IN DETAIL

40

Humber Centre for Excellence in the Built Environment, Hull

Architect: Niall McLaughlin Architects
Structural engineer: Price & Myers
M&E engineer: XCO2 Conisbee

The Humber Centre will provide an education resource for the local community and will showcase building and environmental developments arising from regeneration activities in the Humber region. The building is engineered to be carbon neutral by generating the same amount of energy as it uses through renewable sources.

An array of photovoltaic panels and wind turbines will produce electricity and a wood pellet boiler will supply hot water to an underfloor heating system. Fresh air will be drawn in at the eaves across an external gutter with water misters to provide evaporative cooling when necessary.

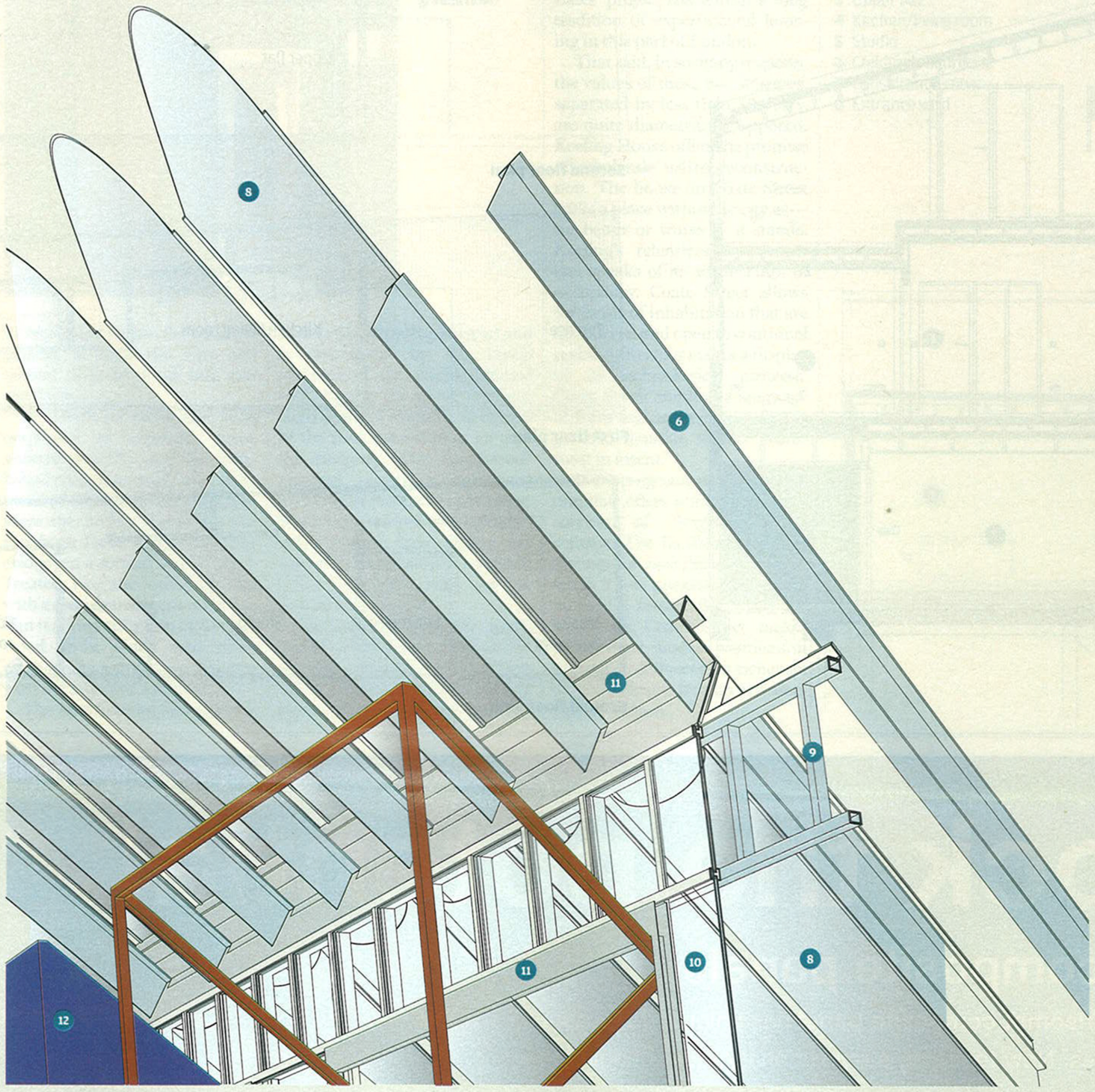
To enable the structure to be dismantled and reassembled, the foundations are a series of precast concrete padstones which sit on the ground. The floor is made from prefabricated steel-framed cassettes bolted together and filled with ballast to resist wind uplift.

The roof is a lean-to structure of 24 steel beam rafters spanning from an eaves beam along the edge of the floor cassette unit to a ladder truss at the ridge. Five steel-framed "caravans" containing offices, WCs and plant rest on their own concrete padstone foundations and support the ladder truss above.

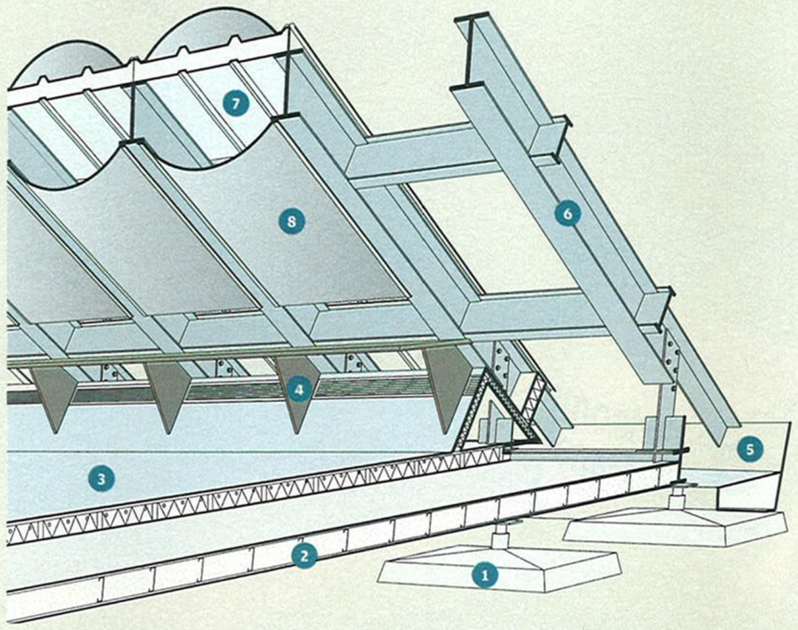
Translucent GRP roof panels 13m long will be fixed to the steel rafters forming a low thermal conductivity waterproof skin.

A reflective, shimmering surface of curved aluminium mesh will be fixed to the underside of the rafters and to the outside of the GRP panels as solar shading. It's intended to project images of the sea, filmed in real time onto the mesh screen outside, reminding passers-by of the city's maritime past.

Drawing and text by Graham Bizley



Cutaway section through top of roof



Cutaway section through roof eaves

The foundations being positioned on site are a series of precast concrete padstones which sit on the ground. The floor is made from steel-framed cassettes bolted together and filled with ballast to resist wind uplift.

1. Padstone foundations
900 x 900 x 125mm-thick concrete padstones at between 2.1m and 2.8m centres on compacted ground.
Adjustable height steel pedestal on each padstone to allow levelling of floor cassettes.

2. Floor cassettes
Prefabricated floor cassette with 152 x 76mm steel channel edge frame on three sides for bolting to adjacent cassettes.
203 x 203mm universal column eaves beam on roof eaves edge to support roof steels.
125 x 50mm light gauge steel channels spanning between steel edges.
12mm WBP plywood sheathing screwed to channels on top and bottom faces.
Voids filled with broken brick ballast to give weight to resist wind uplift.

3. Built-up floor
100mm-thick rigid insulation laid between softwood studs.
Underfloor heating pipes.
18mm WBP plywood floor screwed to softwood studs.
2.5mm linoleum floor finish adhesive fixed and wrapping up vertical face of eaves upstand.

4. Desk
30mm MDF fold-down desktop finished with high gloss 2-pack toughened cellulose paint fixed to eaves upstand.

5. Gutter
1,000 x 250mm-deep stainless-steel troughs in 4m lengths bolted together to form gutter.
150mm-wide aluminium ventilation grille with insect mesh set into plywood soffit over gutter.
Ultraviolet filter in eaves upstand treats incoming air to kill bacteria.

6. Steel roof structure
305 x 165mm x 40kg universal beam (UB) rafters at 1m centres bolted to 700 x 200mm steel connector plates bolted to eaves beam on floor cassettes.
Bottom flange and lower half of web cut off where beam protrudes through envelope at eaves.
Bottom flange cut off where beam protrudes through envelope at top.
305 x 102mm x 31kg UB purlins bolted between beams at minimum 1.8m centres.

7. Translucent roof panels
13m-long x 1m-wide x 80mm-thick translucent profiled GRP panels joined with proprietary metal capping strips.

8. Mesh roof panels
1mm-thick marine grade aluminium mesh with channel frames to long edges fixed above and below.
3mm neoprene isolation strips full length between aluminium and polycarbonate/steel.

9. Steel ladder beam
Steel ladder beam welded up from 90 x 50mm rectangular hollow section (RHS) top and bottom members and 90 x 50mm RHS verticals at nominal 600mm centres.
Roof rafters bolted via cleats to top of ladder beam.

10. Glazing
Polyester powder coated aluminium glazing bars fixed to face of ladder beam and to 60 x 40mm RHS frames on sides of caravans.
Double-glazed sealed units with toughened outer pane, argon filled cavity and laminated inner pane.

11. Aluminium flashing
Polyester powder coated aluminium flashing with joints lapped and sealed with butyl sealant.

12. Caravans
Five "caravans" sitting on concrete padstones supporting ladder beam above.
Each caravan has a steel carcass welded up from 60 x 60mm square hollow sections (SHS).
150 x 50mm softwood studwork screwed to steel carcass and infilled with mineral wool insulation.
12mm birch faced plywood internal finish with vapour barrier.
18mm WBP plywood stressed skin outer sheathing with blue pigmented fibreglass resin finish.

A super-insulated roof caps off the carbon-neutral Humber Centre in Hull, writes David Littlefield

A lean-to to learn from

Niall McLaughlin is modest about the form and structure of his latest project, soon to be erected in Hull. "It's the world's most basic structure," he says.

He's probably right — his new Built Environment Centre is designed along the lines of a lean-to, the sort of thing kids will knock up to make a den. But that is where the simplicity of this project ends.

The centre is the result of an ideas competition run three years ago by the Humber Centre for Excellence in the Built Environment, and it is finally due to be assembled in May. In 2008 the building will be dismantled and moved to another site, where it will stay before moving on again. This pattern is due to be repeated for the next two decades and McLaughlin has committed his practice to sticking with the structure over this period, with a view to refining and reinventing it each time it changes location.

"What we want to do is use it as a kind of learning building," says McLaughlin. "Each time we'll redesign it as necessary. I'd like to think that in 20 years time it might not look remotely like this."

Essentially, the centre is a big wedge. First, concrete padstones are laid out; these are then topped with floor pallettes (filled with ballast to weigh the building down); five large "caravan" modules — prefabricated using standard components supplied by caravan manufacturer Swift Group — are then wheeled into place along one side of this floor plate; and finally, the roof is installed, resting against the top of the caravans and nestled into a transfer beam diagonally opposite at an angle of 34 degrees. McLaughlin reckons the whole process will take three weeks. The detail of the construction is, of course, more complex than that. But in fact, a lot of the work done by engineer Price & Myers focused on creating a complex structure from the most basic components Simplifying and "idiot-proofing" the building elements was a major part of the design process.

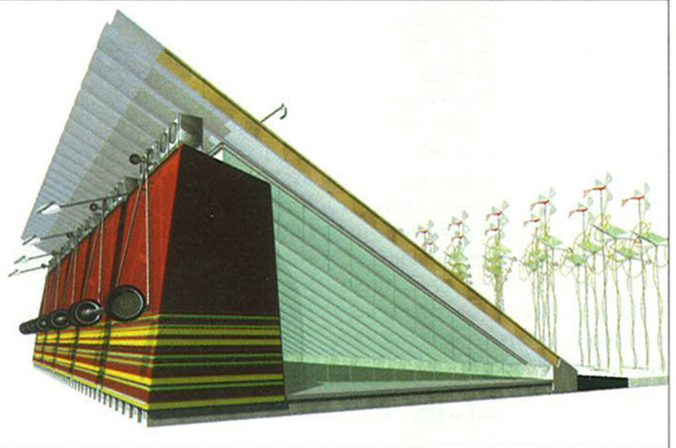
'This is more like an exhibition stand that thinks it's a building'

"This is more like an exhibition stand that thinks it's a building," says Price & Myers engineer Tim Lucas, who needed to create a kit of parts that could be easily dismantled without being merely demolished.

The structure will generate its own power and is designed (if operated at its optimum level) to be "carbon neutral". Apart from all that, this mobile architecture centre is the result of considerable community consultation and local reference — most of its materials, including its blue colour scheme, have been generated locally, and even the use of caravans is inspired by a traditional Hull industry.

One component that is not sourced locally is the chief element of the roof. To look at, the roof is composed of an undulating perforated skin of aluminium — both inside and out. But sandwiched between this cladding is a 100mm-thick polycarbonate product, resting on steel members at 1m centres, more usually seen on warehouse roofs. Sourced from Coventry-based Brett Martin Daylight Systems, these "safelight energy saver plus" slabs of polycarbonate have high insulation properties and a U value of just one. It's also relatively light and strong, as outlined in the product spec: "[It can] withstand loads typical of inadvertent foot traffic or falling person without damage and without dependence on fixings."

As a cost-effective, easy-to- ▶



An early drawing of the prefabricated wedge-shaped Built Environment Centre in Hull.

CREATED USING VECTORWORKS VERSION 11, PROVIDED BY NEMETSCHEK

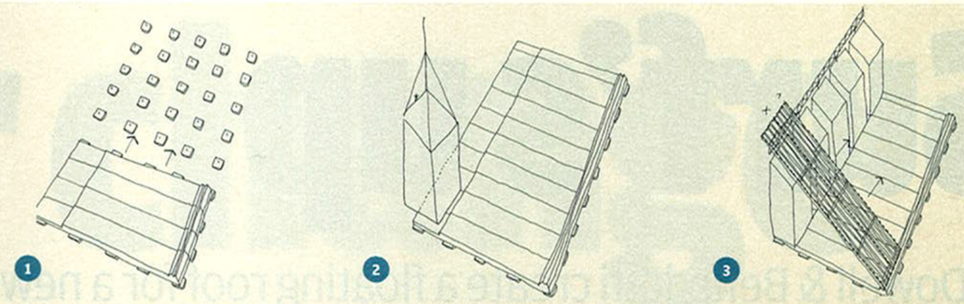
A floating roof creates a landmark in North Yorkshire, page 22

Assembly required

Niall McLaughlin's semi-permanent Humber Centre is composed of a kit of parts, laid down in sequence. First, a series of concrete pads are arranged on a grid system. On the top of each pad is a connecting plate with an adjustable threaded system that allows the height to be altered; then, timber and steel floor cassettes, filled with ballast to anchor the building in high winds, are fitted into place (sketch 1); five "caravan units" are then wheeled into place along one side of the floor plate. These are made of plywood on a steel and timber frame, and use standard components supplied by caravan manu-facturer Swift Group (sketch 2).

These units provide spaces for two offices, two WCs and a kitchen and plant room. A transfer beam is placed along the other side of the floorplate to receive the ends of steel I-beams which lean against a fixture tying the caravan units together; 1m-wide polycarbonate panels are fitted to the steelwork and then clad in perforated aluminium sheets (sketch 3); glazing units fill the gaps between the caravans and provide triangle-shaped walls at the ends of this "lean-to". This volume forms the exhibition space.

Finally, a room which doubles up as seminar and storage space is assembled inside this structure. This element sits on tracks and can be positioned anywhere along the 23m width of the exhibition space.



assemble, large-span insulated product, which lets the light in, it seemed ideal. The problem with a lean-to, however, is that it might provide an ideal "ski slope" for overenthusiastic youngsters. This partly explains the presence of the aluminium cladding, which also acts to keep down solar gain, further reduced by orienting the building towards the east, rather than south.

The undulating metal surface will also act as a screen for moving images, to be projected from one of a number of masts adjacent to the structure. A web-cam will film the sea by day and play it back at night. McLaughlin says the rationale for this low-cost cinematography is two-fold: firstly, in playing back the events of the day, it provides the building with a "dreamlike" quality; secondly, it acts as a reminder of Hull's maritime tradition.

"At one point, 75-80% of the people in Hull worked on the sea or in an industry related to it. The sea is a part of the collective memory of the city," he says. "But now older people say that young people don't even bother to go and look at it."

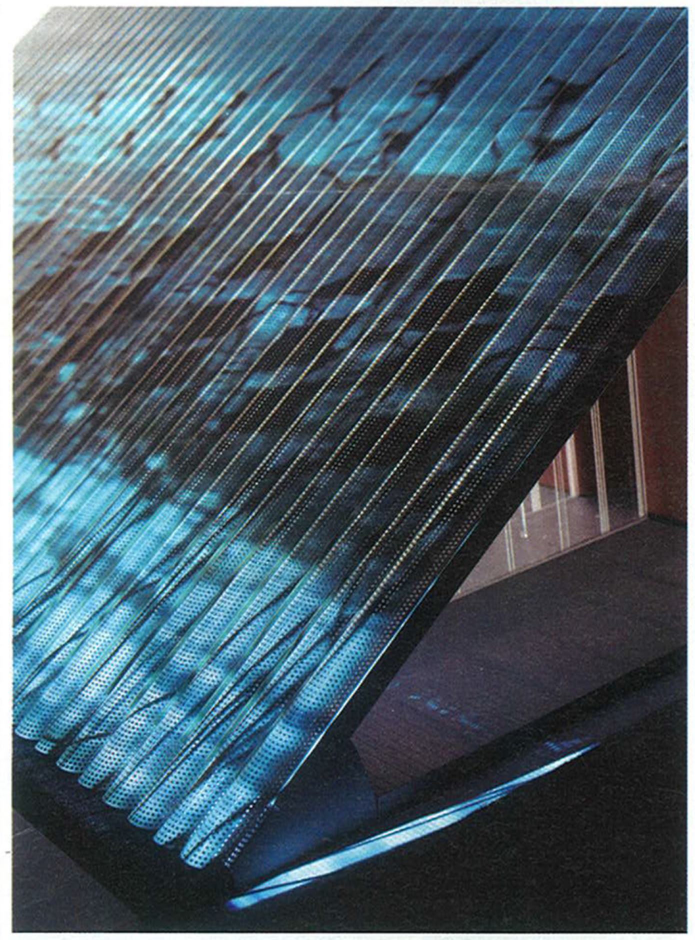
There is a further anti-vandal measure at work to protect the roof or to protect the vandals from themselves. A pool of water sits in a stainless-steel trough at at the lower end of the roof, so only the very desperate will want to get on it. In fact, security is a secondary function for this pool — its main purpose is to cool air that can be sucked into the building through a manually operated vent through the roof's eaves. Warm air is expelled at high level from the main space through vents near the clerestory windows above the caravan modules. Furthermore, the pool is fitted with a sprinkler system which can create a fine mist above the water. Using the principle of the "latent heat of evaporation", by which air is cooled when water becomes vapour, the centre can create its own cool air during the summer months, a technique practised in many Australian gardens.

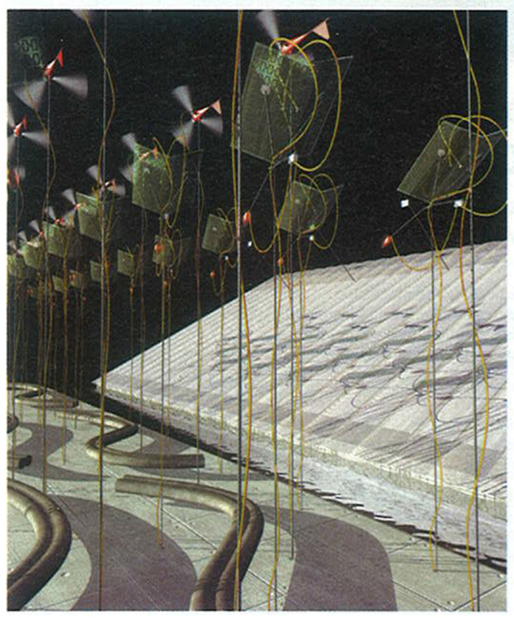
On the other side of the pool, McLaughlin has sited a grid of 39 masts, 23 of which carry photovoltaic cells, while the rest support wind turbines. Worked up in conjunction with environmental engineer XCO_2 Conisbee, which also specified a wood-pellet heater for the building, these energy generators should make the architecture centre self-sufficient in terms of power. The building does not have a battery, however, so most of the electricity it generates will be exported to the national grid by day and imported by night (when power is cheaper anyway). "Basically, we're using the national grid as a battery," says McLaughlin.

When you add it all up, the elements that go into this little complex make for a striking mobile assembly. In fact, this has proved a problem for the Highways Agency, which needed convincing that the centre wouldn't be too much of a distraction for drivers on the nearby A63. The wind turbines were a particular worry for the agency, and were also the target of a local "no" campaign, but McLaughlin managed to convince the authorities that this £500,000 architecture centre is no more distracting than, say, an advertising hoarding.

When you think about it, that's not a bad comparison. This centre has been designed to advertise the benefits of good, progressive and sustainable architecture. When it goes up in May, we'll see if it does just that.

Architect
Niall McLaughlin Architects
Client The Humber Centre for Excellence in the Built Environment
M&E engineer XCO_2 Conisbee
Structural engineer Price & Myers
Contractor Wright Construction
Roofing & cladding RSR Cladding
Aluminium roof panels
Eltherington Aluminium
Roofing material
Brett Martin Daylight Systems





Top: A model of the structure which uses five "caravan" modules to help support the aluminium and polycarbonate roof. On the other side is a grid of 39 masts holding photovoltaic cells and wind turbines.
Middle: The undulating surface to the roof will act as a screen for moving images.
Left: A sketch of the centre shows the stainless-steel trough of water that will be part of the cooling system.