

# SOLUTIONS: TIMBER STRUCTURES

## Project Salvation Army Chelmsford

**Architect**  
Hudson Architects  
**Location**  
Baddow Road,  
Chelmsford, Essex

By Amanda Birch

It is encouraging to come across a client as venerable as the Salvation Army which is also an enlightened patron of architecture.

The desire for a new building emerged from the need to provide accommodation and facilities that met the Salvation Army's changing requirements. It had outgrown its original 1974 one-storey building, in Chelmsford, Essex, where the organisation has had a presence since 1886.

Its layout was impractical, and instead of refurbishment the army decided that it would be more economically viable to demolish the existing structure and rebuild.

Hudson Architects decided to specify structural cross-laminated solid timber for the new building, despite never having used it before. It chose an Austrian-made timber panel system from KLH because of its cost as well as the architect's admiration for DRMM's timber sports hall at Kingsdale School in south-east London.

The layout of the two-storey, part-zinc, part-rockpanel board-clad building reflects two sides to the mission: a hall or gathering place for worship, plus space for the wide range of services and activities the Salvation Army provides such as over 60s clubs, youth activities and toddler groups.

Although these two aspects are intimately connected, there also



Aerial perspective showing the four dormer windows that create the roof's "butterfly effect".

needs to be room for flexibility and separation to enable the spaces to function properly. But of all the services, which range from a community café, IT facilities and a sports hall, it is the worship hall that forms the core of the building.

This square block, measuring 17m x 17m and seating about 320, is where the architect has exploited the plate-like organisation typical of cross-laminated timber structures, pushing the spans of the roof and how it is supported.

The worship hall is top-lit by four dormer windows, each 4.2m wide, that form a butterfly roof. Project architect Gareth Puttock says what makes the roof so unusual is that the butterfly and hip meet at the same point.

"We had an aesthetic in mind that we wanted to achieve," says Puttock. "We could have done it in steel – but it just wouldn't have looked right."

It was also an aesthetic that had

to be carried through by structural engineer Techniker, which has worked with KLH during the past four years, developing a number of standard connection details.

Techniker director Matthew Wells explains the roof structure: "We have taken the panels and made them interact to become a 'true' plate structure similar to but more reliable than a house of cards."

With the timber structure now in place – it took a mere 24 days to assemble – and the £1.96 million building presently being fitted out, not only has the client been convinced of its value, so too have the contractor and structural engineer.

And when it opens on March 21, the presence of the new Chelmsford building will be announced with its shining beacon, a 13m-tall x 3m-wide tower made from the longest single piece of KLH timber available.



Timber panels were treated with intumescent varnish and lined in some places with MDF.

### CROSS-LAMINATED TIMBER

Cross-laminated timber is a timber product manufactured using low-grade timber off-cuts reduced to strips, then glued in perpendicular layers under high pressure, either mechanically or in a vacuum bag.

The product has high in-plane stiffness and can span in two directions. The manufacturing processes, combined with the effects of cross-lamination, minimise swelling and shrinkage, and give particularly stable timber elements.

Structural engineer Techniker has been involved in applications of the KLH system both as an economical alternative to other structural forms, and for its own sake as a building material. Techniker director Matthew Wells says

that early examples of the system's use had it as a substitute for reinforced concrete construction, with floor slabs supported on solid walls.

"In forming large enclosures such as sports halls, the in-plane stiffness of the panels is sufficient to provide all the lateral resistance necessary to resist wind loads without additional bracing," says Wells.

"By making all cross-walls out of solid timber, it is possible to achieve very robust cellular structures which can be taken to 10 storeys and above, and resistance to progressive collapse is easily provided for."

Techniker and KLH have developed a number of standard connection details mainly using off-the-shelf products to



Erection of the panel system, with the tower to the right.

reduce the complexity of connections and keep costs down.

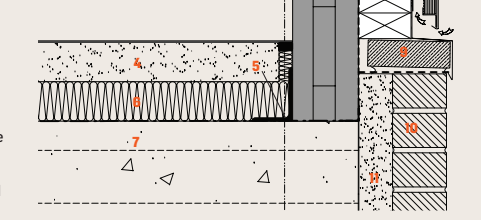
A huge attraction is the quick assembly. The timber arrives on site in a flat pack with cut-outs for windows, doors and concealed services already accommodated. Wall and floor panels are generally joined to adjacent panels by forming

half-lap joints, screwed together at regular intervals.

In multistorey construction, floor panels tend to sit directly onto wall panels with regular screw fixing. Wall panels above are then placed onto the floor panels and fixed with proprietary angle brackets and ties at regular centres.

### Wall detail

- 1 Aluminium frame window
- 2 Rheinzink window sill profile
- 3 Cross-laminated solid timber panel
- 4 75mm floor screed
- 5 Fixing plate
- 6 75mm insulation
- 7 200mm precast slab
- 8 Rheinzink cladding
- 9 Concrete cill
- 10 Blue engineering brick
- 11 Concrete fill



The butterfly roof in the worship hall.

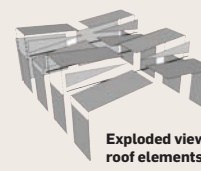
### ROOF AND CANOPY

The two most conspicuous structural elements of the Salvation Army scheme, making the most of cross-laminated timber technology, are the butterfly roof and the canopy on the front (north) elevation.

The roof has no trusses or cross-beams, and relies only on the in-plane stiffness of the panels and cross-ties to resist spreading forces.

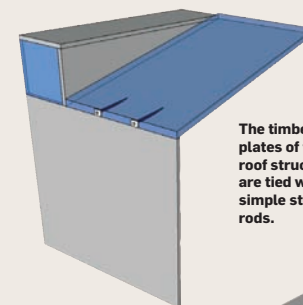
The butterfly roof panels are tied at all joints with bespoke steel brackets to enable the roof to act as a diaphragm, distributing horizontal loads to the end cross-walls.

The 16m-long canopy

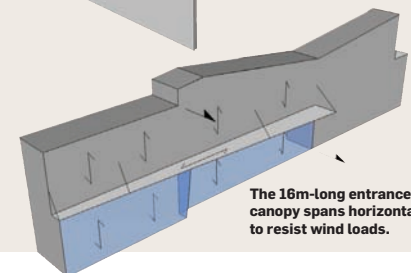


Exploded view of roof elements.

structure, which comprises three segments of the cross-laminated timber strapped together, not only provides shelter but is also critical in providing lateral stability to the front elevation. It does this by being engineered as a horizontal beam, enabling it to resist wind loads and to transfer horizontal loads into the end cross-walls.



The timber plates of the roof structure are tied with simple steel rods.



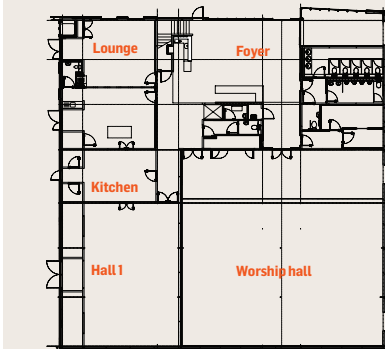
The 16m-long entrance canopy spans horizontally to resist wind loads.

### INTERIOR DETAILS

With cross-laminated timber technology, interiors can often be left unfinished and without coverings. The panels were treated with an intumescent varnish while the architect recommended leaving the interiors unlined where possible, despite concerns by the client that they could resemble a sauna. As a result, spaces such as the sports hall have been left

with raw KLH timber, while more public and visible areas such as the foyer have been lined 3m high with MDF.

The technology has good insulation properties, and only one layer of insulation was fitted to the exterior. The need for internal doors or window frames was also eliminated, but the timber doesn't absorb sound well, although a thin layer of plasterboard helps with this.



Ground floor plan

PHOTOS: HUDSON ARCHITECTS



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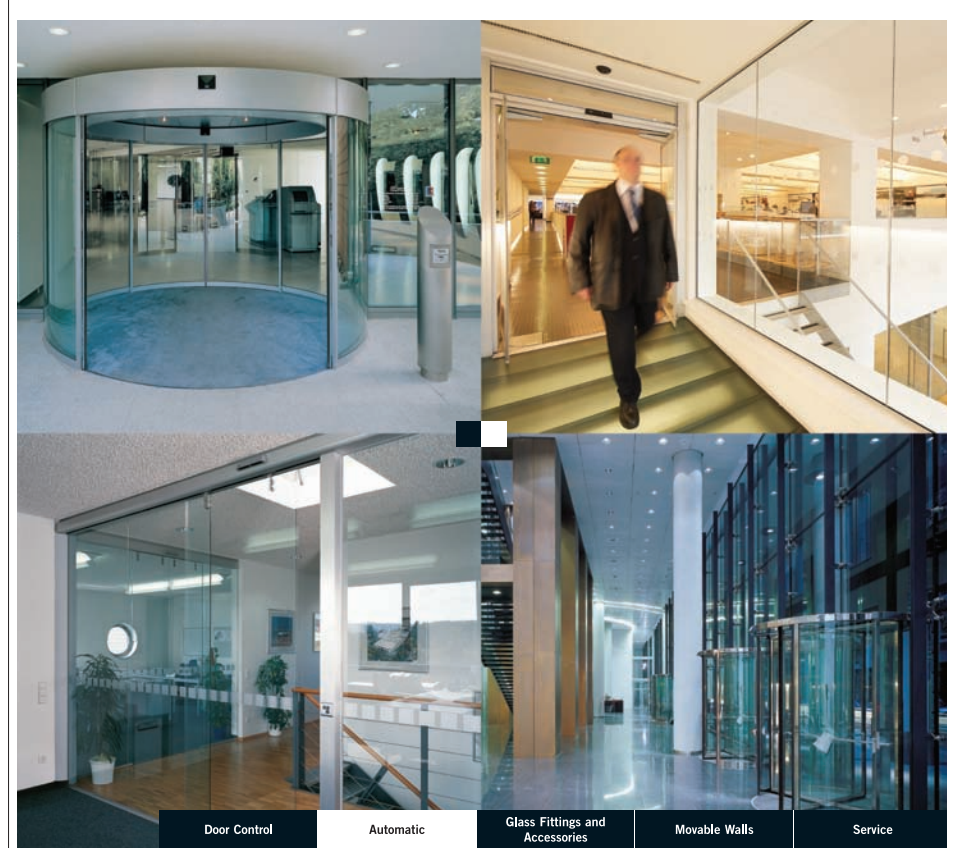
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