WISE – THE WALES INSTITUTE FOR SUSTAINABLE EDUCATION

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http://info.cat.org.uk/wise

WISE, the Wales Institute for Sustainable Education, is a state of the art educational facility. It provides thousands of people with an opportunity to learn about green architecture, renewable energy and other environmental technologies. CAT is now a world-class training resource, with expertise gained over 35 years and real-life examples of sustainable materials and technologies.

The building is home to CAT's post-graduate courses, on renewable energy, building design and environmental sustainability. We also run accredited courses for trade professionals and educators, in areas such as solar water heating and electricity, heat pumps, wood fuels and water management. The WISE building also provides teaching and workshop spaces for our short public courses on environmental building, ecology, renewable energy, water and sanitation, woodland skills and organic gardening.

Venue Hire http://venuehire.cat.org.uk

WISE is available for conferences and events. Facilities include the 180-seat theatre, seminar rooms and workshops, 24 en suite twin bedrooms and a research laboratory. There's also a restaurant, bar and reception area and outdoor spaces.

About the building

All the materials were chosen to minimise energy inputs and the environmental impact of the construction. Very high standards of insulation and air tightness were specified, combined with design to maximise natural daylighting and ventilation, and low energy fixtures and fittings - all to give a very low energy, low impact building.

Throughout WISE, materials with a low embodied energy have been used - such as timber, earth and hemp. The *embodied energy* of a building element is the total of all the energy used to extract, transport and process the materials used to manufacture it. For example, harvesting and cutting wood to make a timber frame uses much less energy than mining and firing ore to produce a steel-framed building.

WISE has energy-efficient glazing to enhance natural day lighting and passive heat gain from the sun, so that the energy requirements are minimal. Hot water for the en suite shower rooms will be produced by an array of solar water heating collectors on the roof of WISE. Additional hot water and space heating comes from wood-fuelled heating systems also in place at CAT.

Every stage of construction was monitored, from the materials used to the daily journey to work made by the construction workers, so that full environmental footprint can be calculated. This monitoring will continue throughout the building's life.

The Construction Process

The aggregate fill for the foundations was all **slate**, from the CAT site. Parts of the site had bedrock (a low grade slate) that needed to be removed, and this provided sufficient loose aggregate to create a level site.

Slate from a demolished old quarry building was used to build the walls of the courtyard, and as we didn't have slate on site suitable for the decorative facing on the plinth walls, this was brought in from Blaenau Ffestiniog.

Sand lime (calcium silicate) bricks were used to construct the plinth walls that support the frame. These are autoclaved (cured in pressurised steam) instead of being fired, which means they have a lower embodied energy than standard clay bricks.

These bricks are affected by moisture and will expand and contract. To ensure they would work for WISE, we incorporated carefully designed movement joints and used lime mortar (itself flexible).

With hindsight, due to the number of bricks involved, it would have been faster, and so more economical, to use some form of block work - but at the moment it is difficult to find an environmentally sound alternative to conventional blocks.

The brickwork forms a cavity wall filled with *perlite* to provide insulation. The top few inches was mixed with *limecrete* (see below) to provide a cap to the wall. **Perlite** is a volcanic rock that 'puffs up' when heated to high temperatures. As well as insulation under the ground floor slabs, it was used in some walls and ceilings.

At CAT, we avoid the use of cement as much as possible, due to its very high embodied energy. Instead, we've mainly used **limecrete**, which, though not as strong, is more than adequate for many situations. The limecrete mix used shale aggregate from Wenlock and sand from Condover Quarry (both in Shropshire), with St Astier lime. We wanted to use recycled aggregate, but CAT is just too far from major built-up areas to be able to source them readily. The raft foundation had to be ordinary concrete reinforced with steel to achieve the required strength and stiffness - as did the raking foundations that went up the side of the slate tip. Raft foundations spread the building load over a wide area and are stiff enough to withstand some movement of the underlying ground; unreinforced concrete or limecrete would crack in this situation.

We have been able to drastically reduce the embodied energy where we have had to use concrete, by substituting 50 per cent of the Ordinary Portland Cement (OPC) for Ground Granulated Blast Furnace Slag (GGBS). This is a by-product of the iron and steel industry and used to be considered waste, but is now a quite common substitute aggregate.

Traditional fired **clay pipes** have been used for ducts and drains, instead of PVC pipes. We avoided using PVC because it has a high embodied energy and causes other pollution problems during manufacture and disposal.

Timber Frame

The frame is FSC (Forest Stewardship Council) certified European whitewood glue-laminated (glulam) timbers, jointed with steel flitch plates. Glulam uses small sections of solid timber glued side by side and end to end, with staggered joints, to make large beams and columns that can carry high loads over long spans. The formaldehyde glues are not particularly eco friendly, but very small quantities are used.

Due to the size and complexity of the frame we were unable to source it in Britain, and eventually settled on a Danish supplier.

Rammed Earth

At 7.2 metres, the circular Sheppard Theatre has the highest rammed earth walls in the UK. To make rammed earth walls, loose, moist subsoil is compacted in thin layers between shuttering or formwork. Mechanical compaction forces clay molecules to bond with the aggregate (a physical rather than a chemical bond), giving the wall its strength. Particle size and grading, moisture content, and clay content are all critical to the performance of the finished wall.

Llynclys Quarry near Oswestry was identified as source of suitable material (the earth for the walls in our Information Centre also came from Llynclys), and samples of several different materials were taken for testing. The material chosen was a waste product that had already been processed and had a suitable grading - particles of 6mm and less.

A proprietary circular shuttering system with an adjustable radius was used for the theatre walls. Earth was added in 150mm layers and compacted using a hand held pneumatic ram. Four sections of wall were built, with 2 full height gaps for doors. The rammed earth provides structural support for the roof, but does not form the external walls – these are timber-framed glazing (on the south side) and hemp and lime. There is a corridor around the theatre, between the rammed earth and the external walls.

Earth specialists Rowland Keable (of http://rammedearthconsulting.com) and Andy Simmonds (www.simmondsmills.com) were brought in to advise.

We also used **Earth Blocks** for internal partition walls on the ground floor, adding extra *thermal mass* to the building. Made of un-stabilised subsoil similar to that required for rammed earth, blocks are manufactured by compressing the earth in a mould. They can be laid like conventional masonry, using a thin layer of clay slurry as mortar. In the past, we've manufactured blocks at CAT, but it is now possible to buy them ready-made.

Hemp and Lime

The lime binder, *Tradical HB*, was developed to use with hemp. It's based on high purity air lime blended with other materials (including 15% cement). This was mixed dry with the hemp fibre and water was added as the material was sprayed into formwork erected round the timber frame - similar to the process of casting concrete.

The material was sprayed against temporary shuttering to completely enclose the timber frame and create walls 500mm thick. This provides a high degree of insulation and air tightness whilst remaining breathable.

Other Insulation and Roofing

Cellulose (recycled paper) was used for roof insulation, with cork as an insulation layer in some roofs. Cork was also used in key places in the foundations, to prevent cold bridging. As cork is water resistant, it can be used in situations where many other natural insulation materials would be unsuitable.

The roof of the Sheppard Theatre is made from sheet **stainless steel**. Producing this metal is energy intensive, but the main feedstock is recycled steel, so no new ore is usually needed. Stainless steel is extremely durable, and as it is valuable it will always be recycled.

Centre for Alternative Technology
Canolfan y Dechnoleg Amgen

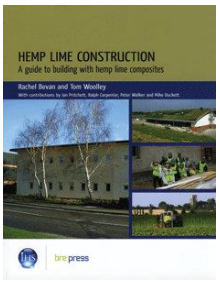
Venue Hire at WISE

http://venuehire.cat.org.uk/ ☎ 01654 704973

The WISE building can be hired to deliver conferences, meetings, training sessions or one-off events. Facilities include the 180-seat Sheppard Theatre, several seminar rooms and 24 en suite bedrooms. See our website for more details.

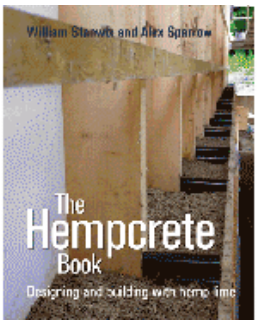
CAT Mail Order

http://store.cat.org.uk/ ☎01654 705959



Hemp Lime Construction
A guide to building with hemp & lime, packed with practical information on materials, design and construction and fully illustrated with case studies and design details. **120 pages, £30**

The Hempcrete Book: Designing & Building with Hemp-Lime
A detailed practical manual for architects, surveyors, professional builders and self-builders. Explains how to source and mix hempcrete and how to use it in new builds and restoration. In colour throughout, fully illustrated with beautiful photographs, this book provides a full explanation of construction techniques, highlighting potential pitfalls and how to avoid them. Includes a comprehensive resources section and examples of completed builds, with design notes. **£35**



CAT Short Courses 2018

Many more eco-building courses listed at: http://courses.cat.org.uk/ ☎ 01654 704966

2 - 6 April ***Timber Frame Self Build***
Frames will be made, erected and clad in the practical sessions. Lectures cover the ecological building methods and design for low energy sustainable housing.

5 – 6 May ***Building with Rammed Earth***
This practical, hands-on course gives a thorough grounding in this method and its application around the world.

4 Aug ***Hempcrete - Retrofitting for self-builders***
Learn about preparing, shuttering, mixing and applying hempcrete in renovation and retrofit, for both timber frame infill and solid wall insulation.

CAT Charity

http://support.cat.org.uk/ ☎ 01654 704950

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