NCC Rideau Canal Skateway Chalets

2013 Canadian Consulting Engineering Awards Submission
Technical Building Category

Halsall

Project Summary

The Rideau Canal Skateway Chalets were designed and constructed to provide modernized change room and washroom facilities for the 1 million Ottawa residents and visitors who use the picturesque Rideau Canal Skateway every year. Spanning almost 8 kilometers, the Rideau Canal Skateway is the world's largest naturally-frozen skateway. The Rideau Canal system was constructed between 1826 and 1832 to join the Ottawa River to Lake Ontario in Kingston. In 1971, the National Capital Commission (NCC) began clearing snow between Parliament Hill and Dow's Lake to allow skaters to use the long stretch of ice that formed each winter. The original timber and steel skating huts dated from that era as well.

In 2010, the NCC, which oversees this section of the Rideau Canal UNESCO World Heritage Site, decided to upgrade the skateway chalets to provide greater functionality, universal user access, easier annual transport and installation, and distinctive aesthetics that would enhance visitors' overall skating experience.

Halsall was engaged to provide structural engineering services for the seven new chalets – four change rooms and three washrooms. Working with CSV Architects, Halsall provided a structural design that is welcoming, safe and durable, yet easily transported, installed and removed each season. The new chalets were completed on schedule and installed for the Winter 2011 season.

Innovation

Halsall employed several design innovations to achieve the project's challenging requirements.

To capture the architectural roof profile, Halsall designed custom steel sections that were deliberately left exposed to highlight this feature. Beam penetrations in the exposed sections were maximized for both aesthetics and to minimize building weight. Normally an expensive feature, the custom steel sections could be justified because the profile was standardized and repeated throughout all seven buildings.

Consideration had to be given to lifting the chalet buildings as well. Different penetration patterns were used at the steel sections supporting the lifting point locations. This was done to maintain adequate strength to support the self-weight of the structure. To optimize the structure's stiffness, we used computer modeling to generate the most efficient truss profile along the front of each building. A combination of steel deck and rod tension bracing at architectural skylights was used to resist roof diaphragm loads in the at-rest and during-lift design cases. Both elements were capable of conforming to the slope of the roof.

Finally, an engineered timber floor joist system was used to satisfy the architectural insulation and mechanical and electrical service requirements.

This project has already been recognized for its excellence and innovation by a 2012 Ontario Association of Architects Award. It was also the subject of a feature article in Canadian Architect's February 2012 issue.

Above:
Before and after shots of the custom steel sections used to capture the architectural roof profile. The steel sections were intentionally left exposed to highlight this feature.

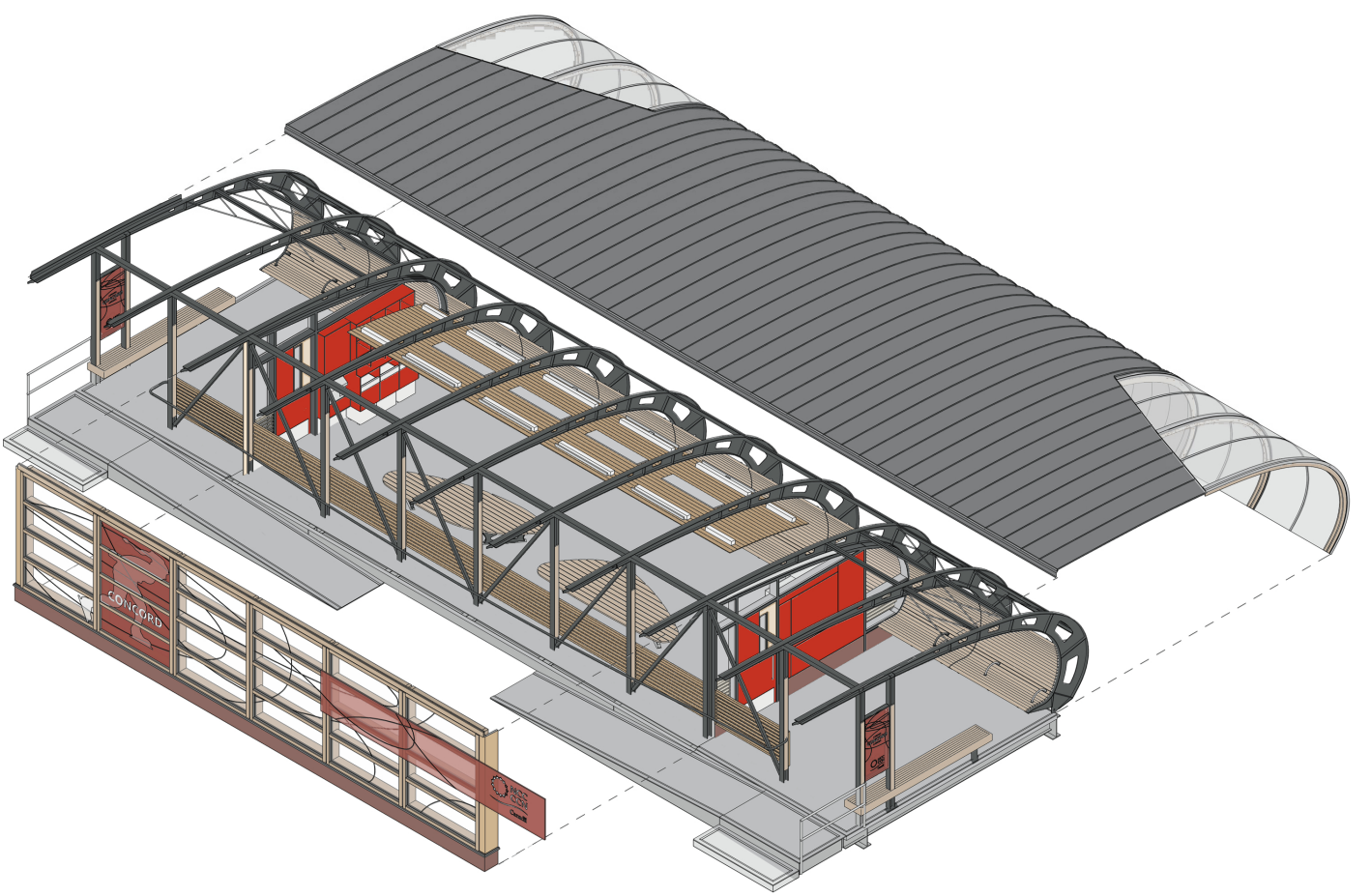
Complexity

The chalets' small size belies the considerable structural engineering challenges inherent in this project. Halsall was required to come up with a structural system that not only made the chalets durable, safe, easily transportable and easily installed, but that gave life to the architectural vision for modern, yet heritage-sensitive, facilities.

The largest challenge was the design requirements for installing and removing the chalets from the canal each season and then transporting them to and from their storage locations. Road dimensions and weight restrictions imposed by the lifting cranes could not be exceeded. The stiffness of the chalet structures was also critical to the design. An optimal stiffness was required to maintain deflection tolerances of the architectural finishes, glazing and doors during installation, removal, transportation, and use. Castellated, curved and tapered steel beams were designed to achieve the elegant architectural profile of the roofs while minimizing the weight of the structures. Full-height hybrid Vierendeel trusses were also used along the front of each building to minimize steel section sizes and weight while increasing the stiffness of the buildings. Lifting connections on the roofs also had to be considered in the design.

Another challenge was designing the lifting frame to install and remove the chalets from the canal each year. To equally support the chalet's four lifting points from the single lifting point of the crane, Halsall designed an independent steel rigging frame. The steel frame provided a balanced lift that eliminated any horizontal loads and resulting stresses on the chalet structure. The weight of the lifting frame had to be carefully considered as the total effective weight of the chalets, including the lifting frame, was limited by the crane capacity.

The supporting foundation in the canal during the winter season proved to be another challenge. The environmental impact to the canal was the top priority in determining the foundation type. The final decision was to reduce the initial number of foundation supports for each building from eight to four, and to drive a permanent helical pile system into the base of the canal. Boating on the canal in the summer restricted the allowable height of the pile system, so a custom height steel interface between the steel structure and the piles was required at each building location. As well, since soil conditions varied between soft soils and bedrock, different pile designs were required for each building.



Above:
Exploded Axonometric View - Chalet Assembly

Social and Economic Benefits

The new chalets are an important part of the NCC's plan to maintain the economic viability of the skateway. They are helping to boost economic development through tourism and increased attendance at such prominent events as the annual February Winterlude Festival, the Bed Race, the Great Canadian Beaver Cup Pond Hockey Classic, skating demonstrations and more.

The canal skateway and the skating huts have been Ottawa fixtures for over four decades. By improving the amenities along the skateway, the NCC is ensuring that skaters will continue to enjoy and appreciate this unique outdoor skating rink for generations to come. Making the chalets larger, more welcoming, and more accessible has meant that the skateway is available for an even larger segment of the population. And making them more easily transportable means their annual trek from storage to canal is much less disruptive to the natural flow of traffic.

Above:
The new skateway chalets are used as a refuge from Ottawa's cold winter conditions, as seen in this shot below where skaters prepare for the outdoors.

Environmental Impact

The new chalets have made significant contributions to the environmental quality of life. The design and construction of the chalets is aesthetically pleasing and fits in with both the canal's natural surroundings and the built environment. Materials and design methods were deliberately chosen for their low environmental impact and because they would not adversely affect the canal's functionality in the off-season. For example, architectural finishes included mostly wood - a renewable resource. Other materials chosen for their performance and longevity include solid zinc roofing. Finally, the new modern chalets contribute to the continued viability of what was once primarily a commercial waterway.

Sustainable practices were also incorporated into the chalet's design. Energy savings were realized with energy efficient windows, daylight sensors and LED lighting. Radiant heating was used to combat the almost continuous influx of outdoor air during the chalets' use. The structure itself also contributed to the sustainable aspects of the project. Steel was the primary building material used for the chalets, incorporating a significant recycled content. The floor system primarily consisted of Laminated Veneer Lumber (LVL) joists, a recycled timber product. Some carbon reduction resulted when the only concrete portion of the project – the footings – were replaced with steel helical piles.

Above:
As shown in this image, wood (a renewable resource) was used for most architectural finishes.

Meeting the Client's Needs

The NCC's overall objective was to create distinctive and high quality structures that would respect the canal's UNESCO World Heritage Site status and provide a memorable experience for skaters and other visitors.

The skateway change rooms and washrooms are a crucial part of the infrastructure serving the canal. Since there are very few other change room or washroom facilities within walking distance of the canal, these facilities are necessary to provide skaters with a welcome refuge from Ottawa's cold winter conditions.

In commissioning new chalets to replace the old huts that were built in the 1970s, the NCC was looking to increase the amount of space available to skaters, provide universal accessibility, maintain a visual connection with the skateway outside, make the user experience more pleasant overall, and make it easier to transport the skateways each year from their off-season storage location to the canal.

Designed with a unique rigid steel frame, the new chalets are finished with glass and wood, creating a warm and inviting refuge. Floor to ceiling windows allow natural light to flood into the buildings and connect the inside with the skateway outside. Each of the change rooms now comfortably sits over 40 people, with space for an additional 12 skaters on sheltered porches at each end of the building. Large ramps offer barrier-free access for all canal visitors, and the specially-designed sloped roofs mean that snow, ice and rain are shed off the back of the buildings - not onto visitor's heads!

A key objective was to make it easier to transport and install the chalets each year. The old chalets were too large to fit under Ottawa's many downtown bridges so they had to be transported along a special route. The new chalets were designed with a curved vaulted form which not only fits easily under the bridges, but references the surrounding built environment and the historic city centre.

Judging from the positive feedback from the NCC and skateway visitors, the new chalets have been a hit. As one skater commented, they "fit in so well with the canal…they give you a real feeling of space."

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Images

Photos courtesy of Gordon King