DEVELOPING A WOOD CULTURE FOR NON-RESIDENTIAL CONSTRUCTION

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Abstract

Light frame wood construction has been used for decades in North America for residential construction. However, wood as a construction material for non-residential buildings almost disappeared in Eastern Canada and was replaced by steel and concrete. Over the last 10 to 15 years, important efforts were made in Eastern Canada and in the Province of Quebec in particular to develop a wood culture and promote the use of wood for non-residential construction. In 2008, the Quebec Government adopted a policy to favor the use of wood in public buildings construction provided that the design meets building code requirements and that the construction cost is no more than 5 % higher than for a standard steel and concrete project. Laval University has been very active in the development of this policy and is committed to the development of wood culture in general. Two major building projects were realized on campus since 2004: the Gene-H.-Kruger Building and the TELUS Stadium. A 44 meter span wooden bridge was also built at Montmorency Forest, Laval University’s experimental forest station. These projects were realized as demonstrations that wood can be used for non-residential building economically while valorizing the aesthetic character of wood. They were also aimed at showing the variety of wood-based products available in the market. Wood construction for non-residential buildings is gaining ground in Quebec but work remains to be done. Some of the significant aspects that need to be improved include the development of tools and documentation for engineers and architects involved in these projects, better training programs at the technical and professional levels, and pursue research in the areas of wood based products and construction.

Keywords: wood culture, wood construction, wood bridge, carbon neutral construction.
Light frame wood construction has been used for decades in North America for residential construction. However, wood as a construction material for non-residential buildings almost disappeared after the Second World War in Eastern Canada and was replaced by steel and concrete. Over the last 10 to 15 years, important efforts were made in Eastern Canada and in the Province of Quebec in particular to develop a wood culture and promote the use of wood for non-residential construction. In 2008, the Quebec Government adopted a policy to favor the use of wood in public buildings construction provided that the design meets building code requirements and that the construction cost is no more than 5% higher than for a standard steel and concrete project (MRNF 2008). In 2011, the Quebec Government put together a working group, the Beaulieu Commission, to enquire on the reasons explaining the slow development of non-residential wood construction and recommend measures to correct that situation. In parallel, Laval University has been very active in promoting the use of wood as a construction material for non-residential buildings and is committed to the development of wood culture in general. The Quebec Government policies and Laval University actions to promote the use of wood in non-residential construction will be described in this paper.

Methods used to Promote Wood as a Construction Material

Wood Use Strategy for Construction in Quebec
The Wood Use Strategy for Construction in Quebec (MRNF 2008) was put in place to increase the use of structural and appearance wood in domestic building construction, mainly in non-residential and multi-family construction by about 60% from 2006 to 2014. The aims of this strategy were to support the Quebec wood products industry and reduce greenhouse gas emissions. Two main courses of action were set within this strategy: 1) the Quebec Government should lead by example, using wood in its own buildings. Public order givers must consider the option of using wood when preparing their initial plans and specifications; 2) increase the use of wood in multi-family and non-residential construction by supporting innovation, develop tools to support designers and promote a new appreciation of wood in Quebec. Three specific measures were set to support innovation: 1) technology transfer to construction professionals and promoters; 2) applied research and development to develop new products and systems; and 3) university research involving training of highly qualified people.

Beaulieu Commission on the Utilization of Wood in Building Construction
The Beaulieu Commission was launched in March 2011 to enquire on the reasons explaining the slow development of non-residential wood construction and recommend measures to correct that situation. They published their final report in February 2012 (Beaulieu 2012). The Commission pointed out that progress has been made on the use of wood in non-residential construction but slower than expected. A number of recommendations were made to improve the situation:

1. Improve availability of documentation, design tools, technical support and training for engineers and architects;
2. Improve training programs on the use of wood for non-residential construction at high school, technical school and university levels;
3. Make timber construction course mandatory for civil engineering students;
4. Improve continuing education on wood construction;
5. Develop research chairs.

Showcase Projects at Laval University
Laval University offers undergraduate and graduate training programs in forestry in general and in wood science and engineering in particular. Laval is strongly committed to promote the use of wood in non-residential construction and to contribute to the development of a wood culture in general. Since 2005, three major wood construction projects were completed at Laval: the Gene-H.-Kruger Building, the TELUS Stadium, and the Montmorency Forest Wood Bridge. These projects will be described below.

Results and Discussion

Gene-H.-Kruger Building
The Gene-H.-Kruger Building is shown in Figure 1. Opened in October 2005, it is the home of the Wood Research Centre at Laval University. It is used for teaching and research in wood science and engineering at the undergraduate and graduate levels. The whole structure is made of black spruce and Douglas-fir glulam beams. Exterior siding, windows and interior wall panels are made of wood and wood-based panels. The building usable area is about 8000 m². It includes 18 laboratories, three classrooms, one conference room of 100 person capacity, one meeting room of 20 person capacity and Faculty, postdoctoral fellows and graduate student offices.

TELUS Stadium
The TELUS Stadium is shown in Figure 2. Its main function is as a soccer field but it is also used for rugby and football. It was opened in January 2012. It can host 500 spectators. The field has a size of 60 m × 100 m. The main structure is made of 13 black spruce glulam arches of 72 m span installed at 9 m interval. Steel bars are also used in the structure, therefore forming a hybrid structure. Black spruce from northern Quebec with particularly slow growth, small knots and high mechanical properties is used in the main arches.

Montmorency Forest Wood Bridge
The Montmorency Forest Wood Bridge is shown in Figure 3. It was opened in June 2011. The Montmorency Forest is Laval University forest experimental station located 75 km north of Quebec City, Canada. It is a 6664 ha forest managed by the Faculty of Forestry, Geography and Geomatics of Laval University. It is used for teaching, research and recreation. The wood bridge shown in Figure 3 is used to cross the Montmorency River, a tributary of the St-Laurence River. The bridge has a 44 m span and a width of 4.8 m. The structure is made of 12 glulam arches and 10 glulam beams made of black spruce from northern Quebec. The bridge was built and installed on the principle of a carbon neutral project. Therefore, 1941 trees were planted on the Montmorency Forest territory to compensate the balance of 129.4 tons of CO₂ emitted in this project.
Figure 1. Gene-H.-Kruger Building at Laval University. a) main entrance; b) back entrance; c) wood structure; d) main hallway; e) conference room; f) laboratory.
Figure 2. TELUS Stadium, Laval University, Quebec City, Canada. a) location on campus; b) main entrance; c) hybrid structure; d) hybrid structure during construction; e) assembly and installation of main arches; f) glulam connectors to concrete base.
Figure 3. Montmorency Forest Wood Bridge. a) completed project; b) installation of bridge section with a crane; c) installation of bridge section and connectors; d) installation of bridge section and connectors to concrete base; e) installation of connectors to concrete base.
Conclusions

Significant efforts are currently deployed in the Province of Quebec, Canada to develop a wood culture in the area of non-residential construction. Progress were made and interesting showcase projects were realized at Laval University, elsewhere in Quebec and elsewhere in Canada such as FPInnovations laboratories in Quebec City and Vancouver, and the Faculty of Forestry at the University of British Columbia. More work remains to be done to insure a faster development of wood construction in the Province of Quebec. Some of the significant aspects that need to be improved include the development of tools and documentation on wood construction for engineers and architects involved in these projects, better training programs at the technical and professional levels, and pursue research in the areas of wood-based products and wood construction.

References


Other links of interest:

http://www.ffgg.ulaval.ca/fileadmin/images/Faculte/Foret_Momo/Fiche_technique_pont_de_bois.pdf