Proposed Strategic Housing Development (Alterations to Phase 1 Residential and Proposed Phase 2 Residential Development)	HOMAN O'BRIEN Engineering Excellence.

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SECTION 1 BUILDING REGULATIONS & BER

1.1 Development Description

The proposal relates to alterations to the Phase 1 permission for 45 no. apartments (Reg. Ref.: D17A/0950 & ABP Ref.: 300745-18), from second to fourth floor level of the rejuvenated Frascati Centre. The proposed development also includes the provision of 57 no. additional apartments, as an extension of the Phase 1 permission, located above the existing / permitted podium car park to the north west of the centre, as a Phase 2 residential development. The subject application therefore relates to a total of 102 no. residential units.

The proposed alterations to the 45 no. apartments (Block A and B) and associated development, permitted under the Phase 1 residential development, includes the following:

- Internal rationalisation of the permitted units, including changes in overall unit size and internal layouts, and associated external alterations including the provision of winter gardens.
- Provision of an external walkway connection between the Phase 1 and Phase 2 residential blocks at second floor level.
- The refuse, car and cycle parking facilities permitted at lower ground floor level will be altered to cater for the additional residential units, including the introduction of a barrier control system.
- The main entrance to the Phase 1 residential scheme from Frascati Road will serve both the permitted and proposed units.
- A concierge facility room to serve the overall residential development is proposed at second floor level near the main core of Phase 1, with an associated minor reduction in the area of the permitted communal terrace at second floor level.
- The communal open space for Phase 1 and 2 will be accessible to all residents.
- Alterations to the cycle parking provision at lower ground floor / basement level and at the first-floor level podium car park.

The Phase 2 proposal consists of 20 no. studios, 22 no. 1 beds and 15 no. 2 beds (57 no. apartments) in three no. blocks (Block D, E & F), arranged around a central communal courtyard space, above the existing and permitted podium car park to the north west of the centre. Block D is a five storey block, Block E is a part two to part four storey block and Block F is a part two to part three storey block, all above three levels of podium / basement car park. Balconies / winter gardens are provided to all apartments (on the north western, north eastern, south western elevations and into the internal courtyard) and access to the blocks is via stair / lift cores and an external walkway fronting the communal courtyard. A roof terrace is also proposed at fifth floor level of Block E.

The proposal includes the allocation of 57 no. car parking spaces at lower ground floor level and 214 no. bicycle parking spaces at lower ground and surface level for the 102 no. residential units. The proposal includes alterations to existing surface car parking to provide additional landscaping and bicycle spaces, a bin storage area and stair / lift cores are proposed within the existing / permitted basement / podium car parks below the Phase 2 residential units, and the proposal includes all associated ancillary site development works. The proposal also includes alterations to the location of 30 no. permitted cycle parking spaces associated with the rejuvenation of the Frascati Centre, Reg. Ref.: D14A/0134, as amended.

1.2 Introduction

The residential units will be designed to comply with the new Building Regulations TGD L 2019 – Conservation of Fuel and Energy – Dwellings.

This new version of TGD L includes the requirements for Nearly Zero Energy Building (NZEB).
The Apartments have been analysed for compliance with TGD L – Conservation of Fuel and Energy Dwellings 2019.

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 2019, 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 2019 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 Pitched roof - Insulation at ceiling - Insulation on slope Flat roof	 0.16 0.16 0.20	0.3
Walls	0.18	0.6
Ground floors[3]	0.18	0.6
Other exposed floors	0.18	0.6
External doors, windows and rooflights	1.4[4,5]	3.0

Notes:

1. *The U-value includes the effect of unheated voids or other spaces.*
2. *For alternative method of showing compliance see paragraph 1.3.2.3.*
3. *For insulation of ground floors and exposed floors incorporating underfloor heating, see paragraph 1.3.2.2.*
4. *Windows, doors and rooflights should have a maximum U-value of 1.4 W/m^2K.*
5. *The NSAI Window Energy Performance Scheme (WEPS) provides a rating for windows combining heat loss and solar transmittance. The solar transmittance value g_{perp} measures the solar energy through the window.*

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 as detailed below.

The following input data was applied:

2.1 General Input Data

Table 2	Maximum Element U-value (W/m²K)	
Fabric Element	**Part L 2019 requirement**	**Frascati Phase 2 Residential: 1 and 2 Bedroom Apartments**
Wall	0.18	0.18*
Window	1.4	1.4
Door	1.4	1.4
Ground Floor	0.18	0.18
Exposed Floor	0.18	0.18
Roof	0.20	0.15

* For 1 bedroom apartments, the adjusted U value of the cavity wall and spandrel panel together must be less or equal to 0.18. In this report we have considered the U value of the cavity wall 0.16 and 0.5 for spandrel panel. The U value of the cavity wall has to compensate for the spandrel panel.

  Spandrel panel cannot be worse than 0.6 W/m²K

Air tightness test according to CIBSE TM 23 best practice standards to achieve **3 m3/m2/hr at 50 Pa** or **0.15 air changes per hour**.

Thermal Bridging factor is **0.08** which represents the use of ACDs throughout or equivalent.
The use of ACDs throughout is to be confirmed by Architect.

Thermal mass of each apartment varies between **low to medium**.

Lighting: Use of LED lights in the residences.

PV Panel: Power: 325 Watts peak power
Delivered Energy: 269 kWh/year per panel

2.2 Details of Exhaust Air Heat Pump in Regards to Ventilation, Space and Water Heating

Table 3	ITEM
1.	**Ventilation**
	System: Nibe F730 ***Operation Method:*** Exhaust Air Heat Pump ***Specific Fan Power W/l/s:*** 0.77 (PCDB data) ***Exhaust Air Flow Rate (m^3/h):*** 180 **Number of Wet Rooms:** 03
2.	**Space Heating**
	System: Nibe F730 ***Number of Heat Pump:*** 01 ***Seasonal Efficiency:*** 132 % ***Operating Temperature:*** 55°C ***Circulation Pump Electricity Consumption (kWh/yr):*** 27 **LPHW System with Radiators**
3.	**Water Heating**
	System: Nibe F730 ***Seasonal Efficiency:*** 91 % ***Storage Volume (m^3):*** 180 ***Declared Loss:*** 1.22 Cylinder heated by Boiler having Thermostat and Separate Time Control of DHW Boiler and thermal store within a single casing

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 minimize heat gains in summer and heat loss in winter and also ensures that the choice of heating 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:

Table 4 Element	**New Buildings & extensions to existing buildings [W/m^{2}k]**	**Proposed for this development [W/m^{2}k]**	**Percentage Improvement**
Walls	0.18	0.18	0%
Floors	0.18	0.18	0%
Windows	1.4	1.40	0%
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 pressurization 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 not been included in the scheme.

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 included.

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 shall be included.

3.2.6 Wind Turbines.

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

SECTION 4 RESULTS

4.1 Energy results

The following table shows the energy performance criteria, carbon performance criteria and renewable energy ratio of the current proposed strategy.

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

Building Block	Apartment Type	Apartment Number	EPC	CPC	RER	BER Rating	No. of PV Panels	Compliant
D	1 Bed	517	0.28	0.28	0.36	A3	01	YES
F	2 Bed	332	0.27	0.26	0.31	A2	01	YES

APPENDIX 1

TELECOMMUNICATIONS

As part of the design process the impact of the development on any major telecommunications links has also been considered. There is no existing telecommunication equipment immediately adjacent the site but given the urban location of the site there a significant number of telecommunications equipment sites in the locality.

In summary given the amount of telecoms equipment in the general locality, there is potential for the taller elements of the proposed scheme to impact on certain microwave links.

It is predicted that most providers will be able to reconfigure their equipment to compensate for the proposed structure. The full extent of the likely impact of the proposed development on local microwave links cannot be determined until detailed design stage.

In summary, given the amount of equipment there is potential that the structure will have an impact on certain microwave links in the area. It is just as likely however that given the prevalence of telecommunications infrastructure in the area that most providers will be able to reconfigure the networks to compensate for any such impact.

The exact requirements of the telecommunication providers can only be established following a grant of planning permission and at that stage the design team will ascertain if a microwave repeater is required, the best location for this on the roof of the new development and whether planning permission is required for this piece of infrastructure. If this is the case planning permission will be sought.