StoraEnso

Partner of Stora Enso

B&K STRUCTURES

Hardman Square Manchester-Spinningfields, UK

Hardman square is a celebration of green space, nestled in the heart of Manchester's business district, with interlinked footpaths, planted areas and landscaped spaces. Spanning across four floors, timber frame structure with "living walls" on the external elevations. It features commercial first floor area and on the second floor and a 'sumptuous' roof garden followed by open plan office spaces.

The building is based on a four level regular 6 metre grid pattern, which reveals the entire concept of the structure when viewed externally.

The uninterrupted spans, and a slim-profile floor build up to match the slim perimeter glulam beams, have been achieved with the application of cross-laminated timber (CLT) with glued-laminated timber (GLT) Rib Panels for the floors.

External steel diagonal bracing gives rigidity to the structure and has made it possible to create 6 metre cantilevers in the structural bays at either end of the building. A planter support system forms the final layer of the façade appearing as bands of green across the building and wrapping over the roof-terrace.

Forming a link between Spinningfield's green space, 'The Field' and the surrounding commercial buildings was a key driver. The Pavilion's strongly gridded expressed timber structure clad in living greenery does this by offering warmth and variety from the surrounding steel and aluminum context of the corporate workspace.

The innovative use of CLT and glulam Rib Panels for the floorplate was a key part of the design, enabling the long, uninterrupted spans and slim floor profile required to match the external glulam beams. Floor depths have been reduced by up to 50% when compared to a standard CLT panel and floor to ceiling heights have been maximised. Use of the panels, which were designed by specialist timber engineers at Engenuiti and manufactured by Stora Enso, has also resulted in a lighter weight structure overall.

Engenuiti, was engaged at concept stage to undertake the extensive engineering required to realize the architect's vision of an externally expressed timber and steel frame, which introduced very complex issues relating to differential thermal movement and shrinkage.

The central Manchester site was heavily constrained during construction including a strict limitation to work within the building's footprint which is surrounded by multi-storey operational commercial buildings. B&K Structures were on site for just 12 weeks and installed the timber and steel structural elements in full height sections to overcome the site constraints.

High level of technical achievement, innovation and best practice in the use of timber technology

The Pavilion is an example of best practice in terms of advanced timber engineering, collaborative DfMA methodology, achieving design excellence and realizing the client's aspirations.

The externally expressed timber frame was necessary to enable building above existing basements. The steel diagonal bracing diagram gives rigidity and forms the truss which enables formation of the timber cantilevers at either end of the grid. These cantilevers are significant and could have proved a highly complex problem to solve, however the innovative grid design and Rib panels delivered the perfect solution.

The external frame is subject to all weather conditions which creates significant opposing forces relating to differential thermal movement and shrinkage of the two materials. Resolving this required intensive detailed analysis and an iterative process of optimisation to release connections from built up stresses, while maintaining the required structural stiffness of the frame.

CLT Rib Panels are a viable and sustainable alternative to the steel and concrete composite decks routinely used for commercial floors, however there was no UK precedent for their use at the time and Engenuiti drew on specialist expertise to combine disparate existing guidance on CLT to build in house software to achieve the design.

Delivered on-time, on-budget

Mass timber and DfMA methodology enabled rapid construction in the heavily constrained city centre site. There was a strict limitation to work within the building's footprint which is surrounded by operational multi-storey commercial buildings. B&K Structures were on site for just 12 weeks and installed the timber and steel structural elements in full height sections to overcome the site constraints.

The Ribs were produced at Stora Enso's Ybbs Mill and an adjacent Rubner sawmill in Austria. The prefabricated rib panels contributed to the low footprint of the building as there was little raw material waste. Today Stora Enso produces Rib panels onsite in their mills with even less emissions and more efficiency.

Sustainable, energy efficient and low-carbon

Using embodied energy figures from the University of Bath's Inventory of Carbon and Energy (ICE) - which takes into account "cradle to gate" analysis of materials, Sheppard Robson estimated that the Pavilion would have a vastly reduced carbon footprint when compared to a similar size building built in steel or concrete structure. Stora Enso have calculated that a total of 289.64 m^3 of CLT and 172.42 m^3 of glulam was used for the Rib Panels and frame of the Pavilion, which equates to 338 tonnes of CO_2. Other key benefits of building with CLT and glulam included minimised material waste, reduced construction time and a reduction in the amount of concrete used for piling. Today Stora Enso has even lower EPDs on their materials.

Predesign phase collaboration

Realizing the unique design of the externally expressed frame required advanced engineering expertise and Engenuiti were brought on at concept stage to ensure a design was in place that could be put out to tender. They drew on expertise gained over many years and completed timber projects and developed specialist software to achieve the composite design needed to deliver this complex building.

The use of Rib panels for the floors has a strong basis for the advancement of mass timber construction, particularly for large commercial and adaptable buildings where longer spans are needed than is possible with CLT alone.

The hybrid approach to using timber with other structural materials expands the possible applications.

The collaborative process on this project was refined and efficient, underlining the importance of early engagement of a highly skilled and experienced project & delivery team, well versed in DfMA methodology and with a track record in the delivery of mass timber buildings.

RIBA Awards Shortlisted



Photo credit: Stora Enso



Photo credit: B&K Structures

General

Delivery year

2018

Building type

Commercial

Area (m²)

1,840

Storeys

4

Products

Products and Services

Sylva™ CLT Rib Floors, Sylva™ CLT Floors and Roofs, Sylva™ GLT Beams and Columns, Rib Panels, Sylva™ CLT Stairs

Product quality

Visual quality (VI), Non visual quality (NVI)

Product volume (m³)

404

Product delivery duration (weeks)

7

Number of deliveries

13

StoraEnso

Team

Partner of Stora Enso

B&K Structures

Developer

Allied London

Architect

Sheppherd Robson

Structural Engineer

Engenuiti

MEP Designer

DSA Engineering

Main contractor

BAM Construction

Specialist Timber Subcontractor

B&K Structures

Others

Construction cost (€)

5,300,000

Timber superstructure erection duration (weeks)

7