Working together for a world without waste

Case study: Construction and operational resource efficiency

Okehampton Business Centre

This case study describes the resource efficiency measures that were undertaken during the development of a greenfield site adjacent to Dartmoor National Park. The development comprises a suite of sixteen low energy offices and is considered to be a beacon of sustainable development in the South West.

Background

The Okehampton Business Centre was opened to the public in September 2008. The 1140m^2 development comprises 13 office spaces and three mezzanine workshops.

The £6 million development was funded jointly by the South West Regional Development Agency (SWRDA), Objective Two European Regional Development Fund and the West Devon Council. The development included a civil engineering scheme as well as the building construction itself, costing £3 million each. The focus on this case study is the building design and construction, further information on the civils element can be found on the CEEQUAL website[1].

The aim was to deliver a building that was not only sustainable but also provided a high level of user satisfaction and comfort. The project achieved its targeted BREEAM Excellent rating and includes a biomass boiler fuelled by wood pellets which helps meet the buildings heat demand for 90% of the year; whilst a 6kW wind turbine and 8.6 kWp of integrated photovoltaic cells satisfy up to 60% of the buildings electricity needs.

Okehampton Business Centre

This project was included in SWRDA's Sustainable Office study[2] which explored the associated capital and operational costs; and operational and embodied carbon[3] of three offices to gain an appreciation of the whole life cost and whole life carbon implications of pursuing higher levels of environmental performance. Detailed information on costs and carbon is provided in four reports which can be accessed on the SWRDA archive website.

Organisations involved

- West Devon Borough Council (Proprietor)
- Archial prev. SMC Penrose (Architect)
- Halcrow Group Ltd (M&E Designer and BREEAM assessors)

Resource efficiency measures

Wastage rate

Site Waste Management Plans (SWMP) were not a legislative requirement at the time of construction but were a condition of SWRDA funding. Waste was a major concern for the team and the contractor imposed their own benchmark targets for waste reduction. The development of a comprehensive SWMP, was fundamental to diverting over 80% of the total construction waste being diverted from landfill. This included 100% of concrete, wood, and metal waste being either reused on site or sent to a recycling facility. For example, timber was re-used as formwork and over 33 tonnes of concrete were recycled for use on site.

Scarcity and security

All major building elements (external wall, roof and upper floor slabs) were all A rated as per the Green Guide[4] ratings. Including, 100% of the timber used on site being FSC certified (Forest Stewardship Council).

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1 www.ceequal.com/awards_037.htm

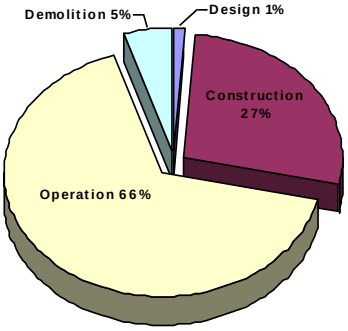
2 http://webarchive.nationalarchives.gov.uk/20120119231442/http://www.southwestrda.org.uk/working_for_the_region/working_for_the_environment/sustainable_construction/sustainable_offices.aspx

3 *Carbon is used as shorthand for carbon dioxide equivalents, and refers to Green House Gas emissions*

4 *Green Guide ratings are assigned from A+ to E, where A+ represents the best environmental performance/least environmental impact and E is the worst environmental performance/ most environmental impact.*

Carbon

The SWRDA study shows that construction related carbon emissions are a substantial proportion of a buildings total carbon profile, see graph below[1].



Typical carbon profile for an office building (over a 60 year design life)

However, the study also clearly shows that over the full design life of a building any additional embodied carbon from measures such as enhanced insulation and renewable generation is offset by the operational carbon savings they achieve.

In the particular case of Okehampton the solution reduced both the embodied and operational carbon. The embodied carbon was 1% lower than if the building was designed to achieve building regulations only. The main reasons for this reduction were the substitution of wall cladding in place of wall masonry and the substitution of a glued laminated timber (glulam) roof structure in place of a steel structure. The carbon savings these provided outweighed the increased embodied carbon from insulation and heating systems changes.

The operational carbon is reduced from 56 tonnes/year for a building designed to achieve building regulations, to 41 tonnes/year for the building as designed to achieve BREEAM Excellent.

Glulam roof structure

Energy in construction

The on site electricity consumption was measured by an electricity meter which constantly displayed energy use versus benchmark energy use. Benchmarks were based on previous project experience and Construction KPIs as National benchmarks had yet to be determined. The technology provided site personnel a visual and instantaneous method of monitoring which combined with the contractors' own ethos of limiting energy use on site, facilitated in a major behavioural change within site staff. The final result being that energy consumption remained well below the self-set benchmarks, 94% of time.

Water in construction

Similar to energy, on site water use versus benchmarks were displayed. One major benefit was the early identification of a major water leak which was equivalent to 60% of a weeks water use.

The water consumption steadily increased during the latter part of the project as result of both the increasing number of people on site and the nature of site work that required increased water. However, the overall the per person water consumption did not change significantly. The resulted in water use being 15% below the self-set target.

Water in use

Water in use is the volume of water that is consumed during building operation i.e. post construction.

The development achieved all available credits under BREEAM in the water section as a result of specifying grey water and rainwater harvesting systems. These systems were designed to supply 100% of the water volume required for urinal flushing and external planting, thereby reducing the use of potable water considerably. In addition, water efficient fittings and sanitary ware, a leak detection system, and a water meter were fitted to reduce the predicted water use.

As a result the building's water consumption rate is an extremely low 1.27m^3/person/year as compared to the Defra recommended water consumption rates for new build offices in 2012 of 3m^3/person/year.

Lessons Learned

Construction costs

Resource efficiency had a positive impact on construction costs. An effective SWMP, optimised excavations and recycling on site reduced the cost of material imports, waste management/landfill and associated transport.

However the reuse of recycled aggregates inadvertently resulted in the use of excess energy and increasing the embodied carbon, as the secondary aggregates required sorting and often washing and rewashing; a process which virgin aggregates often do not require.

The reduced weight benefits of substituting a steel structure with glulam wood[5] had additional benefits. Fewer vehicle movements were required than originally conceived and less material was required in supporting structures than would have been required to support a steel or concrete roof structure.

The installation of both a biomass and gas boiler resulted in a larger plant room (due to planning issues the biomass boiler was located inside and the LPG cylinder underground). The remainder of the plant room included an oversized thermal store sized for 48 hours use to make best use of the biomass burn times and associated energy monitoring equipment. Although cost increases were minimised by combining the LPG area under the parking bay for the biomass delivery, the construction costs increased marginally as a result of the larger plant.

However, the increased construction cost provides a cost benefit during operation. Previous experience had proved that a larger plant room allowed for much simpler and cheaper maintenance of the plant room.

Reduction in potable water

The development included a water harvesting system and was installed very early during construction, and commissioned during building handover as programmed. It was later realised that had the team commissioned the system during construction, the construction phase itself could have utilised the rainwater harvested and substituted in place of the potable water.

Operation costs

The water and energy efficiency measures in addition to the following design features have resulted in direct savings in operational costs.

- The building's orientation was carefully planned to exploit the natural contours of the land and the north facing aspects for the major windows
- Natural lighting has been encouraged through the installation of north lights, sun tubes and high performance windows. Structural shading with wing walls, deep eaves and brise soleil has maximised the potential of solar gain whilst minimising glare.
- Only energy efficient lighting was specified.
- Natural ventilation integrated with both automated and manual opening windows whilst utilising the north light to draw air flow through the building as a linear chimney effect.

Feedback from the office tenants has been that their energy bills are significantly lower than they expected. This is also true of the Facility Management (FM) company who are responsible for expenditures related to the water and sewerage charges. The FM company have commented that bills for Okehampton are considerably lower than those for similar office buildings in West Devon.

Recognition and publicity

Since the centre opened it has been hailed as a beacon for the sustainable development of commercial property in the UK - winning five prestigious industry awards.

- Michelmores and Western Morning News Commercial Property Awards-Project of the Year for a building over £3-million – winner 2009
- LABC (Local Authority Building Control) Awards - Best Sustainability Awards - National Winners
- RegenSW - Sustainable energy agency awards - Best small renewable energy scheme 2008 Winners
- CEEQUAL Excellent
- BREEAM Offices 2006, Excellent

The highly publicised sustainability credentials of the development have benefited all organisations involved with associated recognition and promotion.

The FM company have also reported that the building enjoys much higher occupancy rates than other similar office spaces in the region and that its tenants are extremely content with their premises, with no complaints reported over the past four years.

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[5] *A structural steel beam may be 20% heavier and a concrete beam 600% heavier than an equivalent glulam beam. Glued Laminated Timber Association (www.glulam.co.uk)*

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