The Mosaic Centre for Conscious Community and Commerce

Edmonton, Alberta

Canadian Wood Council
Conseil canadien du bois

WoodWORKS! Program of the Canadian Wood Council

Cover Photo: Rory by Western Archrib

Photo Above: Ross Auser

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Introduction

Located in Edmonton, Alberta, the Mosaic Centre for Conscious Community and Commerce was designed to be the province's first "net-zero energy" commercial building and demonstrate the feasibility of low-energy-use buildings in cold climates.

The owners challenged the design team to deliver a net-zero energy building capable of gaining certification by the Living Building Institute (see **text box** below) and LEED® Platinum. In addition, feasibility analysis favoured wood construction to meet all building science challenges and also provide an enhanced interior work environment.

Construction started in mid-March 2014 and was completed in the fall of 2015 — three months ahead of schedule and on budget.

The 2,790 m² (30,000 ft.²) building is located in the emerging southwest Edmonton community of Summerside (**Figure 1**).

FIGURE 1 Site Plan

1. Entry
2. Roof top terrace
3. Green house "village"
4. PV array
5. PV array on trellis
6. Balcony below
7. Daycare sunken terrace
8. Restaurant patio
9. Wellness raised terrace
10. Underground rainwater collection
11. Rain garden
12. Service access
13. Hybrid vehicle parking

0 5 10m

The **Living Building Challenge™** is the built environment's most rigorous performance standard. It calls for the creation of building projects at all scales that operate as cleanly, beautifully and efficiently as nature's architecture. To be certified under the Challenge, projects must meet a series of ambitious performance requirements over a minimum of 12 months of continuous occupancy.

Net-zero energy certification is based on actual performance rather than modeled outcomes.

To date, twenty-one projects have achieved certification through the Living Building Challenge, five of which have achieved Full Certification, and many others have entered the twelve-month operational phase required prior to audit.

http://living-future.org/lbc

Building Description

The Mosaic Centre has three levels and a roof terrace. The building features exposed glulam framing and floor/roof panels while the atrium showcases finely detailed wood-steel stairs and bridges. In addition to office space for 110 people, the Mosaic Centre houses a child-care centre and a restaurant and wellness centre, games room and a large common atrium area with bleacher style seating.

The building is bright and roomy with beautiful exposed wood beams, feature stairs and a three-storey living wall in the foyer. It has large south facing windows and thermally massive concrete floors. The layouts of the main, second and third floors are shown in (**Figure 2**).

The main floor is a structural concrete slab that rests on the ground but is not supported by it. The suspended floors are glulam decking with concrete topping (**Figure 3**).

The walls combine wood framing and batt insulation with exterior, rigid insulation (**Figure 4**).

The roof combines glulam decking and rigid insulation (**Figure 5**).

The Mosaic Centre was designed and built using integrated project delivery (IPD). Unlike traditional project delivery whereby designers maximize their individual outcomes, IPD attempts to optimize the whole, not the parts, by creating a shared ownership in project outcome.

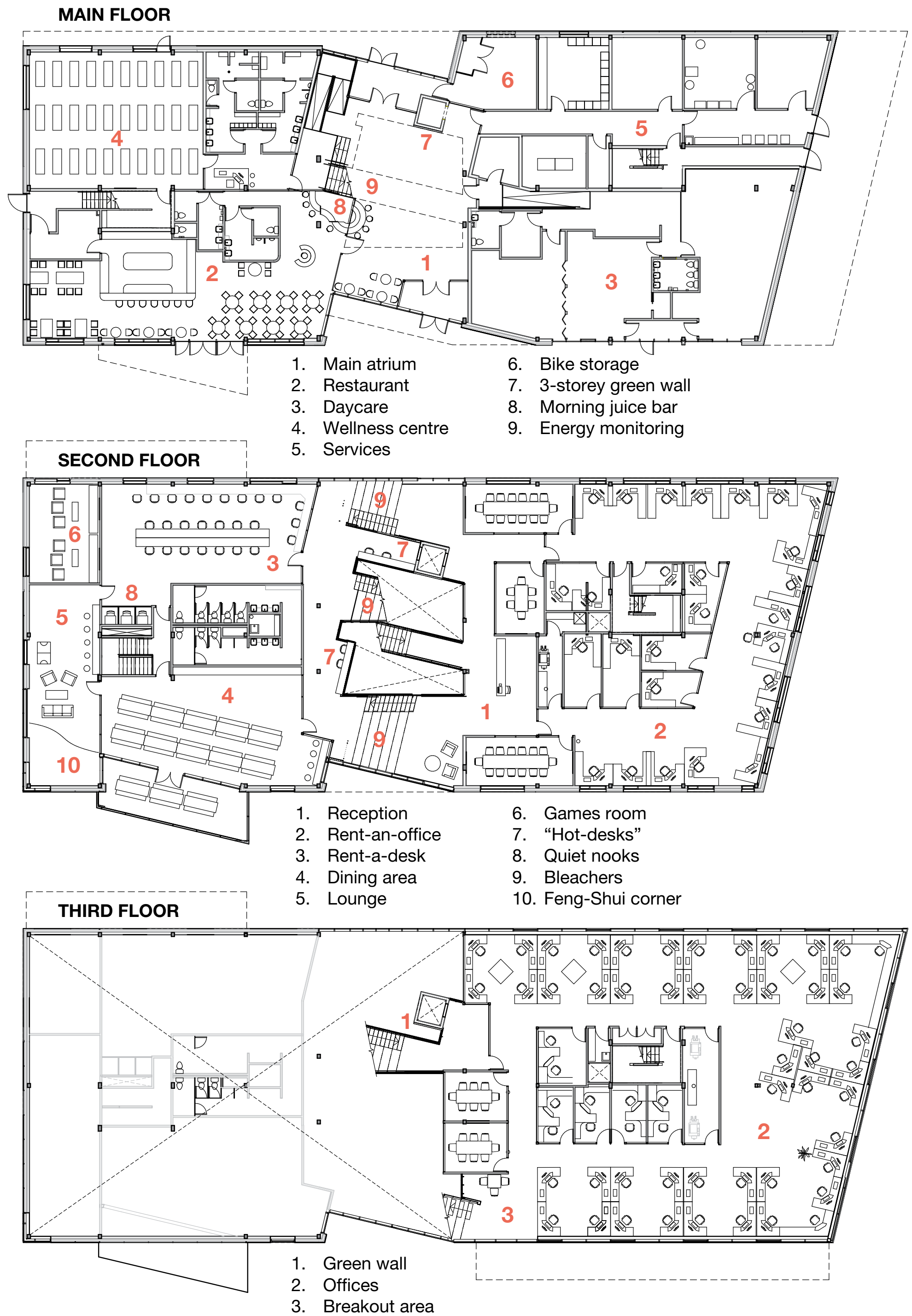
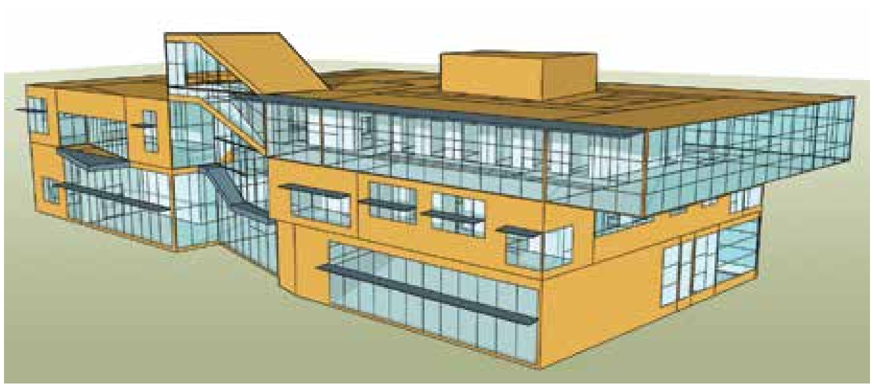


FIGURE 2

0 5 10m



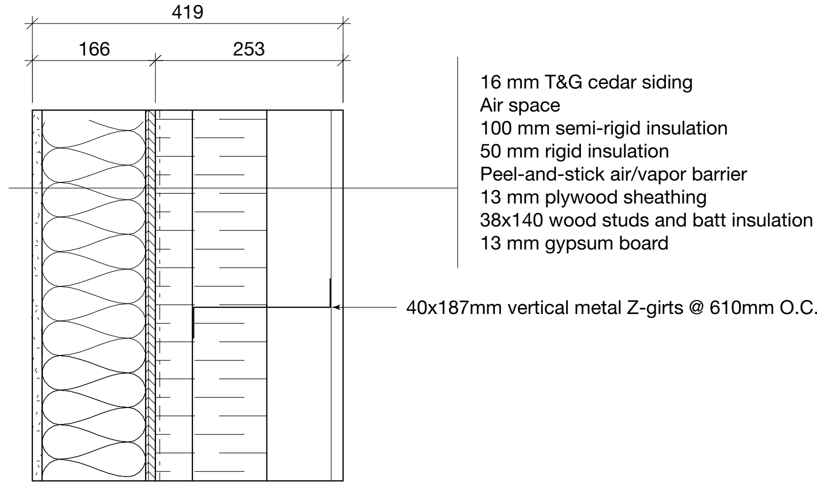


FIGURE 4
Typical wall section

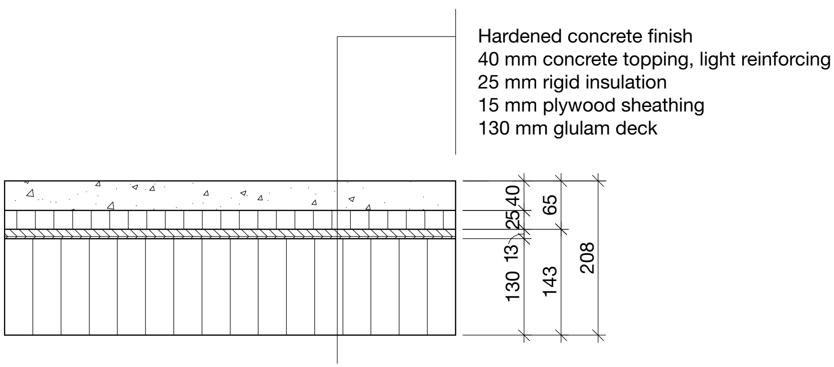


FIGURE 3
Typical suspended floor section

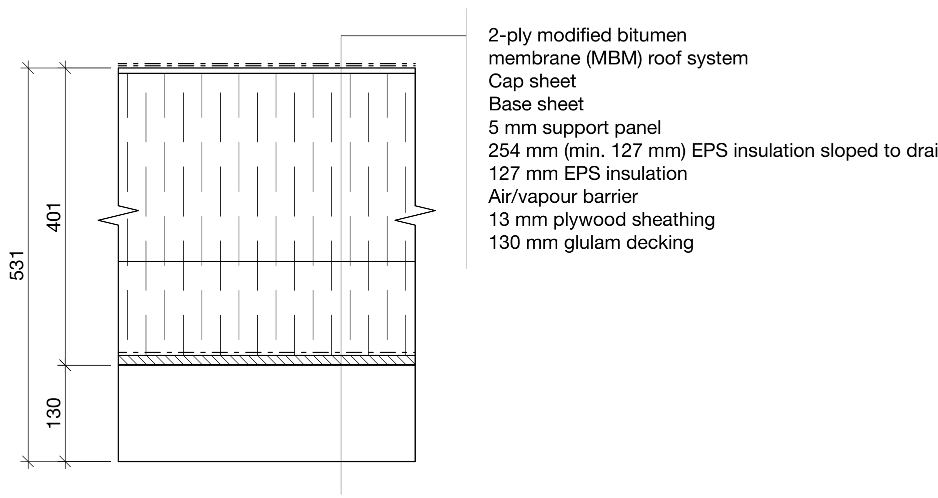


FIGURE 5
Typical roof section

Net-zero Energy

Prior to design, energy modelling was done to examine net-zero-energy feasibility and develop cost benefit analyses for envelope and renewable energy options. The analysis compared the cost benefit of increasing insulating levels relative to the cost of renewable energy generation. For example, wall R values ranging from 30 to 50 were compared.

It is well known that increasing insulation levels brings diminishing returns as more is added. Unlike residential net-zero houses in cold climates, the energy modelling showed that a commercial building like the Mosaic Centre, due to higher occupancy loads and equipment, is cooling dominated on an annual basis. Based on these facts, it was determined that the cost-effective insulations levels were: slab-on-grade – R10; walls – R30; and roof – R50.

Net-zero energy use is achieved first by reducing energy needs by providing a high performance building envelope, low-energy mechanical systems and lighting, large insulating windows, and numerous other energy-saving touches. Second, renewable energy from photovoltaic panels and geothermal wells is used to eliminate reliance on fossil fuels. Electricity is sold to the grid when site generation exceeds needs and purchased for the opposite situation. Solar panels installed on the building's roof and walls provide electrical needs. Heating needs are met using geo-thermal energy and excess heat from the computer server room is redistributed throughout the building.

Photo: Ross Auser

Solar Electricity

The user requirements stipulated that all the solar panels be mounted on the building – none were permitted to be in the landscaping or offsite. In addition, 20% of the rooftop was set aside for patio space. The 560 solar panels on the building's rooftop produce 193 kW of solar energy and 83 solar panels on the side of the building produce 20 kW, for a total potential capacity of 213 kW.

Numerous module configurations were tested – flat, angled, and a combination of the two – to determine the most economical design. A flat-mounted design proved to be the most economical solution, even factoring in that the modules would be covered by snow in the winter months and that there would be little production between November and March. At Edmonton's latitude there is very little solar potential in the winter months due to the short days and low sun angle. So, in the summer months, the system over produces and the surplus energy is "stored" in Edmonton's electricity grid (used by the neighborhood). In the winter months, electricity is "withdrawn" from the grid when the system cannot produce enough to power the building. Financing for the solar photovoltaic system was arranged through a solar lease with ENMAX (see **text box** below).

The attachment system for the solar collector racks used concrete ballast for hold-down so that the roof membrane did not need to be penetrated by mechanical fasteners.

Photo: Ross Auser

The Mosaic Centre is one of the first commercial buildings in Alberta to use a solar lease to generate clean, renewable energy from the sun. One of the largest barriers to adopting solar on commercial buildings is the upfront capital cost. In a typical scenario, the owner of a solar system is essentially pre-purchasing roughly 20 to 25 years of electricity. This can be a significant deterrent when embarking on a new building project where the budget is always tight. By signing a solar lease, the Mosaic Centre has taken much of that upfront cost and spread it out over a 15 year period, effectively paying for the energy over time as the building uses the energy instead of upfront.

www.enmax.com

Geothermal Energy

The Mosaic Centre is heated and cooled using geothermal energy. The parking lot on the north side of the building houses a geothermal field with 32 boreholes 70 metres deep. A series of ground-source heat pumps, located in the mechanical room, circulates a mixture of food-grade antifreeze (20% propylene glycol) and water through the network of three-quarter inch vertical piping.

The geothermal system makes a significant contribution toward achieving net-zero-energy. When the building requires heat, the high pressure glycol mixture is pumped through the system to "soak up" available heating energy from the soil and then back into the building's mechanical room to the heat pumps. Here, the fluid temperature is elevated to 93 °C before it is circulated throughout the interior of the building to the individual variable refrigerant flow heating units by way of another refrigerant loop. In the warmer summer months, the system is reversed and energy is dissipated back into the ground. Acting as a giant battery, the soil beneath the Mosaic Centre stores heat during the summer months for use in the frigid Edmonton winter.

Lighting

The lighting load was minimized by eliminating as many overhead light fixtures as possible and relying on natural light and task lighting when necessary. Also, pole-mounted LED site lighting is equipped with a time-clock/daylight controller to meet minimum light levels and site lighting is supplemented by building-mounted lighting.

Ventilation

With all of the south-facing glass and concrete floors, the building actually has a much larger cooling load than one would imagine for an office building in Edmonton. The building has to run its cooling system in February when it's -10 ºC outside if the sun is shining brightly. Unusual for a commercial building, the windows can be opened. This helps regulate the temperature in the summer and gives workers a measure of control over their environment.

Photo: Ross Auser

Additional Environmental Features

- The restaurant has a no-throw-away-food policy, produces some garden foods on site, and uses honey produced in the 4-hive apiary on the roof.
- 4 electric car charging stations and room for 8 more when demand increases.
- 213 kW capacity PV solar array and 32 borehole geothermal system.
- 95% of all materials diverted from landfill during construction.
- Nearly all wood scraps from building's structure reused for benches, desks, washroom vanities, partitions, planters and interior art.
- Fibreglass triple-glazed curtainwall system used to reduce thermal bridging.
- Concrete floors designed to store thermal energy and reduce sound transmission.
- Sunshades designed to stay icicle-free.
- Low-maintenance mechanical and electrical systems.
- Fresh air delivery to occupied areas determined by CO_2 levels.
- No VOC or toxic products used, minimal Red-Listed materials.
- 25 m^2, 3-storey green-wall helps purify the air and keep the humidity levels pleasant.
- 5 m cantilever helps reduce the physical footprint of the building.
- Parking stalls will be reclaimed into natural landscape as employees acclimatize to commuting by bicycle.
- 25-bicycle storage, 2 showers located in the bike storage area, and a bicycle repair bench.

Photo: Josh Kjenner

- 30% edible landscape with bio-swales and a rain garden to naturally drain and retain rain water on site.
- 40% more landscaped area than what City of Edmonton requires.
- On-site composting.
- 7000 gal (26,500 L) rainwater retention underground tank, for irrigation of plants.
- 100% LED lighting (except for the green-wall halide lighting), to reduce electrical consumption.
- Slow elevator to encourage use of the stairs, reduce heat output and reduce electricity use.
- Building tours to over 1,500 visitors, documentaries, brochures and public lectures provided by owner/architect/builder group for education purposes.

Photo: Josh Kjenner

"We toured several buildings prior to commissioning the design. Every time we went into a wood building it felt different and that is the feeling we wanted this building to have."

Dennis Cuku, Mosaic Centre co-owner

Advantages of Building with Wood

The owners wanted the Mosaic Centre tenants to benefit from the feeling of being in a wood building for a more positive occupant experience. The exposed wood ceiling, decking and columns were designed using glulam to satisfy all of the building's design targets: beauty, pragmatism, sustainability and health.

In addition, the wood structure complimented the net-zero-energy aspirations for the building, and being energy neutral over the service life of the building has huge environmental advantages.

Not only are the structural elements beautiful, they are also sustainable. The glulam elements are an efficient use of wood because they do not require large dimension timbers and provide consistent and reliable engineering properties.

Using sustainably harvested wood products that store carbon, instead of non-renewable, energy-intensive building materials that require large amounts of fossil fuels to manufacture, can help slow climate change. Trees provide the only major building material grown by energy from the sun.

The on-line Carbon Calculator tool (**http://www.woodworks.org/design-and-tools/design-tools/online-calculators/**) calculates the amount of carbon that is not released to the environment when wood construction is used instead of other major building materials. The carbon calculation for the Mosaic Centre is shown on the right. The carbon benefit of the wood structure is equivalent to taking 273 cars off the road for one year or, expressed differently, the energy to operate a home for 121 years. And this does not include the fossil-fuel for heating and cooling energy saved over the extent of its service life.

Carbon Summary

Results

Volume of wood products used:
19,705 cubic ft (0 board feet)

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

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

Avoided greenhouse gas emissions:
971 metric tons of carbon dioxide

Total potential carbon benefit:
1427 metric tons of carbon dioxide

Equivalent to:

273 cars off the road for a year

Energy to operate a home for 121 years

Project Name:	Mosaic Centre
Date:	February 17, 2016

Results from this tool are estimates of average wood volumes only. Detailed life cycle assessments (LCA) are required to accurately determine a building's carbon footprint. Please refer to the References and Notes' for assumptions and other information related to the calculations.

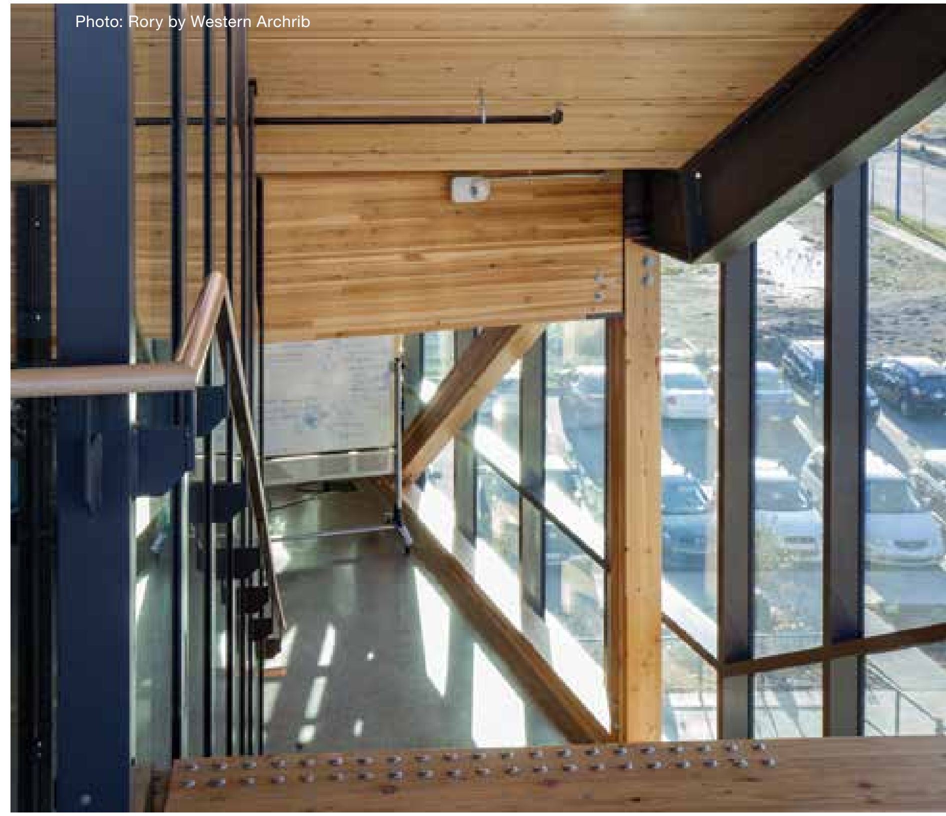


Photo: Rory by Western Archrib


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Photo: Josh Kjenner

Photo: Isaac

Structure

In the early design phases of the project, concrete, steel and wood construction were explored. Wood was selected based on its low embodied energy and the appearance exposed wood elements could provide. Steel framing was used to connect the east and west buildings by way of the interchange stairs.

Typical glulam columns sizes are 215 x 266 mm and typical beams are 215 x 800 mm. All beams, columns and decking received two coats of a water-based, low-VOC clear finish.

The second floor and roof is 130 mm laminated wood decking (Westdeck). The decking is an alternative to cross-laminated timber (CLT) for floors. Because all the lumber is laid in the same direction,

Photo: Ross Auser

larger spans are possible than for CLT and several exposed appearances are available including flat-sanded, fluted, rough-sawn, and wire-brushed texture. The decking came with a factory applied sealer coat to protect against handling and site weathering. In addition, areas permanently exposed to view on the underside received two coats of the water-based finish.

A heavy timber framing system comprises the primary floor and roof framing. Exposed solid wood flooring is supported on a series of glulam beams and columns on the second and third floors, topped with concrete.

At the north, south and east perimeter of the third storey, an exposed heavy timber truss supports the cantilevered floor on the east side. Photovoltaic panels cover the majority of the roof, supported by a secondary steel support frame. A heavy timber structure was used for the elevator, while the stairs combine steel and timber framing.

Most high-efficiency buildings minimize the amount of glazing they use because this is the weakest part of the entire thermal envelope. The Mosaic Centre used glass extensively, made practical by the use of triple-glazed windows and the R value of fiberglass composite curtain wall framing developed for mid-rise commercial applications. The fibreglass curtain wall framing on the north side of three-story central atrium is 8.4 m high.

It should be noted that the exposed structural elements are a major architectural feature of the interior spaces.

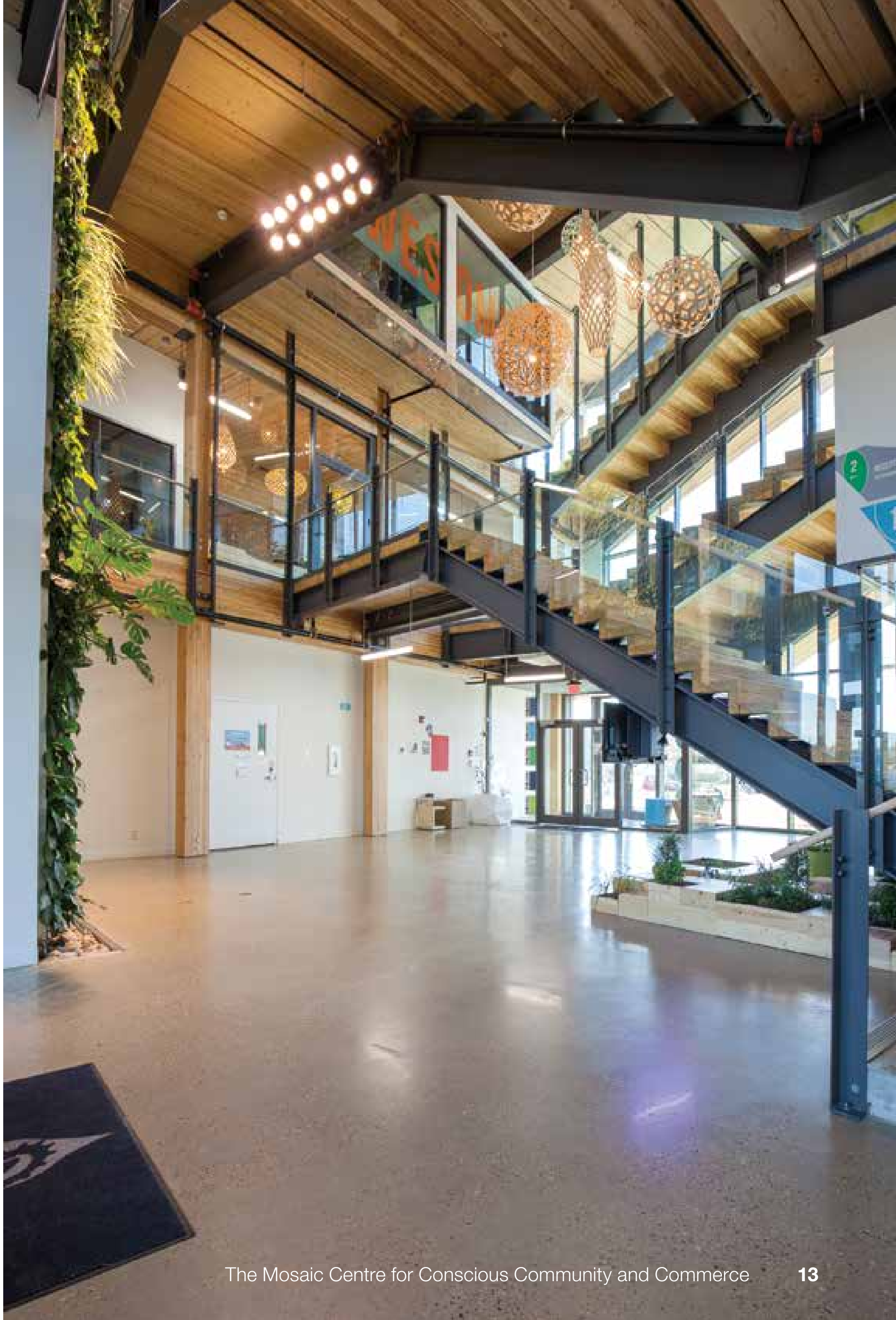

Photo: Rory by Western Archrib

Meeting Building Code Requirements

The Mosaic Centre was designed to meet the Alberta Building Code based on Article 3.2.2.54., Group D, ‘up to 3 storeys sprinklered.’ Accordingly, the building is sprinklered throughout and is permitted to be of combustible construction. Floor assemblies are required to be fire separations having fire resistance ratings (FRR) of at least 45 min. The glulam columns qualify as heavy timber construction as defined in Subsection 3.1.4. of the Code and, as a result, can be used where the required FRR is 45 min.

Photo: Josh Kjenner

Photo: Ross Auser

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Photo: Western Archrib

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Wood WORKS! Program of the Canadian Wood Council

www.wood-works.org

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www.cwc.ca

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Atlantic Wood *WORKS!*: 1-902-667-3889
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NATIONAL FUNDERS

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