

Steel Arches

Steel backbone for Kenora's new concert venue



JAMES GALLAGHER, TENSILE INTEGRITY INC.
Two large steel arches are the backbone for Kenora's new Whitecap Pavilion. The venue consists of white wave-shaped fabric covers supported on the steel framework.

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When a new concert venue was proposed for Kenora's waterfront, a simple bandshell design was tossed about. What the city ended up with is anything but simple.

The striking new events venue — aptly called Whitecap Pavilion — consists of white wave-shaped fabric covers or canopies supported on a steel framework that forms a 24,000-square-foot tensile structure.

The stage cover features two peaks or cones. It is supported by "rabbit ears" — steel tripod towers projecting off the arch at one end, explains Dave Bowick, principal of the Toronto-based Blackwell Bowick Partnership Ltd., the structural consultant for the project which was completed last fall.

Whitecap Pavilion is one of the largest tensile fabric structures of its kind in Canada. It has been a complex project to engineer, he says.

Like any tensile fabric structure, one of the big challenges was dealing with "extremely complex geometries," says Bowick. The connections of the structure required "a lot of adjustment to allow the fabric to be pulled into its final stressed condition."

Where the membrane plates come together and "very complex shapes arise" was the toughest part of the project, he points out.

The resulting forms are "extremely beautiful and elegant," derived from their required function. "In some ways they look like they are designed to be beautiful but it is a form entirely derived from the demands on the structure," Bowick explains.

The design and analysis was done with NDN, software tailored to large deformation

structures which include tensile structures, he says, adding conventional analysis software programs assume structures move very little, which is anything but the case at the Kenora project. "It takes special algorithms to work these things out."

The new venue is 74 metres long by about 15 metres high. The structure is designed in three segments spliced together, says Bowick. The steel frame incorporates two large steel chevron truss arches, which make up a triangle in cross-section.

Choosing a three-sided box truss, instead of a conventional four-sided one, cut steel requirements by 25 per cent, says Bowick, adding that a flat-arch truss wasn't an option because it has no lateral stability, a prerequisite of the unusual fabric tensile structure.

Keeping costs down was a prime directive of owner the City of Kenora as the project moved from a simple design to

a complex one. "For every piece of program that was added (at the design stage) it had to be done in a more economical fashion than the prior program," says the engineer.

To meet the "very tight" budget, Blackwell Bowick engineered as much design repetition of steel components as possible into a building form that doesn't lend itself to repetitive parts assembly.

"We worked very hard to massage the geometry to make the tripods (perimeter supports) as identical as possible," explains the engineer.

While the complex design was not cheap, neither were the coatings required to protect the steel from the elements. The pricey PSX coating specified is comprised of inorganic zinc with a specialized epoxy topcoat. "It is cheaper to make a structure heavier than it is to protect it," says Bowick.

To further protect the structure from the environment, continuous seal welds were specified, pins were caulked and coated in the field and hardware was either galvanized or made of stainless steel, he adds.

General contractor KMA Contracting Inc. retained Tensile Integrity Inc. as the fabric structures sub-consultant. The venue is a design by landscape architect Hilderman Thomas Frank Cram.

The team included Seaman Corporation (membrane fabric supplier), Lightweight Manufacturing (roof membrane fabrication), and Sopers (sidewall fabrication).

Blackwell Bowick has experience with tensile fabric structures, including a number of amphitheatres and shade structures in Canada and the U.S. The engineering firm had a small role in the new cable-supported retractable roof installed on Vancouver's B.C. Place Stadium.



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