Green Wood Trust's Woodland College

Shropshire UK

Owner/Client: The Green Wood Trust
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Reed-bed design: Dr Chris Weedon, Centre for Alternative Technology, Machynlleth — Tel: 01654 702400

Completed: Nov. 1998
Typical building population: 10 staff/volunteers based in the building with regular groups of 30 school children/ students and up to 100 adults for occasional events
Useable floor area: 170m2
Ann. Consumption of potable water: 2.3 cu.m/person/year
Ann. Opperating energy demand: approx. 45kWh/m2yr (all electric over this period, will be partly wood later)
Ann. Emission of CO2: 22kg/m2yr
Construction costs per m2: £588/m2 (not accounting for some volunteer labour)
Total project cost inc. landscaping, fees etc: £126,000.

INTRODUCTION

Phase I of the Green Wood Trust's College, is an education and office facility for an environmental charity based in the Ironbridge Gorge, Shropshire - a World Heritage Site. The new building was intended for a variety of uses, ranging from classroom based activities to lectures an craft or music events. The building also provides for a reception area, office space, library and seminar room.

The designers of the building, together with the director of the trustees, intended that in its construction methods, its materials and its operation, the new college should aim to minimise its negative impact on the environment and to maximise its posative impact on the locality both physically and socially. The budget was extremely low and an approach was taken to ensure that all the basic energy efficient measures were taken and carried out well rather than specifying the use of expensive photovoltaic panels or even solar water heating. These elements can be intergrated later to further reduce CO2 emmissions.

This led to a design that incorporates:

- **-very high levels of energy efficiency**
- **-non-toxic and environmentally low impact building products, and the extensive use of renewable timber and wood products,**
- **-low water usage appliances,**
- **-on-site biological system to treat the building's waste i.e. sewage and 'grey' water from showers and sinks,**
- **-innovative low embodied energy timber structure utilising low value local timber,**
- **-local skills and tradespeople.**

Green Wood Trust Plan: Phase I built; Phase II unbuilt.

1. Energy Efficiency

Using the sun

The position of the building on the site was largely dictated by railway regulations; however within these limitations, its orientation and the position of the wall and roof glazing has been designed to optimise the amount of solar radiation entering and warming the building. The large overhangs are intended to prevent overheating in summer, as are the plants that will be grown over some of the windows - cutting out sun in the summer, but allowing it in during the winter when the leaves have fallen. The highly glazed entrance lobby will collect heat from the sun and warmed air will naturally rise up to heat the first floor.

Heat Recovery

At first floor level warm stale air is extracted via vents near the ceiling and taken to a domestic heat exchanging unit. Up to 70% of the heat from the outgoing air is extracted and used to preheat the cold fresh incoming air, which is then distributed around the building. This unit also deals with the warm, moist air from the w.c.'s and shower on the ground floor. The main hall has its' own free-standing heat recovery unit incorporating an electric preheater. It is calculated that using the heat exchangers alone should maintain an average temperature of 11 degrees centigrade - this means that only a very small heating system is needed to top up the building's heating requirements.

Insulation

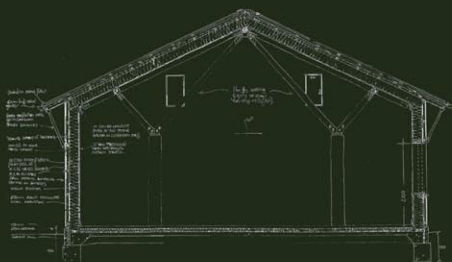
Walls and ceiling
High levels of insulation have been adopted with 300mm of cellulose insulation in the ceiling and 250mm in the walls. The floor contains 150mm of polystyrene insulation under the concrete screed .
Air tightness
An air tightness/vapour control sheet has been carefully fitted by a subcontractor under close supervision. EAA provided instructions on best practice.
Windows and doors
The timber windows and doors have been made by the GWT themselves and incorporate double glazed units with low emissivity glass and insulated edge spacers. All doors are insulated. Windows have not yet been sealed to the air-tightness layer; when this is complete, we would expect the energy performance to improve.
Heat storage
All internal partition walls (including the two storey fire wall) are built using dense concrete blocks in order to store heat gained during warmer periods, and remain warm into periods of colder weather.
Lighting
Low energy lights have been used where possible, particularly in the main hall

Technical Summary
Peak space heating loads for the building 5 KW
'U' values in W/m2Kfor walls=0.16, floor=0.17 & pitched roof=0.13, vert. windows=1.5, rooflights=2.0 & ext. doors=0.7

Overall a 70% reduction in total energy demand (compared to a conventional building) should be possible and an 80% reduction in CO2 emissions (in part due to the use of wood as a heating fuel).
At 29W/m2, the size of the installed heating plant per unit floor area is the second lowest known figure in the UK – the lowest is the Elizabeth Fry Building at the University of East Anglia.

2. Heating System

The building has operated for a year with no heating system using a temporary electric oil filled radiator as necessary. Use has also been made of the electric preheater in the larger heat recovery unit for the main classroom and a small electric water heater for the utility sink. It is over this period that electricity useage has been recorded. Recently a clean burning wood stove has been installed in the main classroom with a separate air supply. A back boiler and hot water store are soon to be added which will remove approx. half the heat output from the stove into the two storey part of the building. The hot water store will feed two radiators via a small pump to heat the lobby /office above and the rear room. It will also supply the hot water used in the small utility area under the stairs – rendering the electric water heater redundant when the stove is lit. Electricity will only be used to run the heat recovery units from now on.



3. Materials and products

As important as energy efficiency is the efficiency with which we produce and use building materials. Modern building products can seem simple and easy to use, but often have a high environmental impact due to the way in which their raw materials are quarried, transported and manufactured. The by-products of these processes can create large volumes of industrial waste, some of it toxic. Some materials not only affect the health of the environment during their manufacture or disposal, but can affect our personal health when they are used inside a building or when they degrade over time or are burnt in a fire.

In the new building, the materials we have been most concerned about are timber, paint, insulation products, timber preservatives, roofing materials and floor finishes. The following illustrates some of the products used:

Wood and cellulose based materials:simple chemistry,low embodied energy, renewable or waste resource, low toxicity
Recycled newsprint insulation blown into wall and ceiling cavities (Warmcell). The bitumen impregnated fibre board external structural sheathing reduces cold bridging through the wall studs and provides racking resistance (Bitvent). Bitumen impregnated wood fibre roofing sheets were used on the roof (Onduline). All timber used in the building was sourced locally from responsibly managed woodlands and sawn on site using a mobile sawmill. No preservation treatment was required on any timbers.

Paints and finishes: simple chemistry, low toxicity in production use and disposal, based on renewable resources
The paints used were selected on the basis of their use of renewable plant-based solvents,rather than oil-based solvents and the use of simple formulas and natural pigments that reduce the quantity of waste by-products. The microporous woodstain on the windows contains no added biocides or preservative chemicals and allow the wood to 'breathe', whilst the plant oils 'feed' the wood. The silicate based mineral paint used on the internal walls and ceiling already has natural properties that prevent the growth of fungi and algae spores and the anti-condensation properties of the paint help to ensure a healthy internal environment. The larch timber cladding and oak window sub cills have been left untreated, being naturally durable and protected by the large roof overhangs. Natural linoleum has been used on the floors throughout.

Masonry
Locally produced concrete blocks and aggregate from local quarry was used for concrete work.

5. Construction methods

Building with local timber

Timber has been used extensively in the other buildings at the Green Wood Trust and the new classroom takes a more innovative approach yet. The Trust was concerned to build its new woodland college in a way that demonstrated the possibilities using low grade forest thinnings to *create a* modern ecologically sound (and energy efficient) building yet with some of the qualities found in mediaeval timber buildings. *These natural qualities create links between our built environment, our local communities and the natural world .* This can help us to understand the consequences of our activities on the environment more directly.

Main classroom

The main space has been designed as an aisled room and the roundwood sweet chestnut columns and ash roof struts constitute the main structural frame. Any future maintenance problems are made easier to deal with by designing in the ability to remove and replace most of the poles. The external walls were built using 10" x 2" larch studs, nailed from a floor plate to the perimeter wall beam (supported by the pole structure).

The method of using an internal timber frame has been adopted to allow a variety of different ways of building the external walls. Making the outer walls *non- loadbearing* opens up the easy application of 'green' building materials such as;

Low density earth blocks
wattle and daub
straw bales
different type of timber wall using small section material
using non stress graded (low grade) and unseasoned sawn timber

The other advantages of an internal frame are: easy detailing for air leakage where the irregular frame meets the external fabric: future adaptability of external walls: ensuring longevity of timber frame: allowing the structure to be expressed.

7. Contractors, trades people and volunteers

The project employed young environmentally based businesses giving them experience in a larger building project. Tradespeople recieved training in the environmental aspects of their subcontracted work and volunteers were used as much as possible. The building caters for a diverse range of user groups and has a permanent display describing the benefits of an energy efficient and ecological approach to designing and building.

6. Water use and waste treatment

3no. dual-flush low-water usage toilets (Ifo Cera) are installed using the factory preset flushes of either 6 or 3 ;itres per flush. As confidence grows in these they will be reset to 4 or 2 litre flush settings. Wash basins are fitted with spray taps to again reduce water consumption. Due to problems with connecting to the main public sewer an on-site reed bed filtration system was built, treating black and grey water. The reed beds and associated pond provide a rich habitat for birds, small mammals and pondlife.

Timber species used;

Douglas Fir for the window frames, Scotland
European Larch for the wall studs and ceiling rafters, Shropshire
European Larch for the external cladding, Shropshire
Cleft sweet chestnut for the external eaves supports, Sussex
English oak for the window sub-cills, Shropshire
Sweet Chestnut for columns, Shropshire
Ash for roof struts, Shropshire

8. Summary

The building has become a very popular venue with local organisations as well as the Green Wood Trust staff and visitors. The combination of natural materials, healthy building products and low construction and running costs have resulted in a simple building that is nevertheless aesthetically rich and well finished. The fact that it has such low fuel use shows how much could be achieved by using simple basic design strategys and affordable energy efficiency measures.

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