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

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

- Lin Zheng, MSc student (Topic: Connection and shear wall performance of hybrid CLT panels.)
- Hossein Farboodi, MSc student (Topic: Stress distribution in CLT under concentrated load.)
- Linlin Ma, visiting PhD student (Xi'an University of Architecture and Technology)
- Dr. Yutu Yang, visiting professor (Nanjing Forestry University)

The IRC research group now consists of 5 PhD students, 6 MSc students, 2 visiting scholars, and 3 PDF, conducting over 15 research projects. A broad range of research topics, from high performance brace and hold-down connections, floor vibration, timber-concrete floor systems, innovative applications of CLT and hybrid CLT, to panelized roof in light frame construction, are being studied. As we are approaching the end of the current code cycle, these research projects are expected to provide input for code change proposals in time for the next edition of building code and CSA O86 standard. In addition to the previously mentioned code-related project on development of self-tapping screw design provisions, work has commenced on the development of a product standard for mechanically laminated timber panels, such as nailed laminated and doweled laminated timber.

Canadian Academy of Engineering Fellow

Dr. Chui has been named one of fifty-four new Fellows to the Canadian Academy of Engineering (CAE). Congratulations Dr. Chui.

"Members of the CAE are nominated and elected by their peers to honorary Fellowships, in view of their distinguished achievements and career-long service to the engineering profession. Fellows of the Canadian Academy of Engineering are committed to ensuring that Canada's engineering expertise is applied to the benefit of all Canadians." [Media Release, Canadian Academy of Engineering]

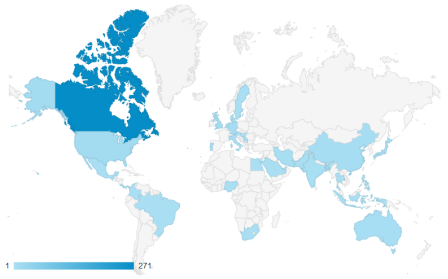
Catherine Lalonde Memorial Award 2019

IRC PhD student Md Abdul Mirdad has been awarded one of three 2019 Catherine Lalonde Memorial Awards by the Canadian Wood Councle. Abdul's work focuses on better understanding of timber-concrete composite beams with dowel type connectors and the influence of sound proofing intermediate layers. Besides Abdul, Gabriella Vojtila from Queen's University and the team of Shawn Dylan Johnston and Siqi Wang from the University of Toronto received the annual award. Gabriella works on the performance of fully concealed beam-column connectors under seismic loading, Shawn and Siqi work on an architectural solution for a community centre with innovative structural solutions in mass timber. The IRC would like to congratulate all awardees.

Graduates of 2019

With Marko Spasojevic the first student of the IRC program graduated this year. Marko graduated with a Master of Science. His thesis is titled "Structural and Hygrothermal Performance of Light Wood-Frame Walls with Insulated Sheathing". Jan Niederwestberg graduated from the University of New Brunswick. Jan's PhD thesis is titled "Influence of Laminate Characteristics on Properties of Single-layer and Cross Laminated Timber (CLT) Panels". While Marko joined a consulting company in Edmonton, Jan remains with the IRC. Congratulations and best of luck to both graduates.

Website and YouTube Channel



The groups website has generated interest all over the world during the last 12 month. Due to the recent relocation of the website two data sets are available. The current ARTS homepage has been visited 953 times in the period between January 1st and December 8th 2019. Most of the traffic originated from Canada (71%); followed by China (14%); India, Iraq and the United States of America (5% each). For the same time period, the webpages from the previous website (which are still linked to the new website) were called 353 times. Again, most of the calls originated from Canada (75%). The figure above shows the web traffic associated to the webpages all over the world. Currently the YouTube Channel has ten subscribers and holds 17 videos from testing. The videos on the channel have been viewed 364 times since December 2018. The team is currently working on brushing up some of the existing content and adding additional videos.

Mass Timber Survey

The IRC has conducted a mass timber survey for the Natural Research Council of Canada and B.C. Forestry Innovation Investment Ltd. The goals of the survey were to:

- describe the current research landscape for mass timber in Canada and USA,
- perform a gap analysis and identify the immediate and medium term research priorities and technical challenges,
- provide initial recommendations to enable coordination and collaboration among researchers and other groups.

Seven stakeholder groups were identified, Producers, Design Consultants, Material Associations, Builders, Regulators and Insurance Companies, and 217 survey invitations were send out. A total of 84 responses were received to the survey, which presents a response rate of about 40%. The survey report is currently under review and is expected to be completed in early 2020. The IRC would like to thank to all participants.

Project updates

Flexural behaviour of panel-to-panel connections in cross laminated timber

As shown in the figure on the right, bending tests on two types of panel-to-panel connections used in cross-laminated timber (CLT) floor systems have been completed in August 2019. The tests aim to investigate the flexural behaviour of typical panel-to-panel connections used in CLT floors, which are currently designed by treating them as one-way systems. The one-way model assumption is conservative but two-way model would overestimate the system stiffness if the presence of semi-rigid panel-to-panel connections is not properly considered in the analysis. These connections allow partial transfer of bending moment from one panel to the adjacent panel. In order to develop an equivalent plate model that account for the 'reduced' system stiffness in the minor strength direction, the rotation performance of the connections need to be determined. In this research, the double surface-spline connection and butt joints have been studied with different screw spacing, screw diameter, screw length and spline thickness. The resulting bending moment versus rotation curves were used to determine the rotation stiffness and strength of connection assemblies. Further study will be conducted to develop an equivalent plate-model for CLT floors and these stiffness results will be the input in the model.

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ARTS YouTube Channel

Influence of support conditions on serviceability of MTP floors

Between July to November 2019, experimental investigations have been conducted to examine the influence of support conditions on the vibration serviceability of MTP floors. A total of seven MTP panels (CLT and GLT) with different thickness were tested at four different spans. The influence of end-support restraints, multi-span continuity and beam support flexibility on the vibration design parameters such as mid-span deflection and fundamental frequency have been examined. The test setup can be seen in Figure 1. The ultimate goal is to develop mechanics-based design equations to quantify the influence of various support conditions in MTP floor systems.

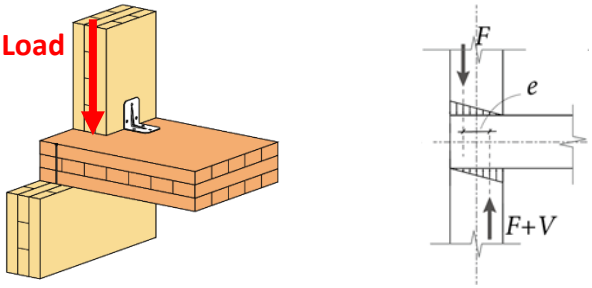
a) End-support restraints b) Multi-span continuity c) Beam support flexibility

Figure 1: Test setup for MTP support tests

Based on the test results, a preliminary investigation of the influence of end support loading restraints has been carried out. As shown in Figure 2, an internal lever arm, *e*, can be used to characterize the influence of end support loading restraints exerted by the up storeys. Once the lever arm is known, the moment induced by the loading at the end support can be determined. By analysing the test results, empirical equations can be derived between the end support loading and the lever arm as shown in Figure 3. The fitted curve can be expressed as

$$\frac{e}{d^{1/3}} = \frac{40}{F^{0.6}}$$

where *d* is the deflection of a related simply supported beam and *F* is the end-support loading. Further validation will be conducted and a final reliable design equation will be proposed in the early future.



a) Up storey loading b) Lever arm, *e*

Figure 2: a) Loading from upper storeys, and b) internal lever arm

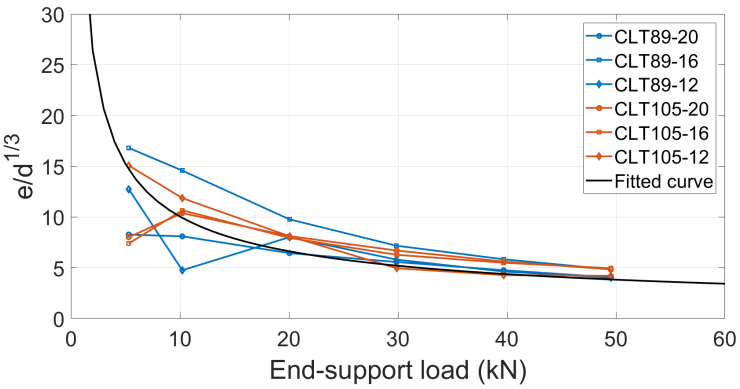


Figure 3: Curve fitting between the lever arm and the end support loading