

## Framing a Zero Energy Development (ZED)

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### Peak oil and power down

In Britain most of us live our lives consuming energy as if it will never run out and the construction industry continues to construct buildings which are inefficient and will become expensive to run. We do however have a choice and this involves building to Zero Energy Development (fossil fuel) or ZED standards to reduce energy consumption to a third of current levels allowing clean renewable energy to

Camborne, Cornwall, in 10 weeks as the centre piece for a sustainability exposition. The build was organised by the Cornwall Sustainable Building Trust and built by 3 carpenters and some eco-build students with huge support and sponsorship from local companies. The flat pack kit of parts has been designed to meet the highest environmental standards and can be adapted for housing, offices or schools and has the potential for small high-rise.

rubber waterproofing membranes, and virtually everything else down to the kitchen sink. It is rather like building flat packed furniture that you live in.

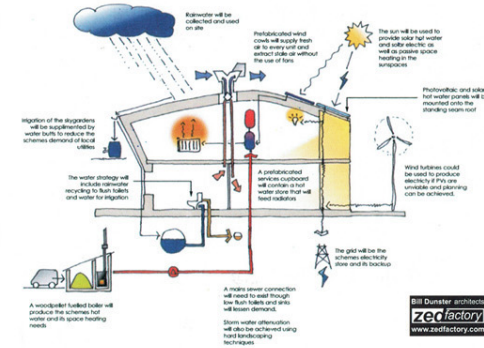
The engineering is by Mark Lovell Design Engineers and the glulam timber is specified to BS 5268 as this grade has twice the shear capacity and far better stiffness than that of solid section timber. All the structural members including joists and rafters are CNC (Computer Numerical Control) cut and drilled. Solid timber sections are always an option but require larger wall and floor sections as well as more substantial joints. Off-the-shelf glulams can be specified in whitewood, (*Picea abies*) redwood (*Pinus sylvestris*) or Douglas fir (*Pseudotsuga menziesii*) or hardwoods like chestnut (*Castanea sativa*) and oak (*Quercus* spp.) for specialist applications or where additional strength is required.



External studwork modules and membrane installation.

The party walls use 160mm square posts at 2m centres with 200mm square posts running offset along the middle. Double 270x90mm beams are jointed into the posts and fixed with bolts. The bracing is between posts in party walls and adjacent to the stair core. A shear plane is formed on all floors and the roof with 18mm WBP plywood laid on C14 joists hung of the beams. The fair faced 45mm thick white concrete planks made with cement replacement and recycled aggregate are suspended from the beams using steel fixings. Timber cover plates along structural grid lines provide fire protection, to the fixings and the modular connection for internal studwork partitions.

For the prototype, reclaimed concrete railway sleepers were used for foundations and were connected to the ground floor beams using adjustable steel shoes. Commercially precast concrete foundations will be used with steel stub columns lifting the superstructure clear of the ground.



Renewable energy and water harvesting diagram for a ZED.

be generated on site to power our homes. Consideration also needs to be given to the embodied energy of making and transporting materials, but this must be weighed up against the life cycle of the buildings in which they are being used. The manufacturing of concrete for example produces more CO<sub>2</sub> than timber but has a very high thermal capacity and is therefore ideal as thermal mass to minimise internal temperature fluctuations reducing the energy needed for heating and avoiding mechanical cooling. Timber on the other hand is a better insulator with a low thermal capacity for making efficient warm structures and is easy to engineer for fire protection using a charring rate. To combat climate change and ecological degradation caused in part by construction both directly by energy consumption in use and indirectly in the production of materials and components for the building fabric, a third green industrial revolution is evolving.

A prototype 3 bedroom, 130m<sup>2</sup> house designed by Bill Dunster Architects, ZEDfactory was built in December 2004 in



Assembled glulam frame.

Making the building water tight is a priority on site and the roof membrane is completely preformed to fit like a glove over the roof with the water tight breather membrane and standard window sizes installed to form the walls to complete the envelope. Factory painted CNC cut laminated redwood was used by Clearwood Joinery for the double glazed windows for good durability and a robust finish.

with solar thermal water heating for summer the wood fuelled pellet stove provides both space heating and hot water during winter and is also the focal point of the house.

Building an air tight envelope brings issues of air quality and moisture caused by cooking and bathrooms. A rotating cowl provides wind and passive stack ventilation without the need for any



UK grown western red cedar rainscreen boarding.

very fragrant but paler in colour than the Canadian wood. Samples are currently being tested in laboratories with early indications showing that the timber is very durable indeed.

### Eco-functional possibilities

As World demand for energy outstrips supply, fuel poverty will become an increasing problem putting local material supply and long-term thinking back on the economic agenda. Building sustainably in the 21st century is something that the construction industry cannot ignore and the seeds of an eco-functional architecture need to be given room to grow to re-address the balance with nature so important for our survival.



All photographs by courtesy of Zedfactory unless shown otherwise



Planning permission was granted this summer for two semi-detached RuralZEDs in Cornwall.

### Natural building physics

The thermal performance of timber is excellent and allows the posts and beams to be integrated into the 300mm thick insulation zone of the walls, roof and the floor giving a U Value of 0.1 W/m<sup>2</sup>K. The walls are breathable but also airtight using a membrane manufactured by Klobber which is wrapped around the outside of the external studwork to minimise any penetrations through it which have to be fully sealed. The double glazed sunspace provides a buffer zone in peak summer and winter and is a source of low-grade space heating in mid-season. Coupled

mechanical equipment. Ducted air is supplied through a heat exchanger unit providing 100% fresh air 100% of the time. Keeping timber components dry and well ventilated is vital for their long term service and this is why robust detailing and ventilated voids behind rain screens are so important. The suitability of western red cedar (*Thuja plicata*) for cladding is well known and the RuralZED rainscreen uses FSC UK grown wrc supplied by Tino Rawnsley Woodland Products cut from the Duchy woodlands and dried in a solar kiln. The timber is from 50 year old plantations and typically has 8 growth rings per inch, is



The lounge and dining area of the prototype show house at the exposition. Photo: Mike McLaren



ZED homes are affordable and can range from single rural developments to multi-storey town houses.