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NEW BUILD PROJECT OF THE YEAR – BROCKHOLES VISTORS CENTRE

Project Practical Completion June 2011. Commissioning October 2011.

Introduction

Brockholes Visitor Centre is located on a 67 hectare nature reserve in Preston, Lancashire. The Centre is built on a 2400 square metre concrete pontoon that floats on the lake within the reserve. Accommodating a restaurant, shops, exhibition, education and conference facilities, the five barn-like structures that make up the Visitors Centre generate income to maintain the wetlands throughout the year.

The project aimed for the highest environmental performance from the outset and maintained that aim throughout construction to completion and into operation. While the BREEAM "Outstanding" design brief target was an important driver, further environmental analysis and design was undertaken, including whole building embodied energy analysis, on-site sewage treatment analysis, low energy catering analysis and attendance of Lancashire Wildlife Trust's own site specific ecologist throughout design and construction. Additionally, the client brief required that EPC A-rating was exceeded by delivering an asset rating of 10 or less.

Unique Challenges

The floating aspect of the visitors centre is a design response to the site specific conditions. The building location is in a designated flood zone from the River Ribble. Whilst this creates ideal habitat for wading birds and their human observers it does present some challenges for the observation point, that is, the Visitors Centre. It is envisaged that about once every 15 years the site will flood, raising the lake level to 4m higher than normal. During this event the whole Visitors Centre will float up and fall again once the flood recedes, effectively making the buildings flood proof. To coordinate with this strategy the incoming and outgoing services of water, electricity, drainage and communications are waterproof and flexible with enough extra length to accommodate the movement. [See Figure 1]

The architecture is strikingly unique. Key aspects of the scheme are the open vaulted buildings with no ceilings or wall voids. Floors are smooth and continuous polished concrete. To ensure the architectural vision was realised all services are concealed. Primary distribution routes are a system of floor trenches with only localised access points. All services are flexible and are pushed or pulled through long sections of trench under the floor and between adjacent buildings. For example pre-insulated pipe from a coil was used for heating and water services. Detailing this strategy required extensive coordination between the architect, structural engineer and services engineer. Initially the Contractor was surprised at the unique approach and suggested continuous floor access which would have compromised the architecture. The design team stood firm, all the services have been installed as intended and the result is viewed by all as a key success of the scheme. [See Figure 1]

Due to the nature of the facility, the highest environmental standards for ecology and land use are inherent to the project. The design of the visitors centre and surrounding landscape was undertaken with direct input by the LWT's own site ecologist. Parts of the landscaping and drainage works were designed to create desirable site specific habitats whilst conforming to the stringent site specific EA conditions for ground water protection. Examples include the retention ponds and planted swales which form part of the surface water drainage scheme. Overall, the site has exceeded its targets for the attraction of certain species which include little ringed and ringed plover, lapwing, oystercatcher and redshank. [See Figure 1]

Energy : Carbon : Performance : Design : Innovation

The building is designed to minimise energy demands whilst providing the highest standard of internal conditions. The form and orientation of the spaces is designed in response to the climate. The shallow plan depths, opening roof-lights and tall space heights work together so that all the main spaces have exceptional daylighting and are naturally ventilated. Daylight factors exceed 4% in all main spaces and 2% in many secondary spaces such as WCs. Shading is carefully designed using a combination of fixed building elements, deciduous vegetation, internal blinds and external retractable awnings.

The function of the facade as a whole is a key success. The awnings are external, providing the most effective form of shading. Their relationship to the window means that even when deployed, natural ventilation is not inhibited and occupants can still have excellent views to outside. In winter the awnings can be retracted allowing the spaces to fully benefit from daylight and passive solar heating.

Heating demand is minimised by using exceptional standards of insulation. The main solid elements are structural insulated panels (SIP). These incorporate BREEAM A-rated polyurethane insulation and FSC certified sheet timber. The SIPs provide efficiency in construction material and yield wall U value of 0.1W/m2/K. The windows use the highest specification double glazed units available; these are combined with low conductivity timber frames and thermal break edge spacers to produce an overall U value of 1.1W/m2/K. This is comparable to triple glazing but cheaper and with better light transmission properties. Quality and performance was maintained and proven by the inclusion of laboratory U value testing of the facade system in the construction contract. [See Figure 2.] The façade system results in a 40% reduction in heat loss when compared to a part L notional building.

To complement the excellent daylight, the electric lighting is designed to be highly efficient. Sources are high frequency fluorescent and metal halide. Wherever possible, the design has used bare light sources without energy wasting diffusers in order to maximise the light output. This has been achieved by using the architecture itself to reflect and diffuse light. Simple, robust lighting controls complete with user overrides are included that automatically dim and/or turn off the lights when there is enough daylight available or the spaces are unoccupied. [See Figure 3]

All the spaces are successfully naturally ventilated so that with the exception of the WCs and kitchen no mechanical cooling or fans are required at all. The scheme uses a mixture of automated small vents which provide minimum fresh air based on room CO2 concentration and large manual opening vents that provide cooling in summer. The small vent control minimises ventilation heat loss and is enhanced by inclusion of a CO2 room concentration weather compensation algorithm. That is, when it is very cold the rooms are supplied with 4l/s/p not 8l/s/p. This has proved successful to control draughts and we (the designers) feel it is a balanced response to the need for indoor air quality and energy conservation.

The kitchen is an exemplar of low carbon catering where design stage carbon emissions analysis led to the inclusion of LPG fuel and a mixed mode ventilation system that can operate without fans when hob cooking is not taking place. When cooking is in use, the fans are variable speed so that at low loads the energy required for kitchen ventilation and the associated heating can be minimised.

Heat is provided by a high efficiency low NOx emission biomass boiler supplied with wood fuel from locally grown sources. The heating and ventilation system, whilst automated has simple to use, intuitive controls that are physical and in the spaces rather than virtual, at a remote computer. An “Ipod” strategy was adopted, where the aim is to design user controls that are so intuitive they require no training to use.

Water consumption is minimised by using low use fittings including 6/4 l WC flushes with delayed action inlet valve and guidance on appropriate flushing operation, low flow taps and ultra-low flow urinals with presence flush detection. Water wastage is prevented by closing local area shut off valves by presence detection and by using mains supply leak detection. 100% of WC flushing is provided by rain water harvested from the surrounding lake.

The site has no mains sewer so an on-site sewage management system had to be included. The Design and Client teams undertook detailed options analysis that considered, amongst other aspects, cost, space and energy demands. As a result the development includes a constructed wetland sewage treatment system that coordinates with the site ecology and incurs energy demands that are a fraction (25%) of municipal sewage treatment.

The building includes extensive and detailed temperature, energy, carbon and water metering systems. In addition to being broken down by area, the following systems are separately metered, lighting, small power, heating, hotwater, catering and non-catering. The system is further enhanced by providing data analysis and presentation that allows building users and managers to monitor and respond to the use of these resources. Visitors can view and interrogate the building systems and metering through an interactive graphical user touch screen.

The Client brief requirement relating to carbon emissions has been met. The building has achieved an EPC A rating with a EPC Carbon Asset Rating of 9. Energy efficiency measures alone reduce carbon emissions by 35% compared to the Building Regulations Target Emissions Rating. When the biomass boiler is included, carbon emissions are reduced by 85% compared to the TER. [See Figure 04]

Materials and Waste

Responsibly sourced, robust materials of low environmental impact have been used throughout the project. These include FSC timber for structure, windows, walls and floors, oak shake roofing, A Rated polyurethane insulation, low VOC finishes and zero ODP insulation. The design team undertook embodied energy options analysis and the results of informed the decision to use concrete rather than a steel pontoon. Recycled aggregates were used in the pontoon floor construction.

Construction site impacts were minimised by the Contractor by monitoring and reporting energy, carbon and water, implementing best practice policies in respect of air, water and ground pollution, using an environmental materials policy and ensuring that at least 80% of site timber was responsibly sourced and 100% was legally sourced.

The Contractor has complied with the Considerate Constructors Scheme, achieving a score of 36. Construction waste was minimised through a Site Waste Management Plan. This achieved less than 5 tonnes of waste per 100sqm of floor area and some 80% (by volume) of non-hazardous construction was diverted from landfill recycled or reused.

Costs of Low Carbon Measures

The energy saving thermal and daylight performance of the building fabric is inherent to the design and is not considered an additional cost. The biomass boiler was cheaper than providing gas to the site. Air and ground source heat pumps along with LPG boilers were considered but were determined to be more expensive that the biomass option in terms of carbon saving per pound invested. The building air permeability was specified at 4m3/hr/m2 @ 50Pa. The contractor provided a contract price to meet 10 m3/hr/m2 @ 50Pa and a day rate for further work required to achieve 4 m3/hr/m2 @ 50Pa. This was considered a reasonable approach, worked in practice and achieved measured air permeabilities from 4 to 10 with an average of 6 at an acceptable cost.

Performance Data

Max Fordham has conducted Client post occupancy surveys as part of the seasonal commissioning process. An excerpt of the first of these surveys is shown in Figure 04. In general the survey results show that the Client's brief and actual user performance requirements have been met for heating, cooling, ventilation and lighting. Where problems have been noted, these are being fed back into the seasonal commissioning process and rectified.

The building's logging system is being used to monitor the building performance. Figure 05 shows some of the initial data. The contract includes the requirements for performance monitoring. As of this month the controls specialist will be producing monthly reports documenting temperature, illuminance, air quality (CO2), heating delivery, energy use and water use. These will be used to identify problems, tune the settings, ensure performance and minimise energy use.

BREEAM

The project has been awarded BREEAM 'Outstanding' at design stage and is currently being assessed at Post Construction Stage. Key successes in the BREEAM have been achieving innovation credits for considerate constructors, daylight, low or zero carbon technologies, water metering and construction site waste management.

Commissioning and Handover

Best practice CIBSE and BSRIA commissioning procedures have been followed and seasonal commissioning is specified for the future. A key tool was the Max Fordham Commissioning and Handover Schedule which presents all of the required commissioning and handover tasks in the form of flow diagrams. The process has been overseen by a Specilaist Commissioning Manager. Client training has occurred and will continue throughout the 12 months following PC. The specification stipulates project specific training needs. The O+M manual content was developed and refined as a collaborative effort between Consultants, Contractors, Specialists and the Client building Manager. A basic (BREEAM compliant) Users Guide has been produced which includes laymans descriptions of how to operate the building along with energy efficiency design strategies and monitoring procedures.