Heavy Timber Structures in Canada

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Introduction

Heavy timber construction in North America is slowly catching up with Europe. This presentation will show the efforts of a structural engineering company from Vancouver Canada to bring the Canadian level of design and fabrication to the current level in Europe.

In the process of design and fabrication of heavy timber structures, new technologies can be found in three basic areas: design and detailing, new connection systems, and new fabrication processes.

Design and detailing these days highly depends on computer software. Engineers use structural analysis programs to analyze and design their structures. In Canada the process of computerized design of heavy timber structures other than simple beams and columns is currently not available to engineers.

In the area of new materials North America is one of the leaders. Paralam, microlam, fibre reinforced glulam and other new materials have been developed in the United States and Canada.

In the area of new heavy timber connections the gap between Europe and North America is still wide. The last major heavy timber connection developed in Canada or United States was glulam rivet in the late 1950's. During the last 40 years in Europe several new heavy timber connection systems have been developed and successfully used in innovative structures. This presentation will show out attempts to use these European systems both in Canada.

In the area of fabrication a lot changed in North America during the last few years. Only four years ago we did not have a single CNC cutting machine. Now we have 14 and one company has also a 5 axis Creno machine.

North American progress in these areas will be illustrated using project examples during the conference presentation.

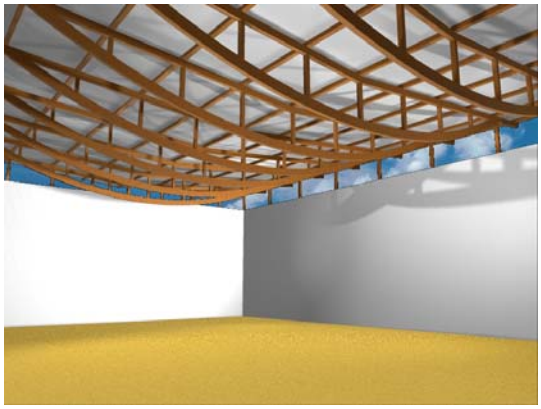
Design and Detailing

The cost of design and detailing can be a substantial part especially for the small heavy timber projects. In Canada the only available software for design of timber elements covers simple beams and columns. All more complicated structures can be analyzed using computer software but all the design of members and connections has to be done by hand. Equilibrium Consulting Inc. currently works closely with a German software developer Dlubal to change this.

The second part of design of heavy timber structures: design of connections is usually even more time consuming. The latest version of RStab a software offered by the same German company introduces modules to speed up design of heavy timber connections. We are currently working on adapting these modules to the North American design codes.

Our firm designs many schools and community centers in remote areas of British Columbia. The typical part of the project is a gymnasium. In one of our latest projects heavy timber trusses use a new connection system from Swiss company SFS. These self drilling tight fit bolts do not require pre-drilling in steel and wood and provide a cost competitive solution for typical projects. In the process of design these trusses our engineers use Rstab software to analyze structural forces, design heavy timber members and preliminary design the connections.

Gymnasium trusses for Skeetichestn School in Cache Creek, B.C. are being designed with SFS WS connectors, which is the first application of this system in North America.



Skeetichestn School, Cache Creek, B.C.
($2.3M, Construction Cost)
Architect: Ib Hansen Architect
Principal-in-Charge: Eric Karsh

New Connection Systems

Design of heavy timber connections is the specialty of Equilibrium Consulting Inc. Our company introduced two new connection systems from Europe to the North American market: Bertsche System from Germany and SFS WS System from Switzerland.

The introduction of a new system requires the joint effort of architects, engineers and manufacturers. It is first up to the engineer to present the new system to the architect for his approval of the esthetical impact. The next step is for the engineer to explain to the

manufacturer how the system needs to be installed. The manufacturer needs to have appropriate equipment for installation of the system.

In the early 1990's Robert Malczyk was involved in design of first Canadian structures using tight fit pins. At that time Canadian manufacturers did not have access to the CNC cutting machines and the connections with more than pins offered a major challenge to the installers because of low accuracy of cuts.

Today (late 2003) the situation have changed. British Columbia manufacturers have access to the latest CNC technologies and levels of accuracy increased dramatically. These new improvements enabled our firm to successfully introduce heavy timber connection system Bertsche in Canada.

The first application of the system was in gymnasium trusses for school in Kamloops, B.C. The rods suspending the structure disappear into the glulam without additional steel elements thanks to the Bertsche system anchors inserted in the wood members.

Sk'lep School, Kamloops , B.C.
($3.1M, Construction Cost)
Architect: Ib Hansen Architect
Principal-in-Charge: Eric Karsh

The next project where Bertsche system was used is in private residence in ski resort Whistler in B.C. The high snow loads resulted in high tension loads in bottom chord of the truss. The steel ring is connected with the glulam bottom chord through the Bertsche insert.

In the same residence the roof of the round tower forms a rotunda structure with tension ring supporting radial beams. The ring beams needed to be spliced for transportation and Bertsche connectors provide the invisible splice connector.

Groves 2 Residence, Whistler, B.C.
($3.5M, Construction)
Architect: Resort Plan International
Principal-in-Charge: Robert Malczyk

New Fabrication Processes

The major change over the last few years in British Columbia was the introduction of computerized cutting machines. Several of basic Hundegger K-2 machines are in use and one five axis Creno machine is also producing larger structures.

This technological progress enables the engineers to design new types of structures with new connection systems. New more complicated and curved shapes of heavy timber elements become available to designers. The high accuracy of the new machines enables the designers to introduce heavy timber structures to large scale structures.

The example of successful use of CNC technology is illustrated in NVIT/UCC Merritt Campus project. CNC turned glulam columns support reinforced concrete slabs in this architecturally and structurally innovative design. The project received two major awards in 2002: Lt. Governor of BC Award in and North American Wood Council Award.

NVIT/UCC Merritt Campus – Phase I
(Construction cost $7.6M)
Architect: Busby + Associate Architects
Principal-in-Charge: Eric Karsh