Innovative Applications of Engineered Wood

Canadian Wood Council
Conseil canadien du bois

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Project of the Canadian Wood Council

INNOVATIVE APPLICATIONS OF ENGINEERED WOOD

Table of contents

Canadian forest management practices are among the most advanced in the world, and around 90% of the country's commercial forests are certified as sustainable by third party organizations such as the Canadian Standards Association (CSA), the Forest Stewardship council (FSC), the International Standards Organization (ISO) and the Sustainable Forests Initiative (SFI) Both CSA and FSC have 'chain of custody' labelling systems that can trace the origin, harvesting and processing history of individual timbers.

These advances in management practice have been paralleled by advances in the area of product development and manufacturing technology which have led to the introduction of several new engineered wood products (EWPs).

EWPs are high-tech, high-performance products that offer consistency of structural performance, dimensional stability and freedom from defects, making it possible to integrate them successfully with other construction materials on large and complex projects. Environmentally, the benefits of EWPs are significant.
All engineered wood products utilize small dimension lumber, veneers or wood fibres that help to maximize the potential of the worlds' only truly renewable construction material.

FEATURED ENGINEERED WOOD PRODUCTS

Glue laminated timber (Glulam)

Glulam was first introduced in the 1950s, and along with plywood remains the most familiar.. Glulam technology continues to advance, and the material still plays a significant role structurally and aesthetically. Traditionally glulams used 2x laminations glued together under pressure, to form simple beams or arches. Nowadays glulams may also be curved in two directions, or have laminations stepped to correspond to the bending moment diagram, leading to greater efficiency and increased expressive possibilities.

Parallel strand lumber (PSL)

PSL uses high grade veneers peeled from small dimension trees, and bonded together with water-resistant, thermosetting glue. PSL comprises shreds of veneer that are mixed with glue and extruded into billets up to 80 feet in length. The material is then cut to a range of standard sizes for use as lintels, beams, posts and truss members.

Laminated strand lumber (LSL)

The manufacture of LSL converts up to 75% of a log into useable lumber. The process utilizes small-diameter; plentiful trees that are not suitable for use as conventional sawn lumber. The wood is cut into thin strands and then glued together using a steam-injection process. The result is a large billet that can be milled into a range of sizes for use as rim boards, headers, beams, columns, studs, sill plates, and stair stringers.

Wood I-joists (TJIs)

Wood I-joists are made up of 2x3, 2x4 solid sawn lumber (or sometimes LVL) or Machine Stress Rated (MSR) lumber flanges and an oriented strand board or plywood web. They are manufactured in long lengths and provide a roof and floor framing system that can run continuously over a number of supports. Holes can be drilled in the web to accommodate ductwork and other services, making wood I-joists a viable alternative to open web steel or composite joists. There are various profiles of wood I-Joists available.

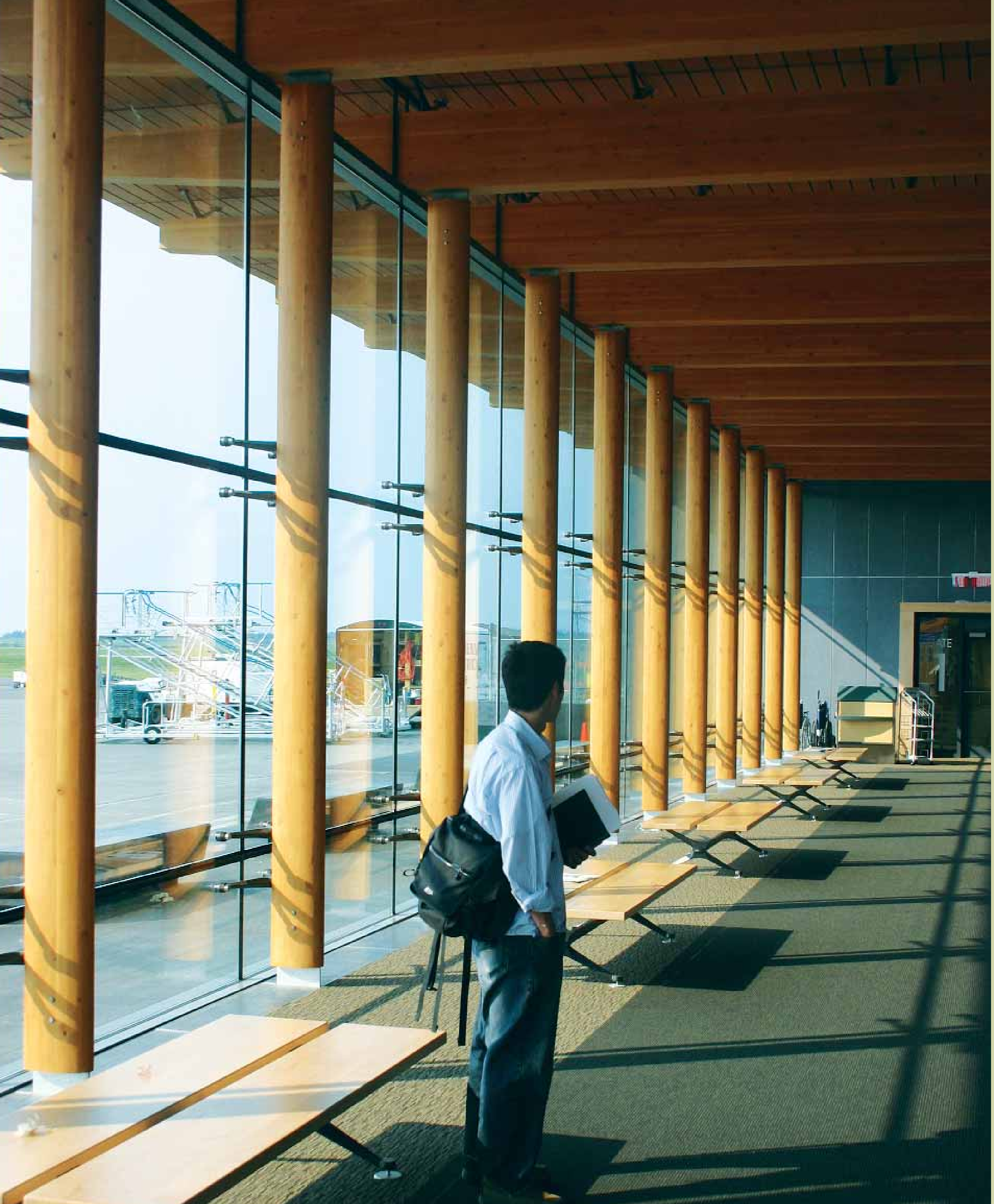
Laminated veneer lumber (LVL)

LVL is essentially thick plywood, but with the grain in each layer of veneer laid up in the same direction. From the resulting billet, generally 1-3/4in. inches thick, a range of standard beam sizes can be cut, the grain of the veneers running along the length of the beam. LVL is generally used for lintels and headers, but also to support point loads in a range of building types. Wider beams can be fabricated onsite by nailing several LVL members together, making handling easier and eliminating the need for a crane.

Engineered wood trusses

The most familiar engineered wood trusses are those used in residential roof construction, which often use MSR lumber members as small as 2x3. However the same design principles and manufacturing techniques can be applied to trusses of varying geometry, and considerably greater load and span requirements. These trusses use MSR or sawn lumber, sized for the required loads, with elements connected together by nailing plates.

The full range of engineered wood products forms a system of primary and secondary structural elements, cladding and decking systems that can be connected using a variety of simple, readily available hangers, brackets and hardware. In the hands of architects and engineers, these products have also been used in innovative ways in many non-traditional applications.



Glulam

Airport Expansion

Prince George, BC

What began as a modest renovation project expanded in scope to include a new departure lounge, international arrivals area, security screening area, baggage make-up room, support offices and renovations to the existing check-in hall and arrivals areas. The challenge was to develop a design solution that would integrate new and existing parts of the building and at the same time capture the character and aspirations of the Prince George region.

MacFarlane Green Architects chose to meet this challenge architecturally, (rather than taking the thematic approach which is common in contemporary airport design) and, together with structural engineers Equilibrium Consulting Inc., used structure, materials and transparency to enhance both the experience of air travel, and the connection to place. Through program organization and the careful design of interior partitions it is possible for those entering the terminal

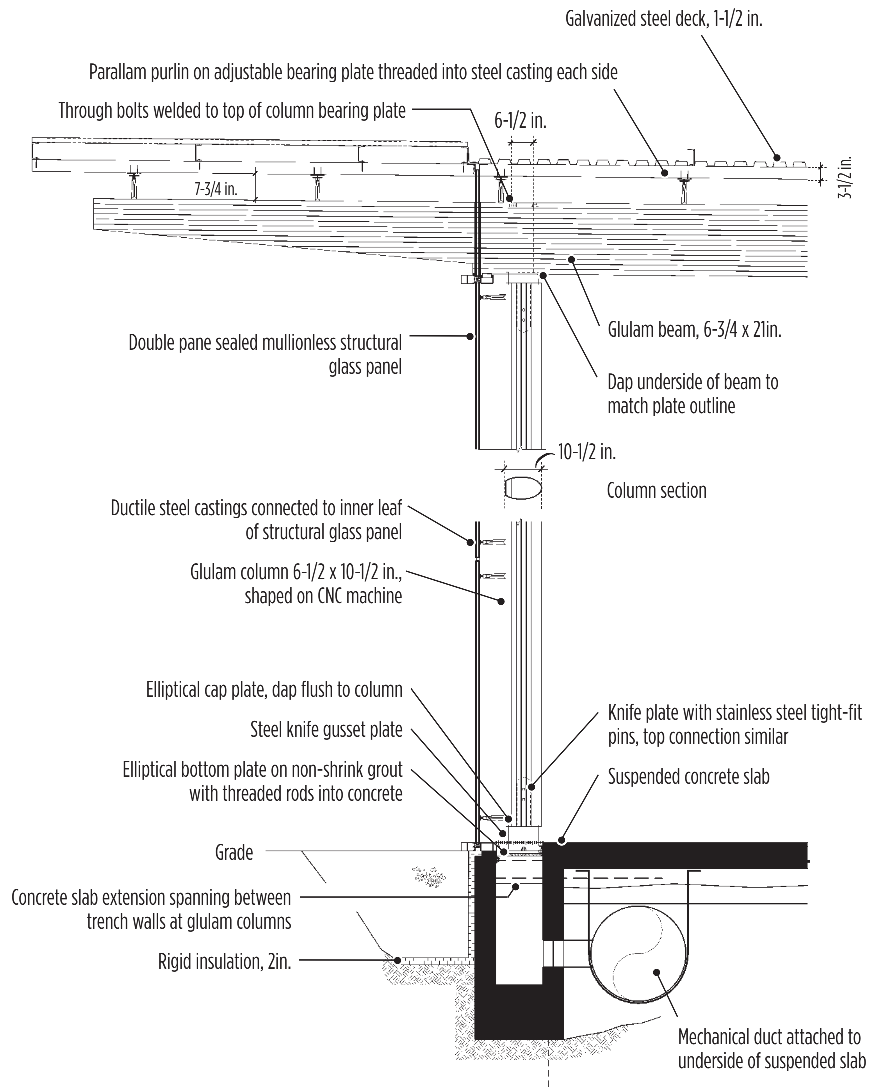
from the land side to see through the building to the awaiting aircraft – a rarity in a contemporary airport however small. Similarly, deplaning passengers approach the transparent curtain wall of the airside façade, and are immediately introduced to the qualities of structure and detail that give the building its unique character.

The high-performance, point-fixed curtain wall system (developed in Austria) is supported on custom steel castings of a shallow wishbone configuration. The same castings have been used to support the roof by floating the ceiling above the beams, creating a concealed compartment for services, and as a support system for the benches in the departure lounge.

Internally, the public areas of the building are organized around a central day-lit spine that connects and unifies old and new portions of the building. An elegant system of glulam and steel portal frames lifts a continuous glass skylight above the surrounding flat roofs, bringing daylight deep into the building. Bands of horizontal Douglas Fir sunscreens, mounted alternately on the east and west sides of the spine filter the light and create an ever changing shadow play on the walls and floor of the concourse. As the position of the sun shades changes, so does the supporting structure: steel where the concourse abuts the original building, glulam where it adjoins the new structure.

The glulam columns that support the central skylight and the curtain wall in the arrivals area are milled to an elliptical cross section on a state-of-the-art 5 axis computer numerically controlled CNC machine. (These machines use the digital files created by architects and engineers in the design of structural elements, and cut, form shape and drill these elements with millimeter precision.) The elliptical columns are then connected to the horizontal members by discrete and highly efficient tight fit pins. The purity and elegance of the structure is further enhanced by the use of colourless polyurethane glue which eliminates the usual black lines between laminates that has long been characteristic of glulam construction.

Through the innovative application of cost effective technical solutions, MacFarlane Green's judicious interventions have created a new sense of transparency and spatial definition. The elegance and economy of expression celebrate the precision of contemporary craftsmanship and the increased emphasis now being placed on value added engineered wood products and environmental stewardship. ▲



Section through roof and glazed wall

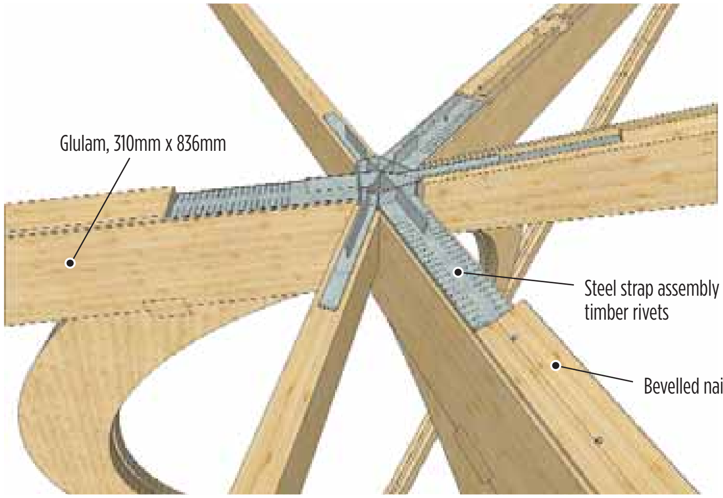
Glulam

Carlo Fidani Peel Regional Cancer Centre

Mississauga, ON

Farrow Partnership Architects are in the forefront of a new humanist movement in architecture, a movement that believes buildings should be designed with human interests and dignity in mind. In the field of health care in particular, research is beginning to provide empirical proof that patients heal more quickly and staff morale and performance increases in a non-institutional setting where natural materials, such as wood, and natural light figure prominently.

This knowledge was uppermost in the architects' minds when they approached the design of a lobby/atrium space which would connect the new Regional Cancer Centre with renovated existing space at the Credit Valley Hospital in Mississauga ON. Conceived as a village gathering space, the 40ft. high atrium features a forest of nine tree columns whose glulam branches curve and intertwine. The organic forms enhance the emotive quality of the space which is bathed in natural light from clerestory windows.



Linkage of "tree" elements

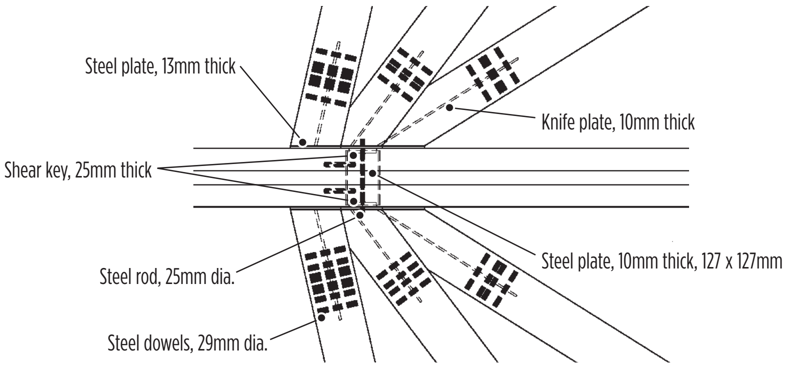
The intertwined glulam trees constitute a single structural system interconnected by embedded steel plates. The intricate form and the complexity of fabrication meant that collaboration between architect, structural engineer and glulam manufacturer was essential from the outset.

The roof system is supported at five points, four of them steel beams at the second floor level. Within the structure, 35 potential load paths needed to be analyzed to ensure that the net maximum connection forces were realized. The glulam supplier was instrumental in resolving the many complex connections and addressing the challenges of fabrication and assembly ahead of time. Most of the steel plate connections are concealed, maintaining the integrity of the overall concept.

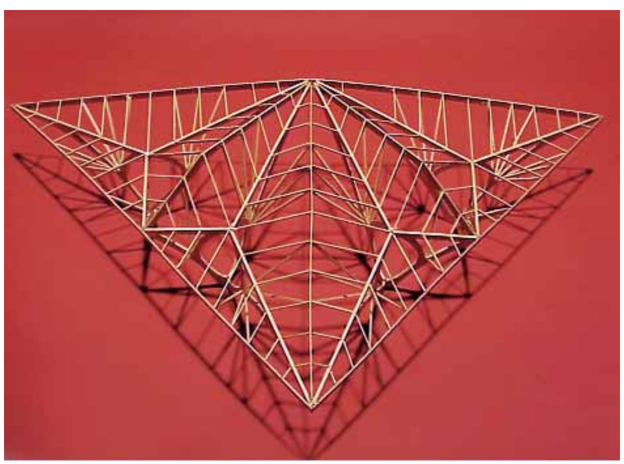
The complexity of the structure also posed problems with respect to fire protection. Analysis showed that conventional sprinklers could not reach all the exposed surfaces of the structure, presenting an unacceptable risk of a fire taking hold. The solution was to import and test a high pressure misting system that would protect the structure by coating it with a thin film of water droplets.

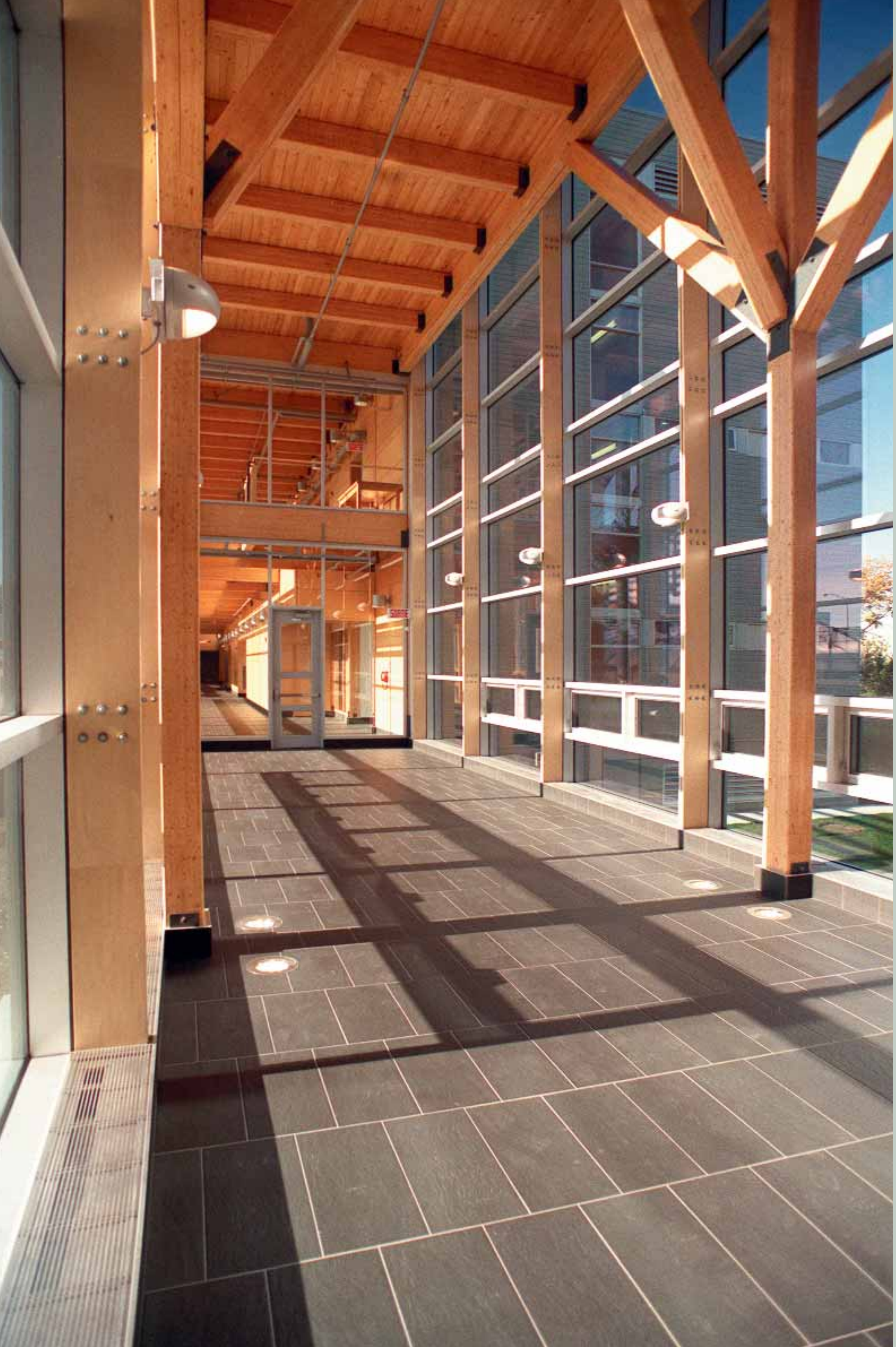
Released from misting heads mounted 5ft. off the ground, in a fire situation the vapour would be carried upward with the increasing air temperature, enveloping all surfaces of the structure. The water vapour prevents oxygen in the air from coming in contact with the wood and so starves the fire.

With its humanist approach, complex forms and innovative technology, this project represents a new benchmark in the use of engineered wood in Canada. ▲



Strut node plan





Glulam

Eugene Kruger Building

Laval University, St Foy, QC

The 80,000 s.f. program for this all-wood building includes both research facilities for the wood industry and undergraduate teaching space for 200 students and faculty. The project is located on the edge of Laval University's suburban Quebec campus and connected to the existing buildings of the Faculty of Forestry and Geomatics.

The client's main objectives were twofold: to demonstrate the potential of all wood construction in a large non-residential building and to apply the University's newly adopted sustainable design principles to a built project for the first time. The completed building has helped to break the preconception of wood as a low-tech material for small scale projects, and reinforce the virtues of wood as a green building material.

The building expresses the essentially technological nature of eastern wood construction, employing a palette of engineered structural and non-structural wood products. These are assembled in a simple, geometric composition of repetitive modules within a primary glulam frame. The design approach is deliberate, taking wood out of its familiar residential context and associating it with other manufactured materials such as thin metal sections and glass.

Unlike conventional glulam products, the columns and beams of the Kruger building utilize nominally 2x2 sections formed by squaring the trunks of nominally 3in. diameter Black Spruce. The sections are laid up and laminated horizontally to create the required section width, as well as vertically to create the required depth. A section cut across one of these glulam members reveals a distinctive checkerboard pattern.

Sustainable development goals are achieved by using the principles and tools of bioclimatic design (the use of natural energy, sun and wind, to decrease reliance on grid electricity and fossil fuels, in a manner that increases the users' comfort and sense of well being.)

The design therefore seeks to provide a pleasurable experience by the greatest possible exposure to natural elements such as sunlight and wind and natural materials such as wood. Extensive operable glazing in occupied rooms, activity and circulation spaces provides a sociable environment in contact with the wooded site. Thus light is married with wood and the building with the material that shapes it.

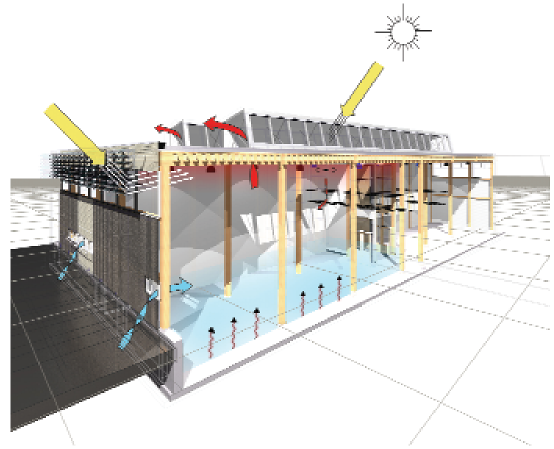
The solid volumes enclosing the building's functional spaces are punctuated by a series of glass prisms revealing the activities within and showcasing the building's elegant wood structure.

The narrow academic wing has rooms on one side of the corridor only, facilitating natural cross ventilation. Its southerly orientation permits passive solar heat gain. The wider research wing required the use of roof monitors to achieve day lighting and cross ventilation.

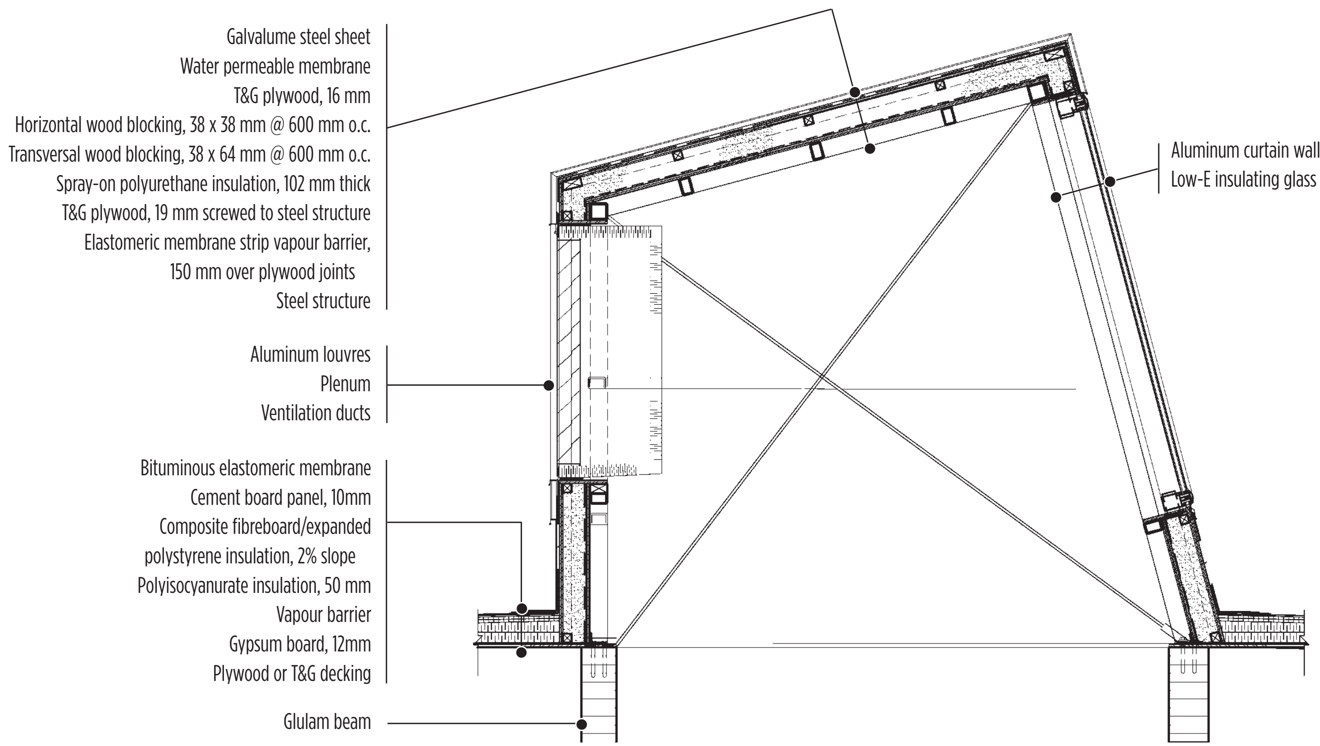
Using only architectural strategies (form, orientation, materials) with the addition of electro magnetic controls, the building achieves over 30% reduction in energy consumption when compared to the reference building in the Model National Energy Code for Buildings (MNECB).

Systematic use of light models and the ENERGY 10 program (which calculates orientation, occupant heat load, passive solar gain etc.), determined the design of the building envelope (geometry of fenestration, roof monitors, sunshades, etc.).

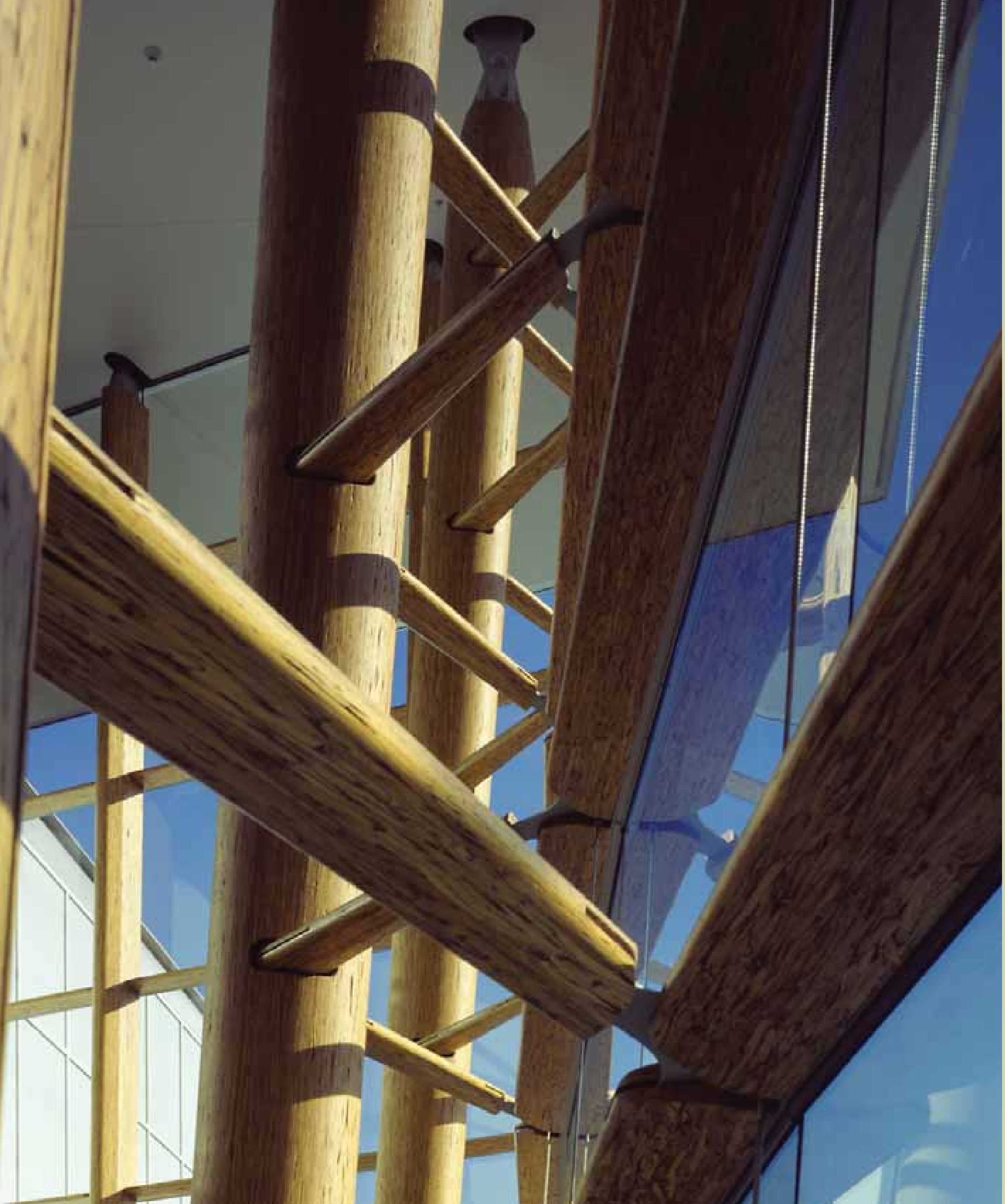
According to an independent study carried out by the Athena Sustainable Materials Institute, the extensive use of wood results in a 40% overall reduction of embodied energy in the Kruger Building's construction materials, 85% reduction in water pollution and 25% reduction in air pollution. ▲



Building section at research wing showing ventilation and radiant floor heating flows



Section through research wing roof monitor



Parallel Strand Lumber

Surrey Central City Atrium North Wall

Surrey, BC

The city of Surrey is located in southwestern British Columbia, between Vancouver and the US border, and is one of the fastest growing municipalities in Canada. Surrey is made up of six distinct suburban communities, each with a local retail and commercial centre, but until now has lacked a central downtown core. Although 25% of the region's workforce lives in Surrey, it provides only 5% of the region's jobs. With more than 1 million s.f. of office, educational and retail space, the recently completed Surrey Central City will go some way to addressing that imbalance, and at the same time create a nucleus for future urban development.

Located adjacent to a major transit interchange, the site was occupied by an existing shopping mall. Although in much need of a facelift, the mall was nonetheless attracting more than 1000 visitors per hour. Capitalizing on this solid base of pedestrian activity, the new development is built around and over the mall. An office tower, designed with an offset service core and state of the art wiring to attract high-tech tenants, rises from what is now a four storey podium. The three storeys that were added above the mall have large contiguous floor plates and were designed to house the new Technical University of BC.

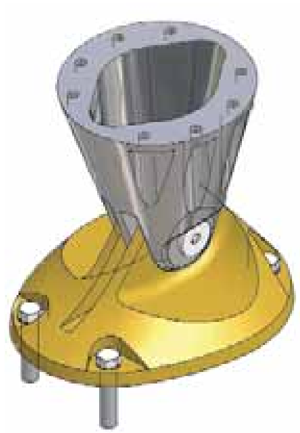
The public focus of the complex is the revitalized shopping mall. With its original roof removed, and overlooked by the balconies of the university campus above, what was previously a dull and uninspiring retail space has become a grand, airy and animated galleria. At its north end, the galleria connects to an irregularly shaped atrium, the north wall of which, with its sweeping curved form, defines an entrance forecourt that faces the transit interchange and is the grand entry to the building. The complex includes three substantial structural applications of wood, the galleria roof; the space frame that covers the entrance atrium, and the support system for atrium north wall.

The most innovative application of engineered wood is the supporting system for the glass entry wall, which comprises a series of turned and tapered parallel strand lumber columns and muntins, the largest component of which is 45 ft in length and 24in. in diameter. The facade is an irregular curve in plan, and tilts at 4 degrees from vertical. It is divided into upper and lower sections by a mid-height concrete canopy that projects from the building. The glazing of the lower facade is supported by a series of 24in. diameter tapered PSL columns, which also carry the concrete canopy. Large ductile iron castings connect the ends of the columns to the concrete at top and bottom.

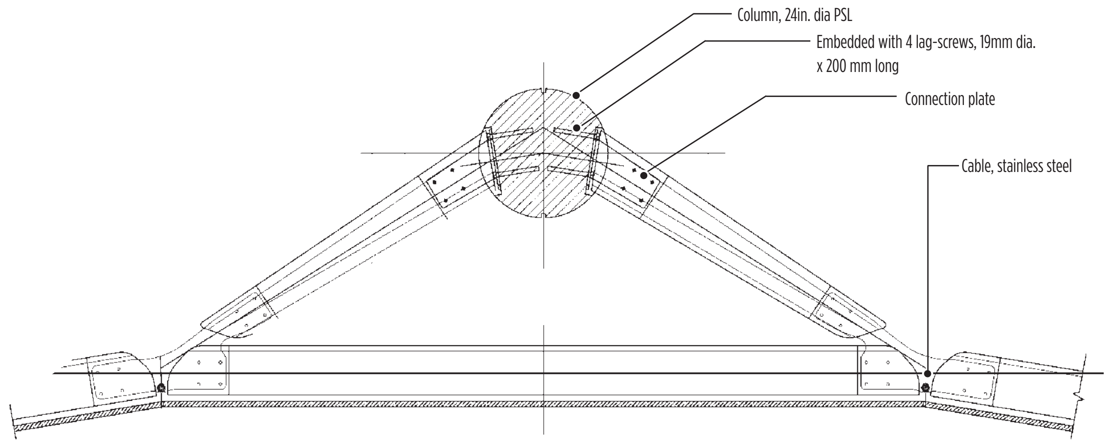
These columns are set back from the glazing and support tapered PSL arms reaching out to provide restraint for horizontal PSL muntins, which carry the glazing. Vertical loads on the muntins are carried at each facet point (approximately 12ft. on centre) by spring loaded stainless steel cables suspended from the concrete above. The similar upper facade, which meets the underside of the atrium roof, consists of a series of more frequent, smaller PSL columns.

Bing Thom Architects chose wood structures for the public spaces to provide a visually warm and tactile contrast to the smooth synthetic surfaces so typical of contemporary office environments. Schematic design of the wood structures was done by Fast + Epp Partners, and the design/build contractor was StructureCraft Builders Inc.

The atrium itself is roughly triangular in plan, bounded by the multi-faceted north wall, the curved base of the office tower, and by the end of the galleria. The geometric constraints of these variable edge conditions precluded the use of a regular structure, and so a finely gritted space frame was chosen to best approximate the varying perimeter conditions.



Column anchor



Plan, bracing from column to glazing at facade

The space frame provides two-way action, and consistent stiffness permitting a curved 20ft. edge cantilever. The seven foot deep tetrahedral space truss is another innovative use of engineered wood. It consists of nearly four thousand Douglas Fir peeler cores. These are an inexpensive by-product of the plywood industry generally destined for a low end use such as fence posts.

To overcome the inherent weakness of the material, a confined lag screw connection was devised and extensively tested, allowing these peeler core members to be used both in tension as well as compression. The connections consist of a central node to which are attached the appropriate number of flat fixing plates. Each plate has three holes which accept lag bolts that are screwed into the end grain of the member. The end of the member is restrained by a steel band that performs the same function as the clamp on a hose pipe. ▲

Laminated Strand Lumber

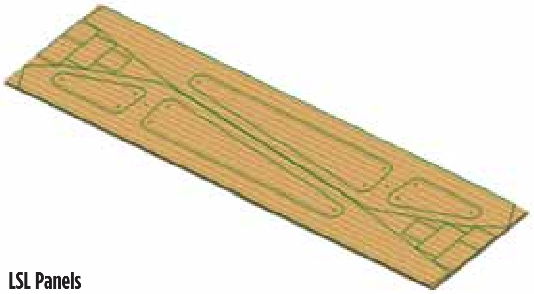
False Creek Community Center

Vancouver, BC

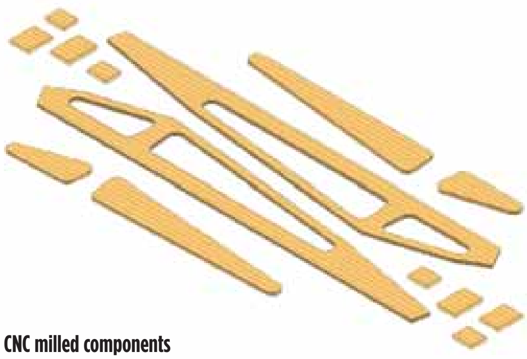
In the unique urban context of Vancouver's Granville Island, the extension to the False Creek Community Centre designed by Henriquez Partners and engineered by Fast and Epp, showcases a unique application of CNC technology to engineered wood panels.

The existing community centre occupied several converted warehouse structures of heavy timber and steel construction that were connected by circulation routes converging from three access points. A semi derelict boat shed bordered the main access from the north, and this became the site of the new gymnasium, with a new fitness centre inserted above the existing administrative offices.

With a prominent site and a tight budget, the objective was to design a striking structure that would achieve

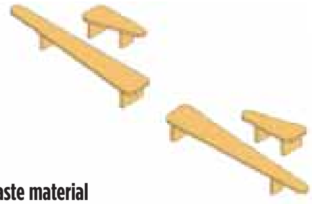


LSL Panels



CNC milled components

Roof trusses



Benches from waste material

economy through innovative design. By adopting a lightweight timber structure it was possible to float the building on a waffle raft, and avoid the expense of the piled foundations that are commonly used in this area.

The spaces between the vertical posts of the heavy timber frame are infilled with non-load bearing wood stud walls and the required lateral resistance is provided by a layer of plywood fastened to the inner face of the wall. The plywood was upgraded to Good One Side, so that it could be exposed internally, and eliminate the need for a separate interior finish for the gymnasium wall. The plywood is fixed with a carefully orchestrated arrangement of exposed screws and washers that addresses both structural and aesthetic considerations.

The gymnasium roof trusses were seen as having the greatest potential in determining the character of the interior space. Inspired in part by the wings of Granville Island's ever-present seagulls, the trusses are a counter intuitive application of LSL panels made possible by CNC technology. Rather than build up trusses from a series of discrete 'positive' elements in the usual manner, the 'negative shapes have been milled out of a single slab of laminated strand lumber board, and the truss completed with a steel cable extending along the bottom edge as a tension chord. The left over material from the manufacture of the trusses has been assembled to form benches in the newly expanded lobby. ▲

Laminated Strand Lumber

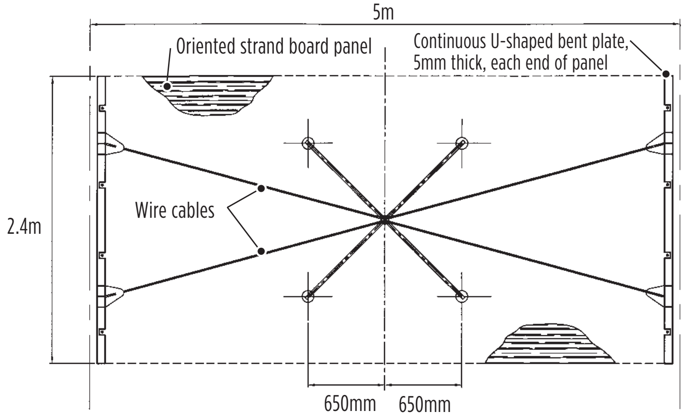
Gilmore Skytrain Station

Burnaby, BC

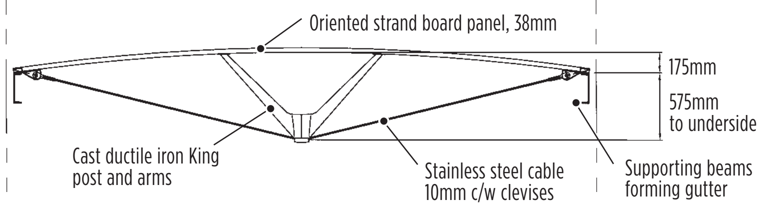
The Gilmore Skytrain Station in the city of Burnaby, adjacent to Vancouver, occupies a low visibility location next to the site of a future high-rise building. Site and budget constraints called for a simple, economical, yet architecturally unique expression. The solution has a strong engineering quality arrived at by the close association of the architects and structural engineers.

The Gilmore Station is one of several for the Millennium Line extension of the public light rail transit system. The design theme for all was to use wood to create a distinctive West Coast ambiance. Wood is not traditionally used in transit stations. However, design parameters were established so that that wood elements remained out-of-reach of vandals, have no direct weather exposure, and have a minimum 45-minute fire-resistance rating.

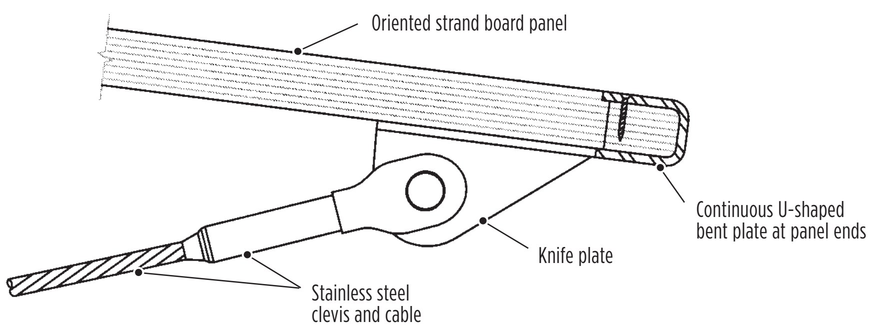
The project makes a feature of the various elevators, stairs and escalators to celebrate the movement of people as they come and go. A transparent effect was important to enhance the safety and security of the station, thus essential elements include open, clear spaces, the use of glass for visibility, and generous canopies for protection from wind and rain.



Roof panel plan



Roof panel elevation



Cable connection

The wood component consists of 64 identical LSL board panels, each 8ft wide and 16ft. long, supported by simple structural steel frames spaced at 16ft. 4in. centres. The fabricator pre-bowed each 1 1/2-in. thick panel using weights, the resulting curve being maintained through the use of 3/8-in. diameter stainless steel wires and custom-cast iron support arms and fittings. The panel and steel units were then inverted and covered with a roofing membrane that sheds water into gutters incorporated into the steel channel beams and round columns. From inside the station, transit users experience the visual warmth of the exposed wood panels.

The roof structure took only two days to erect and represents a novel application of an economical engineered wood product. The curved canopy roof lends a "high-tech" look that can be seen from a distance. The walls and roof were designed in a modular fashion for reconfiguration and adaptation to future development around the site.▲

Wood I-Joists

Mountain Equipment Co-op

Ottawa, ON

The Mountain Equipment Co-op store in Ottawa was the first retail building to comply with Canada's C-2000 green building standard. The two storey structure incorporates many material and components salvaged from the single storey grocery store that previously occupied the site.

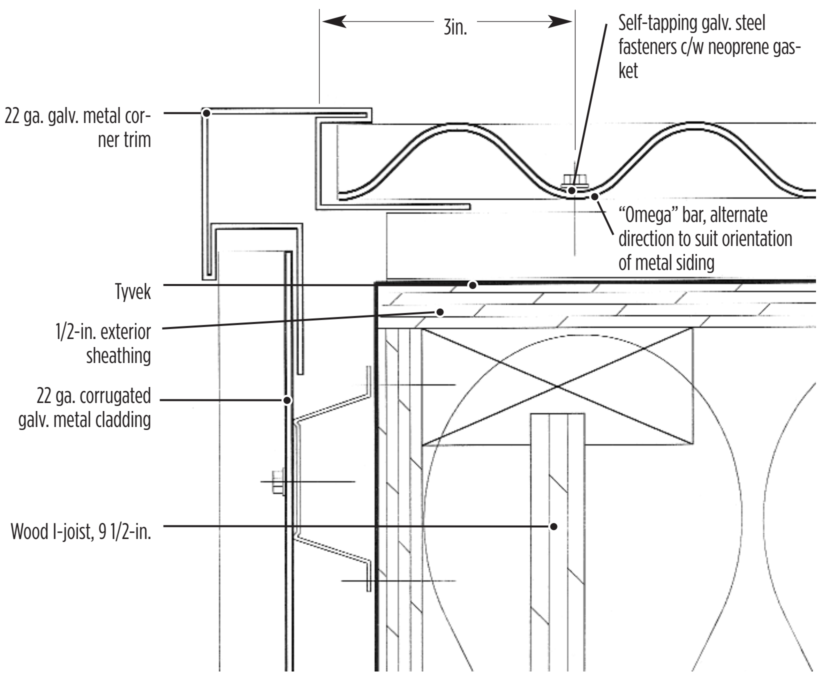
Rebuilding from salvaged material posed some problems as the original structure of steel columns, beams and open web joists had been sized for Ottawa snow loads but not for a retail floor load. Concrete and steel options were considered for the ground floor but did not score highly when rated for environmental performance.

Large Douglas Fir timbers salvaged from old submerged log booms on the St. Lawrence and Ottawa rivers were also available, and a timber frame fashioned from these logs offered an interesting alternative. Ultimately this option was chosen for its aesthetics, low embodied energy and recycled or salvaged content,

To make the timber frame as light as possible, beams of 12x12 span between columns on a 22ft grid. The lower face of the beam is reinforced at mid-span by lag bolting on a 3x10. This is engaged at each end by a 6x10 knee brace that transfers compression loads to the column. With structural loads carried by this post and beam frame system, the enclosing walls of the building became non load bearing.

Four options were compared for the building envelope

1 concrete block with 4in. of insulation in the cavity,
2 2x6 salvaged studs with rock wool insulation,
3 a Durisol wall system-concrete filled forms made from wood waste and cement with cavity insulation, and
4 a wood I-joist stud system filled with cellulose insulation. Wall systems needed to have a minimum insulation of R-20.



Plan detail at typical corner

The design team used the Green Building Assessment Tool, a chart that compares the attributes of the wall types according to the categories of re-usability, recycled content, embodied energy, longevity, structural efficiency, cost, thermal value, and ease of construction. The team gave a score between 1 and 4 for each wall system in each category. The 2x10 wood I-joist systems scored the highest based on the criteria and had a high thermal value R-value of 35.

The walls extend the full two stories in a balloon-frame fashion. Bolted steel brackets at the floor line secure the I-joist studs to the timber floor beams. The stud walls are insulated and sheathed with oriented strand board and self-adhesive elastomeric air barrier strips taped at the joints. Cladding was applied as a rain screen with a 3/4-in. backup air space. The joists themselves offer the same advantages as when used as a flooring system, enabling services to be run through holes drilled in the centre third of the member – an innovative solution readily transferable to a variety of other situations. ▲

Engineered Wood Trusses

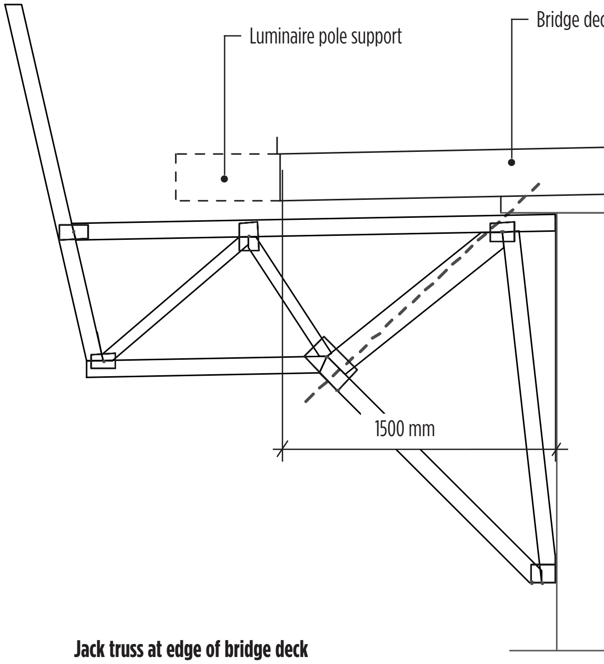
William R. Bennett Bridge

Kelowna, BC

The William R. Bennett Bridge is part of an extensive highway improvement program in the Okanagan Valley, located in southern British Columbia, and one of the province's fastest growing regions. Spanning Lake Okanagan between Kelowna and Westbank, the new 5-lane bridge replaces the 3-lane structure built in 1958.

Concrete bridge decks over steel girders are normally formed by bridge contractors using a combination of steel and heavy timber concrete forming systems supporting a plywood pour deck. These systems are labour intensive but because of their flexibility can be easily adapted to varying bridge designs, spans and conditions.

However, because of its tight schedule, large spans and complexity, and the tight Okanagan skilled labour market, the Bennett Bridge project lent itself to a new and innovative solution. The bridge's per-



Jack truss at edge of bridge deck

manent reinforced concrete deck is supported by steel girders set longitudinally between both fixed in place and floating reinforced concrete piers.

The spacing between these girders is approximately 16ft. (longer than usual on a bridge of this size); and this section makes up about half of the overall bridge. The profile of these sections clearly provided an opportunity for repetitive and reusable members; an advantage for prefabrication.

The bridge concrete deck sub-contractor, CMF Construction Ltd., used engineered trusses as the principal elements of the overall deck forming system. In collaboration with Acu-Truss Industries Ltd., CMF developed a prototype solution for the first sections of the bridge. This ultimately became the basis for a bridge deck forming system utilizing two typical trusses that were light weight, easy to install and strip, reusable on other sections of the project and recyclable.

One of the two typical trusses developed is a tandem 'jack' truss designed to cantilever off the two outside girders. It serves a dual purpose; it not only carries the dead load of wet cast in place concrete it also serves as a catwalk and safety rail during and after the pour. The second typical truss, 'a needle truss' is erected between the main steel girders and acts as the principal support for the concrete form plywood through the centre sections of the bridge decks longitudinal span. The top chord of these trusses is cambered, meaning that the concrete deck poured on top of them is thinner in mid-span and thicker at he supports – reflecting load distribution in the structure.

Both trusses incorporate common 2x4 and 2x6 lumber, laid up in two or three plies, and connected using standard gang nail plates. Purlins at 16in. centres connect the top chords and provide support for the plywood pour deck. This lumber shuttering system was found to be the most economical for the construction of this large scale project.

Reclaiming the usable lengths and gang nail plates was investigated as an option for the trusses on completion of the project, but was found to be uneconomical given current market conditions for wood products and available labour in the area. Instead, the trusses will be economically disposed of and the wood fibre recycled.▲

Conclusion

While the hand built tradition of North American wood building will continue to have its place long into the future, there is also the sense that we are at the dawn of a new era – one in which new products and new technology will support greater economy and efficiency in the use of wood, while opening the door to new applications and architectural expression.

AIRPORT EXPANSION

CLIENT Prince George Airport Authority, Prince George, BC **ARCHITECT** McFarlane Green Architecture + Design , North Vancouver, BC **STRUCTURAL ENGINEER** Equilibrium Consulting, Vancouver, BC **CONSTRUCTION** Wayne Watson Construction, Prince George, BC **PHOTOS** McFarlane Green Architecture + Design, North Vancouver, BC

CARLO FIDANI PEEL REGIONAL CANCER CENTRE

CLIENT Credit Valley Hospital, Mississauga, ON **ARCHITECT** Farrow Partnership Architects Inc., Toronto, ON **STRUCTURAL ENGINEER** Halsall Associates Ltd., Toronto, ON **CONSTRUCTION** PCL Constructors Canada, Mississauga, ON **GLULAM SUPPLY AND INSTALLATION** Timber Systems Limited, Markham, ON **PHOTOS** Peter Sellar, Klik Photography, Toronto, ON

EUGENE KRUGER BUILDING

CLIENT Université Laval, Service des Immeubles **ARCHITECT** Gauthier Gallienne Moisan Architectes, Quebec, QC **STRUCTURAL ENGINEERS** BPR Inc., Quebec, QC **CONTRACTOR** Hervé Pomerleau inc., Saint-Georges de Beauce, QC **PHOTOS** Laurent Goulard architecte, Quebec, QC

SURREY CENTRAL CITY ATRIUM NORTH WALL

CLIENT ICBC Properties Ltd., Vancouver, BC **ARCHITECT** Bing Thom Architects Inc., Vancouver, BC **STRUCTURAL ENGINEER, BASE BUILDING** Jones Kwong Kishi Structural Engineers, NorthVancouver, BC **STRUCTURAL ENGINEER, TIMBER STRUCTURES** Fast + Epp, Vancouver, BC **GENERAL CONTRACTOR** PCL Constructors Canada Inc., Vancouver, BC **DESIGN BUILD TIMBER FABRICATOR/ ERECTOR** StructureCraft Builders Inc., Vancouver, BC **PHOTOS** Nic Lehoux, Vancouver, BC

FALSE CREEK COMMUNITY CENTRE

CLIENT Vancouver Parks Board **ARCHITECT** Henriquez Partners Architects, Vancouver, BC **STRUCTURAL ENGINEER** Fast & Epp Partners, Vancouver, BC **LSL FABRICATOR** Structurlam Products Ltd., Penticton, BC **PHOTOS** Christopher Grobowski, Vancouver, BC

GILMORE SKYTRAIN STATION

CLIENT Rapid Transit Project 2000, Burnaby, BC **ARCHITECT** Busby + Associates Ltd. Vancouver, BC **STRUCTURAL ENGINEER** Fast & Epp Partners, Vancouver, BC **GENERAL CONTRACTOR** Dominion Construction, Vancouver, BC **PHOTOS** Nic Lehoux Photography, Vancouver, BC

MOUNTAIN EQUIPMENT CO-OP

CLIENT Mountain Equipment Co-op, Ottawa, ON **ARCHITECT** Linda Chapman Architect & Christopher Simmonds Architect in Joint Venture **STRUCTURAL ENGINEER** Cleland Jardine Engineering Limited **CONSTRUCTION MANAGER** Justice Construction **PHOTOS** Ewald Richter

WILLIAM R. BENNETT BRIDGE

CLIENT Province of British Columbia Ministry of Transportation **DESIGN/BUILD CONTRACTOR** SNC Lavalin Inc., Burnaby, BC **DECK SUBCONTRACTOR** CMF Construction Ltd., Nanaimo, BC **ENGINEERED TRUSS FABRICATOR** Acu-Truss Inc., Vernon, BC **PHOTOS** Stephanie Tracey, Photography West Kelowna, BC

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