NEWBUILDS NEWSLETTER: SPRING 2014

NEWBuildS Activities:

NEWBuildS Workshop 2014

- NEWBuildS hosted its 4th Annual Workshop on May 7 & 8, 2014 at Radisson Hotel Vancouver Airport, Richmond, BC with 2 Keynotes Speakers, Dr. Stefan Winters, Technische Universität München (TUM) & Dr. Samuel Glass, USDA Forest Service.
- NEWBuildS research network is entering the final year of its operations, with 37 research projects having either been completed or reached the final phase of the research.
- This was a well-attended work with 193 registered participants –50% more participants than the last Workshop in Vancouver in 2012. This confirms the interest in the NEWBuildS program. There were 44 designers, 33 producers, 27 regulators, 31 external researchers and 57 NEWBuildS researchers (including FPInnovations scientists).
- Dr. Winters' presentation was entitled "High-rise timber buildings in Europe -Projects, challenges, solutions and future development". Europe has its own set of challenges and requirements. The new construction is now possible with massive timber, hybrid construction and process such as prefabrication and panelization as they are now built all over Europe. The challenges are in the construction details, fire safety requirements, moisture control and quality control.

- Dr. Glass' presentation "Building Envelope Performance of Wood-based Building Systems: Research Perspectives from the U.S" provided an overview of building envelope research at US Forest Products Lab.. US is now focused on reducing home energy use by up to 50% by 2017 with research focused on heat, air, moisture transfer and hygrothermal analysis. US Forest Product Lab has built a CARWASH facility – chamber for analytic research on wall assemblies exposed to simulated weather.

- NEWBuildS appreciates the session moderations by Prof. F. Lam, Prof. S. Stiemer, Prof. G. Hadjisophocleous, Mr. C. Dagenais and Dr. J. Wang.

- Workshop 2014 was a 1 & ½ day event and consisted of 5 sessions – Structural, Connection Behaviour, Fire Performance, Acoustic & Vibration and Durability & Energy. There were 23 presentations by 28 presenters.
- The workshop package with presentation abstracts and attendees list is available on the web site @ http://newbuildscanada.ca/news/events/. All presentations, including keynote speakers, are available at Member-only area @ http://newbuildscanada.ca/members/researchers/ under "Annual Workshops & Theme Meetings".
- Exit Survey indicated that the participants rated the Workshop with a score of 4.5 out of 5.0 (excellent).

SPECIAL PRESENTATION SESSION: HQP Tall Wood Building Design Project – May 7, 2014

- As reported earlier, NEWBuildS initiated a special project to execute the design of a high-rise wood building based on the FPInnovations Tall Wood Building Guide with the knowledge gained in NEWBuildS research projects.
- This project was under the leadership of 3 professional experts; **Mr. Robert Drew**, Perkins+ Wills, Architect; **Mr. Eric Karsh**, Equilibrium Consulting and **Mr. Andrew Harmsworth**, GHL Consultants. The 3 HQP design teams developed the specifications, including geometry, location and specific needs, of a high-rise building with focus on structural performance (seismic and wind), fire resistance and building envelope issues.
- A special presentation session took place in the morning of May 7 for the project team to present the design of 20-storey tall wood building with an one-storey podium. The HQPs had 6 presentations on Architectural Design, Building Envelope, Lateral & Gravity Load Resistance, Fire Risk Modeling and Fire Resistance Design.

- The 3 experts hosted a Panel Discussion on the Tall Wood Building Design and addressed the challenges in developing alternative solutions for tall wood buildings design. This project provided a case study of how a wood based tower could be analysed to demonstrate compliance to relevant building code objectives through the alternative solution process in Canada.
- All presentations are available @ http://newbuildscanada.ca/news/events/.

This project is jointly funded by NSERC (Natural Sciences and Engineering Research Council of Canada) and BC FII (Forestry Innovation Investment).

The 2nd Annual FIBRE Conference

May 12 to 15, 2014, University of British Columbia, Vancouver, BC

FIBRE

- FIBRE is "**F**orest **I**nnovation **b**y **R**esearch and **E**ducation" and consists of eight forest sector research networks, of which NEWBuildS is one. This was the 2nd FIBRE Network Conference and highlighted university-led forest product/process innovations, university-industry collaborations and student training.
- The conference was held at the UBC Earth Sciences Building (ESB), an innovative five-storey building where wood is the primary structural material. It showcases the application of cross laminated timber (CLT) in North America with a cutting-edge technology and design on a "floating" glulam staircase.
- NEWBuildS HQPs participated in the Poster Sessions with 18 posters. Two projects were selected to participate in the Marcus Wallenberg Competition – Ms. P. Wilbur, Western University presented "Practical Height Limits for Tall Timber Buildings" and Mr. J. Schneider, UBC presented "Performance Assessment of Conventional and Novel Connections for Timber-Steel Hybrid Buildings".

Workshop on Seismic Force Modification Factor for Hybrid Structure

- This workshop took place on January 14, 2014 at University of British Columbia between NEWBuildS researchers and FPInnovations scientists. The topics were; Force Modification Factors: Background and Evaluation Methods, Earthquake Loading and Simulation, Steel - Timber Hybrid Structures: Over Strength and Ductility Factors and An Approach to derive System Seismic Force Modification Factor for Hybrid Structures.
- It was followed with a discussion on derivation of seismic modification factors and the analysis of seismic performance of hybrid structures.

<u>NEWBuildS Administration:</u>

NEWBuildS – 9 month extension to Sept 2015

NEWBuildS Strategic Network was originally established under the NSERC Forest Sector R&D Initiative in February 2010. NSERC, FPInnovations and Natural Resources Canada (NRCan) have partnered to create the $34 million, five-year initiative to support commercially relevant research programs that will create new market opportunities for the Canadian forest sector. Research funded under this initiative will be conducted through 2014.

The Board at its May 2014 meeting approved a request to NSERC for a 9 month extension. The extension is necessary to permit some PIs to spend the research funds and HQPs to complete their research and fulfill the mandate of their research projects.

Congratulations to Ms. Lynn Embury-Williams

NEWBuildS congratulates Ms. Lynn Embury-Williams, Chair of Board of Directors with her recent appointment as Executive Director of WoodWORKS! BC in April 2014. Ms. Embury-Williams provides crucial leadership and guidance to NEWBuildS. She will continue as the Chair of BoD of NEWBuildS.

NEWBuildS Project Enhancement Fund 2014 Competition:

- NEWBuildS Project Enhancement Fund awards are intended to support activities to enhance the quality of NEWBuildS research projects with a maximum amount of $6,per award.
- For 2014, NEWBuildS approved 7 awards with a total fund amount of $42,000.

NEWBuildS Outreach Committee:

At the completion of each research project, each PI/HQP is requested to submit the research thesis and also prepare a Tech Note. The Tech Note captures the essential findings of the research project and summarizes the valuable information for industry, design professionals and researchers.

- Thesis has detailed research findings and posted @ http://newbuildscanada.ca/publications/thesis/ when available.
- Tech Notes are available for download @ http://newbuildscanada.ca/publications/tech-note/. There have been 14 Tech Notes posted to-date.

New Year 5 Research Projects:

NEWBuildS is pleased to announce 2 new Research Projects for Year 5.

- T2-11-C4 – "Light wood frame structures - development of design and construction guidelines" with Principal Investigators Dr. Ying-Hei Chui, UNB, and Dr. Ghasan Doudak, uOttawa.
- T2-12-C4 – "Heavy and hybrid frame structure - development of design" with Principal Investigator, Dr. Siegfried Stiemer, UBC.

The two projects are designed to compile all research findings from earlier NEWBuildS research findings for light wood frame and heavy and hybrid frame structures respectively.

Update on NEWBuildS Web site:

NEWBuildS web site www.newbuildscanada.ca is updated constantly. All projects, events and presentations are available now to reflect the latest developments. The web site has 2 main areas; Public and Member (brown bar). Member area has relevant and on-going NEWBuildS research documents and presentations. Please contact Kenneth Koo kenneth.koo@fpinnovations.ca if you are interested in earlier presentations and documentations.

The traffic growth at NEWBuildS web site is astonishing as follows;

Year	Visitors	Visits	Web Pages	# hits	Bandwidth Downloads (GB)
2010 (since Oct)	328	695	9,940	51,011	1.11
2011	7,839	3,811	61,395	263,700	12.28
2012	4,728	18,373	74,611	233,441	19.28
2013	6,568	27,350	80,573	263,065	27.13
2014 (up to June)	4,474	15,096	48,135	285,211	145.30

This confirms that dissemination goal of NEWBuildS is being fulfilled by the amount of traffic on our web site.

Future Network and related events:

- World Conference on Timber Engineering
  August 10 – 14, 2014
  Quebec City, Quebec
- Tall Wood Building Design Project Road Show
  Eastern and Western Canada ; Dates TBD

Featured Project:

PROJECT T3-6-C2: **Sound Insulation of Wood Building Systems in Mid-rise Buildings**

Lead Investigator: **Dr. Trevor Nightingale, Carleton University / NRC**
HQP: **Armin Eslami**

Introduction:

Double-leaf stud walls are commonly used assemblies in lightweight buildings. However this type of wall performs relatively poorly under shear loads. Main sources of this type of load are wind and earthquake loads. One approach to overcome this weakness is to add a shear-resisting layer inside the wall cavity. Theoretical study shows that despite its positive effect on the strength, it has a negative impact on sound insulation capability of the wall in low and mid frequency region.

Due to lack of adequate experimental study on triple-leaf walls a series of tests were performed in order to observe the actual acoustical behaviour of the walls and to validate the theoretical models.

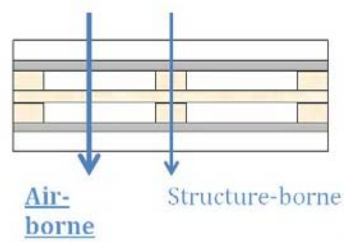

Figure 1 Different sound transmission paths through a triple-leaf wall

The sound transmission path is divided into structure-borne and air-borne paths. In structure-borne sound transmission, which includes the flanking transmission path the sound travels through the solid matter and the connections, and in air-borne transmission the acoustic wave travels through the air gaps. This research is focused on the latter.

Measurements:

Standard: The measurement of airborne sound insulation was performed according to the ISO 10140-Part 2. This standard procedure is a part of ISO 140, which is a series of basic building acoustic standard tests. The series consist of instructions to laboratory measurements of sound transmission of specimens and their mountings and also the basic measurement procedure and requirements for test facilities and equipment.

Rooms: The sound transmission loss test is performed in the reverberant chambers of the Acoustics group at the National Research Council Canada. There are two horizontally adjacent rooms of which the smaller one is designated the source room and the larger one the receiving room. These rooms have low flanking sound transmission. The diffuse field is produced in either room by two loudspeakers sitting at the bottom corners of the wall in front of the test sample. The average sound pressure level inside both rooms is calculated by the recordings of the moving microphones.

Specimen: A test frame which is 3.658m wide, 2.438m high and 381mm deep is enclosing the test structure and is placed in the gap between two rooms.

Several test specimens were tested for the sound transmission, including single, double and triple layers, but only one typical triple-leaf system is discussed here. The typical specimen is made up of one layer of 3/16 in. thick polypropylene sheet on one end, 93 mm air gap, 1/16 in. thick Aluminum sheet in the middle, 93 mm air gap on the other side of the middle sheet and a 3/16 in. thick polypropylene sheet on the other end. The assembly is 1.220 m long and 1.220 m wide (4 ft. × 4 ft.) which fits into an aperture cut in the filler wall.

Figure 2 The test specimen installed in the filler wall

Figure 3 The cross section of the triple-leaf wall in the filler wall

The filler wall consists of double 33 mm × 65 mm (1 1/4 in. × 2 1/2 in.) steel stud framing spaced nominally 610 mm on center with two layers of 16 mm (5/8 in.) gypsum board Firecode Type X directly attached on each side and a 20 mm air gap. Cavities between studs filled with 610 mm wide × 65 mm thick insulation. The filler wall is designed to have high sound insulating properties.

Each plate was tightly restrained on both sides by wood strips along the perimeter of the plate, as shown in Figure 3. The wood strips were covered by sill gasket on the surfaces touching the wall frame and the structure and were attached to the filler wall by screws.

Method:

The main assumption is that the acoustic field in both rooms is diffuse. In diffuse fields the acoustical modal density of the room is high enough that it is not possible to see standing waves. The sound waves at each point in the room are coming randomly from different directions. The diffusiveness of the room is determined by "Schroeder frequency" which is a function of the damping and the volume of the room.

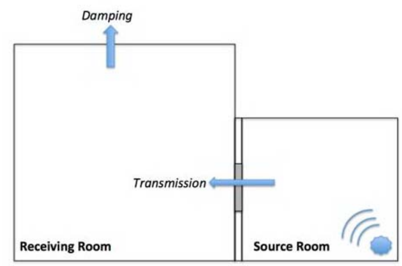

Figure 4 The acoustic energy balance for the source and the receiving room

The method is based on the acoustic energy balance which means: the rate of change energy content in a room = the energy generated by the source (here loudspeakers) – transmitted energy.

The main path for energy transmitted is through the specimen. In order to calculate this sound transmission the average acoustic energy density in both rooms is measured using microphones at different positions inside the rooms. The energy density of the receiving room plus the damped energy by the surfaces of that room and by the air is used to measure the transmitted acoustic energy. The dissipated energy is calculated using the reverberation time measurement.

Modeling

The theoretical modeling of airborne sound transmission was done using transfer matrix model. This model relates the acoustic pressure and velocity of one side of the substructure to the other side of it in form of a matrix and using impedance concept. For complex systems like the triple-leaf wall these matrices can be multiplied to obtain the total sound transmission.

The sound transmission loss of the model is solved separately for all angles of incidence; weighted average for a reverberant (diffuse) field is calculated.

Results and Discussions

The measured and predicted transmission loss against the frequency is shown in Figure 5. The transmission loss increases with the capability of sound insulation by the wall.

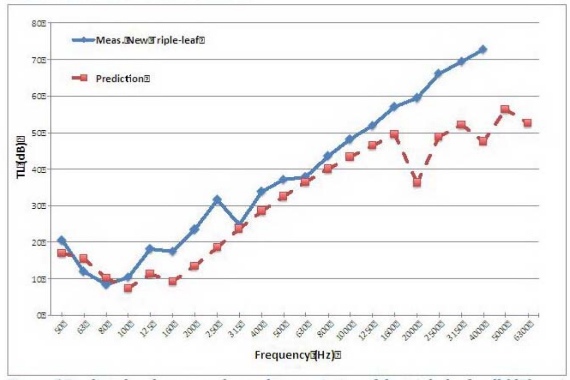

Figure 5 Predicted and measured sound transmission of the triple-leaf wall (dB) against frequency (Hz)

For both curves the sound insulation by the wall is increased with frequency. At lower frequency range the difference between the measurement and prediction is larger than that for higher frequencies. A closer look at the data reveals that at that lower range the diffuse field assumption is not satisfied; therefore the measurements are only accurate for frequencies beyond that range.

The prediction shows two dips in the TL curve which is due to the resonance of the wall system (three degree of freedom mass-spring-mass-spring-mass resonance). At higher frequencies there are a number of other dips in the prediction curve that are due to the standing waves in the cavities between the plates.

Potentials

The trend of the predicted TL is very similar to the test results which mean that the model has the capability to be used for predicting the sound transmission of the wall. With this model it would also be possible to design a wall that has certain acoustical behavior.