DESIGNING FOR SUSTAINABILITY

REDUCING THE CARBON FOOTPRINT WITH EMBEDDED CARBON FOR LARGE SCALE, HYBRID TIMBER STRUCTURES

About the Customer

Bush Bohlman & Partners, a Vancouver, Canada based structural engineering design firm, is known for the creative expertise they bring to major engineering projects in Western Canada that include hospitals, university campus buildings, government buildings, seismic retrofits, mass timber, and tall wood buildings. An early adopter of mass timber structures, Bush Bohlman has extensive wood design experience to handle projects requiring the unique technical challenges faced when designing with engineered wood.

> “Structures can account for up to 80% of a building’s embodied carbon footprint; our early collaborative design approach helps us develop options that reduce this footprint and even lead to regenerative design to provide a net positive to the environment.
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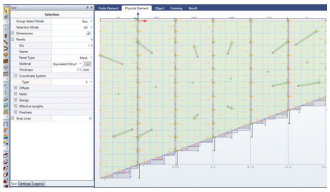
> In response to climate change and increasing natural disasters, we plan and design projects with climate change resilience in mind.
>
> Trevor Whitney,
> Partner, Structural Engineer
> Bush Bohlman & Partners



LEFT: Top view of CLT panels with grids and strip line view.
CENTER: CLT stress contour results from S-TIMBER.
RIGHT: Final model view in S-TIMBER.

Their Challenge

Bush Bohlman was required to perform the structural analysis and timber design for the British Columbia Institute of Technology, (BCIT), student plaza, a pedestrian and public transport user gateway for the institute. The structure needed to establish a strong campus identity with a biophilic design and demonstrable support for sustainable building practices while ensuring structural safety according to local design codes. The hybrid mass timber structure consists of a Cross-Laminated Timber (CLT) canopy, CLT columns, and steel columns.

The pedestrian comfort walkway needed to meet sustainability, reliability, and structural design requirements. For the structural engineering design team, these projects are unique and fluid. New structural models must be developed and modified for the project's life as the requirements are updated by project stakeholders. This structure involved a pitched roof, skylight openings in the roof CLT panels, and supporting columns constructed from CLT and hollow structural steel. In addition to maintaining a current structural model, the engineers needed to apply local timber design codes to analyze the complex two-way bending behaviour of the cantilevering roof panels and irregular column layout.

Our Solution

The engineer opted to use S-TIMBER to model and analyze the 3D structure. Altair collaborated with Bush Bohlman to ensure the correct modeling parameters were applied while simulating the structure.

S-TIMBER was able to perform a hybrid analysis of the timber and steel elements in one operation and code-check the timber elements for code compliance. Using S-TIMBER's built- in and customizable material databases allowed for a quick definition of the materials conforming to the proprietary CLT required. Modeling automation allowed for easier responses to structural changes resulting from design revisions.

With the help of Altair's technical support team, the engineers were able to overcome some technical design challenges using S-TIMBER strip line integration capabilities to extract the structural demands at junctions and supporting columns to design the timber connections and supports further. Strip lines gather loads at the FE mesh nodes over their width to provide results in specific areas of interest depending on where the engineer locates the lines as well as the underlying mesh, which S-TIMBER automatically generate

Results

By using S-TIMBER, the engineers were able to simulate the complex two-way bending behaviour of the cantilevering roof panels and asymmetrical column layout. Having the model in S-TIMBER allowed for changes to be analyzed and re-designed, without the need to manually design individual timber and steel elements. S-TIMBER's design reports presented the design calculations concisely, yet transparently, for faster and easier reviews. A 3D visualization of the finished model was available for sharing with project partners.

The engineers could also export the final model into a CAD compliant format for additional postprocessing to provide the necessary drawings for fabrication purposes.

To learn more, please visit altair.com/aec