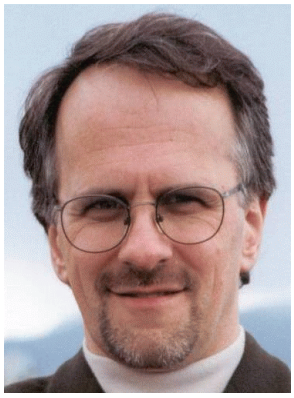


Paul A. Fast, P.Eng.
Fast + Epp
Structural Engineers
Vancouver, B.C., CAN

Neue projektbezogene Anwendungen von Holzbauelementen an der Westküste von Kanada

Neue projektbezogene Anwendungen von Holzbauelementen an der Westküste von Kanada

The West Coast of Canada is a region rich in natural resources and has for many years yielded some of the finest timber stands in the world. Douglas Fir, spruce and cedar grow in abundance in close to ideal rainforest conditions. Unfortunately, despite the presence of this plentiful resource, West Coast engineers and architects have yet to tap into the full potential that this natural, homegrown product offers for exciting and innovative design opportunities. While much use has been made of wood in the residential building sector resulting in the very cost effective and flexible North American style wood frame housing techniques, it has not experienced as much popularity in the institutional sector.

During the past thirty years, our European counterparts have taken much larger strides forward in the design of highly sophisticated engineered timber buildings. Evidence of this is the fact that while there are many timber manufacturing firms with CNC capabilities in Europe, there are still only a small handful of such companies in North America and only one on the West Coast of Canada. Heavy timber construction in North America has generally been limited to conventional post and beam applications that in most instances do not stretch the capabilities of carpenters. Relatively low construction budgets, a lower population base, and a lesser appreciation for good architecture have not helped the situation.

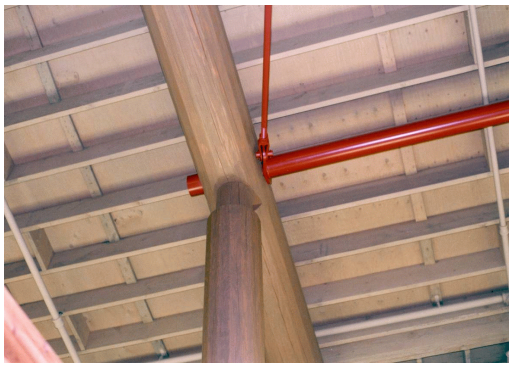
However in recent years, there has been a renewed interest in Western Canada in architectural structures that feature innovative applications of not only traditional wood materials but also new engineered wood products and connections. Despite limitations relating to hitech machinery, engineers and architects are working together to explore new design territory and create visually striking buildings that better represent the vast natural timber resources we enjoy in our part of the world.

Fast + Epp is taking a leading role in both the design and manufacturing aspects of these new developments.

Anspayaxw School, Kispiox, B.C. - Log-steel tensioned trusses

During the past decade, significant public funding has been committed to building new schools and gymnasiums for native Indian bands, resulting in numerous design commissions for our firm. The native groups have expressed a strong desire to reflect the traditional building styles of their ancestors. This has resulted in many projects that consist of heavy timber log construction. However, remote building conditions and heavy reliance on inexperienced native carpenters precludes using overly advanced building designs. An example of this is the Anspayaxw School in northern British Columbia. It features an exposed steel tensioned log roof structure supported by log columns and reflects the early bridge building techniques of the local Gitksan natives.

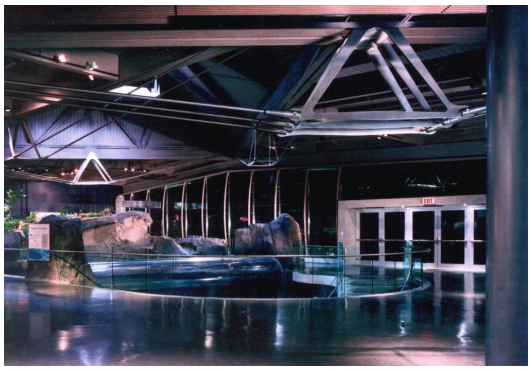
The success of this design very much depended on simple connections that could be constructed by local native carpenters. The primary and most difficult connection was at the log rafter-log column-steel tension rod location where every effort was made to avoid a long drill hole in the plane of the tension rod through the log rafter. This was solved by drilling a large, perpendicular to grain hole through the log rafters that would accommodate a 150mm dia. steel pipe pin spanning between adjacent pairs of rafters. The steel tension rods were then attached to the steel pipe which transfer compression forces into the log rafters.



Whitehorse Tourism Business Centre, Yukon - Fish belly trusses with fire killed pine struts

Another project that features an unusual design component and included a local native Indian labour component was the Whitehorse Tourism Business Centre in the Yukon, one of Canada's northern territories. The building consists of a two storey office component and a single storey display area. Fish belly trusses spanning 12.5 metres across the display area were designed using a curved 75mm dia. bottom tension chord, a pair of 150mm x 200mm glulaminated top chords and 100mm dia. pine sapling struts. The struts were salvaged from a forest fire and the char scraped off to expose a series of fine, black charred striations along the surface of the wood resulting in a very rustic appearance that reflects the history of the Yukon Territory.

Pacific Canada Aquarium - Parallam-stainless steel trusses



Several years ago, our firm was commissioned to design a new roof for the Pacific Canada Aquarium pool in Vancouver. This project represented a major turning point for us as a company as it launched us head first into the business of designing and building. The 680sq.m. roof features a central pyramid form with skylites that is surrounded by flat roof areas. The structure is comprised of 38mm x 140 mm wood decking supported by Parallam beams and Parallam-stainless steel tension rod trusses spanning up to 20 metres. The stainless steel undercarriage, with the exception of the tension rods, consists entirely of custom-machined connectors and a central yoke. When the project was tendered, the prices for the unusual roof structure were over budget and left the survival of the design in serious doubt. Convinced that further savings were achievable in the connection design phase and erection procedures, Fast + Epp then offered to construct the roof themselves through a newly established entity called StructureCraft Builders. The subsequent successful building of the Aquarium roof then catapulted the company into a whole new arena of activity and adventure.

Skytrain Stations, Vancouver/Burnaby, B.C.

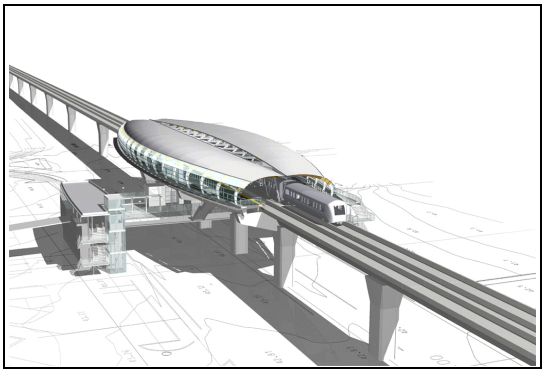
In the meantime, the Province of British Columbia decided to build an extension to the existing Rapid Transit Line in the Greater Vancouver region. The original phase of construction resulted in almost identical ‘‘cookie cutter’’ steel roof structures. Planners decided that the next phase would be highlighted by exciting station designs with each station bearing a unique identity for the local neighbourhood. The stations are generally 80 metres long and up to 22 metres wide. Early during the conceptual design of Phase 2, Fast + Epp suggested to the Chief Architect for the new Millenium Line extension that wood also be given fair consideration as a primary construction material for some of the 12 new stations. This would be a ground breaking approach for rapid transit stations in North America. The Architect then established a 5-fold design criteria that would have to be met.

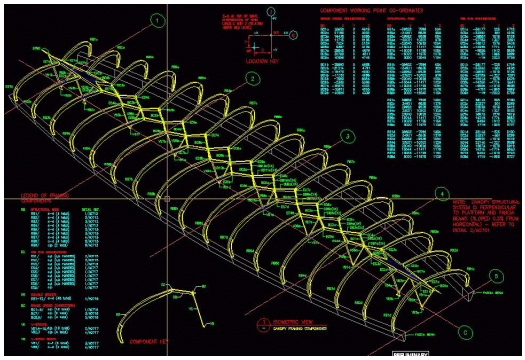
- Wood used only in out-of-reach locations
- Fire and flame spread ratings to meet heavy timber classification
- No timber directly exposed to weather.
- Economical construction.
- Modern appearance.

This resulted in timber being implemented as a construction material in 6 stations, four of which were designed by Fast + Epp.

Brentwood Station -
Glulam-steel arches with solid timber roof shell

This station was identified as being the signature station for the new Millenium Line by virtue of its ideal geographic location and outstanding views of the surrounding city and mountains. The structure consists of variable size glulam arches connected to curved steel I-shape haunches at the exterior end, and double steel plate struts at the interior end. The roof consists of standard size 38mm x 89mm spruce laminations nailed together to form an easy to construct shell roof cover. All arch geometry was developed using Microstation software and sent directly to the steel and timber subcontractors for manufacture and assembly. Steel plates and glulam rivets were used to achieve a full moment connection at steel-glulam interfaces.





Gilmore Station -
Bowed Timberstrand panels with cast steel struts/stainless steel cables

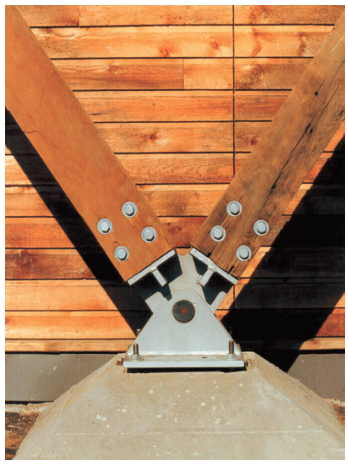
This station was tendered together with the Brentwood Station and required an economical roof structure to offset the increased costs of the geometrically more complex and expensive Brentwood roof. A unique 2.4metre x 5.0metre roof panel was developed using 38mm thick Timberstrand boards. The 64 identical wood panels were pre-bowed using 10mm dia. stainless steel cables that stretch below a central adjustable compression strut assembly. This assembly consists of four elegantly shaped cast steel arms connected to a common cast steel piston hub. The panels are supported by a conventional steel column and beam frame. In view of the refined design and manufacturing requirements for this panel, StructureCraft elected to bid the project and was the successful bidder, thereby preserving a greater degree of control over the final design and aesthetic value.

Rupert/Renfrew Stations - Glulam and steel roofs

These 2 sister stations feature free form roof structures with a playful interchange of steel and wood components. The dominant structural elements are the curved glulaminated beams which are supported by steel columns. Exposed steel decking serves as the roof cover at both stations.

Asphalt Testing Laboratory, Vancouver - 95% recycled timber components

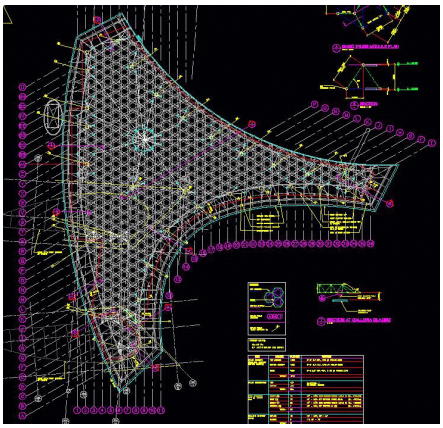
This 500 sq. metre building was a pilot project that was to demonstrate the reuseability of building materials. Salvaged structural components that were available from a decommissioned warehouse on the building site included 4 partly damaged heavy timber trusses, glulam beams, tongue and groove wood decking and steel crane columns. Two of the four trusses were reconditioned (in part using pieces from the remaining two), extended and haunched to form the exterior roof supports. Glulam beams were used not only as conventional beams but also laid on their flat side and dowelled together to form a solid wood floor that required no further finishes. The salvaged wood decking was used to construct the roof diaphragm and shear wall sheathing and steel columns were used to construct a large overhead door frame. Challenges encountered during the project included issues surrounding lumber grade assumptions and under-designed connection details resulting from more stringent modern codes.



Ferndale School, Washington and Surrey City Centre - 3D Space frame with peeler cores and cast steel connectors

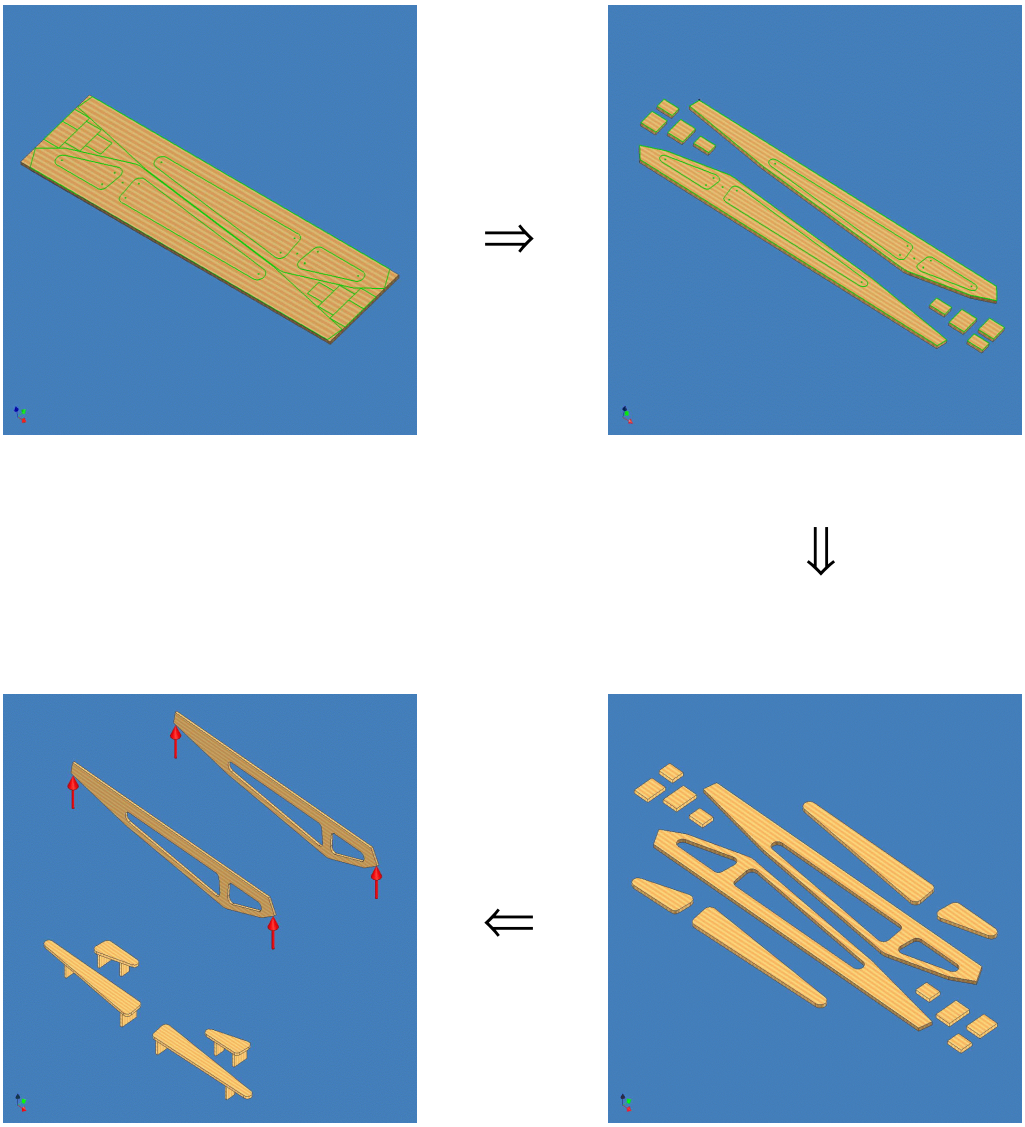
Another recent new application of timber elements has been the development of a 3-dimensional space frame roof structure utilizing peeler core logs connected with steel casting/bolt assemblies. The first application of this concept was a 1400 sq. metre roof over a multi-purpose room and library for a middle school in Ferndale, Washington. Designed by Geiger Engineers,USA and built by StructureCraft, it incorporated 125mm and 170mm dia. log struts to form an elegant 'Takanaka' truss form, 2.1 metres in depth and spanning up to 22metres between timber tree columns. The exposed roof diaphragm consists of 28mm thick Douglas Fir Plywood and together with the exposed struts creates a unique architectural ambience and structural form.

A similar structure with modified connectors is now being designed and constructed by our firms in Surrey, B.C. The roof will cover an area of 2000 sq. metres and will span up to 30metres with a central skylit area being supported by a series of steel cables and log struts. A space frame type structure lends itself well to forming this roof which is triangular in plan with curved sides. Connections also make generous use of steel casting technology to achieve elegant, economical design solutions.

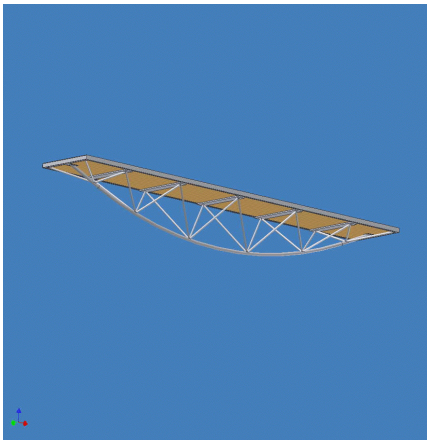


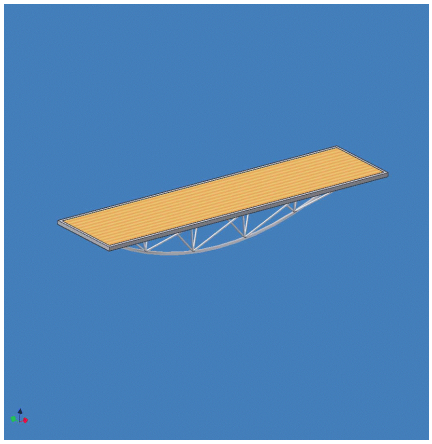
False Creek Community Centre, Vancouver - Custom shaped Timberstrand trusses

In contrast to some of these larger budget projects, interesting design opportunities are often discovered in the smaller projects or isolated components of larger projects. A current design project involves a small 400 sq. metre gymnasium addition to an existing community centre in downtown Vancouver. Working in close conjunction with the architect, 89mm thick Timberstrand boards were shaped and cut out to form a series of light, elegant trusses spanning 12.5 metres across the gymnasium. Thin 60mm wide steel plates were let into the bottom of the truss to improve the tension capacity. This approach to truss design maximizes architectural freedom of expression in a similar manner to what steel castings offer in connection design. In this instance, remaining wood cut outs are also being used to build benches and tables for the new foyer.



Ecole Gabriele Roy, Surrey, B.C. - Timberstrand Pedestrian Walkway





This new school project will include a suspended pedestrian walkway extending through the entry foyer. The bridge will span 9 metres between the 2nd floor levels of two wings of the building. As 5'-0" wide by 89mm thick Timberstrand board will efficiently form the walkway surface and the top chord of a truss assembly. The bottom chord of the truss and diagonals are 75mm dia. steel tubes with simple plate connections to the Timberstrand board.

Despite limited fabrication capabilities and less generous construction budgets compared to our European counterparts, progress is being made on the West Coast of Canada in utilizing our vast timber resources to create architecturally striking, elegant structures. In particular, engineered wood products such as Timberstrand and the utilization of custom steel castings in timber connections provides architects and engineers with a host of new design opportunities. Further development of new high strength wood products, connectors and CNC machinery will open up even more unexplored design terrain. Design build ventures will also continue to offer designers opportunities to retain tight control of their designs and develop architectural structures that their Clients will be proud of.