NEWBuildS Bulletin #3: Fall 2011

NEWBuildS Activities:

Theme II Research Exchange, June 2011

- Dr. Ian Smith & Mr. Conroy Lum, Theme II co-leaders, hosted the Theme II Research Exchange on June 13 -14, 2011 at NRC Institute for Research in Construction, Ottawa, Ontario. It was attended by 50 participants within the Network, fire consultant, CMHC, NRC/IRC and CWC. This Exchange provided an opportunity for regulatory and research bodies to review the research work undertaken and to ensure overall direction is consistent with industry and code development process.
- There were 7 Sessions on Fire Performance, Vibrations and Acoustics, Hybrid Building Systems, NRC Research and Breakout Sessions. The keynote guest speaker is Prof. Andrea Frangi, ETH Zurich – Institute of Structural Engineering.
- The 15 presentations are available at http://newbuildscanada.ca/members/researchers/ "June 13-14, 2011 Theme II Research Exchange."

- After the Exchange, staff of NRC Institute for Research in Construction invited attendees to take a tour of its facilities in fire engineering, building acoustics and building envelope.

Theme I Research Exchange/Working Meeting – September 2011

- Dr. Frank Lam and Dr. Mohammad Mohammad, Theme I co-leaders, hosted a Theme 1 Meeting on Sept 27, 2011 at FPInnovations, Pointe-Claire, QC. There were 18 participants including researchers from within the Network, representatives of Cecobois and 2 CLT manufacturers; Nordic and KLH Canada.
- HQPs of 5 Theme I CLT research projects and one Theme II project (T2-1-C4) presented their progress and research findings. Dr. Mohammad presented a summary of research activities on CLT at FPInnovations.
- Presentations are available at http://newbuildscanada.ca/members/researchers/ "September 27, 2011 Theme I Research Exchange/Meeting."

- The CLT manufacturers extended their welcome and invited all to visit 2 building sites with CLT construction in Longueil, QC.

NEWBuildS International Expert Panel established

An International Expert Panel (IEP) has been established to provide an impartial review of research proposals and, when necessary, the direction and progress of existing projects. Members of IEP are:

Dr. Sam Glass	US Forest Products Laboratory	Building Science
Dr. Andrea Frangi	ETH – Zurich, Switzerland	Fire
Dr. Gerhard Schickhofer	Graz University of Technology, Austria	Structural

Cross-Laminated Timber Symposium and Workshop – Oct 2011

UNB, NEWBuildS and FPInnovations hosted the Cross Laminated Timber (CLT) Symposium and Workshop on October 12 and 13, 2011 at Moncton, New Brunswick. It was attended by about 50 participants, including CLT and wood products manufacturers, adhesive suppliers, design professionals, researchers, building contractors, and government economic development officers. Presentations are available at http://www.unb.ca/fredericton/forestry/wstc/news/seminars.html

NEWBuildS Progress Reports

Progress Reports (PR) must be submitted twice a year (July and December). The Scientific Steering Committee (SSC) endorsed the revised and improved format. All PRs should be submitted in the new format to maintain reporting consistency. All past and current PRs are posted and available at Member area of the web site.

NSERC Strategic Network Enhancement Initiative (SNEI)

This new NSERC program will support specific activities related primarily to HQP training, international linkages and technology transfer. NSERC will provides support of up to $100,000 for 1 year. Deadline for submission is January 19th, 2012. All PI's are requested to submit their suggestions and proposals to NEWBuildS.

New Project Proposal

Proposals were solicited in May 2011 for possible funding from NEWBuildS members. Two proposals were received and they were reviewed by the IEP and SSC. The SSC voted and provided its recommendation to BoD for approval in November 2011. The successful proposal entitled 'Developing durable wood-frame building envelope systems for net-zero energy ready buildings' was jointly submitted by University of Waterloo and Ryerson University. It will commence in

January 2012 and will be part of Theme 4. Its project code is T4-7-C10 and will be conducted by one MSc student.(MSc8-T4).

Interaction with external stakeholders by Management Team

- The Scientific Director and the Chairperson of BoD attended the Joint Forestry Network Symposium and formation of **Forest Innovation By Research and Education (FIBRE) (http://reseauxfibrenetworks.ca/)** on Oct 18th & 19th in Ottawa. FIBRE was formed and established to share information and coordinate the 8 forestry related networks working with NRCan, FPInnovations and NSERC and create synergy between parties. There will be a joint FIBRE conference tentatively scheduled for 2013. Presentations made at the Symposium are available on http://newbuildscanada.ca/members/researchers/

  Ms. Carla Dickof, UBC and Prof George Hadjisophocleous, Carleton University were present at the Symposium with posters on their research.

- CWC initiated a project, known as 'Wood and Wood-hybrid Mid-rise Buildings' project (hereby referred to as Mid-rise project), with the intent to develop technical information that will lead to a review of the storey limit in the National Building Code of Canada for combustible construction. The project is being jointly undertaken by Institute for Research in Construction, NRC and FPInnovations, and is scheduled to end in 2013. CWC, FPInnovations and NRC expressed a desire to collaborate with NEWBuildS researchers and ensure there is synergy between NEWBuildS program and the Mid-rise project. To that end a Student Workshop has been planned for January 2012 when graduate students working on selected projects will present their research to the Mid-rise project team.

Future Network and related events

- CWC/NRC/FPInnovations/NEWBuildS - Mid-rise Building Project Student Workshop, January 2012, Ottawa, ON.
- NEWBuildS Workshop, May 2nd and 3rd, 2012 (Wed and Thurs), Vancouver, BC
- NEWBuildS BoD Meeting, May 4th, 2012 (Fri), Vancouver, BC
- Theme Meetings (optional), May 1st, 2012 (Tue), Vancouver, BC

Featured Project:

PROJECT T2–3–C4: NICHE FOR AND FEASIBILITY OF STEEL-FRAME MULTI-MATERIAL MID-RISE HYBRID SYSTEMS

Lead Investigator: **Dr. Siegfried Stiemer, University of British Columbia & Dr. Solomon Tesfamariam, UBC Okanagan**

HQP: **Ms. Carla Dickof**

FPInnovations Co-Investigator(s): **Dr. Marjan Popovski**

The objectives of this project are to enable construction of mid-rise buildings using steel-wood building systems and to provide technical tools to predict structural responses of hybrid systems. Design principles on strength and serviceability performance of hybrid buildings will be developed based on the research results.

Hybrid systems are commonly used around the world in many types of structures with different types of material. Steel and concrete hybrid members and systems are the most common. Steel and timber hybrid systems are less common but do exist. In Canada, NBCC 2010 limits the height of wood frame buildings to 4 storeys and provides no information on expected ductility and overstrength from steel and wood hybrid systems.

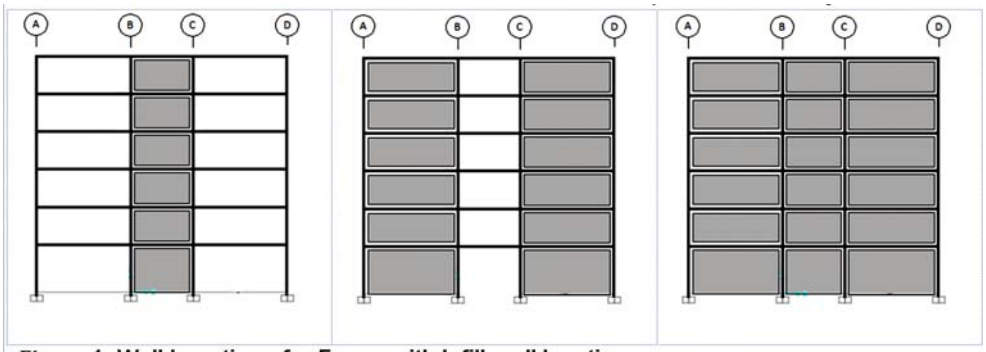
Hybridization allows each material to be used to maximize its advantages and minimize their respective weaknesses. Hybridization can be done at the component level, creating one member from multiple materials, or can be done at the system level, creating a system from members of different materials. Several issues are immediately obvious using timber and steel in any seismic force resisting system (SFRS), the largest being the incompatibility associated with the difference in material properties and the susceptibility of timber splitting. Moment frames of steel are extremely ductile but generally show large deflections during seismic events. Wood is comparatively much weaker; larger members are usually required resulting in stiffer systems. Further, wood does not produce post-yield deflection, especially when loaded perpendicular to the grain, resulting in a less ductile system. To optimize the hybridization of these types of systems, timber should be used in elements intended to remain elastic, or where steel members are susceptible to buckling. Connections also pose an important problem for this kind of system to be addressed in later stages of this project.

In Phase 1 of this project we are developing a catalogue of steel-timber hybrid vertical SFRSs and evaluating their ductility, overstrength, and general seismic response. We are currently conducting static and dynamic analyses using Vancouver's seismic hazard index on different types of hybrid SFRS with a multitude of parameters listed in Table 1.

Table 1: Parameters of Interest

Parameter	Options				
SFRS Type	Frame and walls		Frame with steel brace		
	Steel vs. steel-wood frame	CLT vs. OSB walls	Wood vs. steel-wood frame	Steel vs. steel-wood brace	Eccentric vs. Concentric
Ductility	Limited Ductility		Moderately Ductile	Ductile	
Storeys	9		6	3	
Floor Mass	Concrete on steel		Wood floor on steel joists	Wood floor on wood joists	
Braced Bays	One Bay		3 bays with central braced		

To date we have completed static finite element modeling on hybrid steel frames and wood walls. In order to accomplish this, a 3D steel moment frame building was designed for a 3, 6, and 9 storey configuration, subsequently a single frame from the 3D structure was taken and analysed using the Vancouver Hazard Spectrum as a base for comparison. The same frame was then modeled with the inclusion of wood walls in various bays as shown in Figure



1. **Figure 1: Wall Locations for Frame with Infill wall locations**

Initial results show a significant increase in capacity and stiffness of the system. **Adding a single bay of shear walls reduced the drift of the building at the design base shear determined from the NBCC 2010 from 260mm to 64mm.** Adding two bars of shear walls reduced the drift to 56mm, and 3 bays reduced it further to 54mm. Clearly the addition of a single bay of shear walls has a significant impact, with diminishing returns for larger areas of wall. As expected, the frame with infill shear walls act similarly to a concrete frame with infill masonry walls with the stresses focused in a diagonal across the wall as shown in Figure 2; further modeling can be completed with an equivalent diagonal strut.

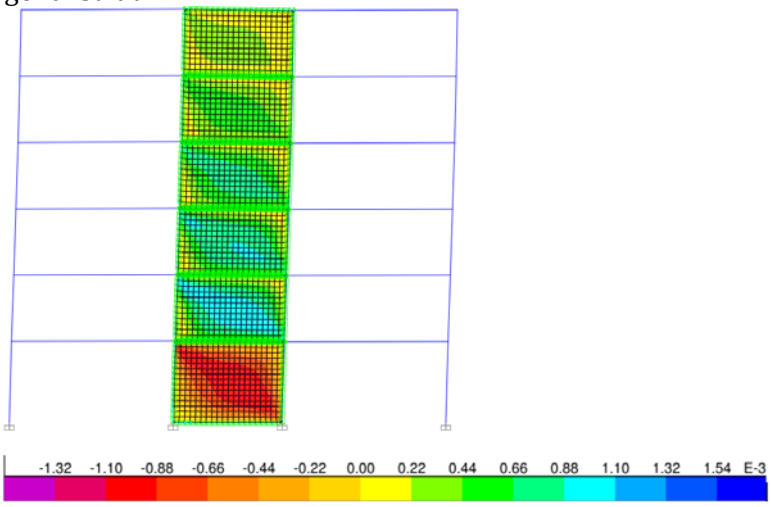


Figure 2: Deflected steel moment frame with infill wood shear walls with panel shear

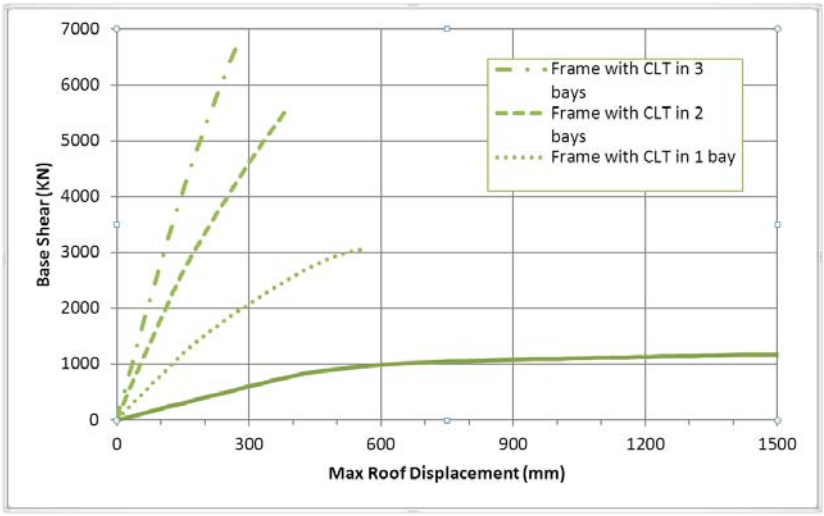


Figure 3: Pushover Curve comparison between frames with CLT infill walls at 6 storeys

The static pushover curve also shows a significant increase in the capacity of the system with the addition of CLT infill walls as shown in Figure 3