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Case Study 11

Treglown Court

Owner:
Rowan Properties Partnership

Architect:
Stride Treglown

M&E Consultant:
WSP

Location:
Cardiff Bay, Wales

Building Type:
Office

Project Description

Treglown Court is a new 500 m^2 office building designed to accommodate over 50 employees of Stride Treglown Architects. A new Cardiff office was required in order to allow the business to expand and develop in Wales. Development of a new office also provided Stride Treglown with an opportunity to demonstrate their ability and knowledge of exemplary building design, whilst targeting the requirement to reduce their carbon emissions.

The building was the first office building in the UK to achieve BREEAM 2008 Outstanding at design stage and, at the time of construction, obtained the highest BREEAM 2008 Design Stage score in the UK.

Key Drivers

The key client driver was to provide an exemplar building in sustainability which minimised energy consumption and waste. The client was also keen to develop the first BREEAM 'Outstanding' office in the UK.

Key Features

Renewable and low carbon technologies installed at the Treglown Court development include:

- A 5 m^2 photovoltaic array, coupled with the recent addition of an additional, much larger 100 m^2 mono–crystalline photovoltaic array; and
- Wood pellet 50 kW biomass boiler, supplemented by a high efficiency 18 kW domestic gas fired boiler.

Treglown Court is thought to be the first privately funded 'zero carbon' office development in the UK.

The new Treglown Court Office building
Reproduced with permission of Stride Treglown

LZC Technologies

- Biomass boiler
- Photovoltaics

> To use a quote from Colin King of the BRE, "Fabric first, fit and forget", that is the way we approached this project, thus reducing our reliance upon renewables
>
> Gareth Davies
> Director, Stride Treglown

Other sustainable features of the development include:

- A highly efficient timber building envelope utilising a Structurally Insulated Panel System (SIPS);
- The building is naturally ventilated using passive stack ventilation (exploiting the natural buoyancy of air);
- Grey water recycling is used to flush WCs and all sanitary fittings use a very low water flowrate;
- All major building elements are BRE Greenguide A or A+ rated;
- A Building Management System (BMS) controls the natural ventilation system and lighting, which is sensor controlled and zoned; and
- A sustainable urban drainage system (SUDS) and a 'Nature' roof to attenuate rainwater run–off.

Procurement

The initial design of the building was undertaken internally by Stride Treglown who subsequently invited tenders from six local mid–sized contractors under a JCT Intermediate Form of Contract. The SIPS wall, floor and roof were procured from Wood Newton based in Nottingham, who were employed as the envelope contractor for the development.

The 'green components' and fit out of the development were funded by Stride Treglown.

The biomass boiler was manufactured by Guntamatic and supplied by Treco while the PV arrays were sourced from Dulas (smaller array) and WDS Green Energy (larger array).

Scheme costs and finance

The construction cost of Treglown Court was in the region of £820,000, equating to approximately £1,670 per m^2. Fit out of the building added an additional £270/m^2.

Stride Treglown approached the Forestry Commission Wales for advice regarding the use of biomass for heating. A grant of £8,000 was obtained for the biomass boiler from the Wood Energy Business Scheme (WEBS), a scheme run by the Forestry Commission. At the design stage, the biomass boiler was predicted to consume approximately 7.5 tonnes of wood pellets per year at a cost of around £1,500. The original, small, PV array cost approximately £4,500. Since completion of the building, Stride Treglown has invested a further £60,000 to cover the cost of a much larger PV array. Revenue will be generated from the PV arrays under the Government Feed–In Tariff schemes and this is anticipated to result in a payback period of less than 10 years.

Technology selection process

Stride Treglown were keen to employ a holistic approach to carbon reduction in the design of Treglown Court. As a priority, passive design features were targeted in order to 'be lean' in terms of energy. Key passive design features implemented on the new office building include:

- Natural stack ventilation;
- Highly glazed north façade to maximise daylight penetration whilst minimising unwanted solar gain;

- Deep set windows to the south to facilitate solar shading in summer;
- Highly insulated Structurally Insulated Panel building envelope; and
- 'Nature' roof to add thermal mass and increase heat lag times.

Energy efficient systems were then selected in order to maximise the energy efficiency of the development. For instance, a BMS system controls window opening to achieve effective and controlled natural ventilation throughout the building. A low temperature underfloor heating system is used to provide space heating. Highly efficient, zoned lighting is also employed throughout the building, including the use of LEDs to reduce the lighting energy load.

Solar PV array on southern facade
Reproduced with permission of Stride Treglown

Only once the energy demand of the development had been reduced as far as possible, through passive design and energy efficiency, were renewable energy solutions considered. Renewables were, therefore, sized to meet the predicted residual heat and power demands, of 18.3 MWh/annum and 17.2 MWh respectively. A number of renewable power technologies including wind power, photovoltaics and combined heat and power (CHP) were considered for the development.

Office buildings have relatively high heat and power baseloads as they are occupied throughout the day. Load matching was therefore an important consideration during the selection of renewable technologies. CHP was discounted as the relatively constant output of heat and power did not suit the varying load profile of the office.

In terms of renewable electricity, the relatively low annual average wind speed meant that wind was not a feasible option for the site. It was decided instead to utilise photovoltaics to generate on–site renewable electricity for the development. This technology was well suited to the office as the load profile of the development varied in line with the variations in electricity generation form the array i.e. high load and maximum generation during the day. Initially, a 5 m^2 array of PVs was installed to provide 20% renewables, however Stride Treglown have since invested in a much larger 100 m^2 array mounted on the roof and south façade. Renewable power generated on–site now exceeds the entire regulated power demand, making the development 'carbon neutral'. The relatively high installation cost of the PV array is being compensated for by the Government Feed–In Tariff.

The design predictions of regulated carbon emissions for the building were originally 14.2kgCO_2/m^2, a 55% improvement over 2006 Building Regulations. This has been reduced to zero with the addition of further PVs.

Large PV array and open roof windows
Reproduced with permission of Stride Treglown

Ground source heat pumps (GSHP), air source heat pumps (ASHP), solar hot water (SHW) and biomass boilers were considered as technologies to meet the heat demand of the office. A GSHP was discounted early on due unsuitable site conditions (the development was constructed on the site of a former steelworks). Additionally, the GSHP has a high cost of installation and potentially low carbon savings (as the heat pump would likely have been supplied by mains power). Solar thermal collectors were discounted due to the minimal hot water requirements of the office building.

A biomass boiler was selected to meet 80% of the space heating and hot water demand of the building, with a high efficiency 18 kW gas boiler used during times of peak load and for summer hot water. Biomass was selected due to its relatively low cost for significant carbon emissions savings. Wood pellets for the biomass are sourced locally from Wales and stored on–site in an external hopper, with the biomass boiler and associated plant located in a rear plant room.

Monitoring and operation

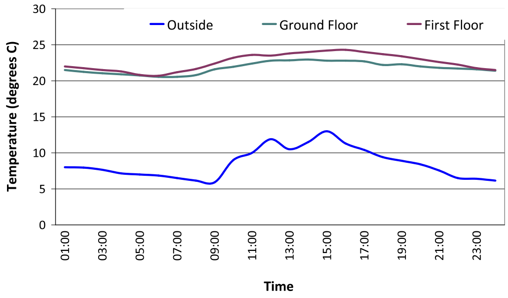
The operational EPC on completion was rated at 29 ('B' rating), however with the addition of the later PV array this is now reduced to 0 ('A+' rated).

The energy load of the building is currently being monitored, as part of seasonal commissioning as required for a BREEAM 'Outstanding' building.

The natural ventilation and heating/cooling systems have been operating well since occupation of the building in November 2010. Internal temperatures have not approached maximum allowable design values during working hours.

When temperatures have occasionally approached maximum acceptable levels, the BMS system has been accessed remotely to activate window opening and air purging at night. For example, during a particularly warm April weekend when the building was unoccupied the BMS system was activated to open windows to reduce temperatures to an acceptable level for the start of the following working week.

It has been observed that there is a slight internal temperature variation between the ground and first floor of the building. The ground floor is less dependant on the controlled BMS ventilation than the first floor, due to frequent 'air purges' from e.g. opening of external doors.



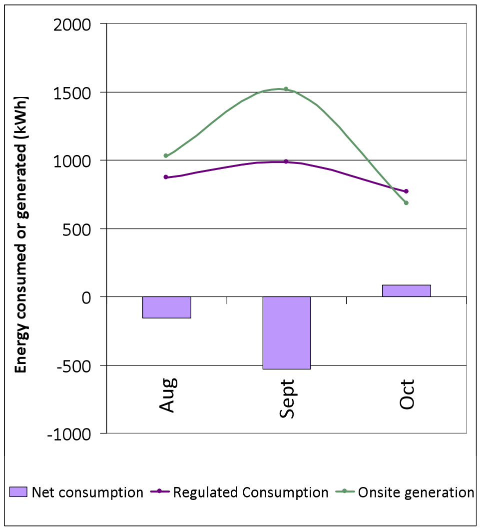
Variations in internal and external temperatures over a typical working day in October
Data provided by Stride Treglown

There have been some initial issues with the biomass boiler since occupation of the building in December 2010, which failed during a period of particularly cold weather. Despite this, the highly efficient thermal envelope meant that heating supplied by the small back–up gas boiler during this period was sufficient to keep occupants warm. The boiler failures were due to condensate from the pellets freezing in the external pellet auger pipe. This pipe is now fully lagged and since that time no further problems have been encountered.

Since occupation of the building, two deliveries of biomass pellets have been made, at a total cost of £1,845 between November 2010 and October 2011. However, at the end of October 2011 only a small proportion of the second delivery has been consumed; therefore, the annual fuel cost should prove to be less than the original prediction of £1,500.

Since the installation of the larger PV array, the amount of on–site renewable power generated has dramatically increased. For instance, in September 2011, the PV arrays generated 1,517 kWh while during the same period 986 kWh of regulated power was consumed. As monitoring of energy consumption and PV generation has not yet been undertaken for a full operational year, it is not possible to gauge an accurate picture as to the carbon offsetting potential of the large PV array. However, initial measurements taken between August and October 2011 indicate that during summer months the amount of energy produced by the PV array exceeds that consumed from regulated sources, while during winter months; the amount generated by the PV array reduces.

> "We had around 20 desk fans in our old office which ran almost continuously during the summer months. The natural ventilation strategy in the new office is working well and there is now not a single desk fan in the building!"
>
> Anthony Walsh
> Senior Associate,
> Stride Treglown



Offsetting of energy consumption from large PV array
Data provided by Stride Treglown

Lessons Learnt

Technical supply issues:

- Ensure the M&E consultant for the project undertakes a low and zero carbon technology feasibility study at an early project stage (RIBA Stage C);
- Use the energy hierarchy approach, only utilising renewables once passive design and energy efficiency options have been exhausted; and
- The time lag between EPCs undertaken before construction and those undertaken post completion can reduce ratings due to changes and updates to the EPC software calculator.

Occupat involvement

- As this building was effectively a self build, Stride Treglown was heavily involved throughout, in terms of the design, the cost and the priorities given to the sustainable technologies adopted.

Timber and recycled Falzinc facades with biomass pellet hopper in background
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- The handover process and 'aftercare package' to building occupants is critical for buildings which implement BMS. Consideration should be given to the potential appointment of a dedicated specialist to assist with snagging of BMS and metering arrangements during the first 12 months of operation.

Financial lessons:

- The cost to the design team in terms of the time spent in achieving the BREEAM Outstanding rating at an affordable price has been immense and consultants following this course should be aware of the commitment required; and
- With a more simple design, it would be possible to deliver a BREEAM Outstanding office for a lower cost. However, the cost of green offices is not yet reflected in enhanced values or rents.

Awards and Achievements

- Green IT Environmental Project of the Year 2010;
- British Council of Offices Regional Award (offices below 2,000sq.m) 2011;
- Constructing Excellence Wales Demonstration Award 2011;
- UK Commercial Property Awards – Architecture Award (Offices) 2011; and
- ACE Building Services Awards (large firm) – Highly Commended 2011.

References and Acknowledgements

Gareth Davies
Director, Stride Treglown

Anthony Walsh
Senior Associate, Stride Treglown

Further information

National Calculation Method for EPBD
www.ncm.bre.co.uk

Stride Treglown website
www.stridetreglown.co.uk

These case studies are presented to show examples of how buildings can be designed and built to be low carbon and incorporate renewable and low carbon technologies. This case study is part of a series of case studies supporting a separate practice guidance document on low carbon buildings.
For further information see www.wales.gov.uk/planning

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