Energy and Sustainability Strategy

148 Oxford Road, Oxford, OX4 2EA

PR10887

Date: 23/10/2023

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Notice

Document History

Client: Bob Pope
Project: 148 Oxford Road, Oxford, OX4 2EA
Document title: Energy & Sustainability Strategy
ERS reference: PR10887

Revision	Remarks	Author	Checked	Approved	Date
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Contents

Executive summary

ERS Consultants Ltd has been appointed to prepare an Energy & Sustainability Statement for the site located at 148 Oxford Road, Oxford, OX4 2EA.

The proposal is for the conversion of a first-floor office to a flat and a new build flat adjacent to this. This report will be focusing on the new-build flat, implementing careful design and implementing sustainability measures.

Proposed schedule of accommodation are as follows:

- 1x New flat - 1-Bedroom flat – 65.32m^2

Total floor area for habitable dwelling: 65.32m^2

This energy and sustainability strategy outlines the key measures to be incorporated in the design, in regards to sustainability, carbon emissions, renewable energy and environmental impact of the considered development in accordance and with guidance from the following documents and policies:

- Oxford Local Plan 2036 RE1
- The National Planning Policy Framework (NPPF) July 2021

In line with the Oxford Local Plan 2036 RE1, the development would need to achieve a 40% reduction in regulated CO_2 emissions against a Building Regulations (Part L 2021) compliant scheme.

Elmhurst Design SAP 10.2 has been used as this development will be completed to 2021 Building regulation standards. The site-wide reduction will still need to achieve compliance with the Target Energy Rating (TER) at the Be Green stage.

This energy & sustainability statement will demonstrate how a selection of sustainable energy efficient measures and low-carbon technologies are used in the reduction of the site wide carbon emissions for the development.

A detailed calculation has been undertaken to establish the energy consumption and carbon emissions of the proposed development.

The methodology used to determine the expected operational CO_2 emissions for the development is in accordance with the standard three-step Energy Hierarchy and the CO_2 savings achieved for each step are outlined below:

Baseline – (CO_2 emissions Part L of the Building Regulation)

Initially in the energy assessment, the baseline regulated CO_2 emissions of the development must be established. This is the standard that all subsequent reductions will be gauged. For this development, the baseline regulated CO_2 emissions calculated for the unit is **0.74 Tonnes CO_2/Year.**

Be Lean – Use less energy

The second step addresses, reduction in energy demand through the adoption of passive and active design measures with emphasis on a fabric first approach.

Emphasis will be put on the buildings fabric performance in order to reduce energy consumption, as less heating and cooling will be lost through the high performance fabric hence reducing the demand. Fabric first measures include levels of insulation beyond Building Regulation 2021 requirements which will help in achieving low air tightness levels. A scheme for construction detailing will also be specified in order to minimise heat loss through thermal bridging.

With the addition of the lean fabric improvements the energy regulated CO_2 emissions are shown to reduce by **45.66% to 0.40 TonnesCO_2/Year** for the proposed site.

Be Clean – Supply energy efficiently

Once demand for energy has been minimised, all planning applications must demonstrate how their energy systems will exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly to reduce CO_2 emissions.

When selecting the proposed heating system, it is imperative to consider carbon dioxide emissions, as all combustion processes can emit oxides of Nitrogen (NOx) and, solid or liquid fuelled appliances (such as those using biomass or biodiesel) can also emit Particulate Matter. These pollutants contribute to Enfield's poor air quality and can have negative impacts on the health of local residents and occupiers of the development. It is important that these impacts are taken into account in determining the heating strategy of a development.

The space conditioning and hot water system network in this stage of the development will remain the same as the previous stage, which is an SAP Default Air Source Heat Pump but will have the addition of an mcs certificate.

In this project there will be no direct heating networks or CHP incorporated so therefore, the Be Clean scenario will not further reduce CO_2 emissions on site for the proposed development, therefore meaning there are no changes to be implemented to the development.

At this stage, the main heating system is an SAP Default air source heat pump with mcs certificate. With this addition, the CO_2 emissions are shown to reduce by **53.03% to 0.35 Tonnes CO_2/Year** from the baseline for the proposed site.

Be Green – Use renewable energy

At this stage of the project, various low-zero carbon options were considered to meet the required reduction. In the end, it was decided that the same heating system as the Be Clean stage can be used in addition to 1.00kWp of PV facing South East with an export capable meter.

By implementing that low carbon heating system, the regulated carbon emissions have been reduced by **67.33% from the baseline to 0.24 Tonnes CO_2/Year.**

This concludes this proposed development using the proposed specification in this report completes the **40% Carbon Emissions Reduction** against **Part L Building Regulations standards by using the Part L 2021 carbon emission factors**.

Energy & carbon demand summary

Table 1 Energy and Carbon Reductions for Site Wide Reduction				
	Fabric energy kWh/year	Energy Consumption Savings (%)	Total CO_2 Emissions (Tonnes CO_2/Year)	CO_2 Emissions Savings (%)
Baseline	3,974		0.74	
Be Lean	4,257	-7.11%	0.40	45.66%
Be Clean	3,687	14.34%	0.35	7.38%
Be Green	2,796	22.42%	0.24	14.29%
Total Reduction		**29.65%**		**67.33%**

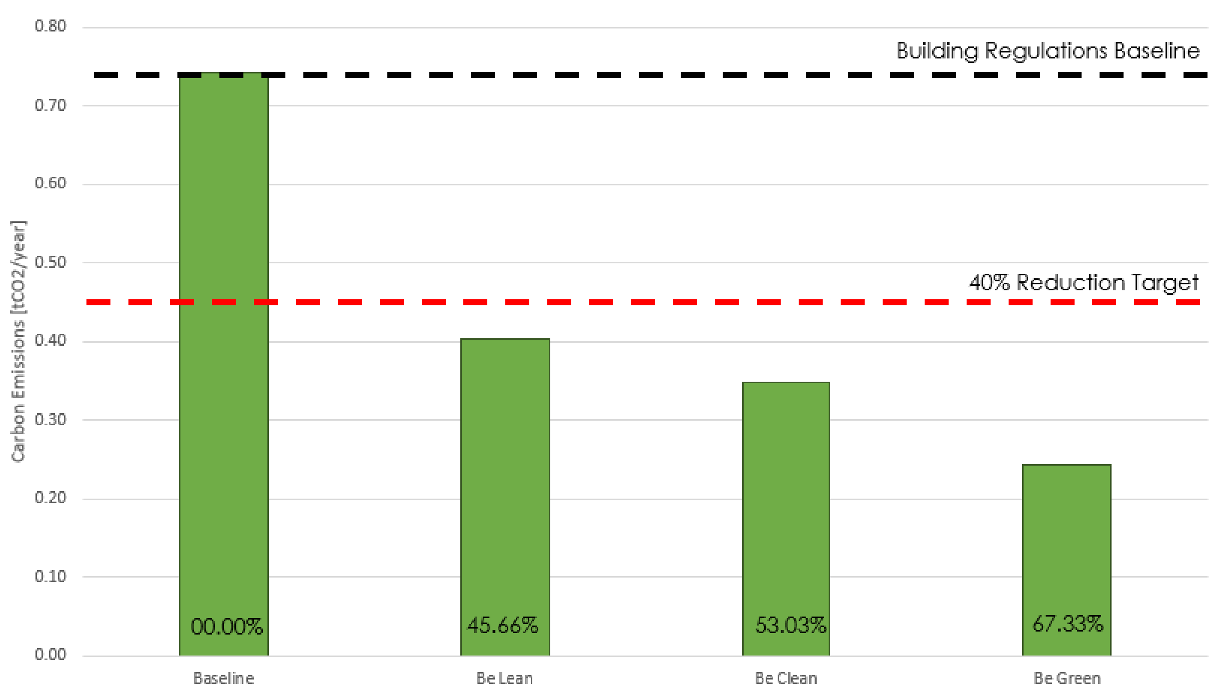


Fig.1 CO_2 Reduction for Site-wide carbon reduction

As shown in Table 1, the provisional baseline annual carbon dioxide emissions of the proposed development have been calculated to achieve **0.74 Tonnes CO_2/Year** for the plot and through the design development this has been reduced to achieve the following:

New-build reduction achieved: 67.33% (0.24 Tonnes CO_2/Year).

<table>
<tr><th colspan="4">Table 2: Proposed Fabric Specifications</th></tr>
<tr><th colspan="4">Fabric Construction and Insulation</th></tr>
<tr><th>Element</th><th>Type</th><th colspan="2">U-Value</th></tr>
<tr><td>Exposed Floor to retail</td><td>Exposed Floor - Solid</td><td colspan="2">0.18</td></tr>
<tr><td>External Walls</td><td>Cavity Wall</td><td colspan="2">0.19</td></tr>
<tr><td>Roof at Joists</td><td>Pitched – insulated at joists</td><td colspan="2">0.12</td></tr>
<tr><td>Windows</td><td>Window</td><td>Double glazed, argon filled, 16mm unit with low-e coat; G-Value of 63%; 70% Frame Factor</td><td>1.20</td></tr>
<tr><td>Doors</td><td>Solid Door</td><td>Solid or minimally glazed;</td><td>1.20</td></tr>
</table>

Table 3: Proposed System Specifications

Space Heating

Main Heating System	SAP Default Air Source Heat Pump supplying radiators MCS Certified;
Heating Controls	Time and temperature zone control;
Secondary Heating	None;

Water Heating

Heat source	From Main Heating	**Cylinder Size**	170 litres	**Heat Loss**	1.63 kWh/Day
WWHRS Instantaneous System 1	N/A	**WWHRS Instantaneous System 2**	N/A		
Water Use <=125 l/p/d	Yes	**Cold Water Source**	From Mains		
Shower(s)	Combination boiler or unvented hot water system	**Flow Rate [l/min]**	9 l/min		
Bath Count	0	Cylinder Pipework is fully insulated where possible; Full cylinder heating controls installed;			
Solar Thermal	Not Installed;				

Ventilation

Mechanical Ventilation System	Nuaire MRXBOXAB-ECO3	**Number of Wetrooms, excluding kitchen**	1
Cooling system	Not installed;		
Pressure Test Blower Door	3.00m³/hm² @ 50 Pa (Please note ERS can provide Air Leakage Testing)		

Other

Detailing (linear thermal bridging junctions – formerly ACDs)	Enhanced construction details from the insulation manufacturer have been used where available. The dwellings must be constructed to this standard, and the relevant forms must be completed as building work progresses. Any deviation from this will require an update to the SAP calculations as the psi-values will change; **Masonary Cavity Hybrid Insulation 90mm (0.022/mK) Insulation with 10mm residual gap and 0.19W/mK Lightweight Blockwork** https://www.recognisedconstructiondetails.co.uk/walls/masonry-cavity-wall-hybrid-insulation							
Lighting	**No. Fittings**	20	**Power [W]**	2	**Efficacy [lm/W]**	75	**Capacity [lm]**	150
Tariff and Meters	Standard	**Smart Electricity Meter**	Yes	**Smart Gas Meter**	Not present			
PV/Renewables	1kWp of PV facing Southeast							

Please note: There may be upgrades compared to your original specification to achieve building regulation approval under the relevant Approved Document Part L. Failure to implement these upgrades may result in a Building Regulation Failure at final stage. Please ensure any changes to the specification are made through this office to ensure ongoing compliance.

Introduction

Site & proposal

The site is located at the land of **148 Oxford Road, Oxford, OX4 2EA**

Sitewide Gross Internal Area for all dwellings: 141.94 m²,
New Build flat internal Area; 65.32 m²,

The approximate site location of the proposed development is shown in the site plan Fig.2.

Fig.2 Site Plan

Policy context

This energy and sustainability statement will seek to respond to the energy policies that apply to this development. The most relevant applicable energy policies in the context of the proposed development are presented below.

- Oxford Local Plan 2036 RE1
- The National Planning Policy Framework (NPPF) July 2021

All the aforementioned policies focus on zero carbon targets for residential developments with a minimum 40% on site reduction beyond Part L 2021.

Calculation methodology

The sections below present the methodology followed in determining carbon emissions reduction savings for the proposed scheme.

The methodology employed by the energy and sustainability statement is in line with the GLA's Guidance on preparing energy assessments.

The baseline CO_2 emissions are first established, i.e., the emissions of a scheme that is compliant with Part L 2021 of the Building Regulations.

The approved software used to model and calculates the energy performance and carbon emissions are SAP 2012 version by Elmhurst Energy Systems Ltd.

Baseline:

The buildings baseline uses Mains Gas as the main source of heating on the notional calculations. The full specification of the baseline can be found in Table 1.1 of the Approved Document L Volume, 2021 Edition.

Be Lean: use less energy

The demand for energy is reduced through a range of passive and active energy efficiency measures; as part of this step the dwellings' fabric u-values and glazing have been improved to a high standard, in addition to this suitable heating systems are utilised as per the specifications in Table 2 and 3. The main heating system used are SAP default gas combination boiler.

Be Clean: supply energy efficiently

As much of the remaining energy demand is supplied as efficiently as possible in the previous stage, we consider the option of communal and network-based heating strategies, but due to high costs and the scale of the development this is not a viable option. At this stage, the main heating is to be an SAP Default air source heat pump with mcs certificate and MVHR.

Be Green: use renewable energy

Renewable and low-zero carbon technologies are incorporated to offset part of the carbon emissions of the development. The uptake of low or zero carbon technologies is based on feasibility and viability considerations, including their compatibility with the energy system determined in the previous step.

The implementation of the Energy Hierarchy determines the total regulated carbon savings that can be feasibly and viably achieved on site.

The 40% improvement for the development against the baseline emissions is compared to the relevant targets for each element and in case of a shortfall; savings through off-site measures should be achieved.

The Conclusions section summarises the energy strategy and associated carbon savings for the proposed development.

The carbon emissions factors used in all calculations in this document are those used for Part L of the Building Regulations. The relevant factors are reproduced in Table 4 below.

Table 4 Carbon Emission Factors for selected fuel type

Fuel	Emissions kg CO2e per kWh	Primary energy factor
Mains Gas	0.210	1.130
Bulk/Bottled LPG	0.241	1.141
Liquid Fuels	0.024	1.286
Heating Oil	0.298	1.180
Wood Pellets	0.053	1.325
Grid Electricity	0.136	1.501

* Table extracted from the document SAP Version 10.2 (21-04-2022). Table 12: Fuel prices, emission factors and primary energy factors, Page 189. this can be found in the appendix of the report.

Be Lean – Use less energy

The proposals incorporate a range of passive and active design measures that will reduce the energy demand for space conditioning, hot water, and lighting. Measures will also be put in place to reduce the risk of overheating, the regulated carbon saving achieved in this step of the Energy Hierarchy is **45.66%** when compared against the baseline level for the development.

Passive design measures

Enhanced U-values

The heat loss of different building fabric elements is dependent upon their U-value. A building with low U-Values provide better levels of insulation and reduced heating demand during the cooler months.

The proposed development will incorporate high levels of insulation and high-performance glazing beyond Part L 2021 targets and notional building specifications, to reduce the demand for space conditioning (heating and/or cooling).

Table 5 demonstrates the improved performance of the proposed building fabric beyond the Building Regulations requirements.

Table 5 Proposed fabric U-Values		
Domestic (U-Values in W/m²k)		
Element	**Part L 2021 Building Regulation**	**Proposed**
Wall	0.26	0.19 (External Wall)
Floor	0.18	0.12 (Exposed Floor to retail)
Roof	0.16	0.12 (Roof at Joists)
Windows	1.60	1.20
Solid Doors	1.60	1.20
These u-values are recommended but may change during the construction stage, to meet site constraints, any worsening of the u-values must ensure the required 40% reduction in Carbon is met before completion;		

Air tightness improvement

Heat loss may also occur due to air infiltration. Although this cannot be eliminated altogether, good construction detailing and the use of best practice construction techniques can minimise the amount of air infiltration.

The proposed development will aim to improve upon the Part L 2021 minimum standards for air tightness by targeting air permeability rates of **3.00m³/m².h at 50Pa**.

Active design measures

High efficacy & low energy lighting

Where artificial lighting will be needed it will be low energy lighting without compensating for luminance, and will accommodate LED.

Water

The National Planning Policy Framework requires water efficiency in new developments to meet the highest national standard. For residential development, this is defined in the supporting text as the 'optional Building Regulation' for water efficiency in new dwellings, which is 110 litres per day per person.

There are presently no other national standards for non-residential developments than those in the Building Regulations. However, the principle of water efficiency in line with the waste hierarchy applies to all developments. As a result, all developments should seek to reduce demand through efficiency measures, and then meet remaining demand from sustainable sources wherever possible.

For all developments, the submitted information should set out an approach to water management that reduces water usage and waste and priorities demand reduction measures over supply measures.

Reducing water use

Development, whether new construction or change of use and refurbishment, can save water by including measures such as:

- systems for greywater reuse
- aerated washbasin/kitchen taps and shower heads,
- sensor and low flush toilets,
- shower timers, and
- water efficient white goods and appliances

Water use during construction can be reduced through measures including:

- closed loop wheel washers,
- waterless wheel washing using angled steel grids to remove debris,
- high pressure low volume power hoses,
  recirculating water where possible,
- limiting the water used for flushing building services by stopping it as soon as the flush water turns clear, and employing a regime for monitoring water use and water waste.

Choosing the best location for a boiler can reduce water consumption and heat loss. By minimising the length of hot water pipes the volume of water that must be drawn off each time a tap or shower is used can be reduced. Positioning hot water pipes above pipes carrying cold water will reduce heat transfer. Further heat loss can be reduced by insulating the piping.

For all new dwellings, a completed "water efficiency calculator for new dwellings" worksheet that accords with Part G of the building regulations' Approved Documents will be provided prior to occupation. The calculation will demonstrate that the new dwellings will achieve a maximum water usage of 110 litres per person per day.

Controls and Monitoring

Advanced lighting and space conditioning controls will be incorporated, specifically:

- For areas of infrequent use, occupant sensors will be fitted for lighting, whereas day lit areas will incorporate daylight sensors where appropriate;
- Heating and cooling systems controls will comprise time and temperature controls, both centrally for the whole building, and locally for each space;
- Smart metering to be installed on all new dwellings for adequate monitoring;

Overheating Risk Analysis

Passive solar gain refers to the process whereby a building is heated by the sun, either directly from sunlight passing through a window and heating the inside of the building, or indirectly as sunlight warms the external fabric of the building and the heat travels to the interior. The level of passive solar gain can significantly impact upon the quality of a building, how it is used and the energy needed for it to be inhabited comfortably. Passive solar gain can reduce the need for mechanical heating, which in turn reduces energy use and carbon emissions.

Key factors that influence passive solar gain include the physical characteristics of the site, immediate surroundings, orientation of buildings, external design, internal layout and the construction materials used.

Whilst passive solar gain can reduce the carbon emissions associated with heating, if used incorrectly it can lead to overheating, which in turn can lead to the installation of mechanical cooling equipment (e.g., air conditioning). Mechanical cooling increases energy consumption and requires maintenance, resulting in costs and carbon emissions. Mechanical cooling units also produce heat that requires dissipation. The need for mechanical cooling can be avoided or lessened by designing-in passive ventilation and passive cooling measures. Developments should not incorporate mechanical cooling unless passive measures have been fully explored and appraised and proposals that include mechanical cooling should clearly demonstrate that passive measures would not be adequate.

The potential overheating for the development is to be assessed in accordance to Part O of the Building Regulation. Utilising the simplified approach is the first protocol to ensure the scheme does not over heat, where the simplified approach fails to meet the required reduction, a dynamic simulation will need to be undertaken. The Part O Analysis will be completed post-planning stage.

The following list includes some of the key considerations in the design of new schemes:

- Rooms that are most frequently occupied should benefit from a southerly aspect, but with appropriate measures to avoid overheating.
- Orientation and layout of habitable rooms, and window size and orientation, should be carefully considered in relation to the path of the sun.
- Rooms that include a concentration of heat generating appliances (e.g., kitchens) or are less frequently occupied (e.g. bathrooms) should be located in the cooler

part of the building, generally the northern side.

- Conservatories and atria can be used to assist natural ventilation in the summer by drawing warm air upward to roof vents, and to collect heat during the spring and autumn.

- Where there is a chance that overheating can occur (e.g. due to large expanses of glazing on roofs and south facing elevations), design measures such as roof overhangs, brise soleil, external shuttering, photochromatic and thermochromic glass and a lighter colour palette can help.

- Zonal heating and ventilation systems and controls can be used allowing areas subject to high solar gain to occupy their own temperature control zone. Dynamic controls reduce energy waste.

- Use of materials to build in thermal mass to absorb excess heat during warmer periods and release it slowly during cooler periods (e.g. day/night, summer/winter).

- Buildings should be designed for passive ventilation:
    - cross ventilation with windows located on opposite walls and/or roof mounted turbines or wind cowls that assist with circulation of air by drawing air through windows or top floor openings and
    - passive stack ventilation (PSV) that uses pressure differences to draw in fresh air from outside to replace rising warm air which is released from the top of the building. A heat exchanger can be placed where the air escapes the building to reduce heat loss.

Be Lean CO_2 emissions & savings

By means of energy efficiency measures and suitable heating systems, regulated CO_2 emissions for the site are shown to reduce by **45.66%** compared to the baseline.

Be Clean – Supply energy efficiently

By means of installing a SAP default electric powered Air Source Heat Pump and MVHR at this stage the site-wide reduction is shown to be **53.03**% compared to the baseline.

Low Carbon Energy Sources

Combined Heat and Power (CHP)

The presence of a year-round base hot water generation heat load in residential units is favourable to CHP. To date, there are readily available micro gas fired CHP units (such as EC power) on the market. At this stage of the energy hierarchy gas fired CHP should be considered for the development's LZC strategy, however, the carbon reductions due to CHP are extremely sensitive to the system design, unit selection and running time.

CHP (Combined Heat & Power) is a-technology that can offer energy efficiency in use, however the system itself needs to run on a 24-hour basis. The heat generated would be exceeding the demand and needs for this site, and would require to have an outlet area which can profit from this excess; however, this development does not have a space that benefit from this; therefore, this option has considered not feasible for this development.

Heat Networks

All new developments should look connect, or be connection ready, where a heat distribution network already exists. The investigation of opportunities should cover all scales and should not be limited to district heating systems.

Be Green – Use renewable energy

Renewable technologies feasibility study

Methods of generating on-site renewable energy (Green) were assessed, once Lean and Clean measures were considered.

This section provides an overview of the technologies considered, a brief assessment of their feasibility, a proposed mixture of suitable technologies.

The proposed development will benefit from an energy efficient building fabric which will reduce the energy consumption of the proposed development in the first instance.

A range of renewable technologies were subsequently considered including:

- Biomass;
- Ground/water source heat pumps;
- Wind energy;
- Photovoltaic panels, and,
- Solar thermal panels.

In determining the appropriate renewable technology for the site, the following factors were considered:

- CO_2 savings achieved;
- Site constraints;
- Financial benefit
- Any potential visual impacts

Demand profiles

The balance of technologies chosen will depend on the development's energy demand patterns.

Keeping in mind that the space heating energy demand changes according to the season. While hot water energy demand will provide a significant base load throughout the year.

At this early stage in the design, it is possible only to outline the likely feasibility of specific technologies. Further descriptions of the LZC technologies below are included in Appendix A.

Table 6. Renewable and Low Zero Carbon Technologies

Renewable Technology	Comments	Lifetime (Years)	Maintenance	External Impact	Site Feasibility	Adopted for Site
BIOMASS 	Burning of wood pellets releases high NOx emissions and there are limitations for their storage and delivery within an urban location.	20	High	High	1	☐
PV 	PV panels would generate significant carbon savings, whilst having minimal impact on the appearance of the building and no adverse impact on the amenity of neighbouring buildings.	25	Low	Med	10	☒
Solar Thermal 	Solar thermal array mounted on the roof may contribute to carbon reductions, but will reduce the amount of available roof space where Photovoltaics are proposed	25	Low	Med	6	☐
Air Source Heat Pump 	Ground loops require space and additional time at the beginning of the construction process and very high capital costs; however, the air source heat pump is a viable and cost-effective solution to meet the required carbon reductions.	20	Med	Low	10	☒
Wind 	Due to insufficient open area for installation of a stand-alone wind turbine and planning issues this option has not considered in this development.	25	Med	High	0	☐

Detailed assessment of Photovoltaic Panels

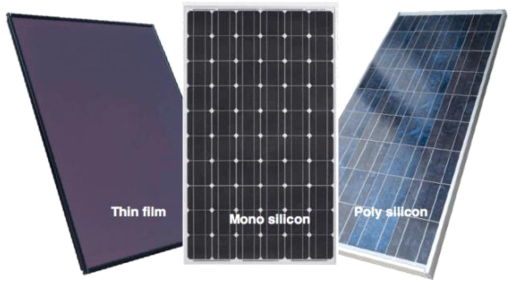


Fig 3. Photovoltaic Panels

Four types of solar cells are available on the market at present and these are mono-crystalline, polycrystalline, thin film and hybrid panels as seen in Figure 3. Although mono-crystalline and hybrid cells are the most expensive, they are also the most efficient with an efficiency rate of 12-20%. Poly-crystalline cells are cheaper but they are less efficient (9-15%). Thin film cells are only 5-8% efficient but can be produced as thin and flexible sheets.

Air Source Heat Pumps is considered as a highly efficient low zero carbon technology solution to meet the required carbon reductions for the houses. This typology does not require any photovoltaic panels to meet the required carbon reduction.

The PV shall comprise **1.00kWp for new build flat** to be mounted on the sloped roof facing the rear of the dwelling; Table 7 summarizes the technical data for the proposed PV array. In total, the PV installation would produce a further regulated CO_2 savings of **14.29%** for the **development**.

Table 7. Proposed PV Specifications	
Photovoltaic Panels	
Module Efficiency	15%
Panel Orientation	South East
Tilt	To roof angle
Power to be installed (per flat)	1.00kWp/flats in Block A
Energy Generation	891.08kWh/yr/
CO_2 savings (site-wide)	**0.11tCO_2/yr**

Be Green CO_2 emissions & savings

The incorporation of low or zero carbon technologies, such as highly efficient Air Source Heat Pumps and PV will further reduce CO_2 emissions of the site by a further **67.33**% compared to the baseline.

Flood zone risk assessment for planning

The Environment Agency has developed a flood risk map for planning to identify the relative risk of flooding for proposed development planning locations. Flood zones assume that no defences are present and so where these do exist, they are only indicative of the potential for flooding.

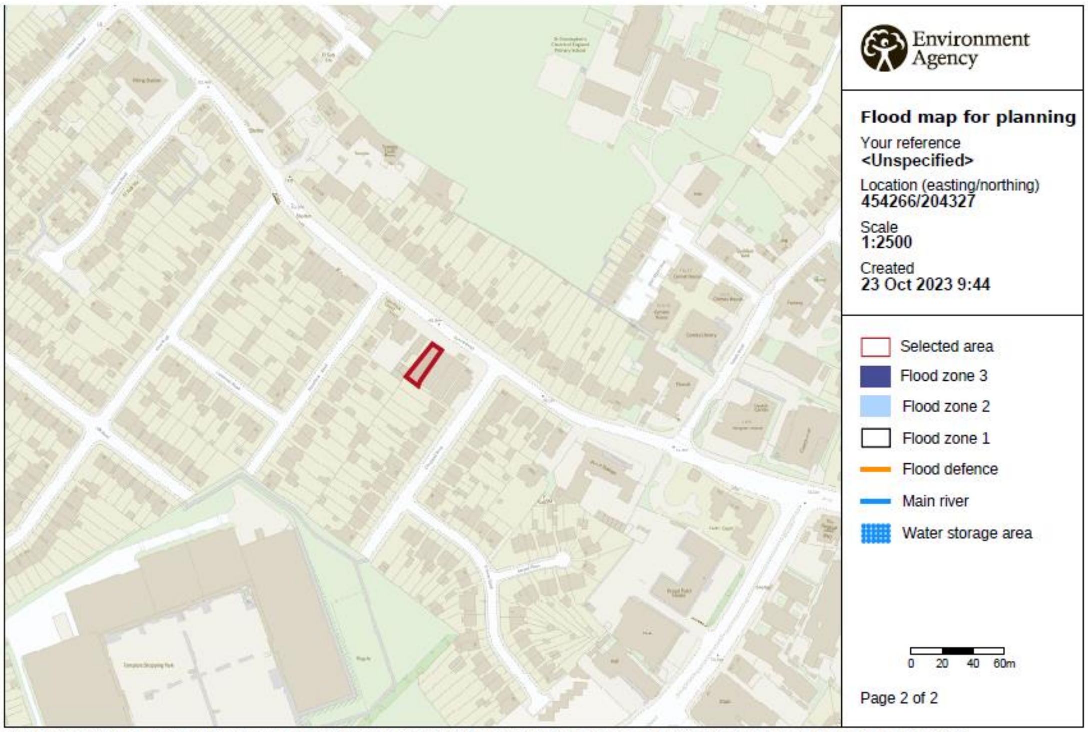


Fig 4. Environment Agency Flood Zone Interactive Map

The whole of the development lies within flood zone 1 of the Environment Agency's flood risk map as seen in fig. 4. Land located within flood zone 1 is at low risk of flooding having an associated annual probability of flooding of less than 1 in 1000 (0.1%).

Study approach

In accordance with Planning Practice Guidance for Flood Risk document, land within flood zone 1 is suitable for all uses. Assessment of this site has been based upon the Environment Agency's flood interactive map, the topographical site survey and the architect's proposed development layout.

Flood vulnerability

Based on the Environment Agencies flood map, the development site is located within Flood Zone 1 and in accordance with Planning Practice Guidance for Flood Risk neither a sequential or exception test is required.

Conclusion

Following the implementation of the three-step Energy Hierarchy, the proposed development has been designed to meet energy policies set out by the proposed development local and national planning requirements, which demonstrates the client and the design team's commitment to enhancing sustainability of the scheme.

Based on the results and outline figures, the proposed development on the Land adjacent to **148 Oxford Road, Oxford, OX4 2EA** will satisfy the relevant policies for sustainable design and construction requirements of energy consumption and carbon emissions.

The new development will be designed with a high level of insulation and low air permeability to reduce heat loss as much as is practically possible, also the use of low energy lighting and A – Rated White goods are essential for the reduction of energy consumption. The control strategy throughout the proposed site must be carefully designed to ensure the most economical operation of all equipment.

To achieve the required reduction of carbon emissions, several options were considered, however the best option in regards to site location and development size, was the implementation of an Air Source Heat Pump with MCS Certificate and PV Panels. Different possible renewable energy options have been identified; bearing in mind that selection is a complex process which requires a more detailed estimation of energy demand patterns; therefore, further analysis will be undertaken as the design progresses.

All buildings are to have suitable meter/smart meter management installed on every household, so that the homeowner can benefit from accurate savings to allow for suitable management of energy usage.

The baseline annual energy consumption of the site on this development have been calculated to be **0.74 Tonnes CO_2/Year** of CO_2 emissions. By incorporating on-site renewable/ LZC technologies the total CO_2 emissions will be reduced to **0.24 Tonnes CO_2/Year**, equivalent to 67.33% reduction over Part L 2021 requirements.

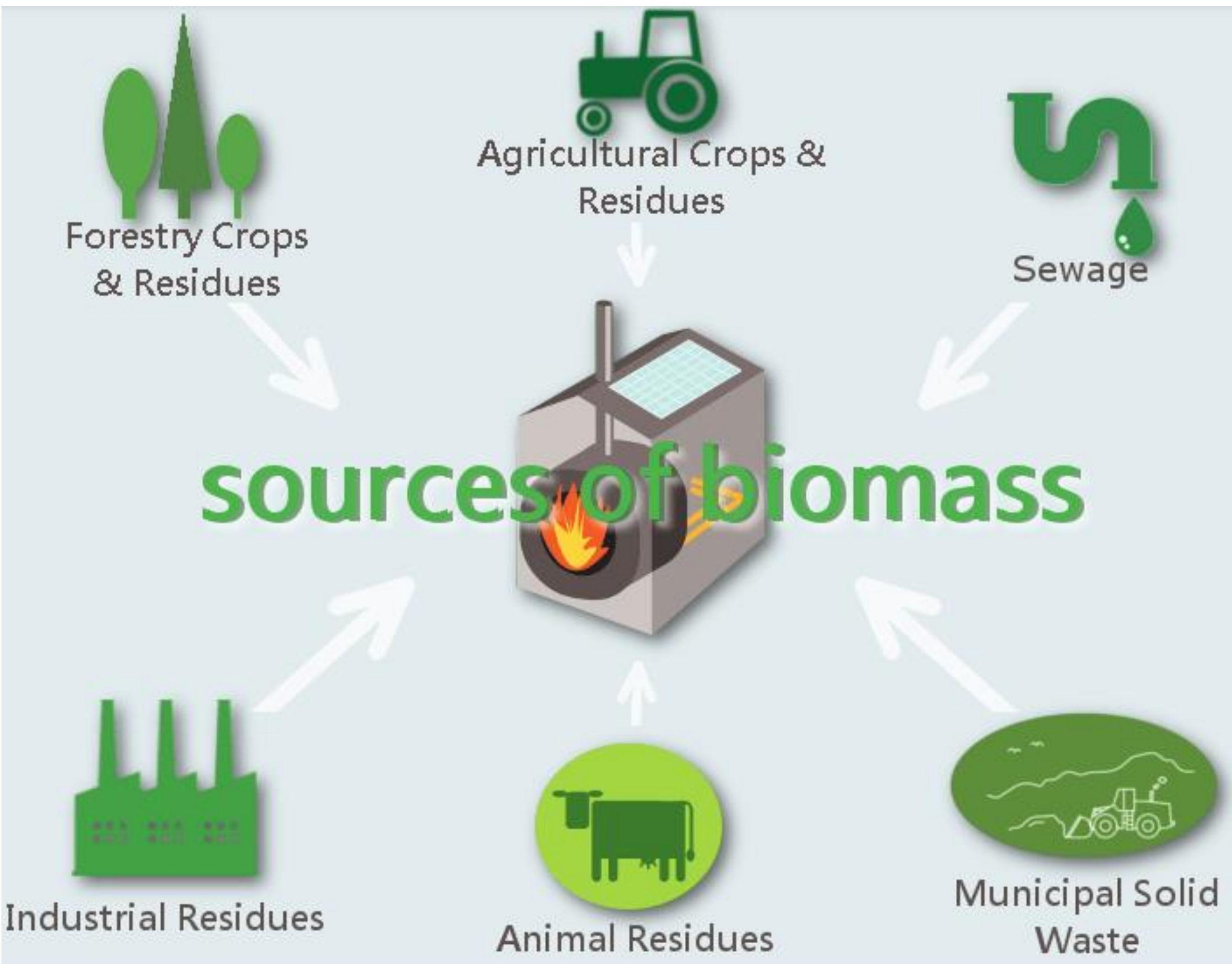
Post construction each building/dwelling is to have suitable testing to be provided to ensure the dwellings satisfy the requirements of this document and building regulation standards at the time of completion. These reports are to be provided as As-Built SAP worksheets, EPC and Air testing, for all conditioned spaces in the development.

Appendix A - Low or Zero Carbon Energy Sources

Biomass As a fuel

Biomass is a renewable energy source, generated from burning wood, plants and other organic matter, such as manure or household waste. It releases CO_2 when burned, but considerably less than fossil fuels. We consider biomass a renewable energy source, if the plants or other organic materials being burned are replaced.

Biomass is known for its versatility, given it can be used to generate heat, electricity, be used in combined heat and power units and be used as liquid fuel. In domestic settings, it tends to be found in the form of wood-fuelled heating systems.



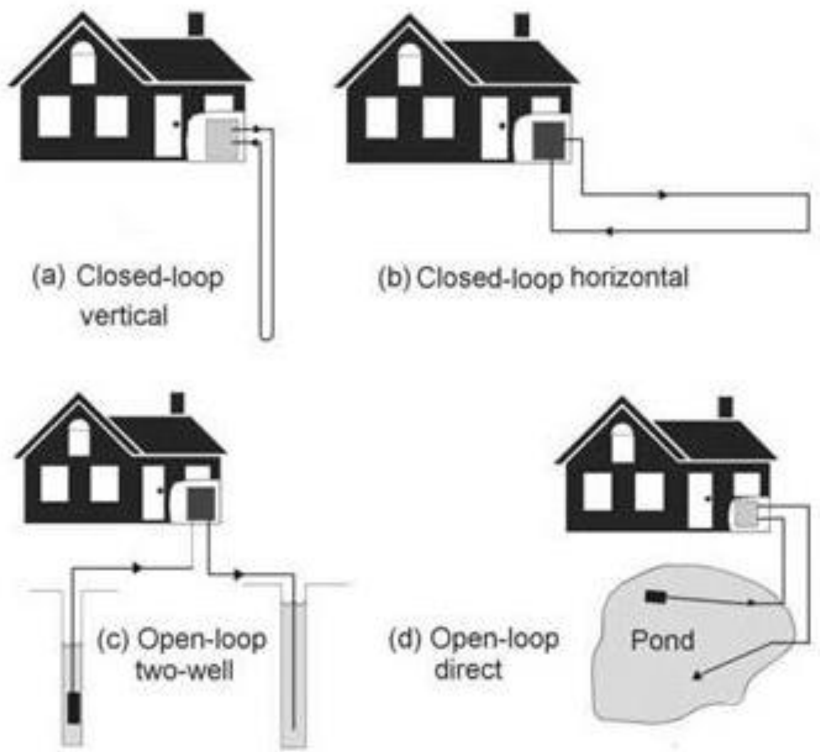
Geothermal Energy:

Geothermal energy technologies use the heat energy stored in ground; either for direct-use applications: such as using the grounds' heat to defrost a driveway or the indirect use with additional equipment such as a geothermal heat pump. Most commercial installations couple a heat pump with the ground to upgrade the low-grade heat from the ground or ground water to a higher-grade heat, where it can be used for heating purposes.

The suitability of a ground source system depends heavily on the type of earth coupling heat exchange system used:

Ground source earth coupling options

The right choice of appropriate heat exchanger depends on several factors such as: size of space heating/hot water system, available site area for the heat exchangers, and local ground conditions. Due to the specialist nature of this technology, we recommend that a specialist is employed to size the heat exchangers based on a desk-top study of the site's geological conditions – this normally being required in advance of any other contractor appointment.



Vertical Closed Loop System

A frequently used and simple ground source heat exchanger, for a small to medium size project, is a closed loop vertical system. The system comprises of vertically drilled boreholes, usually up to 100 m deep, into which are inserted two polyethylene pipes with a U-shape connector at the base of the hole – effectively providing a flow down to the bottom of the hole and return back up to the surface. All the flow and return loops are connected together across the site - completing the entire heat exchange loop.

Water is pumped around the loop and is then circulated around the heat pump to achieve the required heat exchange. The distance between boreholes is dependent on ground conditions but is typically a minimum of a 6mx6m grid, to prevent overlapping of the heat exchange process between loops.

Horizontal Closed Loop System

Horizontal closed loop heat exchangers are usually applied to small projects such as individual houses, which usually require a relatively low heat output. Consisting of horizontal trenches 1.5-2m deep, with either straight pipes or 'slinky' coiled pipes, these require significant excavation work and significant site area to achieve appreciable outputs as such are not normally suited to medium to large projects.

Vertical Open Boreholes System

A further option is a vertical open borehole system. The system involves the abstraction and discharge of natural ground water using boreholes; into which pumps are inserted, connected to collapsible pipework. Each borehole pump abstracts ground water, circulates it around the heat pump and then discharges the water back to the ground via an absorbing well, some distance from the original abstraction borehole. The system is capable of providing very high rates of heat exchange for a relatively small number of boreholes, which makes it very efficient in terms of site area required. However, this depends greatly on the availability of ground water, which in turn varies according to location. A major downside of this system is that the extraction of water from deep boreholes via pumps consumes a lot of energy, as the water has to be physically lifted to the surface by the pump – this in effect reduces the carbon emissions saved by this system as a whole.

Ground source heat exchange options in summary:

Vertical loop system - closed boreholes

- moderate heat capacity
- relatively low installation cost

Vertical open system - open boreholes

- high heat capacity
- high running energy
- high installation cost

Horizontal loop system – straight pipes

- low capacity,
- high installation cost
- extensive ground excavation work

Horizontal coiled loop system – 'slinky' pipes

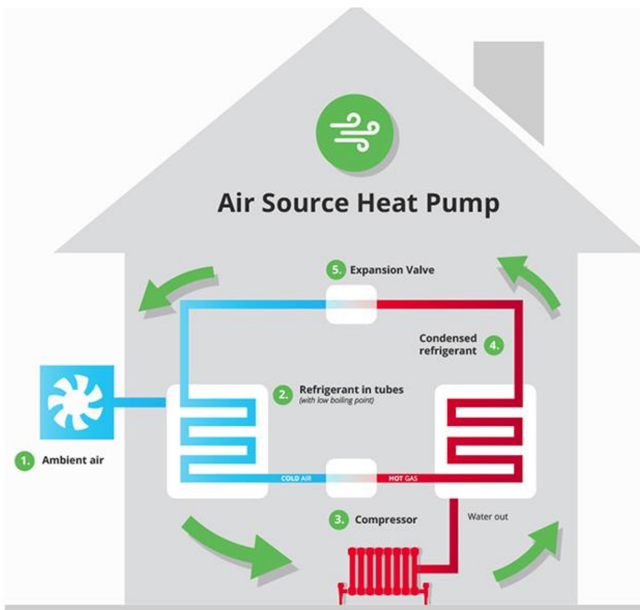
- good capacity
- low installation cost
- extensive ground excavation work

Air Source Heat Pumps

Heat pumps are basically refrigeration units which work in reverse – instead of cooling being produced and heat rejected, the unit produces heat and rejects cooling. Conventional heat pumps use air as the medium to reject this 'coolth' to atmosphere. Ground source units use the ground as a means of improving the unit efficiency because the ground is a constant 11-13 °C at depths of 50m down – this suits the heat pump much better during the coldest weather than the extremes of air temperature. Reversible heat pumps can also be used for cooling, however this is not being considered further for this project.

A heat pump consumes electrical power to drive the compressor and other ancillary elements. The ratio between total energy input and heat energy output of the heat pump is a measure of its efficiency – usually referred to as 'Coefficient of Performance' - COP. A ground source heat pump has a higher COP than an air cooled heat pump – this additional energy effectively being the grounds' natural contribution to the system.

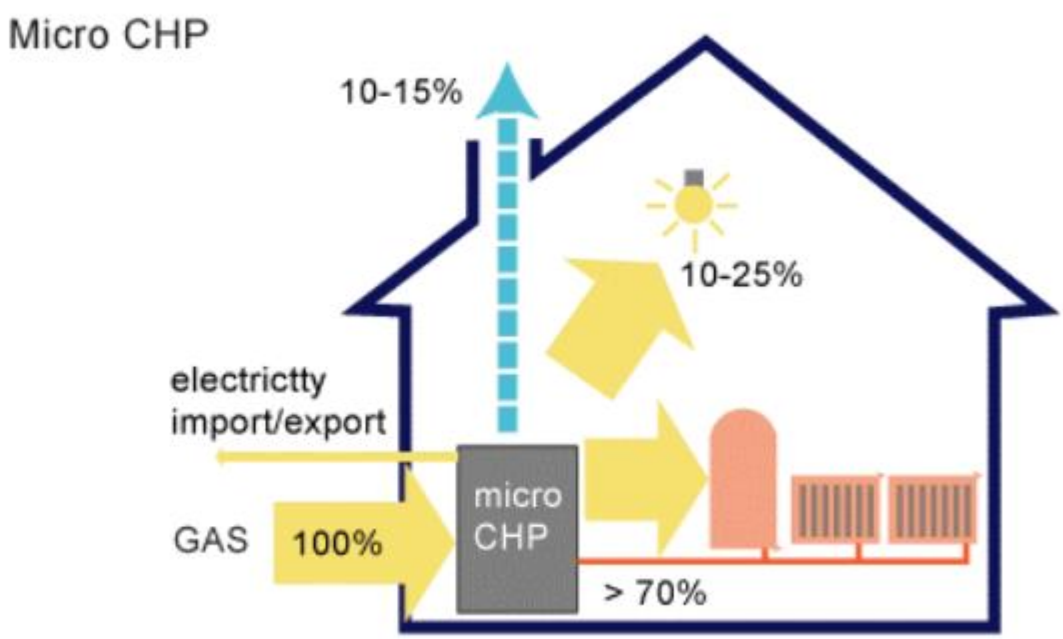
The heat produced by a heat pump is usually used to either provide space heating say to underfloor heating or radiators or the heat is used to generate domestic hot water via a storage vessel.



CHP

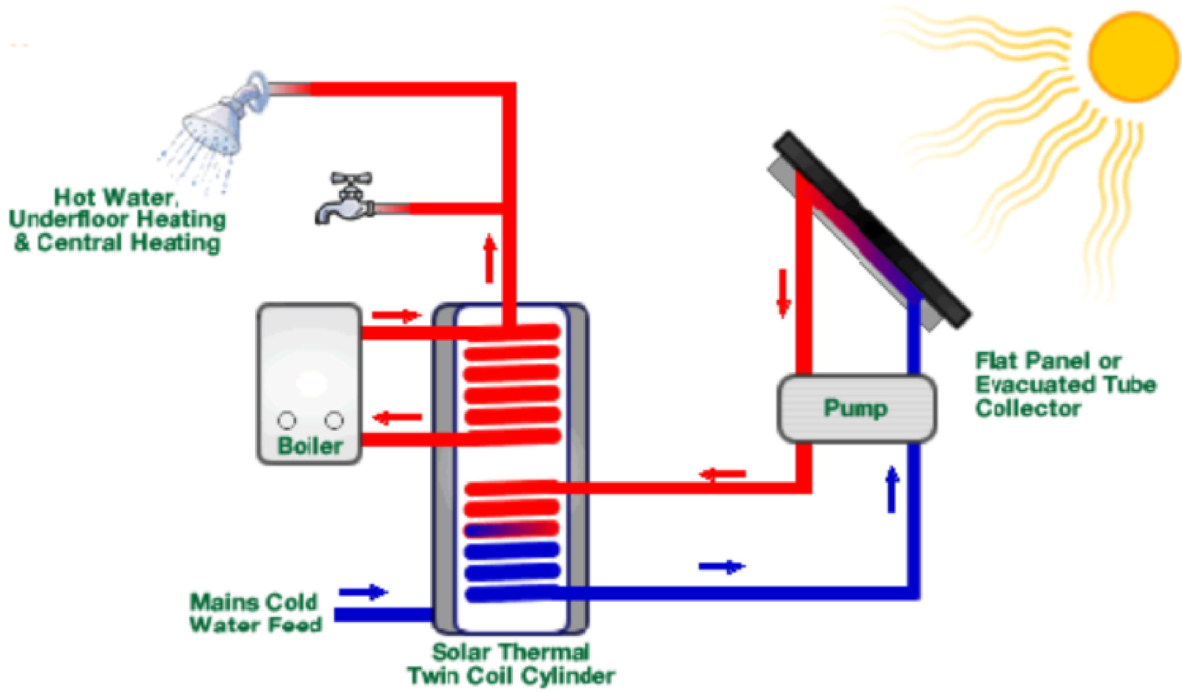
Combined heat and power (CHP) is a process involving simultaneous generation of heat and electricity, where the heat generated in the process in harnessed via heat recovery equipment. CHP at the large commercial size is now fairly common in premises which have a simultaneous demand for heating and electricity for long periods, such as hospitals, recreational centres and hotels. In addition, small CHP systems are now becoming available for individual houses, group residential units and small non-domestic premises. Compared with using centrally generated electricity supplied via the grid, CHP can offer a more efficient and economic method of supplying energy demand, if installed and operated appropriately, owing to the utilization of heat which is normally rejected to the atmosphere from central generating stations, and by reducing network distribution losses due to local generation and use.

Heat generated will be used for space and water heating, and additional heat storage may be used to lengthen use periods, to assist in warm-up and to improve overall energy efficiency. For overall good energy efficiency, as with all CHP, usage must be heat demand led. Thus, a sophisticated control system is required and users should be made aware of efficient operating practices.



Solar thermal collectors

Solar thermal collectors (flat plate or evacuated tubes) convert solar thermal energy into heat for hot water generation. These are usually located on a roof oriented south facing in an ideal slope of 45 degree. Solar collectors properly sized and designed provide approx 50% of annual hot water demand.



Photovoltaic

Photovoltaic modules convert sunlight directly into DC electricity and can be integrated into buildings. Photovoltaics (PVs) are distinct from other renewable energy technologies since they have no moving parts to be maintained and are silent. PV systems can be incorporated into buildings in various ways: on sloped roofs and fl at roofs, in façades, atria and shading devices. Modules can be mounted using frames or they can be fully incorporated into the actual building fabric; for example, PV roof tiles are now available which can be fitted in place of standard tiles.

Currently, a PV system will cost between £1500 and £2500 per kWp, and frequently part of this cost can be offset owing to the displacement of a conventional cladding material. Costs have fallen significantly since the first systems were installed (1980s) and are predicted to fall further still.

While single crystal silicon remains the most efficient flat plate technology (15–16% conversion efficiency); it also has the least potential for cost reduction. PV cells made from poly-crystalline silicon have become popular as they are less expensive to produce, although they have a slightly lower efficiency.

Thin film modules are constructed by depositing extremely thin layers of photosensitive materials on a low-cost backing such as glass, stainless steel or plastic. As much less semiconductor material is required as for crystalline silicon cells, material costs are potentially much lower. Efficiencies are much lower, around 4–5%, although this can be boosted to 8–10% by depositing two or three layers of thin film material. Thin film production also requires less handling as the films are produced as large, complete modules and not as individual cells that have to be mounted in frames and wired together. Hence, there is the potential for significant cost reductions with volume production.

Since PVs generate DC output, an inverter and other equipment is needed to deliver the power to a building or the grid in an acceptable AC form. The cost of the inverter and these 'Balance of System' (BOS) components can approach 30% of the total cost of a PV system. Hence, simplification and cost reductions in these components over the coming years will also be necessary to make PV systems affordable.

Wind energy

Wind power is the most successful and fastest spreading renewable energy technology in the UK with a number of individual and group installations of varying size, capacity and location. Traditionally, turbines are installed in non-urban areas with a strong trend for large offshore wind farms. In parallel with the design and development of ever-bigger machines, which are deemed to be more efficient and cost-effective, it is being increasingly recognized that smaller devices installed at the point of use, i.e. urban settings, can play an important role in reducing carbon emissions if they become mainstream.

At present there is a wide range of available off-the-shelf wind products, many manufactured in the UK and EU with proven good performance and durability. The dominant type is horizontal axis wind turbines (HAWT), which are typically ground mounted. Vertical axis wind turbines (VAWT) have limited market presence and there is a trade-off between lower efficiency and potentially higher resistance to extreme conditions. Capacity ranges from 500W to more than 1.5MW, but, for practical purposes and in built-up areas in particular, machines of more than 1kW and below 500kW are likely to be considered.
Wind technology is also currently one of the most cost-effective renewable energy technologies, which is attributable to the large scale of installations reducing the unit output cost. Individual building or community wind projects, although smaller, have the advantage of feeding electricity directly into the building's electricity circuit, thus sparing costly distribution network development and avoiding distribution losses. The downside is the still high capital cost per kW installed for smaller turbines, plus location constraints, such as visual intrusion and noise. The wind regime in urban areas is also a concern owing to higher wind turbulence which reduces the potential electricity output.

In most cases, wind turbines are connected to the electricity grid and all generated energy is used regardless of the building demand fluctuations. The output largely depends on the wind speed and the correlation between the two is a cube function. This means that in short periods of above-average wind speeds the generation increases exponentially. As a result, it is difficult to make precise calculations of the annual output of a turbine, but average figures can provide useful guidance to designers and architects. In reasonably windy areas (average wind speed of 6m/s) the expected output from 1kW installed is about 2500kWh annually. The cost per kW installed varies considerably by manufacturer and size of machine with an indicative bracket of £2,500–£5,000. With a lifespan of more than 20 years, wind turbines can save money if design and planning are carried out in a robust way.

Building-integrated wind turbines are starting to be a reality in the UK, but potential projects may face difficulties with obtaining planning permission. There are a few examples now of permitted development rights for certain rooftop turbines in some local councils. A number of horizontal axis devices specifically designed for building integration are now available commercially, having design and reliability parameters relevant to the urban context. Building-mounted vertical axis devices are under development. At present, turbines installed near buildings, as well as community installations for groups of buildings, should be regarded as the larger wind energy source related to buildings, when they contribute to the carbon emissions from these premises using 'private wire' networks. However, the contribution of several building-integrated turbines in a development is likely to become significant in the next few years.

Appendix B-Fuel prices and emission factors

	Standing Charge £	Unit Price p/kWh	Emission Kg CO2 p/kWh	PE Factor	Fuel Code
Gas fuels:					
mains gas	92	3.64	0.210	1.130	1
bulk LPG	62	6.74	0.241	1.141	2
bottled LPG (for main heating system)		9.46	0.241	1.141	3
bottled LPG (for secondary heating)		11.20	0.241	1.133	5
LPG subject to Special Condition 11F (a)	92	3.64	0.241	1.163	9
biogas (including anaerobic digestion)	62	6.74	0.024	1.286	7
Liquid fuels:					
heating oil		4.94	0.298	1.180	4
bio-liquid HVO from used cooking oil (d)		6.79	0.036	1.180	71
bio-liquid FAME from animal/vegetable oils (e)		6.79	0.018	1.180	73
B30K (0		5.49	0.214	1.136	75
bioethanol from any biomass source		47	0.105	1.472	76
Solid fuels: (g)					
house coal		5.58	0.395	1.064	11
anthracite		4.19	0.395	1.064	15
manufactured smokeless fuel		5.91	0.366	1.261	12
wood logs		5.12	0.028	1.046	20
wood pellets (in bags for secondary heating)		6.91	0.053	1.325	22
wood pellets (bulk supply for main heating)		6.25	0.053	1.325	23
wood chips		3.72	0.023	1.046	21
dual fuel appliance (mineral and wood)		4.77	0.087	1.049	10
Electricity: (a)					
standard tariff	81 30	16.49	0.136 (s)	1.5010t)	
7-hour tariff (high rate) (h)	7 32	19.60	0.136 (s)	1.5010t)	
7-hour tariff (low rate) (h)		9.40 31	0.136 (s)	1.501 (t)	
10-hour tariff (high rate) (">	21 34	20.54	0.136 (s)	1.501 (t)	
10-hour tariff (low rate) fib)		12.27 33	0.136 (a)	1.501 (0	
18-hour tariff (high rate) (">	26 38	17.41	0.136 (s)	1.501 (0	
18-hour tariff (low rate) 00		14.17 40	0.136 (s)	1.501 (t)	
24-hour heating tariff	26 35	14.04	0.136 (s)	1.501 0)	
electricity sold to grid, PV		5.59 (0 60	0.136 (s)	0.501 0)	
electricity sold to grid, other		5.59 () 36	0.136 (s)	0.501 0)	
electricity, any tariff 0)		N/A 39	0.136 (s)	1.501 0t)	
Heat networks: (k)	92 0)				
heat from boilers - mains gas		4.44 51	0.210	1.130	
heat from boilers - LPG		4.44 52	0.241	1.141	
heat from boilers - oil (assumes 'gas oil')		4.44 53	0.335	1.180	
heat from boilers that can use mineral oil or biodiesel		4.44 56	0.335	1.180	
heat from boilers using HVO from used cooking oil		4.44	0.036	1.180	

	57		
heat from boilers FAME from animal/vegetable oils (a)	4.44 58	0.018	1.180
heat from boilers - B30D 0)	4.44 55	0.269	1.090
heat from boilers - coal	4.44 54	0.375	1.064
heat from electric heat pump	4.44 41	0.136 (s)	1.501 0)
heat recovered from waste combustion	4.44 42	0.015 0')	0.063
heat from boilers - biomass	4.44 43	0.029	1.037
heat from boilers - biogas (landfill or sewage gas)	4.44 44	0.024	1.286
heat recovered from power station	3.77 45	0.015 0')	0.063
high grade heat recovered from process (Appendix C4.3)	3.77 47	0.011	0.051
low grade heat recovered from process (Appendix C4.4)	3.77 49	0.136 001)	1.501 (001)
heat recovered from geothermal or other natural processes	3.77 46	0.011	0.051
heat from **CHP**	3.77 48	as above0D	as above0D

Appendix C, D, E, F and G

This appendix contains the following reports used in producing the content of this Energy and Sustainability Statement.

Appendix C - Flood risk map for planning to show the location of the site with regards to the relevant flood zone areas.

Appendix D - Floor plans and elevations used to produce SAP calculations for this development.

Appendix E – SAP calculation reports for the selected units that were used to base the calculations on for this report. The reports are for the final stage of the energy hierarchy (Be Green). The reports demonstrate how reduction has been achieved over the baseline figures.

Appendix F – Sample water efficiency calculations to demonstrate how the required target suggested could be achieved.

Appendix G – Sample calculated psi values.

Flood map for planning

Your reference	Location (easting/northing)	Created
<Unspecified>	**454266/204327**	**23 Oct 2023 9:44**

Your selected location is in flood zone 1, an area with a low probability of flooding.

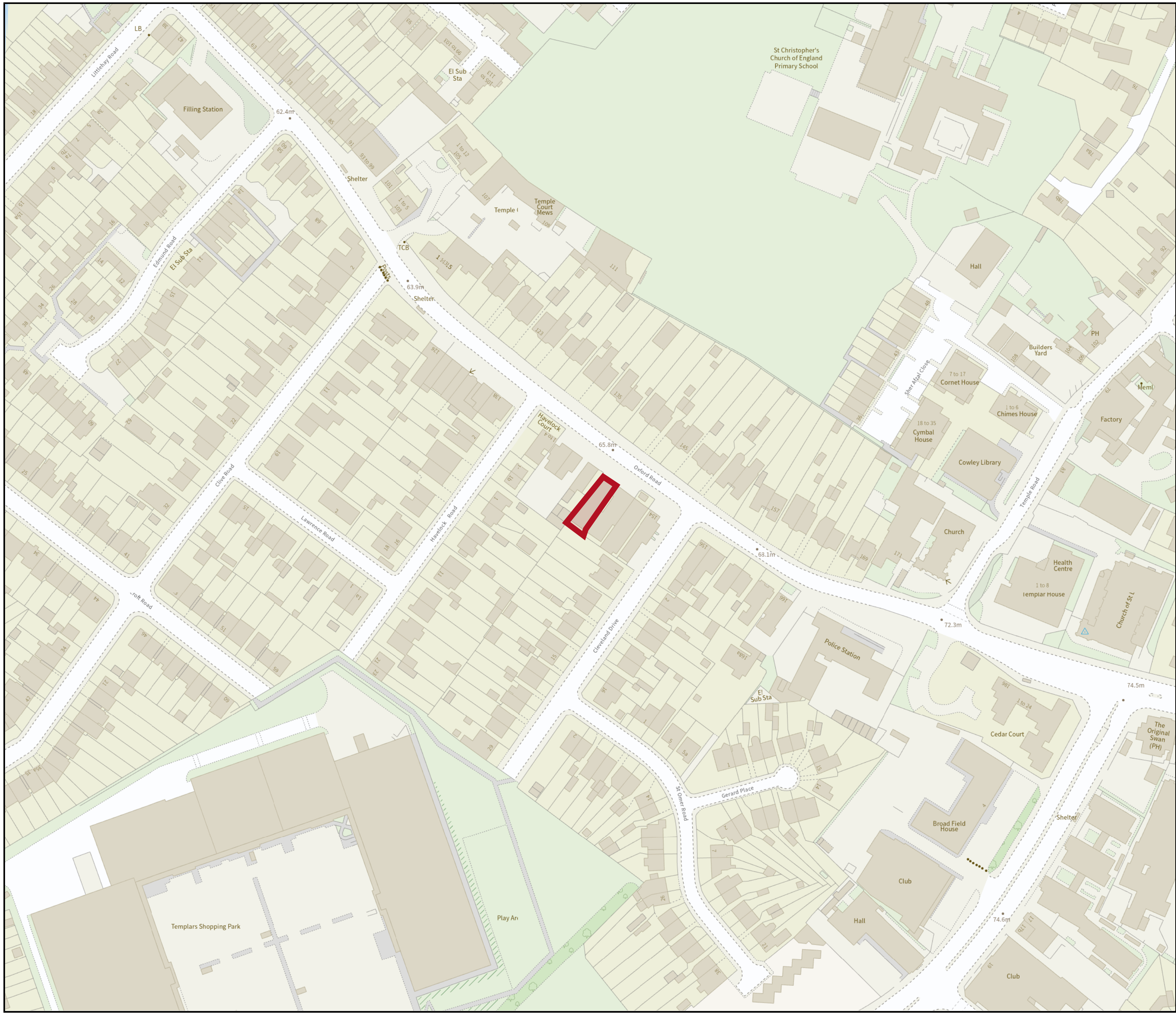
You will need to do a flood risk assessment if your site is **any of the following:**

- bigger that 1 hectare (ha)
- In an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.



Environment Agency

Flood map for planning

Your reference
<Unspecified>

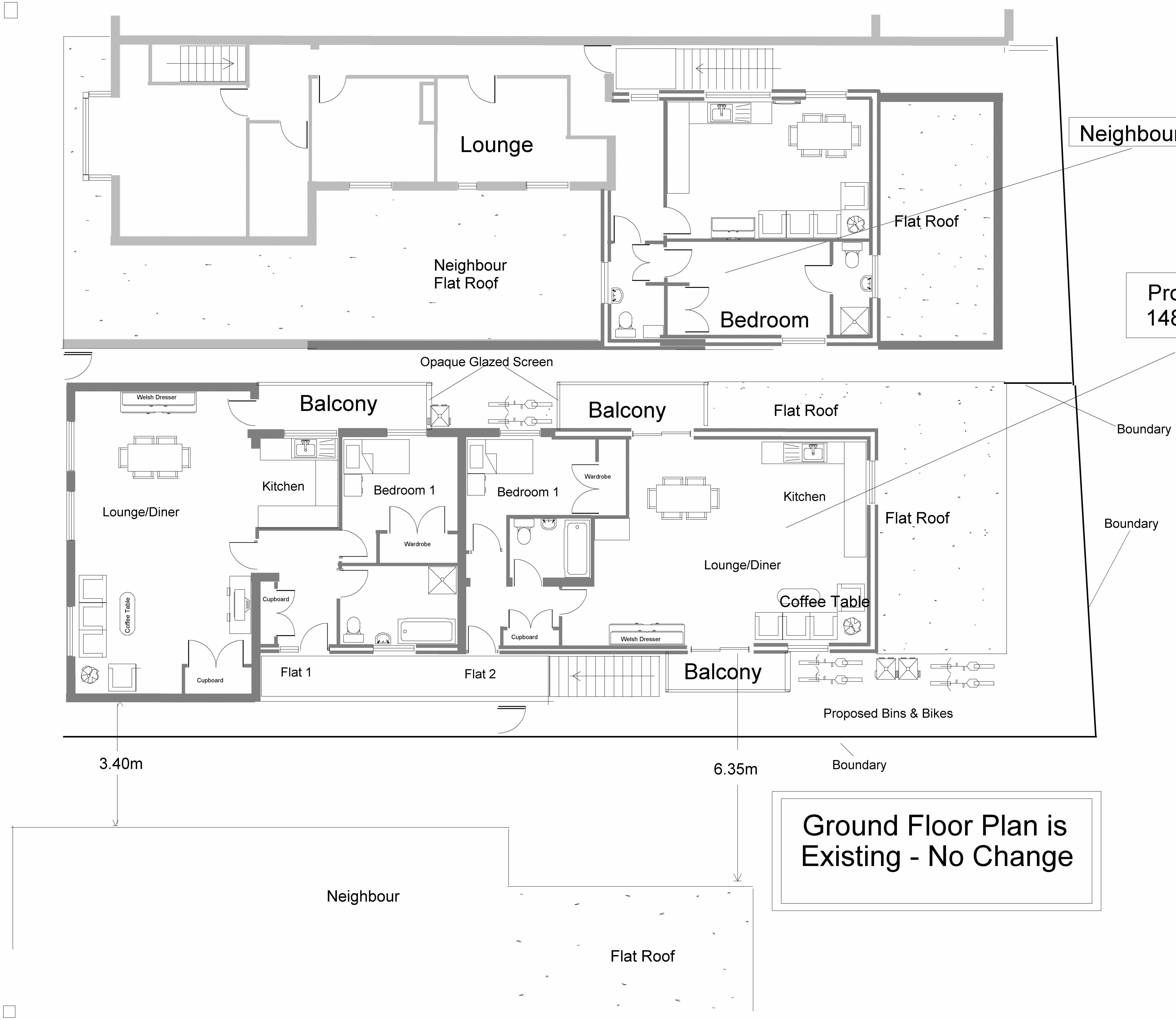
Location (easting/northing)
454266/204327

Scale
1:2500

Created
23 Oct 2023 9:44

- Selected area
- Flood zone 3
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Water storage area

0 20 40 60m



Project

Proposed Flats Plans

For

148 Oxford Road
Cowley
Oxford

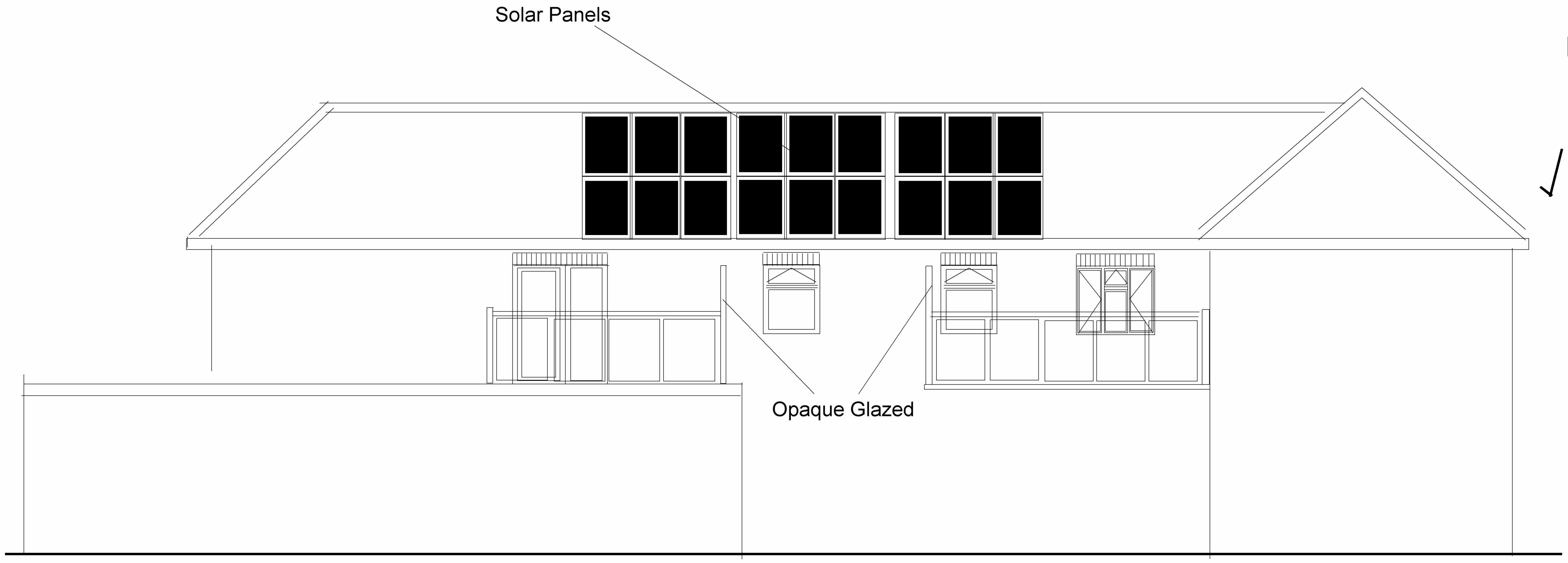
Drawn

Pope Ingram Associates
(Services & Management)
44 Campion Road
Abingdon OX14 3TQ
Tel: 01235 526676
Mob: 07881 408836

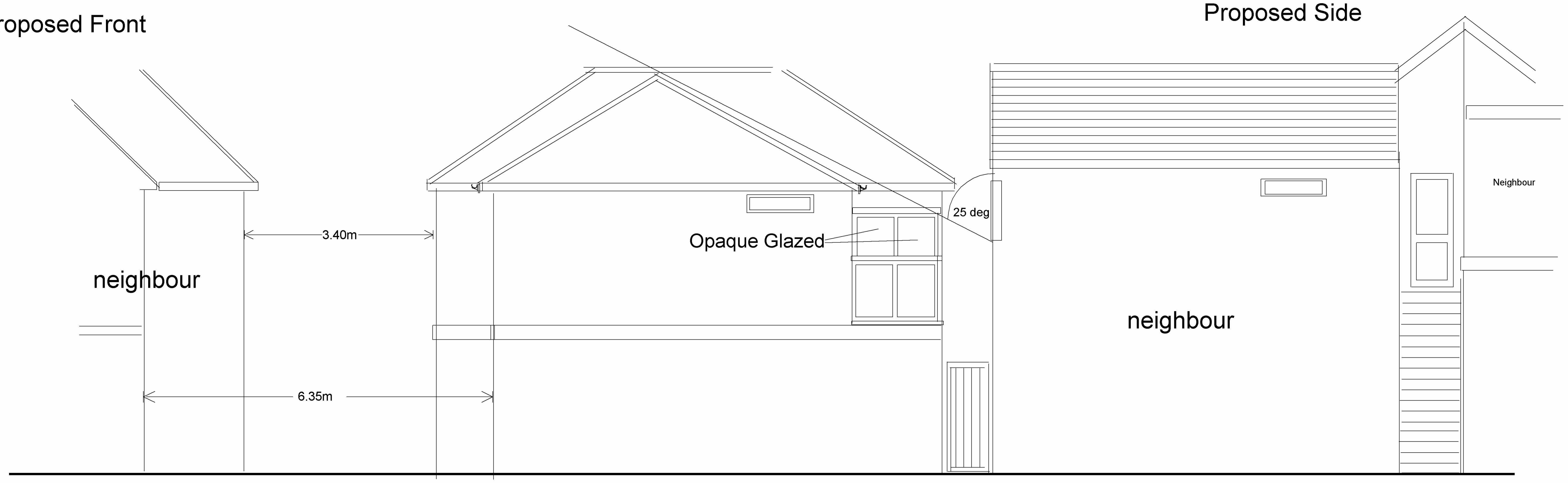
Scale 1 : 100

Drwg No: 3113/Prop Plans

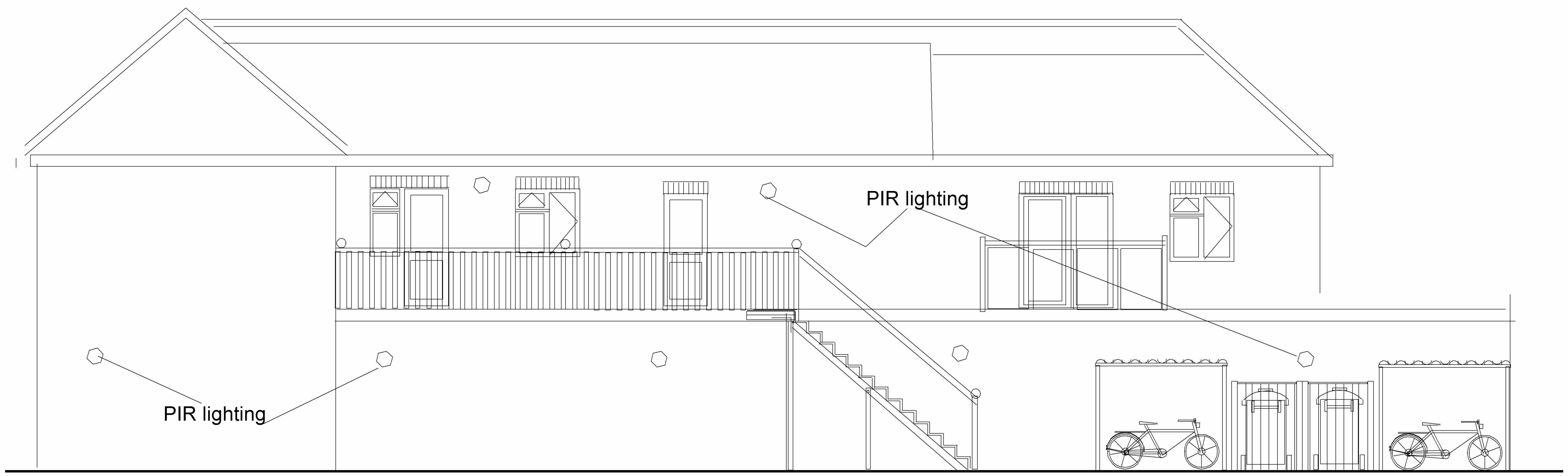
Proposed Front



Proposed Side



Proposed Rear



Proposed Side

Project

Proposed Elevations

For
148 Oxford Road
Temple Cowley
Oxford
OX4 2EA

Drawn
Pope Ingram Associates
(Services & Management)
44 Campion Road
Abingdon OX14 3TQ
Tel: 01235 526676
Mob: 07881 408836

Scale 1 : 100

Drwg No: 3030/Prop Elev

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Mon 23 Oct 2023 13:56:43

Project Information			
Assessed By	Iraj Maghounaki	Building Type	Flat, Semi-detached
OCDEA Registration	EES/015723	Assessment Date	2023-10-23

Dwelling Details			
Assessment Type	As designed	Total Floor Area	65 m^2
Site Reference	148 Oxford Road	Plot Reference	003-Be Green
Address	148 Oxford Road, Oxford, OX4 2EA		

Client Details	
Name	148 Oxford Road
Company	Bob Pope
Address	148 Oxford Road, Temple Cowley, Oxford, OX4 2EA

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*11.37 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	3.71 $kgCO_2/m^2$	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*60.85 kWh_{PE}/m^2*	
Dwelling primary energy	42.81 kWh_{PE}/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*45.5 kWh/m^2*	
Dwelling fabric energy efficiency	43.2 kWh/m^2	OK

2a Fabric U-values

Element	*Maximum permitted average U-Value [W/m²K]*	Dwelling average U-Value [W/m²K]	Element with highest individual U-Value	
External walls	*0.26*	0.19	Walls (1) (0.19)	OK
Party walls	*0.2*	0	Party Wall (1) (0)	**N/A**
Curtain walls	*1.6*	0	N/A	**N/A**
Floors	*0.18*	0.18	Exposed to Retail (0.18)	OK
Roofs	*0.16*	0.12	Roof (1) (0.12)	OK
Windows, doors, and roof windows	*1.6*	1.2	NW (1.2)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))

Name	Net area [m²]	U-Value [W/m²K]
Exposed wall: Walls (1)	57.4346	0.19
Party wall: Party Wall (1)	14.31	0 **(!)**
Upper floor: Exposed to Retail, Exposed to Retail	65.32	0.18
Exposed roof: Roof (1)	65.32	0.12

2c Openings (better than typically expected values are flagged with a subsequent (!))

Name	Area [m²]	Orientation	Frame factor	U-Value [W/m²K]
NW, Solid Door	1.6849	North West	N/A	1.2
NW, Glazing	3.5496	North West	0.7	1.2
NW, Glazing	1.3447	North West	0.7	1.2
SE, Glazing	3.4155	South East	0.7	1.2
SE, Glazing	1.1781	South East	0.7	1.2
SW, Glazing	0.4026	South West	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))

Building part **1 - Main Dwelling**: Thermal bridging calculated from linear thermal transmittances for each junction

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.018 **(!)**	MHF-100-E2-01

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E3: Sill	Calculated by person with suitable expertise	0.02 **(!)**	MHF-100-E3-01
External wall	E4: Jamb	Calculated by person with suitable expertise	0.015 **(!)**	MHF-100-E4-01
External wall	E20: Exposed floor (normal)	Calculated by person with suitable expertise	0.053	MHF-100-E20-01
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.059	MHF-100-E10-01
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.043	MHF-100-E12-01
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.041	MHF-100-E16-01
External wall	E18: Party wall between dwellings	Calculated by person with suitable expertise	0.055	MHF-100-E18-03
Party wall	P7: Exposed floor (normal)	SAP table default	0.48	
Party wall	P4: Roof (insulation at ceiling level)	Calculated by person with suitable expertise	0.04	MPW-P4-01

3 Air permeability (better than typically expected values are flagged with a subsequent (!))		
Maximum permitted air permeability at 50Pa	*8 m^3/hm^2*	
Dwelling air permeability at 50Pa	3 m^3/hm^2, Design value **(!)**	OK
Air permeability test certificate reference		

4 Space heating	
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	219.3%
Emitter type	Radiators
Flow temperature	45°C
System type	Air source heat pump
Manufacturer	
Model	
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	170 litres
Declared heat loss	1.63 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	
Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	75 lm/W	OK
External lights control	N/A	

8 Mechanical ventilation		
System type: Balanced whole-house mechanical ventilation with heat recovery		
Maximum permitted specific fan power	*1.5 W/(l/s)*	
Specific fan power	0.47 W/(l/s)	OK
Minimum permitted heat recovery efficiency	*73%*	
Heat recovery efficiency	91%	OK
Manufacturer/Model	MRXBOX-ECO3	
Commissioning		

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	1 kWp
Orientation	South East
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

12 Declarations	
a. Assessor Declaration	
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.	
Signed:	Assessor ID:
Name:	Date:
b. Client Declaration	
N/A	

Full SAP Calculation Printout

elmhurst energy

Property Reference	148 Oxford Road	Issued on Date	23/10/2023
Assessment Reference	003-Be Green	Prop Type Ref	PR10887
Property	148, Oxford Road, Oxford, OX4 2EA		

SAP Rating	85 B	DER	3.71	TER	11.37
Environmental	97 A	% DER < TER			67.37
CO_2 Emissions (t/year)	0.21	DFEE	43.21	TFEE	45.54
Compliance Check	See BREL	% DFEE < TFEE			5.12
% DPER < TPER	29.65	DPER	42.81	TPER	60.85

Assessor Details	Mr. Iraj Maghounaki	Assessor ID	V571-0001
Client	PR10887, 148 Oxford Road		

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.3200 (1b)	x	2.4300 (2b)	=	158.7276	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	65.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	158.7276	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	81.9000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2531	0.2499	0.2467	0.2307	0.2276	0.2116	0.2116	0.2084	0.2180	0.2276	0.2339	0.2403	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Glazing (Uw = 1.20)			9.8800	1.1450	11.3130			(27)
Solid Door			1.6800	1.2000	2.0160			(26)
Exposed to Retail			65.3200	0.1800	11.7576			(28b)
External Wall	69.0100	11.5600	57.4500	0.1900	10.9155	110.0000	6319.5000	(29a)
Roof at Plane	65.3200		65.3200	0.1200	7.8384	9.0000	587.8800	(30)
Total net area of external elements Aum(A, m2)			199.6500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	43.8405			(33)
Party Wall			14.3100	0.0000	0.0000	70.0000	1001.7000	(32)
Internal Wall 1			96.8600			9.0000	871.7400	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	8780.8200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		134.4277	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	7.5600	0.0180	0.1361

	Length	Psi	L x Psi	
E3 Sill	3.3400	0.0200	0.0668	
E4 Jamb	17.7000	0.0150	0.2655	
E20 Exposed floor (normal)	22.8800	0.0530	1.2126	
E10 Eaves (insulation at ceiling level)	22.5500	0.0590	1.3304	
E12 Gable (insulation at ceiling level)	5.8700	0.0430	0.2524	
E16 Corner (normal)	4.8600	0.0410	0.1993	
E18 Party wall between dwellings	4.8600	0.0550	0.2673	
P7 Party Wall - Exposed floor (normal)	5.8700	0.4800	2.8176	
P4 Party wall - Roof (insulation at ceiling level)	5.8700	0.0400	0.2348	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			6.7828	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss		(33) + (36) + (36a) =	50.6233	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	13.2554	13.0885	12.9215	12.0867	11.9197	11.0849	11.0849	10.9180	11.4189	11.9197	12.2537	12.5876	(38)
Heat transfer coeff	63.8788	63.7118	63.5448	62.7100	62.5431	61.7083	61.7083	61.5413	62.0422	62.5431	62.8770	63.2109	(39)
Average = Sum(39)m / 12 =												62.6683	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9779	0.9754	0.9728	0.9600	0.9575	0.9447	0.9447	0.9422	0.9498	0.9575	0.9626	0.9677	(40)
HLP (average)												0.9594	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy												2.1274	(42)
Hot water usage for mixer showers	67.3750	66.3625	64.8871	62.0641	59.9808	57.6575	56.3370	57.8013	59.4064	61.9008	64.7845	67.1169	(42a)
Hot water usage for baths	25.8774	25.4931	24.9519	23.9540	23.2068	22.3783	21.9308	22.4682	23.0533	23.9399	24.9583	25.7899	(42b)
Hot water usage for other uses	36.4166	35.0923	33.7681	32.4439	31.1196	29.7954	29.7954	31.1196	32.4439	33.7681	35.0923	36.4166	(42c)
Average daily hot water use (litres/day)												119.2159	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	129.6690	126.9479	123.6070	118.4620	114.3072	109.8312	108.0632	111.3891	114.9036	119.6088	124.8351	129.3234	(44)
Energy conte	205.3640	180.7721	189.9794	162.1685	153.8795	135.0503	130.6930	137.9229	141.6876	162.3080	177.8505	202.4891	(45)
Energy content (annual)											Total = Sum(45)m =	1980.1651	
Distribution loss (46)m = 0.15 x (45)m	30.8046	27.1158	28.4969	24.3253	23.0819	20.2575	19.6040	20.6884	21.2531	24.3462	26.6776	30.3734	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6300	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8802	(55)
Total storage loss	27.2862	24.6456	27.2862	26.4060	27.2862	26.4060	27.2862	27.2862	26.4060	27.2862	26.4060	27.2862	(56)
If cylinder contains dedicated solar storage	27.2862	24.6456	27.2862	26.4060	27.2862	26.4060	27.2862	27.2862	26.4060	27.2862	26.4060	27.2862	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	255.9126	226.4289	240.5280	211.0865	204.4281	183.9683	181.2416	188.4715	190.6056	212.8566	226.7685	253.0377	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	255.9126	226.4289	240.5280	211.0865	204.4281	183.9683	181.2416	188.4715	190.6056	212.8566	226.7685	253.0377	(64)
								Total per year (kWh/year) = Sum(64)m =				2575.3341	(64)
12Total per year (kWh/year)												2575	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
					Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =							0.0000	(64a)
Heat gains from water heating, kWh/month	108.7224	96.6322	103.6070	93.0554	91.6038	84.0386	83.8943	86.2983	86.2455	94.4063	98.2697	107.7665	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	99.0731	109.6881	99.0731	102.3755	99.0731	102.3755	99.0731	99.0731	102.3755	99.0731	102.3755	99.0731	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	186.1380	188.0695	183.2021	172.8400	159.7597	147.4661	139.2532	137.3217	142.1891	152.5512	165.6315	177.9251	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	(71)
Water heating gains (Table 5)	146.1323	143.7979	139.2568	129.2437	123.1234	116.7203	112.7612	115.9923	119.7854	126.8902	136.4857	144.8475	(72)
Total internal gains	489.2542	499.4663	479.4428	462.3700	439.8671	421.4728	405.9983	407.2979	419.2609	436.4253	462.4035	479.7565	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	4.5900	36.7938	0.6300	0.7000	0.7700	51.6131	(77)
Southwest	0.4000	36.7938	0.6300	0.7000	0.7700	4.4979	(79)
Northwest	4.8900	11.2829	0.6300	0.7000	0.7700	16.8618	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	72.9727	129.9003	192.6119	263.5912	318.0042	325.7160	309.8587	267.7335	216.9512	147.5786	88.4244	61.7894	(83)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total gains	562.2269	629.3666	672.0548	725.9612	757.8713	747.1888	715.8570	675.0314	636.2120	584.0039	550.8279	541.5459	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.1835	38.2836	38.3842	38.8952	38.9990	39.5266	39.5266	39.6338	39.3138	38.9990	38.7919	38.5870	
alpha	3.5456	3.5522	3.5589	3.5930	3.5999	3.6351	3.6351	3.6423	3.6209	3.5999	3.5861	3.5725	
util living area	0.9484	0.9236	0.8846	0.7992	0.6697	0.5027	0.3723	0.4089	0.6104	0.8227	0.9197	0.9537	(86)
MIT	19.5483	19.7898	20.1092	20.5115	20.7972	20.9468	20.9862	20.9806	20.8910	20.5346	19.9958	19.5113	(87)
Th 2	20.1018	20.1039	20.1060	20.1168	20.1189	20.1297	20.1297	20.1318	20.1254	20.1189	20.1146	20.1103	(88)
util rest of house	0.9402	0.9119	0.8670	0.7698	0.6244	0.4419	0.3015	0.3358	0.5489	0.7901	0.9056	0.9463	(89)
MIT 2	18.4232	18.7248	19.1202	19.6093	19.9317	20.0908	20.1226	20.1212	20.0388	19.6484	18.9940	18.3830	(90)

Living area fraction fLA = Living area / (4) = 0.6660 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	19.1725	19.4340	19.7788	20.2101	20.5080	20.6609	20.6977	20.6935	20.6063	20.2386	19.6612	19.1344	(92)

Temperature adjustment 0.0000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
adjusted MIT	19.1725	19.4340	19.7788	20.2101	20.5080	20.6609	20.6977	20.6935	20.6063	20.2386	19.6612	19.1344	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9300	0.9018	0.8598	0.7731	0.6451	0.4795	0.3480	0.3835	0.5836	0.7948	0.8972	0.9364	(94)
Useful gains	522.8734	567.5686	577.8019	561.2285	488.8664	358.2746	249.1098	258.8792	371.2989	464.1917	494.2112	507.1239	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	950.0365	925.9869	843.8019	709.2581	550.8817	374.0059	252.8619	264.2279	403.6659	602.8255	789.8085	944.0173	(97)
Space heating kWh	317.8093	240.8571	197.9040	106.5814	46.1394	0.0000	0.0000	0.0000	0.0000	103.1436	212.8301	325.0486	(98a)

Space heating requirement - total per year (kWh/year) 1550.3135

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)

Solar heating contribution - total per year (kWh/year) 0.0000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating kWh	317.8093	240.8571	197.9040	106.5814	46.1394	0.0000	0.0000	0.0000	0.0000	103.1436	212.8301	325.0486	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 1550.3135

Space heating per m2 (98c) / (4) = 23.7341 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)

Fraction of space heat from main system(s) 1.0000 (202)

Efficiency of main space heating system 1 (in %) 219.3000 (206)

Efficiency of main space heating system 2 (in %) 0.0000 (207)

Efficiency of secondary/supplementary heating system, % 0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	317.8093	240.8571	197.9040	106.5814	46.1394	0.0000	0.0000	0.0000	0.0000	103.1436	212.8301	325.0486	(98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)	144.9199	109.8300	90.2435	48.6007	21.0394	0.0000	0.0000	0.0000	0.0000	47.0331	97.0498	148.2210	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	255.9126	226.4289	240.5280	211.0865	204.4281	183.9683	181.2416	188.4715	190.6056	212.8566	226.7685	253.0377	(64)

Efficiency of water heater 190.4000 (216)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(217)
Fuel for water heating, kWh/month	134.4079	118.9228	126.3277	110.8648	107.3677	96.6220	95.1899	98.9872	100.1080	111.7945	119.1011	132.8980	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	9.6625	8.7274	9.6625	9.3508	9.6625	9.3508	9.6625	9.6625	9.3508	9.6625	9.3508	9.6625	(231)
Lighting	27.7740	22.2813	20.0619	14.6982	11.3533	9.2757	10.3569	13.4622	17.4861	22.9427	25.9137	28.5459	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-18.0400	-28.4065	-45.5423	-56.0346	-63.9508	-60.1450	-59.3029	-53.9281	-44.6716	-34.0975	-20.6851	-15.2338	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-4.0008	-9.3782	-21.0432	-35.7367	-51.1011	-53.5259	-52.6402	-42.8606	-29.4390	-14.8547	-5.6669	-3.0641	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year

Space heating fuel - main system 1	706.9373	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	190.4000	
Water heating fuel used	1352.5914	(219)
Space cooling fuel	0.0000	(221)

Electricity for pumps and fans:

(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5875)

mechanical ventilation fans (SFP = 0.5875) 113.7680 (230a)

Total electricity for the above, kWh/year 113.7680 (231)

Electricity for lighting (calculated in Appendix L)	224.1519	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-823.3494	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	1574.0993	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	706.9373	0.1555	109.9401	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1352.5914	0.1409	190.6016	(264)
Space and water heating			300.5417	(265)
Pumps, fans and electric keep-hot	113.7680	0.1387	15.7810	(267)
Energy for lighting	224.1519	0.1443	32.3520	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-500.0380	0.1329	-66.4417	
PV Unit electricity exported	-323.3113	0.1227	-39.6606	
Total			-106.1023	(269)
Total CO2, kg/year			242.5726	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.7100	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	706.9373	1.5757	1113.9550	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1352.5914	1.5211	2057.3683	(278)
Space and water heating			3171.3233	(279)
Pumps, fans and electric keep-hot	113.7680	1.5128	172.1082	(281)
Energy for lighting	224.1519	1.5338	343.8116	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-500.0380	1.4910	-745.5501	
PV Unit electricity exported	-323.3113	0.4501	-145.5268	
Total			-891.0769	(283)
Total Primary energy kWh/year			2796.1663	(286)
Dwelling Primary energy Rate (DPER)			42.8100	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)			Volume (m3)	
Ground floor	65.3200 (1b)	x	2.4300 (2b)		=	158.7276	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 65.3200							(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	158.7276	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	2 * 10 =	20.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1260	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3760	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3196	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4075	0.3995	0.3915	0.3516	0.3436	0.3036	0.3036	0.2956	0.3196	0.3436	0.3596	0.3755	(22b)

Effective ac	0.5830	0.5798	0.5766	0.5618	0.5590	0.5461	0.5461	0.5437	0.5511	0.5590	0.5646	0.5705	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			1.6800	1.0000	1.6800			(26)
TER Opening Type (Uw = 1.20)			9.8800	1.1450	11.3130			(27)
Exposed to Retail			65.3200	0.1300	8.4916			(28b)
External Wall	69.0100	11.5600	57.4500	0.1800	10.3410			(29a)
Roof at Plane	65.3200		65.3200	0.1100	7.1852			(30)
Total net area of external elements Aum(A, m2)			199.6500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	39.0108			(33)
Party Wall			14.3100	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 134.4277 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	7.5600	0.0500	0.3780
E3 Sill	3.3400	0.0500	0.1670
E4 Jamb	17.7000	0.0500	0.8850
E20 Exposed floor (normal)	22.8800	0.3200	7.3216
E10 Eaves (insulation at ceiling level)	22.5500	0.0600	1.3530
E12 Gable (insulation at ceiling level)	5.8700	0.0600	0.3522
E16 Corner (normal)	4.8600	0.0900	0.4374
E18 Party wall between dwellings	4.8600	0.0600	0.2916
P7 Party Wall - Exposed floor (normal)	5.8700	0.1600	0.9392
P4 Party wall - Roof (insulation at ceiling level)	5.8700	0.1200	0.7044

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.8294 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 51.8402 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	30.5389	30.3700	30.2045	29.4270	29.2816	28.6044	28.6044	28.4790	28.8652	29.2816	29.5758	29.8835	(38)
Heat transfer coeff	82.3791	82.2102	82.0447	81.2672	81.1217	80.4446	80.4446	80.3192	80.7054	81.1217	81.4160	81.7237	(39)
Average = Sum(39)m / 12 =												81.2665	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2612	1.2586	1.2560	1.2441	1.2419	1.2315	1.2315	1.2296	1.2355	1.2419	1.2464	1.2511	(40)
HLP (average)												1.2441	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.1274 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	59.8889	58.9889	57.6774	55.1681	53.3163	51.2511	50.0773	51.3789	52.8057	55.0230	57.5862	59.6594	(42a)
Hot water usage for baths	25.8774	25.4931	24.9519	23.9540	23.2068	22.3783	21.9308	22.4682	23.0533	23.9399	24.9583	25.7899	(42b)
Hot water usage for other uses	36.4166	35.0923	33.7681	32.4439	31.1196	29.7954	29.7954	31.1196	32.4439	33.7681	35.0923	36.4166	(42c)
Average daily hot water use (litres/day)												112.3140	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	122.1829	119.5743	116.3974	111.5660	107.6427	103.4248	101.8035	104.9667	108.3029	112.7310	117.6368	121.8659	(44)
Energy conte	193.5078	170.2722	178.8984	152.7282	144.9078	127.1729	123.1225	129.9707	133.5483	152.9748	167.5952	190.8126	(45)
Energy content (annual)										Total = Sum(45)m =		1865.5115	
Distribution loss (46)m = 0.15 x (45)m	29.0262	25.5408	26.8348	22.9092	21.7362	19.0759	18.4684	19.4956	20.0322	22.9462	25.1393	28.6219	(46)

Water storage loss:

Store volume 170.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.5003 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.8102 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(56)
If cylinder contains dedicated solar storage	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	241.8855	213.9682	227.2761	199.5453	193.2855	173.9900	171.5002	178.3484	180.3654	201.3525	214.4124	239.1903	(62)
WWHRS	-27.3787	-24.2139	-25.3555	-20.9953	-19.5669	-16.7435	-15.6944	-16.6894	-17.3235	-20.4225	-23.1362	-26.8717	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	214.5068	189.7543	201.9207	178.5500	173.7186	157.2465	155.8058	161.6590	163.0419	180.9301	191.2762	212.3186	(64)
								Total per year (kWh/year) = Sum(64)m =				2180.7285	(64)
12Total per year (kWh/year)												2181	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
					Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =							0.0000	(64a)
Heat gains from water heating, kWh/month	103.0435	91.5723	98.1859	88.2358	86.8840	79.7387	79.6404	81.9174	81.8585	89.5663	93.1791	102.1474	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	99.0731	109.6881	99.0731	102.3755	99.0731	102.3755	99.0731	99.0731	102.3755	99.0731	102.3755	99.0731	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	186.1380	188.0695	183.2021	172.8400	159.7597	147.4661	139.2532	137.3217	142.1891	152.5512	165.6315	177.9251	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Losses e.g. evaporation (negative values) (Table 5)	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	(71)
Water heating gains (Table 5)	138.4993	136.2683	131.9703	122.5498	116.7796	110.7482	107.0435	110.1041	113.6924	120.3848	129.4154	137.2948	(72)
Total internal gains	481.6213	491.9367	472.1563	455.6762	433.5232	415.5007	400.2807	401.4097	413.1678	429.9199	455.3333	472.2039	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	4.5900	36.7938	0.6300	0.7000	0.7700	51.6131	(77)
Southwest	0.4000	36.7938	0.6300	0.7000	0.7700	4.4979	(79)
Northwest	4.8900	11.2829	0.6300	0.7000	0.7700	16.8618	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	72.9727	129.9003	192.6119	263.5912	318.0042	325.7160	309.8587	267.7335	216.9512	147.5786	88.4244	61.7894	(83)
Total gains	554.5939	621.8370	664.7683	719.2674	751.5274	741.2166	710.1393	669.1432	630.1189	577.4985	543.7577	533.9933	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	29.6084	29.6693	29.7291	30.0135	30.0674	30.3205	30.3205	30.3678	30.2225	30.0674	29.9587	29.8459	
alpha	2.9739	2.9780	2.9819	3.0009	3.0045	3.0214	3.0214	3.0245	3.0148	3.0045	2.9972	2.9897	
util living area	0.9588	0.9412	0.9137	0.8528	0.7517	0.6029	0.4660	0.5070	0.7028	0.8706	0.9390	0.9628	(86)
MIT	18.8848	19.1482	19.5386	20.0684	20.5225	20.8282	20.9417	20.9236	20.7122	20.1411	19.4369	18.8415	(87)
Th 2	19.8714	19.8734	19.8754	19.8849	19.8866	19.8948	19.8948	19.8964	19.8917	19.8866	19.8830	19.8793	(88)
util rest of house	0.9514	0.9307	0.8977	0.8244	0.7022	0.5233	0.3611	0.4015	0.6304	0.8397	0.9263	0.9561	(89)
MIT 2	17.4428	17.7742	18.2630	18.9163	19.4455	19.7714	19.8669	19.8569	19.6643	19.0187	18.1487	17.3933	(90)
Living area fraction									fLA = Living area / (4) =			0.6660	(91)
MIT	18.4031	18.6892	19.1125	19.6836	20.1628	20.4752	20.5827	20.5673	20.3621	19.7661	19.0066	18.3578	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4031	18.6892	19.1125	19.6836	20.1628	20.4752	20.5827	20.5673	20.3621	19.7661	19.0066	18.3578	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9388	0.9169	0.8846	0.8186	0.7154	0.5667	0.4279	0.4674	0.6631	0.8358	0.9138	0.9441	(94)
Useful gains	520.6537	570.1396	588.0715	588.8082	537.6306	420.0409	303.8354	312.7773	417.8220	482.6848	496.9079	504.1351	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1161.8002	1133.6158	1034.7895	876.3501	686.5135	472.6248	320.3847	334.7117	505.3861	743.5720	969.3866	1157.0241	(97)
Space heating kWh	477.0130	378.6560	332.3582	207.0301	110.7689	0.0000	0.0000	0.0000	0.0000	194.1001	340.1847	485.7494	(98a)
Space heating requirement - total per year (kWh/year)												2525.8604	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	477.0130	378.6560	332.3582	207.0301	110.7689	0.0000	0.0000	0.0000	0.0000	194.1001	340.1847	485.7494	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2525.8604	
Space heating per m2										(98c) / (4) =		38.6690	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	92.3000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	477.0130	378.6560	332.3582	207.0301	110.7689	0.0000	0.0000	0.0000	0.0000	194.1001	340.1847	485.7494	(98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)	516.8072	410.2448	360.0847	224.3013	120.0097	0.0000	0.0000	0.0000	0.0000	210.2926	368.5641	526.2724	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	214.5068	189.7543	201.9207	178.5500	173.7186	157.2465	155.8058	161.6590	163.0419	180.9301	191.2762	212.3186	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.7984	85.5780	85.1697	84.3925	83.0785	79.8000	79.8000	79.8000	79.8000	84.2177	85.3361	85.8549	(217)
Fuel for water heating, kWh/month	250.0126	221.7326	237.0803	211.5709	209.1018	197.0508	195.2454	202.5802	204.3132	214.8362	224.1444	247.2993	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	20.5854	16.5144	14.8694	10.8940	8.4148	6.8750	7.6763	9.9779	12.9603	17.0046	19.2067	21.1576	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-51.0957	-67.4692	-90.9299	-95.7047	-98.0812	-89.8462	-88.7704	-86.2440	-81.1353	-73.9536	-54.5463	-44.7377	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

```
(235a)m          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)
(235c)m          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)
(233b)m        -44.5457   -91.3266  -177.2996  -260.4219  -338.8668  -338.4787  -334.4306  -285.5432  -212.5816  -128.4519   -58.7419   -35.4021 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234b)m          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(235b)m          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)
(235d)m          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (235d)
Annual totals kWh/year
Space heating fuel - main system 1                                                                                                        2736.5768 (211)
Space heating fuel - main system 2                                                                                                           0.0000 (213)
Space heating fuel - secondary                                                                                                               0.0000 (215)
Efficiency of water heater                                                                                                                  79.8000
Water heating fuel used                                                                                                                   2614.9677 (219)
Space cooling fuel                                                                                                                           0.0000 (221)

Electricity for pumps and fans:
Total electricity for the above, kWh/year                                                                                                   86.0000 (231)
Electricity for lighting (calculated in Appendix L)                                                                                        166.1363 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation                                                                                                                            -3228.6047 (233)
Wind generation                                                                                                                              0.0000 (234)
Hydro-electric generation (Appendix N)                                                                                                       0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)                                                                                               0.0000 (235)
Appendix Q - special features
Energy saved or generated                                                                                                                   -0.0000 (236)
Energy used                                                                                                                                  0.0000 (237)
Total delivered energy for all uses                                                                                                       2375.0762 (238)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12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
----------------------------------------------------------------------------------------------------
                                                                                      Energy      Emission factor          Emissions
                                                                                    kWh/year           kg CO2/kWh       kg CO2/year
Space heating - main system 1                                                      2736.5768               0.2100          574.6811 (261)
Total CO2 associated with community systems                                                                                  0.0000 (373)
Water heating (other fuel)                                                         2614.9677               0.2100          549.1432 (264)
Space and water heating                                                                                                   1123.8244 (265)
Pumps, fans and electric keep-hot                                                    86.0000               0.1387           11.9293 (267)
Energy for lighting                                                                 166.1363               0.1443           23.9786 (268)

 Energy saving/generation technologies
PV Unit electricity used in dwelling                                               -922.5141               0.1360         -125.4477
PV Unit electricity exported                                                      -2306.0906               0.1266         -291.8826
Total                                                                                                                     -417.3304 (269)
Total CO2, kg/year                                                                                                         742.4019 (272)
EPC Target Carbon Dioxide Emission Rate (TER)                                                                               11.3700 (273)


----------------------------------------------------------------------------------------------------
13a. Primary energy - Individual heating systems including micro-CHP
----------------------------------------------------------------------------------------------------
                                                                                      Energy Primary energy factor       Primary energy
                                                                                    kWh/year           kg CO2/kWh          kWh/year
Space heating - main system 1                                                      2736.5768               1.1300         3092.3318 (275)
Total CO2 associated with community systems                                                                                  0.0000 (473)
Water heating (other fuel)                                                         2614.9677               1.1300         2954.9135 (278)
Space and water heating                                                                                                   6047.2454 (279)
Pumps, fans and electric keep-hot                                                    86.0000               1.5128          130.1008 (281)
Energy for lighting                                                                 166.1363               1.5338          254.8253 (282)

 Energy saving/generation technologies
PV Unit electricity used in dwelling                                               -922.5141               1.5027        -1386.2176
PV Unit electricity exported                                                      -2306.0906               0.4646        -1071.4797
Total                                                                                                                    -2457.6974 (283)
Total Primary energy kWh/year                                                                                             3974.4742 (286)
Target Primary Energy Rate (TPER)                                                                                           60.8500 (287)


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SAP 10 WORKSHEET FOR New Build (As Designed)   (Version 10.2, February 2022)
CALCULATION OF FABRIC ENERGY EFFICIENCY
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----------------------------------------------------------------------------------------------------
1. Overall dwelling characteristics
----------------------------------------------------------------------------------------------------
                                                                                        Area         Storey height             Volume
                                                                                        (m2)                   (m)               (m3)
Ground floor                                                                         65.3200 (1b)     x       2.4300 (2b)     =    158.7276 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)                65.3200                                                            (4)
Dwelling volume                                                                            (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    158.7276 (5)



----------------------------------------------------------------------------------------------------
2. Ventilation rate
----------------------------------------------------------------------------------------------------
                                                                                                                         m3 per hour

Number of open chimneys                                                                                         0 * 80 =       0.0000 (6a)
Number of open flues                                                                                            0 * 20 =       0.0000 (6b)
Number of chimneys / flues attached to closed fire                                                              0 * 10 =       0.0000 (6c)
Number of flues attached to solid fuel boiler                                                                   0 * 20 =       0.0000 (6d)
Number of flues attached to other heater                                                                        0 * 35 =       0.0000 (6e)
Number of blocked chimneys                                                                                      0 * 20 =       0.0000 (6f)
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Number of intermittent extract fans	2 * 10 =	20.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1260	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			3.0000	(17)
Infiltration rate			0.2760	(18)
Number of sides sheltered			2	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.2346	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2991	0.2933	0.2874	0.2581	0.2522	0.2229	0.2229	0.2170	0.2346	0.2522	0.2639	0.2757	(22b)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0.0000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5447	0.5430	0.5413	0.5333	0.5318	0.5248	0.5248	0.5235	0.5275	0.5318	0.5348	0.5380	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Glazing (Uw = 1.20)			9.8800	1.1450	11.3130			(27)
Solid Door			1.6800	1.2000	2.0160			(26)
Exposed to Retail			65.3200	0.1800	11.7576			(28b)
External Wall	69.0100	11.5600	57.4500	0.1900	10.9155	110.0000	6319.5000	(29a)
Roof at Plane	65.3200		65.3200	0.1200	7.8384	9.0000	587.8800	(30)
Total net area of external elements Aum(A, m2)			199.6500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	43.8405			(33)
Party Wall			14.3100	0.0000	0.0000	70.0000	1001.7000	(32)
Internal Wall 1			96.8600			9.0000	871.7400	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	8780.8200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		134.4277	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	7.5600	0.0180	0.1361
E3 Sill	3.3400	0.0200	0.0668
E4 Jamb	17.7000	0.0150	0.2655
E20 Exposed floor (normal)	22.8800	0.0530	1.2126
E10 Eaves (insulation at ceiling level)	22.5500	0.0590	1.3304
E12 Gable (insulation at ceiling level)	5.8700	0.0430	0.2524
E16 Corner (normal)	4.8600	0.0410	0.1993
E18 Party wall between dwellings	4.8600	0.0550	0.2673
P7 Party Wall - Exposed floor (normal)	5.8700	0.4800	2.8176
P4 Party wall - Roof (insulation at ceiling level)	5.8700	0.0400	0.2348

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7828	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	50.6233	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	28.5333	28.4423	28.3531	27.9342	27.8558	27.4910	27.4910	27.4234	27.6315	27.8558	28.0144	28.1802	(38)
Heat transfer coeff	79.1566	79.0656	78.9764	78.5575	78.4791	78.1143	78.1143	78.0467	78.2548	78.4791	78.6377	78.8035	(39)
Average = Sum(39)m / 12 =												78.5571	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2118	1.2104	1.2091	1.2027	1.2015	1.1959	1.1959	1.1948	1.1980	1.2015	1.2039	1.2064	(40)
HLP (average)												1.2027	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy												2.1274	(42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	25.8774	25.4931	24.9519	23.9540	23.2068	22.3783	21.9308	22.4682	23.0533	23.9399	24.9583	25.7899	(42b)
Hot water usage for other uses	36.4166	35.0923	33.7681	32.4439	31.1196	29.7954	29.7954	31.1196	32.4439	33.7681	35.0923	36.4166	(42c)
Average daily hot water use (litres/day)												57.0984	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	62.2940	60.5854	58.7200	56.3979	54.3264	52.1737	51.7262	53.5878	55.4972	57.7080	60.0506	62.2065	(44)
Energy conte	98.6584	86.2728	90.2504	77.2059	73.1338	64.1536	62.5583	66.3529	68.4336	78.3092	85.5531	97.4003	(45)
Energy content (annual)											Total = Sum(45)m =	948.2826	
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	83.8597	73.3319	76.7129	65.6250	62.1638	54.5306	53.1746	56.4000	58.1686	66.5628	72.7202	82.7903	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	83.8597	73.3319	76.7129	65.6250	62.1638	54.5306	53.1746	56.4000	58.1686	66.5628	72.7202	82.7903	(64)

	Total per year (kWh/year) = Sum(64)m =	806.0402	(64)
12Total per year (kWh/year)		806	(64)

Electric shower(s)	47.9610	42.7337	46.6635	44.5304	45.3660	43.2748	44.7173	45.3660	44.5304	46.6635	45.7861	47.9610	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 545.5538 (64a)

Heat gains from water heating, kWh/month	32.9552	29.0164	30.8441	27.5389	26.8824	24.4513	24.4730	25.4415	25.6747	28.3066	29.6266	32.6878	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts (66)m	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	99.0731	109.6881	99.0731	102.3755	99.0731	102.3755	99.0731	99.0731	102.3755	99.0731	102.3755	99.0731	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	186.1380	188.0695	183.2021	172.8400	159.7597	147.4661	139.2532	137.3217	142.1891	152.5512	165.6315	177.9251	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	(71)
Water heating gains (Table 5)	44.2946	43.1792	41.4571	38.2484	36.1323	33.9602	32.8938	34.1956	35.6594	38.0465	41.1480	43.9353	(72)
Total internal gains	384.4165	395.8476	378.6432	368.3748	349.8760	338.7127	326.1309	325.5012	335.1348	344.5816	364.0658	375.8443	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	4.5900	36.7938	0.6300	0.7000	0.7700	51.6131	(77)
Southwest	0.4000	36.7938	0.6300	0.7000	0.7700	4.4979	(79)
Northwest	4.8900	11.2829	0.6300	0.7000	0.7700	16.8618	(81)

Solar gains	72.9727	129.9003	192.6119	263.5912	318.0042	325.7160	309.8587	267.7335	216.9512	147.5786	88.4244	61.7894	(83)
Total gains	457.3892	525.7479	571.2551	631.9660	667.8802	664.4286	635.9896	593.2347	552.0859	492.1602	452.4902	437.6337	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	30.8138	30.8493	30.8841	31.0488	31.0798	31.2250	31.2250	31.2520	31.1689	31.0798	31.0171	30.9519	
alpha	3.0543	3.0566	3.0589	3.0699	3.0720	3.0817	3.0817	3.0835	3.0779	3.0720	3.0678	3.0635	
util living area	0.9741	0.9595	0.9365	0.8818	0.7868	0.6395	0.4999	0.5469	0.7463	0.9038	0.9597	0.9772	(86)
MIT	18.7729	19.0464	19.4482	19.9981	20.4791	20.8086	20.9341	20.9117	20.6737	20.0535	19.3221	18.7190	(87)
Th 2	19.9105	19.9117	19.9128	19.9179	19.9188	19.9233	19.9233	19.9241	19.9216	19.9188	19.9169	19.9149	(88)
util rest of house	0.9692	0.9520	0.9241	0.8577	0.7411	0.5610	0.3925	0.4393	0.6782	0.8790	0.9509	0.9729	(89)
MIT 2	17.8970	18.1667	18.5614	19.0936	19.5365	19.8134	19.8979	19.8873	19.7146	19.1575	18.4457	17.8467	(90)

Living area fraction fLA = Living area / (4) = 0.6660 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	18.4803	18.7525	19.1520	19.6960	20.1642	20.4761	20.5880	20.5695	20.3533	19.7542	19.0294	18.4276	(92)

Temperature adjustment 0.0000

adjusted MIT	18.4803	18.7525	19.1520	19.6960	20.1642	20.4761	20.5880	20.5695	20.3533	19.7542	19.0294	18.4276	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9608	0.9419	0.9136	0.8520	0.7524	0.6031	0.4605	0.5060	0.7075	0.8746	0.9417	0.9651	(94)
Useful gains	439.4532	495.1845	521.9190	538.4386	502.4927	400.7349	292.8862	300.1804	390.6189	430.4351	426.1129	422.3517	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1122.4666	1095.2598	999.2090	848.1032	664.2668	459.0084	311.5174	325.4175	489.3490	718.4145	938.0979	1121.1858	(97)
Space heating kWh	508.1620	403.2506	355.1038	222.9586	120.3600	0.0000	0.0000	0.0000	0.0000	214.2567	368.6292	519.9325	(98a)

Space heating requirement - total per year (kWh/year) 2712.6533

Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)

Solar heating contribution - total per year (kWh/year) 0.0000

Space heating kWh	508.1620	403.2506	355.1038	222.9586	120.3600	0.0000	0.0000	0.0000	0.0000	214.2567	368.6292	519.9325	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 2712.6533

Space heating per m2 (98c) / (4) = 41.5287 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	734.2742	578.0457	593.1550	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7558	0.8240	0.7921	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	554.9812	476.3097	469.8276	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	735.8738	704.7129	656.7032	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	130.2427	169.9320	139.0354	0.0000	0.0000	0.0000	0.0000	(104)

Cooled fraction fC = cooled area / (4) = 1.0000 (105)

Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	32.5607	42.4830	34.7588	0.0000	0.0000	0.0000	0.0000	(107)

Space cooling requirement	109.8025	(107)
Energy for space heating	41.5287	(99)
Energy for space cooling	1.6810	(108)
Total	43.2097	(109)
Fabric Energy Efficiency (DFEE)	43.2	(109)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)
Ground floor	65.3200 (1b)	x	2.4300 (2b)	=	158.7276 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 65.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	158.7276 (5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	2 * 10 =	20.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1260	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3760	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3196	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4075	0.3995	0.3915	0.3516	0.3436	0.3036	0.3036	0.2956	0.3196	0.3436	0.3596	0.3755	(22b)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) 0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0.0000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5830	0.5798	0.5766	0.5618	0.5590	0.5461	0.5461	0.5437	0.5511	0.5590	0.5646	0.5705	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			1.6800	1.0000	1.6800			(26)
TER Opening Type (Uw = 1.20)			9.8800	1.1450	11.3130			(27)
Exposed to Retail			65.3200	0.1300	8.4916			(28b)
External Wall	69.0100	11.5600	57.4500	0.1800	10.3410			(29a)
Roof at Plane	65.3200		65.3200	0.1100	7.1852			(30)
Total net area of external elements Aum(A, m2)			199.6500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	39.0108			(33)
Party Wall			14.3100	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 134.4277 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	7.5600	0.0500	0.3780
E3 Sill	3.3400	0.0500	0.1670
E4 Jamb	17.7000	0.0500	0.8850
E20 Exposed floor (normal)	22.8800	0.3200	7.3216
E10 Eaves (insulation at ceiling level)	22.5500	0.0600	1.3530
E12 Gable (insulation at ceiling level)	5.8700	0.0600	0.3522
E16 Corner (normal)	4.8600	0.0900	0.4374
E18 Party wall between dwellings	4.8600	0.0600	0.2916
P7 Party Wall - Exposed floor (normal)	5.8700	0.1600	0.9392
P4 Party wall - Roof (insulation at ceiling level)	5.8700	0.1200	0.7044

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		12.8294	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	51.8402	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	30.5389	30.3700	30.2045	29.4270	29.2816	28.6044	28.6044	28.4790	28.8652	29.2816	29.5758	29.8835	(38)
Heat transfer coeff	82.3791	82.2102	82.0447	81.2672	81.1217	80.4446	80.4446	80.3192	80.7054	81.1217	81.4160	81.7237	(39)
Average = Sum(39)m / 12 =												81.2665	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2612	1.2586	1.2560	1.2441	1.2419	1.2315	1.2315	1.2296	1.2355	1.2419	1.2464	1.2511	(40)
HLP (average)												1.2441	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.1274 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	25.8774	25.4931	24.9519	23.9540	23.2068	22.3783	21.9308	22.4682	23.0533	23.9399	24.9583	25.7899	(42b)
Hot water usage for other uses	36.4166	35.0923	33.7681	32.4439	31.1196	29.7954	29.7954	31.1196	32.4439	33.7681	35.0923	36.4166	(42c)

Average daily hot water use (litres/day) 57.0984 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	62.2940	60.5854	58.7200	56.3979	54.3264	52.1737	51.7262	53.5878	55.4972	57.7080	60.0506	62.2065	(44)
Energy conte	98.6584	86.2728	90.2504	77.2059	73.1338	64.1536	62.5583	66.3529	68.4336	78.3092	85.5531	97.4003	(45)

Energy content (annual) Total = Sum(45)m = 948.2826

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	83.8597	73.3319	76.7129	65.6250	62.1638	54.5306	53.1746	56.4000	58.1686	66.5628	72.7202	82.7903	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	83.8597	73.3319	76.7129	65.6250	62.1638	54.5306	53.1746	56.4000	58.1686	66.5628	72.7202	82.7903	(64)

Total per year (kWh/year) = Sum(64)m = 806.0402 (64)

12Total per year (kWh/year) 806 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Electric shower(s)	47.9610	42.7337	46.6635	44.5304	45.3660	43.2748	44.7173	45.3660	44.5304	46.6635	45.7861	47.9610	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 545.5538 (64a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	32.9552	29.0164	30.8441	27.5389	26.8824	24.4513	24.4730	25.4415	25.6747	28.3066	29.6266	32.6878	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	106.3693	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	99.0731	109.6881	99.0731	102.3755	99.0731	102.3755	99.0731	99.0731	102.3755	99.0731	102.3755	99.0731	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	186.1380	188.0695	183.2021	172.8400	159.7597	147.4661	139.2532	137.3217	142.1891	152.5512	165.6315	177.9251	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	33.6369	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	-85.0955	(71)
Water heating gains (Table 5)	44.2946	43.1792	41.4571	38.2484	36.1323	33.9602	32.8938	34.1956	35.6594	38.0465	41.1480	43.9353	(72)
Total internal gains	384.4165	395.8476	378.6432	368.3748	349.8760	338.7127	326.1309	325.5012	335.1348	344.5816	364.0658	375.8443	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	4.5900	36.7938	0.6300	0.7000	0.7700	51.6131	(77)
Southwest	0.4000	36.7938	0.6300	0.7000	0.7700	4.4979	(79)
Northwest	4.8900	11.2829	0.6300	0.7000	0.7700	16.8618	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	72.9727	129.9003	192.6119	263.5912	318.0042	325.7160	309.8587	267.7335	216.9512	147.5786	88.4244	61.7894	(83)
Total gains	457.3892	525.7479	571.2551	631.9660	667.8802	664.4286	635.9896	593.2347	552.0859	492.1602	452.4902	437.6337	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	29.6084	29.6693	29.7291	30.0135	30.0674	30.3205	30.3205	30.3678	30.2225	30.0674	29.9587	29.8459	
alpha	2.9739	2.9780	2.9819	3.0009	3.0045	3.0214	3.0214	3.0245	3.0148	3.0045	2.9972	2.9897	
util living area	0.9744	0.9604	0.9384	0.8857	0.7940	0.6490	0.5101	0.5569	0.7542	0.9067	0.9605	0.9774	(86)
MIT	18.6690	18.9468	19.3595	19.9333	20.4352	20.7887	20.9254	20.9012	20.6453	19.9986	19.2458	18.6244	(87)
Th 2	19.8714	19.8734	19.8754	19.8849	19.8866	19.8948	19.8948	19.8964	19.8917	19.8866	19.8830	19.8793	(88)
util rest of house	0.9695	0.9529	0.9261	0.8617	0.7482	0.5690	0.3990	0.4461	0.6854	0.8821	0.9517	0.9731	(89)
MIT 2	17.7678	18.0426	18.4489	19.0081	19.4723	19.7738	19.8662	19.8554	19.6670	19.0822	18.3476	17.7291	(90)

Living area fraction fLA = Living area / (4) = 0.6660 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	18.3680	18.6447	19.0553	19.6242	20.1135	20.4497	20.5716	20.5518	20.3185	19.6925	18.9458	18.3254	(92)

Temperature adjustment 0.0000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
adjusted MIT	18.3680	18.6447	19.0553	19.6242	20.1135	20.4497	20.5716	20.5518	20.3185	19.6925	18.9458	18.3254	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9609	0.9425	0.9151	0.8552	0.7584	0.6111	0.4690	0.5143	0.7141	0.8770	0.9423	0.9651	(94)
Useful gains	439.5054	495.5076	522.7564	540.4625	506.4899	406.0394	298.3011	305.1066	394.2195	431.6192	426.3631	422.3615	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1158.9082	1129.9568	1030.0985	871.5275	682.5197	470.5739	319.4932	333.4714	501.8659	737.5976	964.4340	1154.3755	(97)
Space heating kWh	535.2357	426.3499	377.4625	238.3668	130.9661	0.0000	0.0000	0.0000	0.0000	227.6480	387.4110	544.6184	(98a)
Space heating requirement - total per year (kWh/year)												2868.0585	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	535.2357	426.3499	377.4625	238.3668	130.9661	0.0000	0.0000	0.0000	0.0000	227.6480	387.4110	544.6184	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2868.0585	
Space heating per m2											(98c) / (4) =	43.9078	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	756.1791	595.2900	610.4258	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7410	0.8107	0.7783	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	560.3370	482.6062	475.0759	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	735.8738	704.7129	656.7032	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	126.3865	165.2474	135.1307	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	31.5966	41.3119	33.7827	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												106.6912	(107)
Energy for space heating												43.9078	(99)
Energy for space cooling												1.6334	(108)
Total												45.5412	(109)
Fabric Energy Efficiency (TFEE)												45.5	(109)

breglobal

Job no: PR10887
Date: 23/10/2023
Assessor name: Iraj Maghounaki
Registration no: BRE400012
Development name: 148 Oxford Road, Oxford, OX4 2EA

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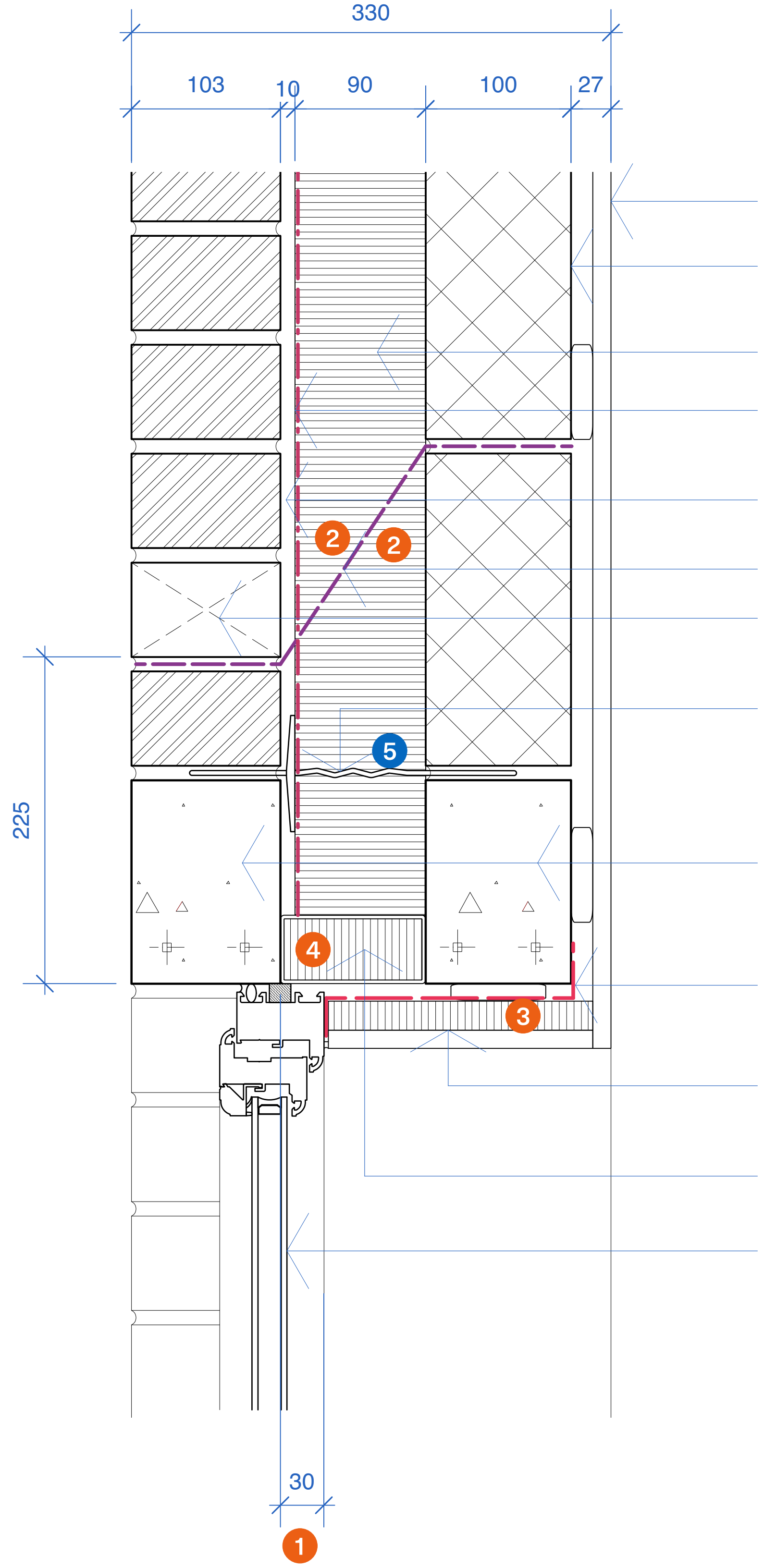
WATER EFFICIENCY CALCULATOR FOR NEW DWELLINGS - (BASIC CALCULATOR)

	House Type:	Type 1		Type 2		Type 3		Type 4		Type 5		Type 6		Type 7		Type 8		Type 9		Type 10	
	Description:	Flat 2																			
Installation Type	Unit of measure	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day
Is a dual or single flush WC specified?		Dual																			
WC	Full flush volume	6	8.76		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
	Part flush volume	3	8.88		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Taps (excluding kitchen and external taps)	Flow rate (litres / minute)	6	11.06		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Are both a Bath & Shower Present?		Bath & Shower																			
Bath	Capacity to overflow	155	17.05		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Shower	Flow rate (litres / minute)	8	34.96		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Kitchen sink taps	Flow rate (litres / minute)	6	13.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Has a washing machine been specified?		No																			
Washing Machine	Litres / kg	0	17.16		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Has a dishwasher been specified?		No																			
Dishwasher	Litres / place setting	0	4.50		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Has a waste disposal unit been specified?		No	0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Water Softener	Litres / person / day		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
	Calculated Use		115.4		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
	Normalisation factor		0.91		0.91		0.91		0.91		0.91		0.91		0.91		0.91		0.91		0.91
Code for Sustainable Homes	Total Consumption		105.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
	Mandatory level		Level 3/4		-		-		-		-		-		-		-		-		-
Building Regulations 17.K	External use		5.0		5.0		5.0		5.0		5.0		5.0		5.0		5.0		5.0		5.0
	Total Consumption		110.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
	17.K Compliance?		Yes		-		-		-		-		-		-		-		-		-

Construction Detail



Calculated Ψ (Psi) value for use in SAP Calculation

	Internal leaf block thermal conductivity (W/mK)					
Insulation thermal conductivity (W/mK)	0.11	0.15	0.19	0.28	0.6	1.33
0.019	0.022	0.020	0.019	0.017	0.016	0.015
0.022	0.022	0.020	0.018	0.017	0.014	0.014

f-values: 0.957 - 0.961 (values above 0.75 indicate low risk of condensation and mould)

Ψ (Psi) value Thermal Compliance Notes

1. Minimum 30mm overlap of window frame and insulated wall cavity.
2. Ensure insulation rigid board is cut and fitted around the angle of the cavity tray.
3. Minimum 15mm insulation with λ≤0.026W/mK to head reveal.
4. Insulated cavity barrier with λ≤0.026W/mK fixed in accordance with maufacturers guidelines. If fixing spikes are used, they should be installed at the required centres. For compression fit cavity barriers, use the correct size for a compressive fit in the cavity.

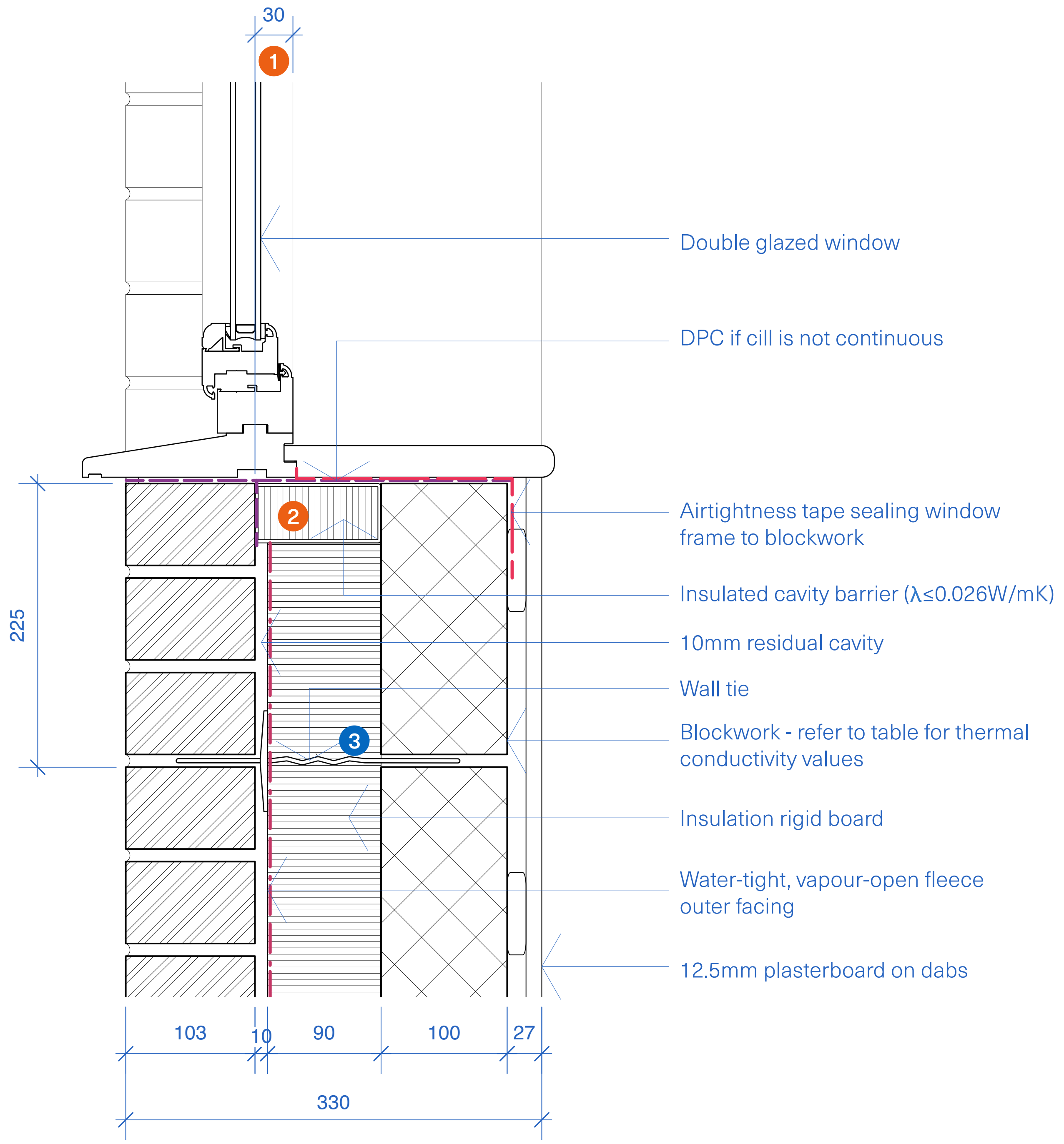
Construction Notes

5. Wall tie: 225mm maximum distance from opening. No greater than 450mm vertical spacing.
450mm horizontal centres for first row of wall ties above and below opening.
Only use insulation retaining clips that are compatible with the wall tie.

General Notes

The cavity must be closed at the top of the wall and openings for the provisions of Diagram 5.3 ADBv1 to apply.

Construction Detail



Calculated Ψ (Psi) value for use in SAP Calculation

	Internal leaf block thermal conductivity (W/mK)					
Insulation thermal conductivity (W/mK)	0.11	0.15	0.19	0.28	0.6	1.33
0.019	0.022	0.021	0.021	0.020	0.020	0.020
0.022	0.021	0.020	0.020	0.019	0.018	0.018

f-values: 0.885 - 0.898 (values above 0.75 indicate low risk of condensation and mould)

Ψ (Psi) value Thermal Compliance Notes

1. Minimum 30mm overlap of window frame and insulated wall cavity.
2. Insulated cavity barrier with λ≤0.026W/mK fixed in accordance with maufacturers guidelines. If fixing spikes are used, they should be installed at the required centres. For compression fit cavity barriers, use the correct size for a compressive fit in the cavity.

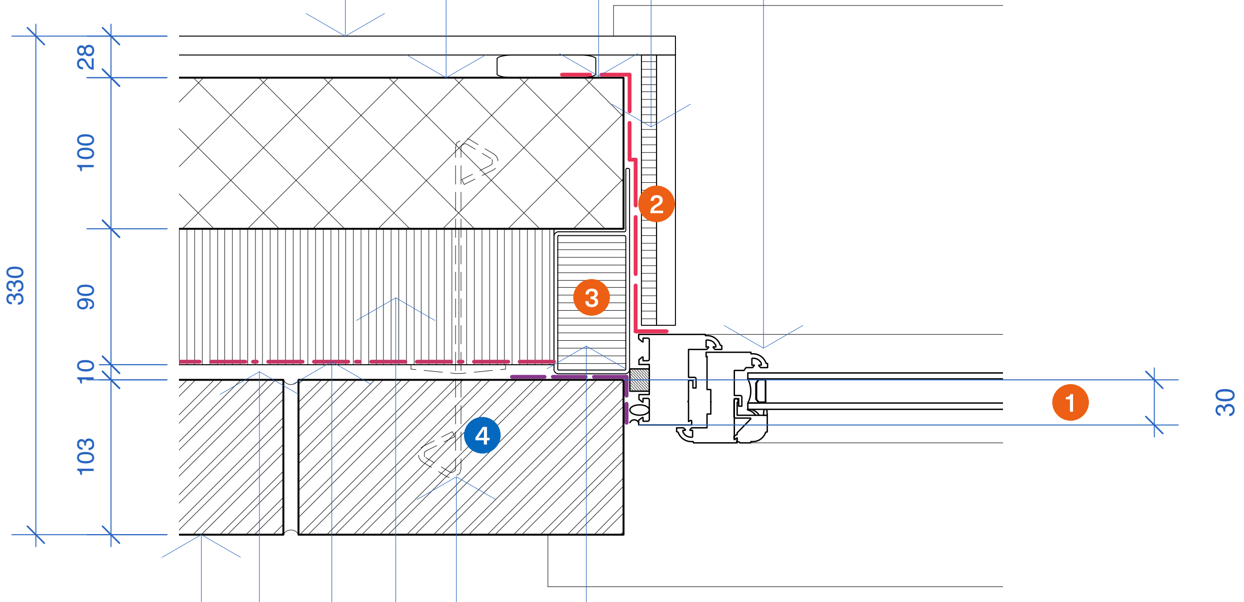
Construction Notes

3. Wall tie: 225mm maximum distance from opening. No greater than 450mm vertical spacing. 450mm horizontal centres for first row of wall ties above and below opening. Only use insulation retaining clips that are compatible with the wall tie.

General Notes

The cavity must be closed at the top of the wall and openings for the provisions of Diagram 5.3 ADBv1 to apply.

Construction Detail



Calculated Ψ (Psi) value for use in SAP Calculation

	Internal leaf block thermal conductivity (W/mK)					
Insulation thermal conductivity (W/mK)	0.11	0.15	0.19	0.28	0.6	1.33
0.019	0.017	0.016	0.016	0.016	0.015	0.016
0.022	0.016	0.015	0.015	0.014	0.014	0.014

f-values: 0.934 - 0.943 (values above 0.75 indicate low risk of condensation and mould)

Ψ (Psi) value Thermal Compliance Notes

1. Minimum 30mm overlap of window frame and insulated wall cavity.
2. 10mm insulation with λ≤0.026W/mK to window jamb reveal.
3. Insulated cavity barrier with λ≤0.026W/mK fixed in accordance with maufacturers guidelines. If fixing spikes are used, they should be installed at the required centres. For compression fit cavity barriers, use the correct size for a compressive fit in the cavity.

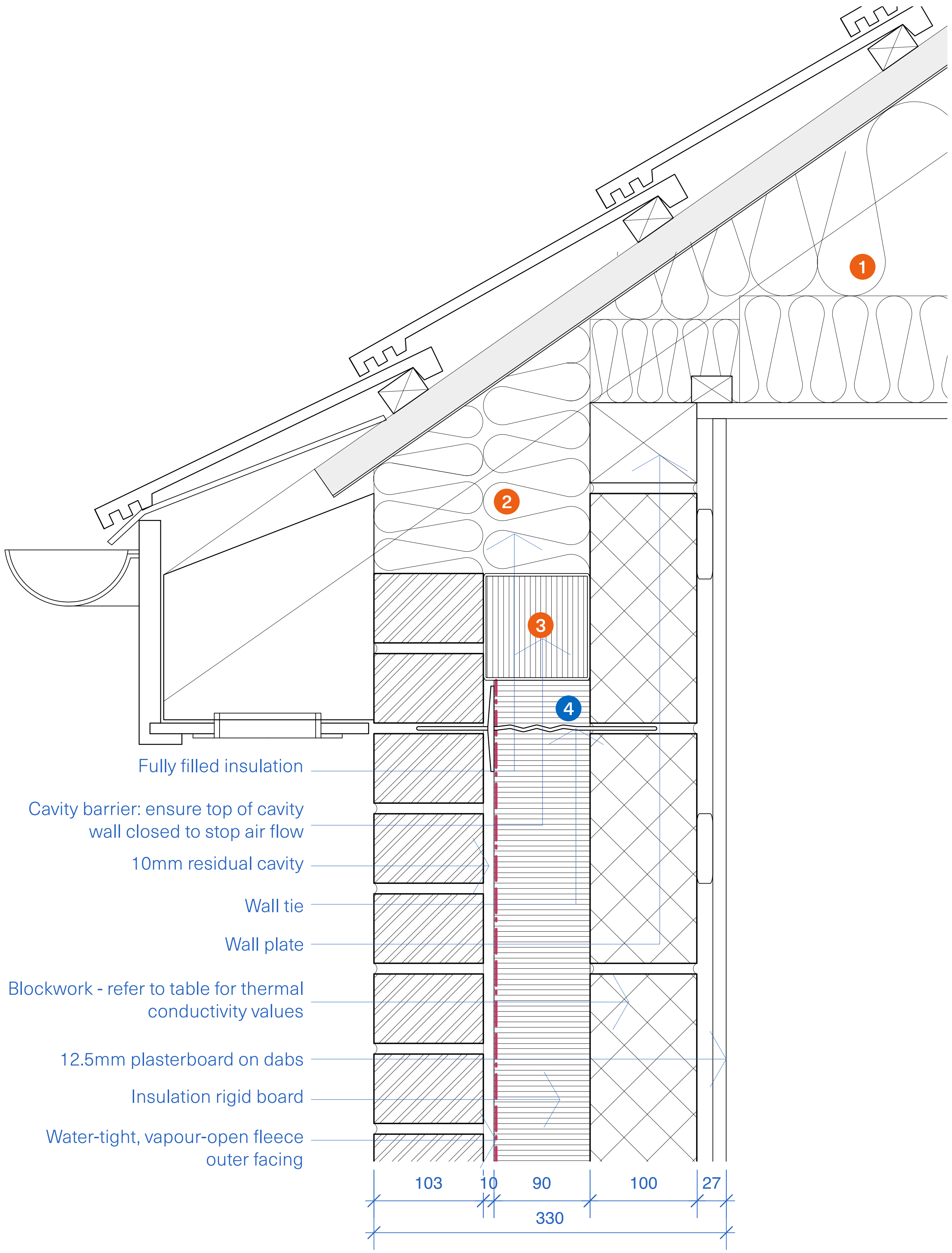
Construction Notes

4. Wall tie: 225mm maximum distance from opening. No greater than 450mm vertical spacing.
450mm horizontal centres for first row of wall ties above and below opening.
Only use insulation retaining clips that are compatible with the wall tie.

General Notes

The cavity must be closed at the top of the wall and openings for the provisions of Diagram 5.3 ADBv1 to apply.

Construction Detail



Calculated Ψ (Psi) value for use in SAP Calculation

	Internal leaf block thermal conductivity (W/mK)					
Insulation thermal conductivity (W/mK)	0.11	0.15	0.19	0.28	0.6	1.33
0.019	0.056	0.060	0.063	0.067	0.073	0.078
0.022	0.052	0.056	0.059	0.062	0.068	0.072

f-values: 0.919 - 0.933 (values above 0.75 indicate low risk of condensation and mould)

Ψ (Psi) value Thermal Compliance Notes

1. 400mm insulation quilt (0.044 W/mK), minimum roof pitch 40°.
2. Ensure continuity of insulation between the loft and external wall.
3. Horizontal/vertical cavity barriers need to be fixed in accordance with manufacturers guidelines.
If fixing spikes are used, they should be installed at the required centres.
For compression fit cavity barriers, use the correct size for a compressive fit in the cavity.

Construction Notes

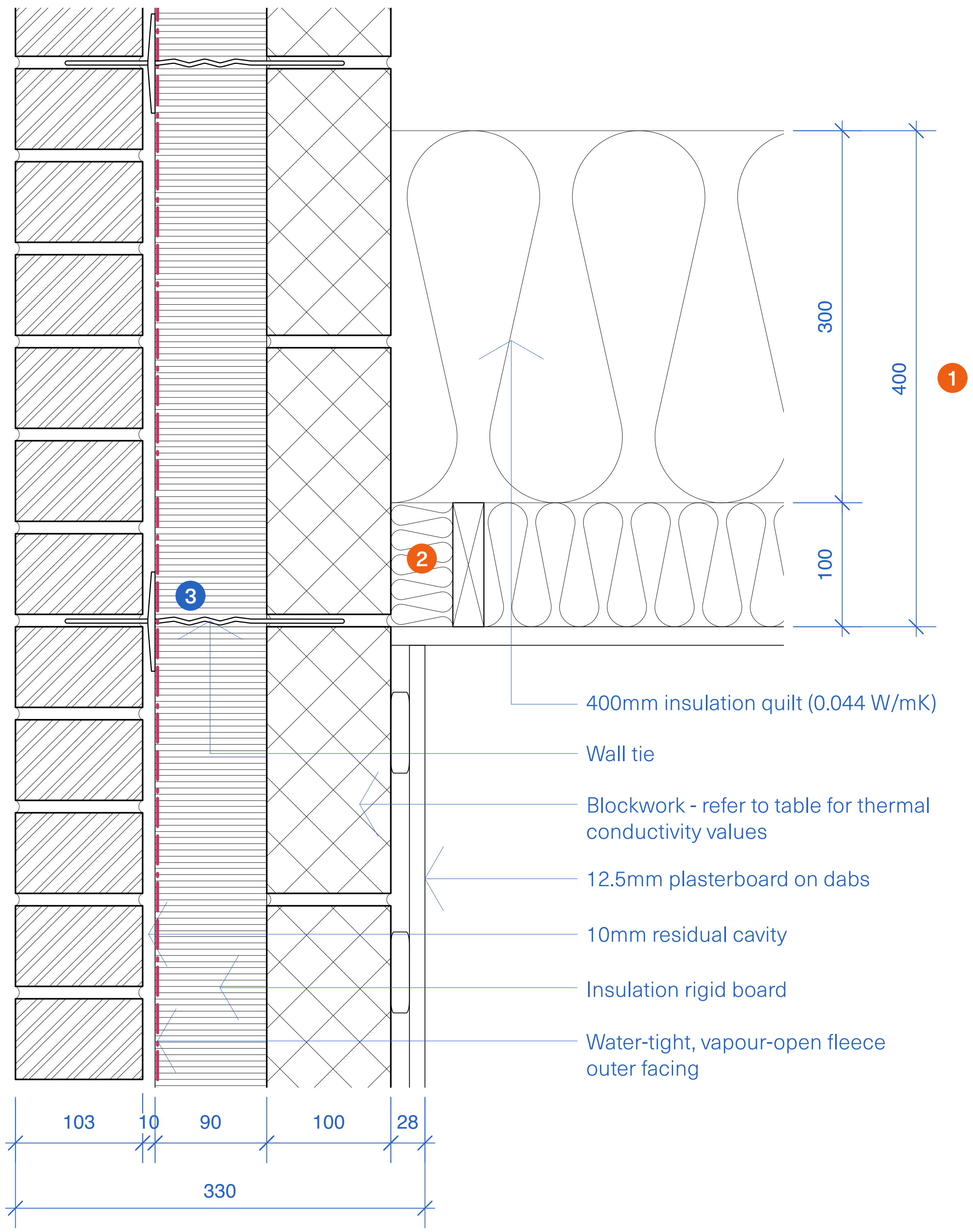
4. Wall tie: 225mm maximum distance from opening. No greater than 450mm spacing.
Only use insulation retaining clips that are compatible with the wall tie.

General Notes

The cavity must be closed at the top of the wall for the provisions of Diagram 5.3 ADBv1 to apply.

Maintain clear separation of components to prevent congestion within the cavity and mortar joints.

Construction Detail



Calculated Ψ (Psi) value for use in SAP Calculation

	Internal leaf block thermal conductivity (W/mK)					
Insulation thermal conductivity (W/mK)	0.11	0.15	0.19	0.28	0.6	1.33
0.019	0.028	0.035	0.041	0.055	0.096	0.174
0.022	0.030	0.036	0.043	0.056	0.097	0.174

f-values: 0.868 - 0.942 (values above 0.75 indicate low risk of condensation and mould)

Ψ (Psi) value Thermal Compliance Notes

1. 400mm insulation quilt (0.044 W/mK).
2. Fill the space between the wall and joist with insulation.

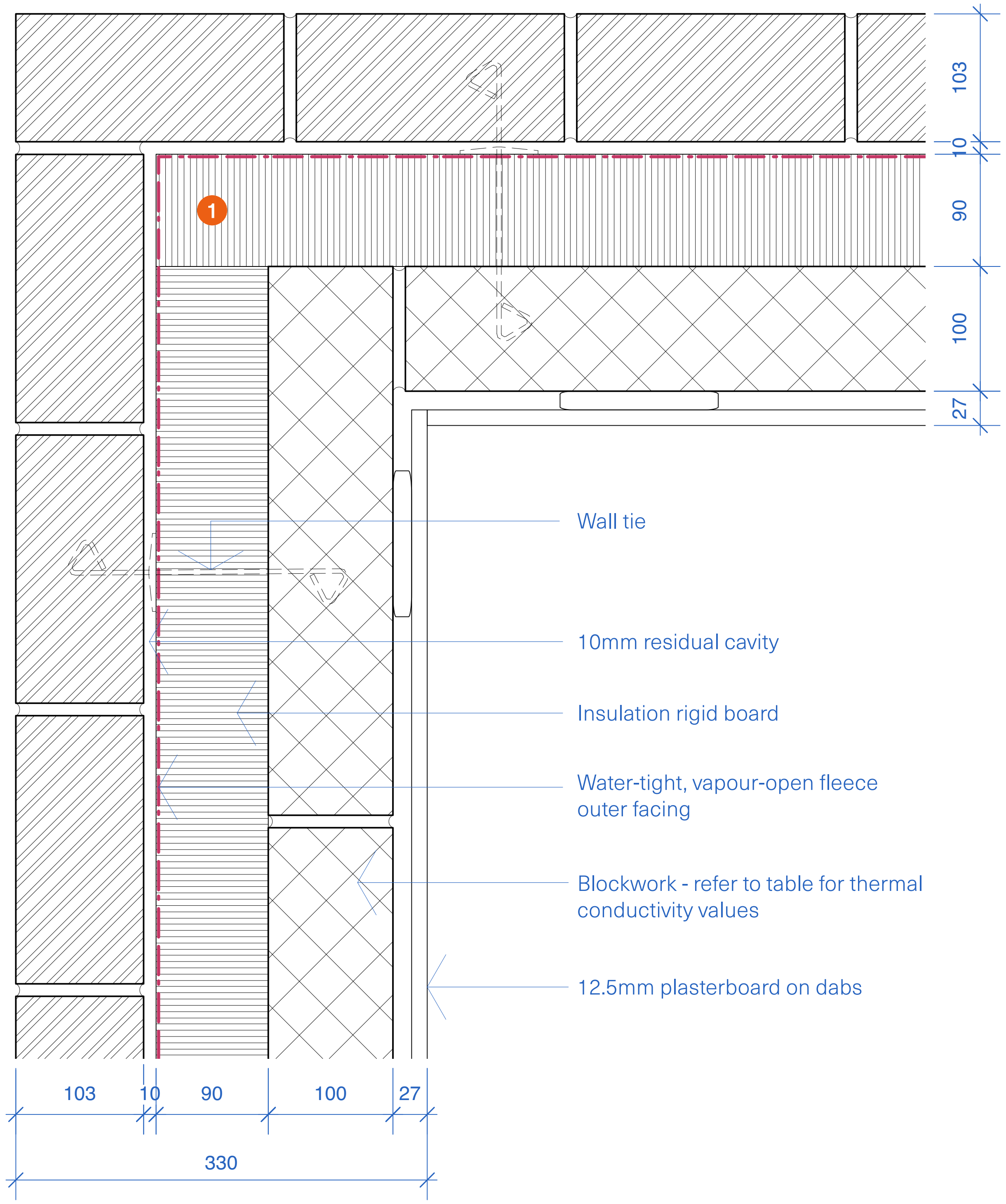
Construction Notes

3. Wall tie: 225mm maximum distance from opening. No greater than 450mm spacing. Only use insulation retaining clips that are compatible with the wall tie.

General Notes

The cavity must be closed at the top of the wall for the provisions of Diagrams 5.3 and 8.1 ADBv1 to apply.

Construction Detail



Calculated Ψ (Psi) value for use in SAP Calculation

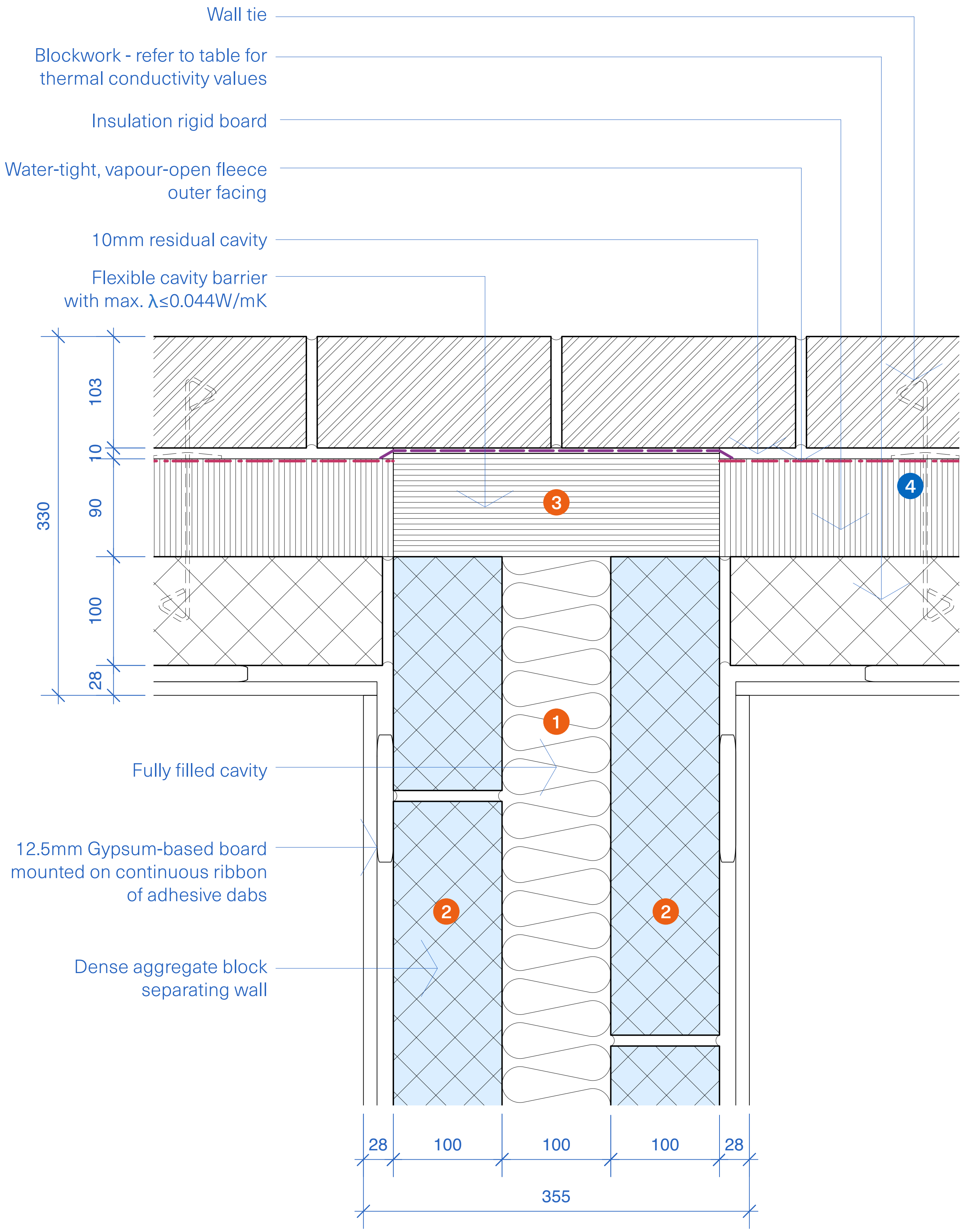
Insulation thermal conductivity (W/mK)	Internal leaf block thermal conductivity (W/mK)					
	0.11	0.15	0.19	0.28	0.6	1.33
0.019	0.033	0.035	0.037	0.040	0.044	0.047
0.022	0.035	0.038	0.041	0.044	0.049	0.052

f-values: 0.904 - 0.952 (values above 0.75 indicate low risk of condensation and mould)

Ψ (Psi) value Thermal Compliance Notes

1. Ensure continuity of insulation at the corner.

Construction Detail



Calculated Ψ (Psi) value for use in SAP Calculation

Insulation thermal conductivity (W/mK)	Internal leaf block thermal conductivity (W/mK) 0.11	0.15	0.19	0.28	0.6	1.33
0.019	0.055	0.055	0.055	0.055	0.055	0.055
0.022	0.055	0.055	0.055	0.055	0.055	0.055

f-values: 0.951 - 0.964 (values above 0.75 indicate low risk of condensation and mould)
The above Psi values are applicable per dwelling on either side of the party wall.

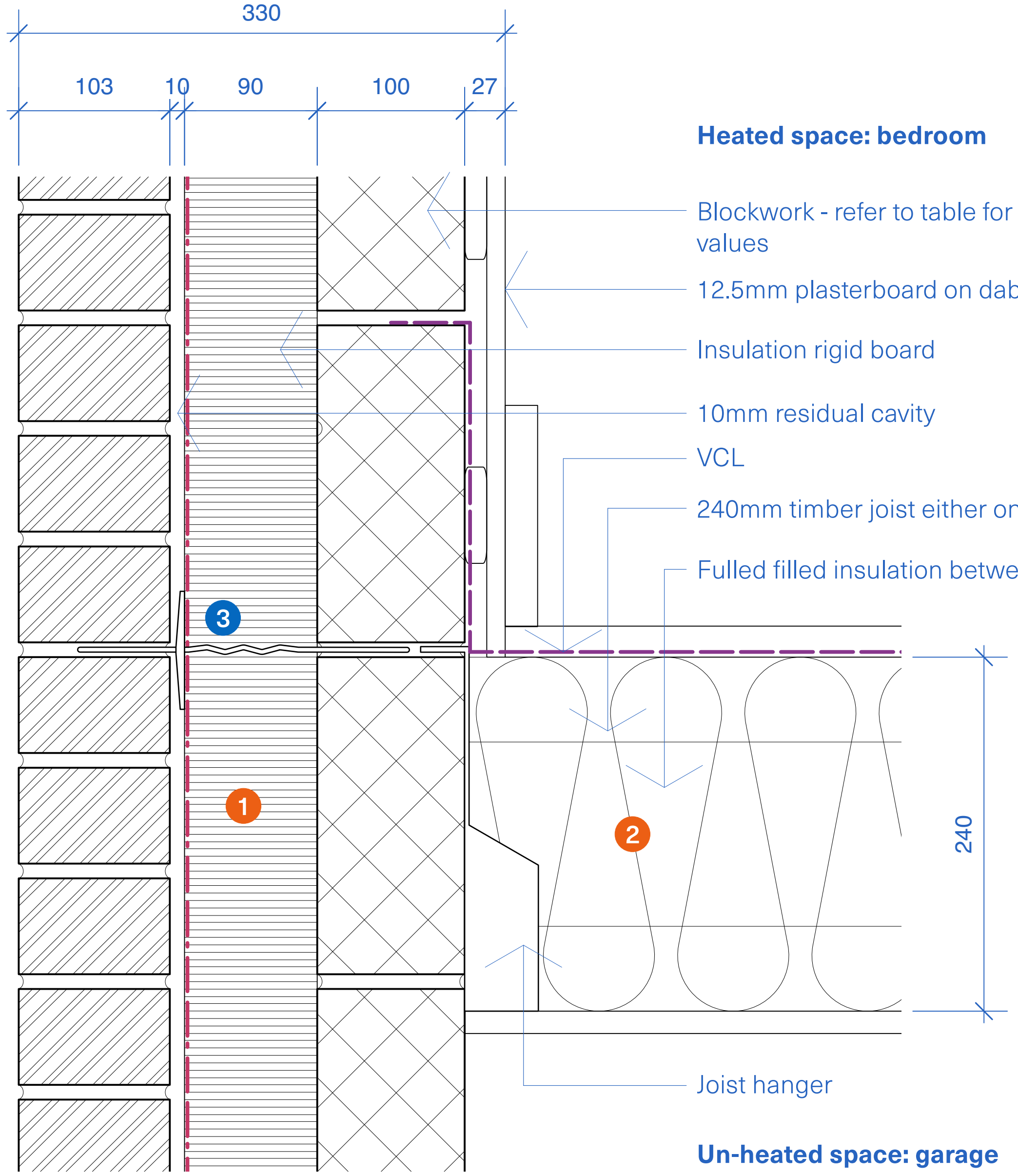
Ψ (Psi) value Thermal Compliance Notes

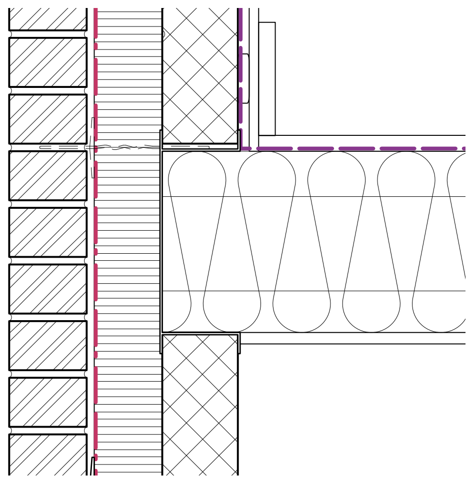
1. Fully fill the separating wall 100mm cavity with insulation (0.036 W/mK).
2. 2 x 100mm Dense Aggregate block separating wall.
3. Close the external wall cavity with flexible cavity barrier with max. λ≤0.044W/mK.
Dependent on the type of cavity barrier used, a DPC should be provided to prevent the barrier absorbing moisture.
Horizontal/vertical cavity barriers need to be fixed in accordance with manufacturers guidelines.
If fixing spikes are used, they should be installed at the required centres.
For compression fit cavity barriers, use the correct size for a compressive fit in the cavity.

Construction Notes

4. Type A (part E) wall ties at no more than 2.5 ties/m2 (900 x 450mm spacing).
Wall ties: no greater than 900mm horizontal spacing.

Construction Detail





Joist built-in option

The timber joist can be built-in at this junction rather than a joist hanger.
This does not affect the modelled Psi-values.

Calculated Ψ (Psi) value for use in SAP Calculation

	Internal leaf block thermal conductivity (W/mK)					
Insulation thermal conductivity (W/mK)	0.11	0.15	0.19	0.28	0.6	1.33
0.019	0.037	0.045	0.052	0.068	0.115	0.200
0.022	0.038	0.045	0.053	0.068	0.115	0.198

f-values: 0.836 - 0.905 (values above 0.75 indicate low risk of condensation and mould)

Ψ (Psi) value Thermal Compliance Notes

1. Insulation to be continuous across the floor abutment zone.
2. Timber joist fully filled with minimum 240mm mineral wool between joists over garage, maximum λ≤0.044W/mK.

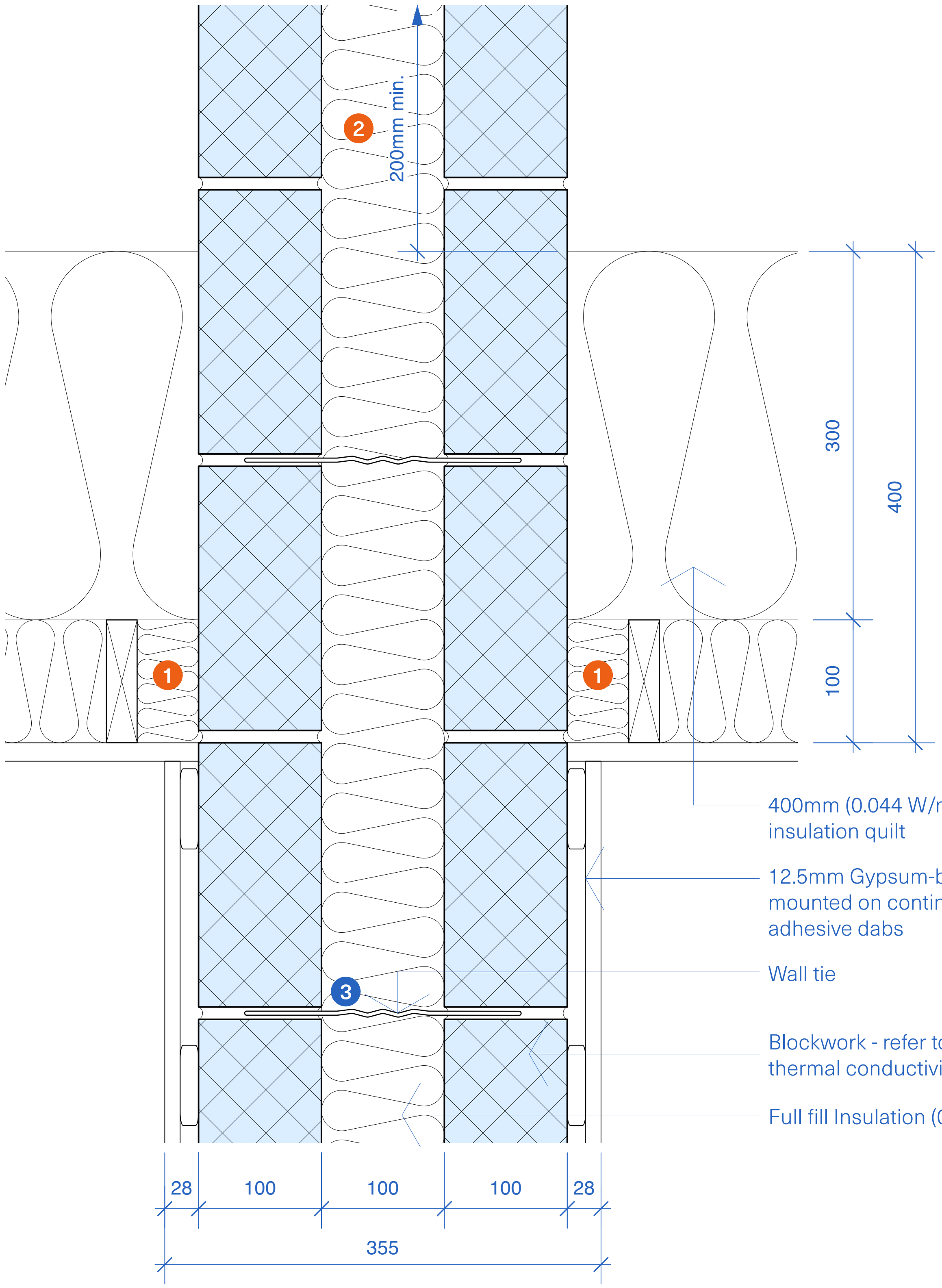
Construction Notes

3. Wall tie: No greater than 450mm vertical spacing.
Only use insulation retaining clips that are compatible with the wall tie.

General Notes

Maintain clear separation of components to prevent congestion within the cavity and mortar joints.

Construction Detail



Calculated Ψ (Psi) value for use in SAP Calculation

	Separating Wall Block Conductivity: W/mK			
Roof Insulation Thermal Conductivity (W/mK)	0.15	0.19	0.6	1.33
0.044	0.033	0.040	0.101	0.190

f-values: 0.890 - 0.957 (values above 0.75 indicate low risk of condensation and mould)
The above Psi-values are applicable per dwelling on either side of the party wall.

Ψ (Psi) value Thermal Compliance Notes

1. Fill the space between the separating wall and last joist with insulation.
2. Ensure that the cavity insulation extends at least 200mm above the top of the loft insulation.

Construction Notes

3. Type A (part E) wall ties at no more than 2.5 ties/m2 (900 x 450mm spacing).
Wall ties: no greater than 900mm horizontal spacing.

General Notes

The cavity must be fire-stopped (same resistance as the compartment wall) at the top of the wall to the underside of the roof for the provisions of Diagram 8.1 ADBv1 to apply.