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HND Quantity Surveying (Year2)

Management of Sustainable Construction

Word Count: 1355

Energy Efficiency.

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Introduction.

Throughout this assignment I will be looking at the energy consumption of a detached house which currently has an Energy Efficiency Rating Level F. The data given to us mentions that the detached house has a potential of 73/100 rating (Level C). By reducing the amount of consumption from Lighting, Heating, Appliances and others we can achieve a greater energy rating which will help to reduce carbon emissions and save the homeowner money on monthly bills.

There are certain refurbishment works that can be carried out to improve the energy efficiency rating. These works include Change all lighting to LED, improving insulation of cavity walls and ceiling & Change heating and hot water system to combined gas and PV panels. The aims and objectives for this assignment are as follows;

To calculate the following:

- Cost of the different refurbishment works.
- Current cost of energy consumption per year, and the expected savings with each intervention, separately and together (you can use average cost of energy for electricity and gas in the UK)
- Payback period for each intervention according to the savings obtained in energy.

LEDs require substantially less electricity than conventional light bulbs. Performing for a much longer time than their incandescent, halogen and CFL counterparts.

“For example, a 60W halogen light bulb would be replaced with a 9W LED. That’s a reduction of 85% in electricity consumption. The LED bulb will also last for over 20,000 hours, as opposed to 2,000 hours for the halogen – ten times longer!” (LEDHut2020)

In order to accurately calculate the full costs of changing the lighting from traditional to LED we must first total the amount of LED needed in each part of the house.

Basement:

Width 17.8 meters

Length 11.5 meters

Height 2.9 meters (assumed)

We are also to assume the illumination intensity to be medium, a light colouring of the walls and the light placement to be more central rather than placed in the corners. From these calculations the required illuminate for the basement area is 472 Watts or 61411 lumens. As a result, from these findings we require the use of 40no 12-Watt lights

The average price for a single 12 Watt Light is between £23 -£30. I have chosen to take the average price between these two rates which is £26.50.

Cost for LED 12-Watt Lights $£26.50 \times 24 = £636$.

Labour costs must also be considered to the overall costs of changing to LED Lighting. I believe this work to be no more than a two-working day with an hourly rate of £15.

$7.5 \text{ hours} \times £15 = £112.50$

Basement Cost = £748.50

Ground Floor & First Floor.

Width 14.1 meters

Length 10.5 meters

Height 2.4 meters (assumed)

As the ground and first floor have the same floor area, I will calculate the ground floor costs then multiply by two to get the overall cost of these floors. We are also to assume the illumination intensity to be medium, a light colouring of the walls and the light placement to be more central rather than placed in the corners. However, the use of rooms on the ground and first floor differs to that of the basement therefore less illuminate is required. From the calculations above the required illuminate for the ground floor is 26649 Lumens or 204 Watts. There are also a few options you can chose I have decided to go for a 10-Watt bulb which results in 21no lights.

The average price for a single 10 Watt Light is between £20 -£27. I have chosen to take the average price between these two rates which is £23.50.

Cost for LED 12-Watt Lights $£23.50 \times 21 = £493.50$

Labour costs must also be considered to the overall costs of changing to LED Lighting. I believe this work to be no more than a two-working day with an hourly rate of £15.

$7.5 \text{ hours} \times £15 = £112.5$

Ground Floor Cost = £606.

First Floor Cost = £606.

Overall cost for changing all lighting to LED Lighting.

Basement Cost = £748.50

Ground Floor Cost = £606.

First Floor Cost = £606.

Total - £1,960.50

Reports have proved that the majority of heat lost in uninsulated houses is down to the exterior walls. As heat flows from a warm area to the cold. In order to be more energy efficient, we must insulate exterior walls.

Reports online suggest that costs for injecting cavity wall insulation can cost upwards of £700 all depending on a variety of factors such as where the property is located, ease of accessibility and most importantly the overall size of the property. From the drawings provided we know that the property has a cavity wall area of 390m² and that the house is a detached property. A detached property would also need scaffolding around all four walls which should also be factored into the over costs. As this is a rather large property, I have added an extra amount to the average total.

“The average cost to inject cavity wall insulation is around £500, with quote estimates ranging between £400 and £700. The cost will vary depending on the property size, access and location.” (Price Your Job 2020)

Cavity insulation experts don't have a tendency to charge by the hour usually just by the scope of the project. Insulating four exterior walls on a detached house should take up to 5 working hours.

Materials & Equipment - £800

Tradesmen - £250

Scaffolding - £200

Overall cost for cavity wall insulation - £1250

There are several ways to insulate ceilings in properties, I have chosen a traditional PIR insulation board which will be fixed to the ceiling then skimmed and decorated. In order to find the cost of this refreshment we must firstly calculate the overall ceiling area. As mentioned above we know the width and length of the floor area is 14.1 meters wide x 10.5 meters long. This gives us a ceiling area of 148m². As we are insulating the ground and first floor, we must multiply this meterage by 2 giving a total area of 296m². I have chosen a Celotex 100mm GA4100 PIR Insulation Board - 2.4m x 1.2m for this refurbishment. Each

board covers an area of 2.88m² which when divided by the total area gives you 102 boards.

each board is priced at £35.87 Labour costs of £5.50 per m².

Unit	QTY	Rate	Total
Celotex 100mm GA4100 Insulation Board	102	£35.87	£3,658.74
Labour	296m ²	£5.50	£1,628.00

Total cost for improving ceiling insulation is £5,286.74

Changing to a combine boiler can offer a higher energy efficiency output for a property.

Combi boilers generate heating and hot water on demand. The costs for changing to a combi boiler can depend on a variety of factors, such as the quality of new boiler to be installed, whether you are replacing a boiler like for like will be less expensive as you would only be changing the unit itself not the pipework included. Changing to a system boiler to a combi boiler would be more expensive as a conversion would be necessary. And lastly the time taken for installation.

For the purpose of this exercise we are going to assume that the original boiler is a regular/open vent one.

Type of Installation	Average Cost of Boiler	Time Taken for Installation
Remove DHW Storage Cylinder and Attic Tanks and Replace Open Vent Boiler with a Combi.	£800 - £1200	2-3 Working Days £150 per day

Average cost of a boiler can range between £800-1200. I have chosen a Worcester Greenstar Combi ErP Boiler 25i. And the average cost for a tradesman is £150 per day, this is what I currently pay on the construction site I am working on. (BoilerHut2020)

Materials - £1,100

Labour - £450

Total Cost - £1,550

The use of Solar Panels is becoming more popular each year. Using PV panels can reduce your households carbon emissions and also save you money on your energy bills, however this comes at a price as installing PV systems can be expensive. *“The average domestic solar PV system is 4kWp and costs around £6,200” (Energy Saving Trust 2020)*

As this is a large property, I have estimated for more than the average domestic house. Report also state that a likely installation fee is in the region of £1000.

PV Panels £7,500

Labour (Installation) £1,000

Total Cost £8,500

Tables 1 – 4 in the appendix show the average energy consumption for Gas and Electric in the UK based on Low, Medium & High households. It also shows the average costs for these categories. From the figures given in the description brief we can assume that the energy consumption for the house would fall under the High category.

The current cost of gas consumption per year for a high category is on average £844.33 based on the figures above from UK Power, OVO and Smarter Business. The cost for high electricity consumption is £734.00

Improvement 1 changing all lighting to LED shows a saving of 79% reducing the kWh to 31kWh. Therefore, reducing the average cost of electricity from £734.00 to £154.1

Improvement 2 improving insulation of cavity walls and ceiling from table 5 we can see there is a reduction of 35% bringing it down to 428 kWh. From these refurbishments there is an overall saving from £844.33 to £548.81

Improvement 3 change heating and hot water system to combined gas and PV panel. From the figures given in the brief it shows that the energy consumption actually increases due to

these refurbishments. Therefore, from table 5 we can see this increase is 14%. As a result, the cost for energy consumption per year will increase from £844.33 to £964.25.

Improvement 4 is a combination of improving insulation of cavity walls and ceiling and change heating and hot water system to combined gas and PV panel from the figures in table 4 shows 752 kWh consumption reduced to 159 kWh, this is a saving of 78% which would give you a saving from £844.33 to £185.75 per year.

As most energy consumptions are dual bills it will be worth summarising these costs as together in gas and electricity.

Changing all lighting to LED annual saving of £579.97

improving insulation of cavity walls and ceiling and change heating and hot water system to combined gas and PV panel annual saving of £658.58

Total annual savings based on refurbishments 1,2 &3 = £1,238.55

The payback period is essentially the number of years it takes to recover the costs of the refurbishment works. This is calculated by dividing the overall costs of the refurbishment by the annual savings.

Overall cost for changing all lighting to LED Lighting - £1,960.50

Annual saving £579.97

Payback period 3 Years, 3 Months

Overall cost for improving insulation of cavity walls and ceiling

Cavity Walls £1,250.00

Ceilings £5,286.74

Annual savings £295.52

Payback period 22 Years 1 Month

Overall cost for change heating and hot water system to combined gas and PV panel

Hot Water System £1,550.00

PV Panel System £8,500.00

Annual Savings -£199.92

From the figures given in the description it shows it actually costs more per year for the PV panels therefore a payback period cannot be calculated.

Appendix

Table 1

Gas	UK Power	OVO	Smarter Business
Low	8,000 kWh	9,000 kWh	8,000 kWh
Medium	12,000 kWh	13,500 kWh	12,000 kWh
High	17,000 kWh	19,000 kWh	17,000 kWh

Table 2

Gas	UK Power	OVO	Smarter Business
Low	£396	£465	£367
Medium	£576	£666	£533
High	£893	£893	£747

Table 3

Electric	UK Power	OVO	Smarter Business
Low	1900 kWh	2000 kWh	2000 kWh
Medium	3100 kWh	3200 kWh	3100 kWh
High	41600 kWh	4900 kWh	4600 kWh

Table 4

Electric	UK Power	OVO	Smarter Business
Low	£408	£319	£367
Medium	£588	£487	£533
High	£744	£711	£747

Table 5

Improvement	Original (kWh)	New kWh	Diff	% Saving
1	148 kWh	31 kWh	117 kWh	79%
2	752 kWh	428 kWh	264 kWh	35%
3	752 kWh	863 kWh	-111 kWh	-14%
2&3	752 kWh	158 kWh	594 kWh	78%

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