Shane Homes YMCA at Rocky Ridge

CALGARY, AB

Canadian Wood Council
Conseil canadien du bois

woodWORKS!
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Cover photo: David Troyer
Photos this page: Adam Mork

Introduction

Calgary's aspirations to become a world-class city are supported by its recent investments in infrastructure and architecture, including the $192-million Shane Homes YMCA at Rocky Ridge, which was bolstered by the largest private donation ever contributed to the local YMCA. Shane Homes is a Calgary-based development company, established in 1979, that contributed $3.5 million for the project. This is the first recreational facility for the northwest corner of the city, serving a community of more than 100,000 residents.

Nestled in Calgary's rolling foothills, the curvilinear design of the Shane Homes YMCA at Rocky Ridge is inspired by the surrounding landscape. The building is sited within a natural park featuring reconstructed wetlands. Multiple pathways and a timber pedestrian bridge curve throughout the site, linking to the regional pathway system. Glulam timber is the primary structural component, allowing for a geometrically complex design at considerably less cost than other materials. The dramatic silhouette is defined by the largest freeform timber roof structure in North America.

Construction began in 2014, and since opening to the public in January 2018, this new recreation centre has become a bustling hub of sport and activity. The Shane Homes YMCA has won numerous awards, including a 2019 Wood *WORKS!* Prairie Wood Design Award, a 2018 Canadian Wood Council Award and a 2017 CanBIM Best in BIM Award.

Photo: Adam Mork

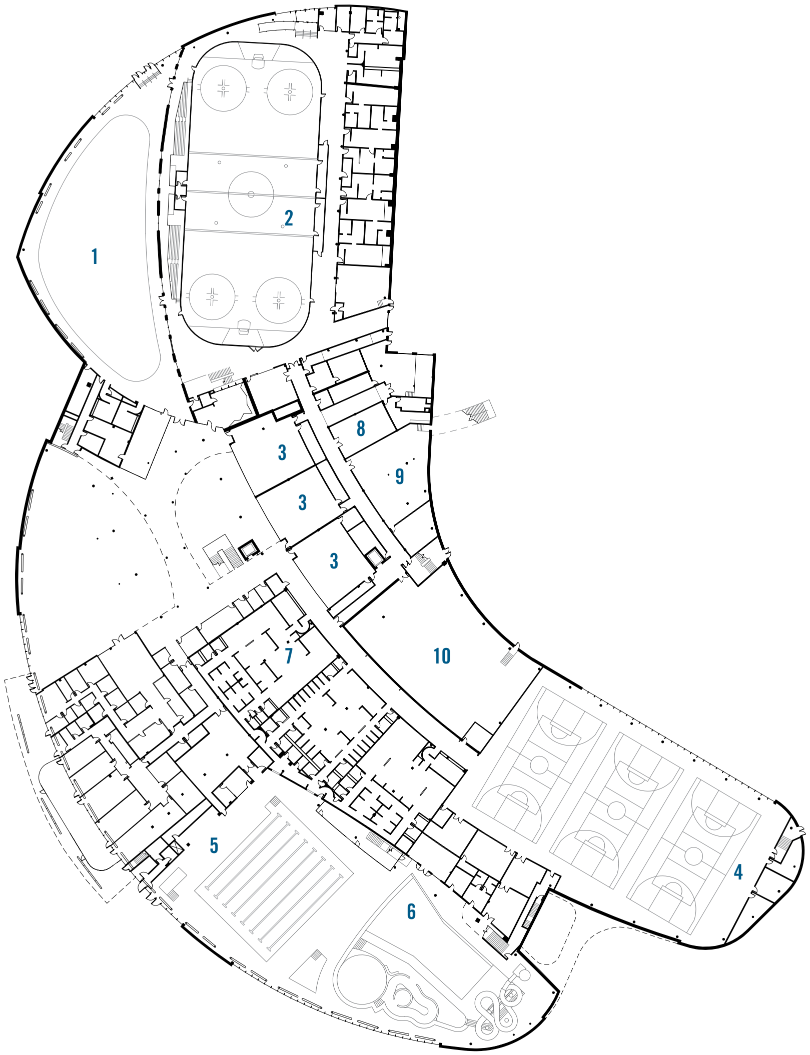
Photo: David Troyer

Project Description

At 26,385 sq.m. (284,006 sq.ft.), the LEED Gold–targeted structure was the largest YMCA in the world at the time it was built (surpassed by another Calgary YMCA project completed in 2019), with the largest glulam roof in North America. The structural system consists of long-span glulam beams supported on steel. All building elements are set beneath a rolling roof structure that wraps the interior programs, expanding the volume over the areas where extra height is required, and lowering where it isn't needed. The low horizontal form of the building is stitched comfortably into the site's topography, elegantly mirroring the natural contours of the surrounding prairie features. To emulate the warm tones of the prairie countryside, the exterior facade is comprised of brass tiles. The ribbon-like form of the facade creates large, curving expanses of glulam-supported high-performance glazing, accommodating key views from within the facility while selectively revealing the activity to passersby.

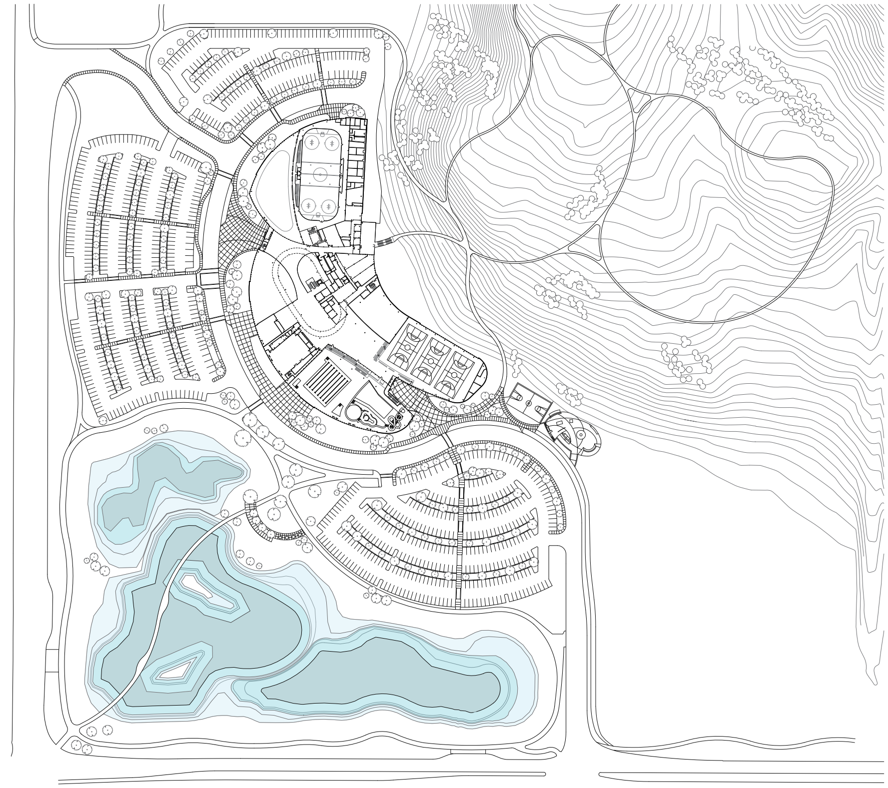
Photo: Adam Mork

Universal inclusiveness and accessibility were pillars of the three-storey design. There are two main entrances, with several secondary access points. At the reception area, entering on the second level from the sloping site allows the building to be vertically organized. Diverse uses are integrated into a single, open space in which all activities are visible, with most of the athletic facilities on the first level. A grand public concourse overlooks activity areas and provides visual access for spectators to the aquatics, gymnasium and ice functions. The library, visual arts components and theatre are arranged around the active concourse on the second level, creating a compact plan that promotes interaction between users, while the top level features a 200-metre running track with views of the entire volume. Program layering and an open, well-lit plan enhance the visual impact of the structural elements, which includes steel columns at the perimeter to support the roof beams.



1. Recreation Ice Rink
2. Hockey Rink
3. Fitness Studios
4. Three Mixed Courts
5. Swimming Lanes
6. Aquatic Park
7. Change Room
8. Loading/Service
9. Boiler/Chiller
10. Air Handling

Level 1 Floor Plan



Site Plan

The facility includes a skateboard park, a climbing wall, a 25-metre pool with eight lanes, a leisure pool, two ice rinks (one for hockey and one for recreational skating), three full-size gyms, a large fitness area and studios, a running track, a 250-seat theatre, art spaces and even a 279-sq.m. (3,000-sq.ft.) “self service” library, the first of its kind for the city. The natatorium includes almost 300 spectator seats overlooking the lap pool and bleachers on the pool deck. Tenant spaces provide food service and physiotherapy amenities. One set of central change rooms serves all activities, except hockey; the universal change room is among the first in Alberta and Canada, providing an open, barrier-free area to support a diversity of abilities, orientations and family arrangements. Oversized private change stalls accommodate families and people with attendants. There is only one short public corridor in the building, connecting the change rooms.

Structure

In the early stages of planning a freeform roof, several structural systems were considered; a glulam girder and purlin system was quickly identified for its ability to achieve the design objectives in a cost-effective manner, largely due to prefabrication. The project was developed with extensive input by Structurlam (the Penticton-based glulam fabricator), from the concept design stage through to and following the construction tender. To ensure fabrication timelines could be met, Structurlam worked with GEC Architecture and RJC Engineers to determine an optimized, curved primary beam production system. This involved using one consistent glulam arch layout and moving sections of the beam in and out along this primary jig line. The single-roof glulam beam design resulted in significant cost savings for the City of Calgary, while simplifying material shipping and storage requirements.

Photos: Top left and right, David Troyer; bottom and opposite page, Adam Mork

The roof is curved in plan and section, with the geometry determined by timber beams of differing lengths, elevations and angles. Each glulam beam is 315mm wide by 1,500-1,800mm deep, made of Douglas fir sourced from B.C. forests; one beam could weigh up to 8,000 kg. The building features a total of 160 primary beams and nearly 2,000 purlins, in a wide variety of lengths. Each beam is uniquely positioned to create the building's organic plan and undulating, 17,280-sq.m. (186,000-sq.ft.) roof. The structural system works similarly to a large tent, with a roller-coaster brace frame around the perimeter. Snow drift loads were calculated, which resulted in extremely high loading conditions along the perimeter of the building around the parapet; coordinated BIM and fabrication delivery systems from all team members ensured high-capacity connections.

Photo: David Troyer

Materials

STRUCTURAL

Frame:
Glulam beams with glulam purlins on steel columns with exposed cross-bracing (Structurlam/Glenmore Fabricators & Hometech)

Floor:
Exposed structural concrete (PCL)

Roof:
Canem metal deck (Thermal Systems)

Interior partitioning:
Concrete/masonry/steel stud (PCL/Brxton/BC Drywall)

EXTERIOR

Siding:
TECU brass interlocking shingles (Thermal Systems)

Roofing:
Galvanized Kalzip standing seam (Thermal Systems)

Special technical considerations:
Timed egress and smoke generation calculations were needed to demonstrate the safety of the open, multi-storey space.

Carbon Summary

RESULTS:

Volume of wood products used:
2,822 cubic meters (99,657 cubic feet)

U.S. and Canadian forests grow this much wood in:
8 minutes

Carbon stored in the wood:
2537 metric tons of carbon dioxide

Avoided greenhouse gas emissions:
982 metric tons of carbon dioxide

Total potential carbon benefit:
3519 metric tons of carbon dioxide

EQUIVALENT TO:

744 cars off the road for a year

Energy to operate 372 homes for a year

Results from this tool are based on wood volumes only and are estimates of carbon stored within wood products and avoided emissions resulting from the substitution of wood products for non-wood products. The results do not indicate a carbon footprint or global warming potential and are not intended to replace a detailed life cycle assessment (LCA) study. Please refer to the References and Notes' for assumptions and other information related to the calculations.

Environment

The Shane Homes YMCA is aiming to achieve LEED Gold status through several initiatives. A heat and power cogeneration system produces electrical and thermal energy from natural gas, which significantly reduces waste energy and greenhouse gas emissions, operational costs and the capital costs of a boiler capacity and backup generator. The system also heats the swimming pools and domestic hot water. Overall carbon dioxide emissions are reduced to less than half of the equivalent energy from a coal-fired source. Grey water from the whirlpool backwash is used within the facility to flush all urinals and toilets, and the site itself is designed so that stormwater runoff is pretreated in bioswales and oil and grit separators in order to protect the wetlands. The use of timber throughout the facility further reduces the amount of carbon released into the atmosphere.

Site considerations played a significant role in the design, out of respect for a habitat that supports a variety of wildlife. The wetlands area was expanded and regenerated, so that the site runoff enters a densely vegetated zone to optimize filtration before flowing into the regional drainage system. A variable control structure regulates the water levels to help sustain the wetlands, while a timber bridge and perimeter pathways invite visitors to enjoy the natural setting.

Photo: Adam Mork

Photos: Two images above, David Troyer

Photos: Top left and above, Adam Mork

Technology & Design

The design team incorporated a repetitive structural beam profile with a common radius that aligns along a consistent radial grid. During design, parametric modelling software was implemented to adjust the formal geometry and optimize the dimensional deviation between the radial glulam beams and the structural roof deck bridging between them. Parametric software also was used to calculate the compound curvature of the sacrificial lamination layers of the glulam beams and produce surface profiles used by the glulam fabricator's CNC machinery. By using the Grasshopper plug-in for Rhino3D, the architect was able to optimize the curvature deviation between each beam length, and control the amount of sacrificial lamination required for beam manufacturing. Parametric modelling allowed for real-time exterior envelope calculations to run parallel to design, which played a large role in delivering 3D geometric controls to the glulam and steel fabricators. Three-dimensional models developed in Revit, Rhino and Solid Works were shared among the team throughout the process, resulting in minimal field modifications.

Due to transportation constraints, glulam beams that spanned the 80-metre width of the building were not feasible. By engineering large moment splice connections at mid-span, with connections ranging from 2-4 metres in length, the beams were reduced to a maximum of 27 metres. This also provided a substantial cost savings. The location of the splices was optimized to minimize moment design forces within the glulam, and each moment connection was individually optimized for screw placement and local forces. Structurlam also deployed the use of pre-engineered primary beam-to-purlin connections, in the form of Knapp Ricons. Based on loading a variety of screw patterns, different Ricon sizes were used in each connection location. The use of pre-engineered connections significantly shortened supply lines, simplified deployment and eased quality assurance and supply chain concerns.

With 2,750 sq.m. of glulam, seasonal shrinkage was a major consideration due to the fact that the beams typically shrink and expand 20mm vertically and 3mm horizontally – however, at this scale, those numbers rise considerably, to as much as 180mm across the entire roof. The movement was accommodated in the roof assembly joints, with all bolt holes being pre-machined on CNC in Structurlam's facility, while multiple types and sizes of self-tapping screws and fully threaded rods were used to reinforce the glulam connections in several conditions.

Structurlam provided design supply services and brought on ISL Engineering for specialty engineering design, while PCL Construction oversaw the proper installation of all components. PCL awarded the structural steel contract to Glenmore fabricators, who installed the steel and mass timber glulam roof system, with the assistance of a specialty timber installation group, HomeTec. PCL proposed a BIM solution to address the challenges of the complex design, so the team created a 3D model based on 2D drawings, which was then hosted on a cloud platform so that multidisciplinary teams could collaborate in real time. This was the first global project coordinated in BIM 360 with such a large number of trades, on a scale of this size. This system is estimated to have accelerated the structure and envelope by approximately two months, resulting in significant cost savings for the client. Despite most construction occurring during the winter months, the project was on time and on budget.

Three Dimensional Modeling Development Sequence

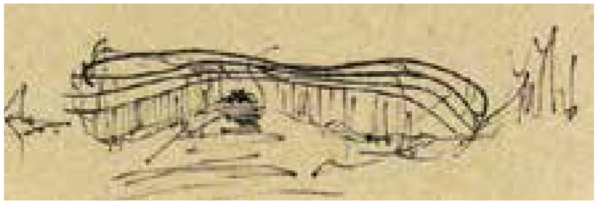


Image 1
Early sketch development of the massing concept.

Image 2
First generation Rhino modeling study of the building form.

Image 3
Second generation Rhino model study of the structure geometry.

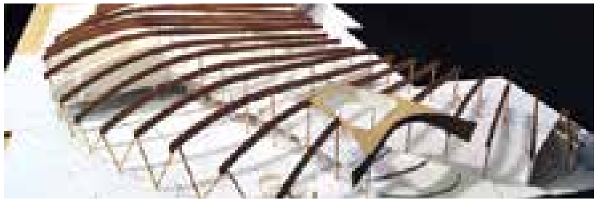


Image 4
Card model constructed at large scale to study the interiors and perimeter structure.

Image 5
Photorealistic rendering of the wetland reconstruction and pedestrian walkway.

Image 6
Revit working drawing level structural model showing primary structural frame. Architectural layers have been hidden to show the frame geometry.

Conclusion

GEC Architecture is a strong advocate for an integrated and collaborative design/construction process, and the Shane Homes YMCA at Rocky Ridge is a testament to the success of their methods. The design complexity, scale and schedule presented many challenges that were tackled with grace, resulting in a structure that elevates the use of mass timber in an application that is both practical and beautiful. By understanding the limitations and potential of the fabrication process, the design team was able to coordinate its vision throughout the shop drawing, fabrication and erection phases. The tangible results included record-breaking enrollment for the facility, which will continue to anchor and inspire the community for many years to come.

Photos: Adam Mork

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