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# SECTION 1 BUILDING REGULATIONS & BER

### *1.1 Compliance Criteria*

This report sets out to review the method of compliance with building regulations to the residences in this project. It is important to note that the input data currently used is preliminary, and the design will develop as the project progresses.

At this early stage of the project, a number of assumptions have been made. Future information can be input to the DEAP software as it becomes available.

The dwellings have been analysed for compliance with the 2018 TGD for Part L (NZEB). This document has only been released for public consultation, and the contents may well change when the submissions have been considered. Unforeseen requirements may necessitate alterations to the design when the full 2018 TGD L is released.

We have set out a number of options to demonstrate compliance. The option used will be determined once the standards and calculation methods as well as definitions have been ratified and published by Department of Environment (DOE).

There are five main criteria that this report aims to demonstrate compliance with

- Building Energy Rating
- Energy Performance Coefficient (NZEB)
- Carbon Performance Coefficient (NZEB)
- Renewable contribution
- Maximum elemental U-Values

**Building Energy Rating (BER)**

There is no specific BER rating that is required to comply with Part L. However, dwellings compliant with NZEB will usually achieve a BER of A2-A3.

**Energy Performance Coefficient (EPC) & Carbon Performance Coefficient (CPC)**

The EPC and CPC are the two figures that are used to determine whether the dwelling complies with Part L on an overall basis.

The EPC is the calculated primary energy consumption of the proposed dwelling, divided by that of a reference building of the same size. To comply with Part L and NZEB requirements, the EPC must be better than the Maximum Energy Performance Coefficient (MPEPC) which is 0.30.

The CPC is the calculated carbon dioxide emissions of the proposed dwelling, divided by that of a reference building of the same size. To comply with Part L and NZEB requirements, the CPC must be better than the Maximum Carbon Performance Coefficient (MPCPC) which is 0.35.

**Renewable Contribution**
To satisfy part L, 20% of the building energy must be provided via renewable technologies. This is measured in the form of a renewable energy ratio (RER).

**Maximum Elemental U-Values**
Technical Guidance Document Part L 2018 (public consultation) sets out maximum U-Values which may not be exceeded for each construction type:

| Table 1 | Maximum elemental U-value ($W/m^2K$)[1, 2] | |
|---|---|---|
| **Column 1 Fabric Elements** | **Column 2 Area-weighted Average Elemental U-Value (Um)** | **Column 3 Average Elemental U-value – individual element or section of element** |
| Roofs<br><br>Pitched roof<br>- Insulation at ceiling<br>- Insulation on slope<br><br>Flat roof | <br><br><br>0.16<br>0.16<br><br>0.20 | 0.3 |
| Walls | ~~0.21~~ 0.18 | 0.6 |
| Ground floors[3] | ~~0.21~~0.18 | 0.6 |
| Other exposed floors | ~~0.21~~0.18 | 0.6 |
| External doors, windows and rooflights | ~~1.6~~ 1.4~~[4,5]~~ | 3.0 |

***TGD Part L 2018 (Public Consultation)***

# SECTION 2 INPUT DATA

The DEAP software is used to calculate the BER of the building. Similar to the calculation to demonstrate compliance with Part L. This report and the accompanying calculations are based on the design information and the input data has been detailed below. As the project progresses, the model can be refined, and the results will increase in accuracy.

It should be noted that this report and the accompanying calculations are based on preliminary information and a number of assumptions have had to be made at this stage. As the project progresses, the model can be refined, and the results will increase in accuracy.

A range of options were modelled, which will be laid out in the following pages. The following input data will be applied to all five options:

**General Input Data**

- Air permeability of 3 $m^3/m^2.h$
- Whole house mechanical ventilation with heat recovery
- SFP of 0.65 W/l/s
- 84% heat recovery efficiency
- Roof U-Value of 0.15 $W/m^2.K$ (on top floor apartments)
- Wall U-Value of 0.18 $W/m^2.K$
- Glazing U-Value of 1.40 $W/m^2.K$
- Thermal bridging factor of 0.08
- 100% of lighting outlets to be low energy (LED)
- Medium thermal mass
- Group heating scheme

**Option 1:** **Centralised Gas Boilers + Heat Pumps (Water Source) + HIUs Specific Input Data (A3-A2 Rating)**

- Gas boilers of 91% seasonal efficiency to meet 30% of the heating load
- Water-source heat pumps with seasonal efficiency of 380% to meet 90% of the heating load

**Option 2:** **Centralised Gas Boilers + CHP + PV + HIUs Specific Input Data (A2 Rating)**

- Gas boilers of 91% seasonal efficiency to meet 90% of the heating load
- CHP unit to meet 10% of the heating load
- CHP electrical efficiency of 36.5%
- CHP thermal efficiency of 52.8%
- 320W PV panels to be included in scheme
- Table below shows minimum number of PV panels for each apartment type to comply with NZEB:

| Apartment Type | Number of PV Panels Required | Area of PV Panels Required ($m^2$) | kW Peak Required |
|---|---|---|---|
| 1 Bed Mid-Floor | 2 | 3.2 | 0.64 |
| 1 Bed Top-Floor | 3 | 4.8 | 0.96 |
| 2 Bed Mid-Floor | 3 | 4.8 | 0.96 |
| 2 Bed Top-Floor | 4 | 6.4 | 1.28 |
| Total | 1,330 | 2,128 | 681 |

**Option 3:** **Centralised Gas Boilers + Heat Pumps (Water Source) + Micro Heat Pumps Specific Input Data**

- Gas boilers of 91% seasonal efficiency to meet 35% of the heating load
- Water-source heat pumps with seasonal efficiency of 600% to meet 65% of the heating load
- Input methodology for this option is currently under review by SEAI and may be subject to change

**Option 4:** **Centralised Gas Boilers + Heat Pumps (Water Source) + Micro Heat Pumps Specific Input Data**

- Gas boilers of 91% seasonal efficiency to meet 25% of the heating load
- Water-source heat pumps with seasonal efficiency of 440% to meet 75% of the heating load

**Option 5** **Centralised Gas Boilers + Heat Pumps (Water Source), + HIUs Specific Input Data (A3-A2 Rating)**

- Air-source heat pumps with seasonal efficiency of 380% to meet 90% of the heating load

# SECTION 3 ENERGY EFFICIENCY & SUSTAINABILITY

### *3.1 Reducing Energy Consumption – Building Fabric*

In order to reduce the energy consumption of the heating and lighting systems, integration between the architects, services engineer and structural engineer is required. This approach ensures the form of the building seeks to minimise heat gains in summer and heat loss in winter and also ensures that the choice of heating, cooling and ventilation systems will complement the building design and vice versa.

### *3.1.1 Elemental U-Values*

The U-Value of a building element is a measure of the amount of heat energy that will pass through the constituent element of the building envelope. Increasing the insulation levels in each element will reduce the heat lost during the heating season and this in turn will reduce the consumption of fuel and the associated carbon emissions and operating costs.

It is possible to exceed the requirements of the current building regulations. The current target U-Values are identified below:

| Element | New Buildings & extensions to existing buildings [W/m$^2$k] | Proposed for this development [W/m$^2$k] | Percentage Improvement |
|---|---|---|---|
| Walls | 0.21 | 0.18 | 14% |
| Floors | 0.21 | 0.15 | 29% |
| Windows | 1.60 | 1.40 | 13% |
| Roofs | 0.20 | 0.15 | 25% |

### *3.1.2 Air Permeability*

A major consideration in reducing the heat losses in a building is the air infiltration. This essentially relates to the ingress of cold outdoor air into the building and the corresponding displacement of the heated internal air. This incoming cold air must be heated if comfort conditions are to be maintained. In a traditionally constructed building, infiltration can account for 30 to 40 percent of the total heat loss; however, construction standards continue to improve in this area.

With good design and strict on-site control of building techniques, infiltration losses can be significantly reduced, resulting in equivalent savings in energy consumption, emissions and running costs.

In order to ensure that a sufficient level of air tightness is achieved, air permeability testing will be specified in tender documents, with the responsibility being placed on the main contractor to carry out testing and achieve the targets identified in the tender documents.

A design air permeability target of **3 m$^3$/m$^2$/hr** has been identified

Air testing specification will require testing to be carried out in accordance with:

- BS EN 13829:2001 'Determination of air permeability of buildings, fan pressurisation method'
- CIBSE TM23: 2000 'Testing buildings for air leakage'

### *3.2 Low Carbon & Renewable Energy Solutions*

The building services design on any project is responsible for a large part of how a building will consume energy. The design of heating, ventilation and lighting systems will determine the energy consumption characteristics of the building.

The approach that has been adopted to delivering a development which is both highly efficient and sustainably designed has been to involve all members of the design team from the earliest possible stage in the design process. This integrated design approach will be continued throughout the design process.

This approach ensures that the knowledge and expertise of each member of the design team was available from the outset. The goals for sustainable design were identified at this early stage and each element of the design was progressed accordingly.

Several renewable and low carbon technologies were considered during the preliminary design process.

#### *3.2.1 Combined Heat & Power*

The inclusion of combined heat and power plant in any building scheme must be given very careful consideration due to the large capital costs involved and the potential risk of higher running costs than would be incurred if separate heating plant and grid electricity were used.

The most important consideration when designing CHP plant is to carefully assess both the heat load and the electrical load. A CHP installation will typically operate at approximately 80% combined efficiency. Approximately 60% of the useful output will be thermal energy with the remaining 40% being available as electric energy.

E.g. a CHP plant which consumes 100kWhrs of gas will produce approximately 80kWhrs of useful output. 50 kWhrs of this output will be available as thermal energy while the electric energy output will be 30kWhrs.

Following analysis, CHP has been included for in option 2.

#### *3.2.2 Heat Pump Technology*

The general principal of heat pump technology is the use of electrical energy to drive a refrigerant cycle capable of extracting heat energy from one medium at one temperature and delivering this heat energy to a second medium at the desired temperature. The basic thermodynamic cycle involved is reversible which allows the heat pump to be used for heating or cooling.

The efficiency of any heat pump system is measured by its coefficient of performance (CoP). This is a comparison between the electrical energy required to run the heat pump and the useful heat output of the heat pump, e.g. a heat pump requiring 1kW of electrical power in order to deliver 3kW of heat energy has a CoP of 3.0.

This operating principle can be applied to different situations, making use of the
Most readily available heat source on any given site. The most common types are.

- Ground Source
- Water Source
- Air Source

Water source heat pumps generally offer the highest CoP however they can be more expensive to install and must have a source of water from a well, lake or river.

Air-source heat pump technology has been analysed in Option 5, water source heat pump technology is being assessed as part of options 1, 3 and 4.

#### *3.2.3 Bio-Mass Boilers*

The use of bio-fuel in the form of wood chip or wood pellet can provide a realistic alternative to conventional fuels such as oil or gas. In terms of heat output, biomass boilers operate in exactly the same manner as conventional oil or gas fired boilers. There are, however, important differences to be considered.

The major drawback of a biomass heating system is the inconvenience associated with supply and storage of fuel, the increased maintenance of the boiler plant when compared to gas or oil-fired systems and the increased capital costs. The advantage of the system, however, is the practically zero net carbon emissions associated with the combustion of wood products and the marginal cost savings which can be achieved.

When natural gas is available as a potential fuel source it is always very difficult to make a sound financial argument for the inclusion of biomass heating systems. The unit cost of wood pellet or indeed wood chip (although slightly cheaper than pellet) is generally only marginally less than the unit of cost of natural gas (less than 10%).

This marginal saving is typically offset by the increase in maintenance costs and is never sufficient to offset the increase in capital costs associated with this installation of the biomass systems.

Biomass technology will not be included in the development.

#### *3.2.4 Solar Water Heating*

Solar thermal collection uses of the sun's energy and transfers the heat generated to the building's domestic hot water supply. Two distinct types of collection panel are available. The evacuated tube array and the flat panel collector. The evacuated tube array is the more effective of the two as it is capable of generating approximately twice as much hot water from the same surface area of flat panel.

Solar thermal collection can deliver up to 50% of the total annual hot water load of a Building.

Solar thermal technology will not be included in the development.

### *3.2.5 Photovoltaic (PV) Panels*

PV Panels are capable of generating direct current electricity from the sun's energy, which can then be converted to alternating current and used within the building. They are generally a "maintenance free" technology as there are no moving parts. They also typically have a 20-year manufacturer's guarantee on electrical output and can be expected to operate effectively for 30 years or more.

Capital costs have also reduced significantly in recent years due to worldwide increase in production levels, particular from China. They are adaptable and scalable in that the amount installed can be selected to suit the budget available.

PV panels were included in option 2.

### *3.2.6 Wind Turbines.*

Due to the urban nature of the site wind energy has not been considered.

## SECTION 4 ENERGY RESULTS

The following table shows the energy performance criteria, carbon performance criteria and renewable energy ratio of each option.

The BER achieved by each option is also given, although this is not a requirement for NZEB compliance.

| Option | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 |
|---|---|---|---|---|---|
| **Proposed BER Rating** | A2 | A2 | A2 | A2 | A2 |
| **EPC** | 0.28 | 0.27 | 0.29 | 0.30 | 0.28 |
| **CPC** | 0.27 | 0.24 | 0.27 | 0.28 | 0.27 |
| **Renewable Energy Ratio** | 21% | 27% | 25% | 23% | 21% |
| **NZEB Compliant** | Yes | Yes | Yes | Yes | Yes |

***NOTE:***

The optimum option will be determined and decided upon once the TGD L 2018 is formally published by Department of Environment (DOE) along with the ratified calculation method.

The DOE have not yet confirmed if PRS Schemes are covered by TGD L Domestic or Non-Domestic.

We have the ability to adjust the design to suit the requirements of Domestic or Non-Domestic in compliance with TGD L once determined by the DOE.