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CONSULTING ENGINEERS

SOCIAL HOUSING BUNDLE 3

PROPOSED DEVELOPMENT AT FORTBARRINGTON ROAD, ATHY, CO. KILDARE

Compliance Report on Part L and Life cycle report

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1 INTRODUCTION

The EU Directive on the Energy Performance of Buildings (EPBD) contains a range of provisions aimed at improving energy performance of residential and non-residential buildings, both new-build and existing. This Directive was adopted into Irish law as Regulation in 2006.

The EPBD obliges specific forms of information and advice on energy performance to be provided to building purchasers, tenants and users. This information and advice provide consumers with information regarding the energy performance of a building and enables them to take this into consideration in any decisions on property transactions.

As part of the Directive, a Building Energy Rating (BER) certificate, which is effectively an energy label, will be required at the point of sale or rental of a building, or on completion of a new building. As such the Dwellings Energy Assessment Procedure (DEAP) was created a base procedure in which the BER can be calculated. The Dwelling Energy Assessment Procedure (DEAP), which is the Irish official procedure for calculating and assessing the energy performance of dwellings. The procedure takes account of the energy required for space heating, ventilation, water heating and lighting, less savings from energy generation technologies. For standardized occupancy, it calculates annual values of delivered energy consumption, primary energy consumption, carbon dioxide emissions and costs, both totals and per square meter of total floor area of the dwelling.

The report sets out to discuss options of methodologies in Energy Efficiency, Conservation and Renewable Technologies that will be employed in part or in combination with each other. The proposed techniques to be employed to achieve compliance with both the building regulations Part L 2021 (NZEB) and the local Strategic Environmental Plan (HC 12) are provided.

We have also reviewed the “Energy Efficiency and Climate Change Adaptation Design Statement” and have addressed the relevant objectives.

2 STRUCTURE AND BUILDING ELEMENTS

While the construction works will incur an initial investment, the lifetime running cost of the units must be considered to reduce water, fuel and electrical energy consumption. To that end methods will be explored to further improve the building's energy rating and reduce the carbon emissions. This includes decreasing the thermal conductivity (heat losses) of the building fabric, take advantage of passive solar gain to reduce the heating demand in the space and increase day lighting to reduce artificial lighting.

2.1 FABRIC 'U' VALUES EMPLOYED

- Walls - 0.13 W/m2.K
- Window - 0.8 W/m2.K (solar fraction (g factor) of 0.65 or greater, Frame factor of 0.7 or better)
- Roof - 0.12 W/m2.K
- Doors - 1.2 W/m2.K (This is to include frame)
- Ground Floor slab - 0.11 W/m2.K
- Thermal Bridging - Factor of 0.08, with junctions details to conform with "Limiting Thermal Bridging and Air Infiltration – Acceptable Construction Details"

2.2 AIR PERMEABILITY (AIR TIGHTNESS AGAINST INFILTRATION)

One of the most significant heat loss factors in any buildings is through controlled and uncontrolled ventilation through the introduction of ambient/outside air into the heated space. The dwellings are to be constructed with a high degree of air tightness to a possible value of **3 m3/m2/hr**. with a permeability test conducted post construction to demonstrate this level.

3 BUILDING SERVICES (M&E) OPTIONS REVIEW

Figure 1: Typical Photovoltaic Arrangement

Use of energy efficient technologies Heat pumps, solar thermal panels, energy efficient boiler plant, photovoltaics (PV) and Mechanical heat recovery ventilation or Demand control ventilation have been considered. In addition, temperature and zone controls will be used to reduce fuel and electricity demand.

Once the energy consumption has been reduced, a portion of the remaining electrical and thermal (hot water + heating) demand will be met by renewable sources. Not all renewables may be suitable to employ but it is intended to evaluate effectiveness of technologies such as heat pumps, solar panels and onsite generation from or photovoltaic panels.

Solar and Photovoltaic panels are apt due to the unobstructed southerly and south easterly elevations. PV is particularly suitable due to a simultaneous requirement for heating, hot water and electrical demand. The on-site generation of electricity will supplement the electrical requirement for lighting, motors, etc & reduce the electrical demand and from the grid.

Applying this to each dwelling would considerably reduce the demand from the grid and consequently reduce losses and emissions from power stations. Such is the benefit of on site or distributed generation, the DEAP model determines that each kWh offset from PV equates to 2.5 times the thermal equivalent.

Where there is little demand, excess electricity can be diverted via an immersion in the Hot water cylinder. It is our intention that, should this technology be employed, the housing will be 'future proofed' for this eventuality and that the design will incorporate this facility without the requirement to revisit the installation in the future.

3.1 Heating Systems

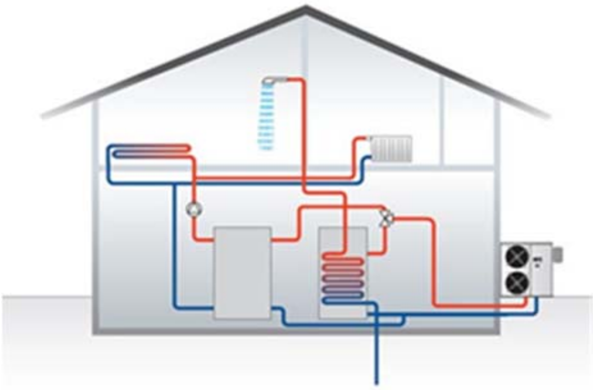

Figure 2: Typical Air Source HP arrangement

The Heating System may consist of an air- water heat pump serving radiators and hot water. Heat pumps take advantage of this by transferring the heat/Energy from the outside air. Through compression, heat pumps can 'pump up' heat at low temperature and release it at a higher temperature so that it may be used again. A heat pump looks similar and can perform the same functions as a conventional gas or oil boiler, i.e. Space heating and sanitary hot water production. For every unit of electricity used to operate the heat pump, up to four to five units of heat are generated. Therefore, for every unit of electricity used to pump the heat, 4-5 (400-500%) units of heat are produced. Efficiencies in order of 600% may also be achieved depending on ambient conditions. Air/water heat pumps collect heat from the outside air.

A central time clock and separate time and temperature controls to each zone is too provided (e.g. via 2-port valves). Such zones may consist of;

- Ground floor living areas,
- Bedrooms
- Domestic Hot water

While Natural gas has been considered as a fuel source for this development, this has been ruled out in order to reduce the reliance on fossil fuels and to reduce carbon emissions.

We have deemed air sourced heat pumps as a suitable option for this development. This may be on the basis of either a monobloc system, exhaust air heat pumps or hot water heat pumps.

3.2 WATER HEATING

In this development we have different solutions available based on the heat pumps options mentioned in the previous section for heating and hot water.

Hot water can be served from the primary heating plant (air sourced heat pump- ASHP) linked via a probe to the cylinder. The Hot Water will be generated via a time clock and as such heats the water on demand. If PV is utilised and is producing energy, then hot water may also be generated via an immersion.

The exhaust air heat pump or hot water heat pump operate in a similar fashion to the ASHP to generate hot water from the either fresh air or exhaust air.

3.3 MECHANICAL VENTILATION HEAT RECOVERY (MVHR) SYSTEM OR DEMAND CONTROL VENTILATION

In our design strategy we shall consider mechanical ventilation from wet areas e.g. toilets, utility rooms in accordance with Part F, with supply air provided to habitable spaces (bedrooms, circulation and living spaces).

See Figure 6 for a typical type arrangement of Heat recovery ventilation which provides a continuous supply of fresh air to the dwelling through special air valves or grilles located in each habitable room thereby eliminating the number of opening required in the structure.

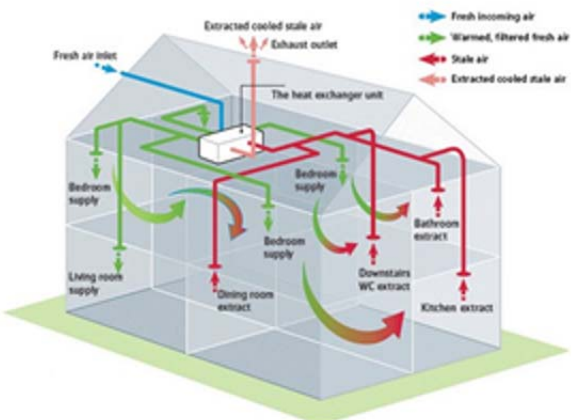

Figure 6: Typical Mechanical Ventilation Heat Recovery (MVHR) Arrangement

Continuous extract is also provided with the outgoing stale air and from wet areas with the exhausted air preheating the incoming fresh air via a heat exchanger in the unit 90% of the heat can be recovered through this process that would otherwise be wasted.

While MVHR would have the effect of reducing the energy demand (or increasing the energy efficiency) of each unit, renewable technologies such as heat pumps, solar thermal and solar PV offset would offset this demand.

The alternative of demand control ventilation provides a lower cost solution with much less maintenance cost associated on a yearly basis. The MHRV system requires the filters in the system to be cleaned or changed on an annual basis not only to keep the system operating but also to maintain efficiency in the system. If the air tightness of the development is less than 4 m3/m2/hr then heat recovery ventilation or demand control system will be required to be employed. We would propose to review both options through Stage i design looking at the overall energy performance of the units in terms of fabric U-Values, air tightness, heat recovery/Demand control ventilation and renewable options to provide the most economical solution with the best life cycle costs.

Demand controlled MEV system consumes only slightly more energy – 1070 kWh – per heating period than an 80% heat recovery system. The corresponding extra cost, €47, is much smaller than the cost of the annual filter changes necessary to maintain the level of performance of HR units (see graph 1 below).

Heat recovery or Demand Control ventilation maybe used for this development.

3.4 LIGHTING

All lighting to be energy efficient with provision made for low energy lamps such as LED which use 80% less electricity and last up to 10 times longer than ordinary light-bulbs in the dwellings.

	Traditional Incandescent	Eco-Halogen	CFL	LED
				
Power Consumption	60W	42W	13W	6W
Brightness	700 lumens= 60W	625 lumens= 54W	741 lumens= 60W	500 lumens= 60W
Energy Efficiency*	E	D	A	A+
Lifespan	1,000hrs = 1 year	2,000hrs = 2 year	10,000hrs = 10 year	30,000hrs = 30 year
Cost per Bulb	1	3	3.5	9.45
Yearly Running Cost	10.8	7.56	2.34	1.08
15 year Lifetime Cost	Yearly Running Cost + 15 Bulbs = €177	Yearly Running Cost + 7.5 Bulbs = €135.90	Yearly Running Cost + 1.5 Bulbs = €40.35	Yearly Running Cost + 1 Bulb = €25.65

* All calculations are based on 1,000 hours per year at €0.18 per kWh
* A+ = Most Efficient, G = Least Efficient

Table 1: Home Bulb Options

As detailed in Table 1 LED lighting consumes the least amount of power to achieve the required lighting levels. Combined with a long lifespan this minimises whole life costs and reduces the carbon footprint of each home.

4 EV (ELECTRIC VEHICLE) CHARGING COMPLIANCE

4.1 REGULATIONS

In accordance with Building Regulations Technical Guidance Document L 2021 Conservation of Fuel and Energy – Dwellings, the current policy on EV charging states in regulation 5 Part (f)

"(f) A new building (containing one, or more than one, dwelling), which has more than 10 car parking spaces, shall have installed ducting infrastructure (consisting of conduits for electric cables) for each car parking space to enable the subsequent installation of recharging points for electric vehicles."

In terms of this development this would mean ducting to ALL CARPARK SPACES for future EV charging connections.

4.2 PUBLIC STREET PARKING PROPOSAL

In this development curtilage parking is not available, the approach is a public network that is installed and managed through a specialist EV charging company such as "Easygo" www.easygo.ie

This company can manage the infrastructure and operate it as a public network rather than a resident network.

The resident will sign up with the EV charging company and have an account with them and pay for charging their car.

The proposal for this development is all spaces are to be ducted for future EV charging points in accordance with Part L 2021.

5 RESULTS AND PROPOSAL

We are proposing for the development at Fortbarrington Road, Athy, County Kildare the following means of heating, hot water, lighting and renewable energy.

1. U-Values as stated in section 2.1
2. Air sourced heat pump or exhaust air heat pump.
3. Hot water from ASHP, exhaust air heat pump or Hot water heat pump.
4. Demand control ventilation system or HRV.
5. LED lighting throughout
6. All spaces with future ducting for EV charging

6 LIFE CYCLE

6.1 HEATING & HOT WATER

The life cycle of the heating system can be demonstrated on the basis of running costs versus capital costs. The running costs are calculated below on the basis of various the two traditional options for heating and hot water against the air sourced heat pump proposed for this development.

6.1.1 Running cost

Fuel Costs (1)	Space Heating (c/kWh)	Domestic Hot Water (c/kWh)
Electricity (2) (3)	3.59	6.47
Gas Boiler (4)	6.71	6.71
Oil Boiler (5)	8.86	8.86

House 150 (m2)

	Daikin Heat Pump		
	Ref	kWh/m2/yr	Annual Running Costs (€/yr)
A2 Rated	NZEB	50	355.65
A3 Rated	2011 Regs	75	490.275
B1 Rated	2008 Regs	100	624.9
B3 Rated	2005 Regs	150	894.15
C Rated	Late 90's	225	1298.025
D Rated	Late 80's	300	1701.9

	Traditional Gas Boiler		
	Ref	kWh/m2/yr	Annual Running Costs (€/yr)
A2 Rated	NZEB	50	503.25
A3 Rated	2011 Regs	75	754.875
B1 Rated	2008 Regs	100	1006.5
B3 Rated	2005 Regs	150	1509.75
C Rated	Late 90's	225	2264.625
D Rated	Late 80's	300	3019.5

	Traditional Oil Boiler		
	Ref	kWh/m2/yr	Annual Running Costs (€/yr)
A2 Rated	NZEB	50	664.5
A3 Rated	2011 Regs	75	996.75
B1 Rated	2008 Regs	100	1329
B3 Rated	2005 Regs	150	1993.5
C Rated	Late 90's	225	2990.25
D Rated	Late 80's	300	3987

(1) Based on SEAI Domestic Fuel Comparison
(2) Heat Pump Space Heating SPF 4.5
(3) Heat Pump DHW SPF 2.5
(4) Gas Boiler Eff (90%)
(5) Oil Boiler Eff (90%)

As a comparison of a gas boiler against the air sourced heat pump the running costs for an A" rated NZEB house are as follows:

ASHP - € 355.65

Gas boiler - € 502.25

This demonstrates an annual saving of €146.60 per year at current utility rates being assumed over the life of the plant.

Both a domestic gas boiler and an air sourced heat pump have an estimated life span of 15 years. This provides a saving of **€2,199** over the life of the plant.

6.1.2 Capital costs

The Capital costs associated with the gas boiler and ASHP are as follows:

Gas boiler

Gas Boiler - € 650.00
Flue - € 200.00
Hot water cylinder - € 350.00
Gas pipework & certification- € 450.00
GNI capital contribution - € 260.00
Total - € 1,910.00

ASHP including hot water storage - € 4,100.00

Therefore, the initial capital cost difference is **€2,190.00** additional for the air sourced heat pump

6.1.3 Maintenance costs

Both gas boiler and air sourced heat pump require maintenance checks.

Gas Boiler requires annual check and servicing - €120.00 per year

ASHP requires bi-annual checks - €120 per visit - €60 per year

Therefore, a saving of **€900** for ASHP over the life of the plant.

6.2 SUMMARY

Therefore, over the life of the plant the costs for the air sourced heat pump has a life cycle of approximately **€900** less per housing unit.