CLT: Implementation in Canada – Status report

Brettsperrholz in Kanada – ein Statusbericht

CLT : introduction au Canada – état des choses

Compensato multistrato in Canada – Status Report

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Abstract

The success of Cross Laminated Timber (CLT) in Europe in the last two decades has created great interest in Canada. Canadian researchers have been building on the extensive research conducted in Europe to study the properties of CLT panels.

The acceptance of CLT assemblies and systems in the Canadian code system is very important for CLT to become an acceptable building product and system in North America. A market study and a Codes and Standards Road Map have been developed under a CLT Advisory Committee. A number of CLT buildings have been constructed using CLT from Europe. Commercial production of CLT in Canada is anticipated to start as early as 2011.

1. Research at the University of British Columbia (UBC) under Forestry Innovation Investment (FII) projects

Since 2005, a series of projects has been conducted at UBC on CLT under funding from FII. The research work at UBC has been driven primarily by the desire to find a suitable use for a low grade, deteriorating resource, a result of the Mountain Pine Beetle infestation of lodgepole pine trees in British Columbia. UBC's research focused on developing three-dimensional computer models to predict the stiffness and vibration properties of various configurations of the CLT products under out-of-plane loading. CLT panels of nominal dimensions 4' by 8' (1.2 m by 2.4 m) were made at UBC to compare two different types of connections, viz. glue and nails in 2007. Later on, forty CLT panels of nominal dimensions 4' by 14' (1.2 m by 4.3 m) were manufactured at CST Innovations to study the mechanical performance of CLT products with different layout configurations. A modular structure using CLT was designed and built with locally manufactured CLT structural components in 2009 for display during the 2010 Vancouver Winter Olympics.

Papers and reports

1. Chen, Y., 2009. Development of cross lamination technology for MPB engineered wood products – thick laminated MPB wood plates. Annual report for Forestry Innovation Investment Ltd., MDP 09-0083.
2. Chen, Y., A. Oudjehane and F. Lam, 2008. Bending behavior of thick laminated mountain pine beetle wood plates with different connections. BC Journal of Ecosystems and Management, 9(3), 170.
3. Chen, Y. and F. Lam, 2008. Development of thick laminated MPB wood plates. Annual report for Forestry Innovation Investment Ltd., MDP 2008-066B.
4. Chen, Y., 2007. Development of MPB thick laminated wood plate products. Annual report for Forestry Innovation Investment Ltd., MDP 2007-020A.
5. Chen, Y., 2006. Development of MPB thick laminated wood plate products – Literature review of the structural analysis issues. Annual report for Forestry Innovation Investment Ltd., MPB 2006-06.
6. Betz, J., 2006. Development of MPB thick laminated wood plate products – Study on cost effectiveness, consumer acceptance, and application of thick solid cross–laminated wood panels in Europe. Annual report for Forestry Innovation Investment Ltd., MPB 2006-06.

2. Research at UBC and UNB under a NRCan Value to Wood Project

Under a NRCan (Natural Resources Canada) Value to Wood Project, several studies were conducted on the use of CLT including: the evaluation of calculation methods for CLT elements used for floors loaded in the out-of-plane direction and used for walls loaded in the in-plane direction; the use of dowel-type fasteners to transfer loads between CLT elements by showing how to estimate dowel load-carrying capacity based on the European Yield Model; the use of CLT as beam elements; and the use of CLT in building systems. The contributions from UBC and the University of New Brunswick (UNB) are listed below:

Papers and reports

1. Lam F., J.Y. Chen & S. Li. (2009) Bending Behavior of Three-Layer CLT Plates. Report prepared for Natural Resources Canada Value to Wood Program Project # UBC07. University of B.C. Vancouver Canada.
2. Bejtka I. (2008) Cross (CLT) and diagonal (DLT) laminated timber as innovative material for beam elements. Report prepared for Natural Resources Canada Value to Wood Program Project # UBC07. University of B.C. Vancouver Canada.
3. Bejtka I. and F. Lam. (2008) Cross Laminated Timber as Innovative Building Material. In Proc. Canadian Society of Civil Engineering CSCE 2008 Annual Conference. Québec, QC June 10-13, 2008. CD-Rom Proceedings.
4. Smith I. and A. Asiz. (2009) Summary: UNB contributions to NRCan project UBC07. University of New Brunswick. Fredericton, Canada.
5. Smith I. and A. Asiz. (2008) Large X-Lam Floor and Roof Plates for Composite Construction. International Association for Bridge and Structural Engineering IASBE Congress IASBE 2008: Creating and Renewing Urban Structures - Tall Buildings, Bridges and Infrastructure. September 14 - 19, 2008, Chicago, Illinois.
6. Asiz A. and I. Smith. (2009) Structural connections for massive timber plate elements in hybrid structures (as submitted). International Association for Bridge and Structural Engineering IASBE Congress 2009 Bangkok Thailand.
7. Asiz A. and I. Smith. (2009) Demands Placed on Steel Frameworks of Tall Buildings Having Reinforced Concrete or Massive Wood Horizontal Slabs. (Draft manuscript prepared for submission to Structural Engineering International (SEI) quarterly Journal of the International Association for Bridge and Structural Engineering (IABSE))

3. Research at FPInnovations Forintek under theNRCan Transformative Technologies Program

There are several research projects devoted to CLT under FPInnovations' Transformative Technologies Program under NRCan. These projects are in line with the CLT Codes and Standards Road Map, and cover a wide range of topics.

FPInnovations published a report entitled "CLT Primer" (Crespell and Gagnon 2010) which served the purpose of introducing CLT to North America, and is planning to produce a CLT Handbook with the following chapters:

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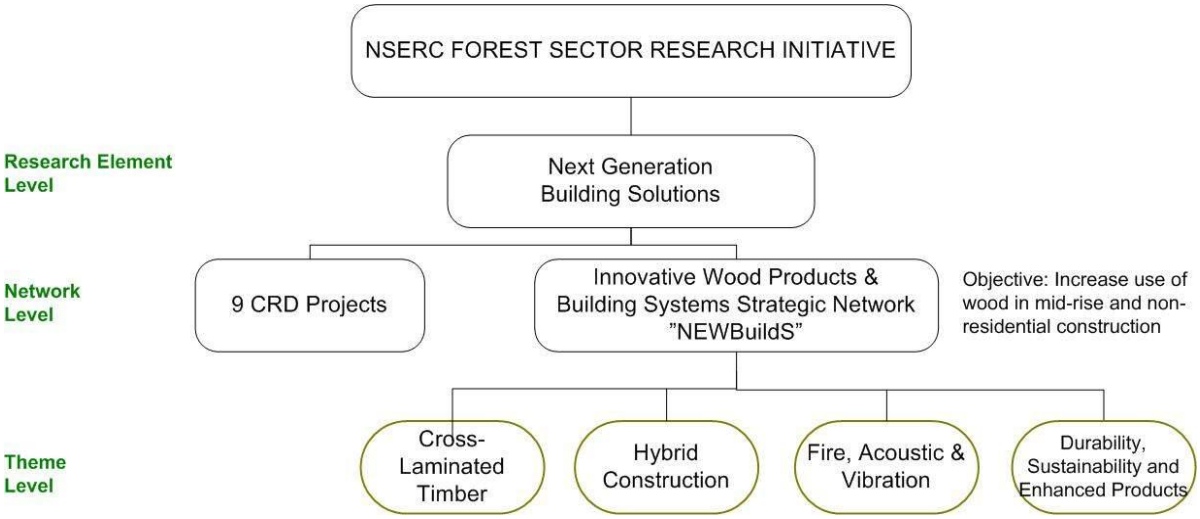
The research work to date at UBC, UNB and FPInnovations has been benefiting from the knowledge compiled via well established relationships with European research institutes. The European studies including in-plane shear properties (Bogensperger et al 2007, Joebstl et al 2008) and out-of-plane flexural and shear rigidity (Gsell et al 2007), bending strength (Steiger and Gülzow 2009), fastening (Uibel and Blass 2006 and Blass and Uibel 2007), creep in plate bending (Joebstl et al 2007), testing of full-scale specimens to evaluate fire (Frangi et al 2008b) and seismic (Ceccotti 2008) performance of CLT buildings have been very valuable for Canadian research teams' efforts in implementation of CLT in Canada. This information and the complementary testing and analytical work are expected to generate sufficient information for the early adopters in North America. At this stage, a certain degree of conservatism will be assumed in making recommendations, and future research activities at FPInnovations and universities will help fine tune those procedures that will be offered to the design and construction community and industry.

4. Future Research under the NSERC Forest Sector R&D Initiative

As a direct response to the Canadian Federal Budget 2008, NSERC was allocated new funds for collaborative research that directly contributes to the knowledge and innovation needs of Canada's forest industry. This new investment is being directed by the industrial and government stakeholders and FPInnovations with the purpose of transforming the forest sector industry.

FPInnovations Flagship Innovation Program in the FPInnovations Strategic Plan forms the basis of the priorities for this initiative, with the following five research elements (each having an FPInnovations manager identified as lead contact):

- Energy and Chemicals from Forest Biomass
- Integrated Value Maximization
- Next Generation Building Solutions
- Next Generation Pulps and Papers
- Novel Bioproducts from Forest Biomass



Under the "Next Generation Building Solutions" research element of the NSERC Forest Sector R&D Initiative, based on the recommendations from FPInnovations, eight Collaborative Research and Development Grants (CRD), and a strategic network for Innovative Wood Products and Building Systems (NEWBuildS) were established. CLT is one of the four research themes in the NEWBuildS Strategic Network which is being led by Dr. Frank Lam from UBC and Dr. Mohammad Mohammad of FPInnovations.

In establishment of NEWBuildS, the FPInnovations Scientific Lead (Mr. Erol Karacabeyli) consulted with FPInnovations staff, academia and the NSERC lead, and subsequently made recommendations about the appointment of the Scientific Director (Dr. Y. H. Chui), Theme Co-Leaders and an initial list of topics for NEWBuildS. NEWBuildS includes Co-Theme leaders from universities and FPInnovations, and each project has an FPInnovations scientist as collaborator. This strategic network is expected to lead to

- Stronger universities re: Wood Structures (e.g. successfully attracted new researchers from Civil Engineering Depts.)
- Multi-disciplinary research in universities (e.g. Acoustic-fire-structural)
- Further engagement of industry and the design and construction community in university research
- Effective collaboration between FPInnovations and universities

The CLT Theme in NEWBuildS, in close cooperation with FPInnovations research program will focus on the development of methods to measure structural properties of CLT panels and on the study of system behaviours, including structural, fire, acoustics, vibration and hygro-thermal, of CLT structures.

5. References

[1] Blass, H. J. and Uibel, T. 2007. Edge joints with dowel type fasteners in cross laminated timber Paper 40-7-2. Proceedings of CIB-W18 Timber Engineering, University of Karlsruhe, Karlsruhe, Germany.

[1] Bogensperger, T., Moosbrugger, T. and Schickhofer, G. 2007. New test configuration for CLT-wall-elements under shear load. Proceedings of CIB-W18 Timber Engineering, University of Karlsruhe, Karlsruhe, Germany. Paper 40-21-2.

[2] Ceccotti, A. 2008. New technologies for construction of medium-rise buildings in seismic regions: the XLAM case. Structural Engineering International 18(2): 156-165.

[3] Frangi, A., Fontana, M., Knobloch, M. and Bochicchio, G. 2008. Fire behaviour of cross-laminated timber panels. Proceedings of the 9th International Symposium on Fire Safety Science, Karlsruhe, Germany.

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[8] Uibel, T. and Blass, H. J. 2006. Load carrying capacity of joints with dowel type fasteners in solid wood panels. Proceedings of CIB-W18 Timber Engineering, University of Karlsruhe, Karlsruhe, Germany. Paper 39-7-5.