UNIVERSITY OF ALBERTA

NSERC CRSNG

NSERC Industrial Research Chair in Engineered Wood and Building Systems

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Content:

NEWSLETTER

Remark from IRC holder

With the end of the Winter term of 2018, most IRC graduate students have completed the majority of their course requirements. We expect that they will now be able to focus their attention to their thesis research. Most of the research to-date has focused on testing of self-tapping screw connections and related materials properties including embedment and withdrawal strength at various insertion angles. A preliminary research plan on the lateral load testing of 7m tall wall system built with mass timber panels has been developed. The goal of this tall wall test program is to develop technical information for seismic design of tall mass timber wall systems.

The IRC group welcomes the following HQP to the group over the last few months:

- Dr. Sigong Zhang, PDF (Topic: Prefabricated mid-rise light wood frame buildings)
- Ahmed Mowafy, PhD student (Topic: Hybrid steel-timber self-centering wall systems)
- Mehsam Tanzim Khan, MSc student (Topic: In-plane shear and bending properties of mass timber panels)
- Adrian Moreau, NSERC Undergraduate Summer Research Award student
- Chen Yuan, Summer u/g research assistant
- Tianxia Wei, Summer u/g research assistant
- Rafid Khan, Summer research assistant (High School)

Successful NSERC RTI application

The IRC was part of a successful NSERC Research Tools and Instrumentation (RTI) application “Hybrid Testing System for Seismic Mitigation of Civil Structures” that will enable the researchers to purchase a state-of-the-art Hybrid Testing System (HTS) capable of performing full-scale pseudo-dynamic experimental testing in combination with numerical simulation under seismic loads. The HTS system will consist of a controller and two loading actuators (1000kN and 500kN capacity). The crucial benefit of the HTS is in physically testing the critical part of a structure that is expected to respond in the inelastic range or to become unstable. The rest of the structure can be modeled using finite element analysis. This pseudo-dynamic technique is versatile and viable with high performance computers. The HTS allows full-scale testing of structural components without the need to scale down a specimen to lab limits.

WCTE 2018 in Seoul

The World Conference of Timber Engineering is the world’s largest conference for developments and innovations the field of timber construction. Several IRC members will travel to Seoul to present their work. The following work will be presented:

- *Behaviour of Mass Timber Panel Concrete Connections with Inclined Self-Tapping Screw and Insulation Layer* (Mirdad, M. A., Chui, Y.-H.)
- *Reliability Analysis of Load-Carrying Capacity for Connections Consisting of Inclined Self-Tapping Screws* (Zhao, R., Joyce, T., Chui, Y.-H.)
- *Bending Properties of Innovative Multi-Layer Composite Laminated Panels* (Zhou, J., Niederwestberg, J., Chui, Y.-H., Gong, M.)
- *Shear Properties of Innovative Multi-Layer Composite Laminated Panels* (Niederwestberg, J., Zhou, J., Chui, Y.-H., Gong, M.)
- *Strain Distribution of 5-Layer Composite Laminated Panels using Digital Imaging Correlation Technique* (Niederwestberg, J., Zhou, J., Chui, Y.-H.)
- *Development of ISO Baseline Vibration Design Method for Timber Floors* (Hu, L., Chui, Y.-H., Hamm, P., Toratti, T., Orskaug, T.)

Contact Us

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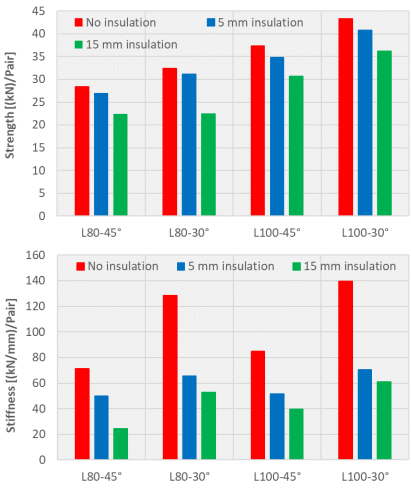
Project updates

GLT-Concrete Connection Tests

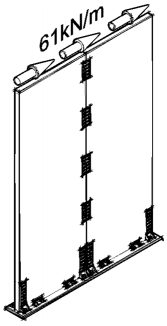


Glue Laminated Timber (GLT) concrete specimen with 11mm self-tapping screws were tested in shear. The screws were inserted parallel to the grain at 30° and 45° insertion angles. Two different embedment length (80mm and 100mm) were tested with three insulation thicknesses (0mm (no insulation), 5 mm and 15 mm) in between GLT and concrete. The objective of the connection tests was to evaluate the influence of a sound insulation layer on the performance of connections. The figures below show the results for a pair of screws (screw in tension and compression) where "L#" indicates the embedment length of screw followed by the screw insertion angle. From the top figure it can be seen that there is a strength due to the use of insulation layers. A stiffness reduction of due to the insulation was observed (bottom figure). Concrete crushing combined with wood embedment was the dominant failure observed for specimens with insulation. The specimens without insulation showed screw yielding along with wood embedment.

Small-Scale I-Joist Diaphragm Tests

Small-scale diaphragm tests were conducted as a part of MITACS Accelerate project-Investigation of wood I-joists for floor applications in mid-rise wood construction. The performance of I-joist diaphragms is compared with diaphragms built with sawn lumber joists. The specific objective is to determine if the fastener row factor for diaphragm constructed with lumber framing members can be applied to diaphragm constructed with wood I joists. The I-joist diaphragms are built by using partially-cut I-joist in the centre member where the panel joint is located. Single, double and triple rows of nails are included in the tests to investigate the fastener row factor in CSA O86. In the tests, compressive loading is applied at the centre member. Initial test results support the use of fastener row factor in CSA O86 for the wood I-joists tested.

Tall Wall Project



The inclusion of CLT into the CSA O86 was a significant step for the recognition of mass timber panels (MTP) as a main stream structural material for massive and tall buildings. A number of key challenges remain to be addressed to give designers all necessary provisions for the design with MTPs. The provisions provide guidance about the shearwall design for seismic events and specify the locations of energy dissipation. Even though CSA O86 provides guidance about the general concept for the design with MTPs certain questions remain unanswered. The objectives of the project are:

- To gain information about MTP behaviour and performance as shearwall elements
- Evaluate influence of connection strength, stiffness and ductility on MTP shearwalls
- Validation of finite element models, for development of $R_d R_o$ values
- To provide technical data for design provisions on the in-plane behaviour of MTPs
- Validation of design provision for predicting lateral drift (Δ_{MTP} and $\Delta_{connection}$)

The shear wall specimens will be 7m tall and the applied lateral load will be equivalent to that experienced by a 4-storey building located in Victoria BC. Panel-to-panel, hold-down and base shear joints containing self-tapping screws with different ductility and stiffness characteristics will be tested prior to the shear wall tests to develop design information for those joints.