	ı	
Company Comp	(add ad	lditiona	l lines if	FGHRS	and/or V	vwhrs	applies	, see Ap	pendix (G)					
Output from water heater (64)m= 54.55	(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
(64)me 64.56 43.1 47.27 64.21 91.58 101.17 97.13 108.07 109.26 64.96 46.72 52.56 Output from water heater (annual).	FHRS	107.13	98.14	99.64	66.02	34.47	9.77	9.05	10.4	10.53	71.54	99.1	105.28	1	(63) (G2)
Company Comp	Output f	from w	ater hea	ter											
Heat gains from water heating, kWh/month 0.25 ′ [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (67)m + (59)m] (65)m 50.92 44.49 46.22 40.85 39.49 34.64 32.98 36.97 37.38 42.75 45.84 49.64 (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	(64)m=	54.55	43.1	47.27	64.21	91.58	101.17	97.13	108.07	109.26	64.96	46.72	52.56		_
(65)me 50.92 44.49 46.22 40.85 39.49 34.64 32.98 36.97 37.38 42.75 45.84 49.64 (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	_		-	-	-	-	-	-	Outp	out from wa	ater heate	r (annual)₁	12	880.57	(64)
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	Heat ga	ains froi	m water	heating,	kWh/mo	onth 0.2	5 ´ [0.85	× (45)m	+ (61)m	n] + 0.8 x	د [(46)m	+ (57)m	+ (59)m]	
Metabolic gains (Table 5), Watts Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (66)m 85.06 8	(65)m=	50.92	44.49	46.22	40.85	39.49	34.64	32.98	36.97	37.38	42.75	45.84	49.64		(65)
Metabolic gains (Table 5), Watts Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	incluc	de (57)ı	m in cald	culation (of (65)m	only if c	ylinder i	s in the o	dwelling	or hot w	ater is fr	om com	munity h	eating	
Separation Sep	5. Inte	ernal ga	ains (see	Table 5	and 5a):	•						•		
Separation Sep	Metabo	lic gain	s (Table	.5) Wat	ts										
(66)me 85.06 85.06 85.06 85.06 85.06 85.06 85.06 85.06 85.06 85.06 85.06 85.06 85.06 85.06 85.06 85.06 85.06 (67) Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 (67)me 13.29 11.8 9.6 7.27 5.43 4.58 4.95 6.44 8.64 10.97 12.81 13.66 (67) Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 (68)me 148.22 149.76 145.88 137.63 127.22 117.43 110.89 109.35 113.22 121.48 131.89 141.68 (68) Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 (69)me 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 (69) Pumps and fans gains (Table 5a) (70)me 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3						May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(67)m=	(66)m=	85.06	85.06	85.06	85.06	85.06	85.06	85.06	85.06	85.06	85.06	85.06	85.06		(66)
(67)m=	Liahtina	g gains	(calcula	ted in Ar	pendix l	L. equat	ion L9 o	r L9a). a	lso see	Lable 5	ļ.			J	
(68)m=	ř		<u> </u>					<u> </u>		·	10.97	12.81	13.66		(67)
(68)m=	L Applian	ces ga	ins (calc	ulated ir	Append	dix L. ea	uation L	13 or L1	3a), also	see Ta	ble 5				
(69)m= 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 (69) Pumps and fans gains (Table 5a) (70)m= 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	·· -		<u> </u>							ı —		131.89	141.68		(68)
(69)m= 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 31.51 (69) Pumps and fans gains (Table 5a) (70)m= 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	Cooking	g gains	(calcula	ted in A	ppendix	L, equat	ion L15	or L15a	, also se	ee Table	5	Į.		I	
(70)m= 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	ř		r `	·		· ·	ı			1	1	31.51	31.51		(69)
(70)m= 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	Pumps	and far	ns gains	(Table 5	 Ба)						ļ			ı	
(71)m=	· -			·		3	3	3	3	3	3	3	3		(70)
(71)m=	Losses	e.g. ev	aporatio	n (nega	tive valu	es) (Tab	le 5)							I	
(72)m= 68.44 66.21 62.12 56.74 53.07 48.11 44.33 49.69 51.92 57.47 63.66 66.73 (72) Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m (73)m= 281.47 279.29 269.12 253.16 237.24 221.64 211.69 217 225.31 241.44 259.88 273.58 (73) 6. Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Table 6d Table 6c (W) Northeast 0.9x 0.77 x 3.85 x 11.28 x 0.63 x 0.7 = 13.28 (75) Northeast 0.9x 0.77 x 3.85 x 22.97 x 0.63 x 0.7 = 27.02 (75)			 	<u> </u>				-68.05	-68.05	-68.05	-68.05	-68.05	-68.05		(71)
Total internal gains =	Water h	neating	gains (T	able 5)										I	
(73)m= 281.47 279.29 269.12 253.16 237.24 221.64 211.69 217 225.31 241.44 259.88 273.58 (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 Area Table 6d Flux Table 6a Table 6b Table 6c (W) Northeast 0.9x 0.77 x 3.85 x 11.28 x 0.63 x 0.7 = 13.28 (75) Northeast 0.9x 0.77 x 3.85 x 22.97 x 0.63 x 0.7 = 27.02 (75)	(72)m=	68.44	66.21	62.12	56.74	53.07	48.11	44.33	49.69	51.92	57.47	63.66	66.73		(72)
(73)m= 281.47 279.29 269.12 253.16 237.24 221.64 211.69 217 225.31 241.44 259.88 273.58 (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 Area Table 6d Flux Table 6a Table 6b Table 6c (W) Northeast 0.9x 0.77 x 3.85 x 11.28 x 0.63 x 0.7 = 13.28 (75) Northeast 0.9x 0.77 x 3.85 x 22.97 x 0.63 x 0.7 = 27.02 (75)	Total in	nternal	gains =				(66)	m + (67)m	ı + (68)m -	- (69)m + ((70)m + (7	1)m + (72)	m	J	
Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation. Orientation: Access Factor Area Flux g_{-} FF Gains Table 6d m^2 Table 6a Table 6b Table 6c (W) Northeast $0.9x$ 0.77 \times 3.85 \times 11.28 \times 0.63 \times 0.7 $=$ 13.28 (75) Northeast $0.9x$ 0.77 \times 3.85 \times 22.97 \times 0.63 \times 0.7 $=$ 27.02 (75)					253.16	237.24	221.64	211.69	217	225.31	241.44	259.88	273.58		(73)
Orientation: Access Factor Table 6d Area m² Flux Table 6a g_{-} Table 6b FF Table 6c Gains (W) Northeast $0.9x$ 0.77 x 3.85 x 11.28 x 0.63 x 0.7 = 13.28 (75) Northeast $0.9x$ 0.77 x 3.85 x 22.97 x 0.63 x 0.7 = 27.02 (75)	6. Sola	ar gains	5:												
Table 6d m ² Table 6a Table 6b Table 6c (W) Northeast 0.9x 0.77 x 3.85 x 11.28 x 0.63 x 0.7 = 13.28 (75) Northeast 0.9x 0.77 x 3.85 x 22.97 x 0.63 x 0.7 = 27.02 (75)	Solar ga	ains are o	calculated	using sola	r flux from	Table 6a	and assoc	ated equa	tions to co	nvert to th	e applicab	le orientat	ion.		
Northeast 0.9x 0.77	Orientat	tion: A	Access F	actor	Area							FF		Gains	
Northeast 0.9x 0.77 × 3.85 × 22.97 × 0.63 × 0.7 = 27.02 (75)		7	Table 6d		m²		Tal	ole 6a	Т	able 6b	Ta	able 6c		(W)	
	Northeas	st _{0.9x}	0.77	X	3.8	35	x 1	1.28	X	0.63	x	0.7	=	13.28	(75)
Northeast $0.9x$ 0.77 x 3.85 x 41.38 x 0.63 x 0.7 = 48.69 (75)	Northeas	st _{0.9x}	0.77	X	3.8	35	x 2	2.97	X	0.63	_ x [0.7	=	27.02	(75)
	Northeas	st _{0.9x}	0.77	X	3.8	35	x 4	1.38	X	0.63	x	0.7	=	48.69	(75)
Northeast 0.9x 0.77 x 3.85 x 67.96 x 0.63 x 0.7 = 79.96 (75)	Northeas	st _{0.9x}	0.77	x	3.8	35	x 6	7.96	x	0.63	x	0.7	=	79.96	(75)

Northood o														
Northeast _{0.9x}	0.77	x	3.8	5	X	9	1.35	X	0.63	X	0.7	=	107.48	(75)
Northeast _{0.9x}	0.77	×	3.8	5	x	9	7.38	X	0.63	X	0.7	=	114.58	(75)
Northeast _{0.9x}	0.77	x	3.8	5	x	(91.1	X	0.63	X	0.7	=	107.19	(75)
Northeast _{0.9x}	0.77	×	3.8	5	x	7	2.63	X	0.63	X	0.7	=	85.45	(75)
Northeast _{0.9x}	0.77	x	3.8	5	X	5	0.42	X	0.63	x	0.7	=	59.33	(75)
Northeast _{0.9x}	0.77	×	3.8	5	x	2	8.07	x	0.63	x	0.7		33.02	(75)
Northeast 0.9x	0.77	×	3.8	5	x		14.2	x	0.63	×	0.7	_ =	16.7	(75)
Northeast _{0.9x}	0.77	X	3.8	5	x	9	9.21	x	0.63	×	0.7	_ =	10.84	(75)
Northwest _{0.9x}	0.77	×	6.3	19	x	1	1.28	x	0.63	x	0.7		22.03	(81)
Northwest 0.9x	0.77	X	6.3	19	x	2	2.97	x	0.63	x	0.7	=	44.85	(81)
Northwest _{0.9x}	0.77	X	6.3	19	x	4	1.38	x	0.63	×	0.7	_ =	80.81	(81)
Northwest _{0.9x}	0.77	X	6.3	9	x	6	7.96	x	0.63	×	0.7	_ =	132.71	(81)
Northwest _{0.9x}	0.77	X	6.3	9	x	9	1.35	x	0.63	×	0.7		178.39	(81)
Northwest _{0.9x}	0.77	X	6.3	9	x	9	7.38	x	0.63	×	0.7	<u> </u>	190.18	(81)
Northwest _{0.9x}	0.77	X	6.3	9	x	9	91.1	x	0.63	x	0.7	=	177.91	(81)
Northwest 0.9x	0.77	X	6.3	19	x	7	2.63	x	0.63	×	0.7	=	141.83	(81)
Northwest _{0.9x}	0.77	X	6.3	9	x	5	0.42	x	0.63	x	0.7	<u> </u>	98.46	(81)
Northwest _{0.9x}	0.77	X	6.3	9	x	2	8.07	x	0.63	x	0.7	=	54.81	(81)
Northwest _{0.9x}	0.77	X	6.3	9	x		14.2	x	0.63	×	0.7		27.72	(81)
Northwest 0.9x	0.77	X	6.3	9	x	9	9.21	х	0.63	x	0.7	=	17.99	(81)
_								_						
Solar gains in	watts, ca	alculated	for eacl	n mont	:h			(83)m	n = Sum(74)m.	(82)m			_	
Solar gains in (83)m= 35.31	watts, ca	alculated 129.49	for eacl 212.67	n mont 285.87	$\overline{}$	04.76	285.1	(<mark>83</mark>)m		<mark>(82)m</mark> 87.84	44.43	28.84]	(83)
Ť	71.87	129.49	212.67	285.87	7 3			`			44.43	28.84]	(83)
(83)m= 35.31	71.87	129.49	212.67	285.87	7 3			`	.28 157.79		<u> </u>	28.84]	(83) (84)
(83)m= 35.31 Total gains – i	71.87 nternal a 351.16	129.49 Ind solar 398.61	212.67 (84)m = 465.82	285.87 = (73)m 523.1	7 3 1 + (6	83)m	, watts	227	.28 157.79	87.84	<u> </u>	<u> </u>]	, ,
(83)m= $35.31Total gains – i(84)$ m= 316.78	71.87 nternal a 351.16	129.49 and solar 398.61 erature	212.67 (84)m = 465.82 (heating	285.87 = (73)m 523.1 seaso	7 3 n + (6 5 n)	83)m 26.41	, watts 496.79	444	.28 157.79	87.84	<u> </u>	<u> </u>	21	, ,
(83)m= 35.31 Total gains – i (84)m= 316.78 7. Mean inter	71.87 nternal a 351.16 nal temp during h	nd solar 398.61 perature (212.67 (84)m = 465.82 (heating eriods in	285.87 = (73)m 523.1 season the liv	7 3 n + (i 5 on) ving	83)m 26.41 area 1	, watts 496.79 from Tal	444	.28 157.79	87.84	<u> </u>	<u> </u>	21	(84)
(83)m= 35.31 Total gains – i (84)m= 316.78 7. Mean inter Temperature	71.87 nternal a 351.16 nal temp during h	nd solar 398.61 perature (212.67 (84)m = 465.82 (heating eriods in	285.87 = (73)m 523.1 season the liv	7 3 n + (6 5 on) ving m (s	83)m 26.41 area 1	, watts 496.79 from Tal	227 444 ole 9	.28 157.79	87.84	7 304.31	<u> </u>	21	(84)
(83)m= 35.31 Total gains – i (84)m= 316.78 7. Mean inter Temperature Utilisation fac	71.87 nternal a 351.16 rnal temp during heter for ga	129.49 and solar 398.61 perature (eating peating for limits)	212.67 (84)m = 465.82 (heating eriods in	285.87 = (73)m 523.1 season the lives, h1,	7 3 n + (i 5 on) ving m (s	83)m 26.41 area t	, watts 496.79 from Tal ble 9a)	227 444 ole 9	.28 157.79 .28 383.1 , Th1 (°C)	329.2	7 304.31	302.42	21	(84)
(83)m= 35.31 Total gains – i (84)m= 316.78 7. Mean inter Temperature Utilisation face Jan	71.87 nternal a 351.16 mal temp during h ctor for ga Feb 0.98	nd solar 398.61 perature (eating peains for li Mar 0.96	212.67 (84)m = 465.82 (heating eriods in iving are Apr 0.9	285.87 = (73)m 523.1 season the livea, h1, May 0.77	7 3 n + (i 5 on) ving m (s	83)m 26.41 area f ee Ta Jun 0.61	, watts 496.79 from Tal ble 9a) Jul 0.47	227 444 cole 9 A 0.5	.28 157.79 .28 383.1 , Th1 (°C) ug Sep .4 0.78	87.84 329.2	7 304.31 Nov	302.42 Dec	21	(84)
(83)m= 35.31 Total gains – i (84)m= 316.78 7. Mean inter Temperature Utilisation fact Jan (86)m= 0.99	71.87 nternal a 351.16 mal temp during h ctor for ga Feb 0.98	nd solar 398.61 perature (eating peains for li Mar 0.96	212.67 (84)m = 465.82 (heating eriods in iving are Apr 0.9	285.87 = (73)m 523.1 season the livea, h1, May 0.77	7 3 n + (i 5 on) ving m (s	83)m 26.41 area f ee Ta Jun 0.61	, watts 496.79 from Tal ble 9a) Jul 0.47	227 444 cole 9 A 0.5	.28 157.79 .28 383.1 , Th1 (°C) .28 383.1 , Th1 (°C) .28 383.1	87.84 329.2	7 304.31 Nov 0.98	302.42 Dec	21	(84)
(83)m= 35.31 Total gains – i (84)m= 316.78 7. Mean intervent of the second of the se	71.87 nternal a 351.16 nal temp during h etor for ga Feb 0.98 l tempera	nd solar 398.61 perature eating period of the solution of the	212.67 (84)m = 465.82 (heating eriods in iving are Apr 0.9 iving are 20.3	285.87 = (73)m 523.1 season the livea, h1,n May 0.77 ea T1 (20.69	7 3 3 5 5 5 5 7 7 7 8 7 7 7 8 7 7 7 7 7 7 7 7	83)m 26.41 area 1 ee Ta Jun 0.61 ow ste	496.79 from Talble 9a) Jul 0.47 ps 3 to 7	227 444 ole 9 A 0.5 7 in T 20.	.28 157.79 .28 383.1 , Th1 (°C) ug Sep .4 0.78 .7 Columbia C	87.84 329.2 Oct 0.94	7 304.31 Nov 0.98	302.42 Dec 0.99	21	(84)
(83)m= 35.31 Total gains – i (84)m= 316.78 7. Mean inter Temperature Utilisation fact Jan (86)m= 0.99 Mean internal	71.87 nternal a 351.16 nal temp during h etor for ga Feb 0.98 l tempera	nd solar 398.61 perature eating period of the solution of the	212.67 (84)m = 465.82 (heating eriods in iving are Apr 0.9 iving are 20.3	285.87 = (73)m 523.1 season the livea, h1,n May 0.77 ea T1 (20.69	7 3 3 5 5 5 5 7 7 7 8 7 7 7 8 7 7 7 7 7 7 7 7	83)m 26.41 area 1 ee Ta Jun 0.61 ow ste	496.79 from Talble 9a) Jul 0.47 ps 3 to 7	227 444 ole 9 A 0.5 7 in T 20.	.28 157.79 .28 383.1 , Th1 (°C) .28 Sep .28 383.1 .28 Sep .29 Sep .20 87.84 329.2 Oct 0.94	7 304.31 Nov 0.98	302.42 Dec 0.99		(84)	
(83)m= 35.31 Total gains – i (84)m= 316.78 7. Mean inter Temperature Utilisation fact Jan (86)m= 0.99 Mean interna (87)m= 19.31 Temperature (88)m= 20	71.87 Internal a 351.16 Inal temp during h etor for ga Feb 0.98 I tempera 19.48 during h 20	nd solar 398.61 perature (eating periods for 10 10 10 10 10 10 10 10 10 10 10 10 10	212.67 (84)m = 465.82 (heating eriods in iving are 20.3 eriods in 20	285.87 = (73)m 523.1 seaso n the livea, h1, May 0.77 ea T1 (20.69 n rest c	7 3 3 5 5 5 5 5 5 5 5 6 5 6 6 6 6 6 6 6 6	area face Ta Jun 0.61 ow ste 20.9 velling	, watts 496.79 from Table 9a) Jul 0.47 ps 3 to 7 20.97 from Table 9a	2277 4444 bole 9 A 0.5 7 in T 20.	.28 157.79 .28 383.1 , Th1 (°C) .28 Sep .28 383.1 .28 Sep .29 Sep .20 87.84 329.2 Oct 0.94	7 304.31 Nov 0.98	Dec 0.99	21	(84) (85) (86) (87)	
(83)m= 35.31 Total gains – i (84)m= 316.78 7. Mean inter Temperature Utilisation face [86)m= 0.99 Mean internation (87)m= 19.31 Temperature (88)m= 20 Utilisation face	71.87 Internal a 351.16 Inal temp during h ctor for ga Feb 0.98 I tempera 19.48 during h 20 ctor for ga	nd solar 398.61 perature (peating peatins for li	212.67 (84)m = 465.82 (heating eriods ir iving are 20.3 eriods ir 20 eest of decrease of the second	285.87 = (73)m = 523.1 seaso n the livea, h1,n May 0.77 ea T1 (20.69 n rest c 20 welling	7 3 3 1 + ((5 5 5 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6	area free Ta Jun 0.61 ow ste 20.9 velling 20 ,m (se	from Talble 9a) Jul 0.47 ps 3 to 7 20.97 from Talble 9a)	2277 4444 bole 9 A 0.5 7 in T 20. able 9 9a)	.28 157.79 .28 383.1 , Th1 (°C) .28 383.1 .28 383.1 .29 Sep .20 Sep	87.84 329.2 Oct 0.94 20.26	Nov 0.98 19.69	Dec 0.99	21	(84) (85) (86) (87) (88)
(83)m= 35.31 Total gains – i (84)m= 316.78 7. Mean inter Temperature Utilisation fact [86)m= 0.99 Mean internation (87)m= 19.31 Temperature (88)m= 20 Utilisation fact (89)m= 0.98	71.87 Internal a 351.16 Inal temp during h etor for ga Feb 0.98 Il tempera 19.48 during h 20 etor for ga	nd solar 398.61 perature (peating peatins for li 0.96 atture in l 19.83 peating pe	212.67 (84)m = 465.82 (heating eriods in iving are 20.3 eriods in 20 eest of do 0.87	285.87 = (73)m = 523.1 seaso n the livea, h1,0 May 0.77 ea T1 (20.69 n rest of 20 welling 0.73	7 3 3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	83)m 26.41 area f ee Ta Jun 0.61 ow ste 20.9 velling 20 ,m (se 0.53	yatts 496.79 from Tal ble 9a) Jul 0.47 ps 3 to 7 20.97 from Tal 20 ee Table 0.37	2277 4444 bole 9 A 0.5 7 in T 20. able 9 9a) 0.4	.28 157.79 .28 383.1 .Th1 (°C) .ug Sep .4 0.78 .able 9c) .95 20.77 .9, Th2 (°C) .0 20	87.84 329.2 Oct 0.94 20.26	7 304.31 Nov 0.98	Dec 0.99		(84) (85) (86) (87)
(83)m= 35.31 Total gains – i (84)m= 316.78 7. Mean inter Temperature Utilisation fact [86)m= 0.99 Mean internation (87)m= 19.31 Temperature (88)m= 20 Utilisation fact (89)m= 0.98 Mean internation	71.87 Internal a 351.16 Inal temp during h ctor for ga Feb 0.98 I tempera 19.48 during h 20 ctor for ga 0.97 I tempera	nd solar 398.61 perature (eating perature in language) ature in language) 20 ains for ranguage) ature in tagentary	212.67 (84)m = 465.82 (heating eriods in iving are 20.3 eriods in 20 eest of do 0.87 the rest	285.87 = (73)m 523.1 seaso the livea, h1,i May 0.77 ea T1 (20.69 n rest c 20 welling 0.73 of dwe	7 3 7 5 7 5 7 5 7 7 7 7 7 7 7 7 7 7 7 7 7 7	83)m 26.41 area f ee Ta Jun 0.61 w ste 20.9 /elling 20 ,m (se 0.53	from Table 9a) Jul 0.47 ps 3 to 7 20.97 from Table 0.37 collow ste	2277 4444 bole 9 A 0.5 7 in T 20. 9a) 0.4	.28 157.79 .28 383.1 . Th1 (°C) .28 383.1 . Th1 (°C) .29 Sep .44 0.78 .40 0.72 .41 0.72 .42 0.72 .43 0.72	87.84 329.2 Oct 0.94 20.26 20 0.92 e 9c)	7 304.31 Nov 0.98 19.69 20 0.97	Dec 0.99 19.25 20 0.98	21]	(84) (85) (86) (87) (88) (89)
(83)m= 35.31 Total gains – i (84)m= 316.78 7. Mean inter Temperature Utilisation fact [86)m= 0.99 Mean internation (87)m= 19.31 Temperature (88)m= 20 Utilisation fact (89)m= 0.98	71.87 Internal a 351.16 Inal temp during h etor for ga Feb 0.98 Il tempera 19.48 during h 20 etor for ga	nd solar 398.61 perature (peating peatins for li 0.96 atture in l 19.83 peating pe	212.67 (84)m = 465.82 (heating eriods in iving are 20.3 eriods in 20 eest of do 0.87	285.87 = (73)m = 523.1 seaso n the livea, h1,0 May 0.77 ea T1 (20.69 n rest of 20 welling 0.73	7 3 7 5 7 5 7 5 7 7 7 7 7 7 7 7 7 7 7 7 7 7	83)m 26.41 area f ee Ta Jun 0.61 ow ste 20.9 velling 20 ,m (se 0.53	yatts 496.79 from Tal ble 9a) Jul 0.47 ps 3 to 7 20.97 from Tal 20 ee Table 0.37	2277 4444 bole 9 A 0.5 7 in T 20. able 9 9a) 0.4	.28 157.79 .28 383.1 , Th1 (°C) .28 383.1 , Th1 (°C) .29 Sep .44 0.78 .40 0.78 .41 0.72 .42 0.72 .43 0.72 .44 0.72 .46 0.72 .47 19.78	87.84 329.2 Oct 0.94 20.26 20 0.92 e 9c) 19.11	Nov 0.98 19.69 20 0.97	Dec 0.99 19.25 20 0.98		(84) (85) (86) (87) (88) (89)
(83)m= 35.31 Total gains – i (84)m= 316.78 7. Mean inter Temperature Utilisation fact [86)m= 0.99 Mean internation (87)m= 19.31 Temperature (88)m= 20 Utilisation fact (89)m= 0.98 Mean internation	71.87 Internal a 351.16 Inal temp during h ctor for ga Feb 0.98 I tempera 19.48 during h 20 ctor for ga 0.97 I tempera	nd solar 398.61 perature (eating perature in language) ature in language) 20 ains for ranguage) ature in tagentary	212.67 (84)m = 465.82 (heating eriods in iving are 20.3 eriods in 20 eest of do 0.87 the rest	285.87 = (73)m 523.1 seaso the livea, h1,i May 0.77 ea T1 (20.69 n rest c 20 welling 0.73 of dwe	7 3 7 5 7 5 7 5 7 7 7 7 7 7 7 7 7 7 7 7 7 7	83)m 26.41 area f ee Ta Jun 0.61 w ste 20.9 /elling 20 ,m (se 0.53	from Table 9a) Jul 0.47 ps 3 to 7 20.97 from Table 0.37 collow ste	2277 4444 bole 9 A 0.5 7 in T 20. 9a) 0.4	.28 157.79 .28 383.1 , Th1 (°C) .28 383.1 , Th1 (°C) .29 Sep .44 0.78 .40 0.78 .41 0.72 .42 0.72 .43 0.72 .44 0.72 .46 0.72 .47 19.78	87.84 329.2 Oct 0.94 20.26 20 0.92 e 9c) 19.11	7 304.31 Nov 0.98 19.69 20 0.97	Dec 0.99 19.25 20 0.98	21	(84) (85) (86) (87) (88) (89)
(83)m= 35.31 Total gains – i (84)m= 316.78 7. Mean inter Temperature Utilisation fac [86)m= 0.99 Mean interna (87)m= 19.31 Temperature (88)m= 20 Utilisation fac (89)m= 0.98 Mean interna (90)m= 17.74 Mean interna	71.87 Internal a 351.16 Inal temp during h ctor for ga Feb 0.98 I tempera 19.48 during h 20 ctor for ga 0.97 I tempera 17.99	nd solar 398.61 perature (peating peating for 10.96 atture in 11.83 peating peating peating peating peating peating peating peating for records atture in terms of the second of the seconds of the seconds of the seconds of the seconds of the seconds of the seconds of the second of t	212.67 (84)m = 465.82 (heating eriods in iving are 20.3 eriods in 20 est of do 0.87 the rest 19.15 r the wh	285.87 = (73)m 523.1 seaso the livea, h1, May 0.77 ea T1 (20.69 n rest of 20 welling 0.73 of dwe 19.67	7 3 n + (i	83)m 26.41 area f ee Ta Jun 0.61 bw ste 20.9 velling 20 ,m (se 0.53 T2 (fd 19.92	, watts 496.79 from Tal ble 9a) Jul 0.47 ps 3 to 7 20.97 from Ta 20 ee Table 0.37 ollow ste 19.98	2277 4444 bole 9 A 0.5 7 in T 20. able 9 0.4 eps 3 19.	.28 157.79 .28 383.1 , Th1 (°C) .28 383.1 , Th1 (°C) .29 Sep .44 0.78 .44 0.72 .44 0.72 .44 0.72 .45 7 in Table .47 19.78 .48 6 in Table .49 19.78	87.84 329.2 Oct 0.94 20.26 20 0.92 e 9c) 19.11	Nov 0.98 19.69 20 0.97 18.3 ving area ÷ (-	Dec 0.99 19.25 20 0.98 17.66 4) =		(84) (85) (86) (87) (88) (89) (90) (91)
(83)m= 35.31 Total gains – i (84)m= 316.78 7. Mean intermediate Temperature Utilisation fact	71.87 Internal a 351.16 Inal temp during h ctor for ga Feb 0.98 Il tempera 19.48 during h 20 ctor for ga 0.97 Il tempera 17.99 Il tempera 18.7	nd solar 398.61 perature (peating peatins for limits of limits	212.67 (84)m = 465.82 (heating eriods in iving are 20.3 eriods in 20 eest of do 0.87 the rest 19.15 r the wh	285.87 = (73)m = 523.1 seaso n the livea, h1,n May 0.77 ea T1 (20.69 n rest of 20 welling 0.73 of dwe 19.67	7 3 7 1 3 7 1 4 (i	83)m 26.41 area f ee Ta Jun 0.61 ow ste 20.9 /elling 20 ,m (se 0.53 T2 (fc 19.92	watts 496.79 from Tal ble 9a) Jul 0.47 ps 3 to 7 20.97 from Ta 20 ee Table 0.37 collow ste 19.98 A × T1 20.45	2277 4444 bole 9 A 0.5. 7 in T 20. 9a) 0.4 + (1 20.	.28 157.79 .28 383.1 .Th1 (°C) .ug Sep .4 0.78 .able 9c) .95 20.77 .action 7 in Table .action 7 in Table .a	87.84 329.2 Oct 0.94 20.26 20 0.92 e 9c) 19.11 19.66	Nov 0.98 19.69 20 0.97 18.3 ving area ÷ (-	Dec 0.99 19.25 20 0.98		(84) (85) (86) (87) (88) (89)

ı						1				1		1	ı	
(93)m=	18.33	18.55	18.98	19.55	20.01	20.24	20.3	20.29	20.1	19.51	18.81	18.27		(93)
			uirement											
			ternal ter or gains	•		ed at ste	ep 11 of	Table 9	b, so tha	t Ti,m=(76)m an	d re-calc	culate	
trie ut	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisa			ains, hm		iviay	<u> </u>	<u> </u>	_ /wg	Гоор		1 1101	200		
(94)m=	0.97	0.96	0.93	0.86	0.73	0.55	0.4	0.47	0.72	0.91	0.96	0.98		(94)
Usefu	ıl gains,	hmGm	, W = (94	4)m x (84	4)m	ļ	ļ	<u> </u>	1	<u> </u>	<u>!</u>			
(95)m=	308.85	338.37	372.56	401.57	381.16	291.07	200.45	207.18	276.85	298.29	292.92	295.86		(95)
Month	nly aver	age exte	rnal tem	perature	from Ta	able 8	!		!			!	l	
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat	loss rate	for me	an intern	al tempe	erature,	Lm , W =	=[(39)m	x [(93)m	– (96)m]				
(97)m=	780.34	759.16	694.06	592.1	462.03	313.57	205.93	216.26	333.66	495.27	651.35	782.3		(97)
Space	e heatin	g require	ement fo	r each n	nonth, k\	Wh/mon	th = 0.02	24 x [(97)m – (95)m] x (4	1)m			
(98)m=	350.79	282.77	239.19	137.18	60.17	0	0	0	0	146.55	258.07	361.91		_
								Tota	l per year	(kWh/yea	r) = Sum(9	8)15,912 =	1836.63	(98)
Space	e heatin	g require	ement in	kWh/m²	/year								36.46	(99)
9a En	erav rea	uiremer	nts – Indi	vidual h	eating s	vstems i	ncludino	ı micro-C	CHP)					
	e heatir		no mai	rradai ii	oamig oʻ	y otorno r	nordan ig	, , , , , , ,	, , , , , , , , , , , , , , , , , , ,					
-		•	at from s	econdar	y/supple	mentary	system						0	(201)
Fracti	on of sp	ace hea	at from m	nain syst	em(s)			(202) = 1	- (201) =				1	(202)
			ng from	-	` ,			(204) = (2	02) x [1 –	(203)] =			1	(204)
			ace heat	-					, .	, ,,			90.3	(206)
	•	•					- 0/							╡`
EIIICIE			ry/suppl					1		T	1		0	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ar
Space		· ·	ement (c		· ·	I		<u> </u>		440.55			ı	
ļ	350.79	282.77	239.19	137.18	60.17	0	0	0	0	146.55	258.07	361.91		
(211)m		<u> </u>)4)] } x 1			<u> </u>	1			I			l	(211)
	388.47	313.14	264.89	151.92	66.63	0	0	0	0	162.29	285.8	400.79		٦
								lota	ıl (kWh/yea	ar) =Sum(2	211) _{15,1012}	₂ =	2033.92	(211)
•		•	econdar	• , .	month									
			00 ÷ (20			0	0	Ι ,	0	0	0			
(215)m=	0	0	0	0	0	U	0	O Tota	l (kWh/yea			0	0	7(245)
107								1018	ii (KVVII/yee	ar) =50m(2	2 1 3) _{15,101}	2	0	(215)
	heating	•	tor (colo	ulotod ol	hovo)									
Output	54.55	43.1	ter (calc 47.27	64.21	91.58	101.17	97.13	108.07	109.26	64.96	46.72	52.56		
Efficier		ater hea						1			1		81	(216)
(217)m=	<u> </u>	88.95	88.62	87.11	84.45	81	81	81	81	87.22	88.74	89	01	(217)
			kWh/mo		U T. TU	L	L "		L "		1 30.74			ν=/
		•) ÷ (217)											
(219)m=		48.46	53.34	73.71	108.44	124.91	119.91	133.42	134.88	74.47	52.65	59.05		
l						-		Tota	ıl = Sum(2	19a) ₁₁₂ =	-		1044.59	(219)
Annua	ıl totals									k'	Wh/yeaı	, ,	kWh/year	_
Space	heating	fuel use	ed, main	system	1								2033.92	
												'		_

Water heating fuel used				1044.59]
Electricity for pumps, fans and electric keep-hot					
mechanical ventilation - balanced, extract or pos	itive input from outsid	е	248.47]	(230a)
central heating pump:			30]	(230c)
boiler with a fan-assisted flue			45]	(230e)
Total electricity for the above, kWh/year	sum	n of (230a)(230g) =		323.47	(231)
Electricity for lighting				234.63	(232)
Total delivered energy for all uses (211)(221) +	(231) + (232)(237b)	=		3636.61	(338)
12a. CO2 emissions – Individual heating system	s including micro-CHF	o .			
	Energy kWh/year	Emission fa kg CO2/kWh		Emissions kg CO2/yea	ır
Space heating (main system 1)	•				ır](261)
Space heating (main system 1) Space heating (secondary)	kWh/year	kg CO2/kWh		kg CO2/yea	_
	kWh/year	kg CO2/kWh	=	kg CO2/yea	(261)
Space heating (secondary)	kWh/year (211) x (215) x	0.216 0.519 0.216	=	kg CO2/yea	(261)
Space heating (secondary) Water heating	kWh/year (211) x (215) x (219) x	0.216 0.519 0.216	=	kg CO2/yea 439.33 0 225.63	(261) (263) (264)
Space heating (secondary) Water heating Space and water heating	kWh/year (211) x (215) x (219) x (261) + (262) + (263) +	kg CO2/kWh 0.216 0.519 0.216 (264) =	= = =	kg CO2/yea 439.33 0 225.63 664.96	(261) (263) (264) (265)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-hot	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (231) x	kg CO2/kWh 0.216 0.519 0.216 0.519	= = =	kg CO2/yea 439.33 0 225.63 664.96 167.88	(261) (263) (264) (265) (267)

El rating (section 14)

(274)



Appendix C

Project: 0317

Generating energy on-site:-

Final SAP Outputs & Dwelling Emission Rates

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 10:59:48

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 100.28m² Plot Reference: Site Reference: 231 Watford Road - GREEN Sample 1

Address:

Client Details:

Name: Address:

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity

Fuel factor: 1.55 (electricity)

25.2 kg/m² Target Carbon Dioxide Emission Rate (TER)

Dwelling Carbon Dioxide Emission Rate (DER) 10.44 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 53.5 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 42.3 kWh/m²

OK 2 Fabric U-values

Element Average Highest

External wall 0.16 (max. 0.30) 0.16 (max. 0.70) OK Party wall 0.00 (max. 0.20) OK Floor 0.14 (max. 0.25) OK 0.14 (max. 0.70)

Roof (no roof) Openings 1.10 (max. 2.00) OK 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 3.50 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system:

Heat pumps with radiators or underfloor heating - electric

NIBE Fighter 360

Secondary heating system: None

5 Cylinder insulation

No Separate Cylinder Hot water Storage:

N/A

6 Controls			
Space heating controls Hot water controls:	TTZC by plumbing and e No cylinder thermostat No cylinder	electrical services	ок
7 Low energy lights			
Percentage of fixed lights windle Minimum	th low-energy fittings	100.0% 75.0%	ок
8 Mechanical ventilation			
Continuous extract system Specific fan power: Maximum		1.05 0.7	Fail
9 Summertime temperature		•	
Overheating risk (Thames v Based on:	alley):	Slight	OK
Overshading: Windows facing: South East Windows facing: South Wes Ventilation rate:		Average or unknown 15.34m ² 1.28m ² 3.00	
10 Key features			
Air permeablility Windows U-value Party Walls U-value Photovoltaic array		3.5 m³/m²h 1.1 W/m²K 0 W/m²K	

		User D	Notaile:						
Access Name	Noil Inghom	USELL		o Nium	hor.		STD()	010042	
Assessor Name: Software Name:	Neil Ingham Stroma FSAP 2012		Strom Softwa					010943 on: 1.0.5.41	
		Property	Address						
Address :									
1. Overall dwelling dime	ensions:	_							
Ground floor			a(m²)	(1a) x		ight(m) 2.75	(2a) =	Volume(m³) (3a)
	a)+(1b)+(1c)+(1d)+(1e)+(1					75	(2a) -	213.11	
	a)+(1b)+(1c)+(1d)+(1e)+(1	11)1	00.28	(4)) . (20) . (26	4) . (2.5) .	(2n)		-
Dwelling volume				(3a)+(3b)+(30)+(30	d)+(3e)+	(311) =	275.77	(5)
2. Ventilation rate:	main seconda	rv	other		total			m³ per hou	r
Number of chimneys	heating heating	-, □ + □		7 = [40 =		_
•			0	」	0		20 =	0	(6a)
Number of open flues		」	0	」	0		10 =	0	(6b)
Number of intermittent fa				Ļ	0			0	(7a)
Number of passive vents				Ļ	0		10 =	0	(7b)
Number of flueless gas fi	res				0	X 4	40 =	0	(7c)
							Air ch	anges per ho	ur
Infiltration due to chimne	ys, flues and fans = $(6a)+(6b)+(6b)$	7a)+(7b)+((7c) =	Γ	0		÷ (5) =	0	(8)
If a pressurisation test has b	een carried out or is intended, proce	ed to (17),	otherwise o	continue fr	rom (9) to		` '	-	``
Number of storeys in the	he dwelling (ns)							0	(9)
Additional infiltration	.25 for steel or timber frame o	r 0 35 fo	r maenni	v consti	ruction	[(9)	-1]x0.1 =	0	(10)
	resent, use the value corresponding t			•	uction			0	(11)
deducting areas of openii		1 (222)	مطا مامم	ontor O			ı	_	7,40
If no draught lobby, en	floor, enter 0.2 (unsealed) or (ter 0.05, else enter 0	o. i (Seale	ea), eise	enter 0				0	(12)
• ,	s and doors draught stripped							0	(14)
Window infiltration	0 11		0.25 - [0.2	x (14) ÷ 1	00] =			0	(15)
Infiltration rate			(8) + (10)	+ (11) + (1	12) + (13)	+ (15) =		0	(16)
•	q50, expressed in cubic metr	•	•	•	etre of e	envelope	area	3.5	(17)
	ity value, then $(18) = [(17) \div 20] +$							0.18	(18)
Air permeability value applie Number of sides sheltere	es if a pressurisation test has been do ad	ne or a de	gree air pe	rmeability	is being u	sed		0	(19)
Shelter factor	eu .		(20) = 1 -	[0.075 x (19)] =			0	(20)
Infiltration rate incorporat	ting shelter factor		(21) = (18) x (20) =				0.18	(21)
Infiltration rate modified f	or monthly wind speed						!		
Jan Feb	Mar Apr May Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	eed from Table 7								
(22)m= 5.1 5	4.9 4.4 4.3 3.8	3.8	3.7	4	4.3	4.5	4.7		
Wind Factor (22a)m = (2	2)m ÷ 4								
	1.23 1.1 1.08 0.95	0.95	0.92	1	1.08	1.12	1.18		
			•			•		•	

Adjusted infiltration rate (allowing for shel	ter and wind	speed) =	(21a) x	(22a)m		ı		1	
0.22 0.22 0.21 0.19 Calculate effective air change rate for the	0.19 0.17	0.17	0.16	0.18	0.19	0.2	0.21		
If mechanical ventilation:	аррисавіе са	1S C						0.5	(2
If exhaust air heat pump using Appendix N, (23b)	= (23a) × Fmv (equation (I	N5)) , othe	rwise (23b) = (23a)			0.5	— \(\)
If balanced with heat recovery: efficiency in % all	owing for in-use	factor (fron	n Table 4h) =				0.0	
a) If balanced mechanical ventilation w	_				2h)m + (23b) x [1 – (23c)		(
24a)m= 0 0 0 0	0 0	0	0	0	0	0	0		(2
b) If balanced mechanical ventilation w	thout heat re	coverv (N	л ИV) (24b	m = (22)	2b)m + (23b)	ļ	l	
24b)m= 0 0 0 0	0 0	0	0	0	0	0	0		(2
c) If whole house extract ventilation or p	ositive input	ventilatio	on from o	utside	!	<u> </u>	!		
if $(22b)m < 0.5 \times (23b)$, then $(24c) =$	•				.5 × (23b)			
24c)m= 0.5 0.5 0.5 0.5	0.5 0.5	0.5	0.5	0.5	0.5	0.5	0.5		(2
d) If natural ventilation or whole house	oositive input	ventilation	on from I	oft		!	•	•	
if (22b)m = 1, then (24d)m = (22b)n	otherwise (2	24d)m =	0.5 + [(2	2b)m² x	0.5]			1	
24d)m= 0 0 0 0	0 0	0	0	0	0	0	0		(2
Effective air change rate - enter (24a) o	r (24b) or (24	c) or (24	ld) in box	(25)				1	
25)m= 0.5 0.5 0.5 0.5	0.5 0.5	0.5	0.5	0.5	0.5	0.5	0.5		(2
3. Heat losses and heat loss parameter:									
LEMENT Gross Openings	Net A	rea	U-val	ıe	AXU		k-value		Χk
area (m²) m²	Α,	m²	W/m2	K .	(W/I	K)	kJ/m²·ł	K kJ	l/K
/indows Type 1	15.3	4 x1	/[1/(1.1)+	0.04] =	16.16				(
/indows Type 2	1.28	x1	/[1/(1.1)+	0.04] =	1.35				(:
loor	100.2	28 x	0.14	=	14.0392	2	110	11030	.8 (
Valls Type1 68.22 16.62	51.6	X	0.16	=	8.26		60	3096	(
/alls Type2 43.24 0	43.2	4 x	0.15	_ = [6.47		60	2594.	4 (
otal area of elements, m²	211.7	' 4							 (
arty wall	15.2	1 X	0	=	0	\neg	45	684.4	5 (
arty ceiling	100.2	28					30	3008.	(
iternal wall **	175.1	8					9	1576.6	=
for windows and roof windows, use effective windo			g formula 1	/[(1/U-valu	ıe)+0.04] a	L as given in			`الـــــُــُ
include the areas on both sides of internal walls a	nd partitions				, -	-			
abric heat loss, $W/K = S (A \times U)$			(26)(30)	+ (32) =				46.28	(
eat capacity Cm = S(A x k)				((28).	(30) + (32	2) + (32a)	(32e) =	21990.67	(
hermal mass parameter (TMP = $Cm \div T$	FA) in kJ/m²k	(= (34)	÷ (4) =			219.29	(
or design assessments where the details of the co on be used instead of a detailed calculation.	nstruction are no	t known pi	recisely the	indicative	e values of	TMP in T	able 1f		
nermal bridges : S (L x Y) calculated usi	ng Appendix	K						15.42	
details of thermal bridging are not known (36) = 0 .	05 x (31)						'		
otal fabric heat loss				(33) +	(36) =			61.7	
entilation heat loss calculated monthly				(38)m	= 0.33 × (25)m x (5)	•	
Jan Feb Mar Apr	May Jun	Jul	Aug	Sep	Oct	Nov	Dec		
8)m= 45.5 45.5 45.5 45.5	45.5 45.5	45.5	45.5	45.5	45.5	45.5	45.5		(
eat transfer coefficient, W/K				(39)m	= (37) + (37)	38)m			
9)m= 107.2 107.2 107.2 107.2 1	07.2 107.2	107.2	107.2	107.2	107.2	107.2	107.2		

Heat loss para	ameter (I	HLP), W	′m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07		
						l .	l .		Average =	Sum(40) ₁	12 /12=	1.07	(40)
Number of day		nth (Tab	le 1a)		ı			ı	1				
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m= 31	28	31	30	31	30	31	31	30	31	30	31		(41)
4. Water hea	ting ene	rgy requi	irement:								kWh/ye	ear:	
Assumed occu if TFA > 13. if TFA £ 13.	9, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9)2)] + 0.0	0013 x (¯	TFA -13		74		(42)
Annual average Reduce the annual not more that 125	ge hot wa al average	hot water	usage by	5% if the a	lwelling is	designed t	` ,		se target o		.32		(43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage i	in litres pe	r day for ea			ctor from	Table 1c x			!	!			
(44)m= 109.26	105.28	101.31	97.34	93.37	89.39	89.39	93.37	97.34	101.31	105.28	109.26		
	•	•				!	!			m(44) ₁₁₂ =		1191.9	(44)
Energy content of	f hot water	used - cal	culated mo	onthly = 4 .	190 x Vd,r	n x nm x C	OTm / 3600) kWh/mor	nth (see Ta	ables 1b, 1	c, 1d)		
(45)m= 162.03	141.71	146.23	127.49	122.33	105.56	97.82	112.25	113.59	132.37	144.5	156.91		_
If instantaneous v	water heati	na at noint	of use (no	hot water	r storage)	enter∩in	hoves (46		Total = Su	m(45) ₁₁₂ =	=	1562.77	(45)
			·	·	· · ·		· · ·	,	10.00	04.07	00.54		(46)
(46)m= 24.3 Water storage	21.26 loss:	21.93	19.12	18.35	15.83	14.67	16.84	17.04	19.86	21.67	23.54		(46)
Storage volum) includir	ng any so	olar or W	/WHRS	storage	within sa	ame ves	sel	0			(47)
If community h	neating a	and no ta	ınk in dw	elling, e	nter 110	litres in	(47)						
Otherwise if no	o stored	hot wate	er (this in	icludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in ((47)			
Water storage					4.144	<i>,</i> , , ,							
a) If manufact				or is kno	wn (kVVI	n/day):				0.	54		(48)
Temperature f										0.9	072		(49)
Energy lost from b) If manufact		•	•		or io not		(48) x (49)) =			0		(50)
Hot water stor			-								0		(51)
If community h	•			- (7,					0		(- /
Volume factor	from Ta	ble 2a									0		(52)
Temperature f	factor fro	m Table	2b								0		(53)
Energy lost fro		_	, kWh/ye	ear			(47) x (51)) x (52) x (53) =		0		(54)
Enter (50) or	(54) in (55)								0.	91		(55)
Water storage	loss cal	culated t	for each	month			((56)m = ((55) × (41)	m				
(56)m= 28.12	25.4	28.12	27.22	28.12	27.22	28.12	28.12	27.22	28.12	27.22	28.12		(56)
If cylinder contain	s dedicate	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Append	x H	
(57)m= 28.12	25.4	28.12	27.22	28.12	27.22	28.12	28.12	27.22	28.12	27.22	28.12		(57)
Primary circuit	t loss (ar	nnual) fro	om Table	<u>-</u> -							0		(58)
Primary circuit	,	•			59)m = ((58) ÷ 36	65 × (41)	m					
(modified by	/ factor f	rom Tab	le H5 if t	here is s	solar wat	ter heatii	ng and a	cylinde	r thermo	stat)			
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m													
(61)m= 0 0		0	0	0	0) 0	Т	0	0	0	0	1	(61)
Total heat required	for water h	L neating ca	L alculated	l for eac	:h month	(62)ı	m =	0 85 x (′45)m +	(46)m +	(57)m +	J :(59)m + (61)m	
(62)m= 190.15 167		154.7	150.45	132.78	125.94	140.	_	140.8	160.5	171.71	185.04]	(62)
Solar DHW input calcula	ted using Ap	pendix G o	r Appendix	H (negat	ive quantity	y) (ent	er '0'	if no sola	r contribu	tion to wate	r heating)	J	
(add additional line											-		
(63)m= 0 0	0	0	0	0	0	0		0	0	0	0]	(63)
Output from water	neater	•	•	•	•	•				•	•	•	
(64)m= 190.15 167	11 174.35	154.7	150.45	132.78	125.94	140	.37	140.8	160.5	171.71	185.04]	
	•	•	•	•	•		Outpo	ut from wa	ater heate	er (annual)	l12	1893.9	(64)
Heat gains from wa	ter heating	j, kWh/m	onth 0.2	5 ´ [0.85	5 × (45)m	ı + (6	1)m]] + 0.8 x	((46)m	+ (57)m	+ (59)m]	
(65)m= 53.87 47.	12 48.62	42.39	40.67	35.1	32.52	37.	32	37.77	44.01	48.04	52.17]	(65)
include (57)m in	calculation	of (65)m	only if o	ylinder	is in the	dwell	ing c	or hot w	ater is f	rom com	munity h	neating	
5. Internal gains	see Table	5 and 5a):										
Metabolic gains (Ta	ıble 5), Wa	itts											
Jan F		Apr	May	Jun	Jul	Αι	ug	Sep	Oct	Nov	Dec]	
(66)m= 137.11 137	11 137.11	137.11	137.11	137.11	137.11	137	.11	137.11	137.11	137.11	137.11		(66)
Lighting gains (cald	ulated in A	ppendix	L, equat	ion L9 c	r L9a), a	lso s	ee T	able 5				-	
(67)m= 23.72 21.	7 17.13	12.97	9.7	8.19	8.85	11.	.5	15.43	19.59	22.87	24.38]	(67)
Appliances gains (alculated i	n Append	dix L, eq	uation L	.13 or L1	3a), a	also	see Tal	ble 5				
(68)m= 256.78 259	44 252.73	238.43	220.39	203.43	192.1	189	.44	196.15	210.45	228.49	245.45]	(68)
Cooking gains (cal	culated in A	Appendix	L, equat	tion L15	or L15a), als	o se	e Table	5	-	-		
(69)m= 36.71 36.	71 36.71	36.71	36.71	36.71	36.71	36.	71	36.71	36.71	36.71	36.71]	(69)
Pumps and fans ga	ins (Table	5a)											
(70)m= 0 0	0	0	0	0	0	0		0	0	0	0		(70)
Losses e.g. evapor	ation (nega	ative valu	es) (Tab	le 5)								_	
(71)m= -109.68 -109	68 -109.68	-109.68	-109.68	-109.68	-109.68	-109	.68	-109.68	-109.68	-109.68	-109.68]	(71)
Water heating gain	s (Table 5)					_						_	
(72)m= 72.41 70.	65.35	58.87	54.67	48.75	43.71	50.	16	52.45	59.16	66.73	70.13		(72)
Total internal gair	s =			(66	i)m + (67)m	า + (68	8)m +	(69)m + ((70)m + (7	71)m + (72))m	_	
(73)m= 417.04 414	76 399.35	374.41	348.89	324.5	308.79	315	.23	328.17	353.33	382.22	404.09		(73)
6. Solar gains:													
Solar gains are calcula	-				•	tions 1			e applica		tion.		
Orientation: Acces		Area m²		Flu Ta	ıx ıble 6a			g_ able 6b	т	FF able 6c		Gains (W)	
						1 1							1,
).77				36.79	X		0.63	_	0.7	=	172.49	[(77)
O - vith t).77				62.67	X		0.63		0.7	=	293.82	(77)
).77				85.75	X]		0.63		0.7	_ =	402.02](77)] ₍₇₇₎
).77				06.25	X		0.63	_ ×	0.7	=	498.12	(77)
Southeast 0.9x).77	15.	.34	X 1	19.01	X		0.63	X	0.7	=	557.93	(77)

		_			-			,						_
Southeast 0.9x	0.77	X	15.	34	X	1	18.15	X	0.63	X	0.7	=	553.9	(77)
Southeast 0.9x	0.77	X	15.	34	x	1	13.91	X	0.63	X	0.7	=	534.02	(77)
Southeast 0.9x	0.77	X	15.	34	x [10	04.39	X	0.63	X	0.7	=	489.39	(77)
Southeast 0.9x	0.77	X	15.	34	x	9	2.85	x	0.63	X	0.7	=	435.3	(77)
Southeast 0.9x	0.77	X	15.	34	x	6	9.27	x	0.63	X	0.7	=	324.73	(77)
Southeast 0.9x	0.77	X	15.	34	x	4	4.07	x	0.63	X	0.7	=	206.61	(77)
Southeast 0.9x	0.77	x	15.	34	x	3	1.49	x	0.63	X	0.7	=	147.62	(77)
Southwest _{0.9x}	0.77	X	1.2	28	x	3	6.79]	0.63	X	0.7	=	14.39	(79)
Southwest _{0.9x}	0.77	×	1.2	28	x	6	2.67		0.63	x	0.7		24.52	(79)
Southwest _{0.9x}	0.77	×	1.2	28	x	8	5.75]	0.63	x	0.7	=	33.55	(79)
Southwest _{0.9x}	0.77	×	1.2	28	x	10	06.25	ĺ	0.63	x	0.7	<u>=</u>	41.56	(79)
Southwest _{0.9x}	0.77	×	1.2	28	x	1	19.01	ĺ	0.63	x	0.7	=	46.56	(79)
Southwest _{0.9x}	0.77	×	1.2	28	x	1	18.15	ĺ	0.63	x	0.7	=	46.22	(79)
Southwest _{0.9x}	0.77	×	1.2	28	x	1	13.91	j	0.63	x	0.7	=	44.56	(79)
Southwest _{0.9x}	0.77	×	1.2	28	x	1(04.39	j	0.63	x	0.7		40.84	(79)
Southwest _{0.9x}	0.77	×	1.2	28	x [9	2.85	j	0.63	x	0.7		36.32	(79)
Southwest _{0.9x}	0.77	×	1.2	28	x	6	9.27	j	0.63	×	0.7	_ =	27.1	(79)
Southwest _{0.9x}	0.77	×	1.2	28	x [4	4.07	ĺ	0.63	×	0.7	-	17.24	(79)
Southwest _{0.9x}	0.77	×	1.2	28	x [3	1.49	j	0.63	×	0.7	-	12.32	(79)
Solar gains in (83)m= 186.89	· · ·	ulated 35.56	for eac 539.68	h month 604.49	$\overline{}$	00.12	578.58	<u> </u>	n = Sum(74)m .23 471.62	1 ' '	1	159.94	1	(83)
(83)m= 186.89 Total gains – ii								530	.23 4/1.02	351.8	3 223.85	159.94]	(00)
(84)m= 603.93		34.91	914.1	953.38	·	24.61	887.37	845	.46 799.79	705.1	6 606.07	564.02	1	(84)
` '				<u> </u>		1.01	007.07		.10 700.70	1 7 00.1	0 000.01	1 00 1.02	J	(= :)
7. Mean inter	•		`						TI 4 (0.0)				Г	7
Temperature	ŭ	٠.			·			ole 9	, Th1 (°C)				21	(85)
Utilisation fac					Ť								1	
Jan	_	Mar	Apr	May	+	Jun	Jul	_	ug Sep	Oct	+	Dec	-	(06)
(86)m= 1	0.99	0.98	0.94	0.85).69	0.52	0.5	0.79	0.96	0.99	1]	(86)
Mean interna	· · ·	- 1		·	1		i			1		1	7	
(87)m= 21	21	21	21	21		21	21	2	1 21	21	21	21]	(87)
Temperature	during hea	ting p	eriods ir	rest of	dw	elling	from Ta	able 9	9, Th2 (°C)	_			_	
(88)m= 20.03	20.03 2	0.03	20.03	20.03	20	0.03	20.03	20.	03 20.03	20.03	3 20.03	20.03		(88)
Utilisation fac	tor for gain	s for r	est of d	welling,	h2,ı	m (se	e Table	9a)						
(89)m= 1	0.99).97	0.92	0.8		0.6	0.41	0.4	15 0.72	0.94	0.99	1		(89)
Mean interna	l temperatu	re in t	he rest	of dwell	ina	T2 (fo	ollow ste	eps 3	to 7 in Tab	le 9c)	-	•	_	
(90)m= 20.03	· · ·	0.03	20.03	20.03	Ť	0.03	20.03	20.	1	20.03	3 20.03	20.03]	(90)
	· · · · · ·			!			<u> </u>		·	fLA = Li	ving area ÷ (4) =	0.23	(91)
Mean interna	l tamperatu	ıra (fa	r tha wh	ole dwa	lling	7) _ fi	Δ . Τ1	 /1	_ fl ∧\ ⊷ Tɔ					
(92)m= 20.25	 	0.25	20.25	20.25	 	رر = ۱۱ 0.25	20.25	20.		20.25	5 20.25	20.25	1	(92)
Apply adjustn					<u> </u>							1 20.20	J	(3-)
المرامي المارية								,	o appi	5pa.c	-			

(00)	20.25	20.25	20.05	20.25	20.05	20.25	20.05	20.05	20.05	20.25	20.05	20.05		(93)
(93)m=	20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25		(93)
			uirement				44 6	T			70)		1.4	
			ernal ter or gains	•		ed at ste	ep 11 of	Table 9	b, so tha	t II,m=(76)m an	d re-calc	culate	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisa	ation fac	tor for g	ains, hm	1:										
(94)m=	1	0.99	0.97	0.92	0.81	0.62	0.44	0.48	0.74	0.94	0.99	1		(94)
Usefu	ıl gains,	hmGm	W = (94)	4)m x (8	4)m									
(95)m=	601.28	724.63	810.35	842.95	773.18	575.86	387.18	406.08	591.42	665.17	600.01	562.23		(95)
Montl	hly aver	age exte	rnal tem	perature	from Ta	able 8	-	-	-		-	-		
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat	loss rate	for mea	an intern	al tempe	erature,	Lm , W =	=[(39)m	x [(93)m	– (96)m]			•	
(97)m=	1710.14	1645.82	1474.29	1217	916.83	605.94	391.54	412.98	659.55	1034.76	1409.97	1720.86		(97)
Space	e heatin	g require	ement fo	r each n	nonth, k\	Nh/mon	th = 0.02	24 x [(97)m – (95)m] x (4	1)m			
(98)m=	825	619.04	493.97	269.32	106.88	0	0	0	0	274.97	583.17	862.03		
			•	•			•	Tota	l per year	(kWh/yeaı	r) = Sum(9	8) _{15,912} =	4034.38	(98)
Snac	a haatin	a requir	ement in	k\/\/h/m²	2/vear								40.23] (99)
		•											40.23](33)
		•	nts – Indi	ividual h	eating sy	ystems i	ncluding	micro-C	CHP)					
•	e heatir	_			,									٦,,,,,
Fract	ion of sp	ace hea	at from so	econdar	y/supple	mentary	system						0	(201)
Fracti	ion of sp	ace hea	at from m	nain syst	em(s)			(202) = 1	- (201) =				1	(202)
Fracti	ion of to	tal heati	ng from	main sys	stem 1			(204) = (2	02) x [1 –	(203)] =			1	(204)
Efficie	ency of r	main spa	ace heat	ing syste	em 1								295.34	(206)
Efficie	ency of s	seconda	ry/suppl	ementar	y heating	g system	ո, %						0	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ar
Space	e heatin	g require	ement (c	alculate	d above))								
	825	619.04	493.97	269.32	106.88	0	0	0	0	274.97	583.17	862.03		
(211)m	n = {[(98)m x (20)4)] } x 1	00 ÷ (20	06)									(211)
, ,	279.34	209.6	167.26	91.19	36.19	0	0	0	0	93.1	197.46	291.88		
								Tota	ıl (kWh/yea	ar) =Sum(2	211) _{15,1012}	=	1366.02	(211)
Snac	e heatin	a fuel (s	econdar	v) k\//h/	month]
•		•	00 ÷ (20	• •	montan									
(215)m=		0	0	0	0	0	0	0	0	0	0	0		
. ,							l	Tota	l ıl (kWh/yea	ar) =Sum(2	1 215), _{510 13}	<u></u> =	0	(215)
Motor	booting									,	715,1012](-/
	heating		ter (calc	ulated a	hove)									
Output	190.15	167.11	174.35	154.7	150.45	132.78	125.94	140.37	140.8	160.5	171.71	185.04		
Efficie	ncv of w	ater hea			l	<u> </u>	l				l	l	207.67	(216)
(217)m=		207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	201.01	」`´´ (217)
, ,					207.07	207.07	207.07	207.07	207.07	207.07	207.07	201.01		(=)
		•	kWh/mo) ÷ (217)											
(219)m=		80.47	83.96	74.49	72.45	63.94	60.64	67.59	67.8	77.28	82.68	89.1		
		<u> </u>						Tota	l = Sum(2	19a) ₁₁₂ =	I.	•	911.97	(219)
Annus	al totals										Wh/year		kWh/year	」` '′
			ed, main	system	1						, 		1366.02	1
-	J			-										_

					_
Water heating fuel used				911.97	
Electricity for pumps, fans and electric keep-hot					
mechanical ventilation - balanced, extract or pos	itive input from outside		253.46]	(230a)
Total electricity for the above, kWh/year	sum of (230a)(230g) =		253.46	(231)
Electricity for lighting				418.92	(232)
Electricity generated by PVs				-932.71	(233)
Total delivered energy for all uses (211)(221) +	(231) + (232)(237b) =			2017.66	(338)
12a. CO2 emissions – Individual heating systems	s including micro-CHP				
	Energy kWh/year	Emission fac kg CO2/kWh	ctor	Emissions kg CO2/yea	r
Space heating (main system 1)	(211) x	0.519	=	708.96	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	473.31	(264)
Space and water heating	(261) + (262) + (263) + (264) =		1182.28	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	131.55	(267)
Electricity for lighting	(232) x	0.519	=	217.42	(268)
Energy saving/generation technologies Item 1		0.519	=	-484.08	(269)
Total CO2, kg/year		sum of (265)(271) =		1047.17	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		10.44	(273)

El rating (section 14)

(274)

90

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 10:59:47

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 52.98m² Plot Reference: Sample 2

Site Reference: 231 Watford Road - GREEN

Address:

Client Details:

Name: Address:

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity

Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER) 25.05 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 7.90 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 35.9 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 27.6 kWh/m²

OK 2 Fabric U-values

Element Average Highest

0.16 (max. 0.70) External wall 0.15 (max. 0.30) OK Party wall 0.00 (max. 0.20) **OK**

Floor (no floor)

Roof (no roof) Openings 1.10 (max. 2.00) OK 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 3.50 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system:

Heat pumps with radiators or underfloor heating - electric

NIBE Fighter 360

Secondary heating system: None

5 Cylinder insulation

No Separate Cylinder Hot water Storage:

N/A

6 Controls			
Space heating controls Hot water controls:	TTZC by plumbing and e No cylinder thermostat No cylinder	electrical services	ок
7 Low energy lights			
Percentage of fixed lights wi Minimum	th low-energy fittings	100.0% 75.0%	ок
8 Mechanical ventilation			
Continuous extract system Specific fan power: Maximum		1.05 0.7	Fail
9 Summertime temperature			
Overheating risk (Thames v. Based on: Overshading:		Slight Average or unknown	ОК
Windows facing: South East Ventilation rate:		6.39m² 6.00	
10 Key features			
Air permeablility Windows U-value Party Walls U-value Photovoltaic array		3.5 m³/m²h 1.1 W/m²K 0 W/m²K	

		l lser I	Details:							
Assessor Name: Software Name:	Neil Ingham Stroma FSAP 2012		Strom Softwa	are Ve	rsion:			0010943 on: 1.0.5.41		
Address :	F	Property	Address	: Sample	e 2					
1. Overall dwelling dime	ensions:									
		Are	a(m²)		Av. He	ight(m)	_	Volume(m	3)	
Ground floor			52.98	(1a) x	2	2.75	(2a) =	145.69	(3a)	
Total floor area TFA = (1	a)+(1b)+(1c)+(1d)+(1e)+(1	n)	52.98	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3c	d)+(3e)+	.(3n) =	145.69	(5)	
2. Ventilation rate:										
	main seconda heating heating	ry	other		total			m³ per hou	ır	
Number of chimneys	0 + 0	+ [0	=	0	X 4	40 =	0	(6a)	
Number of open flues	0 + 0	+ [0	=	0	x 2	20 =	0	(6b)	
Number of intermittent fa	ins				0	x '	10 =	0	(7a)	
Number of passive vents	;			Ē	0	x '	10 =	0	(7b)	
Number of flueless gas fi	ires			F	0	X 4	40 =	0	(7c)	
				L						
							Air ch	nanges per ho	our	
	ys, flues and fans = (6a)+(6b)+(Ţ	0		÷ (5) =	0	(8)	
Number of storeys in the	peen carried out or is intended, procee he dwelling (ns)	ed to (17),	otherwise (continue fi	om (9) to	(16)		0	(9)	
Additional infiltration	no awaning (115)					[(9)	-1]x0.1 =	0	(10)	
Structural infiltration: 0	.25 for steel or timber frame o	r 0.35 fc	r masoni	ry consti	ruction			0	(11)	
• • • • • • • • • • • • • • • • • • • •	resent, use the value corresponding t	o the grea	ter wall are	a (after			'			
deducting areas of openia	ngs);	.1 (seal	ed), else	enter 0				0	(12)	
If no draught lobby, en	,	(000	,,					0	(13)	
Percentage of window	s and doors draught stripped							0	(14)	
Window infiltration			0.25 - [0.2	2 x (14) ÷ 1	00] =			0	(15)	
Infiltration rate			(8) + (10)	+ (11) + (1	12) + (13)	+ (15) =		0	(16)	
•	q50, expressed in cubic metro	•	•	•	etre of e	envelope	area	3.5	(17)	
•	lity value, then $(18) = [(17) \div 20] + (18)$ if a pressurisation test has been do				is boing u	sod		0.18	(18)	
Number of sides sheltere		ne or a de	gree an pe	ппеаышу	is being u	seu		0	(19)	
Shelter factor			(20) = 1 -	[0.075 x (19)] =			1	(20)	
Infiltration rate incorporate	ting shelter factor		(21) = (18) x (20) =				0.18	(21)	
Infiltration rate modified f	or monthly wind speed				_			•		
Jan Feb	Mar Apr May Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Monthly average wind sp	peed from Table 7									
(22)m= 5.1 5	4.9 4.4 4.3 3.8	3.8	3.7	4	4.3	4.5	4.7			
Wind Factor (22a)m = (2	2)m ÷ 4									
	1.23 1.1 1.08 0.95	0.95	0.92	1	1.08	1.12	1.18]		
		•	•	•	•	•	•	•		

Adjusted infiltra	ation rat	e (allowi	ng for sh	nelter an	d wind s	speed) =	(21a) x	(22a)m					
0.22	0.22	0.21	0.19	0.19	0.17	0.17	0.16	0.18	0.19	0.2	0.21]	
Calculate effect		_	rate for t	he appli	cable ca	se	-	-	-			0.5	(23a)
If exhaust air he			endix N, (2	3b) = (23a	a) × Fmv (e	equation (I	N5)) , othe	rwise (23b) = (23a)			0.5	(23b)
If balanced with		0 11		, ,	, ,	. ,	,, .	`	, , ,			0.5	(23c)
a) If balance	d mecha	anical ve	ntilation	with he	at recove	erv (MVI	HR) (24a	a)m = (2)	2b)m + (23b) x [1 – (23c)		(200)
(24a)m= 0	0	0	0	0	0	0	0	0	0	0	0]	(24a)
b) If balance	d mech	anical ve	ntilation	without	heat red	overy (N	лV) (24t	m = (22)	2b)m + (23b)	·	•	
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0]	(24b)
c) If whole h if (22b)n				•					.5 × (23b	D)	•	•	
(24c)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5]	(24c)
d) If natural if (22b)n									0.5]	•	•	•	
(24d)m= 0	0	0	0	0	0	0	0	0	0	0	0]	(24d)
Effective air	change	rate - er	iter (24a) or (24b	o) or (24	c) or (24	d) in box	(25)				_	
(25)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(25)
3. Heat losse	s and he	eat loss p	paramete	er:									
ELEMENT	Gros	·	Openin		Net Ar	ea	U-val	ıe	AXU		k-value		ΑΧk
	area	(m²)	m	²	A ,r		W/m2		(W/	K)	kJ/m²-	K	kJ/K
Windows					6.39	x1	/[1/(1.1)+	0.04] =	6.73	ᆜ .			(27)
Walls Type1	22.1	7	6.39		15.78	3 X	0.16	=	2.52		60	94	6.8 (29)
Walls Type2	17.2	22	0		17.22	2 x	0.15	=	2.58		60	103	33.2 (29)
Total area of e	lements	, m²			39.39								(31)
Party wall					46.48	3 X	0	=	0		45	209	1.6 (32)
Party floor					52.98	3					40	211	9.2 (32a)
Party ceiling					52.98	3					30	158	(32b)
Internal wall **					97.63	3					9	878	3.67 (32c)
* for windows and ** include the area						ated using	formula 1	/[(1/U-valu	ıe)+0.04] a	as given in	paragraph	1 3.2	
Fabric heat los				is anu pan	uuoris		(26)(30)	+ (32) =				11.84	(33)
Heat capacity		•	0)				, , , ,		(30) + (32	2) + (32a).	(32e) =	8658.87	
Thermal mass		,	P = Cm -	- TFA) ir	n kJ/m²K			,,,,,	÷ (4) =	_,	()	163.44	(35)
For design assess	•	`		,			ecisely the	` '	. ,	TMP in T	able 1f	100.44	(00)
can be used inste													
Thermal bridge	•	,			•	<						6.45	(36)
if details of therma Total fabric he		are not kn	own (36) =	= 0.05 x (3	1)			(33) +	(36) =			18.29	(37)
Ventilation hea	at loss ca	alculated	l monthly	/				(38)m	= 0.33 × ((25)m x (5))	10.20	`` ′
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec]	
(38)m= 24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	1	(38)
Heat transfer of	coefficier	nt, W/K					•	(39)m	= (37) + (38)m	•	•	
(39)m= 42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33]	
							•		- Δverage –	Sum(39) ₁	/12-	42.33	(39)

Heat loss para	meter (l	HLP). W/	m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8		
()										Sum(40) ₁ .		0.8	(40)
Number of day	s in mo	nth (Tabl	e 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)
							Į.		·				
4. Water heat	ing one	rav roqui	romont:								kWh/ye	or:	
4. Water near	ing ene	igy requi	rement.								KVVII/ye	tai.	
Assumed occu if TFA > 13.9 if TFA £ 13.9	0, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9)2)] + 0.0	0013 x (⁻	TFA -13		78		(42)
Annual average Reduce the annual									se target o		.43		(43)
not more that 125	litres per	person per	day (all w	ater use, l	hot and co	ld)							
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in	litres pe	day for ea	ch month	Vd,m = fa	ctor from	Table 1c x	(43)		-		-		
(44)m= 84.07	81.01	77.96	74.9	71.84	68.78	68.78	71.84	74.9	77.96	81.01	84.07		
							•			m(44) ₁₁₂ =		917.12	(44)
Energy content of	hot water	used - cal	culated mo	onthly = 4.	190 x Vd,r	n x nm x C	OTm / 3600) kWh/mor	nth (see Ta	ables 1b, 1	c, 1d)		
(45)m= 124.67	109.04	112.52	98.1	94.13	81.22	75.27	86.37	87.4	101.86	111.18	120.74		_
									Total = Su	m(45) ₁₁₂ =	=	1202.49	(45)
If instantaneous wa	ater neati	ng at point	of use (no	not water	r storage),	enter 0 in	boxes (46)) to (61)		,	1		
(46)m= 18.7	16.36	16.88	14.71	14.12	12.18	11.29	12.96	13.11	15.28	16.68	18.11		(46)
Water storage Storage volume		. inaludin	a 001/0	olor or M	WHDC	otorogo	within or	ama vaa	ool		1		(47)
•	` '		•			•		airie ves	SEI	0			(47)
If community he Otherwise if no	•			•			` '	ers) ente	er '∩' in <i>(</i>	47)			
Water storage		not wate	/ (tillo li	1014465 1	motantai	10000 00	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	ora, oric	31 0 111 ((-17)			
a) If manufactu		eclared l	oss facto	or is kno	wn (kWł	n/day):				0.	54		(48)
Temperature fa	actor fro	m Table	2b		•	- 7				0.9	072		(49)
Energy lost from				ear			(48) x (49)) =			0		(50)
b) If manufactu		_	-		or is not	known:					0		()
Hot water stora	-			e 2 (kW	h/litre/da	ıy)					0		(51)
If community h	_		on 4.3								-		
Volume factor f			OL								0		(52)
Temperature fa											0		(53)
Energy lost from		_	, kWh/ye	ear			(47) x (51)) x (52) x (53) =	-	0		(54)
Enter (50) or (, ,	,								0.	91		(55)
Water storage	loss cal	culated f	or each	month			((56)m = (55) × (41)ı	m 				
(56)m= 28.12	25.4	28.12	27.22	28.12	27.22	28.12	28.12	27.22	28.12	27.22	28.12		(56)
If cylinder contains	dedicate	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Append	ix H	
(57)m= 28.12	25.4	28.12	27.22	28.12	27.22	28.12	28.12	27.22	28.12	27.22	28.12		(57)
Primary circuit	•	•									0		(58)
Primary circuit				,	•	. ,	, ,						
(modified by				i	i	i				<u> </u>			(EO)
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

0 111				(0.4)	(00)	o= (44)							
Combi loss o				,	` '	<u> </u>		Т.		Ι.		1	(04)
(61)m= 0	0	0	0	0	0	0	0	0	0	0	0	J	(61)
							`		ì '	ì ´	r` ´ 	(59)m + (61)m	
(62)m= 152.8		140.64	125.31	122.25	108.44	103.39	114.49		129.98	138.4	148.86	J	(62)
Solar DHW inpu									r contribut	ion to wate	er heating)		
(add addition						 		 			1	1	
(63)m= 0	0	0	0	0	0	0	0	0	0	0	0	J	(63)
Output from	water hea	ter										1	
(64)m= 152.8	134.44	140.64	125.31	122.25	108.44	103.39	114.49	114.62	129.98	138.4	148.86		-
							Ou	tput from w	ater heate	r (annual) ₁	12	1533.62	(64)
Heat gains fr	om water	heating,	kWh/mo	onth 0.2	5 ´ [0.85	× (45)m	+ (61)	m] + 0.8 x	k [(46)m	+ (57)m	+ (59)m]	
(65)m= 41.45	36.26	37.41	32.62	31.3	27.01	25.03	28.72	29.06	33.87	36.97	40.15		(65)
include (57	7)m in cald	culation c	of (65)m	only if c	ylinder i	s in the	dwelling	or hot w	ater is f	rom com	munity h	neating	
5. Internal	gains (see	Table 5	and 5a):									
Metabolic ga	,												
Jan		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec]	
(66)m= 88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	1	(66)
Lighting gain	s (calcula	ted in Ap	pendix	L, equat	on L9 o	r L9a), a	lso see	Table 5				1	
(67)m= 15.32	13.6	11.06	8.38	6.26	5.29	5.71	7.42	9.96	12.65	14.77	15.74]	(67)
Appliances g	ains (calc	ulated in	Append	dix L, eq	uation L	13 or L1	3a), als	o see Ta	ble 5	•	•	•	
(68)m= 154.9°	7 156.57	152.52	143.9	133.01	122.77	115.93	114.32	118.38	127	137.89	148.13]	(68)
Cooking gair	ns (calcula	ıted in Ar	pendix	L. eguat	ion L15	or L15a), also s	see Table	5			•	
(69)m= 31.89	_`	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	1	(69)
Pumps and f	ans gains	(Table 5	a)			<u> </u>	I		<u> </u>	l		ı	
(70)m= 0	0	0	0	0	0	0	0	0	0	0	0	1	(70)
Losses e.g. e	evaporatio	n (negat	ive valu	es) (Tab	le 5)	<u> </u>	l		<u> </u>		<u> </u>	J	
(71)m= -71.12	 	-71.12	-71.12	-71.12	-71.12	-71.12	-71.12	-71.12	-71.12	-71.12	-71.12]	(71)
Water heatin	n nains (T	I able 5)					<u> </u>		!		!	J	
(72)m= 55.72		50.29	45.3	42.07	37.51	33.64	38.6	40.36	45.52	51.35	53.96	1	(72)
` '			10.0	12.01		<u> </u>		+ (69)m +		l	<u> </u>	J	(- –)
(73)m= 275.6		263.54	247.24	231	215.24	204.95	210.02	- ` 	234.85	253.68	267.5	1	(73)
6. Solar gai		203.34	241.24	201	210.24	204.93	210.02	210.57	234.03	200.00	207.5		(10)
Solar gains are		usina solar	flux from	Table 6a :	and assoc	iated equa	itions to a	convert to th	ne annlicat	ale orientat	tion		
Orientation:		•	Area		Flu	•		g_	іс арріюці	FF		Gains	
Onemation.	Table 6d		m ²			ble 6a		9_ Table 6b	Т	able 6c		(W)	
Southeast 0.9x	0.77	x	6.3	39	x :	36.79) x [0.63	x [0.7		71.85	(77)
Southeast 0.9x		X	6.3		—	62.67)	0.63		0.7	= =	122.39](77)
Southeast 0.9x	• • • • • • • • • • • • • • • • • • • •	×	6.3			35.75	」^ <u>└</u>]	0.63	^	0.7		167.46](77)
Southeast 0.9x	<u> </u>	x	6.3			06.25	」^ <u>└</u>]x	0.63	^	0.7	-	207.5](77)
Southeast 0.9x		_			-		┆ ⊨		⊣		=		╡
Journedal (J.9)	0.77	X	6.3	9	x 1	19.01	X	0.63	X	0.7	=	232.41	(77)

Southeast 0.9x 0.77	X	6.3	9	x ·	118.15] x [0.63	x	0.7	=	230.73	(77)
Southeast 0.9x 0.77	X	6.3	9	x ·	113.91	x	0.63	x	0.7	=	222.45	(77)
Southeast 0.9x 0.77	X	6.3	9	X ·	104.39	_ x [0.63	x	0.7	=	203.86	(77)
Southeast 0.9x 0.77	X	6.3	9	x	92.85] x [0.63	x	0.7	=	181.33	(77)
Southeast 0.9x 0.77	X	6.3	9	x	69.27] x [0.63	x	0.7	=	135.27	(77)
Southeast 0.9x 0.77	X	6.3	9	x	44.07] x	0.63	x	0.7	=	86.06	(77)
Southeast 0.9x 0.77	X	6.3	9	x	31.49] x [0.63	x	0.7	=	61.49	(77)
Solar gains in watts, c					T	i ' 	= Sum(74)m .	<u> </u>			Ī	(00)
(83)m= 71.85 122.39	167.46	207.5	232.41	230.73		203.8	6 181.33	135.27	86.06	61.49		(83)
Total gains – internal a	431	454.74	463.41	445.97	427.4	413.8	8 399.7	370.12	339.74	328.99]	(84)
` '				l	427.4	413.0	0 399.7	370.12	339.74	320.99		(04)
7. Mean internal temp		_					- 1 (2.0)					_
Temperature during h	•			•		ble 9,	Th1 (°C)				21	(85)
Utilisation factor for g				r `	1 	1	- 0	0-4	Nan	Data]	
Jan Feb	Mar	Apr	May	Jun	Jul	Aug		Oct	Nov	Dec		(86)
(86)m= 0.98 0.97	0.94	0.87	0.75	0.58	0.43	0.46	0.68	0.89	0.97	0.99		(00)
Mean internal temper	1		,	I	i 	1			T		1	(07)
(87)m= 21 21	21	21	21	21	21	21	21	21	21	21		(87)
Temperature during h	, , ,			r .	`	1	`				Ī	
(88)m= 20.25 20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25		(88)
Utilisation factor for g	ains for r	est of d	welling,	h2,m (s	ee Table	9a)			_		•	
(89)m= 0.98 0.96	0.93	0.85	0.71	0.52	0.36	0.39	0.62	0.87	0.96	0.98		(89)
Mean internal temper	ature in t	he rest	of dwell	ng T2 (follow ste	eps 3 t	o 7 in Tab	le 9c)	_		_	
(90)m= 20.25 20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25		(90)
							f	fLA = Livir	ng area ÷ (4) =	0.4	(91)
Mean internal temper	ature (fo	r the wh	ole dwe	lling) =	fLA × T1	+ (1 –	fLA) × T2					
(92)m= 20.56 20.56	20.56	20.56	20.56	20.56	20.56	20.56	20.56	20.56	20.56	20.56		(92)
Apply adjustment to t	i i		•	ì	1	1		·			1	
(93)m= 20.56 20.56	20.56	20.56	20.56	20.56	20.56	20.56	20.56	20.56	20.56	20.56		(93)
8. Space heating require						Table	Ob as the	.t T: /	70\	-ll-	lata	
Set Ti to the mean in the utilisation factor for				ied at s	тер ттог	rabie	9b, so tha	it 11,ff1=(ro)m an	id re-caid	culate	
Jan Feb	Mar	Apr	May	Jun	Jul	Aug	g Sep	Oct	Nov	Dec		
Utilisation factor for g	ains, hm	:			•		•		•		•	
(94)m= 0.98 0.96	0.93	0.86	0.73	0.55	0.39	0.42	0.64	0.88	0.96	0.98		(94)
Useful gains, hmGm	`	<u> </u>			_	_			_		1	
(95)m= 340.86 381.9	400.99	390.69	338.16	244.7	166.3	174.2	3 257.54	324.31	327.58	324.03		(95)
Monthly average exterior (96)m= 4.3 4.9	1			i e	16.6	16.4	144	10.6	7 1	1 4 2]	(96)
(96)m= 4.3 4.9 Heat loss rate for me	6.5 an intern	8.9	11.7	14.6 I m W	16.6 =[(39)m	16.4 x [(93)		10.6	7.1	4.2	I	(50)
(97)m= 688.1 662.7	594.97	493.39	374.87	252.11	167.45	175.9		421.43	569.58	692.33		(97)
Space heating require										<u>I</u>	I	
(98)m= 258.34 188.7	144.32	73.94	27.31	0	0	0	0	72.26	174.24	274.02		
				•	-	•	•	•	•		•	

				Tota	l per year	(kWh/year	r) = Sum(9	8)15,912 =	1213.13	(98)
Space heating requirement in kW	Vh/m²/year								22.9	(99)
9a. Energy requirements – Individ	lual heating sy	ystems i	ncluding	micro-C	HP)					
Space heating:								г		¬(004)
Fraction of space heat from seco		mentary	-	(000) 4	(004)			Ĺ	0	(201)
Fraction of space heat from main	• • • • • • • • • • • • • • • • • • • •			(202) = 1 -	,	(000)1		Ĺ	1	(202)
Fraction of total heating from ma	•			(204) = (20	02) x [1 –	(203)] =		Į	1	(204)
Efficiency of main space heating	•		0.4					Į	277.43	(206)
Efficiency of secondary/supplement	entary heating	g system	า, % 						0	(208)
	Apr May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ear
Space heating requirement (calc 258.34 188.7 144.32 73	3.94 27.31	0	0	0	0	72.26	174.24	274.02		
$(211)m = \{[(98)m \times (204)] \} \times 100$			Ů	Ů		72.20	177.27	214.02		(211)
	6.65 9.84	0	0	0	0	26.04	62.8	98.77		(211)
	1					ar) =Sum(2			437.27	(211)
Space heating fuel (secondary),	kWh/month							L		
$= \{[(98)m \times (201)]\} \times 100 \div (208)$										
(215)m= 0 0 0	0 0	0	0	0	0	0	0	0		_
				Tota	I (kWh/yea	ar) =Sum(2	215) _{15,101}	<i>=</i>	0	(215)
Water heating	4ll · - · \									
Output from water heater (calculated) 152.8 134.44 140.64 12	25.31 122.25	108.44	103.39	114.49	114.62	129.98	138.4	148.86		
Efficiency of water heater	ļ .							!	207.67	(216)
(217)m= 207.67 207.67 207.67 20	07.67 207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67		(217)
Fuel for water heating, kWh/month	h					•	•	•		
$ (219)m = (64)m \times 100 \div (217)m $ $ (219)m = 73.58 64.74 67.72 60 $	0.34 58.87	52.22	49.79	55.13	55.19	62.59	66.64	71.68		
(210)111 10.00 0 1111 01.12 0.	00.07	02.22	10.70		I = Sum(2		00.01	7 1.00	738.49	(219)
Annual totals							Wh/yea	, ,	kWh/yea	
Space heating fuel used, main sys	stem 1						•	[437.27	
Water heating fuel used								Ī	738.49	
Electricity for pumps, fans and ele	ectric keep-ho	t						_		
mechanical ventilation - balanced	d, extract or p	ositive i	nput fron	n outside	€			292.61		(230a)
Total electricity for the above, kWI	h/year			sum	of (230a).	(230g) =			292.61	(231)
Electricity for lighting								Ī	270.51	(232)
Electricity generated by PVs								Ī	-932.71	(233)
Total delivered energy for all uses	s (211)(221)	+ (231)	+ (232).	(237b)	=			Ţ	806.17	(338)
12a. CO2 emissions – Individual	heating syste	ems inclu	uding mi	cro-CHP)			L		
			ergy				ion fac	tor	Emissions	

kWh/year

kg CO2/year

kg CO2/kWh

Space heating (main system 1)	(211) x	0.519	=	226.94	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	383.28	(264)
Space and water heating	(261) + (262) + (263) + (264) =			610.22	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	151.86	(267)
Electricity for lighting	(232) x	0.519	=	140.39	(268)
Energy saving/generation technologies Item 1		0.519	=	-484.08	(269)
Total CO2, kg/year	sun	n of (265)(271) =		418.4	(272)
Dwelling CO2 Emission Rate	(27)	2) ÷ (4) =		7.9	(273)
El rating (section 14)				94	(274)

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 10:59:45

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:**

Flat

Total Floor Area: 92.44m²

Dwelling Details:

Site Reference:

NEW DWELLING DESIGN STAGE

Plot Reference: 231 Watford Road - GREEN

Sample 3

Address:

Client Details:

Name: Address:

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity

Fuel factor: 1.55 (electricity)

28.63 kg/m² Target Carbon Dioxide Emission Rate (TER)

Dwelling Carbon Dioxide Emission Rate (DER) 12.58 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 61.4 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 48.7 kWh/m²

OK

2 Fabric U-values

Element Highest Average External wall 0.15 (max. 0.30) 0.16 (max. 0.70) OK Party wall 0.00 (max. 0.20) OK Floor 0.14 (max. 0.25) OK 0.14 (max. 0.70)

Roof (no roof)

Openings 1.10 (max. 2.00) 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 3.50 (design value)

OK Maximum 10.0

4 Heating efficiency

Main Heating system:

Heat pumps with radiators or underfloor heating - electric

NIBE Fighter 360

Secondary heating system: None

5 Cylinder insulation

No Separate Cylinder Hot water Storage:

N/A

OK

6 Controls			
Space heating controls Hot water controls:	TTZC by plumbing and e No cylinder thermostat No cylinder	electrical services	ок
7 Low energy lights			
Percentage of fixed lights wi Minimum	th low-energy fittings	100.0% 75.0%	ок
8 Mechanical ventilation			
Continuous extract system Specific fan power: Maximum		1.05 0.7	Fail
9 Summertime temperature		N. 4 1 10 4	014
Overheating risk (Thames van Based on:	alley):	Not significant	OK
Overshading: Windows facing: North East Windows facing: North West Ventilation rate:		Average or unknown 3.85m ² 5.11m ² 6.00	
10 Key features			
Air permeablility Windows U-value Party Walls U-value Photovoltaic array		3.5 m³/m²h 1.1 W/m²K 0 W/m²K	

		l Iser I	Details:						
Assessor Name: Software Name:	Neil Ingham Stroma FSAP 2012		Strom Softwa	are Ve	rsion:			0010943 on: 1.0.5.41	
Address :	F	Property	Address	Sample	e 3				
1. Overall dwelling dime	ensions:								
		Are	a(m²)		Av. He	ight(m)	_	Volume(m	³)
Ground floor		9	92.44	(1a) x	2	.75	(2a) =	254.21	(3a)
Total floor area TFA = (1a	a)+(1b)+(1c)+(1d)+(1e)+(1	n) 🤇	92.44	(4)					
Dwelling volume				(3a)+(3b)+(3c)+(3c	d)+(3e)+	.(3n) =	254.21	(5)
2. Ventilation rate:									
	main seconda heating heating	ry	other		total			m³ per hou	ır
Number of chimneys	0 + 0	+	0] = [0	X 4	40 =	0	(6a)
Number of open flues	0 + 0	+ [0] = [0	x 2	20 =	0	(6b)
Number of intermittent fa	ns			Ī	0	x ′	10 =	0	(7a)
Number of passive vents				Ī	0	x ²	10 =	0	(7b)
Number of flueless gas fi	res			Ē	0	x 4	40 =	0	(7c)
				_					
							Air ch	nanges per ho	our
•	ys, flues and fans = $(6a)+(6b)+(6b)+(6a)+(6b)+(6a)+(6b)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a$				0		÷ (5) =	0	(8)
Number of storeys in the	een carried out or is intended, proceence	ea to (17),	otnerwise (continue ir	om (9) to ((16)		0	(9)
Additional infiltration	3 (2)					[(9)-	-1]x0.1 =	0	(10)
Structural infiltration: 0	.25 for steel or timber frame o	r 0.35 fo	r masoni	y constr	uction			0	(11)
if both types of wall are po deducting areas of openir	resent, use the value corresponding t	o the grea	ter wall are	a (after					
,	floor, enter 0.2 (unsealed) or 0	.1 (seale	ed), else	enter 0				0	(12)
If no draught lobby, en	ter 0.05, else enter 0							0	(13)
-	s and doors draught stripped							0	(14)
Window infiltration			0.25 - [0.2	. ,	-			0	(15)
Infiltration rate	.50		(8) + (10)					0	(16)
•	q50, expressed in cubic metro ity value, then $(18) = [(17) \div 20] + (18)$	•	•	•	etre of e	envelope	area	3.5	(17)
•	es if a pressurisation test has been do				is being u	sed		0.18	(18)
Number of sides sheltere	ed							0	(19)
Shelter factor			(20) = 1 -		19)] =			1	(20)
Infiltration rate incorporat	•		(21) = (18) x (20) =				0.18	(21)
Infiltration rate modified for	- 1 	1	1 .			<u> </u>		1	
Jan Feb	Mar Apr May Jun	Jul	Aug	Sep	Oct	Nov	Dec	J	
Monthly average wind sp (22)m= 5.1 5	eed from Table 7 4.9 4.4 4.3 3.8	3.8	3.7	4	4.3	4.5	4.7	1	
(22)m= 5.1 5	4.3 4.4 4.3 3.6] 3.0	3.1	4	4.3	4.5	4.7	J	
Wind Factor (22a)m = (22	2)m ÷ 4								
(22a)m= 1.27 1.25	1.23 1.1 1.08 0.95	0.95	0.92	1	1.08	1.12	1.18		

djusted infilt	tration rat	e (allowi	ng for sh	nelter an	d wind s	peed) =	(21a) x	(22a)m	_		_		
0.22	0.22	0.21	0.19	0.19	0.17	0.17	0.16	0.18	0.19	0.2	0.21		
<i>alculate effe</i> If mechanic		•	rate for t	пе арріі	саріе са	se						0.5	(2
If exhaust air I			endix N. (2	3b) = (23a	a) × Fmv (e	equation (N5)) . othe	wise (23b) = (23a)			0.5	
If balanced wi		0		, ,	,	. ,	,, .	`	, , ,			0.5	(2
a) If balanc		•	-	_					2h\m + (23h) v I	1 _ (23c)	_	(4
4a)m= 0		0	0	0	0	0	0	0	0	0	0]	(:
b) If balanc	ed mech:	L anical ve	L entilation	without	heat red	:overv (I	⊥ MV) (24h)m = (2)	2b)m + (23b)	1	l	
4b)m= 0	0	0	0	0	0	0	0	0	0	0	T 0		(
c) If whole	house ex	tract ver	tilation o	r positiv	l /e input v	/entilatio	on from o	LLLL outside				l	
,	m < 0.5 ×				•				.5 × (23b	o)			
1c)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(
d) If natural	l ventilatio	on or wh	ole hous	e positiv	e input	ventilati	on from I	oft			•	•	
if (22b)	m = 1, the	en (24d)	m = (22l	o)m othe	erwise (2	4d)m =	0.5 + [(2	2b)m² x	0.5]			1	
1d)m= 0	0	0	0	0	0	0	0	0	0	0	0		(
Effective ai	r change	rate - er	nter (24a) or (24b	o) or (24	c) or (24	d) in box	(25)				1	
5)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(
. Heat loss	es and he	eat loss p	paramete	er:									
LEMENT	Gros area		Openin m		Net Ar A ,r		U-valı W/m2	-	A X U (W/		k-value kJ/m²-l		A X k ⟨J/K
indows Typ		()			3.85		/[1/(1.1)+		4.06	$\stackrel{\prime}{\Box}$			
indows Typ					5.11	_	/[1/(1.1)+		5.38				
oor	_				92.44	=	0.14		12.941		75	693	
alls Type1	05.6		0.00			=		=		<u></u>		= =	=
	35.2		8.96		26.32	=	0.16	_	4.21		60	1579	=
alls Type2	82.4		0		82.44	_	0.15	=	12.34		60	494	
otal area of	eiements	, m²			210.1	6							(
arty wall					15.98	×	0	=	0		45	719	0.1
arty ceiling					92.44						30	277	3.2
ternal wall *					154.4						9	1389	.96
or windows an include the are						ated using	g formula 1	/[(1/U-valu	ıe)+0.04] á	as given ir	n paragraph	n 3.2	
abric heat lo				is anu pan	uuons		(26)(30)	+ (32) =				38.93	
eat capacity		,	0)						(30) + (32	2) + (32a)	(32e) =	18340.86	
nermal mas		,	P = Cm -	- TFA) ir	n k.l/m²K			,	÷ (4) =	_, . (0_ 0,	(020)	198.41	==(
r design asses	•	,		•			recisely the	` '		TMP in T	able 1f	190.41	'
n be used inst						,							
nermal bridg	ges : S (L	x Y) cal	culated (using Ap	pendix l	<						14.76	
letails of therm		are not kn	own (36) =	= 0.05 x (3	1)			(0.0)	(0.0)			<u> </u>	
otal fabric h									(36) =			53.69	
entilation he		i –					1 .	<u> </u>	= 0.33 × (·	<u> </u>	1	
	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec 41.94		
Jan	44 ~ 4				41.94	41.94	41.94	41.94	41.94	41.94	4104	I	(
3)m= 41.94	41.94	41.94	41.94	41.94	41.54	41.94	41.94	41.94	11.04	1	41.94	l	,
	coefficie		95.64	41.94	95.64	95.64	95.64		= (37) + (<u> </u>	95.64	1	

leat loss para	meter (H	HLP), W/	m²K					(40)m	= (39)m ÷	- (4)			
1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03		
lumber of day	s in moi	oth (Tabl	lo 10)		<u>!</u>			,	Average =	Sum(40) ₁ .	12 /12=	1.03	(40)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
11)m= 31	28	31	30	31	30	31	31	30	31	30	31		(41)
4. Water heat	ing enei	rgy requi	rement:								kWh/ye	ear:	
ssumed occu if TFA > 13.9 if TFA £ 13.9	N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9)2)] + 0.0	0013 x (¯	TFA -13		66		(42)
nnual averag deduce the annua ot more that 125	l average	hot water	usage by	5% if the c	lwelling is	designed t			se target o		.32		(43
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
lot water usage ir	i litres per	day for ea	nch month	Vd,m = fa	ctor from	Table 1c x	(43)						
14)m= 107.05	103.16	99.27	95.37	91.48	87.59	87.59	91.48	95.37	99.27	103.16	107.05	4407.04	
nergy content of	hot water	used - cal	culated mo	onthly = 4 .	190 x Vd,r	n x nm x E	0Tm / 3600			m(44) ₁₁₂ = ables 1b, 1	L	1167.84	(44
158.75 lbin=	138.85	143.28	124.91	119.86	103.43	95.84	109.98	111.29	129.7	141.58	153.75		
					. ,				Total = Su	m(45) ₁₁₂ =	:	1531.22	(45
instantaneous w									1	ı			
Vater storage	20.83 loss:	21.49	18.74	17.98	15.51	14.38	16.5	16.69	19.46	21.24	23.06		(46
torage volum		includin	g any so	olar or W	/WHRS	storage	within sa	ame ves	sel	0			(47
community h	_			-			' '						
Otherwise if no Vater storage		hot wate	er (this in	ıcludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in (47)			
a) If manufacti		eclared l	oss facto	or is kno	wn (kWł	n/day):				0.	54		(48
emperature fa					`	• ,					072		(49
nergy lost fro	m water	storage	, kWh/ye	ear			(48) x (49)) =			0		(50
o) If manufacti			-										/ =.
lot water stora community h	•			e∠(Kvv	n/iitre/da	ıy)					0		(51
olume factor	_										0		(52
emperature fa	actor fro	m Table	2b								0		(53
nergy lost fro	m water	storage	, kWh/ye	ear			(47) x (51)) x (52) x (53) =		0		(54
Enter (50) or (54) in (5	55)								0.	91		(55
Vater storage	loss cal	culated f	or each	month			((56)m = (55) × (41)ı	m				
66)m= 28.12 cylinder contains	25.4 dedicate	28.12 d solar sto	27.22 rage, (57)ı	28.12 n = (56)m	27.22 x [(50) – (28.12 H11)] ÷ (5	28.12 0), else (5	27.22 7)m = (56)	28.12 m where (27.22 H11) is fro	28.12 m Appendi	хН	(56
57)m= 28.12	25.4	28.12	27.22	28.12	27.22	28.12	28.12	27.22	28.12	27.22	28.12		(57
rimary circuit		<u> </u>			ļ	Į	<u> </u>	ļ	ļ		0		(58
rimary circuit	•	•			59)m = ((58) ÷ 36	65 × (41)	m			~		(50
(modified by	factor fo	rom Tabl	le H5 if t	here is	solar wat	er heatii	ng and a	cylinde	r thermo	stat)			
9)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59

Combi loss calculate	d for each	n month ((61)m =	(60) ÷ 3	65 × (41))m						
(61)m= 0 0	0	0	0	0	0	0	T 0	0	T 0	0	1	(61)
Total heat required f	 or water h	eating ca	L alculated	for eac	L h month	(62)m	= 0.85 × 0	/45)m +	. (46)m +	(57)m +	l (59)m + (61)m	
(62)m= 186.88 164.2		152.13	147.98	130.64	123.96	138.1		157.82	ì ´	181.87		(62)
Solar DHW input calculat			<u> </u>								l	` '
(add additional lines										,g/		
(63)m= 0 0	0	0	0	0	0	0	0	0	0	0		(63)
Output from water h	eater	!	<u>I</u>		!			<u> </u>	-1		1	
(64)m= 186.88 164.2		152.13	147.98	130.64	123.96	138.1	138.51	157.82	168.79	181.87		
	-	!	ļ		<u> </u>	0	utput from w	ater heat	_ I er (annual)₁	12	1862.34	(64)
Heat gains from wat	er heating	, kWh/m	onth 0.2	5 ′ [0.85	× (45)m	+ (61)	m] + 0.8 x	([(46)m	n + (57)m	+ (59)m	1	•
(65)m= 52.79 46.17		41.53	39.85	34.39	31.87	36.57	-	43.13	47.07	51.12	ĺ	(65)
include (57)m in c	alculation	of (65)m	only if c	vlinder i	s in the o	dwellin	a or hot w	ater is	from com	munity h	ı ıeating	
5. Internal gains (s							9			· .,	Jan J	
Metabolic gains (Tal			,									
Jan Fel		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m= 132.88 132.8	8 132.88	132.88	132.88	132.88	132.88	132.88	3 132.88	132.88	132.88	132.88		(66)
Lighting gains (calcu	lated in A	ppendix	L, equat	on L9 o	r L9a), a	lso se	e Table 5		•	•	ı	
(67)m= 25.23 22.4°	18.22	13.8	10.31	8.71	9.41	12.23	16.41	20.84	24.33	25.93	1	(67)
Appliances gains (ca	lculated ir	n Append	dix L, eq	uation L	13 or L1	3a), al	so see Ta	ble 5	-!		I	
(68)m= 243.5 246.0		226.1	208.99	192.91	182.16	179.6		199.56	216.67	232.75		(68)
Cooking gains (calcu	ılated in A	ppendix	L, equat	ion L15	or L15a), also	see Table	5			I	
(69)m= 36.29 36.29		36.29	36.29	36.29	36.29	36.29		36.29	36.29	36.29		(69)
Pumps and fans gai	ns (Table :	5a)			•	•					I	
(70)m= 0 0	0	0	0	0	0	0	0	0	0	0		(70)
Losses e.g. evapora	tion (nega	tive valu	es) (Tab	le 5)	•	•					I	
(71)m= -106.31 -106.3	- ` ` 	-106.31	-106.31	-106.31	-106.31	-106.3	1 -106.31	-106.31	-106.31	-106.31		(71)
Water heating gains	(Table 5)	!	<u> </u>		<u>!</u>	<u> </u>		<u>[</u>	-1	<u>!</u>	1	
(72)m= 70.95 68.7	64.03	57.69	53.57	47.76	42.83	49.15	51.4	57.96	65.38	68.71		(72)
Total internal gains	=	<u> </u>	<u> </u>	(66))m + (67)m	1 + (68)n	n + (69)m + ((70)m + ()m	1	
(73)m= 402.54 400	384.78	360.45	335.73	312.24	297.27	303.88	3 316.68	341.23	369.24	390.26		(73)
6. Solar gains:	1	1										
Solar gains are calculate	ed using sola	ır flux from	Table 6a	and assoc	iated equa	itions to	convert to th	e applica	ıble orientat	tion.		
Orientation: Access		Area		Flu			g _		FF		Gains	
Table (6d	m²		Ta	ble 6a		Table 6b	_	Table 6c		(W)	
Northeast _{0.9x} 0.	77 ×	3.8	35	X 1	11.28	x [0.63	x [0.7	=	13.28	(75)
Northeast _{0.9x} 0.	77 X	3.8	35	x 2	22.97	x [0.63	x	0.7	=	27.02	(75)
Northeast 0.9x 0.	77 X	3.8	35	X Z	11.38	x	0.63	x [0.7	=	48.69	(75)
Northeast 0.9x 0.	77 ×	3.8	35	x (67.96	x	0.63	x [0.7		79.96	(75)
Northeast 0.9x 0.	77 X	3.8	35	x (91.35	x	0.63	x [0.7	=	107.48	(75)

N1464 -		_					, ,		_				- 1
Northeast _{0.9x}	0.77	×	3.8	35	X	97.38	X	0.63	X	0.7	=	114.58	(75)
Northeast _{0.9x}	0.77	X	3.8	35	X	91.1	X	0.63	X	0.7	=	107.19	(75)
Northeast _{0.9x}	0.77	X	3.8	35	X	72.63	X	0.63	X	0.7	=	85.45	(75)
Northeast _{0.9x}	0.77	X	3.8	35	X	50.42	X	0.63	X	0.7	=	59.33	(75)
Northeast _{0.9x}	0.77	X	3.8	35	X	28.07	X	0.63	X	0.7	=	33.02	(75)
Northeast _{0.9x}	0.77	X	3.8	35	X	14.2	X	0.63	X	0.7	=	16.7	(75)
Northeast _{0.9x}	0.77	X	3.8	35	x	9.21	x	0.63	X	0.7	=	10.84	(75)
Northwest 0.9x	0.77	X	5.1	1	X	11.28	x	0.63	X	0.7	=	17.62	(81)
Northwest 0.9x	0.77	X	5.1	1	x	22.97	X	0.63	X	0.7	=	35.87	(81)
Northwest 0.9x	0.77	X	5.1	1	x	41.38	x	0.63	X	0.7	=	64.62	(81)
Northwest _{0.9x}	0.77	X	5.1	1	X	67.96	x	0.63	X	0.7	=	106.13	(81)
Northwest _{0.9x}	0.77	X	5.1	1	x	91.35	x	0.63	x	0.7		142.65	(81)
Northwest 0.9x	0.77	x	5.1	1	х	97.38	x	0.63	x	0.7	-	152.08	(81)
Northwest 0.9x	0.77	x	5.1	1	х	91.1	х	0.63	x	0.7		142.27	(81)
Northwest 0.9x	0.77	x	5.1	1	х	72.63	x	0.63	x	0.7		113.42	(81)
Northwest 0.9x	0.77	×	5.1	1	x	50.42	j x	0.63	×	0.7	_ =	78.74	(81)
Northwest 0.9x	0.77	×	5.1	1	x	28.07	X	0.63	x	0.7	= =	43.83	(81)
Northwest 0.9x	0.77	x	5.1	1	x	14.2	X	0.63	x	0.7	=	22.17	(81)
Northwest _{0.9x}	0.77	X	5.1	1	x	9.21] _x	0.63	×	0.7		14.39	(81)
							J 1						
Solar gains in	watts, calcu	ulated	for eacl	h month			(83)m	ı = Sum(74)m .	(82)m				
(83)m= 30.9	· · ·	13.31	186.08	250.13	266.67	249.46	198	.87 138.07	76.86	38.88	25.23		(83)
Total gains – i	nternal and	solar	(84)m =	= (73)m	+ (83)m	, watts	•	•		•	•		
(84)m= 433.44	462.89 49	98.08	546.53	585.86	578.91	546.73	502	.76 454.75	418.09	408.12	415.49		(84)
7. Mean inter	nal tempera	ature ((heating	season)								
Temperature			`		<i>'</i>	from Tal	ble 9,	Th1 (°C)				21	(85)
Utilisation fac	tor for gain	s for li	iving are	ea, h1,m	(see T	able 9a)		, ,					
Jan	 	Mar	Apr	May	Jun	Jul	Aı	ug Sep	Oct	Nov	Dec		
(86)m= 1	1 (0.99	0.98	0.94	0.84	0.7	0.7	6 0.93	0.99	1	1		(86)
Mean interna	l temperatu	ıre in l	iving are	ea T1 (fo	ollow sta	ens 3 to 7	7 in T	able 9c)		!			
(87)m= 21	21	21	21	21	21	21	2		21	21	21		(87)
	ll	!				!	- - - -		<u> </u>		!		
Temperature (88)m= 20.05	<u>_</u>	10.05	20.05	20.05	20.05	20.05	20.0	` 	20.05	20.05	20.05		(88)
		!					<u> </u>	20.03	20.00	20.03	20.03		(00)
Utilisation fac		- 1			T	1	T –				T	Ī	(00)
(89)m= 1	1 (0.99	0.98	0.92	0.77	0.58	0.6	0.9	0.98	1	1		(89)
Mean interna	l temperatu	ıre in t	he rest	of dwell	ing T2 (follow ste	eps 3	to 7 in Tabl	e 9c)	_		•	
(90)m= 20.05	20.05 2	20.05	20.05	20.05	20.05	20.05	20.0		20.05		20.05		(90)
								1	LA = Liv	ring area ÷ (4) =	0.3	(91)
Mean interna	l temperatu	ıre (fo	r the wh	ole dwe	lling) =	fLA × T1	+ (1	– fLA) × T2					
Mean interna (92)m= 20.34		ure (fo	r the wh	ole dwe	lling) =	fLA × T1	+ (1		20.34	20.34	20.34		(92)
	20.34 2	20.34	20.34	20.34	20.34	20.34	20.	34 20.34	l		20.34		(92)

(02)	20.24	20.24	20.24	20.24	20.24	20.24	20.24	00.04	20.24	20.24	20.24	20.24	1	(93)
(93)m=	20.34	20.34	20.34	20.34	20.34	20.34	20.34	20.34	20.34	20.34	20.34	20.34		(93)
			uirement		1.4.		44 6	T		· T' '	70)		1.4	
			ernal ter or gains	•		ed at ste	ep 11 of	i able 9i	o, so tha	t II,m=(76)m an	d re-calc	culate	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisa	ation fac	tor for g	ains, hm	1:										
(94)m=	1	1	0.99	0.98	0.93	0.8	0.62	0.69	0.91	0.99	1	1		(94)
Usefu	ıl gains,	hmGm	W = (94)	4)m x (8	4)m									
(95)m=	432.45	461.27	494.43	534.66	544	461.57	337.77	344.89	414.39	412	406.51	414.72		(95)
Month	nly avera	age exte	rnal tem	perature	from Ta	able 8		-	-		-	-		
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat	loss rate	for mea	an intern	al tempe	erature,	Lm , W =	=[(39)m :	x [(93)m	– (96)m]				
(97)m=	1533.89	1476.5	1323.48	1093.95	826.17	548.82	357.54	376.67	596.64	931.37	1266.1	1543.45		(97)
Space	e heatin	g require	ement fo	r each n	nonth, k\	Wh/mon	th = 0.02	24 x [(97)m – (95)m] x (4	1)m		•	
(98)m=	819.47	682.24	616.81	402.69	209.93	0	0	0	0	386.41	618.9	839.78		
'								Tota	l per year	(kWh/yeaı	r) = Sum(9	8)15,912 =	4576.24	(98)
Snace	- heatin	a require	ement in	kWh/m²	?/vear								49.5] (99)
		• •											49.5	
			nts – Indi	ividual h	eating sy	ystems i	ncluding	micro-C	CHP)					
-	e heatir	•			./							1		7(004)
			at from so			mentary	-						0	(201)
Fracti	on of sp	ace hea	at from m	nain syst	em(s)			(202) = 1	- (201) =				1	(202)
Fracti	on of to	tal heati	ng from	main sys	stem 1			(204) = (2	02) x [1 –	(203)] =			1	(204)
Efficie	ency of r	nain spa	ace heat	ing syste	em 1								292.62	(206)
Efficie	ency of s	seconda	ry/suppl	ementar	y heating	g system	ո, %						0	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ar
Space	e heatin	g require	ement (c	alculate	d above))								
	819.47	682.24	616.81	402.69	209.93	0	0	0	0	386.41	618.9	839.78		
(211)m	n = {[(98)m x (20	(4)] } x 1	00 ÷ (20	06)		=	-	-		-	-	•	(211)
,	280.05	233.15	210.79	137.62	71.74	0	0	0	0	132.05	211.5	286.99		
				<u> </u>			<u>I</u>	Tota	l (kWh/yea	ar) =Sum(2	1 211) _{15.1012}		1563.88	(211)
Snace	a haatin	a fual (e	econdar	v) k\//h/	month						,]`
•		• '	00 ÷ (20	• •	monun									
(215)m=		0	0	0	0	0	0	0	0	0	0	0		
(-7		_							l (kWh/yea	ar) =Sum(2	1 215), _{540 4} ,	=	0	(215)
14/-4	l4:									(- /15,1012			(=:0)
	heating		ter (calc	ulated a	hovo)									
Output	186.88	164.25	171.4	152.13	147.98	130.64	123.96	138.1	138.51	157.82	168.79	181.87		
Efficier		ater hea											207.67	(216)
(217)m=		207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	201.01	(217)
` ′					207.07	207.07	207.07	207.07	207.07	207.07	207.07	207.07		(211)
		•	kWh/mo (217) ÷ (
(219)m=		79.09	82.54	73.26	71.26	62.91	59.69	66.5	66.7	76	81.28	87.58		
<i>*</i>			I					Tota	l = Sum(2	19a) ₁₁₂ =	l		896.78	(219)
Annua	ıl totals								•		Wh/year		kWh/year	」 ` ⁻′
		fuel use	ed, main	system	1					ĸ	, cai		1563.88	1
•	3			•									<u> </u>	J

					_
Water heating fuel used				896.78	
Electricity for pumps, fans and electric keep-hot					
mechanical ventilation - balanced, extract or pos	itive input from outside		266.28]	(230a)
Total electricity for the above, kWh/year	sum of (2	(30a)(230g) =		266.28	(231)
Electricity for lighting				445.58	(232)
Electricity generated by PVs				-932.71	(233)
Total delivered energy for all uses (211)(221) +	(231) + (232)(237b) =			2239.81	(338)
12a. CO2 emissions – Individual heating system	s including micro-CHP				
	Energy kWh/year	Emission fa kg CO2/kWh		Emissions kg CO2/yea	r
Space heating (main system 1)	(211) x	0.519	=	811.66	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	465.43	(264)
Space and water heating	(261) + (262) + (263) + (264)	=		1277.08	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	138.2	(267)
Electricity for lighting	(232) x	0.519	=	231.25	(268)
Energy saving/generation technologies Item 1		0.519	=	-484.08	(269)
					_
Total CO2, kg/year	s	sum of (265)(271) =		1162.46	(272)

El rating (section 14)

89

(274)

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 10:59:43

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:**

Flat

Total Floor Area: 52.98m²

Dwelling Details:

Site Reference:

NEW DWELLING DESIGN STAGE

Plot Reference: 231 Watford Road - GREEN Sample 4

Address:

Client Details:

Name: Address:

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity

Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER) 25.05 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 7.90 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 35.9 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 27.6 kWh/m²

OK

2 Fabric U-values

Element Average Highest 0.16 (max. 0.70) External wall 0.15 (max. 0.30) OK Party wall 0.00 (max. 0.20) **OK**

Floor (no floor) Roof (no roof)

Openings 1.10 (max. 2.00) OK 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 3.50 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system:

Heat pumps with radiators or underfloor heating - electric

NIBE Fighter 360

Secondary heating system: None

5 Cylinder insulation

No Separate Cylinder Hot water Storage:

N/A

6 Controls		
Space heating controls Hot water controls: TTZC by plumbing No cylinder thermos No cylinder	and electrical services stat	ок
7 Low energy lights		
Percentage of fixed lights with low-energy fittings Minimum	100.0% 75.0%	ОК
8 Mechanical ventilation		
Continuous extract system Specific fan power: Maximum	1.05 0.7	Fail
9 Summertime temperature		
Overheating risk (Thames valley): Based on: Overshading: Windows facing: South East Ventilation rate:	Slight Average or unknown 6.39m² 6.00	OK
ventuation rate.	0.00	
10 Key features		
Air permeablility Windows U-value Party Walls U-value Photovoltaic array	3.5 m³/m²h 1.1 W/m²K 0 W/m²K	

Assessor Name: Neil Ingham Stroma Number: STRO010943 Software Name: Stroma FSAP 2012 Software Version: Version: 1.0.5.41
Software Name: Stroma FSAP 2012 Software Version: Version: 1.0.5.41 Property Address: Sample 4 Address: 1. Overall dwelling dimensions: Area(m²) Av. Height(m) Volume(m³) Ground floor 52.98 (1a) X 2.75 (2a) 145.69 (5) Dwelling volume (3a)+(3b)+(3c)+(3d)+(3e)+(3n) 145.69 (5) 2. Ventilation rate: main heating heating heating heating may per hour heating Number of chimneys 0 x 40 0 (6a) Number of open flues 0 x 10 0 (6a) Number of intermittent fans 0 x 10 0 (7a) Number of passive vents 0 x 10 0 (7a) </td
Address: 1. Overall dwelling dimensions: Area(m²)
Area(m²)
Area(m²)
Ground floor 52.98 (1a) x 2.75 (2a) = 145.69 (3a) Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+(1n) 52.98 (4) Dwelling volume $(3a)+(3b)+(3c)+(3d)+(3e)+(3n) = 145.69$ (5) 2. Ventilation rate: Main heating 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 0 x 10 = 0 (7a) Number of passive vents 0 x 10 = 0 (7b)
Total floor area TFA = $(1a)+(1b)+(1c)+(1d)+(1e)+(1n)$ Dwelling volume $(3a)+(3b)+(3c)+(3d)+(3e)+(3n) = 145.69 $ (5) 2. Ventilation rate: $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$
Dwelling volume $ (3a)+(3b)+(3c)+(3d)+(3e)+(3n) = 145.69 $ (5) $ \hline $
2. Ventilation rate: main heating heating 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 Number of passive vents 0 x 10 = 0 (7a)
Number of chimneys 0 + 0 + 0 + 0 = 0 x 40 = 0 (6a) Number of open flues 0 + 0 + 0 = 0 x 20 = 0 (6b) Number of intermittent fans 0 x 10 = 0 (7a) Number of passive vents 0 x 10 = 0 (7b)
Number of chimneys 0 + 0 + 0 + 0 = 0 x 40 = 0 (6a) Number of open flues 0 + 0 + 0 = 0 x 20 = 0 (6b) Number of intermittent fans 0 x 10 = 0 (7a) Number of passive vents 0 x 10 = 0 (7b)
Number of open flues 0 + 0 + 0 = 0
Number of intermittent fans $ \begin{array}{c ccccc} 0 & x & 10 & = & 0 & (7a) \\ \hline Number of passive vents & 0 & x & 10 & = & 0 & (7b) \end{array} $
Number of passive vents 0 x 10 = 0 (7b)
Air changes per hour
Infiltration due to chimneys, flues and fans = $(6a)+(6b)+(7a)+(7b)+(7c) =$ 0 \div (5) = 0 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16) Number of storeys in the dwelling (ns) 0 (9)
Number of storeys in the dwelling (ns) Additional infiltration [(9)-1]x0.1 = 0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)
If no draught lobby, enter 0.05, else enter 0
Percentage of windows and doors draught stripped 0 (14)
Window infiltration $0.25 - [0.2 \times (14) \div 100] = 0 \tag{15}$
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 3.5 (17) If based on air permeability value, then $(18) = [(17) \div 20] + (8)$, otherwise $(18) = (16)$ 0.18
If based on air permeability value, then $(18) = [(17) \div 20] + (8)$, otherwise $(18) = (16)$ Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used
Number of sides sheltered 0 (19)
Shelter factor $(20) = 1 - [0.075 \times (19)] = 1$ (20)
Infiltration rate incorporating shelter factor $(21) = (18) \times (20) = 0.18$ (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 $(22a)m = (22)m \div 4$
(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 infiltra	ation rat	e (allowi	ng for sh	nelter an	d wind s	speed) =	(21a) x	(22a)m					
0.22	0.22	0.21	0.19	0.19	0.17	0.17	0.16	0.18	0.19	0.2	0.21]	
Calculate effect		_	rate for t	he appli	cable ca	se	-	-	-			0.5	(23a)
If exhaust air he			endix N, (2	3b) = (23a	a) × Fmv (e	equation (I	N5)) , othe	rwise (23b) = (23a)			0.5	(23b)
If balanced with		0 11		, ,	, ,	. ,	,, .	`	, , ,			0.5	(23c)
a) If balance	d mecha	anical ve	ntilation	with he	at recove	erv (MVI	HR) (24a	a)m = (2)	2b)m + (23b) x [1 – (23c)		(200)
(24a)m= 0	0	0	0	0	0	0	0	0	0	0	0]	(24a)
b) If balance	d mech	anical ve	ntilation	without	heat red	overy (N	лV) (24t	m = (22)	2b)m + (23b)	·	•	
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0]	(24b)
c) If whole h if (22b)n				•					.5 × (23b	D)	•	•	
(24c)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5]	(24c)
d) If natural if (22b)n									0.5]	•	•	•	
(24d)m= 0	0	0	0	0	0	0	0	0	0	0	0]	(24d)
Effective air	change	rate - er	iter (24a) or (24b	o) or (24	c) or (24	d) in box	(25)				_	
(25)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(25)
3. Heat losse	s and he	eat loss p	paramete	er:									
ELEMENT	Gros	·	Openin		Net Ar	ea	U-val	ıe	AXU		k-value		ΑΧk
	area	(m²)	m	²	A ,r		W/m2		(W/	K)	kJ/m²-	K	kJ/K
Windows					6.39	x1	/[1/(1.1)+	0.04] =	6.73	ᆜ .			(27)
Walls Type1	22.1	7	6.39		15.78	3 X	0.16	=	2.52		60	94	6.8 (29)
Walls Type2	17.2	22	0		17.22	2 x	0.15	=	2.58		60	103	33.2 (29)
Total area of e	lements	, m²			39.39								(31)
Party wall					46.48	3 X	0	=	0		45	209	1.6 (32)
Party floor					52.98	3					40	211	9.2 (32a)
Party ceiling					52.98	3					30	158	(32b)
Internal wall **					97.63	3					9	878	3.67 (32c)
* for windows and ** include the area						ated using	formula 1	/[(1/U-valu	ıe)+0.04] a	as given in	paragraph	1 3.2	
Fabric heat los				is anu pan	uuoris		(26)(30)	+ (32) =				11.84	(33)
Heat capacity		•	0)				, , , ,		(30) + (32	2) + (32a).	(32e) =	8658.87	
Thermal mass		,	P = Cm -	- TFA) ir	n kJ/m²K			,,,,,	÷ (4) =	_,	(/	163.44	(35)
For design assess	•	`		,			ecisely the	` '	. ,	TMP in T	able 1f	100.44	(00)
can be used inste													
Thermal bridge	•	,			•	<						6.45	(36)
if details of therma Total fabric he		are not kn	own (36) =	= 0.05 x (3	1)			(33) +	(36) =			18.29	(37)
Ventilation hea	at loss ca	alculated	l monthly	/				(38)m	= 0.33 × ((25)m x (5))	10.20	`` ′
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec]	
(38)m= 24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	1	(38)
Heat transfer of	coefficier	nt, W/K					•	(39)m	= (37) + (38)m	•	•	
(39)m= 42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33]	
							•		- Δverage –	Sum(39) ₁	/12-	42.33	(39)

Heat loss para	meter (l	HLP). W/	m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8		
()										Sum(40) ₁ .		0.8	(40)
Number of day	s in mo	nth (Tabl	e 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)
							Į.		·				
4. Water heat	ing one	rav roqui	romont:								kWh/ye	or:	
4. Water near	ing ene	igy requi	rement.								KVVII/ye	tai.	
Assumed occu if TFA > 13.9 if TFA £ 13.9	0, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9)2)] + 0.0	0013 x (⁻	TFA -13		78		(42)
Annual average Reduce the annual									se target o		.43		(43)
not more that 125	litres per	person per	day (all w	ater use, l	hot and co	ld)							
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in	litres pe	day for ea	ch month	Vd,m = fa	ctor from	Table 1c x	(43)		-		-		
(44)m= 84.07	81.01	77.96	74.9	71.84	68.78	68.78	71.84	74.9	77.96	81.01	84.07		
							•			m(44) ₁₁₂ =		917.12	(44)
Energy content of	hot water	used - cal	culated mo	onthly = 4.	190 x Vd,r	n x nm x C	OTm / 3600) kWh/mor	nth (see Ta	ables 1b, 1	c, 1d)		
(45)m= 124.67	109.04	112.52	98.1	94.13	81.22	75.27	86.37	87.4	101.86	111.18	120.74		_
									Total = Su	m(45) ₁₁₂ =	=	1202.49	(45)
If instantaneous wa	ater neati	ng at point	of use (no	not water	r storage),	enter 0 in	boxes (46)) to (61)		,	1		
(46)m= 18.7	16.36	16.88	14.71	14.12	12.18	11.29	12.96	13.11	15.28	16.68	18.11		(46)
Water storage Storage volume		\ inaludin	a 001/0	olor or M	WHDC	otorogo	within or	ama vaa	ool		1		(47)
•	` '		•			•		airie ves	SEI	0			(47)
If community he Otherwise if no	•			•			` '	ers) ente	er '∩' in <i>(</i>	47)			
Water storage		not wate	/ (tillo li	1014465 1	motantai	10000 00	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	ora, oric	31 0 111 ((77)			
a) If manufactu		eclared l	oss facto	or is kno	wn (kWł	n/day):				0.	54		(48)
Temperature fa	actor fro	m Table	2b		•	- ,				0.9	072		(49)
Energy lost from				ear			(48) x (49)) =			0		(50)
b) If manufactu		_	-		or is not	known:					0		()
Hot water stora	-			e 2 (kW	h/litre/da	ıy)					0		(51)
If community h	_		on 4.3								-		
Volume factor f			OL								0		(52)
Temperature fa											0		(53)
Energy lost from		_	, kWh/ye	ear			(47) x (51)) x (52) x (53) =	-	0		(54)
Enter (50) or (, ,	,								0.	91		(55)
Water storage	loss cal	culated f	or each	month			((56)m = (55) × (41)ı	m 				
(56)m= 28.12	25.4	28.12	27.22	28.12	27.22	28.12	28.12	27.22	28.12	27.22	28.12		(56)
If cylinder contains	dedicate	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Append	ix H	
(57)m= 28.12	25.4	28.12	27.22	28.12	27.22	28.12	28.12	27.22	28.12	27.22	28.12		(57)
Primary circuit	•	•									0		(58)
Primary circuit				,	•	. ,	, ,						
(modified by				i	i	i				<u> </u>			(EO)
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

0 111				(0.4)	(00)	o= (44)							
Combi loss o				,	` '	<u> </u>		Т.		Ι.		1	(04)
(61)m= 0	0	0	0	0	0	0	0	0	0	0	0	J	(61)
							`		ì '	ì ´	r` ´ 	(59)m + (61)m	
(62)m= 152.8		140.64	125.31	122.25	108.44	103.39	114.49		129.98	138.4	148.86	J	(62)
Solar DHW inpu									r contribut	ion to wate	er heating)		
(add addition						 		 			1	1	
(63)m= 0	0	0	0	0	0	0	0	0	0	0	0	J	(63)
Output from	water hea	ter										1	
(64)m= 152.8	134.44	140.64	125.31	122.25	108.44	103.39	114.49	114.62	129.98	138.4	148.86		-
							Ou	tput from w	ater heate	r (annual) ₁	12	1533.62	(64)
Heat gains fr	om water	heating,	kWh/mo	onth 0.2	5 ´ [0.85	× (45)m	+ (61)	m] + 0.8 x	k [(46)m	+ (57)m	+ (59)m]	
(65)m= 41.45	36.26	37.41	32.62	31.3	27.01	25.03	28.72	29.06	33.87	36.97	40.15		(65)
include (57	7)m in cald	culation c	of (65)m	only if c	ylinder i	s in the	dwelling	or hot w	ater is f	rom com	munity h	neating	
5. Internal	gains (see	Table 5	and 5a):									
Metabolic ga	,												
Jan		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec]	
(66)m= 88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	1	(66)
Lighting gain	s (calcula	ted in Ap	pendix	L, equat	on L9 o	r L9a), a	lso see	Table 5				1	
(67)m= 15.32	13.6	11.06	8.38	6.26	5.29	5.71	7.42	9.96	12.65	14.77	15.74]	(67)
Appliances g	ains (calc	ulated in	Append	dix L, eq	uation L	13 or L1	3a), als	o see Ta	ble 5	•	•	•	
(68)m= 154.9°	7 156.57	152.52	143.9	133.01	122.77	115.93	114.32	118.38	127	137.89	148.13]	(68)
Cooking gair	ns (calcula	ıted in Ar	pendix	L. eguat	ion L15	or L15a), also s	see Table	5			•	
(69)m= 31.89	_`	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	1	(69)
Pumps and f	ans gains	(Table 5	a)			<u> </u>	I		<u> </u>	l		ı	
(70)m= 0	0	0	0	0	0	0	0	0	0	0	0	1	(70)
Losses e.g. e	evaporatio	n (negat	ive valu	es) (Tab	le 5)	<u>!</u>	l		<u> </u>		<u> </u>	J	
(71)m= -71.12	 	-71.12	-71.12	-71.12	-71.12	-71.12	-71.12	-71.12	-71.12	-71.12	-71.12]	(71)
Water heatin	n nains (T	I able 5)				<u> </u>	<u> </u>		!		!	J	
(72)m= 55.72		50.29	45.3	42.07	37.51	33.64	38.6	40.36	45.52	51.35	53.96	1	(72)
` '			10.0	12.01		<u> </u>		+ (69)m +		l	<u> </u>	J	(- –)
(73)m= 275.6		263.54	247.24	231	215.24	204.95	210.02	- ` 	234.85	253.68	267.5	1	(73)
6. Solar gai		203.34	241.24	201	210.24	204.93	210.02	210.57	234.03	200.00	207.5		(10)
Solar gains are		usina solar	flux from	Table 6a :	and assoc	iated equa	itions to a	convert to th	ne annlicat	ale orientat	tion		
Orientation:		•	Area		Flu	•		g_	о арриоа	FF		Gains	
Onemation.	Table 6d		m ²			ble 6a		9_ Table 6b	Т	able 6c		(W)	
Southeast 0.9x	0.77	x	6.3	39	x :	36.79) x [0.63	x [0.7		71.85	(77)
Southeast 0.9x		X	6.3		—	62.67)	0.63		0.7	= =	122.39](77)
Southeast 0.9x	• • • • • • • • • • • • • • • • • • • •	×	6.3			35.75	」^ <u>└</u>]	0.63	^	0.7		167.46](77)
Southeast 0.9x	<u> </u>	×	6.3			06.25	」^ <u>└</u>]x	0.63	^	0.7	-	207.5](77)
Southeast 0.9x		_			-		┆ ⊨		⊣		=		╡
Journedal (J.9)	0.77	X	6.3	9	x 1	19.01	X	0.63	X	0.7	=	232.41	(77)

Southeast 0.9x 0.77	X	6.3	9	x ·	118.15] x [0.63	x	0.7	=	230.73	(77)
Southeast 0.9x 0.77	X	6.3	9	x ·	113.91	x	0.63	x	0.7	=	222.45	(77)
Southeast 0.9x 0.77	X	6.3	9	X ·	104.39	_ x [0.63	x	0.7	=	203.86	(77)
Southeast 0.9x 0.77	X	6.3	9	x	92.85] x [0.63	x	0.7	=	181.33	(77)
Southeast 0.9x 0.77	X	6.3	9	x	69.27] x [0.63	x	0.7	=	135.27	(77)
Southeast 0.9x 0.77	X	6.3	9	x	44.07] x	0.63	x	0.7	=	86.06	(77)
Southeast 0.9x 0.77	X	6.3	9	x	31.49] x [0.63	x	0.7	=	61.49	(77)
Solar gains in watts, c					T	1 	= Sum(74)m .	<u> </u>			Ī	(00)
(83)m= 71.85 122.39	167.46	207.5	232.41	230.73		203.8	6 181.33	135.27	86.06	61.49		(83)
Total gains – internal a	431	454.74	463.41	445.97	427.4	413.8	8 399.7	370.12	339.74	328.99]	(84)
` '				l	427.4	413.0	0 399.7	370.12	339.74	320.99		(04)
7. Mean internal temp		_					- 1 (2.0)					_
Temperature during h	•			•		ble 9,	Th1 (°C)				21	(85)
Utilisation factor for g				r `	1 	1	- 0	0-4	Nan	Data]	
Jan Feb	Mar	Apr	May	Jun	Jul	Aug		Oct	Nov	Dec		(86)
(86)m= 0.98 0.97	0.94	0.87	0.75	0.58	0.43	0.46	0.68	0.89	0.97	0.99		(00)
Mean internal temper	1		,	I	i 	1			T		1	(07)
(87)m= 21 21	21	21	21	21	21	21	21	21	21	21		(87)
Temperature during h	, , ,			r .	`	1	`				Ī	
(88)m= 20.25 20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25		(88)
Utilisation factor for g	ains for r	est of d	welling,	h2,m (s	ee Table	9a)			_		•	
(89)m= 0.98 0.96	0.93	0.85	0.71	0.52	0.36	0.39	0.62	0.87	0.96	0.98		(89)
Mean internal temper	ature in t	he rest	of dwell	ng T2 (follow ste	eps 3 t	o 7 in Tab	le 9c)	_		_	
(90)m= 20.25 20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25		(90)
							f	fLA = Livir	ng area ÷ (4) =	0.4	(91)
Mean internal temper	ature (fo	r the wh	ole dwe	lling) =	fLA × T1	+ (1 –	fLA) × T2					
(92)m= 20.56 20.56	20.56	20.56	20.56	20.56	20.56	20.56	20.56	20.56	20.56	20.56		(92)
Apply adjustment to t	i i		•	ì	1	1		·			1	
(93)m= 20.56 20.56	20.56	20.56	20.56	20.56	20.56	20.56	20.56	20.56	20.56	20.56		(93)
8. Space heating require						Table	Ob as the	.t T: /	70\	-ll-	lata	
Set Ti to the mean in the utilisation factor for				ied at s	тер ттог	rabie	9b, so tha	it 11,ff1=(ro)m an	id re-caid	culate	
Jan Feb	Mar	Apr	May	Jun	Jul	Aug	g Sep	Oct	Nov	Dec		
Utilisation factor for g	ains, hm	:			•		•		•		•	
(94)m= 0.98 0.96	0.93	0.86	0.73	0.55	0.39	0.42	0.64	0.88	0.96	0.98		(94)
Useful gains, hmGm	`	<u> </u>			_	_			_		1	
(95)m= 340.86 381.9	400.99	390.69	338.16	244.7	166.3	174.2	3 257.54	324.31	327.58	324.03		(95)
Monthly average exterior (96)m= 4.3 4.9	1			i e	16.6	16.4	144	10.6	7 1	1 4 2]	(96)
(96)m= 4.3 4.9 Heat loss rate for me	6.5 an intern	8.9	11.7	14.6 I m W	16.6 =[(39)m	16.4 x [(93)		10.6	7.1	4.2	I	(50)
(97)m= 688.1 662.7	594.97	493.39	374.87	252.11	167.45	175.9		421.43	569.58	692.33		(97)
Space heating require										<u>I</u>	I	
(98)m= 258.34 188.7	144.32	73.94	27.31	0	0	0	0	72.26	174.24	274.02		
				•	-	•	•	•	•		•	

				Tota	l per year	(kWh/year	r) = Sum(9	8)15,912 =	1213.13	(98)
Space heating requirement in kW	Vh/m²/year								22.9	(99)
9a. Energy requirements – Individ	lual heating sy	ystems i	ncluding	micro-C	HP)					
Space heating:								г		¬(004)
Fraction of space heat from seco		mentary	-	(000) 4	(004)			Ĺ	0	(201)
Fraction of space heat from main	• • • • • • • • • • • • • • • • • • • •			(202) = 1 -	,	(000)1		Ĺ	1	(202)
Fraction of total heating from ma	•			(204) = (20	02) x [1 –	(203)] =		Į	1	(204)
Efficiency of main space heating	•		0.4					Į	277.43	(206)
Efficiency of secondary/supplement	entary heating	g system	า, % 						0	(208)
	Apr May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ear
Space heating requirement (calc 258.34 188.7 144.32 73	3.94 27.31	0	0	0	0	72.26	174.24	274.02		
$(211)m = \{[(98)m \times (204)] \} \times 100$			Ů	Ů		72.20	177.27	214.02		(211)
	6.65 9.84	0	0	0	0	26.04	62.8	98.77		(211)
	1					ar) =Sum(2			437.27	(211)
Space heating fuel (secondary),	kWh/month							L		
$= \{[(98)m \times (201)]\} \times 100 \div (208)$										
(215)m= 0 0 0	0 0	0	0	0	0	0	0	0		_
				Tota	I (kWh/yea	ar) =Sum(2	215) _{15,101}	<i>=</i>	0	(215)
Water heating	4ll · - · \									
Output from water heater (calculated) 152.8 134.44 140.64 12	25.31 122.25	108.44	103.39	114.49	114.62	129.98	138.4	148.86		
Efficiency of water heater	ļ .							!	207.67	(216)
(217)m= 207.67 207.67 207.67 20	07.67 207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67		(217)
Fuel for water heating, kWh/month	h					•	•	•		
$ (219)m = (64)m \times 100 \div (217)m $ $ (219)m = 73.58 64.74 67.72 60 $	0.34 58.87	52.22	49.79	55.13	55.19	62.59	66.64	71.68		
(210)111 10.00 0 1111 01.12 0.	00.07	02.22	10.70		I = Sum(2		00.01	7 1.00	738.49	(219)
Annual totals							Wh/yea	, ,	kWh/yea	
Space heating fuel used, main sys	stem 1						•	[437.27	
Water heating fuel used								Ī	738.49	
Electricity for pumps, fans and ele	ectric keep-ho	t						_		
mechanical ventilation - balanced	d, extract or p	ositive i	nput fron	n outside	€			292.61		(230a)
Total electricity for the above, kWI	h/year			sum	of (230a).	(230g) =			292.61	(231)
Electricity for lighting								Ī	270.51	(232)
Electricity generated by PVs								Ī	-932.71	(233)
Total delivered energy for all uses	s (211)(221)	+ (231)	+ (232).	(237b)	=			Ţ	806.17	(338)
12a. CO2 emissions – Individual	heating syste	ems inclu	uding mi	cro-CHP)			L		
			ergy				ion fac	tor	Emissions	

kWh/year

kg CO2/year

kg CO2/kWh

Space heating (main system 1)	(211) x	0.519	=	226.94	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	383.28	(264)
Space and water heating	(261) + (262) + (263) + (264) =			610.22	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	151.86	(267)
Electricity for lighting	(232) x	0.519	=	140.39	(268)
Energy saving/generation technologies Item 1		0.519	=	-484.08	(269)
Total CO2, kg/year	sun	n of (265)(271) =		418.4	(272)
Dwelling CO2 Emission Rate	(27)	2) ÷ (4) =		7.9	(273)
El rating (section 14)				94	(274)

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 *Printed on 12 July 2021 at 10:59:42*

Project Information:

Assessed By: Neil Ingham (STRO010943) Building Type: Flat

Dwelling Details:

NEW DWELLING DESIGN STAGETotal Floor Area: 74.55m²

Site Reference: 231 Watford Road - GREEN Plot Reference: Sample 5

Address:

Client Details:

Name: Address :

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity

Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER) 23.1 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER)

8.08 kg/m²

OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 39.5 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 30.6 kWh/m²

OK

2 Fabric U-values

 Element
 Average
 Highest

 External wall
 0.16 (max. 0.30)
 0.16 (max. 0.70)
 OK

 Party wall
 0.00 (max. 0.20)
 OK

Floor (no floor) Roof (no roof)

Openings 1.10 (max. 2.00) 1.10 (max. 3.30) **OK**

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals 3.50 (design value)

Maximum 10.0 **OK**

4 Heating efficiency

Main Heating system:

Heat pumps with radiators or underfloor heating - electric

NIBE Fighter 360

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No Separate Cylinder

N/A

6 Controls			
Space heating controls Hot water controls:	TTZC by plumbing and e No cylinder thermostat No cylinder	electrical services	ок
7 Low energy lights			
Percentage of fixed lights v Minimum	vith low-energy fittings	100.0% 75.0%	ОК
8 Mechanical ventilation			
Continuous extract system Specific fan power: Maximum		1.05 0.7	Fail
9 Summertime temperature			
Overheating risk (Thames of Based on: Overshading: Windows facing: South East Windows facing: South Ventilation rate:		Slight Average or unknown 12.79m² 1.28m² 6.00	ОК
10 Key features			

		l Iser I	Details:						
Assessor Name: Software Name:	Neil Ingham Stroma FSAP 2012		Strom Softwa	are Ve	rsion:			0010943 on: 1.0.5.41	
Address :	F	Property	Address	Sample	e 5				
1. Overall dwelling dime	nsions:								
		Are	a(m²)		Av. He	ight(m)	_	Volume(m ³	3)
Ground floor		7	74.55	(1a) x	2	2.75	(2a) =	205.01	(3a)
Total floor area TFA = (1a	a)+(1b)+(1c)+(1d)+(1e)+(1	n)	74.55	(4)					
Dwelling volume				(3a)+(3b)+(3c)+(3c	d)+(3e)+	.(3n) =	205.01	(5)
2. Ventilation rate:									
	main seconda heating heating	ry	other		total			m³ per hou	ır
Number of chimneys	0 + 0	+	0] = [0	X 4	40 =	0	(6a)
Number of open flues	0 + 0	+	0] = [0	x 2	20 =	0	(6b)
Number of intermittent far	ns			Ī	0	x '	10 =	0	(7a)
Number of passive vents				Ē	0	x '	10 =	0	(7b)
Number of flueless gas fin	res			Ē	0	X 4	40 =	0	(7c)
				_					
							Air ch	nanges per ho	our
•	/s, flues and fans = $(6a)+(6b)+(6b)+(6a)$				0		÷ (5) =	0	(8)
Number of storeys in the	een carried out or is intended, procee ne dwelling (ns)	ea to (17),	otnerwise (continue ir	om (9) to	(16)		0	(9)
Additional infiltration						[(9)	-1]x0.1 =	0	(10)
Structural infiltration: 0.	25 for steel or timber frame o	r 0.35 fo	r masonı	y constr	ruction			0	(11)
if both types of wall are pr deducting areas of openin	resent, use the value corresponding t	o the grea	ter wall are	a (after					
,	loor, enter 0.2 (unsealed) or 0	.1 (seale	ed), else	enter 0				0	(12)
If no draught lobby, ent	ter 0.05, else enter 0							0	(13)
Percentage of windows	s and doors draught stripped							0	(14)
Window infiltration			0.25 - [0.2	. ,	-			0	(15)
Infiltration rate			(8) + (10)					0	(16)
•	q50, expressed in cubic metro ity value, then $(18) = [(17) \div 20] + (18)$	•		•	etre of e	envelope	area	3.5	(17)
•	s if a pressurisation test has been do				is being u	sed		0.18	(18)
Number of sides sheltere		·	,	,	J			0	(19)
Shelter factor			(20) = 1 -	[0.0 75 x (1	19)] =			1	(20)
Infiltration rate incorporat			(21) = (18) x (20) =				0.18	(21)
Infiltration rate modified for	- 		1				1	1	
Jan Feb	Mar Apr May Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	- 1 1 - 1	T	T		T	1		1	
(22)m= 5.1 5	4.9 4.4 4.3 3.8	3.8	3.7	4	4.3	4.5	4.7		
Wind Factor (22a)m = (22	2)m ÷ 4								
(22a)m= 1.27 1.25	1.23 1.1 1.08 0.95	0.95	0.92	1	1.08	1.12	1.18		

Adjusted infiltra	ation rate	e (allowi	ng for sh	elter an	d wind s	speed) =	(21a) x	(22a)m				_	
0.22	0.22	0.21	0.19	0.19	0.17	0.17	0.16	0.18	0.19	0.2	0.21		
<i>Calcul<mark>ate effec</mark></i> If mechanica		_	rate for t	he appli	cable ca	se	-		-	-			
If exhaust air he			endix N (2	3b) = (23a	a) × Fmv (e	equation (N	N5)) other	wise (23h) = (23a)			0.5	(23
If balanced with		0 11		, ,	, ,	. ,	,, .	`) = (20a)			0.5	(23
		-	-	_					26\m . /	22h) [1 (226)	0	(23
a) If balance (24a)m= 0	0	o 0	0	0	0	0	1K) (24a	0	0	23b) x [0	- 100] 	(24
b) If balance						<u> </u>						J	(-
24b)m= 0	0	0	0	0	0	0	0	0	0	0	0	1	(24
c) If whole ho				-	ļ							J	•
if (22b)m				•					.5 × (23b	o)			
24c)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5]	(2
d) If natural v	/entilatio	on or wh	ole hous	e positiv	/e input	ventilatio	on from I	oft				ı	
if (22b)m				•	•				0.5]			_	
24d)m= 0	0	0	0	0	0	0	0	0	0	0	0		(2
Effective air	change	rate - er	iter (24a	or (24b	o) or (24	c) or (24	d) in box	(25)				-	
25)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(2
3. Heat losses	and he	eat loss r	paramete	er:									
LEMENT	Gros		Openin		Net Ar	ea	U-valı	ıe	ΑXU		k-value	e A	Χk
	area	(m²)	· m		A ,r	m²	W/m2	K .	(W/	K)	kJ/m²-l	K k	J/K
Vindows Type	1				12.79	x1.	/[1/(1.1)+	0.04] =	13.48				(2
Vindows Type	2				1.28	x1.	/[1/(1.1)+	0.04] =	1.35				(2
Valls Type1	41.8	5	14.0	7	27.78	3 x	0.16	=	4.44		60	1666.	8 (2
Valls Type2	24.3	7	0		24.37	7 X	0.15	=	3.65		60	1462.	2 (2
otal area of el	ements	, m²			66.22	2							— (3
Party wall					41.82	<u>x</u>	0		0	\neg [45	1881.	9 (3
Party floor					74.55	5					40	2982	(3
Party ceiling					74.55					Ì	30	2236.	5 (3
nternal wall **					131.1	_					9	1180.0	=
for windows and	roof windo	ows, use e	ffective wi	ndow U-va			formula 1	/[(1/U-valu	ıe)+0.04] á	L as given in			30 (0
* include the area								- 1	, -		, , ,		
abric heat los	s, W/K =	= S (A x	U)				(26)(30)	+ (32) =				22.92	(3
leat capacity (Cm = S(Axk)						((28).	.(30) + (32	2) + (32a).	(32e) =	11409.48	(3
hermal mass	parame	ter (TMF	P = Cm ÷	- TFA) ir	n kJ/m²K			= (34)	÷ (4) =			153.04	(3
or design assess an be used instea				constructi	ion are no	t known pr	ecisely the	indicative	values of	TMP in T	able 1f		
hermal bridge	s : S (L	x Y) cal	culated i	using Ap	pendix l	<						9.46	(3
details of therma	l bridging	are not kn	own (36) =	= 0.05 x (3	1)								
otal fabric hea	at loss							(33) +	(36) =			32.38	(3
entilation hea	t loss ca	alculated	monthly	/				(38)m	= 0.33 × (25)m x (5)	1	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83		(3
leat transfer c	oefficier	nt, W/K						(39)m	= (37) + (38)m			
39)m= 66.21	66.21	66.21	66.21	66.21	66.21	66.21	66.21	66.21	66.21	66.21	66.21		
					ww.stroma	•	•		Average =	0(00)	- 440	66.2 ≱ age	— 1.

Heat loss para	ameter (I	HLP), W	′m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89		
						l	l		Average =	Sum(40) ₁ .	12 /12=	0.89	(40)
Number of day	1	nth (Tab	le 1a)		ı			ı					
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 hea	ting ene	rgy requi	irement:								kWh/ye	ear:	
Assumed occu if TFA > 13. if TFA £ 13.	9, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9)2)] + 0.0	0013 x (¯	TFA -13		35		(42)
Annual average Reduce the annual not more that 125	ge hot wa al average	hot water	usage by	5% if the a	lwelling is	designed t			se target o		.04		(43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage i								- 1					
(44)m= 99.05	95.45	91.85	88.24	84.64	81.04	81.04	84.64	88.24	91.85	95.45	99.05		
	•								Total = Su	m(44) ₁₁₂ =		1080.53	(44)
Energy content of	f hot water	used - cal	culated mo	onthly = 4 .	190 x Vd,r	n x nm x C	OTm / 3600) kWh/mor	nth (see Ta	ables 1b, 1	c, 1d)		
(45)m= 146.89	128.47	132.57	115.58	110.9	95.7	88.68	101.76	102.97	120	130.99	142.25		
If instantaneous u	votor hoot	na ot noint	of upo (no	hot woto	r otorogol	ontor O in	havas (16		Total = Su	m(45) ₁₁₂ =	=	1416.75	(45)
If instantaneous v			·	i	· · ·		· · ·	, , , I		1			(40)
(46)m= 22.03 Water storage	19.27	19.89	17.34	16.63	14.35	13.3	15.26	15.45	18	19.65	21.34		(46)
Storage volum) includir	ng any so	olar or W	/WHRS	storage	within sa	ame ves	sel	0			(47)
If community h	neating a	and no ta	ınk in dw	elling, e	nter 110	litres in	(47)						
Otherwise if no	o stored	hot wate	er (this in	icludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in ((47)			
Water storage													
a) If manufact				or is kno	wn (kWł	n/day):				0.	54		(48)
Temperature f										0.9	072		(49)
Energy lost fro		•	•				(48) x (49)) =			0		(50)
b) If manufactHot water stor			-								0		(51)
If community h	•			_ (,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	-77					0		(0.7)
Volume factor	from Ta	ble 2a									0		(52)
Temperature f	factor fro	m Table	2b								0		(53)
Energy lost fro		_	, kWh/ye	ear			(47) x (51)) x (52) x (53) =		0		(54)
Enter (50) or	(54) in (55)								0.	91		(55)
Water storage	loss cal	culated t	for each	month			((56)m = ((55) × (41)	m				
(56)m= 28.12	25.4	28.12	27.22	28.12	27.22	28.12	28.12	27.22	28.12	27.22	28.12		(56)
If cylinder contain	s dedicate	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Append	ix H	
(57)m= 28.12	25.4	28.12	27.22	28.12	27.22	28.12	28.12	27.22	28.12	27.22	28.12		(57)
Primary circuit	t loss (ar	nnual) fro	m Table	3							0		(58)
Primary circuit	•	•			59)m = ((58) ÷ 36	65 × (41)	m					
(modified by	/ factor f	rom Tab	le H5 if t	here is s	olar wat	ter heatii	ng and a	cylinde	r thermo	stat)			
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

Combi loss calc	vulated f	for each	month ((61)m –	(60) ·	365 🗸 (41	/m							
(61)m= 0	0	0	0	0 0	00) +	0) 0		0	0	T 0	0	1	(61)
Total heat requi		-						!					[. (50)m + (61)m	(- /
	153.87	160.69	142.79	139.02	122.9		129.	_	130.19	148.13		170.37	1	(62)
Solar DHW input ca													1	()
(add additional										CONTIN	ation to wate	or ricating)		
(63)m= 0	0	0	0	0	0	0	0	_	0	0	0	0]	(63)
Output from wat	ter heat	ter				Į.						<u> </u>	ı	
· -	153.87	160.69	142.79	139.02	122.9	1 116.8	129.	.88	130.19	148.13	158.21	170.37]	
				ļ				Outp	out from wa	ater heat	 er (annual)₁	12	1747.88	(64)
Heat gains from	water l	heating,	kWh/mo	onth 0.2	3.0] ` 5	35 × (45)m	ı + (6	1)m	n] + 0.8 x	((46)n	n + (57)m	+ (59)m	 .]	-
(65)m= 48.84	42.72	44.08	38.43	36.87	31.82		33.8		34.24	39.9	43.56	47.3]	(65)
include (57)m	in calc	ulation o	of (65)m	only if c	vlinde	r is in the	dwell	ing	or hot w	ater is	from com	munity h	ı neating	
5. Internal gain					,							,	,	
Metabolic gains	·													
Jan	Feb	Mar	Apr	May	Jur	Jul	Αι	ug	Sep	Oct	Nov	Dec]	
(66)m= 117.57	117.57	117.57	117.57	117.57	117.5	7 117.57	117.	.57	117.57	117.57	117.57	117.57		(66)
Lighting gains (calculat	ted in Ap	pendix	L, equat	ion L9	or L9a), a	lso s	ee T	Table 5		•	•	•	
(67)m= 18.78	16.68	13.56	10.27	7.68	6.48	7	9.′	1	12.22	15.51	18.1	19.3]	(67)
Appliances gain	ns (calcu	ulated in	Append	dix L, eq	uation	L13 or L1	3a), a	also	see Tal	ble 5	•	•	•	
(68)m= 207.68	209.83	204.4	192.84	178.25	164.5	3 155.37	153.	.21	158.64	170.2	184.8	198.51]	(68)
Cooking gains (calcula	ted in A	ppendix	L, equat	ion L1	5 or L15a), als	o se	e Table	5	•	!	•	
(69)m= 34.76	34.76	34.76	34.76	34.76	34.76	34.76	34.7	76	34.76	34.76	34.76	34.76	1	(69)
Pumps and fans	s gains	(Table 5	āa)			•					•	•	•	
(70)m= 0	0	0	0	0	0	0	0		0	0	0	0		(70)
Losses e.g. eva	poratio	n (nega	tive valu	es) (Tab	le 5)	•					•	•	•	
(71)m= -94.05	-94.05	-94.05	-94.05	-94.05	-94.0	5 -94.05	-94.	05	-94.05	-94.05	-94.05	-94.05		(71)
Water heating g	ains (T	able 5)				-					-	•	•	
(72)m= 65.64	63.56	59.25	53.37	49.56	44.19	39.63	45.4	48	47.55	53.63	60.49	63.57		(72)
Total internal g	gains =				(66)m + (67)n	n + (68	3)m +	+ (69)m + ((70)m +	(71)m + (72))m	•	
(73)m= 350.37	348.34	335.48	314.75	293.75	273.4	7 260.27	266.	.06	276.68	297.61	321.66	339.65]	(73)
6. Solar gains:														
Solar gains are ca	lculated ι	using sola	r flux from	Table 6a	and ass	ociated equa	tions t	to co	nvert to th	e applic		tion.		
Orientation: Ad	ccess Fable 6d	actor	Area m²			lux able 6a		т	g_ able 6b		FF Table 6c		Gains	
	able ou					able ba		1	able ob		Table 60		(W)	,
Southeast 0.9x	0.77	X	12.	79	× L	36.79	X		0.63	X	0.7	=	143.82	(77)
Southeast 0.9x	0.77	X	12.	79	×	62.67	X		0.63	×	0.7	=	244.98	(77)
Southeast 0.9x	0.77	X	12.	79	x	85.75	X		0.63	×	0.7	=	335.19	<u> </u> (77)
Southeast 0.9x	0.77	X	12.	79	x	106.25	X		0.63	X	0.7	=	415.32	(77)
Southeast _{0.9x}	0.77	X	12.	79	x	119.01	X		0.63	X	0.7	=	465.19	(77)

I		_1								_				_
Southeast 0.9x	0.77	X	12.	79	X	1	18.15	X	0.63	X	0.7	=	461.82	(77)
Southeast 0.9x	0.77	X	12.	79	X	1	13.91	X	0.63	X	0.7	=	445.25	(77)
Southeast 0.9x	0.77	X	12.	79	X	10	04.39	X	0.63	X	0.7	=	408.04	(77)
Southeast 0.9x	0.77	X	12.	79	X	9	2.85	X	0.63	X	0.7	=	362.94	(77)
Southeast _{0.9x}	0.77	X	12.	79	X	6	9.27	X	0.63	X	0.7	=	270.75	(77)
Southeast 0.9x	0.77	X	12.	79	X	4	4.07	X	0.63	X	0.7	=	172.26	(77)
Southeast 0.9x	0.77	X	12.	79	X	3	1.49	X	0.63	X	0.7	=	123.08	(77)
South 0.9x	0.77	X	1.2	28	x	4	6.75	x	0.63	X	0.7	=	18.29	(78)
South 0.9x	0.77	X	1.2	28	x	7	6.57	X	0.63	x	0.7		29.95	(78)
South 0.9x	0.77	X	1.2	28	x	9	7.53	x	0.63	x	0.7	=	38.15	(78)
South 0.9x	0.77	X	1.2	28	x	1	10.23	X	0.63	x	0.7	=	43.12	(78)
South 0.9x	0.77	X	1.2	28	x	1	14.87	X	0.63	х	0.7	=	44.94	(78)
South 0.9x	0.77	x	1.2	28	x	1	10.55	x	0.63	х	0.7	=	43.24	(78)
South 0.9x	0.77	x	1.2	28	x	10	08.01	x	0.63	x	0.7	=	42.25	(78)
South 0.9x	0.77	×	1.2	28	x	10	04.89	x	0.63	x	0.7	=	41.03	(78)
South 0.9x	0.77	X	1.2	28	x	10	01.89	x	0.63	x	0.7	-	39.86	(78)
South 0.9x	0.77	×	1.2	28	x	8	2.59	x	0.63	x	0.7		32.31	(78)
South 0.9x	0.77	×	1.2	28	x	5	5.42	x	0.63	x	0.7	-	21.68	(78)
South 0.9x	0.77	X	1.2	28	x		10.4	x	0.63	x	0.7	=	15.8	(78)
•		_												
Solar gains in	watts, calcu	lated	for eacl	h month	1			(83)m	n = Sum(74)m .	(82)m			_	
(83)m= 162.11	274.93 37	3.34	458.44	510.12	50	05.07	487.5	449	.07 402.79	303.00	193.94	138.88		(83)
Total gains –	nternal and	solar	(84)m =	= (73)m	+ (8	83)m	, watts				_		_	
(84)m= 512.48	623.27 70	8.82	773.19	803.88	77	78.54	747.77	715	.13 679.48	600.67	7 515.6	478.54		(84)
7. Mean inte	rnal tempera	turo /											<u>I</u>	(04)
Temperature		ilure ((heating	seasor	າ)					•				(04)
	during heat		`			area f	rom Tat	ole 9,	, Th1 (°C)				21	(85)
Utilisation fac	•	ing p	eriods ir	n the livi	ng :			ole 9,	, Th1 (°C)				21	
-	ctor for gains	ing p	eriods ir	n the livi	ng a				, Th1 (°C)	Oct	Nov	Dec	21	
Utilisation fac	ctor for gains	ing po	eriods ir iving are	n the livi ea, h1,m	ng a	ee Ta	ble 9a)		ug Sep	Oct	Nov 0.96	Dec 0.98	21	
Utilisation fac Jan (86)m= 0.98	Feb 1	ing po for li Mar .91	eriods ir iving are Apr 0.82	n the livi ea, h1,m May	ng a	ee Ta Jun ^{0.52}	ble 9a) Jul 0.38	A:	ug Sep 12 0.62	 	+		21	(85)
Utilisation fac	Feb 1 0.95 0 1 temperature	ing po for li Mar .91	eriods ir iving are Apr 0.82	n the livi ea, h1,m May	ng a	ee Ta Jun ^{0.52}	ble 9a) Jul 0.38	A:	ug Sep 12 0.62 Table 9c)	 	+		21	(85)
Utilisation factors (86)m= 0.98 Mean internation (87)m= 21	Feb 1 0.95 0 1 temperature 21	ing positions for library in the second seco	eriods ir iving are Apr 0.82 iving are	n the livi ea, h1,m May 0.69 ea T1 (f	ng a	ee Ta Jun 0.52 w ste	ble 9a) Jul 0.38 ps 3 to 7	0.4 ' in T	ug Sep 12 0.62 Table 9c)	0.86	0.96	0.98	21	(85)
Utilisation factors (86)m= 0.98 Mean internation	Feb 1 0.95 0 0 1 temperature 21 during heat	ing positions for library in the second seco	eriods ir iving are Apr 0.82 iving are	n the livi ea, h1,m May 0.69 ea T1 (f	ng and (see	ee Ta Jun 0.52 w ste	ble 9a) Jul 0.38 ps 3 to 7	0.4 ' in T	ug Sep 12 0.62 Table 9c) 1 21 9, Th2 (°C)	0.86	0.96	0.98	21	(85)
Utilisation factors (86)m= 0.98 Mean internation (87)m= 21 Temperature (88)m= 20.18	Feb 1 0.95 0 0 0 0 0 0 0 0 0	ing positions for line in large in large in large in large positions positions in large p	eriods ir iving are Apr 0.82 iving are 21 eriods ir 20.18	n the livies, h1,m May 0.69 ea T1 (f 21 n rest of 20.18	ng a (se	ee Ta Jun 0.52 w ste 21 relling	Jul 0.38 ps 3 to 7 21 from Ta 20.18	Au 0.4 7 in T 2 able 9 20.	ug Sep 12 0.62 Table 9c) 1 21 9, Th2 (°C)	0.86	0.96	0.98	21	(85) (86) (87)
Utilisation factors (86)m= 0.98 Mean internation (87)m= 21 Temperature (88)m= 20.18 Utilisation factors (81)m= 20.18	Feb 1 0.95 0 1 temperature 21 20.18 20 ctor for gains	ing positions for library in libr	eriods ir iving are 0.82 iving are 21 eriods ir 20.18	n the livies, h1,m May 0.69 ea T1 (for 21 n rest of 20.18 welling,	ng (so (so (so so	ee Ta Jun 0.52 w ste 21 relling 0.18	Jul 0.38 ps 3 to 7 21 from Ta 20.18	Ai 0.4 7 in T 2 8 ble 9 20.	ug Sep 12 0.62 Table 9c) 1 21 9, Th2 (°C) 18 20.18	0.86 21 20.18	21 20.18	0.98 21 20.18	21	(85) (86) (87) (88)
Utilisation factors (86)m= 0.98 Mean internation (87)m= 21 Temperature (88)m= 20.18 Utilisation factors (89)m= 0.97	Feb 1 0.95 0 0 0 0 0 0 0 0 0	ing positions for residual indicates for residual ing positions for residual indicates for res	eriods ir iving are 0.82 iving are 21 eriods ir 20.18 est of do	n the livies, h1,m May 0.69 ea T1 (for 21 n rest of 20.18 welling, 0.64	ng (se collo dw 2 h2,	ee Ta Jun 0.52 w ste 21 relling 0.18 m (se 0.46	Jul 0.38 ps 3 to 7 21 from Ta 20.18 pe Table 0.32	Ai 0.4 7 in T 2 ble 9 20. 9a) 0.3	ug Sep 12 0.62 Table 9c) 1 21 9, Th2 (°C) 18 20.18	0.86 21 20.18	0.96	0.98	21	(85) (86) (87)
Utilisation factors (86)m= 0.98 Mean internation (87)m= 21 Temperature (88)m= 20.18 Utilisation factors (89)m= 0.97 Mean internation	Feb 1 0.95 0 0 0 0 0 0 0 0 0	ing positions for line in land positions for residual end of the land positions for residual end of the land positions for residual end of the land positions for residual end of the land positions for residual end of the land positions for residual end of the land positions for residual end of the land positions for residual end of the land positions for residual end of the land positions for land positions for land positions for residual end of the land positions for land positions	eriods ir iving are Apr 0.82 iving are 21 eriods ir 20.18 est of do 0.79 the rest	n the living the livin	ng (so (so (so so	ee Ta Jun 0.52 w ste 21 velling 0.18 m (se 0.46 T2 (fo	Jul 0.38 ps 3 to 7 21 from Ta 20.18 ee Table 0.32 bllow ste	Al 0.44 / in T 2 / 20. 9a) 0.3	ug Sep 12 0.62 Table 9c) 1 21 19, Th2 (°C) 18 20.18 15 0.56 16 7 in Table	0.86 21 20.18 0.83 le 9c)	0.96 21 20.18	0.98 21 20.18 0.98	21	(85) (86) (87) (88) (89)
Utilisation factors (86)m= 0.98 Mean internation (87)m= 21 Temperature (88)m= 20.18 Utilisation factors (89)m= 0.97	Feb 1 0.95 0 0 0 0 0 0 0 0 0	ing positions for residual indicates for residual ing positions for residual indicates for res	eriods ir iving are 0.82 iving are 21 eriods ir 20.18 est of do	n the livies, h1,m May 0.69 ea T1 (for 21 n rest of 20.18 welling, 0.64	ng (so (so (so so	ee Ta Jun 0.52 w ste 21 relling 0.18 m (se 0.46	Jul 0.38 ps 3 to 7 21 from Ta 20.18 pe Table 0.32	Ai 0.4 7 in T 2 ble 9 20. 9a) 0.3	ug Sep 12 0.62 Table 9c) 1 21 9, Th2 (°C) 18 20.18 10 7 in Table 18 20.18	0.86 21 20.18 0.83 le 9c) 20.18	0.96 21 20.18 0.95	0.98 21 20.18 0.98		(85) (86) (87) (88) (89) (90)
Utilisation factors (86)m= 0.98 Mean internation (87)m= 21 Temperature (88)m= 20.18 Utilisation factors (89)m= 0.97 Mean internation	Feb 1 0.95 0 0 0 0 0 0 0 0 0	ing positions for line in land positions for residual end of the land positions for residual end of the land positions for residual end of the land positions for residual end of the land positions for residual end of the land positions for residual end of the land positions for residual end of the land positions for residual end of the land positions for residual end of the land positions for land positions for land positions for residual end of the land positions for land positions	eriods ir iving are Apr 0.82 iving are 21 eriods ir 20.18 est of do 0.79 the rest	n the living the livin	ng (so (so (so so	ee Ta Jun 0.52 w ste 21 velling 0.18 m (se 0.46 T2 (fo	Jul 0.38 ps 3 to 7 21 from Ta 20.18 ee Table 0.32 bllow ste	Al 0.44 / in T 2 / 20. 9a) 0.3	ug Sep 12 0.62 Table 9c) 1 21 9, Th2 (°C) 18 20.18 10 7 in Table 18 20.18	0.86 21 20.18 0.83 le 9c) 20.18	0.96 21 20.18	0.98 21 20.18 0.98	0.4	(85) (86) (87) (88) (89)
Utilisation factors Jan (86)m= 0.98 Mean internation (87)m= 21 Temperature (88)m= 20.18 Utilisation factors (89)m= 0.97 Mean internation (90)m= 20.18	Feb 1 0.95 0 0 0 0 0 0 0 0 0	ing positions for limited in limi	eriods ir iving are 0.82 iving are 21 eriods ir 20.18 est of do 0.79 the rest 20.18	n the living the livin	ng i (se collo dw 2 h2, collo ing 2	ee Ta Jun 0.52 w ste 21 relling 0.18 m (se 0.46 T2 (fo	Jul 0.38 ps 3 to 7 21 from Ta 20.18 e Table 0.32 ollow ste 20.18	Al 0.4 ' in T 2 ble 9 20. 9a) 0.3	ug Sep 12 0.62 Table 9c) 1 21 9, Th2 (°C) 18 20.18 15 0.56 16 to 7 in Table 18 20.18	0.86 21 20.18 0.83 le 9c) 20.18	0.96 21 20.18 0.95	0.98 21 20.18 0.98		(85) (86) (87) (88) (89) (90)
Utilisation factors (86)m= 0.98 Mean internation (87)m= 21 Temperature (88)m= 20.18 Utilisation factors (89)m= 0.97 Mean internation (90)m= 20.18	retor for gains Feb 0.95 0 al temperatur 21 during heat 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18	ing positions for limited in the second in t	eriods ir iving are Apr 0.82 iving are 21 eriods ir 20.18 est of do 0.79 the rest 20.18 r the wh 20.5	the livies, h1,m May 0.69 ea T1 (f 21 rest of 20.18 welling, 0.64 of dwell 20.18	ng : (se collo col	ee Ta Jun 0.52 w ste 21 relling 0.18 m (se 0.46 T2 (fo 20.18 g) = fl 20.5	Jul 0.38 ps 3 to 7 21 from Ta 20.18 ee Table 0.32 bllow ste 20.18 A × T1 20.5	Ain 0.4 7' in T 2' 20. 9a) 0.3 20. + (1 20.	ug Sep 12 0.62 Table 9c) 1 21 9, Th2 (°C) 18 20.18 15 0.56 16 7 in Table 18 20.18 - fLA) × T2 15 20.5	0.86 21 20.18 0.83 le 9c) 20.18 fLA = Liv	0.96 21 20.18 0.95 20.18 ving area ÷ (0.98 21 20.18 0.98		(85) (86) (87) (88) (89) (90)

(00)	00.5	00.5	00.5	00.5	00.5	00.5	00.5	00.5	00.5	00.5	00.5	00.5		(93)
(93)m=	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5		(93)
			uirement				44 -£	T-1-1- 0	41	4 T: /	70)	-11-	late	
			or gains			ed at ste	ep 11 or	i abie 9i	o, so tha	t 11,m=(76)m an	d re-calc	culate	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisa	ation fac	tor for g	ains, hm	1:									•	
(94)m=	0.98	0.95	0.9	0.8	0.66	0.49	0.34	0.38	0.59	0.84	0.95	0.98		(94)
Usefu	ıl gains,	hmGm	W = (94)	4)m x (84	4)m								•	
(95)m=	500.11	591.21	636.78	622.24	531.55	379.71	256.47	268.75	399.8	505.17	492.01	469.6		(95)
Month	nly aver	age exte	rnal tem	perature	from Ta	able 8								
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat	loss rate	for mea	an intern	al tempe	erature,	Lm , W =	=[(39)m	x [(93)m	– (96)m]			1	
(97)m=	1072.8	1033.08	927.15	768.25	582.87	390.86	258.45	271.69	423.97	655.7	887.42	1079.43		(97)
Space	e heatin	g require	ement fo	r each n	nonth, k\	Wh/mon	th = 0.02	24 x [(97)m – (95)m] x (4	1)m			
(98)m=	426.09	296.94	216.03	105.13	38.18	0	0	0	0	111.99	284.7	453.71		
			-					Tota	l per year	(kWh/yeaı	r) = Sum(9	8) _{15,912} =	1932.77	(98)
Space	e heatin	a reauire	ement in	kWh/m²	² /vear								25.93] (99)
		• •				:	a alvedia a	:	YUD)				20.00	J` ′
	· · · · · · · · · · · · · · · · · · ·		nts – Indi	ividuai n	eating sy	ystems i	nciuaing	micro-C	HP)					
•	e heatir	•	at from s	ocondon	v/cupple	montary	cyctom					I	0	(201)
	•					memary	-	(202) 4	(004)				0	╣ .
Fracti	on of sp	ace hea	at from m	naın syst	em(s)			(202) = 1	, ,				1	(202)
Fracti	ion of to	tal heati	ng from	main sys	stem 1			(204) = (2	02) × [1 – ((203)] =			1	(204)
Efficie	ency of r	nain spa	ace heat	ing syste	em 1								296.31	(206)
Efficie	ency of s	seconda	ry/suppl	ementar	y heating	g system	ո, %						0	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ar
Space	e heatin	g require	ement (c	alculate	d above))								
	426.09	296.94	216.03	105.13	38.18	0	0	0	0	111.99	284.7	453.71		
(211)m	n = {[(98)m x (20	(4)] } x 1	00 ÷ (20	06)		=	=	-		-	_	•	(211)
,	143.8	100.21	72.91	35.48	12.89	0	0	0	0	37.79	96.08	153.12		
								Tota	l (kWh/yea	ar) =Sum(2	211) _{15,1012}		652.27	(211)
Snace	e heatin	n fuel (s	econdar	v) k\//h/	month]
•		• '	00 ÷ (20	• •	111011111									
(215)m=		0	0	0	0	0	0	0	0	0	0	0		
. ,								<u> </u>	l I (kWh/yea	ar) =Sum(2	1 215), _{510 10}	<u> </u> ,=	0	(215)
Water	heating										7 10, 10 12			J` ′
	_		ter (calc	ulated al	hove)									
Output	175.01	153.87	160.69	142.79	139.02	122.91	116.8	129.88	130.19	148.13	158.21	170.37		
Efficier	ncy of w	ater hea						<u> </u>			l		207.67	(216)
(217)m=		207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.07	」\
, ,					201.01	201.01	201.01	201.01	207.07	201.01	207.07	201.01		(= · ·)
		•	kWh/mo (217) ÷ (
(219)m=		74.09	77.38	68.76	66.94	59.19	56.24	62.54	62.69	71.33	76.18	82.04		
		<u> </u>				<u> </u>		Tota	I = Sum(21	19a) ₁₁₂ =	ı	•	841.66	(219)
Annua	al totals										Wh/year	r	kWh/year	J` -'
		fuel use	ed, main	system	1						<i></i>		652.27	1
•	J			-									<u> </u>	_

					_
Water heating fuel used				841.66	
Electricity for pumps, fans and electric keep-hot					
mechanical ventilation - balanced, extract or pos	itive input from outside		267.37]	(230a)
Total electricity for the above, kWh/year	sum of (2	230a)(230g) =		267.37	(231)
Electricity for lighting				331.6	(232)
Electricity generated by PVs				-932.71	(233)
Total delivered energy for all uses (211)(221) +	(231) + (232)(237b) =			1160.2	(338)
12a. CO2 emissions – Individual heating systems	s including micro-CHP				
	Energy kWh/year	Emission fac kg CO2/kWh	ctor	Emissions kg CO2/yea	ır
Space heating (main system 1)	(211) x	0.519	=	338.53	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	436.82	(264)
Space and water heating	(261) + (262) + (263) + (264)) =		775.35	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	138.77	(267)
Electricity for lighting	(232) x	0.519	=	172.1	(268)
Energy saving/generation technologies Item 1		0.519	=	-484.08	(269)
Total CO2, kg/year		sum of (265)(271) =		602.14	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		8.08	(273)

El rating (section 14)

(274)

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Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 10:59:41

Project Information:

Assessed By: Neil Ingham (STRO010943) Building Type: Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 92.44m²

Site Reference: 231 Watford Road - GREEN

Plot Reference: Sample 6

Address:

Client Details:

Name: Address :

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity

Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER)

25.04 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 10.47 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 49.2 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 37.4 kWh/m²

OK

2 Fabric U-values

 Element
 Average
 Highest

 External wall
 0.15 (max. 0.30)
 0.16 (max. 0.70)
 OK

 Party wall
 0.00 (max. 0.20)
 OK

 Floor
 (no floor)
 OK

Roof (no roof)

Openings 1.10 (max. 2.00) 1.10 (max. 3.30) **OK**

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals 3.50 (design value)

Maximum 10.0 **OK**

4 Heating efficiency

Main Heating system:

Heat pumps with radiators or underfloor heating - electric

NIBE Fighter 360

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No Separate Cylinder

N/A

6 Controls			
Space heating controls Hot water controls:	TTZC by plumbing and e No cylinder thermostat No cylinder	electrical services	ок
7 Low energy lights			
Percentage of fixed lights wi Minimum	th low-energy fittings	100.0% 75.0%	ок
8 Mechanical ventilation			
Continuous extract system Specific fan power: Maximum		1.05 0.7	Fail
9 Summertime temperature		N. 4 1 10 4	014
Overheating risk (Thames van Based on:	alley):	Not significant	OK
Overshading: Windows facing: North East Windows facing: North West Ventilation rate:		Average or unknown 3.85m ² 5.11m ² 6.00	
10 Key features			
Air permeablility Windows U-value Party Walls U-value Photovoltaic array		3.5 m³/m²h 1.1 W/m²K 0 W/m²K	

		Lloor F	Details:						
Assessor Name:	Neil Ingham	USELL	Strom	a Num	bor:		STRO	010943	
Software Name:	Stroma FSAP 2012		Softwa					n: 1.0.5.41	
	F	Property	Address	Sample	e 6				
Address :									
Overall dwelling dime	ensions:	A = 0	o(m²\		Av. Ua	iaht/m)		Valuma/m³	\
Ground floor			a(m²) 92.44	(1a) x		ight(m) 2.75	(2a) =	Volume(m³)) (3a)
Total floor area TFA = (1	a)+(1b)+(1c)+(1d)+(1e)+(1		92.44	(4)			」 ` ′		`′
Dwelling volume		′ 🖳	2)+(3c)+(3c	d)+(3e)+	(3n) =	254.21	(5)
							` '	234.21	
2. Ventilation rate:	main seconda	ry	other		total			m³ per hou	r
Number of chimneys	heating heating + 0	- + -	0] = [0	×	40 =	0	(6a)
Number of open flues	0 + 0	╡ + 片	0] ₌ [0	x	20 =	0	 (6b)
Number of intermittent fa	ins				0	x -	10 =	0	(7a)
Number of passive vents	;			F	0	x	10 =	0	(7b)
Number of flueless gas fi				Ľ	0	x	40 =	0	一 (7c)
· ·				L				<u>-</u>	` ′
							Air ch	anges per ho	ur
'	ys, flues and fans = $(6a)+(6b)+(6b)+(6b)$				0		÷ (5) =	0	(8)
If a pressurisation test has be Number of storeys in the	peen carried out or is intended, proced he dwelling (ns)	ed to (17),	otherwise (continue fr	om (9) to	(16)		0	(9)
Additional infiltration	no awoming (no)					[(9)	-1]x0.1 =	0	(10)
Structural infiltration: 0	.25 for steel or timber frame of	r 0.35 fo	r masoni	y consti	ruction			0	(11)
if both types of wall are padeducting areas of openia	resent, use the value corresponding t	to the grea	ter wall are	a (after			•		_
•	floor, enter 0.2 (unsealed) or ().1 (seale	ed), else	enter 0				0	(12)
If no draught lobby, en	ter 0.05, else enter 0	,	,					0	(13)
Percentage of windows	s and doors draught stripped							0	(14)
Window infiltration			0.25 - [0.2	x (14) ÷ 1	00] =			0	(15)
Infiltration rate			(8) + (10)	+ (11) + (1	12) + (13)	+ (15) =		0	(16)
,	q50, expressed in cubic metr	-	•	•	etre of e	envelope	area	3.5	(17)
	lity value, then $(18) = [(17) \div 20] +$							0.18	(18)
Air permeability value applie Number of sides sheltere	es if a pressurisation test has been do	ne or a de	gree air pe	rmeability	is being u	sed	ĺ		7(40)
Shelter factor	eu		(20) = 1 -	[0.075 x ([*]	19)] =			0	(19)
Infiltration rate incorporat	ting shelter factor		(21) = (18) x (20) =				0.18	(21)
Infiltration rate modified f	•							0.10	
Jan Feb	Mar Apr May Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	peed from Table 7								
(22)m= 5.1 5	4.9 4.4 4.3 3.8	3.8	3.7	4	4.3	4.5	4.7		
Wind Factor (22a)m = (2	2)m ∸ 4								
	1.23 1.1 1.08 0.95	0.95	0.92	1	1.08	1.12	1.18		
		•	•		-			l	

Adjusted infiltra	ation rat	e (allowi	ng for sh	nelter an	d wind s	peed) =	(21a) x	(22a)m					
0.22	0.22	0.21	0.19	0.19	0.17	0.17	0.16	0.18	0.19	0.2	0.21		
Calculate effect If mechanica		_	rate for t	he appli	cable ca	se						0.5	(2:
If exhaust air he			endix N. (2	3b) = (23a	a) × Fmv (e	eguation (N	N5)) othe	wise (23b) = (23a)			0.5	—(2)
If balanced with		0 11		, ,	, ,	. ,	,, .	,	, (200)			0.5	— (2)
a) If balance		-		_					2h\m + (23P) ^ [-	1 _ (23c)	. 1001	(2
24a)m= 0	0	o 0	0	0	0	0	0	0	0	0	0	- 100]	(2
b) If balance	-					<u> </u>					, ,		•
24b)m= 0	0	0	0	0	0	0	0	0	0	0	0		(2
c) If whole he	-				ļ	<u> </u>							•
if (22b)m				•					.5 × (23b	o)			
24c)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(2
d) If natural v	/entilatio	on or wh	ole hous	e positiv	/e input	ventilatio	on from I	oft	!				
if (22b)m				•	•				0.5]				
24d)m= 0	0	0	0	0	0	0	0	0	0	0	0		(2
Effective air	change	rate - er	iter (24a) or (24b	o) or (24	c) or (24	d) in box	(25)					
25)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(2
3. Heat losses	s and he	eat loss r	paramete	er:									
LEMENT	Gros		Openin		Net Ar	ea	U-valı	re	AXU		k-value	e A	Χk
	area	(m²)	· m		A ,r	m²	W/m2	K	(W/	K)	kJ/m²·l	≺ kJ	/K
Vindows Type	1				3.85	x1.	/[1/(1.1)+	0.04] =	4.06				(2
Vindows Type	2				5.11	x1.	/[1/(1.1)+	0.04] =	5.38				(2
Valls Type1	35.2	8	8.96		26.32	<u>x</u>	0.16	= [4.21		60	1579.2	2 (2
Valls Type2	82.4	4	0		82.44	, x	0.15	=	12.34		60	4946.4	4 (2
otal area of el	lements	, m²			117.7	2							(3
arty wall					15.98	3 x	0	=	0	\neg	45	719.1	(3
Party floor					92.44	二					40	3697.0	<u> </u>
arty ceiling					92.44	一				֡֟֝֟֝֟֓֓֓֓֓֓֓֓֜֟֜֜֓֓֓֓֓֓֓֓֜֟	30	2773.2	2 (3
nternal wall **					154.4	4				<u> </u>	9	1389.9	=
for windows and	roof wind	ows, use e	ffective wi	ndow U-va			formula 1	/[(1/U-valu	ıe)+0.04] á	ו as given in			<u> </u>
* include the area	s on both	sides of in	ternal wal	ls and part	titions								
abric heat los	s, W/K =	= S (A x	U)				(26)(30)	+ (32) =				25.99	(3
leat capacity (Cm = S(Axk)						((28)	(30) + (32	2) + (32a).	(32e) =	15105.46	(3
hermal mass	parame	ter (TMF	P = Cm -	- TFA) ir	n kJ/m²K			= (34)	÷ (4) =			163.41	(3
or design assess				constructi	ion are no	t known pr	ecisely the	indicative	values of	TMP in T	able 1f		
an be used instea Thermal bridge				ısina An	nendiy l	(10.20	(3
details of therma	,	•			•	`						10.38	(
otal fabric hea		a. o o	····· (00)	0,000,10	.,			(33) +	(36) =			36.38	(3
entilation hea	t loss ca	alculated	l monthly	/				(38)m	= 0.33 × ([25)m x (5])		
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
88)m= 41.94	41.94	41.94	41.94	41.94	41.94	41.94	41.94	41.94	41.94	41.94	41.94		(3
ـــــــــا leat transfer c	oefficier	nt, W/K					•	(39)m	= (37) + (38)m	•	•	
39)m= 78.32	78.32	78.32	78.32	78.32	78.32	78.32	78.32	78.32	78.32	78.32	78.32		

Heat loss para	ameter (I	HLP), W	′m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85		
		!							Average =	Sum(40) ₁	12 /12=	0.85	(40)
Number of day	<u> </u>	<u> </u>	<u> </u>					-					
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		(44)
(41)m= 31	28	31	30	31	30	31	31	30	31	30	31		(41)
4. Water hea	ting ene	rgy requi	irement:								kWh/ye	ear:	
Assumed occi if TFA > 13. if TFA £ 13.	9, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9)2)] + 0.0	0013 x (⁻	ΓFA -13		66		(42)
Annual average Reduce the annual not more that 125	al average	hot water	usage by	5% if the a	lwelling is	designed t			se target c		.32		(43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage				,				1		1			
(44)m= 107.05	103.16	99.27	95.37	91.48	87.59	87.59	91.48	95.37	99.27	103.16	107.05		
` '	<u> </u>					l	l		rotal = Su	m(44) ₁₁₂ =		1167.84	(44)
Energy content of	f hot water	used - cal	culated mo	onthly $= 4$.	190 x Vd,r	m x nm x E	OTm / 3600) kWh/mor	nth (see Ta	ables 1b, 1	c, 1d)		
(45)m= 158.75	138.85	143.28	124.91	119.86	103.43	95.84	109.98	111.29	129.7	141.58	153.75		
									Total = Su	m(45) ₁₁₂ =	=	1531.22	(45)
If instantaneous v	vater heati	ng at point	of use (no	not water	r storage),	enter 0 in	boxes (46)	to (61)	1				
(46)m= 23.81	20.83	21.49	18.74	17.98	15.51	14.38	16.5	16.69	19.46	21.24	23.06		(46)
Water storage Storage volum) includir	na anv sa	olar or W	/WHRS	storane	within sa	ame ves	امء	0			(47)
If community h	,					_		a					(47)
Otherwise if n	•			-			, ,	ers) ente	er '0' in ((47)			
Water storage	loss:		`					,		,			
a) If manufac	turer's d	eclared I	oss facto	or is kno	wn (kWł	n/day):				0.	54		(48)
Temperature f	actor fro	m Table	2b							0.9	072		(49)
Energy lost fro		•	•				(48) x (49)) =			0		(50)
b) If manufac			-										(54)
Hot water stor If community h	•			e Z (KVV	n/litre/da	ly)					0		(51)
Volume factor	•		011 4.0								0		(52)
Temperature f	actor fro	m Table	2b								0		(53)
Energy lost fro	om watei	rstorage	, kWh/ye	ear			(47) x (51)) x (52) x (53) =		0		(54)
Enter (50) or		_								-	91		(55)
Water storage	loss cal	culated t	for each	month			((56)m = ((55) × (41)	m				
(56)m= 28.12	25.4	28.12	27.22	28.12	27.22	28.12	28.12	27.22	28.12	27.22	28.12		(56)
If cylinder contain	s dedicate	l d solar sto	<u>l</u> rage, (57)ı	<u>l</u> m = (56)m		<u>I</u> H11)] ÷ (5			M where (m Append	ix H	
(57)m= 28.12	25.4	28.12	27.22	28.12	27.22	28.12	28.12	27.22	28.12	27.22	28.12		(57)
Primary circuit	t loss (ar	nual) fro	m Table								0		(58)
Primary circuit	,	•			59)m = ((58) ÷ 36	65 × (41)	m					
(modified by				,	•	. ,	, ,		r thermo	stat)			
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

Combi loss calculated	l for each	month ((61)m =	(60) ÷ 3	65 × (41))m						
(61)m= 0 0	0	0	0	0	0	0	T 0	0	Το	0	1	(61)
Total heat required for	r water he	eating ca	Lulated	L I for eac	h month	(62)m	= 0.85 × 0	(45)m +	 - (46)m +	(57)m +	l (59)m + (61)m	
(62)m= 186.88 164.25		152.13	147.98	130.64	123.96	138.1		157.82	`	181.87		(62)
Solar DHW input calculate					l						l	, ,
(add additional lines i										o:ag/		
(63)m= 0 0	0	0	0	0	0	0	0	0	0	0		(63)
Output from water he	ater				!	<u> </u>		I .		!	1	
(64)m= 186.88 164.25	_	152.13	147.98	130.64	123.96	138.1	138.51	157.82	168.79	181.87		
	1	ļ	ļ			0	utput from wa	ater heat	_I er (annual)₁	l12	1862.34	(64)
Heat gains from wate	r heating,	kWh/me	onth 0.2	5 ′ [0.85	× (45)m	+ (61)	m] + 0.8 x	د [(46)m	n + (57)m	+ (59)m	1	•
(65)m= 52.79 46.17	47.64	41.53	39.85	34.39	31.87	36.57	-	43.13	47.07	51.12	ĺ	(65)
include (57)m in ca	lculation o	of (65)m	only if c	vlinder i	s in the o	dwellin	a or hot w	ater is	from com	munity h	ı ıeatina	
5. Internal gains (se				,			<u> </u>			• •	Jan J	
Metabolic gains (Tab			,									
Jan Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m= 132.88 132.88	132.88	132.88	132.88	132.88	132.88	132.88	3 132.88	132.88	132.88	132.88		(66)
Lighting gains (calcul	ated in Ap	pendix	L, equati	ion L9 o	r L9a), a	lso se	e Table 5	•	•	•	ı	
(67)m= 25.23 22.41	18.22	13.8	10.31	8.71	9.41	12.23	16.41	20.84	24.33	25.93	1	(67)
Appliances gains (cal	culated in	Append	dix L, eq	uation L	13 or L1	3a), al	so see Ta	ble 5	_ !		I	
(68)m= 243.5 246.02	T	226.1	208.99	192.91	182.16	179.6		199.56	216.67	232.75		(68)
Cooking gains (calcul	ated in A	ppendix	L, equat	ion L15	or L15a	, also	see Table	5	- !		I	
(69)m= 36.29 36.29	36.29	36.29	36.29	36.29	36.29	36.29		36.29	36.29	36.29		(69)
Pumps and fans gain	s (Table 5	 5a)			•					•	I	
(70)m= 0 0	0	0	0	0	0	0	0	0	0	0		(70)
Losses e.g. evaporati	on (negat	tive valu	es) (Tab	le 5)						•	I	
(71)m= -106.31 -106.31	 	-106.31	-106.31	-106.31	-106.31	-106.3	1 -106.31	-106.31	-106.31	-106.31		(71)
Water heating gains (Table 5)	<u> </u>	<u> </u>		!	<u>!</u>		<u>!</u>	-1	<u>!</u>	1	
(72)m= 70.95 68.7	64.03	57.69	53.57	47.76	42.83	49.15	51.4	57.96	65.38	68.71		(72)
Total internal gains	_! =			(66)m + (67)m	ı + (68)n	n + (69)m + ((70)m + (71)m + (72))m	1	
(73)m= 402.54 400	384.78	360.45	335.73	312.24	297.27	303.88	316.68	341.23	369.24	390.26		(73)
6. Solar gains:						l		l				
Solar gains are calculated	d using sola	r flux from	Table 6a	and assoc	iated equa	itions to	convert to th	e applica	able orienta	tion.		
Orientation: Access		Area		Flu			g_		FF		Gains	
Table 6	d	m²		Ta	ble 6a		Table 6b	-	Table 6c		(W)	
Northeast _{0.9x} 0.7	7 X	3.8	35	x .	11.28	x [0.63	x [0.7	=	13.28	(75)
Northeast _{0.9x} 0.7	7 X	3.8	35	x 2	22.97	x	0.63	x	0.7	=	27.02	(75)
Northeast _{0.9x} 0.7	7 ×	3.8	35	X	11.38	x	0.63	x [0.7	=	48.69	(75)
Northeast _{0.9x} 0.7	7 ×	3.8	35	x (67.96	x	0.63	x [0.7		79.96	(75)
Northeast 0.9x 0.7	7 X	3.8	35	x (91.35	x	0.63	x [0.7	=	107.48	(75)

NI tl t		_					1		_				–
Northeast _{0.9x}	0.77	X	3.8	35	X _	97.38	X	0.63	X	0.7	=	114.58	(75)
Northeast _{0.9x}	0.77	X	3.8	35	x L	91.1	X	0.63	X	0.7	=	107.19	(75)
Northeast _{0.9x}	0.77	X	3.8	35	x	72.63	X	0.63	X	0.7	=	85.45	(75)
Northeast _{0.9x}	0.77	X	3.8	35	X	50.42	X	0.63	X	0.7	=	59.33	(75)
Northeast _{0.9x}	0.77	X	3.8	35	x	28.07	X	0.63	X	0.7	=	33.02	(75)
Northeast _{0.9x}	0.77	X	3.8	35	X	14.2	X	0.63	X	0.7	=	16.7	(75)
Northeast _{0.9x}	0.77	X	3.8	35	x	9.21	X	0.63	X	0.7	=	10.84	(75)
Northwest 0.9x	0.77	X	5.1	1	x	11.28	X	0.63	X	0.7	=	17.62	(81)
Northwest 0.9x	0.77	X	5.1	1	x	22.97	X	0.63	X	0.7	=	35.87	(81)
Northwest 0.9x	0.77	X	5.1	1	x	41.38	X	0.63	X	0.7	=	64.62	(81)
Northwest 0.9x	0.77	X	5.1	1	x	67.96	X	0.63	X	0.7	=	106.13	(81)
Northwest _{0.9x}	0.77	X	5.1	1	x	91.35	x	0.63	X	0.7	=	142.65	(81)
Northwest _{0.9x}	0.77	X	5.1	1	x	97.38	X	0.63	X	0.7	=	152.08	(81)
Northwest _{0.9x}	0.77	X	5.1	1	x	91.1	X	0.63	X	0.7	=	142.27	(81)
Northwest _{0.9x}	0.77	X	5.1	1	x	72.63	х	0.63	X	0.7	=	113.42	(81)
Northwest _{0.9x}	0.77	X	5.1	1	x	50.42	x	0.63	X	0.7	_	78.74	(81)
Northwest _{0.9x}	0.77	x	5.1	1	x	28.07	x	0.63	x	0.7		43.83	(81)
Northwest _{0.9x}	0.77	X	5.1	1	x	14.2	х	0.63	X	0.7	=	22.17	(81)
Northwest _{0.9x}	0.77	X	5.1	1	x	9.21	x	0.63	X	0.7	=	14.39	(81)
Solar gains in (83)m= 30.9		culated	for each	h month 250.13	266.	67 249.46	(83)m	n = Sum(74)m . .87 138.07	(82)m 76.86	38.88	25.23		(83)
Total gains – i	nternal and	d solar	 (84)m =	- (73)m	+ (83	m , watts					l		
(84)m= 433.44	462.89	498.08	546.53	585.86	T 570	04 540.70	_						
7 Maan intar		100.00	0.0.00	000.00	578.	91 546.73	502	.76 454.75	418.09	9 408.12	415.49		(84)
	nal tempe				L	91 546.73	502	.76 454.75	418.09	408.12	415.49		(84)
	nal tempe	rature (heating	season	1)				418.09	9 408.12	415.49	21	
Temperature	during hea	rature (ating p	heating eriods in	season the livi) ng ar	ea from Tal			418.09	408.12	415.49	21	(84)
	during hea	rature (ating p	heating eriods in ving are	season the livi ea, h1,m	ng ar	ea from Tal	ble 9	, Th1 (°C)	418.09			21	
Temperature Utilisation fac	during hea	rature (ating po	heating eriods in	season the livi) ng ar	ea from Tal Table 9a) ın Jul	ble 9	, Th1 (°C)			415.49 Dec 1	21	
Temperature Utilisation fac Jan (86)m= 1	during heator for gain	rature (ating po ns for li Mar 0.99	heating eriods in ving are Apr 0.96	season the livi ea, h1,m May	ng ar (see	ea from Tal Table 9a) In Jul 6 0.6	ble 9,	, Th1 (°C) ug Sep	Oct	Nov	Dec	21	(85)
Temperature Utilisation fac Jan (86)m= 1 Mean interna	during heator for gain	rature (ating po ns for li Mar 0.99	heating eriods in ving are Apr 0.96	season the livi ea, h1,m May	ng ar (see	ea from Talle Table 9a) In Jul 6 0.6 Steps 3 to 7	ble 9,	, Th1 (°C) ug Sep 66 0.88 Table 9c)	Oct	Nov	Dec	21	(85)
Temperature Utilisation fac Jan (86)m= 1 Mean interna (87)m= 21	during heater for gain Feb 0.99 ltemperat 21	rature (ating points for li Mar 0.99 cure in l	heating eriods in ving are Apr 0.96 iving are	season the livi ea, h1,m May 0.9 ea T1 (fo	ng ar (see Ju 0.7	ea from Talle Table 9a) In Jul 6 0.6 Steps 3 to 7	Al 0.6	s, Th1 (°C) ug Sep 66 0.88 Table 9c) 1 21	Oct 0.98	Nov 0.99	Dec 1	21	(85)
Temperature Utilisation fact Jan (86)m= 1 Mean internation (87)m= 21 Temperature	during heater for gain Feb 0.99 It temperat 21 during heater temperates	rature (ating points for li Mar 0.99 cure in l 21 ating points	heating eriods in ving are Apr 0.96 iving are 21	season the livi ea, h1,m May 0.9 ea T1 (for	ng ar (see Ju 0.7 ollow 21	ea from Tal Table 9a) In Jul 6 0.6 Steps 3 to 7	Al 0.6	sep	Oct 0.98	Nov 0.99	Dec 1	21	(85) (86) (87)
Temperature Utilisation fact Jan (86)m= 1 Mean internat (87)m= 21 Temperature (88)m= 20.21	during heater for gain Feb 0.99 lt temperat 21 during heat 20.21	rature (ating points for limited for limi	heating eriods in ving are Apr 0.96 iving are 21 eriods in 20.21	season the livi ea, h1,m May 0.9 ea T1 (for 21 rest of 20.21	ng ar (see Ju 0.7 ollow 21 dwel 20.2	ea from Tal Table 9a) In Jul 6 0.6 Steps 3 to 7 1 21 Ing from Ta 21 20.21	A 0.67 in T 2 able 9	sep	Oct 0.98	Nov 0.99	Dec 1	21	(85)
Temperature Utilisation fact Jan (86)m= 1 Mean internat (87)m= 21 Temperature (88)m= 20.21 Utilisation fact	during heater for gain Feb 0.99 ltemperat 21 during heater 20.21 eter for gain	rature (ating points for li Mar 0.99 ture in l 21 ating points for r	heating eriods in ving are 0.96 iving are 21 eriods in 20.21 est of dv	season the livi ea, h1,m May 0.9 ea T1 (for 21 n rest of 20.21 welling,	ng ar (see Ju 0.7 ollow 21 dwel 20.2	ea from Tal Table 9a) In Jul 6 0.6 Steps 3 to 7 1 21 ling from Ta 21 20.21 (see Table	Al 0.6 7 in T 2 able 9	s, Th1 (°C) ug Sep 66 0.88 Table 9c) 1 21 9, Th2 (°C) 21 20.21	Oct 0.98	Nov 0.99 21 20.21	Dec 1 21 20.21	21	(85) (86) (87) (88)
Temperature Utilisation fact Jan (86)m= 1 Mean internat (87)m= 21 Temperature (88)m= 20.21 Utilisation fact (89)m= 0.99	during heater for gain feet for for gain feet for gain feet for gain feet for gain feet for gain feet for gain feet for gain feet for gain feet for gain feet for gain feet for gain feet for gain feet feet feet feet feet feet feet fee	rature (ating points for li Mar 0.99 cure in l 21 ating points for r 0.98 0.98	heating eriods in ving are Apr 0.96 iving are 21 eriods in 20.21 est of dv 0.95	season the livi ea, h1,m May 0.9 ea T1 (for 21 n rest of 20.21 welling, 0.87	ng ar (see 0.7 ollow 21 dwel 20.2 h2,m	ea from Tal Table 9a) In Jul 6 0.6 Steps 3 to 7 1 21 Iling from Ta 21 20.21 (see Table 9 0.5	A 0.6 7 in T 2 able 9 20. 9a) 0.5	s, Th1 (°C) ug Sep 66 0.88 Table 9c) 1 21 9, Th2 (°C) 21 20.21	Oct 0.98 21 20.21 0.97	Nov 0.99	Dec 1	21	(85) (86) (87)
Temperature Utilisation fact Jan (86)m= 1 Mean internation (87)m= 21 Temperature (88)m= 20.21 Utilisation fact (89)m= 0.99 Mean internation	during heater for gain representation for gain represe	rature (ating points for li Mar 0.99 ture in l 21 ating points for r 0.98 ture in t	heating eriods in Apr 0.96 iving are 21 eriods in 20.21 est of do 0.95 he rest of	season the livi ea, h1,m May 0.9 ea T1 (for 21 rest of 20.21 welling, 0.87 of dwell	ng ar (see	ea from Tal Table 9a) In Jul 6 0.6 Steps 3 to 7 21 ling from Ta 21 20.21 (see Table 9 0.5 2 (follow ste	Al 0.6 7 in T 2 able 9 20. 9a) 0.5	y, Th1 (°C) ug Sep 66 0.88 Table 9c) 1 21 9, Th2 (°C) 21 20.21 67 0.84 to 7 in Table	Oct 0.98 21 20.21 0.97 e 9c)	Nov 0.99 21 20.21	Dec 1 21 20.21	21	(85) (86) (87) (88) (89)
Temperature Utilisation fact Jan (86)m= 1 Mean internat (87)m= 21 Temperature (88)m= 20.21 Utilisation fact (89)m= 0.99	during heater for gain representation for gain represe	rature (ating points for li Mar 0.99 cure in l 21 ating points for r 0.98 0.98	heating eriods in ving are Apr 0.96 iving are 21 eriods in 20.21 est of dv 0.95	season the livi ea, h1,m May 0.9 ea T1 (for 21 n rest of 20.21 welling, 0.87	ng ar (see 0.7 ollow 21 dwel 20.2 h2,m	ea from Tal Table 9a) In Jul 6 0.6 Steps 3 to 7 21 ling from Ta 21 20.21 (see Table 9 0.5 2 (follow ste	A 0.6 7 in T 2 able 9 20. 9a) 0.5	g Sep 66 0.88 Table 9c) 1 21 9, Th2 (°C) 21 20.21 67 0.84 1 to 7 in Table 21 20.21	Oct 0.98 21 20.21 0.97 e 9c) 20.21	Nov 0.99 21 20.21 0.99	Dec 1 21 20.21 1 20.21		(85) (86) (87) (88) (89)
Temperature Utilisation fact Jan (86)m= 1 Mean internation (87)m= 21 Temperature (88)m= 20.21 Utilisation fact (89)m= 0.99 Mean internation	during heater for gain representation for gain represe	rature (ating points for li Mar 0.99 ture in l 21 ating points for r 0.98 ture in t	heating eriods in Apr 0.96 iving are 21 eriods in 20.21 est of do 0.95 he rest of	season the livi ea, h1,m May 0.9 ea T1 (for 21 rest of 20.21 welling, 0.87 of dwell	ng ar (see	ea from Tal Table 9a) In Jul 6 0.6 Steps 3 to 7 21 ling from Ta 21 20.21 (see Table 9 0.5 2 (follow ste	Al 0.6 7 in T 2 able 9 20. 9a) 0.5	g Sep 66 0.88 Table 9c) 1 21 9, Th2 (°C) 21 20.21 67 0.84 1 to 7 in Table 21 20.21	Oct 0.98 21 20.21 0.97 e 9c) 20.21	Nov 0.99 21 20.21	Dec 1 21 20.21 1 20.21	0.3	(85) (86) (87) (88) (89)
Temperature Utilisation fact Jan (86)m= 1 Mean internation (87)m= 21 Temperature (88)m= 20.21 Utilisation fact (89)m= 0.99 Mean internation (90)m= 20.21 Mean internation	during heater for gain feet for for gain feet for gain feet for gain feet for gain feet for gain feet for gain feet for gain feet for gain feet for gain feet for gain feet for gain feet for gain feet for gain feet for gain feet for gain feet for gain feet feet for gain feet feet feet feet feet feet feet fee	rature (ating points for li Mar 0.99 cure in li 21 ating points for ri 0.98 cure in ti 20.21 cure in ti 20.21 cure in ti 20.21	heating eriods in ving are Apr 0.96 iving are 21 eriods in 20.21 est of do 0.95 he rest 6 20.21	season the livi ea, h1,m May 0.9 ea T1 (for 21 n rest of 20.21 welling, 0.87 of dwell 20.21	ng ar (see Ju 0.7 ollow 21 dwel 20.2 h2,m 0.6 ing T2	ea from Tal Table 9a) In Jul 6 0.6 Steps 3 to 7 1 21 Iling from Ta 21 20.21 (see Table 9 0.5 2 (follow ste 21 20.21	Al 0.6 7 in T 2 able 9 20. 9a) 0.5 eps 3	Th1 (°C) ug Sep 66 0.88 Table 9c) 1 21 9, Th2 (°C) 21 20.21 67 0.84 1 to 7 in Table 21 20.21	Oct 0.98 21 20.21 0.97 e 9c) 20.21	Nov 0.99 21 20.21 0.99 20.21	Dec 1 21 20.21 1 20.21		(85) (86) (87) (88) (89)
Temperature Utilisation fact Jan (86)m= 1 Mean internation (87)m= 21 Temperature (88)m= 20.21 Utilisation fact (89)m= 0.99 Mean internation (90)m= 20.21	during heater for gain feet for for gain feet for gain feet for gain feet for gain feet for gain feet for for gain feet for for gain feet for for gain feet for for gain feet feet for for gain feet feet feet feet feet feet feet fee	rature (ating points for li Mar 0.99 cure in li 21 ating points for ri 0.98 cure in ti 20.21 cure (for 20.45	heating eriods in ving are Apr 0.96 iving are 21 eriods in 20.21 est of do 0.95 he rest 6 20.21 r the who 20.45	season the livi ea, h1,m May 0.9 ea T1 (for 21 n rest of 20.21 welling, 0.87 of dwell 20.21 ole dwe 20.45	mg ar (see Ju 0.7 ollow 21 20.2 h2,m 0.6 ling T2 20.2 llling) 20.4	ea from Tal Table 9a) In Jul 6 0.6 Steps 3 to 7 1 21 Iling from Ta 21 20.21 (see Table 9 0.5 2 (follow stee 21 20.21 = fLA x T1 45 20.45	All 0.6 7 in T 2 able 9 20. 9a) 0.5 eps 3 20. + (1	Th1 (°C) ug Sep 66 0.88 Table 9c) 1 21 9, Th2 (°C) 21 20.21 67 0.84 to 7 in Tabl 21 20.21 f f LA) × T2 45 20.45	Oct 0.98 21 20.21 0.97 e 9c) 20.21 LA = Liv	Nov 0.99 21 20.21 0.99 20.21 ring area ÷ (-	Dec 1 21 20.21 1 20.21		(85) (86) (87) (88) (89)

(02)	20.45	20.45	20.45	20.45	20.45	20.45	20.45	20.45	20.45	20.45	20.45	20.45	1	(93)
(93)m=	20.45		L		20.45	20.45	20.45	20.45	20.45	20.45	20.45	20.45		(90)
			uirement		ro obtoin	ad at at	on 11 of	Toble O	b 00 tb0	+ Ti m /	76\m an	d ro oolo	vuloto	
			ernar ter or gains	•		eu ai si	ер птог	rable 9	o, so ma	t 11,ff1=(rojili ali	d re-calc	uiate	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
	ation fac	tor for g	ains, hm	1:			,	,						
(94)m=	1	0.99	0.98	0.96	0.88	0.71	0.53	0.6	0.86	0.97	0.99	1		(94)
Usefu	ıl gains,	hmGm	W = (94)	4)m x (8	4)m		•						•	
(95)m=	431.3	459.43	490.52	523.53	514.57	413.09	292.23	301.69	388.87	406.05	404.73	413.81		(95)
Month	nly aver	age exte	rnal tem	perature	from Ta	able 8							1	
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat	loss rate	for mea	an intern	al tempe	erature,	Lm , W =	=[(39)m	x [(93)m	– (96)m]	_			
(97)m=	1264.8	1217.8	1092.49	904.52	685.23	458.1	301.46	317.12	497.26	771.38	1045.5	1272.63		(97)
Space	e heatin	g require	ement fo	r each n	nonth, k\	Wh/mon	th = 0.02	24 x [(97)m – (95)m] x (4	1)m			
(98)m=	620.12	509.63	447.87	274.32	126.97	0	0	0	0	271.81	461.36	638.96		
			-	-			-	Tota	l per year	(kWh/yeaı	r) = Sum(9	8) _{15,912} =	3351.03	(98)
Space	e heatin	a require	ement in	kWh/m²	2/vear								36.25	(99)
		• •)				00.20](**/
			nts – Indi	ividuai n	eating sy	ystems i	ncluaing	micro-C	HP)					
•	e heatir	•	ot from c	ocondor	v/cupple	montary	cyctom						0	(201)
	•		at from s			пепату	•		(004)				0	╡
Fracti	ion of sp	ace hea	at from m	nain syst	em(s)			(202) = 1	- (201) =				1	(202)
Fracti	ion of to	tal heati	ng from	main sys	stem 1			(204) = (2	02) × [1 –	(203)] =			1	(204)
Efficie	ency of r	main spa	ace heat	ing syste	em 1								287.39	(206)
Efficie	ency of s	seconda	ry/suppl	ementar	y heating	g system	ո, %						0	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ar
Space	e heatin	g require	ement (c	alculate	d above))								
	620.12	509.63	447.87	274.32	126.97	0	0	0	0	271.81	461.36	638.96		
(211)m	n = {[(98)m x (20	(4)] } x 1	00 ÷ (20	06)		=	-	-		-	-	•	(211)
,	215.77	177.33	155.84	95.45	44.18	0	0	0	0	94.58	160.53	222.33		
			!	<u> </u>			<u> </u>	Tota	l (kWh/yea	ar) =Sum(2	1 211) _{15.1012}	<u> </u>	1166.01	(211)
Snace	a haatin	a fual (e	econdar	v) k\//b/	month									J` ′
		•	00 ÷ (20	• •	month									
(215)m=		0	0	0	0	0	0	0	0	0	0	0		
(- /			<u> </u>						l (kWh/yea	ar) =Sum(2	1 215), _{540 4} ,	=	0	(215)
14/040#	h = =4!:==	_							` ,	, ,	715,1012			_(=:=)
	heating		ter (calc	ulated a	hovo)									
Output	186.88	164.25	171.4	152.13	147.98	130.64	123.96	138.1	138.51	157.82	168.79	181.87		
Efficier		ater hea											207.67	(216)
(217)m=		207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.07	(217)
. ,					207.07	207.07	207.07	207.07	207.07	207.07	207.07	207.07		(211)
		•	kWh/mo (217) ÷ (
(219)m=		79.09	82.54	73.26	71.26	62.91	59.69	66.5	66.7	76	81.28	87.58		
,			I					Tota	l = Sum(2	19a) ₁₁₂ =	l		896.78	(219)
Annua	al totals								•		Wh/year		kWh/year	」` ⁻′
		fuel use	ed, main	system	1					ĸ	y cai		1166.01	7
•	3			•									<u> </u>	

					_
Water heating fuel used				896.78]
Electricity for pumps, fans and electric keep-hot					
mechanical ventilation - balanced, extract or posi-	itive input from outside		288.44		(230a)
Total electricity for the above, kWh/year	sum of (2	230a)(230g) =		288.44	(231)
Electricity for lighting				445.58	(232)
Electricity generated by PVs				-932.71	(233)
Total delivered energy for all uses (211)(221) +	(231) + (232)(237b) =			1864.1	(338)
12a. CO2 emissions – Individual heating systems	s including micro-CHP				
	Energy kWh/year	Emission fac kg CO2/kWh	ctor	Emissions kg CO2/yea	r
Space heating (main system 1)	(211) x	0.519	=	605.16	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	465.43	(264)
Space and water heating	(261) + (262) + (263) + (264)	=		1070.59	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	149.7	(267)
Electricity for lighting	(232) x	0.519	=	231.25	(268)
Energy saving/generation technologies Item 1		0.519	=	-484.08	(269)
Total CO2, kg/year	s	sum of (265)(271) =		967.47	(272)
Dwelling CO2 Emission Rate	((272) ÷ (4) =		10.47	(273)

El rating (section 14)

91

(274)

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 10:59:40

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:** Flat

Total Floor Area: 52.98m²

Dwelling Details:

NEW DWELLING DESIGN STAGE

Site Reference: 231 Watford Road - GREEN **Plot Reference:** Sample 7

Address:

Client Details:

Name: Address:

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity

Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER) 25.05 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 7.90 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 35.9 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 27.6 kWh/m²

OK

2 Fabric U-values

Element Average Highest 0.16 (max. 0.70) External wall 0.15 (max. 0.30) OK Party wall 0.00 (max. 0.20) **OK**

Floor (no floor) Roof (no roof)

Openings 1.10 (max. 2.00) OK 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 3.50 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system:

Heat pumps with radiators or underfloor heating - electric

NIBE Fighter 360

Secondary heating system: None

5 Cylinder insulation

No Separate Cylinder Hot water Storage:

N/A

6 Controls			
Space heating controls Hot water controls:	TTZC by plumbing and e No cylinder thermostat No cylinder	electrical services	ок
7 Low energy lights			
Percentage of fixed lights wi Minimum	th low-energy fittings	100.0% 75.0%	ок
8 Mechanical ventilation			
Continuous extract system Specific fan power: Maximum		1.05 0.7	Fail
9 Summertime temperature			
Overheating risk (Thames v. Based on: Overshading:		Slight Average or unknown	ОК
Windows facing: South East Ventilation rate:		6.39m² 6.00	
10 Key features			
Air permeablility Windows U-value Party Walls U-value Photovoltaic array		3.5 m³/m²h 1.1 W/m²K 0 W/m²K	

		Hear F	Details:						
Assessor Name:	Neil Ingham	USEI L	Strom	a Num	ber:		STRO	010943	
Software Name:	Stroma FSAP 2012		Softwa					on: 1.0.5.41	
		Property	Address	: Sample	e 7				
Address :									
1. Overall dwelling dime	ensions:	Δre	a(m²)		Δν Ηρ	ight(m)		Volume(m³	١
Ground floor				(1a) x		2.75	(2a) =	145.69	(3a)
Total floor area TFA = (1	a)+(1b)+(1c)+(1d)+(1e)+(1	n)	52.98	(4)					_
Dwelling volume				(3a)+(3b)+(3c)+(3c	d)+(3e)+	(3n) =	145.69	(5)
2. Ventilation rate:									
	main seconda heating heating		other		total			m³ per hou	r
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 fa	ins			- F	0	X	10 =	0	(7a)
Number of passive vents	;			Ī	0	x	10 =	0	(7b)
Number of flueless gas fi	ires			Ī	0	x	40 =	0	(7c)
				_					
				_			Air ch	nanges per ho	_
	ys, flues and fans = (6a)+(6b)+ neen carried out or is intended, proce			continue f	0		÷ (5) =	0	(8)
Number of storeys in the		cu to (11),	ourorwise (sonunae n	0111 (3) 10	(10)		0	(9)
Additional infiltration						[(9)	-1]x0.1 =	0	(10)
Structural infiltration: 0	.25 for steel or timber frame of	or 0.35 fo	r masoni	ry consti	ruction			0	(11)
if both types of wall are p deducting areas of openi	resent, use the value corresponding	to the grea	ter wall are	a (after					
•	floor, enter 0.2 (unsealed) or).1 (seale	ed), else	enter 0				0	(12)
If no draught lobby, en	,	(2222	- · / ,					0	(13)
• •	s and doors draught stripped							0	(14)
Window infiltration			0.25 - [0.2	2 x (14) ÷ 1	100] =			0	(15)
Infiltration rate			(8) + (10)	+ (11) + (12) + (13)	+ (15) =		0	(16)
Air permeability value,	q50, expressed in cubic metr	es per ho	our per s	quare m	etre of e	envelope	area	3.5	(17)
If based on air permeabil	lity value, then $(18) = [(17) \div 20] +$	(8), otherw	rise (18) = ((16)				0.18	(18)
	es if a pressurisation test has been de	one or a de	gree air pe	rmeability	is being u	sed	I		¬
Number of sides sheltere Shelter factor	ea		(20) = 1 -	[0.075 x (⁻	19)1 =			0	(19)
Infiltration rate incorporate	ting shelter factor		(21) = (18		-71			0.18	(21)
Infiltration rate modified f	•		` , `	, , ,				0.16	(21)
Jan Feb	Mar Apr May Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	peed from Table 7								
(22)m= 5.1 5	4.9 4.4 4.3 3.8	3.8	3.7	4	4.3	4.5	4.7]	
Wind Factor (22a)m = (2.	2)m ÷ 4								
<u> </u>	1.23 1.1 1.08 0.95	0.95	0.92	1	1.08	1.12	1.18]	
` '	1 32 3.00	1		<u> </u>	L		<u> </u>	J	

Adjusted infiltra	ation rat	e (allowi	ng for sh	nelter an	d wind s	speed) =	(21a) x	(22a)m						
0.22	0.22	0.21	0.19	0.19	0.17	0.17	0.16	0.18	0.19	0.2	0.21			
Calculate effect		_	rate for t	he appli	cable ca	se	-	-	-					(23a)
If exhaust air he			endix N, (2	3b) = (23a	a) × Fmv (e	equation (N	N5)) , othe	rwise (23b) = (23a)			0.		$\int_{(23b)}^{(23b)}$
If balanced with		0		, ,	, ,	. ,	,, .	`	, , ,				.5)	(23c)
a) If balance	d mecha	anical ve	ntilation	with he	at recove	erv (MVI	HR) (24a	a)m = (2)	2b)m + (23b) x [1 – (23c)		<u>, </u>](200)
(24a)m= 0	0	0	0	0	0	0	0	0	0	0	0]		(24a)
b) If balance	d mech	anical ve	ntilation	without	heat red	overy (N	лV) (24b	m = (22)	2b)m + (23b)	·	,		
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0			(24b)
c) If whole h if (22b)n				•					.5 × (23b	D)		•		
(24c)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5]		(24c)
d) If natural if (22b)n									0.5]			1		
(24d)m= 0	0	0	0	0	0	0	0	0	0	0	0			(24d)
Effective air	change	rate - er	iter (24a) or (24b	o) or (24	c) or (24	d) in box	(25)				_		
(25)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5			(25)
3. Heat losse	s and he	eat loss r	paramete	er:										
ELEMENT	Gros	•	Openin		Net Ar	ea	U-valı	ıe	ΑXU		k-value	9	ΑХ	k
	area	(m²)	m	²	A ,r		W/m2		(W/	K)	kJ/m²-	K	kJ/k	(
Windows					6.39	x1.	/[1/(1.1)+	0.04] =	6.73	ᆜ .				(27)
Walls Type1	22.1	7	6.39		15.78	3 X	0.16	=	2.52		60	╛╘	946.8	(29)
Walls Type2	17.2	2	0		17.22	2 x	0.15	=	2.58		60		1033.2	(29)
Total area of e	lements	, m²			39.39)								(31)
Party wall					46.48	3 X	0	=	0		45		2091.6	(32)
Party floor					52.98	3					40		2119.2	(32a)
Party ceiling					52.98	3					30		1589.4	(32b)
Internal wall **					97.63	3					9		878.67	(32c)
* for windows and ** include the area						ated using	formula 1	/[(1/U-valu	ıe)+0.04] a	as given in	paragraph	3.2		
Fabric heat los				is anu pan	uuoris		(26)(30)	+ (32) =				11	.84	(33)
Heat capacity		,	0)				, , , , ,		(30) + (32	2) + (32a).	(32e) =		8.87	(34)
Thermal mass			P = Cm ÷	- TFA) ir	n kJ/m²K			,,,,,	÷ (4) =	, (,	(= -)		3.44	(35)
For design assess	•	`		,			ecisely the	` '	. ,	TMP in T	able 1f	100	,](00)
can be used inste						_								7
Thermal bridge	•	•			•	<						6.4	45	(36)
if details of therma Total fabric he		are not kn	own (36) =	= 0.05 x (3	1)			(33) +	(36) =			18	29	(37)
Ventilation hea		alculated	l monthly	/					= 0.33 × ((25)m x (5))	10		/ ۱۷۰
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec]		
(38)m= 24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	24.04	1		(38)
Heat transfer of	coefficier	nt, W/K					•	(39)m	= (37) + (38)m	•	•		
(39)m= 42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33]		
					•	•	•		Average =	Sum(39) ₁	12 /12=	42	.33	(39)

Heat loss para	meter (l	HLP). W/	m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8		
()										Sum(40) ₁ .		0.8	(40)
Number of day	s in mo	nth (Tabl	e 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)
							Į.		Į				
4. Water heat	ing one	rav roqui	romont:								kWh/ye	or:	
4. Water near	ing ene	igy requi	rement.								KVVII/ye	tai.	
Assumed occu if TFA > 13.9 if TFA £ 13.9	0, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9)2)] + 0.0	0013 x (⁻	TFA -13		78		(42)
Annual average Reduce the annual									se target o		.43		(43)
not more that 125	litres per	person per	day (all w	ater use, l	hot and co	ld)							
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in	litres pe	day for ea	ch month	Vd,m = fa	ctor from	Table 1c x	(43)		-		-		
(44)m= 84.07	81.01	77.96	74.9	71.84	68.78	68.78	71.84	74.9	77.96	81.01	84.07		
							•			m(44) ₁₁₂ =		917.12	(44)
Energy content of	hot water	used - cal	culated mo	onthly = 4.	190 x Vd,r	n x nm x C	OTm / 3600) kWh/mor	nth (see Ta	ables 1b, 1	c, 1d)		
(45)m= 124.67	109.04	112.52	98.1	94.13	81.22	75.27	86.37	87.4	101.86	111.18	120.74		_
									Total = Su	m(45) ₁₁₂ =	=	1202.49	(45)
If instantaneous wa	ater neati	ng at point	of use (no	not water	r storage),	enter 0 in	boxes (46)) to (61)		,	1		
(46)m= 18.7	16.36	16.88	14.71	14.12	12.18	11.29	12.96	13.11	15.28	16.68	18.11		(46)
Water storage Storage volume		. inaludin	a 001/0	olor or M	WHDC	otorogo	within or	ama vaa	ool		1		(47)
•	` '		•			•		airie ves	SEI	0			(47)
If community he Otherwise if no	•			•			` '	ers) ente	er '∩' in <i>(</i>	47)			
Water storage		not wate	/ (tillo li	1014465 1	motantai	10000 00	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	ora, oric	31 0 111 ((-17)			
a) If manufactu		eclared l	oss facto	or is kno	wn (kWł	n/day):				0.	54		(48)
Temperature fa	actor fro	m Table	2b		•	- 7				0.9	072		(49)
Energy lost from				ear			(48) x (49)) =			0		(50)
b) If manufactu		_	-		or is not	known:					0		()
Hot water stora	-			e 2 (kW	h/litre/da	ıy)					0		(51)
If community h	_		on 4.3								-		
Volume factor f			OL								0		(52)
Temperature fa											0		(53)
Energy lost from		_	, kWh/ye	ear			(47) x (51)) x (52) x (53) =	-	0		(54)
Enter (50) or (, ,	,								0.	91		(55)
Water storage	loss cal	culated f	or each	month			((56)m = (55) × (41)ı	m 				
(56)m= 28.12	25.4	28.12	27.22	28.12	27.22	28.12	28.12	27.22	28.12	27.22	28.12		(56)
If cylinder contains	dedicate	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Append	ix H	
(57)m= 28.12	25.4	28.12	27.22	28.12	27.22	28.12	28.12	27.22	28.12	27.22	28.12		(57)
Primary circuit	•	•									0		(58)
Primary circuit				,	•	. ,	, ,						
(modified by				i	i	i				<u> </u>			(EO)
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

0 111				(0.4)	(00)	o= (44)							
Combi loss o				,	` '	<u> </u>		Т.		Ι.		1	(04)
(61)m= 0	0	0	0	0	0	0	0	0	0	0	0	J	(61)
							`		ì '	ì ´	r` ´ 	(59)m + (61)m	
(62)m= 152.8		140.64	125.31	122.25	108.44	103.39	114.49		129.98	138.4	148.86	J	(62)
Solar DHW inpu									r contribut	ion to wate	er heating)		
(add addition						 		 			1	1	
(63)m= 0	0	0	0	0	0	0	0	0	0	0	0	J	(63)
Output from	water hea	ter										1	
(64)m= 152.8	134.44	140.64	125.31	122.25	108.44	103.39	114.49	114.62	129.98	138.4	148.86		-
							Ou	tput from w	ater heate	r (annual) ₁	12	1533.62	(64)
Heat gains fr	om water	heating,	kWh/mo	onth 0.2	5 ´ [0.85	× (45)m	+ (61)	m] + 0.8 x	k [(46)m	+ (57)m	+ (59)m]	
(65)m= 41.45	36.26	37.41	32.62	31.3	27.01	25.03	28.72	29.06	33.87	36.97	40.15		(65)
include (57	7)m in cald	culation c	of (65)m	only if c	ylinder i	s in the	dwelling	or hot w	ater is f	rom com	munity h	neating	
5. Internal	gains (see	Table 5	and 5a):									
Metabolic ga	,												
Jan		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec]	
(66)m= 88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	1	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m= 15.32	13.6	11.06	8.38	6.26	5.29	5.71	7.42	9.96	12.65	14.77	15.74]	(67)
Appliances g	ains (calc	ulated in	Append	dix L, eq	uation L	13 or L1	3a), als	o see Ta	ble 5	•	•	•	
(68)m= 154.9°	7 156.57	152.52	143.9	133.01	122.77	115.93	114.32	118.38	127	137.89	148.13]	(68)
Cooking gair	ns (calcula	ıted in Ar	pendix	L. eguat	ion L15	or L15a), also s	see Table	5			•	
(69)m= 31.89	_`	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	1	(69)
Pumps and f	ans gains	(Table 5	a)			<u> </u>	I		<u> </u>	l		ı	
(70)m= 0	0	0	0	0	0	0	0	0	0	0	0	1	(70)
Losses e.g. e	evaporatio	n (negat	ive valu	es) (Tab	le 5)	<u> </u>	l		!		<u> </u>	J	
(71)m= -71.12	 	-71.12	-71.12	-71.12	-71.12	-71.12	-71.12	-71.12	-71.12	-71.12	-71.12]	(71)
Water heatin	n nains (T	able 5)					<u> </u>		!		!	J	
(72)m= 55.72		50.29	45.3	42.07	37.51	33.64	38.6	40.36	45.52	51.35	53.96	1	(72)
` '			10.0	12.01		<u> </u>		+ (69)m +		l	<u> </u>	J	()
(73)m= 275.6		263.54	247.24	231	215.24	204.95	210.02	- ` 	234.85	253.68	267.5	1	(73)
6. Solar gai		203.34	241.24	201	210.24	204.93	210.02	210.57	234.03	200.00	207.5		(10)
Solar gains are		usina solar	flux from	Table 6a	and assoc	iated equa	itions to d	convert to th	ne applicat	ole orientat	tion		
Orientation:		•	Area		Flu	•		g_	о арриоа	FF		Gains	
Onomation.	Table 6d		m ²			ble 6a		Table 6b	Т	able 6c		(W)	
Southeast 0.9x	0.77	x	6.3	39	x :	36.79) x [0.63	x [0.7		71.85	(77)
Southeast 0.9x		x	6.3		—	62.67]	0.63	╡╺╞	0.7	= =	122.39](77)
Southeast 0.9x	• • • • • • • • • • • • • • • • • • • •	X	6.3			35.75] ^ <u> </u>] x [0.63	^	0.7	╡ -	167.46](77)
Southeast 0.9x	<u> </u>	×	6.3			06.25] ^ <u> </u>] _x [0.63	^	0.7		207.5](77)
Southeast 0.9x		_			-		┆ ⊨		⊣		=](77)
Journal (1.9)	0.77	X	6.3	99	x 1	19.01	X	0.63	X	0.7	=	232.41	$L^{(II)}$

Southeast 0.9x 0.77	X	6.3	9	x	118.15] x [0.63	x	0.7	=	230.73	(77)
Southeast 0.9x 0.77	x	6.3	9	x	113.91	x	0.63	x	0.7	=	222.45	(77)
Southeast 0.9x 0.77	X	6.3	9	x	104.39	_ x [0.63	x	0.7	=	203.86	(77)
Southeast 0.9x 0.77	X	6.3	9	x	92.85] x [0.63	x	0.7	=	181.33	(77)
Southeast 0.9x 0.77	X	6.3	9	x	69.27] x [0.63	x	0.7	=	135.27	(77)
Southeast 0.9x 0.77	X	6.3	9	x	44.07] x	0.63	x	0.7	=	86.06	(77)
Southeast 0.9x 0.77	X	6.3	9	x	31.49] x [0.63	x	0.7	=	61.49	(77)
Solar gains in watts, c					T	1 	= Sum(74)m	<u> </u>			Ī	(00)
(83)m= 71.85 122.39	167.46	207.5	232.41	230.73		203.8	6 181.33	135.27	86.06	61.49		(83)
Total gains – internal a	431	454.74	463.41	445.97	427.4	413.8	8 399.7	370.12	339.74	328.99]	(84)
` '				l	427.4	413.0	399.7	370.12	339.74	320.99		(04)
7. Mean internal temp		_										_
Temperature during h				•		ble 9,	Th1 (°C)				21	(85)
Utilisation factor for g				r `	1 	1		0-4	Nan	Data]	
Jan Feb	Mar	Apr	May	Jun	Jul	Aug	<u> </u>	Oct	Nov	Dec		(86)
(86)m= 0.98 0.97	0.94	0.87	0.75	0.58	0.43	0.46	0.68	0.89	0.97	0.99		(00)
Mean internal temper	1 1		,	I	i 	1			T		1	(07)
(87)m= 21 21	21	21	21	21	21	21	21	21	21	21		(87)
Temperature during h	 			r	`	1					1	
(88)m= 20.25 20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25	20.25		(88)
Utilisation factor for g	ains for r	est of d	welling,	h2,m (s	ee Table	9a)					•	
(89)m= 0.98 0.96	0.93	0.85	0.71	0.52	0.36	0.39	0.62	0.87	0.96	0.98		(89)
Mean internal temper	ature in t	he rest	of dwell	ng T2 (follow ste	eps 3 t	o 7 in Tab	le 9c)	_		_	
(90)m= 20.25 20.25	20.25	20.25	20.25	20.25	20.25	20.25	5 20.25	20.25	20.25	20.25		(90)
							1	fLA = Livir	ng area ÷ (4) =	0.4	(91)
Mean internal temper	ature (fo	r the wh	ole dwe	lling) =	fLA × T1	+ (1 –	fLA) × T2				_	
(92)m= 20.56 20.56	20.56	20.56	20.56	20.56	20.56	20.56	20.56	20.56	20.56	20.56		(92)
Apply adjustment to t	1 1		•	ì	1	1		·			1	(22)
(93)m= 20.56 20.56	20.56	20.56	20.56	20.56	20.56	20.56	20.56	20.56	20.56	20.56		(93)
8. Space heating req		on orotius	o obtoir	and at a	top 11 of	Toblo	Oh oo tha	at Time /	76\m an	d ro colo	vulata	
Set Ti to the mean in the utilisation factor for				ieu ai s	ер п о	rabie	90, 80 1118	ıt 11,111=((10)III ali	iu re-caic	Julate	
Jan Feb	Mar	Apr	May	Jun	Jul	Aug	g Sep	Oct	Nov	Dec		
Utilisation factor for g	ains, hm	•				•		•			•	
(94)m= 0.98 0.96	0.93	0.86	0.73	0.55	0.39	0.42	0.64	0.88	0.96	0.98		(94)
Useful gains, hmGm	`	<u> </u>		ı		_		1			1	(0-)
(95)m= 340.86 381.9	400.99	390.69	338.16	244.7	166.3	174.2	3 257.54	324.31	327.58	324.03		(95)
Monthly average exterior (96)m= 4.3 4.9	6.5	perature 8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	1	(96)
Heat loss rate for me					1				1 '.'	7.2		(00)
(97)m= 688.1 662.7	594.97	493.39	374.87	252.11	167.45	175.9		421.43	569.58	692.33		(97)
Space heating requir	ement fo	r each m	nonth, k	Vh/mor	1 = 0.02	24 x [(9	97)m – (95	i)m] x (4	1)m	Į	I	
(98)m= 258.34 188.7	144.32	73.94	27.31	0	0	0	0	72.26	174.24	274.02		
											_	

				Tota	l per year	(kWh/year	r) = Sum(9	08) _{15,912} =	1213.13	(98)
Space heating requirement in kWh	/m²/year								22.9	(99)
9a. Energy requirements – Individua	al heating s	ystems i	ncluding	micro-C	CHP)					
Space heating:	1 / 1-		(г		¬(004)
Fraction of space heat from secon		ementary	•		(004)			ļ	0	(201)
Fraction of space heat from main s	` '			(202) = 1	, ,	(000)1		ļ	1	(202)
Fraction of total heating from main	•			(204) = (2	02) x [1 –	(203)] =		ļ	1	(204)
Efficiency of main space heating s			0.4					ļ	277.43	(206)
Efficiency of secondary/supplemer	tary heatin	g systen	า, % เ						0	(208)
Jan Feb Mar A		Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ear
Space heating requirement (calcul 258.34 188.7 144.32 73.9		0	0	0	0	72.26	174.24	274.02		
$(211)m = \{[(98)m \times (204)] \} \times 100 \div$		_	l °			12.20	177.27	214.02		(211)
93.12 68.02 52.02 26.6		0	0	0	0	26.04	62.8	98.77		(211)
	1					ar) =Sum(2			437.27	(211)
Space heating fuel (secondary), k\	Vh/month							L		
$= \{[(98)m \times (201)]\} \times 100 \div (208)$				_	_	_	_			
(215)m= 0 0 0 0	0	0	0	0	0	0	0	0		_
				Tota	I (kWh/yea	ar) =Sum(2	215) _{15,101}	2=	0	(215)
Water heating	- -									
Output from water heater (calculate 152.8 134.44 140.64 125.		108.44	103.39	114.49	114.62	129.98	138.4	148.86		
Efficiency of water heater	!			l		l		<u>'</u>	207.67	(216)
(217)m= 207.67 207.67 207.67 207.	67 207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67		(217)
Fuel for water heating, kWh/month	•	•	•	•	•	•	•			
(219) m = (64) m x $100 \div (217)$ m (219)m = 73.58 64.74 67.72 60.3	34 58.87	52.22	49.79	55.13	55.19	62.59	66.64	71.68		
(210)1112 01.172 01.172 00.1	00.07	02.22	40.70		I = Sum(2		00.04	71.00	738.49	(219)
Annual totals							Wh/yea	r L	kWh/yea	
Space heating fuel used, main syste	em 1						•	[437.27	
Water heating fuel used								Ī	738.49	$\overline{1}$
Electricity for pumps, fans and elect	ric keep-ho	ot						•		
mechanical ventilation - balanced,	extract or p	ositive i	nput fron	n outside	€			292.61		(230a)
Total electricity for the above, kWh/	/ear			sum	of (230a).	(230g) =		[292.61	(231)
Electricity for lighting								Ī	270.51	(232)
Electricity generated by PVs								Ī	-932.71	(233)
Total delivered energy for all uses (211)(221)) + (231)	+ (232).	(237b)	=			Ţ	806.17	(338)
12a. CO2 emissions – Individual h	eating syste	ems incl	uding mi	cro-CHF)			L		
			ergy				ion fac	tor	Emissions	

kWh/year

kg CO2/year

kg CO2/kWh

Space heating (main system 1)	(211) x	0.519	=	226.94	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	383.28	(264)
Space and water heating	(261) + (262) + (263) + (264) =			610.22	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	151.86	(267)
Electricity for lighting	(232) x	0.519	=	140.39	(268)
Energy saving/generation technologies Item 1		0.519	=	-484.08	(269)
Total CO2, kg/year	sum	n of (265)(271) =		418.4	(272)
Dwelling CO2 Emission Rate	(272	2) ÷ (4) =		7.9	(273)
El rating (section 14)				94	(274)

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 10:59:39

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:** Flat

Total Floor Area: 74.55m²

Dwelling Details:

Site Reference:

NEW DWELLING DESIGN STAGE

Plot Reference: 231 Watford Road - GREEN Sample 8

Address:

Client Details:

Name:

Address:

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity

Fuel factor: 1.55 (electricity)

23.1 kg/m² Target Carbon Dioxide Emission Rate (TER)

Dwelling Carbon Dioxide Emission Rate (DER) 8.08 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 39.5 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 30.6 kWh/m²

OK

2 Fabric U-values

Element Average Highest 0.16 (max. 0.70) External wall 0.16 (max. 0.30) OK Party wall 0.00 (max. 0.20) **OK** Floor (no floor)

Roof (no roof)

Openings 1.10 (max. 2.00) OK 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 3.50 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system:

Heat pumps with radiators or underfloor heating - electric

NIBE Fighter 360

Secondary heating system: None

5 Cylinder insulation

No Separate Cylinder Hot water Storage:

N/A

6 Controls			
Space heating controls Hot water controls:	TTZC by plumbing and e No cylinder thermostat No cylinder	electrical services	ок
7 Low energy lights			
Percentage of fixed lights v Minimum	vith low-energy fittings	100.0% 75.0%	ОК
8 Mechanical ventilation			
Continuous extract system Specific fan power: Maximum		1.05 0.7	Fail
9 Summertime temperature			
Overheating risk (Thames of Based on: Overshading: Windows facing: South East Windows facing: South Ventilation rate:		Slight Average or unknown 12.79m² 1.28m² 6.00	ОК
10 Key features			

User Details:	
Assessor Name: Neil Ingham Stroma Number: STRO010 Software Name: Stroma FSAP 2012 Software Version: Version:	
Property Address: Sample 8 Address:	
1. Overall dwelling dimensions:	
	olume(m³)
Ground floor 74.55 (1a) x 2.75 (2a) =	205.01 (3a)
Total floor area TFA = $(1a)+(1b)+(1c)+(1d)+(1e)+(1n)$ 74.55	
Dwelling volume $(3a)+(3b)+(3c)+(3d)+(3e)+(3n) =$	205.01 (5)
2. Ventilation rate:	
main secondary other total m heating heating	n ³ per hour
Number of chimneys $0 + 0 + 0 = 0 \times 40 =$	0 (6a)
Number of open flues $0 + 0 + 0 = 0 \times 20 =$	0 (6b)
Number of intermittent fans 0 x 10 =	0 (7a)
Number of passive vents 0 x 10 =	0 (7b)
Number of flueless gas fires 0 x 40 =	0 (7c)
Air chang	jes per hour
Infiltration due to chimneys, flues and fans = $(6a)+(6b)+(7a)+(7b)+(7c) = 0$ $\div (5) = 0$	0 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16) Number of storeys in the dwelling (ns)	0 (9)
Additional infiltration [(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0 (11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35	
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0 (12)
If no draught lobby, enter 0.05, else enter 0	0 (13)
Percentage of windows and doors draught stripped	0 (14)
Window infiltration $0.25 - [0.2 \times (14) \div 100] =$	0 (15)
Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area If based on air permeability value, then $(18) = [(17) \div 20] + (8)$, otherwise $(18) = (16)$	3.5 (17)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used	0.18 (18)
Number of sides sheltered	0 (19)
Shelter factor (20) = 1 - [0.075 x (19)] =	1 (20)
Infiltration rate incorporating shelter factor (21) = (18) x (20) =	0.18 (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	
Wind I actor (22a)III - (22)III - 4	

Adjusted infiltr	ation rat	e (allowi	ng for sh	nelter an	d wind s	peed) =	(21a) x	(22a)m					
0.22	0.22	0.21	0.19	0.19	0.17	0.17	0.16	0.18	0.19	0.2	0.21		
Calculate effe		•	rate for t	he appli	cable ca	se	•			•			
If mechanical If exhaust air h			andiv N (2	3h) - (23a) × Emy (e	auation (1	VSV) other	nvice (23h) = (23a)			0.5	(23
) = (23a)			0.5	(23
If balanced with		-	•	_					21.) (001 \ 5	4 (00.)	0	(23
a) If balance						• •	, <u>, , , , , , , , , , , , , , , , , , </u>	<u> </u>	 	- 	- ` ` `	÷ 100] I	(24
(24a)m= 0			0	0	0	0	0	0	0	0	0		(24
b) If balance							·	í ·	 		1 .	Ī	(0.4
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
c) If whole h				•	•		on from c c) = (22b		5 × (23b)			
(24c)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(24
d) If natural if (22b)r				•			on from I 0.5 + [(2		0.5]				
(24d)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
Effective air	change	rate - er	iter (24a) or (24b	o) or (24	c) or (24	d) in box	(25)	-	-	-		
(25)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(25
3. Heat losse	s and he	at loss r	naramete	⊃r·									
ELEMENT	Gros area	SS	Openin m	gs	Net Ar A ,r		U-valı W/m2		A X U (W/		k-value kJ/m²-ł		X k J/K
Windows Type		()			12.79				13.48				(27
Windows Type					1.28	_	·		1.35	\exists			(27
Walls Type1		. <u>. </u>	440	,		=		—, ¦		╡ ,		T [466	`
Walls Type1	41.8		14.0	<u>/</u>	27.78	=	0.16	=	4.44	<u> </u>	60	1666	=
• •	24.3		0		24.37	=	0.15	=	3.65		60	1462	 `
Total area of e	ements	, 1112			66.22	=							(31
Party wall					41.82	X	0	=	0		45	1881	.9 (32
Party floor					74.55						40	298	2 (32
Party ceiling					74.55						30	2236	5.5 (32
nternal wall **	•				131.1	2					9	1180	.08 (32
for windows and						ated using	formula 1	/[(1/U-valu	ıe)+0.04] a	as given in	paragraph	3.2	
** include the area				is and pan	itions		(26)(30)	+ (32) =			ĺ	00.00	
Fabric heat los		•	U)				(20)(00)	, ,	(20) + (2)	2) + (225)	(320) -	22.92	(33
Heat capacity	,		0 – Cm :	TEALin	le 1/m2le			,	(30) + (32) (4) =	2) + (32a).	(32e) =	11409.48	(34
Thermal mass For design assess	•	•		•			acisaly the	` '	. ,	TMD in T	ahle 1f	153.04	(35
can be used inste	ad of a de	tailed calc	ulation.				ecisely life	indicative	values of	TIVII III I	able II		
Thermal bridg					-	(9.46	(36
f details of therma Γotal fabric he		are not kn	own (36) =	= 0.05 x (3	1)			(33) +	(36) =			32.38	(37
/entilation hea	at loss ca	alculated	l monthly	y				(38)m	= 0.33 × ((25)m x (5)		
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
38)m= 33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83		(38
Heat transfer	coefficier	nt, W/K						(39)m	= (37) + (38)m		-	
(39)m= 66.21	66.21	66.21	66.21	66.21	66.21	66.21	66.21	66.21	66.21	66.21	66.21		
												———	

Heat loss para	ameter (I	HLP), W	′m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89		
						l	l		Average =	Sum(40) ₁ .	12 /12=	0.89	(40)
Number of day	1	nth (Tab	le 1a)		ı			ı					
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 hea	ting ene	rgy requi	irement:								kWh/ye	ear:	
Assumed occu if TFA > 13. if TFA £ 13.	9, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9)2)] + 0.0	0013 x (¯	TFA -13		35		(42)
Annual average Reduce the annual not more that 125	ge hot wa al average	hot water	usage by	5% if the a	lwelling is	designed t			se target o		.04		(43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage i								- 1					
(44)m= 99.05	95.45	91.85	88.24	84.64	81.04	81.04	84.64	88.24	91.85	95.45	99.05		
	•								Total = Su	m(44) ₁₁₂ =		1080.53	(44)
Energy content of	f hot water	used - cal	culated mo	onthly = 4.	190 x Vd,r	n x nm x C	OTm / 3600) kWh/mor	nth (see Ta	ables 1b, 1	c, 1d)		
(45)m= 146.89	128.47	132.57	115.58	110.9	95.7	88.68	101.76	102.97	120	130.99	142.25		
If instantaneous u	votor hoot	na ot noint	of upo (no	hot woto	r otorogol	ontor O in	hayaa (16		Total = Su	m(45) ₁₁₂ =	=	1416.75	(45)
If instantaneous v			·	i	· · ·		· · ·	, , , I		1			(40)
(46)m= 22.03 Water storage	19.27	19.89	17.34	16.63	14.35	13.3	15.26	15.45	18	19.65	21.34		(46)
Storage volum) includir	ng any so	olar or W	/WHRS	storage	within sa	ame ves	sel	0			(47)
If community h	neating a	and no ta	ınk in dw	elling, e	nter 110	litres in	(47)						
Otherwise if no	o stored	hot wate	er (this in	icludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in ((47)			
Water storage													
a) If manufact				or is kno	wn (kWł	n/day):				0.	54		(48)
Temperature f										0.9	072		(49)
Energy lost fro		•					(48) x (49)) =			0		(50)
b) If manufactHot water stor			-								0		(51)
If community h	•			_ (,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	-77					0		(0.7)
Volume factor	from Ta	ble 2a									0		(52)
Temperature f	factor fro	m Table	2b								0		(53)
Energy lost fro		_	, kWh/ye	ear			(47) x (51)) x (52) x (53) =		0		(54)
Enter (50) or	(54) in (55)								0.	91		(55)
Water storage	loss cal	culated t	for each	month			((56)m = ((55) × (41)	m				
(56)m= 28.12	25.4	28.12	27.22	28.12	27.22	28.12	28.12	27.22	28.12	27.22	28.12		(56)
If cylinder contain	s dedicate	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (H11)] ÷ (5	0), else (5	7)m = (56)	m where (H11) is fro	m Append	ix H	
(57)m= 28.12	25.4	28.12	27.22	28.12	27.22	28.12	28.12	27.22	28.12	27.22	28.12		(57)
Primary circuit	t loss (ar	nnual) fro	m Table	3							0		(58)
Primary circuit	•	•			59)m = ((58) ÷ 36	65 × (41)	m					
(modified by	/ factor f	rom Tab	le H5 if t	here is s	olar wat	ter heatii	ng and a	cylinde	r thermo	stat)			
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

Combi loss calculated for each month $(61)m = (60) \div 365 \times (41)m$													
(61)m= 0	0 0	or each	0	0	(6U) ÷ 30	05 × (41)	0	T 0	0	T 0	0	1	(61)
	ļ		<u> </u>	<u> </u>								(E0)m + (61)m	(01)
(62)m= 175.01	153.87	160.69	142.79	139.02	122.91	116.8	129.88	130.19	148.13	158.21	170.37	· (59)m + (61)m]	(62)
Solar DHW input		<u> </u>	<u> </u>	L]	(02)
(add additiona									i contribu	iion to wate	or ricating)		
(63)m= 0	0	0	0	0	0	0	0		0	0	0]	(63)
Output from w	/ater hea	ter		ļ		ļ				ļ.		1	
(64)m= 175.01	153.87	160.69	142.79	139.02	122.91	116.8	129.88	130.19	148.13	158.21	170.37	1	
	1	l .	l .	<u> </u>		!	Ou	tput from w	ater heate	r (annual)	12	1747.88	(64)
Heat gains fro	m water	heating,	kWh/m	onth 0.2	5 ´ [0.85	× (45)m	ı + (61)ı	m] + 0.8 x	k [(46)m	+ (57)m	+ (59)m]	_
(65)m= 48.84	42.72	44.08	38.43	36.87	31.82	29.48	33.83	34.24	39.9	43.56	47.3	1	(65)
include (57)	m in calc	culation of	of (65)m	only if c	ylinder i	s in the	dwelling	or hot w	ater is f	rom com	munity h	neating	
5. Internal g	•				•							,	
Metabolic gair	ns (Table	5), Wat	ts										
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec]	
(66)m= 117.57	117.57	117.57	117.57	117.57	117.57	117.57	117.57	117.57	117.57	117.57	117.57	1	(66)
Lighting gains	(calcula	ted in Ap	pendix	L, equati	on L9 o	r L9a), a	lso see	Table 5		-		-	
(67)m= 18.78	16.68	13.56	10.27	7.68	6.48	7	9.1	12.22	15.51	18.1	19.3]	(67)
Appliances ga	ains (calc	ulated ir	Append	dix L, eq	uation L	13 or L1	3a), als	o see Ta	ble 5		•	•	
(68)m= 207.68	209.83	204.4	192.84	178.25	164.53	155.37	153.21	158.64	170.2	184.8	198.51]	(68)
Cooking gains	s (calcula	ted in A	ppendix	L, equat	ion L15	or L15a), also s	ee Table	5	•	•	•	
(69)m= 34.76	34.76	34.76	34.76	34.76	34.76	34.76	34.76	34.76	34.76	34.76	34.76]	(69)
Pumps and fa	ıns gains	(Table 5	ōa)									•	
(70)m= 0	0	0	0	0	0	0	0	0	0	0	0]	(70)
Losses e.g. e	vaporatio	n (nega	tive valu	es) (Tab	le 5)			-		-		-	
(71)m= -94.05	-94.05	-94.05	-94.05	-94.05	-94.05	-94.05	-94.05	-94.05	-94.05	-94.05	-94.05]	(71)
Water heating	gains (T	able 5)				•	•		•		•	•	
(72)m= 65.64	63.56	59.25	53.37	49.56	44.19	39.63	45.48	47.55	53.63	60.49	63.57]	(72)
Total interna	l gains =				(66))m + (67)m	n + (68)m	+ (69)m +	(70)m + (7	71)m + (72))m	•	
(73)m= 350.37	348.34	335.48	314.75	293.75	273.47	260.27	266.06	276.68	297.61	321.66	339.65	1	(73)
6. Solar gain	s:							1					
Solar gains are	calculated	using sola	r flux from	Table 6a	and assoc	iated equa	ations to o	onvert to th	ne applical	ole orienta	tion.		
Orientation:			Area		Flu			g_ -	-	FF		Gains	
	Table 6d		m²		I al	ble 6a		Table 6b	_ '	able 6c		(W)	_
Southeast 0.9x	0.77	X	12.	79	x 3	36.79	X	0.63	Х	0.7	=	143.82	(77)
Southeast 0.9x	0.77	X	12.	79	x 6	62.67	x	0.63	x	0.7	=	244.98	(77)
Southeast 0.9x	0.77	X	12.	79	х <u></u> 8	35.75	x	0.63	x [0.7	=	335.19	(77)
Southeast 0.9x	0.77	Х	12.	79	x 1	06.25	x	0.63	x	0.7	=	415.32	(77)
Southeast 0.9x	0.77	X	12.	79	x 1	19.01	x	0.63	x	0.7	=	465.19	(77)

I		_1								_				_
Southeast 0.9x	0.77	X	12.	79	X	1	18.15	X	0.63	X	0.7	=	461.82	(77)
Southeast 0.9x	0.77	X	12.	79	X	1	13.91	X	0.63	X	0.7	=	445.25	(77)
Southeast 0.9x	0.77	X	12.	79	X	10	04.39	X	0.63	X	0.7	=	408.04	(77)
Southeast 0.9x	0.77	X	12.	79	X	9	2.85	X	0.63	X	0.7	=	362.94	(77)
Southeast _{0.9x}	0.77	X	12.	79	X	6	9.27	X	0.63	X	0.7	=	270.75	(77)
Southeast 0.9x	0.77	X	12.	79	X	4	4.07	X	0.63	X	0.7	=	172.26	(77)
Southeast 0.9x	0.77	X	12.	79	X	3	1.49	X	0.63	X	0.7	=	123.08	(77)
South 0.9x	0.77	X	1.2	28	x	4	6.75	x	0.63	X	0.7	=	18.29	(78)
South 0.9x	0.77	X	1.2	28	x	7	6.57	X	0.63	x	0.7		29.95	(78)
South 0.9x	0.77	X	1.2	28	x	9	7.53	x	0.63	x	0.7	=	38.15	(78)
South 0.9x	0.77	X	1.2	28	x	1	10.23	X	0.63	x	0.7	=	43.12	(78)
South 0.9x	0.77	X	1.2	28	x	1	14.87	X	0.63	х	0.7	=	44.94	(78)
South 0.9x	0.77	x	1.2	28	x	1	10.55	x	0.63	х	0.7	=	43.24	(78)
South 0.9x	0.77	X	1.2	28	x	10	08.01	x	0.63	x	0.7	=	42.25	(78)
South 0.9x	0.77	×	1.2	28	x	10	04.89	x	0.63	x	0.7	=	41.03	(78)
South 0.9x	0.77	X	1.2	28	x	10	01.89	x	0.63	x	0.7	-	39.86	(78)
South 0.9x	0.77	×	1.2	28	x	8	2.59	x	0.63	x	0.7		32.31	(78)
South 0.9x	0.77	×	1.2	28	x	5	5.42	x	0.63	x	0.7	-	21.68	(78)
South 0.9x	0.77	X	1.2	28	x		10.4	x	0.63	x	0.7	=	15.8	(78)
•		_												
Solar gains in	watts, calcu	lated	for eacl	h month	1			(83)m	n = Sum(74)m .	(82)m			_	
(83)m= 162.11	274.93 37	3.34	458.44	510.12	50	05.07	487.5	449	.07 402.79	303.00	193.94	138.88		(83)
Total gains –	nternal and	solar	(84)m =	= (73)m	+ (8	83)m	, watts						_	
(84)m= 512.48	623.27 70	8.82	773.19	803.88	77	78.54	747.77	715	.13 679.48	600.67	7 515.6	478.54		(84)
7. Mean inte	rnal tempera	turo /											<u>I</u>	(04)
Temperature		ilure ((heating	seasor	າ)					•				(04)
	during heat		`			area f	rom Tat	ole 9,	, Th1 (°C)				21	(85)
Utilisation fac	•	ing p	eriods ir	n the livi	ng :			ole 9,	, Th1 (°C)				21	
-	ctor for gains	ing p	eriods ir	n the livi	ng a				, Th1 (°C)	Oct	Nov	Dec	21	
Utilisation fac	ctor for gains	ing po	eriods ir iving are	n the livi ea, h1,m	ng a	ee Ta	ble 9a)		ug Sep	Oct	Nov 0.96	Dec 0.98	21	
Utilisation fac Jan (86)m= 0.98	Feb 1	ing po for li Mar .91	eriods ir iving are Apr 0.82	n the livi ea, h1,m May	ng a	ee Ta Jun ^{0.52}	ble 9a) Jul 0.38	A:	ug Sep 12 0.62	 	+		21	(85)
Utilisation fac	Feb 1 0.95 0 1 temperature	ing po for li Mar .91	eriods ir iving are Apr 0.82	n the livi ea, h1,m May	ng a	ee Ta Jun ^{0.52}	ble 9a) Jul 0.38	A:	ug Sep 12 0.62 Table 9c)	 	+		21	(85)
Utilisation factors (86)m= 0.98 Mean internation (87)m= 21	Feb 1 0.95 0 1 temperature 21	ing positions for library in the second seco	eriods ir iving are Apr 0.82 iving are	n the livi ea, h1,m May 0.69 ea T1 (f	ng a	ee Ta Jun 0.52 w ste	ble 9a) Jul 0.38 ps 3 to 7	0.4 ' in T	ug Sep 12 0.62 Table 9c)	0.86	0.96	0.98	21	(85)
Utilisation factors (86)m= 0.98 Mean internation	Feb 1 0.95 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	ing positions for library in the second seco	eriods ir iving are Apr 0.82 iving are	n the livi ea, h1,m May 0.69 ea T1 (f	ng and (see	ee Ta Jun 0.52 w ste	ble 9a) Jul 0.38 ps 3 to 7	0.4 ' in T	ug Sep 12 0.62 Table 9c) 1 21 9, Th2 (°C)	0.86	0.96	0.98	21	(85)
Utilisation factors Jan (86)m= 0.98 Mean internation (87)m= 21 Temperature (88)m= 20.18	Feb 1 0.95 0 0 0 0 0 0 0 0 0	ing positions for line in large in large in large in large positions positions in large p	eriods ir iving are Apr 0.82 iving are 21 eriods ir 20.18	n the livies, h1,m May 0.69 ea T1 (f 21 n rest of 20.18	ng a (se	ee Ta Jun 0.52 w ste 21 relling	Jul 0.38 ps 3 to 7 21 from Ta 20.18	Au 0.4 7 in T 2 able 9 20.	ug Sep 12 0.62 Table 9c) 1 21 9, Th2 (°C)	0.86	0.96	0.98	21	(85) (86) (87)
Utilisation factors (86)m= 0.98 Mean internation (87)m= 21 Temperature (88)m= 20.18 Utilisation factors (81)m= 20.18	Feb 1 0.95 0 1 temperature 21 20.18 20 ctor for gains	ing positions for library in libr	eriods ir iving are 0.82 iving are 21 eriods ir 20.18	n the livies, h1,m May 0.69 ea T1 (for 21 n rest of 20.18 welling,	ng (so (so (so so	ee Ta Jun 0.52 w ste 21 relling 0.18	Jul 0.38 ps 3 to 7 21 from Ta 20.18	Ai 0.4 7 in T 2 8 ble 9 20.	ug Sep 12 0.62 Table 9c) 1 21 9, Th2 (°C) 18 20.18	0.86 21 20.18	21 20.18	0.98 21 20.18	21	(85) (86) (87) (88)
Utilisation factors (86)m= 0.98 Mean internation (87)m= 21 Temperature (88)m= 20.18 Utilisation factors (89)m= 0.97	Feb 1 0.95 0 0 0 0 0 0 0 0 0	ing positions for limited in limi	eriods ir iving are 0.82 iving are 21 eriods ir 20.18 est of do	n the livies, h1,m May 0.69 ea T1 (for 21 n rest of 20.18 welling, 0.64	ng (se collo dw 2 h2,	ee Ta Jun 0.52 w ste 21 relling 0.18 m (se 0.46	Jul 0.38 ps 3 to 7 21 from Ta 20.18 pe Table 0.32	Ai 0.4 7 in T 2 ble 9 20. 9a) 0.3	ug Sep 12 0.62 Table 9c) 1 21 9, Th2 (°C) 18 20.18	0.86 21 20.18	0.96	0.98	21	(85) (86) (87)
Utilisation factors (86)m= 0.98 Mean internation (87)m= 21 Temperature (88)m= 20.18 Utilisation factors (89)m= 0.97 Mean internation	Feb 1 0.95 0 0 0 0 0 0 0 0 0	ing positions for line in land positions for residual land	eriods ir iving are Apr 0.82 iving are 21 eriods ir 20.18 est of do 0.79 the rest	n the living the livin	ng (so (so (so so	ee Ta Jun 0.52 w ste 21 velling 0.18 m (se 0.46 T2 (fo	Jul 0.38 ps 3 to 7 21 from Ta 20.18 ee Table 0.32 bllow ste	Al 0.44 / in T 2 / 20. 9a) 0.3	ug Sep 12 0.62 Table 9c) 1 21 19, Th2 (°C) 18 20.18 15 0.56 16 7 in Table	0.86 21 20.18 0.83 le 9c)	0.96 21 20.18	0.98 21 20.18 0.98	21	(85) (86) (87) (88) (89)
Utilisation factors (86)m= 0.98 Mean internation (87)m= 21 Temperature (88)m= 20.18 Utilisation factors (89)m= 0.97	Feb 1 0.95 0 0 0 0 0 0 0 0 0	ing positions for limited in limi	eriods ir iving are 0.82 iving are 21 eriods ir 20.18 est of do	n the livies, h1,m May 0.69 ea T1 (for 21 n rest of 20.18 welling, 0.64	ng (so (so (so so	ee Ta Jun 0.52 w ste 21 relling 0.18 m (se 0.46	Jul 0.38 ps 3 to 7 21 from Ta 20.18 pe Table 0.32	Ai 0.4 7 in T 2 ble 9 20. 9a) 0.3	ug Sep 12 0.62 Table 9c) 1 21 9, Th2 (°C) 18 20.18 10 7 in Table 18 20.18	0.86 21 20.18 0.83 le 9c) 20.18	0.96 21 20.18 0.95	0.98 21 20.18 0.98		(85) (86) (87) (88) (89) (90)
Utilisation factors (86)m= 0.98 Mean internation (87)m= 21 Temperature (88)m= 20.18 Utilisation factors (89)m= 0.97 Mean internation	Feb 1 0.95 0 0 0 0 0 0 0 0 0	ing positions for line in land positions for residual land	eriods ir iving are Apr 0.82 iving are 21 eriods ir 20.18 est of do 0.79 the rest	n the living the livin	ng (so (so (so so	ee Ta Jun 0.52 w ste 21 velling 0.18 m (se 0.46 T2 (fo	Jul 0.38 ps 3 to 7 21 from Ta 20.18 ee Table 0.32 bllow ste	Al 0.44 / in T 2 / 20. 9a) 0.3	ug Sep 12 0.62 Table 9c) 1 21 9, Th2 (°C) 18 20.18 10 7 in Table 18 20.18	0.86 21 20.18 0.83 le 9c) 20.18	0.96 21 20.18	0.98 21 20.18 0.98	0.4	(85) (86) (87) (88) (89)
Utilisation factors Jan (86)m= 0.98 Mean internation (87)m= 21 Temperature (88)m= 20.18 Utilisation factors (89)m= 0.97 Mean internation (90)m= 20.18	Feb 1 0.95 0 0 0 0 0 0 0 0 0	ing positions for limited in limi	eriods ir iving are 0.82 iving are 21 eriods ir 20.18 est of do 0.79 the rest 20.18	n the living the livin	ng ; (see collowing to the collowing to	ee Ta Jun 0.52 w ste 21 relling 0.18 m (se 0.46 T2 (fo	Jul 0.38 ps 3 to 7 21 from Ta 20.18 e Table 0.32 ollow ste 20.18	Al 0.4 ' in T 2 ble 9 20. 9a) 0.3	ug Sep 12 0.62 Table 9c) 1 21 9, Th2 (°C) 18 20.18 15 0.56 16 to 7 in Table 18 20.18	0.86 21 20.18 0.83 le 9c) 20.18	0.96 21 20.18 0.95	0.98 21 20.18 0.98		(85) (86) (87) (88) (89) (90)
Utilisation factors (86)m= 0.98 Mean internation (87)m= 21 Temperature (88)m= 20.18 Utilisation factors (89)m= 0.97 Mean internation (90)m= 20.18	retor for gains Feb 0.95 0 al temperatur 21 during heat 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18 20.18	ing positions for limited in the second in t	eriods ir iving are Apr 0.82 iving are 21 eriods ir 20.18 est of do 0.79 the rest 20.18 r the wh 20.5	the livies, h1,m May 0.69 ea T1 (f 21 rest of 20.18 welling, 0.64 of dwell 20.18	ng : (se collo col	ee Ta Jun 0.52 w ste 21 relling 0.18 m (se 0.46 T2 (fo 20.18 g) = fl 20.5	Jul 0.38 ps 3 to 7 21 from Ta 20.18 ee Table 0.32 bllow ste 20.18 A × T1 20.5	Ain 0.4 7' in T 2' 20. 9a) 0.3 20. + (1 20.	ug Sep 12 0.62 Table 9c) 1 21 9, Th2 (°C) 18 20.18 15 0.56 16 7 in Table 18 20.18 - fLA) × T2 15 20.5	0.86 21 20.18 0.83 le 9c) 20.18 fLA = Liv	0.96 21 20.18 0.95 20.18 ving area ÷ (0.98 21 20.18 0.98		(85) (86) (87) (88) (89) (90)

(00)	00.5	00.5	00.5	00.5	00.5	00.5	00.5	00.5	00.5	00.5	00.5	00.5		(93)
(93)m=	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5		(93)
			uirement				44 -£	T-1-1- 0	41	4 T: /	70)	-11-	late	
			or gains			ed at ste	ep 11 or	i abie 9i	o, so tha	t 11,m=(76)m an	d re-calc	culate	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisa	ation fac	tor for g	ains, hm	1:									•	
(94)m=	0.98	0.95	0.9	0.8	0.66	0.49	0.34	0.38	0.59	0.84	0.95	0.98		(94)
Usefu	ıl gains,	hmGm	W = (94)	4)m x (84	4)m								•	
(95)m=	500.11	591.21	636.78	622.24	531.55	379.71	256.47	268.75	399.8	505.17	492.01	469.6		(95)
Month	nly aver	age exte	rnal tem	perature	from Ta	able 8								
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat	loss rate	for mea	an intern	al tempe	erature,	Lm , W =	=[(39)m	x [(93)m	– (96)m]			1	
(97)m=	1072.8	1033.08	927.15	768.25	582.87	390.86	258.45	271.69	423.97	655.7	887.42	1079.43		(97)
Space	e heatin	g require	ement fo	r each n	nonth, k\	Wh/mon	th = 0.02	24 x [(97)m – (95)m] x (4	1)m			
(98)m=	426.09	296.94	216.03	105.13	38.18	0	0	0	0	111.99	284.7	453.71		
			-					Tota	l per year	(kWh/yeaı	r) = Sum(9	8) _{15,912} =	1932.77	(98)
Space	e heatin	a reauire	ement in	kWh/m²	² /vear								25.93] (99)
		• •				:	a alvedia a	:	YUD)				20.00	J` ′
	· · · · · · · · · · · · · · · · · · ·		nts – Indi	ividuai n	eating sy	ystems i	nciuaing	micro-C	HP)					
•	e heatir	•	at from s	ocondon	v/cupple	montary	cyctom					I	0	(201)
	•					memary	-	(202) 4	(004)				0	╣ .
Fracti	on of sp	ace hea	at from m	naın syst	em(s)			(202) = 1	, ,				1	(202)
Fracti	ion of to	tal heati	ng from	main sys	stem 1			(204) = (2	02) × [1 – ((203)] =			1	(204)
Efficie	ency of r	nain spa	ace heat	ing syste	em 1								296.31	(206)
Efficie	ency of s	seconda	ry/suppl	ementar	y heating	g system	ո, %						0	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ar
Space	e heatin	g require	ement (c	alculate	d above))								
	426.09	296.94	216.03	105.13	38.18	0	0	0	0	111.99	284.7	453.71		
(211)m	n = {[(98)m x (20	(4)] } x 1	00 ÷ (20	06)		=	=	-		-	_	•	(211)
,	143.8	100.21	72.91	35.48	12.89	0	0	0	0	37.79	96.08	153.12		
								Tota	l (kWh/yea	ar) =Sum(2	211) _{15,1012}		652.27	(211)
Snace	e heatin	n fuel (s	econdar	v) k\//h/	month]
•		• '	00 ÷ (20	• •	111011111									
(215)m=		0	0	0	0	0	0	0	0	0	0	0		
. ,								<u> </u>	l I (kWh/yea	ar) =Sum(2	1 215), _{510 10}	<u> </u> ,=	0	(215)
Water	heating										7 10, 10 12			J` ′
	_		ter (calc	ulated al	hove)									
Output	175.01	153.87	160.69	142.79	139.02	122.91	116.8	129.88	130.19	148.13	158.21	170.37		
Efficier	ncy of w	ater hea						<u> </u>			l		207.67	(216)
(217)m=		207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.07	」\
, ,					201.01	201.01	201.01	201.01	207.07	201.01	207.07	201.01		(= · ·)
		•	kWh/mo (217) ÷ (
(219)m=		74.09	77.38	68.76	66.94	59.19	56.24	62.54	62.69	71.33	76.18	82.04		
		<u> </u>				<u> </u>		Tota	I = Sum(21	19a) ₁₁₂ =	ı	•	841.66	(219)
Annua	al totals										Wh/year	r	kWh/year	J` -'
		fuel use	ed, main	system	1						<i>a y</i> Gui		652.27	1
•	J			-									<u> </u>	_

					_
Water heating fuel used				841.66	
Electricity for pumps, fans and electric keep-hot					
mechanical ventilation - balanced, extract or posi-	itive input from outside		267.37]	(230a)
Total electricity for the above, kWh/year	sum of (23	30a)(230g) =		267.37	(231)
Electricity for lighting				331.6	(232)
Electricity generated by PVs				-932.71	(233)
Total delivered energy for all uses (211)(221) +	1160.2	(338)			
12a. CO2 emissions – Individual heating systems	s including micro-CHP				
	Energy kWh/year	Emission fackg CO2/kWh		Emissions kg CO2/yea	ır
Space heating (main system 1)	(211) x	0.519	=	338.53	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	436.82	(264)
Space and water heating	(261) + (262) + (263) + (264) =	=		775.35	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	138.77	(267)
Electricity for lighting	(232) x	0.519	=	172.1	(268)
Energy saving/generation technologies Item 1		0.519	=	-484.08	(269)
Total CO2, kg/year	SI	um of (265)(271) =		602.14	(272)
Dwelling CO2 Emission Rate	(2	272) ÷ (4) =	8.08	(273)	

El rating (section 14)

(274)

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Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 10:59:38

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 48m²

Plot Reference: Site Reference: 231 Watford Road - GREEN Sample 9

Address:

Client Details:

Name: Address:

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity

Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER) 31.37 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 10.40 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 55.2 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 42.1 kWh/m²

OK 2 Fabric U-values

Element Average Highest

0.16 (max. 0.70) External wall 0.15 (max. 0.30) OK Party wall 0.00 (max. 0.20) OK Floor (no floor)

Roof 0.12 (max. 0.20)

0.12 (max. 0.35) Openings 1.10 (max. 2.00) 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 3.50 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system:

Heat pumps with radiators or underfloor heating - electric

NIBE Fighter 360

Secondary heating system: None

5 Cylinder insulation

No Separate Cylinder Hot water Storage:

N/A

OK

OK

Regulations Compliance Report

6 Controls			
Space heating controls Hot water controls:	TTZC by plumbing and e No cylinder thermostat No cylinder	electrical services	ок
7 Low energy lights			
Percentage of fixed lights wi Minimum	th low-energy fittings	100.0% 75.0%	ок
8 Mechanical ventilation			
Continuous extract system Specific fan power: Maximum		1.05 0.7	Fail
9 Summertime temperature			
Overheating risk (Thames va Based on: Overshading: Windows facing: South Wes Ventilation rate:	.,	Slight Average or unknown 7.68m ² 6.00	ОК
10 Key features			
Air permeablility Windows U-value Roofs U-value Party Walls U-value Photovoltaic array		3.5 m³/m²h 1.1 W/m²K 0.12 W/m²K 0 W/m²K	

		l Iser I	Details:						
Assessor Name: Software Name:	Neil Ingham Stroma FSAP 2012		Strom Softwa					010943 on: 1.0.5.41	
Address :	F	Property	Address	Sample	e 9				
1. Overall dwelling dime	ensions:								
3		Are	a(m²)		Av. He	ight(m)		Volume(m	³)
Ground floor			48	(1a) x	2	2.75	(2a) =	132	(3a)
Total floor area TFA = (1	a)+(1b)+(1c)+(1d)+(1e)+(1	n)	48	(4)					<u> </u>
Dwelling volume				(3a)+(3b)+(3c)+(3c	d)+(3e)+	.(3n) =	132	(5)
2. Ventilation rate:									
	main seconda heating heating	ry	other		total			m³ per hou	ır
Number of chimneys	0 + 0	+ [0] = [0	X 4	40 =	0	(6a)
Number of open flues	0 + 0	- + -	0	Ī - [0	x	20 =	0	(6b)
Number of intermittent fa	ns				0	x -	10 =	0	(7a)
Number of passive vents				Ē	0	x -	10 =	0	(7b)
Number of flueless gas fi	res			F	0	X 4	40 =	0	(7c)
				L					
				_			Air ch	nanges per h	our —
•	ys, flues and fans = $(6a)+(6b)+(6b)+(6a)+(6b)+(6a)+(6b)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a)+(6a$				0		÷ (5) =	0	(8)
Number of storeys in the	een carried out or is intended, proceence	ea 10 (17),	otrierwise	onunue ir	om (9) to	(10)		0	(9)
Additional infiltration	3 ()					[(9)	-1]x0.1 =	0	(10)
	.25 for steel or timber frame o			•	ruction			0	(11)
if both types of wall are pudeducting areas of openia	resent, use the value corresponding t nas): if equal user 0.35	o the grea	ter wall are	a (after					
,	floor, enter 0.2 (unsealed) or 0	.1 (seal	ed), else	enter 0				0	(12)
If no draught lobby, en	ter 0.05, else enter 0							0	(13)
-	s and doors draught stripped							0	(14)
Window infiltration			0.25 - [0.2	. ,	-			0	(15)
Infiltration rate	250 averaged in autic mate		(8) + (10)					0	(16)
•	q50, expressed in cubic metro ity value, then $(18) = [(17) \div 20] + (18)$	•		•	etre or e	envelope	area	3.5	(17)
· ·	es if a pressurisation test has been do				is being u	sed		0.18	(10)
Number of sides sheltere	ed							0	(19)
Shelter factor			(20) = 1 -		19)] =			1	(20)
Infiltration rate incorporat	•		(21) = (18) x (20) =				0.18	(21)
Infiltration rate modified f	- 1 	11	1 4	0.5.5	0-4	Nan	Data	1	
Jan Feb	Mar Apr May Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp (22)m= 5.1 5	4.9 4.4 4.3 3.8	3.8	3.7	4	4.3	4.5	4.7]	
(1	1	<u>'</u>	I	<u> </u>	l	I	
Wind Factor (22a)m = (22	' 							1	
(22a)m= 1.27 1.25	1.23 1.1 1.08 0.95	0.95	0.92	1	1.08	1.12	1.18		

1 000	ation rate						r `	` ´ 	0.40	0.0			
0.22 Calculate effe	0.22 Ctive air o	0.21 Change i	0.19 rate for t	0.19 he appli	0.17 Cable ca	0.17 se	0.16	0.18	0.19	0.2	0.21		
If mechanica		•										0.5	(23
If exhaust air h	eat pump ι	ısing Appe	endix N, (2	3b) = (23a	ı) × Fmv (e	equation (N	N5)) , othe	rwise (23b) = (23a)		Ī	0.5	(23
If balanced with	n heat reco	very: effic	iency in %	allowing f	or in-use f	actor (from	n Table 4h) =				0	(23
a) If balance	d mecha	anical ve	ntilation	with hea	at recove	ery (MVI	HR) (24a	a)m = (22)	2b)m + (23b) × [1 – (23c)	÷ 100]	
(24a)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
b) If balance	d mecha	anical ve	ntilation	without	heat rec	overy (N	ЛV) (24b)m = (22	2b)m + (2	23b)			
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
c) If whole h if (22b)r	ouse ext n < 0.5 ×			•	•				5 × (23b)			
(24c)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(24
d) If natural if (22b)r	ventilation $r = 1$, the			•	•				0.5]				
(24d)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
Effective air	change	rate - er	iter (24a	or (24b	o) or (24	c) or (24	d) in box	(25)					
(25)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		(25
3. Heat losse	s and he	at loss r	aramete	or.									
ELEMENT	Gros		Openin		Net Ar	ea	U-valı	ie	AXU		k-value	e A 2	(k
	area		m		A ,r		W/m2		(W/I	<)	kJ/m²-k		
Vindows					7.68	x1,	/[1/(1.1)+	0.04] =	8.09				(27
Walls Type1	28.9	5	7.68		21.27	<u>′</u> х	0.16	= [3.4		60	1276.2	(29
Walls Type2	40.2	9	0		40.29) X	0.15	= [6.03		60	2417.4	(29
Roof	48		0		48	X	0.12	= [5.76		9	432	(30
Total area of e	lements	, m²			117.2	4							(31
Party wall					22.38	x	0		0	\neg	45	1007.1	(32
Party floor					48						40	1920	(32
nternal wall **	ı				97.35	<u>=</u>					9	876.15	= (32
for windows and it include the area						ated using	ı formula 1	/[(1/U-valu	ie)+0.04] a	s given in	paragraph	3.2	_
abric heat los	ss, W/K =	= S (A x	U)				(26)(30)) + (32) =				23.29	(3:
Heat capacity	Cm = S(Axk)						((28)	.(30) + (32	2) + (32a).	(32e) =	7928.85	(34
	parame	ter (TMF	P = Cm ÷	- TFA) ir	kJ/m²K			= (34)	÷ (4) =		i	165.18	(3
Thermal mass		ere the de	tails of the	constructi	ion are not	t known pr	ecisely the	indicative	values of	TMP in T	able 1f		_
or design asses													\neg
For design assess an be used inste	ad of a det	ailed calcu	ulation.	using Ap	pendix ł	<						7.78	(3
For design assess an be used inste Thermal bridg f details of therma	ad of a det es : S (L al bridging a	ailed calcu x Y) calc	<i>ulation.</i> culated (•	<		(33) +	(36) =		[31.06	_
For design assess an be used inste Thermal bridge details of therma Total fabric he	ad of a det es:S(L al bridging a at loss	ailed calcu x Y) calcu are not kn	ulation. culated (own (36) =	= 0.05 x (3	•	<			(36) = = 0.33 × (25)m x (5	[]		_
For design assess can be used inste Thermal bridg f details of therma Total fabric he	ad of a det es:S(L al bridging a at loss	ailed calcu x Y) calcu are not kn	ulation. culated (own (36) =	= 0.05 x (3	•	Jul	Aug			25)m x (5 Nov) Dec		_
For design assess can be used inste Thermal bridge If details of thermal Total fabric he Ventilation hea Jan 38)m= 21.78	ad of a detention and of a detention and the second	ailed calcu x Y) calcu are not kn	ulation. culated to	= 0.05 x (3	1)		Aug 21.78	(38)m	= 0.33 × ((36)
For design assess can be used inste Thermal bridge of details of therma Total fabric he Ventilation hea	es : S (L al bridging a at loss at loss ca Feb 21.78	x Y) calc x Y) calc are not kn alculated Mar 21.78	ulation. culated to own (36) = I monthly	= 0.05 x (3 / May	Jun	Jul	⊢ <u> </u>	(38)m Sep 21.78	= 0.33 × (Nov 21.78	Dec		(37
For design assess an be used insternal bridger details of thermal fotal fabric here. Jan Jan 38)m= 21.78	es : S (L al bridging a at loss at loss ca Feb 21.78	x Y) calc x Y) calc are not kn alculated Mar 21.78	ulation. culated to own (36) = I monthly	= 0.05 x (3 / May	Jun	Jul	⊢ <u> </u>	(38)m Sep 21.78	= 0.33 × (Oct 21.78	Nov 21.78	Dec		(3

Heat loss para	ımeter (I	HLP), W	/m²K					(40)m	= (39)m ÷	- (4)			
(40)m= 1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1		
							ı	,	Average =	Sum(40) ₁	12 /12=	1.1	(40)
Number of day	/s in mo	nth (Tab	le 1a)			1		1	1	•			
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m= 31	28	31	30	31	30	31	31	30	31	30	31		(41)
4. Water hea	ting ene	rgy requi	irement:								kWh/ye	ear:	
Assumed occu if TFA > 13.9 if TFA £ 13.9	9, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9)2)] + 0.0	0013 x (¯	TFA -13		63		(42)
Annual average Reduce the annual not more that 125	al average	hot water	usage by	5% if the c	lwelling is	designed i			se target o		.95		(43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage i	n litres pe	r day for ea	ach month	Vd,m = fa	ctor from	Table 1c x	(43)						
(44)m= 80.24	77.32	74.4	71.49	68.57	65.65	65.65	68.57	71.49	74.4	77.32	80.24		
							- (222			m(44) ₁₁₂ =		875.35	(44)
Energy content of	hot water	used - cal	culated m	onthly = 4 .	190 x Vd,r	n x nm x E	OTm / 3600) kWh/mor	nth (see Ta	ables 1b, 1	c, 1d)		
(45)m= 118.99	104.07	107.39	93.63	89.84	77.52	71.84	82.44	83.42	97.22	106.12	115.24		_
If instantaneous v	vater heati	na at point	of use (no	hot water	r storage).	enter 0 in	boxes (46		Total = Su	m(45) ₁₁₂ =	=	1147.73	(45)
(46)m= 17.85	15.61	16.11	14.04	13.48	11.63	10.78	12.37	12.51	14.58	15.92	17.29		(46)
Water storage	l	10.11	14.04	13.40	11.03	10.70	12.57	12.51	14.50	10.92	17.29		(10)
Storage volum	ne (litres) includir	ng any so	olar or W	/WHRS	storage	within sa	ame ves	sel	0			(47)
If community h	neating a	and no ta	ınk in dw	elling, e	nter 110) litres in	(47)						
Otherwise if no		hot wate	er (this in	icludes i	nstantar	neous co	mbi boil	ers) ente	er '0' in ((47)			
Water storage		oolorod l	ana fant	aria kaa	/Id\A/k	2/dox4).							(40)
a) If manufact				JI IS KIIO	WII (KVVI	i/uay).					54		(48)
Temperature f							(40) (40)	\			072		(49)
Energy lost from b) If manufact		•			or is not		(48) x (49)) =			0		(50)
Hot water stor			-								0		(51)
If community h	_		on 4.3										
Volume factor			01								0		(52)
Temperature f											0		(53)
Energy lost fro		_	, kWh/ye	ear			(47) x (51)) x (52) x (53) =	-	0		(54)
Enter (50) or	` , ` `	,	for ooob	manth			//EC\m /	'EE\ (44).		0.	91		(55)
Water storage				ı	Ι	ı	· · ·	(55) × (41)	ı	ı	ı		(=0)
(56)m= 28.12 If cylinder contains	25.4	28.12	27.22	28.12	27.22	28.12	28.12	27.22	28.12	27.22	28.12	iv I I	(56)
· -	s dedicate	u solal slo		ii = (56)iii					ını where (IX II	
(57)m= 28.12	25.4	28.12	27.22	28.12	27.22	28.12	28.12	27.22	28.12	27.22	28.12		(57)
Primary circuit	loss (ar	nnual) fro	m Table	3							0		(58)
Primary circuit					•	. ,	, ,		(1.	-1-1			
(modified by		1	i	i	i					'			(EO)
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)

Combi loss calculated for each month $(61)m = (60) \div 365 \times (41)m$													
(61)m= 0	0	0	0	0 1)111 =	00) +	0)III 0	0	T 0	T 0	0	1	(61)
	<u>l</u>	<u> </u>										J · (59)m + (61)m	(-)
(62)m= 147.1	-i	135.52	120.85	117.96	104.74		110.5		125.34	133.34	143.36]	(62)
Solar DHW input		<u> </u>			<u> </u>		<u> </u>					7	(/
(add addition									21 001111100	tion to wat	or ricating,	,	
(63)m= 0	0	0	0	0	0	0	0	0	0	0	0	1	(63)
Output from	water hea	ter	<u> </u>		<u> </u>	ļ	I		<u>.</u>		<u> </u>	J	
(64)m= 147.1		135.52	120.85	117.96	104.74	99.96	110.5	66 110.64	125.34	133.34	143.36	1	
		l .	l		<u> </u>	-1		Utput from v	/ater heate	er (annual)	l12	1478.85	(64)
Heat gains f	rom water	heating,	, kWh/m	onth 0.2	5 ′ [0.8	5 × (45)m	า + (61)m] + 0.8	x [(46)m	ı + (57)m	+ (59)m	 n]	-
(65)m= 39.57		35.71	31.13	29.87	25.78	- ` 	27.4		32.32	35.29	38.32	1	(65)
include (5	7)m in cald	culation (of (65)m	only if c	vlinde	is in the	dwelli	ng or hot v	vater is f	rom com	munity h	neating	
5. Internal			. ,		,			<u> </u>			,	J	
Metabolic ga													
Jar		Mar	Apr	May	Jun	Jul	Au	g Sep	Oct	Nov	Dec]	
(66)m= 81.57	7 81.57	81.57	81.57	81.57	81.57	81.57	81.5	7 81.57	81.57	81.57	81.57]	(66)
Lighting gair	ns (calcula	ted in Ap	pendix	L, equat	ion L9	or L9a), a	ılso se	e Table 5				_	
(67)m= 13.2°	1 11.73	9.54	7.22	5.4	4.56	4.93	6.4	8.59	10.91	12.74	13.58]	(67)
Appliances (gains (calc	ulated ir	n Append	dix L, eq	uation	L13 or L1	3a), a	lso see Ta	able 5		-	_	
(68)m= 142.0	4 143.52	139.8	131.89	121.91	112.53	106.26	104.7	79 108.5	116.41	126.39	135.77]	(68)
Cooking gai	ns (calcula	ited in A	ppendix	L, equat	ion L1	5 or L15a), alsc	see Table	e 5		-	_	
(69)m= 31.16	31.16	31.16	31.16	31.16	31.16	31.16	31.1	6 31.16	31.16	31.16	31.16]	(69)
Pumps and	fans gains	(Table 5	5a)									_	
(70)m= 0	0	0	0	0	0	0	0	0	0	0	0]	(70)
Losses e.g.	evaporatio	n (nega	tive valu	es) (Tab	le 5)								
(71)m= -65.2	6 -65.26	-65.26	-65.26	-65.26	-65.26	-65.26	-65.2	6 -65.26	-65.26	-65.26	-65.26]	(71)
Water heatir	ng gains (T	able 5)										_	
(72)m= 53.18	51.49	48	43.24	40.15	35.8	32.1	36.8	4 38.52	43.45	49.01	51.5]	(72)
Total intern	al gains =	:			(6	6)m + (67)n	n + (68)	m + (69)m +	(70)m + (7	71)m + (72))m	_	
(73)m= 255.9	254.22	244.81	229.83	214.93	200.3	190.77	195.	203.09	218.24	235.61	248.33		(73)
6. Solar ga	ins:												
Solar gains ar		•				•	ations to	convert to t	he applica		tion.	_	
Orientation:	Access F Table 6d		Area m²			lux able 6a		g_ Table 6b	. 1	FF able 6c		Gains (W)	
Couthwests					_		1 6					. ,	7,
Southwesto.9		X			X	36.79] <u> </u>	0.63	×	0.7	=	86.36	(79)
Southweste o	<u> </u>	X			X	62.67]	0.63	×	0.7	=	147.1	[(79)
Southwesto o	<u> </u>	X			×	85.75] -	0.63	×	0.7	=	201.27	[(79)
Southwesters		X	7.6		X	106.25] -	0.63	×	0.7	_ =	249.38](79)
Southwest _{0.9}	× 0.77	X	7.6	88	Х	119.01	J L	0.63	X	0.7	=	279.33	(79)

Southwest _{0.9x} 0.77	x	7.68	x 1	18.15		0.63	x	0.7	=	277.31	(79)
Southwest _{0.9x} 0.77	x	7.68	x 1	13.91		0.63	x	0.7	=	267.36	(79)
Southwest _{0.9x} 0.77	x	7.68	x 1	04.39		0.63	x	0.7	=	245.02	(79)
Southwest _{0.9x} 0.77	x _	7.68	x (92.85		0.63	x	0.7	=	217.93	(79)
Southwest _{0.9x} 0.77	x _	7.68	x (69.27		0.63	x	0.7	=	162.58	(79)
Southwest _{0.9x} 0.77	x	7.68	X	14.07] [0.63	x	0.7	=	103.44	(79)
Southwest _{0.9x} 0.77	x	7.68	x (31.49		0.63	x	0.7	=	73.91	(79)
Solar gains in watts, ca			1	T	` ′ 	um(74)m .	- 				(00)
(83)m= 86.36 147.1		19.38 279.33 4\m = (72\m	277.31	267.36	245.02	217.93	162.58	103.44	73.91		(83)
Total gains – internal ar	<u>`</u>	79.21 494.26	477.67	458.12	440.52	421.03	380.82	339.05	322.23		(84)
, ,			<u> </u>	430.12	440.52	421.03	360.62	339.05	322.23		(04)
7. Mean internal temper	•		•								_
Temperature during he			_		ole 9, Tr	11 (°C)				21	(85)
Utilisation factor for ga			T T	– –	Ι Δ	0	0-4	NI.	D		
Jan Feb		Apr May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		(86)
(86)m= 0.98 0.97	0.94	0.79	0.64	0.49	0.52	0.73	0.91	0.97	0.99		(00)
Mean internal tempera		<u> </u>	1	i —	1						(07)
(87)m= 21 21	21	21 21	21	21	21	21	21	21	21		(87)
Temperature during he		I	,	from Ta		h2 (°C)	Г				
(88)m= 20 20	20	20 20	20	20	20	20	20	20	20		(88)
Utilisation factor for ga	ins for res	t of dwelling,	h2,m (se	ee Table	9a)						
(89)m= 0.98 0.96	0.93	0.74	0.56	0.39	0.42	0.66	0.88	0.96	0.98		(89)
Mean internal tempera	ture in the	rest of dwell	ing T2 (f	ollow ste	eps 3 to	7 in Tabl	e 9c)				
(90)m= 20 20	20	20 20	20	20	20	20	20	20	20		(90)
						f	LA = Livin	ig area ÷ (4	4) =	0.42	(91)
Mean internal tempera	ture (for th	ne whole dwe	lling) = f	LA × T1	+ (1 – fl	A) × T2					
(92)m= 20.42 20.42	20.42 2	0.42 20.42	20.42	20.42	20.42	20.42	20.42	20.42	20.42		(92)
Apply adjustment to th			1		· ·		·	1			4
(93)m= 20.42 20.42		0.42 20.42	20.42	20.42	20.42	20.42	20.42	20.42	20.42		(93)
8. Space heating requ		aratura abtoir		an 11 af	Table 0	h aa 4ha	4 T: /	7C) m an	d == ==l=	lata	
Set Ti to the mean inte the utilisation factor for			ieu ai si	ерттог	rable 9	b, so ma	ıt 11,111=(rojin an	u re-caid	uiale	
Jan Feb		Apr May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for ga	ins, hm:			<u>'</u>							
(94)m= 0.98 0.96	0.93	0.76	0.59	0.43	0.47	0.69	0.89	0.97	0.98		(94)
Useful gains, hmGm ,		<u> </u>									
(95)m= 335.65 387.1		18.66 376.81	284.08	196.86	205.42	291.11	340.09	327.59	317.2		(95)
Monthly average exter	'		1	100	10.4	1444	40.0	7.4	4.0		(06)
(96)m= 4.3 4.9 Heat loss rate for mea		8.9 11.7	14.6	16.6 -[(30)m	16.4 v [(03)m	14.1 - (96)m	10.6	7.1	4.2		(96)
(97)m= 852.08 820.37		08.99 461.03	307.78	202.09	212.66	334.2	519.16	704.11	857.36		(97)
Space heating require							<u> </u>				, ,
(98)m= 384.22 291.16		37.04 62.66	0	0	0	0	133.23	271.1	401.88		
			-								

				Tota	l per year	(kWh/year	r) = Sum(9	8) _{15,912} =	1918.57	(98)
Space heating requirement i	n kWh/m²/yea	ar							39.97	(99)
9a. Energy requirements – Inc	dividual heati	ng systems i	including	micro-C	CHP)					
Space heating:										_
Fraction of space heat from	secondary/su	ipplementary	system /						0	(201)
Fraction of space heat from	main system((s)		(202) = 1	- (201) =				1	(202)
Fraction of total heating from	main systen	n 1		(204) = (2	02) x [1 –	(203)] =			1	(204)
Efficiency of main space hea	ting system	1							287.51	(206)
Efficiency of secondary/supp	lementary he	eating syster	n, %						0	(208)
Jan Feb Mar	Apr N	May Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ar
Space heating requirement (i								
384.22 291.16 237.27	137.04 62	2.66 0	0	0	0	133.23	271.1	401.88		
(211) m = { $((98)$ m x (204)] } x				ı	ı	ı	Ι			(211)
133.64 101.27 82.53	47.66 21	1.79 0	0	0 Tota	0	46.34 ar) =Sum(2	94.29	139.78		7,0,4
	\ 1.18 <i>(</i> 1.7	4		Tota	ii (Kwii/yea	ar) =Surri(2	2) _{15,1012}	·=	667.3	(211)
Space heating fuel (seconda = $\{[(98)m \times (201)]\} \times 100 \div (201)$	• /	nth								
$\frac{215}{m} = 0 \qquad 0 \qquad 0$		0 0	0	0	0	0	0	0		
, <u> </u>	11	!		Tota	I I (kWh/yea	ı ar) =Sum(2	L 215) _{15,1012}	<u></u>	0	(215)
Nater heating								ļ		
Output from water heater (cal	culated abov		т		·		ı			
147.12 129.48 135.52	120.85 11	7.96 104.74	99.96	110.56	110.64	125.34	133.34	143.36		_
Efficiency of water heater	 	<u> </u>	1	I		I			207.67	(216)
217)m= 207.67 207.67 207.67		7.67 207.67	207.67	207.67	207.67	207.67	207.67	207.67		(217)
Fuel for water heating, kWh/m 219)m = (64)m x 100 ÷ (217										
219)m= 70.84 62.35 65.26	1 1	6.8 50.44	48.13	53.24	53.27	60.36	64.21	69.03		
		-		Tota	I = Sum(2	19a) ₁₁₂ =	-		712.12	(219)
Annual totals						k\	Wh/year		kWh/yeaı	¬
Space heating fuel used, main	n system 1								667.3	╛
Water heating fuel used									712.12	
Electricity for pumps, fans and	d electric kee	p-hot								
mechanical ventilation - bala	nced, extract	or positive i	nput fron	n outside	Э			281.9		(230a
Total electricity for the above,	kWh/year			sum	of (230a).	(230g) =			281.9	(231)
Electricity for lighting								Ī	233.31	(232)
Electricity generated by PVs								ļ	-932.71	(233)
Total delivered energy for all	uses (211)(221) + (231)	+ (232).	(237b)	=			İ	961.92	(338)
12a. CO2 emissions – Indivi	dual heating	systems incl	uding mi	cro-CHF)					
	<u> </u>	_								

Energy

kWh/year

Emissions

kg CO2/year

Emission factor

kg CO2/kWh

Space heating (main system 1)	(211) x	0.519	=	346.33	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	369.59	(264)
Space and water heating	(261) + (262) + (263) + (264)	=		715.92	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	146.31	(267)
Electricity for lighting	(232) x	0.519	=	121.09	(268)
Energy saving/generation technologies Item 1		0.519	=	-484.08	(269)
Total CO2, kg/year	S	sum of (265)(271) =		499.24	(272)
Dwelling CO2 Emission Rate	((272) ÷ (4) =		10.4	(273)
El rating (section 14)				93	(274)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41 Printed on 12 July 2021 at 10:59:37

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:**

Flat

Total Floor Area: 50.38m²

Dwelling Details:

Site Reference:

NEW DWELLING DESIGN STAGE

Plot Reference: 231 Watford Road - GREEN Sample 10

Address:

Client Details:

Name:

Address:

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity

Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER) 32.68 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 11.51 kg/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 61.6 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 47.1 kWh/m²

OK 2 Fabric U-values

Element Average Highest

0.16 (max. 0.70) External wall 0.16 (max. 0.30) OK Party wall 0.00 (max. 0.20) OK Floor (no floor)

Roof 0.12 (max. 0.20) 0.12 (max. 0.35) Openings 1.10 (max. 2.00) 1.10 (max. 3.30)

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

Air permeability at 50 pascals 3.50 (design value)

Maximum **OK** 10.0

4 Heating efficiency

Main Heating system:

Heat pumps with radiators or underfloor heating - electric

NIBE Fighter 360

Secondary heating system: None

5 Cylinder insulation

No Separate Cylinder Hot water Storage:

N/A

OK

OK

Regulations Compliance Report

6 Controls			
Space heating controls Hot water controls:	TTZC by plumbing and el No cylinder thermostat No cylinder	lectrical services	ок
7 Low energy lights			
Percentage of fixed lights w Minimum	ith low-energy fittings	100.0% 75.0%	ок
8 Mechanical ventilation			
Continuous extract system Specific fan power: Maximum		1.05 0.7	Fail
9 Summertime temperature			
Overheating risk (Thames v Based on: Overshading: Windows facing: North Wes Windows facing: North East Ventilation rate:	et	Slight Average or unknown 6.39m² 3.85m² 6.00	OK
10 Key features			
Air permeablility Windows U-value Roofs U-value Party Walls U-value Photovoltaic array		3.5 m ³ /m ² h 1.1 W/m ² K 0.12 W/m ² K 0 W/m ² K	

		l Jser I	Details:						
Assessor Name: Software Name:	Neil Ingham Stroma FSAP 2012		Strom Softwa	are Ve	rsion:			010943 on: 1.0.5.41	
Address :	· ·	Property	Address	Sample	e 10				
Overall dwelling dime	ensions:								
		Are	a(m²)		Av. He	ight(m)		Volume(m ³	3)
Ground floor			50.38	(1a) x	2	.75	(2a) =	138.55	(3a)
Total floor area TFA = (1	a)+(1b)+(1c)+(1d)+(1e)+(1	n) [50.38	(4)					
Dwelling volume				(3a)+(3b)+(3c)+(3c	d)+(3e)+	.(3n) =	138.55	(5)
2. Ventilation rate:									
	main seconda heating heating	ry	other		total			m³ per hou	ır
Number of chimneys	0 + 0	+	0] = [0	X 4	40 =	0	(6a)
Number of open flues	0 + 0	+ [0] = [0	x 2	20 =	0	(6b)
Number of intermittent fa	ns			Ī	0	x ′	10 =	0	(7a)
Number of passive vents				Ī	0	x ′	10 =	0	(7b)
Number of flueless gas fi	res			Ē	0	x 4	40 =	0	(7c)
				L					
				_			Air ch	anges per ho	our —
•	ys, flues and fans = (6a)+(6b)+(neen carried out or is intended, proced			ontinuo fr	0		÷ (5) =	0	(8)
Number of storeys in the		eu 10 (17),	otrierwise (onunue n	om (9) to ((10)		0	(9)
Additional infiltration	3 ()					[(9)-	-1]x0.1 =	0	(10)
	.25 for steel or timber frame o			•	uction			0	(11)
if both types of wall are pudeducting areas of openia	resent, use the value corresponding t nas): if equal user 0.35	o the grea	ter wall are	a (after					
,	floor, enter 0.2 (unsealed) or 0).1 (seal	ed), else	enter 0				0	(12)
If no draught lobby, en	ter 0.05, else enter 0							0	(13)
-	s and doors draught stripped							0	(14)
Window infiltration			0.25 - [0.2	. ,	-	()		0	(15)
Infiltration rate	250 amaza dia adia adia ada		(8) + (10)					0	(16)
•	q50, expressed in cubic metro ity value, then $(18) = [(17) \div 20] +$	•	•	•	etre or e	envelope	area	3.5	(17)
· ·	es if a pressurisation test has been do				is being u	sed		0.18	(10)
Number of sides sheltere	ed							0	(19)
Shelter factor			(20) = 1 -		19)] =			1	(20)
Infiltration rate incorporat	•		(21) = (18) x (20) =				0.18	(21)
Infiltration rate modified f	- 1 	1	1 4	0.5.5	0-4	l Na	Date	1	
Jan Feb	Mar Apr May Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp (22)m= 5.1 5	4.9 4.4 4.3 3.8	3.8	3.7	4	4.3	4.5	4.7]	
(5.0	1 0.0	1	<u> </u>	I	I	l '''	I	
Wind Factor (22a)m = (22	' 		1			1		1	
(22a)m= 1.27 1.25	1.23 1.1 1.08 0.95	0.95	0.92	1	1.08	1.12	1.18		

Adjusted infiltr	ation rat	e (allowi	ng for sh	nelter an	d wind s	peed) =	: (21a) x	(22a)m						
0.22	0.22	0.21	0.19	0.19	0.17	0.17	0.16	0.18	0.19	0.2	0.21			
Calculate effect If mechanica		_	rate for t	he appli	cable ca	se	-		-	-	-			٦٫٫٫
If exhaust air h			endix N (2	3h) = (23a	a) × Fmv (e	equation (N5)) othe	wise (23h	n) = (23a)			0.5		_](23 □ ₍₂₃
If balanced with									,, = (20 0)			0.5](23], ₍₂₂
		-	-	_					Oh)m ı ('22h\ [1 (22.5)	0 . 1001		(23
a) If balance			0	0	0	0	1 (24a	0	0	230) x [0	÷ 100]		(24
b) If balance											_			(-
24b)m= 0			0	0	0	0	0 0	0	0	0	0			(24
c) If whole h														(-
•				•	-		c) = (22k		.5 × (23k	o)				
24c)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5			(24
d) If natural										!	Į.	l		
		`	· · ·		· `		0.5 + [(2		-			ı		
24d)m= 0	0	0	0	0	0	0	0	0	0	0	0			(24
Effective air	change		<u> </u>) or (24k	ŕ	c) or (24	ld) in box	(25)				ı		
25)m= 0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5			(2
3. Heat losse	s and he	eat loss p	paramet	er:										
LEMENT	Gros	_	Openin		Net Ar		U-val		AXU		k-value		ΑX	
Vindovio Tvro	area	(m²)	m) '	A ,r		W/m2		(W/	K)	kJ/m²-l	(kJ/ł	
Vindows Type					6.39		/[1/(1.1)+		6.73	_				(2
Vindows Type	2				3.85	x ¹	/[1/(1.1)+	0.04] =	4.06	ᆗ ,				(2 [:]
Valls Type1	39.9	98	10.2	4	29.74	X	0.16	=	4.76		60	ᆜ	1784.4	(29
Valls Type2	20.0)7	0		20.07	<u> </u>	0.15	=	3	[60	╛╚	1204.2	(29
Roof	50.3	38	0		50.38	X	0.12	=	6.05		9	4	153.42	(3
otal area of e	lements	, m²			110.4	3								(3
Party wall					25.9	X	0	=	0		45		1165.5	(3
arty floor					50.38	3					40		2015.2	(3
nternal wall **					108.6	8					9		978.12	(3
for windows and						ated using	g formula 1	/[(1/U-valu	ue)+0.04] a	as given in	paragraph	3.2		_
* include the area				ls and par	titions		(00) (00)	(00)						7
abric heat los		•	U)				(26)(30)	, ,				24.6	5](3
leat capacity		,			,			,	(30) + (3	2) + (32a)	(32e) =	7600	.84](3
hermal mass	•	•		,				` '	÷ (4) =			150.8	37	(3
or design assess an be used inste				construct	ion are not	known pi	recisely the	ndicative	e values of	'IMP IN I	able 1f			
hermal bridge				using Ap	pendix ł	<						8.15	5	(3
details of therma	al bridging	are not kn	own (36) =	= 0.05 x (3	11)									
otal fabric he	at loss							(33) +	(36) =			32.7	4	(3
entilation hea	at loss ca	alculated	monthly	/				(38)m	= 0.33 × ((25)m x (5)	ı		
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
38)m= 22.86	22.86	22.86	22.86	22.86	22.86	22.86	22.86	22.86	22.86	22.86	22.86			(3
leat transfer o	coefficie	nt, W/K						(39)m	= (37) + (38)m				
39)m= 55.6	55.6	55.6	55.6	55.6	55.6	55.6	55.6	55.6	55.6	55.6	55.6			
							•							_

Heat loss para	meter (l	HLP), W/	′m²K					(40)m	= (39)m ÷	÷ (4)			
(40)m= 1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1		
` /				<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	L Average =	: Sum(40) _{1.}	12 /12=	1.1	(40)
Number of day	s in mo	nth (Tab	le 1a)							, ,	!		
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m= 31	28	31	30	31	30	31	31	30	31	30	31		(41)
										1			
4 Water beet	ina ono	rav roqui	romont:								k\N/b/y/	or:	
4. Water heat	ing ene	rgy requi	rement.								kWh/ye	ar.	
Assumed occu if TFA > 13.9 if TFA £ 13.9	9, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9)2)] + 0.0	0013 x (⁻	TFA -13		.7		(42)
Annual averag											.61		(43)
Reduce the annua not more that 125	_				_	-	to achieve	a water us	se target o	of			
				1				I -	Ι	1	I _ 1		
Jan	Feb	Mar	Apr	May	Jun	Jul Table 10 Y	Aug	Sep	Oct	Nov	Dec		
Hot water usage in	1 litres pei	r day for ea	acn montn	va,m = ra	ctor from	rable 1c x	(43)		,				
(44)m= 82.07	79.08	76.1	73.11	70.13	67.15	67.15	70.13	73.11	76.1	79.08	82.07		_
Enormy content of	hat water	wood ool	aulatad m	onthly 1	100 v Vd "	m v nm v F	Tm / 260/			ım(44) ₁₁₂ =		895.27	(44)
Energy content of	not water	usea - cai		ontniy = 4.	190 x va,r	n x nm x L	1 m / 3600	KVVN/mor	ntn (see 18		c, 1a)		
(45)m= 121.7	106.44	109.84	95.76	91.88	79.29	73.47	84.31	85.32	99.43	108.53	117.86		_
If instantaneous w	ator booti	na ot noint	of upo (ne	a hat water	r 040 r0 r0 l	antar O in	haves (16		Total = Su	ım(45) ₁₁₂ =	=	1173.84	(45)
If instantaneous w								10 (01)					
(46)m= 18.26	15.97	16.48	14.36	13.78	11.89	11.02	12.65	12.8	14.91	16.28	17.68		(46)
Water storage Storage volum		\ includin	a any c	olar or M	/\//LIDC	ctorago	within co	amo voc	col				(47)
_	` '					_		airie ves	SEI	0			(47)
If community h Otherwise if no	•			•			` '	ore) onto	ar 'O' in <i>(</i>	(47)			
Water storage		not wate	ar (tilis ii	iciuues i	nstantai	ieous cc	ilibi boli	ers) erite	51 0 111 ((47)			
a) If manufact		eclared l	oss facto	or is kno	wn (kWł	n/day):				0.	54		(48)
Temperature fa					•	, ,					072		(49)
Energy lost fro				oor			(48) x (49)	١ _					, ,
b) If manufact		_	-		or is not		(40) X (40)	, –			0		(50)
Hot water stora			-								0		(51)
If community h	eating s	ee secti	on 4.3										
Volume factor	from Ta	ble 2a									0		(52)
Temperature fa	actor fro	m Table	2b								0		(53)
Energy lost fro	m watei	storage	, kWh/y	ear			(47) x (51)) x (52) x (53) =		0		(54)
Enter (50) or (54) in (5	55)								0.	91		(55)
Water storage	loss cal	culated f	or each	month			((56)m = (55) × (41)ı	m				
(56)m= 28.12	25.4	28.12	27.22	28.12	27.22	28.12	28.12	27.22	28.12	27.22	28.12		(56)
If cylinder contains	dedicate	d solar sto	rage, (57)	<u>I</u> m = (56)m	x [(50) – (H11)] ÷ (5	0), else (5	7)m = (56)	m where (<u>I</u> (H11) is fro	m Append	ix H	
(57)m= 28.12	25.4	28.12	27.22	28.12	27.22	28.12	28.12	27.22	28.12	27.22	28.12		(57)
Primary circuit	loss (ar	nnual) fro	m Table	e 3							0		(58)
Primary circuit	•	•			59)m = ((58) ÷ 36	65 × (41)	m					
(modified by	factor f	rom Tabl	le H5 if t	here is	solar wat	ter heati	ng and a	cylinde	r thermo	ostat)			
(59)m= 0	0	0	0	0	0	0	0	0	0	0	0		(59)
	-	-	_	-	_	_	_		_				

Combi loss	calculated	for each	month ((61)m –	(60) ± 3	865 ~ (41	/m							
(61)m= 0	0	0	0	01)111 =	00) + 0	0 7 (41)III 0		0	0	0	0	1	(61)
			<u> </u>										J · (59)m + (61)m	(-)
(62)m= 149.8		137.96	122.98	120.01	106.5	101.6	112	_	112.53	127.55	135.75	145.99]	(62)
Solar DHW inp				<u> </u>										` '
(add addition												······································		
(63)m= 0	0	0	0	0	0	0	0		0	0	0	0	1	(63)
Output from	water hea	ter					!						•	
(64)m= 149.8		137.96	122.98	120.01	106.5	101.6	112	.43	112.53	127.55	135.75	145.99]	
				ı		1		Outp	out from wa	ater heate	er (annual)	12	1504.97	(64)
Heat gains f	rom water	heating,	kWh/m	onth 0.2	5 ´ [0.8	5 × (45)m	า + (6	1)m	n] + 0.8 x	κ [(46)m	+ (57)m	+ (59)m	n]	
(65)m= 40.4°	7 35.39	36.52	31.84	30.55	26.36	24.43	28.0	03	28.37	33.06	36.09	39.19]	(65)
include (5	7)m in cal	culation	of (65)m	only if c	ylinder	is in the	dwell	ing	or hot w	ater is f	rom com	munity h	neating	
5. Internal	gains (see	e Table 5	and 5a):										
Metabolic ga	ains (Table	e 5), Wat	ts											
Jar	n Feb	Mar	Apr	May	Jun	Jul	Αι	ug	Sep	Oct	Nov	Dec]	
(66)m= 85.0	6 85.06	85.06	85.06	85.06	85.06	85.06	85.0	06	85.06	85.06	85.06	85.06		(66)
Lighting gair	ns (calcula	ted in Ap	pendix	L, equat	ion L9 d	or L9a), a	ılso s	ee -	Table 5					
(67)m= 13.29	9 11.8	9.6	7.27	5.43	4.58	4.95	6.4	4	8.64	10.97	12.81	13.66		(67)
Appliances (gains (calc	ulated in	Append	dix L, eq	uation l	_13 or L1	3a), a	also	see Ta	ble 5			_	
(68)m= 148.2	22 149.76	145.88	137.63	127.22	117.43	110.89	109	.35	113.22	121.48	131.89	141.68]	(68)
Cooking gai	ns (calcula	ated in A	ppendix	L, equat	ion L15	or L15a), als	o se	e Table	5			_	
(69)m= 31.5°	1 31.51	31.51	31.51	31.51	31.51	31.51	31.	51	31.51	31.51	31.51	31.51]	(69)
Pumps and	fans gains	(Table 5	ōa)										_	
(70)m= 0	0	0	0	0	0	0	0		0	0	0	0]	(70)
Losses e.g.	evaporatio	n (nega	tive valu	es) (Tab	le 5)								_	
(71)m= -68.0	5 -68.05	-68.05	-68.05	-68.05	-68.05	-68.05	-68.	.05	-68.05	-68.05	-68.05	-68.05		(71)
Water heatir	ng gains (T	able 5)											_	
(72)m= 54.39	9 52.67	49.09	44.22	41.06	36.62	32.84	37.0	68	39.4	44.44	50.12	52.67		(72)
Total intern	al gains =	:			(66	6)m + (67)n	n + (68	8)m +	- (69)m + ((70)m + (7	71)m + (72))m	_	
(73)m= 264.4		253.09	237.64	222.23	207.15	197.2	201	.99	209.79	225.41	243.34	256.53		(73)
6. Solar ga														
Solar gains ar		•				•	ations 1	to co		e applica		tion.		
Orientation:	Access F Table 6d		Area m²			ux able 6a		Т	g_ able 6b	Т	FF able 6c		Gains (W)	
Northeast 0.9							1 1						. ,	1(75)
Northeast 0.9		X	3.8		_	11.28]		0.63	×	0.7	=	13.28	(75)
Northeast 0.9	<u> </u>	×	3.8		-	22.97]		0.63	×	0.7	- -	27.02](75)] ₍₇₅₎
Northeast 0.9		×	3.8			41.38]		0.63	×	0.7	- -	48.69](75)] ₍₇₅₎
Northeast 0.9		×	3.8		-	67.96]		0.63	×	0.7	=	79.96](75)] ₍₇₅₎
14011116431 (1.9)	X 0.77	X	3.8	55	x	91.35	X		0.63	X	0.7	=	107.48	(75)

Northeast 0.9x	N 0 .	_		,		_						_
Northeast 0.9x		×	3.85	X	97.38	×	0.63	×	0.7	=	114.58	(75)
Northeast 0.sk		X	3.85	X	91.1	X	0.63	X	0.7	=	107.19	(75)
Northwest 0.9x		X	3.85	X	72.63	×	0.63	X	0.7	=	85.45	(75)
Northeast 0.9x	Northeast _{0.9x} 0.77	X	3.85	X	50.42	X	0.63	X	0.7	=	59.33	(75)
Northwest 0, 9x	Northeast 0.9x 0.77	X	3.85	X	28.07	X	0.63	X	0.7	=	33.02	(75)
Northwest 0, 9x	Northeast 0.9x 0.77	X	3.85	X	14.2	X	0.63	Х	0.7	=	16.7	(75)
Northwest 0, 9x	Northeast 0.9x 0.77	x	3.85	X	9.21	×	0.63	x	0.7	=	10.84	(75)
Northwest 0.9x	Northwest 0.9x 0.77	x	6.39	X	11.28	x	0.63	x	0.7	=	22.03	(81)
Northwest 0.9x	Northwest 0.9x 0.77	x	6.39	X	22.97	x	0.63	x	0.7	=	44.85	(81)
Northwest 0.9x	Northwest 0.9x 0.77	x	6.39	X	41.38	×	0.63	x	0.7	=	80.81	(81)
Northwest 0.9x	Northwest 0.9x 0.77	x	6.39	X	67.96	x	0.63	х	0.7	=	132.71	(81)
Northwest 0.9x	Northwest 0.9x 0.77	x	6.39	X	91.35	×	0.63	х	0.7	=	178.39	(81)
Northwest 0.9x	Northwest 0.9x 0.77	x	6.39	x	97.38	×	0.63	x	0.7	=	190.18	(81)
Northwest 0.9x	Northwest 0.9x 0.77	x	6.39	x	91.1	x	0.63	х	0.7	=	177.91	(81)
Northwest 0.9x	Northwest 0.9x 0.77	x	6.39	X	72.63	×	0.63	x	0.7	=	141.83	(81)
Northwest 0.9x	Northwest 0.9x 0.77	x	6.39	x	50.42	×	0.63	x	0.7	=	98.46	(81)
Solar gains in watts, calculated for each month (83)m = Sum(74)m (82)m	Northwest 0.9x 0.77	×	6.39	x	28.07	×	0.63	x	0.7	=	54.81	(81)
Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m (83)m= 35.31 71.87 129.49 212.67 285.87 304.76 285.1 227.28 157.79 87.84 44.43 28.84 (83) Total gains – internal and solar (84)m = (73)m + (83)m , watts (84)m= 299.73 334.62 382.58 450.3 508.09 511.91 482.29 429.27 367.58 313.24 287.77 285.36 (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 0.9 0.79 0.62 0.48 0.55 0.8 0.94 0.99 0.99 0.99 0.98 0.99 (86) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 21 21 21 21 21 21 21 21 21 21 21 21 21	Northwest 0.9x 0.77	×	6.39	X	14.2	×	0.63	x	0.7	=	27.72	(81)
(83)m= 35.31 71.87 129.49 212.67 285.87 304.76 285.1 227.28 157.79 87.84 44.43 28.84 (83) Total gains – internal and solar (84)m = (73)m + (83)m , watts (84)m= 299.73 334.62 382.58 450.3 508.09 511.91 482.29 429.27 367.58 313.24 287.77 285.36 (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 0.9 0.79 0.62 0.48 0.55 0.8 0.94 0.98 0.99 0.98 0.99 (86) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 21 21 21 21 21 21 21 21 21 21 21 21 21	Northwest 0.9x 0.77	×	6.39	X	9.21	T x	0.63	x	0.7	=	17.99	(81)
(83)m= 35.31 71.87 129.49 212.67 285.87 304.76 285.1 227.28 157.79 87.84 44.43 28.84 (83) Total gains – internal and solar (84)m = (73)m + (83)m , watts (84)m= 299.73 334.62 382.58 450.3 508.09 511.91 482.29 429.27 367.58 313.24 287.77 285.36 (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 0.9 0.79 0.62 0.48 0.55 0.8 0.94 0.98 0.99 0.98 0.99 (86) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 21 21 21 21 21 21 21 21 21 21 21 21 21	Solar gains in watte galar	ulatad	for each man	+h		(02\ ~	- Sum/74)m	(92)m				
Total gains – internal and solar (84)m = (73)m + (83)m , watts (84)m= 299.73 334.62 382.58 450.3 508.09 511.91 482.29 429.27 367.58 313.24 287.77 285.36 (84) 7. Mean internal temperature (heating season) Temperature during heating periods in the living area from Table 9, Th1 (°C)	<u> </u>		- 1	\neg	04.76 285.1	- 			44.43	28.84		(83)
Ref 299.73 334.62 382.58 450.3 508.09 511.91 482.29 429.27 367.58 313.24 287.77 285.36	` '											
Temperature during heating periods in the living area from Table 9, Th1 (°C) 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 0.9 0.79 0.62 0.48 0.55 0.8 0.94 0.98 0.99 0.98 0.99 (86) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= Z1 Z1 Z1 Z1 Z1 Z1 Z1 Z1 Z1 Z1 Z1 Z1 Z1	(84)m= 299.73 334.62 38	32.58	450.3 508.0	9 5	11.91 482.29	429	.27 367.58	313.24	287.77	285.36		(84)
Temperature during heating periods in the living area from Table 9, Th1 (°C) 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 0.9 0.79 0.62 0.48 0.55 0.8 0.94 0.98 0.99 0.98 0.99 (86) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= Z1 Z1 Z1 Z1 Z1 Z1 Z1 Z1 Z1 Z1 Z1 Z1 Z1	7 Mean internal tempera	ature (heating seas	nn)								
Utilisation factor for gains for living area, h1,m (see Table 9a) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	·				area from Ta	ble 9	Th1 (°C)				21	(85)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec		٠.		·			, (3)				21	(/
(86)m= 0.99 0.98 0.96 0.9 0.79 0.62 0.48 0.55 0.8 0.94 0.98 0.99 (86) Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 21 20 20 20 20				Ť		_	ua Sep	Oct	Nov	Dec		
Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m= 21 21 21 21 21 21 21 21 21 21 21 21 21	 	 	 		+	+			+			(86)
(87)m= 21 21 21 21 21 21 21 21 21 21 21 21 21	Mean internal temperatu	ro in li	iving area T1	(follo	w stops 3 to		!!					
Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m= 20 20 20 20 20 20 20 20 20 20 20 20 20					i	1		21	21	21		(87)
(88)m= 20 20 20 20 20 20 20 20 20 20 20 20 20			!		ļ				1			, ,
Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) (89)m= 0.98 0.98 0.95 0.88 0.74 0.55 0.38 0.45 0.73 0.93 0.98 0.99 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 20 20 20 20 20 20 20 20 20 20 20 20 20	· · · · · · · · · · · · · · · · · · ·		ı	of dw		1		20	70	20		(88)
(89)m= 0.98 0.98 0.95 0.88 0.74 0.55 0.38 0.45 0.73 0.93 0.98 0.99 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 20 20 20 20 20 20 20 20 20 20 20 20 20			!		I		0 20	20	20	20		(00)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m= 20 20 20 20 20 20 20 20 20 20 20 20 20				$\overline{}$		_			-		ı	(2.2)
(90)m= 20 20 20 20 20 20 20 20 20 20 20 20 20	(89)m= 0.98 0.98 0	.95	0.88 0.74		0.55 0.38	0.4	15 0.73	0.93	0.98	0.99		(89)
Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$ (92)m= 20.48 20.48 20.48 20.48 20.48 20.48 20.48 20.48 20.48 20.48 20.48 20.48 (92)	Mean internal temperatu	re in t	he rest of dwe	elling	T2 (follow st	eps 3	to 7 in Tabl	e 9c)			•	
Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$ (92)m= 20.48 20.48 20.48 20.48 20.48 20.48 20.48 20.48 20.48 20.48 20.48 20.48 (92)	(90)m= 20 20	20	20 20		20 20	2						(90)
(92)m= 20.48 20.48 20.48 20.48 20.48 20.48 20.48 20.48 20.48 20.48 20.48 20.48 (92)							f	LA = Liv	ing area ÷ (4) =	0.48	(91)
	Mean internal temperatu	re (for	the whole dv	vellin	g) = $fLA \times T1$	+ (1	– fLA) × T2					
Apply adjustment to the mean internal temperature from Table 4e, where appropriate	(92)m= 20.48 20.48 20	0.48	20.48 20.48	3 2	20.48 20.48	20.	48 20.48	20.48	20.48	20.48		(92)
7, pply adjustment to the mean internal temperature nem rubic 40, where appropriate	Apply adjustment to the	mean	internal temp	eratu	re from Table	e 4e,	where appro	priate				

				·				,					ı	
(93)m=	20.48	20.48	20.48	20.48	20.48	20.48	20.48	20.48	20.48	20.48	20.48	20.48		(93)
			uirement											
			ernal ter or gains	•		ed at st	ep 11 of	Table 9	b, so tha	t Ti,m=(76)m an	d re-calc	ulate	
ine ui	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisa			ains, hm	<u> </u>	Iviay	Juli	l Jui	l Aug	Сер	Oct	INOV	Dec		
(94)m=	0.99	0.98	0.96	0.89	0.76	0.58	0.43	0.5	0.76	0.94	0.98	0.99		(94)
	∟ ul gains.	hmGm	, W = (94	1	L 4)m	<u> </u>	l		l		<u> </u>			
(95)m=	295.57	327.38	366.01	402.53	387.83	298.86	208.38	214.75	281.2	293.13	281.52	282.03		(95)
Month	nly avera	age exte	rnal tem	perature	e from Ta	able 8	!				<u> </u>	ļ	l	
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat	loss rate	for mea	an intern	al tempe	erature,	Lm , W =	=[(39)m :	x [(93)m	– (96)m]			l.	
(97)m=	899.41	866.05	777.09	643.64	487.95	326.7	215.5	226.62	354.5	549.11	743.72	904.97		(97)
Space	e heatin	g require	ement fo	r each n	nonth, k\	Wh/mon	th = 0.02	24 x [(97)m – (95)m] x (4	1)m			
(98)m=	449.26	361.99	305.84	173.6	74.49	0	0	0	0	190.46	332.79	463.47		
			-	-	-	-	-	Tota	l per year	(kWh/yeaı	r) = Sum(9	8) _{15,912} =	2351.9	(98)
Space	e heatin	g require	ement in	kWh/m²	²/year								46.68	(99)
•		• •			•	vetame i	ncluding	micro-C	'HDI]
	e heatir		its — iriu	ividual II	calling o	ysterns i	ricidaling	i illicio-c) II <i>)</i>					
•		•	at from s	econdar	v/supple	mentary	system						0	(201)
	•		at from m			Í	•	(202) = 1	- (201) =				1	(202)
	•		ng from	-	` '				02) × [1 –	(203)] =			1	(204)
			•	-				(201) – (2	02) X [1	(200)] -				╣ .
	•	•	ace heat	• .			0.4						289.63	(206)
Efficie	ency of s	seconda	ry/suppl	ementar	y heatin	g systen	า, %						0	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ır
Space			ement (c	i							ı		l	
	449.26	361.99	305.84	173.6	74.49	0	0	0	0	190.46	332.79	463.47		
(211)m	n = {[(98)m x (20	(4)] } x 1	00 ÷ (20)6)	ı					ı		1	(211)
	155.12	124.98	105.6	59.94	25.72	0	0	0	0	65.76	114.9	160.02		,
								Tota	ıl (kWh/yea	ar) =Sum(2	211) _{15,1012}	<u></u>	812.04	(211)
		•	econdar	• •	month									
			00 ÷ (20	r	1	1					Г		l	
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		٦
								lota	ıl (kWh/yea	ar) =Sum(2	215) _{15,1012}	F	0	(215)
	heating	•												
Output	149.83		ter (calc 137.96	ulated a 122.98	120.01	106.5	101.6	112.43	112.53	127.55	135.75	145.99		
Efficier		ater hea		122.90	120.01	100.5	101.6	112.43	112.55	127.55	133.73	143.99	207.67	(216)
	207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	207.67	(217)
			L	l	207.67	207.67	207.67	207.67	207.07	207.07	207.67	207.07		(211)
		•	kWh/mo (217) ÷ (
(219)m=		63.49	66.43	59.22	57.79	51.29	48.92	54.14	54.19	61.42	65.37	70.3		
								Tota	I = Sum(2	19a) ₁₁₂ =			724.69	(219)
Annua	al totals									k'	Wh/year	•	kWh/year	J .
Space	heating	fuel use	ed, main	system	1						•		812.04	
														-

					_
Water heating fuel used				724.69	
Electricity for pumps, fans and electric keep-hot					
mechanical ventilation - balanced, extract or posi	tive input from outside		278.35]	(230a)
Total electricity for the above, kWh/year	sum of (23	0a)(230g) =		278.35	(231)
Electricity for lighting				234.63	(232)
Electricity generated by PVs				-932.71	(233)
Total delivered energy for all uses (211)(221) +	(231) + (232)(237b) =			1117	(338)
12a. CO2 emissions – Individual heating systems	s including micro-CHP				
	Energy kWh/year	Emission fac kg CO2/kWh		Emissions kg CO2/yea	ır
Space heating (main system 1)	(211) x	0.519	=	421.45	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	376.11	(264)
Space and water heating	(261) + (262) + (263) + (264) =			797.56	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	144.46	(267)
Electricity for lighting	(232) x	0.519	=	121.77	(268)
Energy saving/generation technologies Item 1		0.519	=	-484.08	(269)
Total CO2, kg/year	su	m of (265)(271) =		579.72	(272)
Dwelling CO2 Emission Rate	(2'	72) ÷ (4) =		11.51	(273)

El rating (section 14)

(274)

92

231 WATFORD ROAD

ENERGY STRATEGY REPORT & SUSTAINABILITY STATMENT



Appendix D

SAP 10 Emissions

Project: 0317

GLA Emissions Calculation Spreadsheet

The applicant sh	ould comp	plete all the	e light blue	cells including in	nformation on the	e modelled units, th	e area per unit, the	number of units, the	baseline energy co	nsumption figures,	the TER and the 1	IFEE.				SAP 2012 CO2	PERFORMANCE					SA	AP10 CO2 PERFORM.	ANCE			
DOMESTIC I	ENERGY	y consu	JMPTIO	N AND CO2	ANALYSIS																						DEMAND
Unit identifier				Total area	VALIDAT	TON CHECK		REGULATED	ENERGY CONSUMI	PTION PER UNIT (k	Wh p.a.) - TER WO	DRKSHEET			REGUL	ATED CO2 EMISSIO	ONS PER UNIT (kgC	O2 p.a.)				REGULA	ATED CO2 EMISSION	S PER UNIT			Fabric Energy Efficiency (FEE)
(e.g. plot numbe dwelling type etc.)	r, Model	area	lumber of units	represented by model (m²)	Calculated TER 2012 (kgCO2 / m2)	TER Worksheet TER 2012 (kgCO2 / m2)	Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated TER SAP10 (kgCO2 / m2)	Target Fabric Energy Efficiency (TFEE) (kWh/m²)
	Works (Rov	sheet				TER Worksheet (Row 273)	TER Worksheet (Row 211)		TER Worksheet (Row 219)		TER Worksheet (Row 232)	TER Worksheet (Row 231)	N/A														
Sample 1 Sample 2 Sample 3 Sample 3 Sample 4 Sample 5 Sample 5 Sample 6 Sample 6 Sample 7 Sample 7 Sample 9 Sample 9	1000 1000 1000 1000 1000 1000 1000 100	98 44 98 55 44 98 55 8		102.28 92.24 52.94 92.45 72.55 92.45 92.56 92.56 93.56	17.5 17.5 20.0 17.5 16.2 17.6 17.5 16.2 17.6 21.5 22.4	17.6 17.5 20.0 17.5 16.2 17.6 17.5 18.2 21.5 22.4	4459.13 4821.95 1421.95 1236.79 1236.79 12496.13 1259.13 1253.51 1253.51 1253.51	Noturel Ges Noturel Ges Noturel Ges Noturel Ges Noturel Ges Noturel Ges Noturel Ges Noturel Ges Noturel Ges Noturel Ges Noturel Ges Noturel Ges Noturel Ges Noturel Ges Noturel Ges Noturel Ges	250.13 250.51 2407.63 2407.63 232.79 2478.70 2478.70 2	Netural Gas Notural Gas	416.92 476.93 475.93 475.93 434.58 475.93 47	75 75 75 75 75 75 75 75 75 75 75 75 75 7		959 317 1,042 317 496 824 317 496 465 553	544 543 543 543 503 503 503 503 503 406 414	217 140 231 140 172 272 172 172 172 172 172 172 172 172	39 39 39 39 39 39 39 39 39 39 39 39		1,760 926 1,845 926 1,210 1,630 926 1,210 1,031 1,127	932 309 1,013 309 482 802 309 482 452 537	529 518 518 489 521 521 417 439 394 402	98 98 104 104 77 104 63 73 75 55	17 17 17 17 17 17 17 17 17 17 17 17		1.577 1.577 1.652 1.652 1.666 1.066 1.066 1.066 9.18 1.012	15.7 15.2 17.9 15.2 14.3 15.6 15.2 14.3 19.1 20.1	
Sum	69	92	10	692	18.2	-	26,790	N/A	21,875	N/A	3,253	750	0	5,787	4,725	1,688	389	0	12,589	5,626	4,594	758	175	0	11,152	16.1	0.00
NON-DOME	STIC EN	NERGY C	ONSUM	IPTION AND	CO2 ANALY	SIS																					
				Total area	VALIDAT	TON CHECK		REGULATED ENERGY			p.a.) TER - SOUR	E: BRUKL OUTPUT		REGULATED ENERG	Y CONSUMPTION	BY FUEL TYPE (kV	Vh/m² p.a.) TER - S	OURCE: BRUKL.IN		REGULATED	ENERGY CONSUM	PTION BY FUEL TO	YPE (kWh/m² p.a.) -	TER BRUKL	REGULATED C	O2 EMISSIONS	_
Building Use	Area pe (m	er unit N 1²)	lumber of units	represented by model (m²)	Calculated TER 2012 (kgCO2 / m2)	BRUKL TER 2012 (kgCO2 / m2)	Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling	Natural Gas	Grid Electricity				2012 CO2 emissions (kgCO2 p.a.)		Grid Electricity				SAP10 CO2 emissions (kgCO2 p.a.)	BRUKL TER SAP10 (kgCO2 / m2)	

The applicant shou	ild complete all	the light blue	cells including in	nformation on the	be lean' energy co	rsumption figures,	the 'be lean' DER, th	e DFEE and the regi	lated energy dema	nd of the 'be lear	'scenario.				SAP 2012 CO2	PERFORMANCE					SA	P10 CO2 PERFORM	TANCE							
DOMESTIC EN	IERGY CONS	UMPTION	AND CO2 A	NALYSIS																							DOME	STIC ENERGY	DEMAND DATA	
Unit identifier	Model total		Total area		TION CHECK		REGULATED ENER									NS PER UNIT (kgC)						TED CO2 EMISSION				Fabric Energy Efficiency (FEE			AND PER UNIT PER ANN	
(e.g. plot number, dwelling type etc.)	floor area (m ^t)	Number of units	represented by model (m²)	Calculated DER 2012 (kgCO2 / m2)	DER Worksheet DER 2012 (kgCO2 / m2)	Space Heating	Fuel type Space Heating	Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)	CO2 emissions (kgCO2 p.a.)	Domestic Hot Water CO2 emissions (kgCO2 p.a.)	Lighting CO2 emissions (kgCO2 p.a.)	CO2 emissions (kgCO2 p.a.)	CO2 emissions (kgCO2 p.a.)	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated DER SAP10 (kgCO2 / m2)	Dwelling Fabri Energy Efficien (DFEE) (kWh/m	cy (kWh p.a.)	Domestic Hot Water (kWh p.a.)	(kWh p.a.) (kW	diary Cooling h p.a.) (kWh p.a.)
					DER Sheet (Row 384)	DER Sheet [(Row 307a) + (Row 367a x	Select fuel type	DER Sheet [(Row 310a) o (Row 367a x	Select fuel type	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315								(AgCO2 p.a.)										
Sample 1	100.28	1	100.28	15.8	15.8	0.01)] 3648.6	Natural Gas	0.01)] 1389.32	Natural Gas	418.92	534.24	0	788	300	217 140	277	0	1,583	766	292	56	124	0	1,280	12.8					
Sample 1 Sample 2 Sample 2 Sample 4 Sample 5 Sample 5 Sample 7 Sample 8 Sample 9 Sample 9	52.98 92.44 53.00	1	52.98 92.44	15.6 18.1 15.6	15.6 18.1	1082.57 4103.55 1082.57	Natural Gas Natural Gas Natural Gas	1290.78 1306.32 1290.78	Natural Gas Natural Gas Natural Gas	270.51 445.58 270.51	336.29 530.9 336.29	0	234 886 234 373	300 279 282 279 308 294 279 308 210	140 231 140 172	175 276 175	0	828 1,675 828 1,083	227 862 227 362	271 274 271 300	63 104 63	78 124 78		1,280 640 1,364 640 843 1,142 640 843 702	12.1 14.8 12.1					
Sample 5 Sample 6	74.55 92.44	1	92.44 52.98 74.55 92.44 52.98	14.5 15.7 15.6	18.1 15.6 14.5 15.7 15.6	1725.81 2991.47 1082.57	Natural Gas Natural Gas	1427.46 1362.68 1290.78	Natural Gas Natural Gas	331.6 445.58 270.51	442.67 530.9 336.29	0	373 646	308 294	172 231	230 276 175	0	1,083	362 628 227	300 286	77 104 63	103 124 78	0	843 1,142	11.3 12.4 12.1					
Sample 7 Sample 8 Sample 9	92.44 52.98 74.55 92.44 52.98 74.55 48 50.38	1	52.98 74.55 48	15.6 14.5 18.2	15.6 14.5 18.2	1082.57 1725.81 1677.12	Natural Gas Natural Gas Natural Gas	1290.78 1427.46 1062.57	Natural Gas Natural Gas Natural Gas	270.51 331.6 233.31	336.29 442.67 311.73	0	646 234 373 362 439	279 308 320	231 140 172 121	175 230 162	0	1,447 828 1,083 875 955	227 362 352	286 271 300 223	63 77 54	78 103 73		640 843	12.1 11.3 14.6					
Sample 10	50.38	1	50.38	18.9	19.0	2033.92	Natural Gas	1044.59	Natural Gas	234.63	323.47		439	226	122	168	٠	955	427	219	55	75	·	777	15.4					
NON-DOMES	692 TIC ENERGY	10 CONSUME	692 PTION AND	16.2 CO2 ANALYSI	IS	21,154	N/A	12,893	N/A	3,253	4,125	0	4,569	2,785	1,688	2,141	0	11,183	4,442	2,707	758	961	0	8,869	12.8	0.00	0 NON-	0 DOMESTIC EN	0 IERGY DEMAND	0 0
			Total area		TION CHECK	REG	ULATED ENERGY COP	SUMPTION BY ENG	USE (kWh/m² p.a.)	'BE LEAN' BER -	SOURCE: BRUKL OUT	IPUT	LATED ENERGY CO	INSUMPTION BY F	UEL TYPE (kWh/m	p.a.) 'BE LEAN' B	ER - SOURCE: BRU	KLJINP or *SIM.CS			REGULA	TED CO2 EMISSION	NS PER UNIT				REGUL	ATED ENERGY DEN	AND PER UNIT PER ANN	IUM (kWh p.a.)
Building Use	Area per unit (m ^t)	Number of units	represented by model (m²)	Calculated BER 2012	BRUKL BER 2012	Space Heating (kWh/m ^t p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water	Lighting (kWh/m² p.a.)	Auxiliary (kWh/m² p.a.)	Cooling (kWh/m² p.a.)	Natural Gas	Grid Electricity				2012 CO2 emissions (kgCO2 p.a.)	Natural Gas	Grid Electricity				SAP10 CO2 emissions (kgCO2 p.a.)	BRUKL BER SAP10		Space Heating	Domestic Hot Water	Lighting Au (kWh p.a.) (kW	diary Cooling h.p.a.) (kWh.p.a.)
				(kgCO2 / m2)	(kgCO2 / m2)	(, p)		(kWh/m² p.a.)	Water	,, p,	(,	(y py	######################################	минини				(egcoz p.s.)	PAPAPARAMANA	*************				(Ageor p.s.)	(kgCO2 / m2)	-	,	(kWh p.a.)	,, ,	
																										⁴¹ l ^p				
																										,				
SITE-WIDE EN			0 AND CO2 A	ADIV/01		0	N/A	0	N/A	0	•	0	0	0	N/A	N/A	N/A	0	0	0				0	#DIV/0!		0	0	0	0 0
								REGULATE	D ENERGY CONSUM	IPTION								REGULATED CO2 EMISSIONS						REGULATED	CO2 EMISSIONS		REGUL	ATED ENERGY DEN	IAND PER UNIT PER ANN	UM (kWh p.a.)
Use	,	fotal Area (m²)		Calculated BER 2012 (kgCO2 / m2)		Space Heating		Domestic Hot Water		Lighting	Auxiliary	Cooling						2012 CO2 emissions						SAP10 CO2 emissions	Calculated BER SAP10	41h	Space Heating	Domestic Hot Water	Lighting Au	illiary Cooling
-		692				(kWh p.a.)	Mr	(kWh p.a.)	ME	(kWh p.a.)	(kWh p.a.)	(kWh p.a.)						(kgCO2 p.a.)						(kgCO2 p.a.)	(kgCO2 / m2)		(kWh p.a.)	(kWh p.a.)		hp.a.) (kWhp.a.)
Sum		692		16.2	•	21,154		12,893		3,253	4,125	0						11,183						8,869	12.8		٥	0	0	0 0

The applicant should of DOMESTIC ENE					consumption figures	s and the 'be green' D	ER.															SAP 2012	2 CO2 PERFORMAN	NCE								SAP 22 CO2 PE	RFORMANCE				
Nath Marellina		Total	VALIDA:	TION CHECK							SY CONSUMPTION PER		'BE GREEN' SAP DER V	WORKSHEET								REGULATED CO2 EN		T (kgC02 p.s.)									NISSIONS PER UNIT				
(e.g. plot fi number, dwelling type etc.)	odel total Number oor area units (m²)	r of represented by model (m²)	d Calculated DER 2012 (keCO2 / m2)	DER Worksheet DER 2012 (kgCO2 / m2)	Space Heating (Heat Source 1)	Fuel type Space Heating	Domestic Hot Water (Heat Source 1)	Fuel type Domestic Hot Water	Space Heating (Heat source 2)	Fuel type Space Heating	Domestic Hot Water (Heat source 2)	Fuel type Domestic Hot Wate	Space and or Domestic Hot Water from CHP	Fuel type CHP	Total Electricity generated by CHP (Electricity generated by renewable (-)	Lighting	Auxiliary Coolin	g Space Heating	Domestic Hot Water	Space Heating and DHW from CHP	Electricity generated by (CHP	Electricity generated by renewable	Ughting	Auxillary	Cooling	2012 CO2 emissions (kgCO2 p.s.)	Space Heating	Domestic Hot Water	ipace Heating and DHW from DIP	Dectricity generated by CHP	Electricity generated by renewable	Lighting	Auditory C		missions	Calculated DER SAP10 (kgCO2 / m2)
				DER Sheet (Row 204)	DER Sheet Row 207b +	Select fuel type	DER Sheet [Row 310b +	Select fuel type	l'applicable DER Sheet	Select fuel type	V applicable DER Sheet IRow 210c +	Select fuel type	If applicable DER Sheet [(Row 207s + 210s)	If applicable Select fuel type	if applicable DCS Shaat	If applicable	DER Sheet Row 232 (F	ER Sheet DER Sh v 212 + 221) Row 2	wt		if applicable		if applicable							If applicable		l'applicable					
francis I	1 10028	100.28	10.4	10.4	(Row 367b x 0.01)] 1366.02	Grid Electricity	[Row 267b x 0.01]] 911.97	Grid Electricity	(Row 307c + (Row 367c x 0.01))	Grid Electricity	[Row 367c x 0.01]]	Grid Electricity	Row 362 x 0.01	•	[[Row 307s + 210s] × [Row 361 + 262]]	-922.71	4400	252.46 Kow 2	300	m				303			100	N/A	313			303					
Sample 2 Sample 2		52.98 92.44 52.98 74.55 92.44 52.98 74.55 48 50.28	7.9 12.6 7.9	7.9 12.6 7.9	427.27 1562.88 427.27	Grid Electricity Grid Electricity Grid Electricity Grid Electricity	728.49 896.78 728.49	Grid Electricity Grid Electricity Grid Electricity Grid Electricity		Grid Electricity Grid Electricity Grid Electricity Grid Electricity		Grid Electricity Grid Electricity Grid Electricity Grid Electricity				-932.71 -932.71 -932.71	270.51 645.58 270.51 331.6	292.61 292.61 266.28 292.61	227 812 227	282 465 282			494 494 494	217 140 231 140	152 138 152		1,047 418 1,162 418	102 264 102	172 209 172			-217 -217 -217	63 104 63	68 62		188 522 188	15 56 15
Sample 1 Sample 2 Sample 3 Sample 4 Sample 5 Sample 6 Sample 7 Sample 8 Sample 9 Sample 10	52.98 I 92.44 I 52.98 I 74.55 I 92.44 I 52.98 I 74.55 I 48 I 50.38 I	74.55 92.44	8.1 10.5	8.1 10.5 7.9	652.27	Grid Electricity Grid Electricity	841.66 896.78	Grid Electricity		Grid Electricity Grid Electricity Grid Electricity Grid Electricity		Grid Electricity Grid Electricity		Grid Electricity		-932.71 -932.71 -932.71		267.37	329 605 227	427 465 282			-494	172	139 150		602 967	152	196			-117 -217 -217	77 104 63	62 67		270 424	2.6 4.7
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Sum NON-DOMESTI	692 10 ENERGY CON				8,192	N/A	8,041	ajca.	0	N/A	0	N/A	0	N/A	٥	4,327	3,253	2,781 0	4,251	4,172	0	0	-4,841	1,688	1,443	0	6,716	1,909	1,874	0	0	-2,273	758	649	0	2,015	4.4
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Appendix E

Roof Layout indicating PVs

