Part L (NZEB) assessment

For the

Sustainability & Energy Design

At

Waterfront South Central SHD - ABP Ref. ABP-306158-19

For

Waterside Block 9 Developments Limited

Date of Issue: 16/12/2020 Revision: 03

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Document History

Revision No.	Description	Prepared By	Reviewed By	Date
Rev 0	Draft	EN	DB	17/10/2019
Rev 1	Submission	EN	DB	26/11/2019
Rev 2	Updated planning submission	EN	DB	22/05/2020
Rev 3	Updated planning submission	DN	JC	16/12/2020

Contents

1. Executive Summary

Taking cognisance of the EU energy performance of Buildings Directive (EPBD), the Building Regulations Technical Guidance Document, Part L (NZEB), and Dublin City Council's strategy for sustainable urban design and reductions in energy and carbon emissions; the building services design strategy for the residential building is to utilise sustainable design options and energy efficient systems that are technically, environmentally and economically feasible for a project of this kind.

The building services strategy targets a low energy and environmentally friendly building. The proposed Strategic Housing Development, located at Waterfront South Central, North Wall Quay, Dublin 1 will comprise of circa 1005 residential units and 1,894 sq m of commercial space located on Levels 40 to 43 and a public viewing deck at Level 44 with construction and installation scheduled prior to December 2022.

This report describes and demonstrates the design philosophy for the proposed development at Waterfront South Central. The new development will employ a holistic approach to the construction and integration of the building, its systems and its users. This philosophy is supported by the use of sustainable engineering solutions and energy efficient systems where applicable in each building and throughout the development.

Building services strategies are outlined in this report, consisting of passive and active measures designed to reduce energy, carbon and cost impact for the proposed development. The preliminary NZEB-Part L / BER analysis is undertaken on this basis.

This design team recognises the need for the building to be designed and operated in a manner that reduces the environmental impact of the building and development as a neighbourhood. This objective will be achieved in an economical manner whilst maintaining an internal environment that is comfortable for occupants and visitors.

2. Introduction

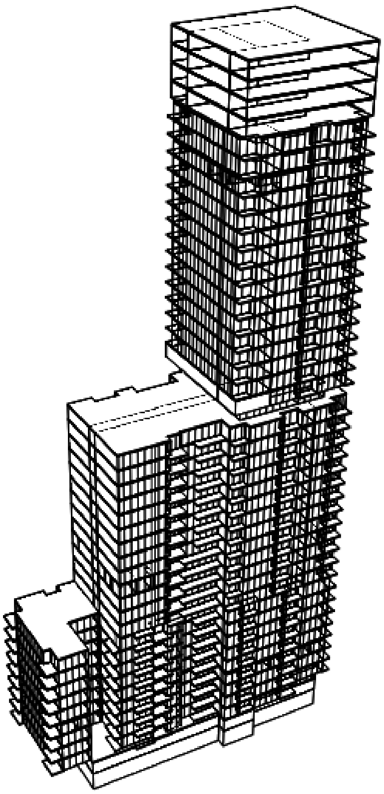
Axiseng were commissioned by Waterside Block 9 Developments Limited to perform a Nearly Zero Energy Building (NZEB) compliance analysis for the proposed development at Project Waterfront, South Central. While undertaking the NZEB analysis on the proposed development, it presented us with an opportunity to develop a building services design to ensure that each building performs with a high energy efficiency and satisfies building regulation NZEB challenges.

Nearly Zero Energy Building (NZEB) means that a building must be designed with a very high energy performance to nearly zero or very low amount of energy required. The approach is to support this energy requirement using renewable sources produced on-site or nearby. The NZEB-Part L compliance calculation used in the report is based on the following regulation.

- ‘Building Regulation 2019 Part L, Conversation of Fuel and Energy –Dwellings’ document for the residential development.
- ‘Building Regulation 2017 Part L, Conversation of Fuel and Energy –Buildings other than Dwellings’ document for the commercial development.

This report schedules a list of different building elements considered for the use of passive and active measures. These elements have been designed to reduce energy, carbon emissions and costs for the duration of the building’s lifecycle. Also utilised in the building analysis are a series of performance metrics to show indicative results on building compliance with the NZEB regulation while achieving a sustainable building services design.

Waterfront Model Building



3. Part L (NZEB) assessment

Based on the NZEB assessment outcome, the following active and passive measures which include low energy technologies that are being considered for the residential and commercial development in order to meet the requirements of Part L of the Building Regulations and meet NZEB standard.

To meet target set out for residential development building, DEAP 4.2.0 workbook has been undertaken to identify the best-fit proposed design in the residential development. IESVE software with NEAP software iSBEMie v.5.5 tool has been undertaken to identify the best-fit proposed design in the commercial development.

The model dimension input was built as per the planning drawings. Glazing dimensions are estimated at this stage of design, the window dimension has been modelled with input data obtained from similar residential development for the purpose of this assessment. The height of glazing within commercial blocks are estimated to be from floor level to ceiling void.

In the Table 1 below, the proposed building services design is proposed, which ensures the residential and commercial development is in compliance with NZEB under the Technical Guidance Document, Part L for dwelling.

Table 1

<table>
<tr><th>Measures</th><th>Description</th><th>Outcome</th></tr>
<tr>
<td>High Performance Construction Fabric</td>
<td>The proposed construction u-values are lower than u-value requirement set out in the building regulation 2019 technical guidance Document L.

Fabric Element for residential development.

<table>
<tr><th>Element</th><th>U-value (W/m2k)</th></tr>
<tr><td>Window / Curtain wall</td><td>1.0 – 1.2 (g-value 0.45)</td></tr>
<tr><td>External Wall</td><td>0.15 – 0.18</td></tr>
<tr><td>Roof</td><td>0.15</td></tr>
<tr><td>Ground Floor or unheated zones i.e. apartment to basement</td><td>0.15</td></tr>
</table>

The proposed construction u-values are lower than u-value requirement set out in the building regulation 2017 technical guidance Document L.

<table>
<tr><th>Element</th><th>U-value (W/m2k)</th></tr>
<tr><td>Window / Curtain wall</td><td>1.4 (g-value 0.22 – 0.35) *</td></tr>
<tr><td>External Wall</td><td>0.18</td></tr>
<tr><td>Roof</td><td>0.15</td></tr>
<tr><td>Ground Floor or floor to unheated zones i.e. office to plantroom</td><td>0.165</td></tr>
</table>

*It is estimated the clear glass type with solar control measure shall achieve less than g-value of 0.22 required for hot-spot zones with the highest solar load to ensure the compliance in line with under section 1.3.5 <i>‘Limiting the effects of solar gain in summer’</i> under building regulation 2017. The types of solar control measure could be assessed and identify a best-fit solution in the latter stage of the detailed design, subjecting to further consult with façade designer.

Passive solar design has been considered including the window design option for maximising daylight and solar heat gains during</td>
<td>Minimise heat losses through the building fabric thus lowering energy consumption and carbon emission

Minimise heat loss and gain impact on heating load requirement all-time during year, thus lowering energy and carbon footprint impact.</td>
</tr>
</table>

<table>
<tr><th>Measures</th><th>Description</th><th>Outcome</th></tr>
<tr><td></td><td>winter to reduce the artificial lighting and space heating load while minimising overheating impact in habitable room during summertime. A further analysis will be required once details on façade built-up during detail design.
The high-performance wall, roof, and glazing is being considered and selected to minimise the heat transfer into the internal spaces. Aside from the reduction in heating energy consumption and carbon emissions, the reduction in heating load results in reduced HVAC capacity and size. This has the net effect of reducing embodied energy consumption associated with manufacture and transportation associated with the plant, as well as the reduced input from the national electricity grid for heating purposes.</td><td></td></tr>
<tr><td>**Air Tightness Construction**</td><td>Airtightness construction, the building will be designed to ensure it is in compliant with the building regulation and achieving air tightness of 3.0 m3/ (h.m2) or 0.15 ach infiltration.

It is technically feasible to reduce the air permeability between 2.5 to 1.5 m3/(h.m^2), this can be achieved if the on-site inspection and quality control is in place to ensure the design intention is achieve in the place.</td><td>Minimise heat losses through the building fabric thus lowering heating load.</td></tr>
<tr><td>**Thermal Bridging**</td><td>The limitation of thermal bridging will be achieved in according with guidance under section 1.3.3 within technical guidance Part L regulation, where provision for thermal bridging is made in accordance with guideline. To account for thermal bridging allowances for additional heat loss, it is assumed construction elements between the junction will be designed to achieve allowance less than 0.08 (W/m2k) factor.

When the details of construction element between junction are known, the transmission heat loss coefficient shall be calculated using the psi values based on construction details.

It is assumed that the u-value of the façade built-up details within commercial development will be calculated taking account of thermal bridging factor. See below table figure on thermal bridging modelled for commercial blocks.

<table>
<tr><th colspan="3">Thermal Bridging</th></tr>
<tr><td>Type of junction</td><td>Junction (metal) psi (W/ (m.k))</td><td>Junction psi (W/ (m.k))</td></tr>
<tr><td>Roof-wall</td><td>0.3</td><td>0.12</td></tr>
<tr><td>Wall-ground floor</td><td>0.32</td><td>0.172</td></tr>
<tr><td>Wall-wall (corner)</td><td>0.18</td><td>0.07</td></tr>
<tr><td>Wall-floor (not ground)</td><td>0</td><td>0.07</td></tr>
<tr><td>Lintel above window/door</td><td>0</td><td>0.3</td></tr>
<tr><td>Sill before window</td><td>0</td><td>0.04</td></tr>
<tr><td>Jamb at window/door</td><td>0</td><td>0.05</td></tr>
</table>

On-site inspection and quality control will be carried to ensure continuity of insulation and to limit local thermal bridging at junction between construction element and other locations e.g. around windows, door and other wall openings.</td><td>Minimise heat losses at junctions between construction element, thus lowering energy consumption and carbon emission.

Air permeability and thermal bridging inputs should be reviewed to allow a reduction in thermal qualities of the façade elements.</td></tr>
<tr><td>**Daylight & Lighting**</td><td>Provision of natural daylight in buildings creates a positive environment by providing connectivity with the outside world, assisting with the well-being of the building inhabitants.</td><td>Reducing lighting electricity energy consumption, thus reducing carbon</td></tr>
</table>

<table>
<tr><th>Measures</th><th>Description</th><th>Outcome</th></tr>
<tr><td></td><td>Daylight also represents an energy source - reducing the reliance on artificial lighting. The potential of full height glazing on the elevations maximises the use of natural daylight and enhances visual comfort, without compromising thermal performance.

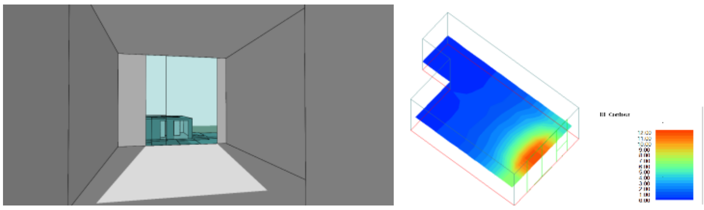


Figure: An example of daylight modelling & daylight factor results in a typical apartment room taken from radiance toolkit, IESVE software

The majority of luminaires selected will be based LED type (A+ Rated) located externally, and internally in circulation spaces, bedroom, lobby, living/dining etc in 30-35% reduction in electrical energy usage.

It is assumed the total wattage power for each apartment compartment is 395 watts.

The following proposed on the lighting installed power and control are modelled in the commercial development.

<table>
<tr><th>Room</th><th>W/m2</th><th>lux</th><th>Control</th></tr>
<tr><td>Open Plan Office</td><td>7</td><td>400-500</td><td>Dimming</td></tr>
<tr><td>Lobby</td><td>7</td><td>200</td><td>Auto on/off</td></tr>
<tr><td>WC</td><td>6</td><td>200</td><td>Auto on/off</td></tr>
<tr><td>Stairs</td><td>7</td><td>150</td><td>Auto on/off</td></tr>
<tr><td>Lift Lobby</td><td>7</td><td>300</td><td>Dimming</td></tr>
<tr><td>Reception</td><td>12</td><td>300</td><td>Dimming</td></tr>
<tr><td>Cafe</td><td>10</td><td>350</td><td>Dimming</td></tr>
<tr><td>Kitchen</td><td>10</td><td>350</td><td>Man on/off</td></tr>
</table></td><td>emission footprint overall.

Enhance healthier residence environment the use of natural daylight.

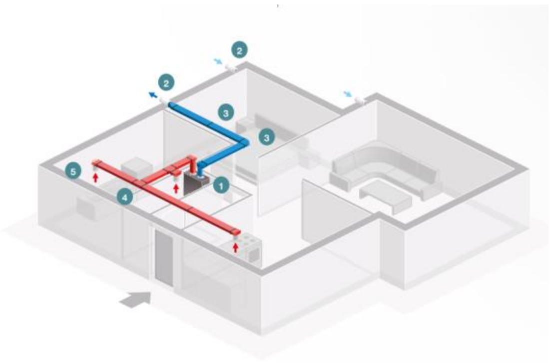
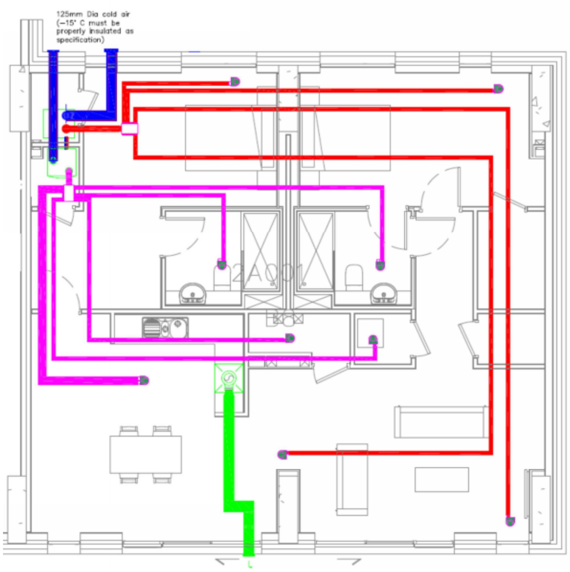
Minimise the time in controlling the lighting system, thus reducing cost.

Free heating from solar load, reducing heating load.</td></tr>
<tr><td>**HVAC system**</td><td>**Ventilation System**
Each apartment compartment is to be fitted dedicated supply and exhaust ductwork arrangement through Exhaust Air Heat Pump Unit (EAHP).

The specific fan power and efficiency of EAHP are selected on the basis of lower specific fan power. In this case, the specific fan power less than 0.32 W/l/s which has been taken into consideration.

The number of intermittent fans and passive vents shall depend on EAHP design solution come with ducting arrangements in line with number of bedroom and bathrooms per apartment compartment.

The inclusion of thermal wheel heat recovery unit into the ventilation systems within commercial development allows for heat transfer between exhaust and supply air before the heating and cooling coils thus reducing heating and cooling load. The AHU and local fan coil unit are selected upon the low specific fan power rating i.e. less than 1.8 w/l/s for AHU unit and 0.2 w/l/s for FCU.</td><td>Heat recovery via exhaust air from wet room and kitchen to allow for heat transfer to incoming air thus reduce the heating load requirement in the apartment compartment, thus increasing heating plant operating performance overall.</td></tr>
</table>

Measures	Description	Outcome
	Heading & DHW system Each apartment compartment in proposed development building will be designed to facilitate Exhaust Air Heat Pump (EAHP), a Joule / NIBE / Comfort zone unit providing heating, domestic hot water and ventilation. Exhaust air heat pump is an energy recycling system, where it collects energy from warm inside air via the ventilation system and re-uses it to temper incoming fresh air and water thus reducing electricity consumption. Model: Joule / NIBE / Comfort zone Type of Heat Pump: Exhaust Air to Water Installation provide: Heating and DHW Back Up Water heater: Yes, electricity Type of DHW: Separate or integrate Hot Water Storage Temperature Applicable: Low temperature (35 - 45°C) Efficiency of Main Heating System: 604 - 665% Efficiency of Main Hot Water System: 212 - 240% The following figure illustrates the typical layout and set up of EAHP unit within an apartment compartment.  Figure: *Joule* EAHP arrangement  Figure: *Comfort zone* EAHP layout	Potential lower capital cost in comparison to central plant installation. The heat pump provides 4 to 5 times more heat energy than the electricity consumed, comparing to other heat generator technologies leading to lower energy and running costs. Heat recovery via air drawn through ducts to the heat pump from the bathrooms, utility and kitchen areas. Eliminate traditional gas fuelled system by substitution with EAHP.

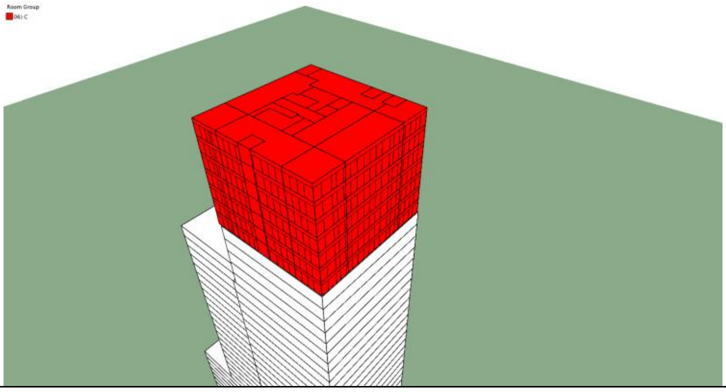
Measures	Description	Outcome
	The selection of EAHP manufacturer model are subject to further review on its cost, spacing requirement, ducting arrangement and performance The proposed HVAC system pertinent to the commercial floors is selected based upon their efficiencies performance, which has been assessed to ascertain their seasonal coefficient performance in terms of heating, cooling and hot water generation. All open plan offices will be fitted with centralised heating and cooling from variable refrigerant flow (VRF) heat pump plant system, whilst providing full climatic control and minimise energy. Domestic hot water will be generated by same VRF system.	Small footprint plant space. Heating output to be reusable. Eliminate the need of boilers and its capital cost. Eliminate the need of heat generator plants thus reducing plant footprint and hard cost.
	Hot Water System & Appliances All hot water taps including the shower head fitting in the proposed development are to be fitted with intelligent water flow regulators to all for full water flow until the discharge rate reaches six litres per minute, to allow for the conservation of water uses well as energy used to heat hot water. Water storage tank will be fitting with factory insulated with thickness up to 100mm to minimise heat loss. Type of System: Unvented Hot water system Water Storage volume (litres): • 180 – 200 litres for each apartment compartment • Approx. 1000 litres for each commercial block The hot water usage target must be achieved with less than 125 litres per day.	Minimise hot water usage, thus reducing heating energy load and increasing heating plant operating performance and reducing the cost.
	Heating Interface Unit (HIU) An HIU is an integrated solution for delivering and recording the heat consumed by each apartment compartment. HIU provide the occupant with localised control and metering of their heating usage in real-time consumption, allowing for a monitoring of their heating energy use and allowing them to reduce the energy and carbon emission.	Reduction in operating costs and maintenance access issues. Robust and cost-effective solution to heating and hot water. Acts as a positive incentive for an occupant to reduce energy.
District Heating	There is a potential of designing the heating systems to facilitate integration of a future District Heating (DH) system. The design philosophy includes the following provisions for future connections: - Space allocations for future heat exchanging plant. - Centralised primary/secondary heating systems with low loss headers to facilitate integration of DH service in commercial development. - EAHP unit to be fitted with docking kit to facilitate integration of DH to allow for supplementary of hot water and heating. - Incoming pipework installed through the basement box wall to facilitate ease of future connection and to eliminate future builder's work. - Space allocation provision in service risers for future heating pipework.	A future district heating system which is proposed to be served from a sustainable and efficient process will potentially eliminates any carbon emissions produced on site for space heating. Not taken into account in the Part L assessment.

<table>
<tr><th>Measures</th><th>Description</th><th>Outcome</th></tr>
<tr><td></td><td>District heating offers many benefits and real cost-saving advantages. It will allow users to decide when, where and how much energy they need, ensuing maximum comfort, whilst providing hot water on demand.</td><td></td></tr>
<tr><td>Building Energy Management System</td><td>Central BMS (Building management system)– check metering (heating) of all individual floors to monitor & optimise substantive energy use. The energy management system will continuously review and fine-tune the operational efficiencies and strategy for the various building services, significantly reducing clients' overall energy consumption and carbon footprint, and reducing energy costs.</td><td>Continuous energy monitoring allows for further energy saving opportunities to be quantified through building lifecycle thus lowering overall cost and carbon footprint.</td></tr>
<tr><td>Part L (NZEB) Result</td><td>Residential Development
The Part L (NZEB) has undertaken on sample apartment units located on the ground, mid-level and upper floor apartment, which are selected to assess the worst-case scenario in each instance.

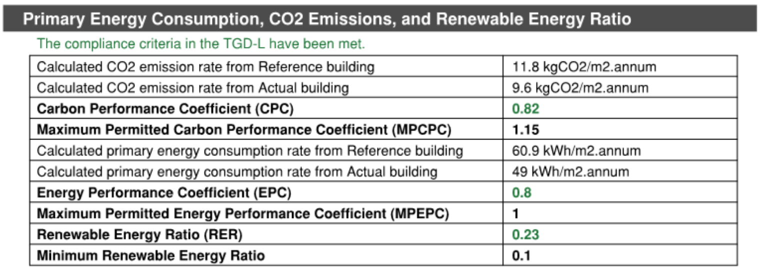
Energy Performance Coefficient (EPC) = 0.235 – 0.284 √
Carbon Performance Coefficient (CPC) = 0.227 – 0.280 √
Renewable Energy Ratio (RER) = 0.24 – 0.38 √
BER = A2 √

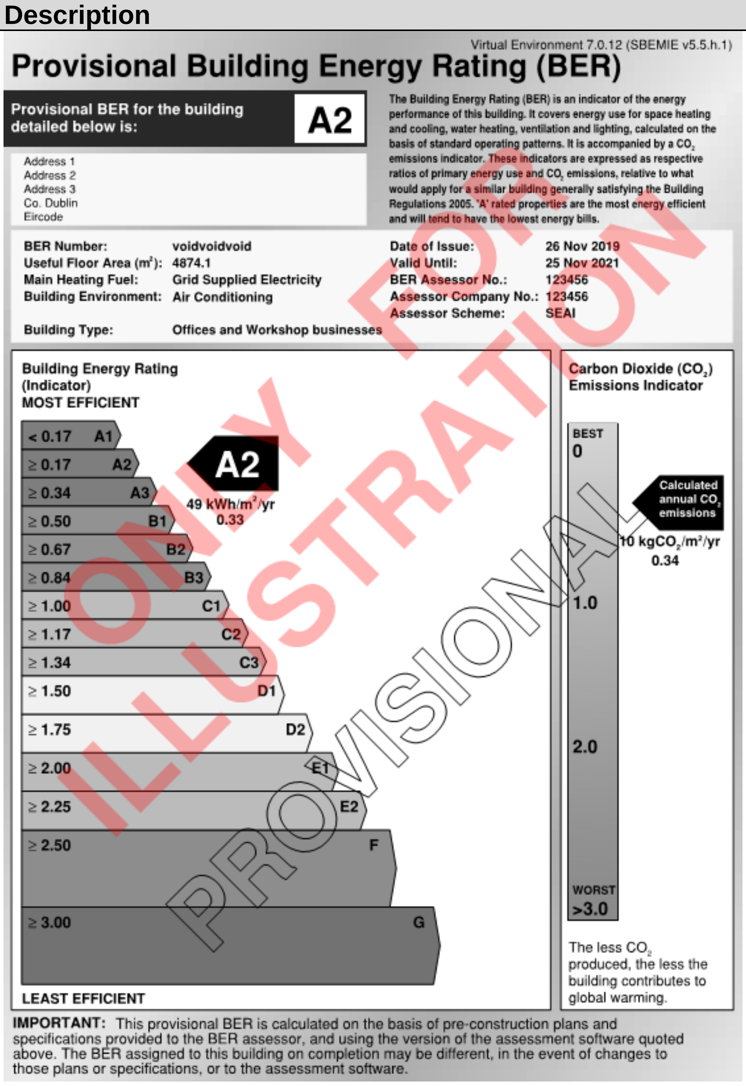
The apartment compartment has achieved compliance with Part L of the building regulations. The calculation of EPC, CPC are less than maximum permitted CPC of 0.35 and EPC of 0.3. A minimum level of energy provision of renewable energy from EAHP unit is achieved with more than 20% of total energy consumption exceed minimum requirement under the Part L.

Commercial Development
An NZEB assessment has been carried out on commercial floors achieving the following energy performance coefficient, carbon performance and renewable energy ratio between block.
<table>
<tr><th>Block</th><th>CPC <1.15</th><th>EPC < 1.0</th><th>RER</th><th>BER</th><th>NZEB Criteria</th></tr>
<tr><td>C</td><td>0.80</td><td>0.82</td><td>0.23</td><td>A2</td><td>√</td></tr>
</table>

Block C


</td><td>In compliance with building regulation Part L (NZEB)</td></tr>
</table>

<table>
<tr><th>Measures</th><th>Description</th><th>Outcome</th></tr>
<tr><td></td><td>
BRIRL

Primary Energy Consumption, CO2 Emissions, and Renewable Energy Ratio
The compliance criteria in the TGD-L have been met.
<table>
<tr><td>Calculated CO2 emission rate from Reference building</td><td>11.8 kgCO2/m2.annum</td></tr>
<tr><td>Calculated CO2 emission rate from Actual building</td><td>9.6 kgCO2/m2.annum</td></tr>
<tr><td>Carbon Performance Coefficient (CPC)</td><td>0.82</td></tr>
<tr><td>Maximum Permitted Carbon Performance Coefficient (MPCPC)</td><td>1.15</td></tr>
<tr><td>Calculated primary energy consumption rate from Reference building</td><td>60.9 kWh/m2.annum</td></tr>
<tr><td>Calculated primary energy consumption rate from Actual building</td><td>49 kWh/m2.annum</td></tr>
<tr><td>Energy Performance Coefficient (EPC)</td><td>0.8</td></tr>
<tr><td>Maximum Permitted Energy Performance Coefficient (MPEPC)</td><td>1</td></tr>
<tr><td>Renewable Energy Ratio (RER)</td><td>0.23</td></tr>
<tr><td>Minimum Renewable Energy Ratio</td><td>0.1</td></tr>
</table>
Building Energy Rating
</td><td></td></tr>
</table>

Measures	Description	Outcome
	Virtual Environment 7.0.12 (SBEMIE v5.5.h.1) **Provisional Building Energy Rating (BER)** Provisional BER for the building detailed below is: **A2** The Building Energy Rating (BER) is an indicator of the energy performance of this building. It covers energy use for space heating and cooling, water heating, ventilation and lighting, calculated on the basis of standard operating patterns. It is accompanied by a CO_2 emissions indicator. These indicators are expressed as respective ratios of primary energy use and CO_2 emissions, relative to what would apply for a similar building generally satisfying the Building Regulations 2005. 'A' rated properties are the most energy efficient and will tend to have the lowest energy bills. Address 1 Address 2 Address 3 Co. Dublin Eircode **BER Number:** voidvoidvoid **Useful Floor Area (m^2):** 4874.1 **Main Heating Fuel:** Grid Supplied Electricity **Building Environment:** Air Conditioning **Building Type:** Offices and Workshop businesses **Date of Issue:** 26 Nov 2019 **Valid Until:** 25 Nov 2021 **BER Assessor No.:** 123456 **Assessor Company No.:** 123456 **Assessor Scheme:** SEAI **Building Energy Rating (Indicator)** **MOST EFFICIENT** < 0.17 A1 ≥ 0.17 A2 ≥ 0.34 A3 ≥ 0.50 B1 ≥ 0.67 B2 ≥ 0.84 B3 ≥ 1.00 C1 ≥ 1.17 C2 ≥ 1.34 C3 ≥ 1.50 D1 ≥ 1.75 D2 ≥ 2.00 E1 ≥ 2.25 E2 ≥ 2.50 F ≥ 3.00 G **LEAST EFFICIENT** A2 49 $kWh/m^2/yr$ 0.33 **Carbon Dioxide (CO_2) Emissions Indicator** BEST 0 1.0 2.0 WORST >3.0 Calculated annual CO_2 emissions 10 $kgCO_2/m^2/yr$ 0.34 The less CO_2 produced, the less the building contributes to global warming. **IMPORTANT:** This provisional BER is calculated on the basis of pre-construction plans and specifications provided to the BER assessor, and using the version of the assessment software quoted above. The BER assigned to this building on completion may be different, in the event of changes to those plans or specifications, or to the assessment software. The commercial development situated on Level 40 to Level 45 in Block C have achieved compliance with Part L of the building regulations. The calculation of EPC, CPC are less than maximum permitted CPC of 1.15 and EPC of 1.0. A minimum level of energy provision of renewable energy from multipurpose unit (four-pipe chiller) and VRF system is achieved with more than 23% of total energy consumption exceed minimum requirement under the Part L.	

4. Summary

This report shows that an NZEB assessment has been undertaken on a number of apartment units in the residential buildings and the office elements situated within development. The active and passive measures considered are scheduled with the resultant impact on energy and carbon emissions identified. The NZEB assessment shows that the proposed development buildings are in compliance with the performance criteria under Part L for dwelling and non-dwelling.

The residential development has an Energy Performance Coefficient (EPC) less than the Maximum Permitted EPC (MPEPC) of 0.3. The building also has a Carbon Performance Coefficient (CPC) less than the Maximum Permitted CPC (MPCP) of 0.35. The Building Energy Rating (BER) achieved at planning stage is A2.

The commercial floors have an Energy Performance Coefficient (EPC) less than Maximum Permitted EPC (MPEPC) of 1. The building also has a Carbon Performance Coefficient (CPC) less than the Maximum Permitted CPC (MPCP) of 1.15. The Building Energy Rating (BER) achieved at planning stage is A3.

The whole development has significant renewable energy sources on-site and satisfies the Renewable Energy Ratio target in this case. It is concluded based on the active and passive measure design in proposed development has achieved the NZEB performance specification for energy and carbon dioxide emissions, therefore it is in compliance with criteria under the Building Regulation Part L 2017 for non-dwelling and Building Regulation Part L 2019 for dwelling.