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Das Verbündnis von Tradition und High-Tech im kanadischen Holzbau

Tradition and high-tech in heavy timber structures in North America

Introduction

Heavy timber structures have a long history in North America. Wood was, and still is, perceived as a traditional low cost material in Canada and US. However, during the last few years, substantial progress has been made to introduce the latest technologies in the use of this traditional material in high-tech structures.

Heavy timber construction in North America is slowly catching up with Europe. This presentation will show the efforts of the structural engineering company Equilibrium Consulting Inc. from Vancouver Canada to bring the North American level of design and fabrication to the level currently present 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 heavy timber connections, the gap between Europe and North America is still wide. The last major heavy timber connection developed in Canada or US was the 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 our attempts to use these European systems both in Canada and the United States.

In the area of fabrication, a lot has changed in North America during the last few years. Only four years ago when I was attending the Garmisch conference, we did not have a single CNC cutting machine in British Columbia. Now we have 7 and one company also has a 5-axis Creno machine for cutting large structures.

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

Design and detailing

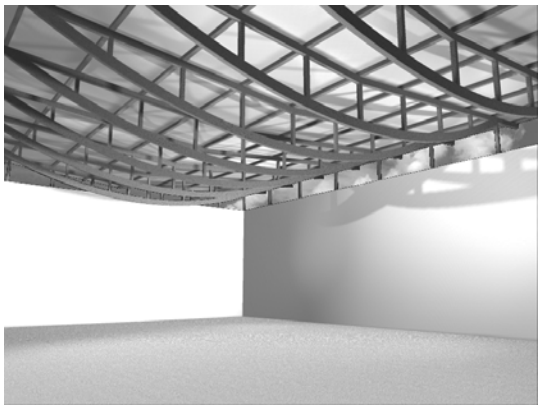
The cost of design and detailing can be a substantial part of costs especially for small heavy timber projects. In Canada, the only available software for design of timber elements covers simple beams and columns. All more complicated structures can be analyzed using computer software but all the design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

The second part of design of heavy timber structures - design of connections - is usually even more time consuming. The latest version of RStab 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 a 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 most projects. In the process of designing, these trusses, our engineers use Rstab software to analyse structural forces, design heavy timber members and perform a preliminary design the connections.

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



Skeetchestn School, Cache Creek, B.C.
$2.3m, Construction Cost
Architect: Ib Hansen Architect
Engineer: Equilibrium Consulting Inc.

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 approval of the esthetical impact. The next step is for the engineer to explain to the manufacturer how the system needs to be installed. Additionally, 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 CNC cutting machines and connections with more than 4 pins offered a major challenge to the installers because of low accuracy of cuts.

Today (late 2003), the situation has 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 the heavy timber connection system Bertsche in Canada.

The first application of the system was in gymnasium trusses for a 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
Engineer: Equilibrium Consulting Inc.

The next project using Bertsche system is a private residence in the ski resort at Whistler in B.C. The high snow loads resulted in high tension forces 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 a tension ring supporting radial beams. The tension ring beams needed to be spliced for transportation reasons and Bertsche connectors provide the invisible splice connector.

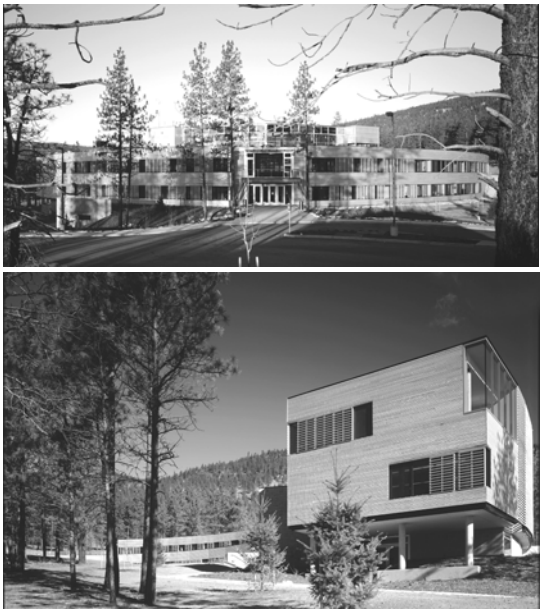
Grove 2 Residence, Whistler, B.C.
$3.5m, Construction cost
Architect: Resort Plan International
Engineer: Equilibrium Consulting Inc.

New fabrication processes

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

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

An example of the successful use of CNC technology is illustrated in the 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: The Lt. Governor of BC Award and the North American Wood Council Award.



NVIT/UCC Merritt Campus – Phase I
Construction cost $7.6m
Architect: Busby + Associates Architects
Engineer: Equilibrium Consulting Inc.

Future potential

Vancouver has been awarded 2010 Olympic games. The organizing committee decided that the new structures built for this occasion need to showcase our local materials. Forestry has always been a base of the province of British Columbia economy. Several large-scale structures are already planned to host the sport events. It is very likely that over the next few years, designers from British Columbia will be able to present new innovative large-scale heavy timber structures at conferences like this.

British Columbia is slowly becoming a center of excellence in the area of wood design and manufacturing. Several successful consulting companies are designing innovative wood structures. Young engineers are being educated in our new university programs. Manufacturers now have access to the latest CNC technologies.

Governments also express support for wood structures viewing it as base for adding more value to our forestry resource.

The formation of a heavy timber cluster of companies is well under way in British Columbia and it will speed up now, as a large number of Olympic structures will be designed in wood, thereby increasing the market size.

NVIT/UCC Merritt Campus
Glulam columns supporting reinforced concrete floors.
Architect: Busby + Associates Architects
Engineer: Equilibrium Consulting Inc.