The Pump House, Coton Hill, Shrewsbury - Building Case Study

Overall Design Features

The Pump House is an 'eco' redevelopment of an old waterworks sited in Shrewsbury Town Centre on the banks of the River Severn. Part of the building was renovated with the remainder as high quality purpose built extension. The building has been awarded a BREEAM 'Excellent' Certification, which is the highest level possible.

The Pump House is now home to the Shrewsbury Environmental Technology Centre and hosts a cluster of innovative enterprises. Its central location enables easy use of public transport, cycling and walking to work.

Image 1 – Pump House western elevation

Design Principles

The principles upon which the scheme is being constructed were:

- To construct a healthy building.
- Minimise energy consumption and CO2 emissions.
- Use the most economic and sustainable building techniques.

To achieve these principles we are utilising the following:

- A Forest Stewardship Council certified laminated wood frame in the new extensions.
- Exceptionally high levels of insulation.
- Biomass heating system.
- Full mechanical ventilation and heat recovery system.
- A large area of photovoltaic solar panels producing a peak output of (7.7kW).
- Solar thermal hot water production.
- High levels of thermal mass to help prevent summertime over-heating.
- Elements of light weight construction for quick heating.
- High levels of air-tightness to reduce heat losses.
- Rainwater recovery system.
- A low-energy lift with a momentum fly-wheel.

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Existing Buildings and New Building Services Core

The original Victorian parts of the building have been retained and brought up to high standards through 'lining' with insulation and heavy block work. This heavy construction gives high thermal mass which warms up slowly and cools down slowly. The new building services core of lift and stairs is also of heavy construction.

New Extension

The new build elements are of a light weight timber framed construction that suits the soft ground conditions and warms up and cools down relatively quickly. The extensions are lime rendered which is preferable to cement render as lime requires less energy in its manufacture and reabsorbs CO_2 during its lifespan.

Having both construction modes present integrates both the 'light weight' and 'heavy weight' approaches to meeting the demands of heating and cooling buildings. In office buildings cooling is often the major challenge with occupancy being high during the daylight hours, along with the presence of large amounts of heat emitting equipment.

Plenum

The new building has a partial cellar or plenum which:

- Moderates the temperature of incoming air for the ventilation system.
- Accommodates a wood pellet store.
- Raises the office floor level above possible flood levels.

Image 2 – Photovoltaic and solar thermal array

Space Heating

Insulation

The building is highly insulated throughout with typical 'U' or heat loss values of 0.15 $W/m^2/^oC$. This compares very favourably with the Building Regulations requirement of 0.25 $W/m^2/^oC$. (With U values less is best!)

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Boiler

The building has central heating which is powered by a 'Windhager' wood pellet boiler which modulates between 7 to 26 kW and runs at about 75 degrees C. Pellets are vacuum fed into the boiler's hopper from a 3.5 tonne pellet store which is refilled about 3 times a year.

There are 7 heating zones in the building which respond to differential controllers and external weather conditions. In this way the heating demands on the boiler are kept to a minimum.

Ventilation

The building has a high level of air tightness which means ventilation and heat loss can be controlled to optimum levels. It achieved 4.7 $m^3/h/m^2$ compared to the required building regulations level of 10 $m^3/h/m^2$.

This is achieved by mechanically assisted heat recovery ventilation systems using heat exchanger units. There are 6 heat exchanger units for different zones in the building. The zones have localised controls with decisions on whether to open windows or use controlled ventilation being made by occupants.

Image 3 – Heat circuit mixers

Water

Rainwater Harvesting

The recovery of rainwater for toilet flushes helps to reduce water use by 20% to 25%. Where practicable, drainpipes lead to a 6,500 litre reservoir under the car park from where it is pumped to a 50 litre expansion tank. This is kept at 3 bar pressure so that water is then immediately available to supply toilet cisterns. The toilets use 4 litres per flush rather than the standard 6 litres and the urinals are waterless helping to reduce the buildings need for water.

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Hot Water

There is a solar thermal evacuated tube array on the south facing roof which supplies hot water for taps and shower. The array meets approximately 100% of summer needs and about 20% of winter. The solar heated water is coiled through a large 'hot water' tank where its heat is transferred to the direct mains fed domestic hot water supply and topped up by the boiler as needed.

Electricity

The building has an array of 44 photovoltaic panels with peak output of 7.7 kW of electricity. A real time display unit in the building foyer gives readings of current output, total electricity generated to date and the amount of CO2 saved.

Electricity is supplied via 9 circuits which are separately metered and monitored to inform understanding of the performance of the building and how it is used

Lighting

The building is lit using optimised minimum levels of electric lighting through sensitive lighting controls. Microwave and PIR motion detectors coupled with light intensity sensors, turn lights on and off, as and when they are needed ensuring that electricity is not wasted. Lighting units are also able to fade in or out depending on the level of illumination needed. It is also timed so that lights will not be left on at night or during the weekend.

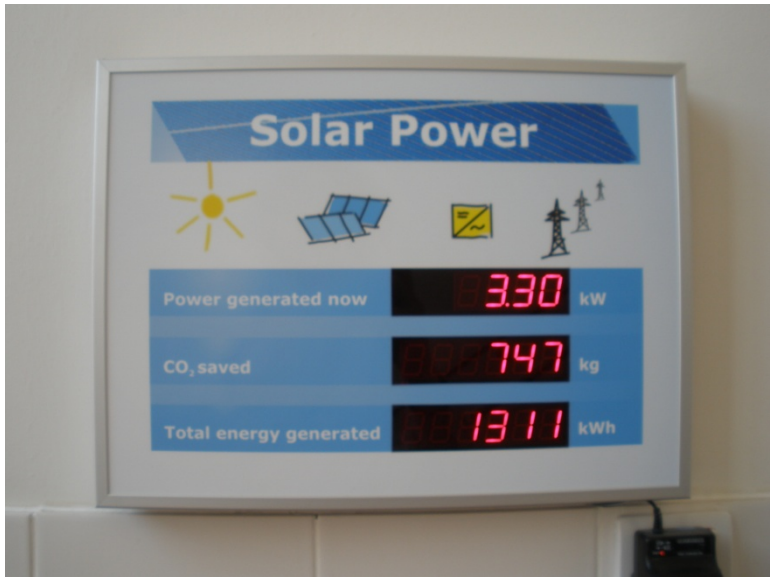

Image 4 – Real-time display of photovoltaic output

Materials

Some general specifications regarding miscellaneous materials elements are listed below.

- Existing building: Brick and block.
- Extensions: Timber framed construction using FSC timber
- Insulation: Heraklith External Boarding, Warmcell and Celotex
- External Render: St Astier Lime Render
- Paints: Earthborne Natural Paints
- Carpets: Made from recycled fibre – BREEAM 'Good'