

**Title: *Building Sustainably – A Stakeholder Approach to Building Design***

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***Summary***

This paper summarises the planned redevelopment of Webber's Yard industrial estate on Dartington Estate in Devon. It discusses the needs of different stakeholders involved in the project and outlines how the design team responded. It argues that this approach to building design and development is particularly sustainable and could be used as a model for the development of other light industrial estates.

It outlines the role of an "environmental champion", or E-Co (Environmental Co-ordinator), in ensuring that environmental issues were considered holistically during the concept design stage to promote sustainable construction.

***Introduction***

Industrial 'tin sheds' – are they sustainable?

140 million m<sup>2</sup> of land in the UK is devoted to manufacturing, in addition to the call centres, data centres and warehouse type retail outlets, all of which tend to utilise steel framed steel clad portal frame structures.

***Context – Dartington Estate***

Dartington Hall Estate was set up in the 1920s by Dorothy and Leonard Elmhirst to promote rural employment that was not dependent on agriculture. This encouraged the Estate to be a centre for innovation and experimentation in education, art, land use, architecture and social responsibility. The estate supports a wide variety of activities and enterprises, which include the Cider Press Centre (a major retail outlet attracting 600,000 visitors a year), Dartington College of Arts, two dairy farms and a conference centre.

***Background – The Webber's Yard Project***

Dartington Hall Trust is responsible for the maintenance and use of the Dartington Hall Estate. The Trust, as the project client, intends to regenerate a small run down industrial estate within its ownership using sustainable principles of development.<sup>1</sup> The required net floor area of the industrial units is 3,500m<sup>2</sup> and the project cost is just over £4 million.

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<sup>1</sup> The Brundtland definition of sustainable development will suffice, that is 'development which meets the needs of present generations without compromising the ability of future generations to meet their own needs.'

The Trust hopes that the redevelopment of Webber's Yard will help encourage the adoption of sustainability criteria by developers of other similar sites by demonstrating that significant improvement in current practices can be achieved whilst still providing a realistic return on investment. NB. Dartington Hall Trust is willing to incur a 15% premium on the capital cost of a standard industrial unit if the redevelopment is more sustainable. They believe that this is worthwhile for the future benefits that such an approach will bring, not least the reduced operating costs and increased occupant satisfaction.

The whole ethos on the Estate is one that embraces sustainable development. It encourages the sustainable use of land and the sustainable operation of the built environment.

### ***The Team***

The Webber's Yard project is nearing completion of the detailed design stage at present and will go on site next year pending sufficient funding. Charles Taylor, the Estate Steward, has co-ordinated the project throughout, maintaining a close involvement as the client representative. Charles, through his role in managing Dartington Estate, will essentially be responsible for keeping the tenants happy when the buildings are in use.

Peter Clegg of Feilden Clegg Architects was the first member of the design team to be brought on board to manage the design process. Peter drafted a number of principles that set the context in which the design team was to develop the design. Atelier one and Atelier ten were responsible for the structural engineering and internal environment, respectively. Davis Langdon & Everest were the quantity surveyors. Andrew Grant Associates undertook the landscape planning and GH Project Management were responsible for tenant and community liaison, market research and co-ordinating funding applications. City University, and later ABS consulting, were brought into the project to look in more detail at the environmental impacts of the project.

### ***The Process***

The design process began by focusing on the design of a single light industrial unit in a way that was 'green'. A set of sustainability principles was drafted by Peter Clegg to help guide the design process, this looked at different construction issues and ranked them from 'Ungreen' to 'Deep Green'. It was felt that at this stage, materials such as earth and timber sourced from the estate should be considered for use in the construction of the buildings – a homegrown industrial estate?

Supplemented by the research undertaken by the design team members, Charles Taylor co-ordinated the environmental issues as well as managing the project. This environmental co-ordinator (E-Co) role<sup>2</sup> proved to be key in ensuring that initial concept design ideas remained through to the detailed design stage. One particular example was ensuring that the whole life cost model provided a fair reflection of the costs in use, taking into account the environmental impact of the development.

The Director of Sustainability, Dan Epstein had a similar experience, at the Earth Centre when he specified indigenous sources of timber for the regeneration of the old coalmine near Doncaster. When the contractor decided to use Canadian timber, the question had to be asked...and the reply was that the timber "was indigenous to Canada".

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<sup>2</sup> This role and the 'E-Co' concept is being further explored in a DETR funded PII project *Realising Quality Energy Efficient Buildings*, and is being shown to be an effective way of getting environmental best practice into reality.

## CIBSE NATIONAL CONFERENCE 1999

The initial design process was undertaken as a research project with the aim to share the experience with others to develop a design approach that produced cost effective, low impact industrial units. This took into account the environmental impact of the construction materials, the energy consumption in use, transport to the site and the impact on the surrounding landscape.

It was felt that for the development to be sustainable the design should be approached from the perspective of a number of stakeholders<sup>3</sup>, which included:

- Dartington Hall Trust (the client)
- Financiers (i.e. EC LEADER II) and Trust Shareholders
- Existing occupants
- Neighbours and other users of the Estate
- The design/development team
- Suppliers
- Past and Future generations
- For educational purposes there are also various audiences within the construction/building industry, in particular developers and other design teams

For each of these stakeholders the team had to consider the impacts that the development might have on them. For example, there are the more obvious issues of capital and operation costs of the project as this will effect the investment by the Trust and other financial investors. Also, there are the less common stakeholder issues related to 'Future generations' and 'Suppliers'.

To develop the site effectively, provide value for money to the client and to support the principles of sustainable development, the team had to respond effectively. The response to the stakeholders was, in hindsight, co-ordinated under three areas.

- Environmental - Feilden Clegg Architects, Atelier 10 & ABS consulting
- Economic/Financial - Davis Langdon Everest
- Social - GH Projects

For example, the building has been designed to operate below the threshold for good practice energy consumption. It has also been designed to minimise embodied energy – which is the energy consumed in the sourcing, transportation and manufacture of construction materials. The table overleaf is a summary of the embodied energy analysis undertaken for the project. Based on the materials selected the units themselves have a certain amount of energy embodied within the building envelope. In addition, for the life-cycle energy burden of the building we must considered the energy consumed in use as well as the energy required for the transportation of materials and construction on site. As an additional exercise we looked at the transport requirements generated by the location of the site and the need for the occupants to commute each day.

This cross-cutting summary is useful as it puts into perspective the contribution made to the total energy burden at each stage of the building's life-cycle. We can see that the proposed 'Elegant Green Box' through quality efficient design has a much lower energy requirement both in terms of embodied energy and energy in use. A 40% reduction in whole life energy use is a realistic opportunity. This is particularly pertinent considering the forthcoming introduction of the climate change levy.

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<sup>3</sup> Stakeholders: Individual, or group of individuals, which have an influence on, or are influenced by, the development.

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For 186 m<sup>2</sup> industrial units:

	Primary energy requirement over 30 years (kWh)	Primary energy requirement over 50 years (kWh)
Elegant Green Box	161,400 for one unit	161,400 for one unit
Tin Shed	510,200 for one unit	510,200 for one unit
'Building Regulations Compliant' energy in use @ 121 kWh/m <sup>2</sup>	859,300 per unit	1,432,200 per unit
'Predicted' energy in use @ 78 kWh/m <sup>2</sup>	580,300 per unit	967,200 per unit

Construction	11,200 per unit	11,200 per unit
Transport of occupants	57,900 per unit	96,500 per unit

Total for a single Elegant Green Box	810,800	1,236,300
Total for a single Tin Shed	1,438,600	2,050,100

In terms of cost, Davis Langdon Everest produced a whole life cost plan for the project. The Trust recognised that capital cost was not the only consideration and felt that the cost throughout operation was an important factor. As a result of this assessment, we actually discovered that due to the lack of maturity of the markets for some 'green' products the desired economies of scale were not always realised.

The *Future generations* issues are tied up with the UK's progress towards sustainability and the need to maintain a capacity for continuance. Going back to the original definition of sustainable development: *we must meet the needs of present generations without compromising the ability of future generations to meet their own*. So the issues here include the use and distribution of resources: Has the project been designed for energy efficiency and water conservation? Are the materials being used for the Webber's Yard project sustainable? It also includes how people are treated and the relationships that we build and maintain. Whether we encourage increased equity or leave it up to the "free" market and lowest cost.

Which brings us to the supply chain, a fundamental issue for sustainable construction. When so many of the companies in the industry are "subbing", to a project manager from a larger organisation the role that (small) supply organisations play is key. If these SMEs do not recognise the importance and benefits of sustainable development then there is little chance, without stringent regulation, of the industry improving its environmental performance.

In the case of the Webber's Yard project there was the opportunity to source materials from the Estate. The planned thinning of the local woodland will provide sufficient timber for the construction of the units. Earth walls are also being considered as an experiment for limited application. This was a relatively unique opportunity to combine the operation of Dartington Estate with the construction of Webber's Yard, but increasingly 'enlightened' suppliers are moving towards more sustainable, or at least "environmentally-friendly", methods of sourcing and manufacturing building components. Preferred supplier framework agreements can allow suppliers the space to develop low impact methods of manufacture without an increase in cost.

Social factors were brought into the equation by the market research undertaken by GH Project Management, who interviewed the existing tenants and other interest groups that were considered stakeholders in the development. The concerns and needs of the (future) tenants were factored into the design where possible. One of their major concerns was car parking space. This shows how the priority for the client can differ slightly from the priorities of the occupants, and again from the financiers. Sustainable development, unlike pure environmentalism, is a balance between environmental, economic and social concerns. Therefore the occupant's business must be sustainable for the development to be viable.

Transport is still considered a key issue for business, and particularly for micro-businesses and SMEs. It is also an issue that has significant environmental implications. Rough calculations showed that the energy consumed for transport per industrial unit could equal up to 10% of the energy consumed throughout the building's life-cycle. In addition, if you consider other environmental factors such as the need for roads, their construction and maintenance, as well as the associated waste production, such as the 38 million tyres that are scrapped each year in the UK, we need to rethink transport and not just construction. This has been proposed by the Government's recent Transport White Paper.

To summarise, the site was designed in the broader context of Dartington Estate in which it sits, that is considering the "neighbours" as well as the occupants of the existing industrial units. Transport and traffic were key issues as this is a rural development. Atelier units were also considered as a possible means to combine living and working space, thus building a "localised" community and reducing the need to travel. The demand for this type of unit has yet to be established.

#### ***Final Product***

The 'Elegant Green Box', as it is known, will be a timber-framed, timber-clad and earth roof industrial unit. Conventional concrete foundations and flooring will be used because a cost effective alternative, such as timber or hemp, was not available as a risk-free option. Prefabricated earth panels will be used in some areas as an experiment looking at their application as shear walls.

The design team chose low embodied energy materials that are energy efficient in manufacture to produce a low u-value building envelope that went beyond the existing building regulations. Passive and active solar design elements were considered and will be utilised where possible, including the effective use of natural daylight and ventilation. The building will contribute to the Kyoto target reductions in CO<sub>2</sub> throughout its life-cycle; in manufacturer, construction and operation.

The building is naturally ventilated with provision for mechanical extraction where it is deemed necessary for processes taking place within the units. Significant use of natural daylight has been used to minimise the artificial lighting requirements.

Regarding the layout of the site there was a balance that needed to be struck between what was considered financially sustainable and appropriately dense, with consideration given to the need for 'green' space. Optimising the brownfield space available for development with occupants need for 'ecological' (or 'living') space. The landscape strategy aimed to produce an energy efficient microclimate as well as presenting the site in a way that it is considered a benefit to the local community, rather than a blot on the landscape as many industrial estate are thought of.

***What's been done to date***

As mentioned above, the project is at the detailed design stage at present and £1.6 million of funding is still required to regenerate the whole site. A site layout has been produced and the construction process has been separated into four phases. The site will be a mix of single and combined units, with some areas of the site being set aside for quieter business activities.

A number of specialist reports have been produced. Atelier one produced a report on the structural performance of earth walls and their application to the site in Devon. Atelier ten undertook a study, modelling thermal, ventilation and lighting requirements in the units, taking into account the use of rooflights and high level vents.

ABS consulting and City University produced a report on the environmental sustainability aspects of the project. Looking at the life-cycle impacts of the chosen materials, in particular exploring the embodied energy of the materials. This study compared the new 'Green Box' design with a conventional 'tin shed' – that is a steel-framed, steel clad industrial unit.

GH Project Management has produced a market research report on the demand for light industrial units in the region and the requirements of the tenants and local community. DLE have produced a whole life cost plan covering a 50-year lifespan.

The project has received planning approval as well as funding from the EC LEADER II regional programme. At present the Trust is exploring funding possibilities through ERDF and English Partnerships as well as the new local Regional Development Agency.

Copies of these reports are available through Charles Taylor at Dartington Hall Trust.

***Barriers to, and Opportunities for, Sustainable Construction***

We have heard a lot of talk about *rethinking construction*. So far, the Movement for Innovation has relatively few examples of sustainable construction. The project has asked fundamental questions about the redevelopment of an industrial estate without being a 'blue sky' project with no limits. You could call it 'green sky' research & innovation as it is grounded in reality.

The project has considered the sustainable use of resources; not just energy, but water, people and materials selection. This has included an attempt to minimise the transportation of goods and people by sourcing both materials and the construction workforce locally. It is often said that the most significant socio-economic impact that the construction industry has is through employment, which may be true. But this project demonstrates that construction can give something more in addition.

By considering the needs of all the stakeholders including the local community and future generations this project regenerates a failing industrial estate which will continue to provide jobs after the project is complete. It should also be more attractive than the existing estate. This will have two key benefits; the first is that the occupants should find it a nicer place to work, and the second is that the local residents may actually be proud of this new industrial estate.

Through careful design and selection of material it also means that the project will give something back for years to come. It will contribute, in its small way, to reducing CO<sub>2</sub> emissions and water consumption. Moreover repetition of the project in other areas would increase the benefits gained from this project. By the end of the life of the buildings in fifty years time, new trees growing on Dartington Estate will be of sufficient size to produce a new estate. The market for the reuse of materials should, by 2050, be sufficiently developed to make use of the timber no longer suitable for structural applications.

**Conclusion**

Obviously the Webber's Way project is a rare example of an innovative enlightened client leading the way. It is difficult for the majority of clients to justify this type of novel expenditure, but this project has proved in principle that there are benefits to be gained from sustainable approaches to construction. One of the reasons that the Trust can afford this kind of expenditure is the nature of their long term commitment to the site and to Devon. So they will reap the long term benefits.

The stakeholder approach to building design is being encouraged by ABS with other clients and we have seen some interest. The 'E-Co' role played by 'the client' Charles seems to have payed dividends to date.

A close eye will be kept on the progress of this project, in particular to see if the design intent is realised in practice. Many issues tend to fall down the gap during the construction process and we hope that the environmental co-ordinator role will be maintained by Charles Taylor to ensure that the construction process does produce the desired result. By ensuring that this is the case, most of the stakeholders will be satisfied as long as the environmental interests are metered by common (economic) sense.

Sustainable industrial units may still be considered by some a contradiction in terms, but this demonstration project could prove otherwise, and start to point the way forward.