Research in Progress 2018-19

Mass Timber and Tall Wood Building Research in Canada and the United States

DRAFT October 17, 2018
Acknowledgments

The list of research projects in this document was gathered with assistance from the following organizations:

- Natural Resources Canada
- Mass Timber Institute
- Ontario Ministry of Natural Resources and Forestry
- Softwood Lumber Board
- TallWood Design Institute
- U.S. Forest Service - Forest Products Laboratory

Contact

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The Think Wood Research Library links to publications about structural systems composed of mass timber, heavy timber, and light-frame construction (for buildings five stories and up).
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Mechanical Properties

1. **Bonding Mixed Species for Advanced Biomaterials**
   - **Description**: This project is expected to reveal if cross-laminated mixed hardwood and softwood species would have bonding properties similar to softwood CLT using commercial adhesives for timber laminating. The results will provide baseline data on adhesion properties of bonding mixed northern wood species.
   - **Investigators**: USDA Forest Service Forest Products Laboratory, Michigan Technological University
   - **Timeline**: 2017 to October 2018
   - **Contact**: Xiping Wang, Forest Products Laboratory, xwang@fs.fed.us
     Xinfeng Xie, Michigan Technological University, xinfengx@mtu.edu

2. **Engineering Performance Characteristics of Hardwood Cross-Laminated Timber**
   - **Description**: Two major outcomes are expected. First is the establishment of a technical basis for developing allowable bending strength and stiffness of hardwood CLT panels. Second is the development of models for predicting the mechanical properties of CLT products made of low-grade hardwood lumber.
   - **Investigators**: Michigan Technological University, USDA Forest Service Forest Products Laboratory
   - **Timeline**: September 2017 to April 2019
   - **Contact**: Xinfeng Xie, Michigan Technological University, xinfengx@mtu.edu
     Xiping Wang, Forest Products Laboratory, xwang@fs.fed.us

3. **Mass Plywood Panel Product Development Testing**
   - **Description**: In August 2017 the TallWood Design Institute began phase two of testing an innovative engineered wood product - the mass plywood panel (MPP) for Freres Lumber Company in Lyons, Oregon. The concept for the new product was developed during a 2015 technical tour to mass timber facilities in Austria, led by the OSU College of Forestry. A first round of testing in 2016 focused on helping Freres Lumber Company identify the most appropriate lay-up pattern, and Sinha and his team then tested an optimized layup at different thicknesses that would eventually be taken to market. Phase two includes bending tests to investigate the strength and stiffness of the product. Later, connections, acoustic performance characteristics and a rocking shear wall application of the product will also be tested. MPP, like CLT, can be used as a substitute for traditional building materials, providing much lower embodied energy and greater carbon sequestering properties than concrete and steel. Freres says that some advantages of MPP are that it uses 20-30 percent less wood than CLT. Large-format panels can be manufactured at the production facility in order to minimize waste and labor on job sites. The light weight of the panels can help save on transportation costs and logistics during construction.
   - **Investigators**: TallWood Design Institute
   - **Timeline**
   - **Contact**: Arijit Sinha, Oregon State University, arijit.sinha@oregonstate.edu
4. Mass Timber Products from Under-utilized Species in Northwestern Ontario
Description Lakehead University will enhance teaching facilities and student labs for research in wood properties at the wood supply level, sourcing & testing newly-developed mass timber products using under-utilized species and address knowledge gaps in species potential of larch, birch, and poplar, and developing strategic partnerships in northwestern Ontario.
Investigators Lakehead University
Timeline
Contact Mathew Leitch, Lakehead University, 807-343-8659

5. Producing CLT Panels from Low Value Appalachian Hardwoods: Part 2, Demonstrating CLT Panel Production, Properties, and Use
Description
Investigators West Virginia University
Timeline
Contact

Seismic, Wind and Structural Performance
6. Adoption of Post-Tensioning Systems in North America
Description Expand applications of wood products by establishing a new building system that will provide a higher level of seismic performance
Investigators FPInnovations
Timeline April 2018 to March 2019
Contact Steven Kuan, FPInnovations, steven.kuan@fpinnovations.ca

7. Behavior of CLT Diaphragm Panel-to-Panel Connections with Self-tapping Screws
Description Understanding how roof and floor systems (commonly called diaphragms by engineers) that are built from Pacific Northwest-sourced cross-laminated timber (CLT) panels perform in earthquake prone areas is a critical area of research. These building components are key to transferring normal and extreme event forces into walls and down to the foundation. The tests performed in this project will provide data on commonly used approaches to connecting CLT panels within a floor or roof space and the performance of associated screw fasteners. Structural engineers will directly benefit through improved modeling tools. A broader benefit may be increased confidence in the construction of taller wood buildings in communities at greater risk for earthquakes.
Investigators TallWood Design Institute
Timeline
Contact Thomas Miller, Oregon State University, Thomas.Miller@oregonstate.edu
8. **Blast-Resistant Testing for Loaded Mass Timber Structures**

*Description*
The outcomes of the quasi-static testing will include
- establishing a resistance function to compare to the resistance function created from previous testing without axial load,
- potentially quantifying residual capacity after bending failure, and
- determining if a ductile failure mode exists when inducing a compression failure in the outer lamination.

*Live blast testing outcomes will include*
- proving the efficacy of CLT technology in real blast resistant applications and establishing a basis for the design methods recommended for use.

*Investigators*
USDA Forest Service Forest Products Laboratory, WoodWorks™ – Wood Products Council, Softwood Lumber Board

*Timeline*
July 2017 to late 2017

*Contact*
Christopher (Adam) Senalik, Forest Products Laboratory, christopherasenalik@fs.fed.us
Lisa Podesto, WoodWorks™ – Wood Products Council, lisa@woodworks.org

9. **Composite Concrete-CLT Floor Systems for Tall Building Design**

*Description*
This project will optimize the strength, stiffness, vibration characteristics, acoustic qualities and fire resistance of cross-laminated floor systems utilizing a composite concrete and cross-laminated timber product. This project includes development, testing and optimization of an economical shear connector (to connect the CLT panel to the concrete slab) that will be compared with existing screw and steel plate solutions. The resulting prototype floor system will be tested at full scale.

*Investigators*
TallWood Design Institute

*Timeline*

*Contact*
Christopher Higgins, Oregon State University, chris.higgins@oregonstate.edu

10. **Connections for Stackable Heavy Timber Modules in Midrise to Tall Wood Buildings**

*Description*
A 12-story timber building with stackable CLT modules will be analyzed by computer modeling based on the information gathered in the test. A report detailing the design procedure, test results, and simulation results will be developed at the end.

*Investigators*
University of British Columbia

*Timeline*
April 2018 to March 2019

*Contact*
Frank Lam, University of British Columbia, frank.lam@ubc.ca
11. Cross-Laminated Timber Fasteners Solutions for Tall Wood Buildings
Description
Constructing buildings with CLT requires development of novel panel attachment methods and mechanisms. Architects and engineers need to know the engineering strength properties of connected panels, especially in an earthquake prone area. This project will improve knowledge of three types of wall panel connections: wall-to-floor, wall-to-wall, and wall-to-foundation. Testing will determine the strength properties of metal connectors applied with different types and sizes of screw fasteners. The data will be used to develop a modeling tool that engineers can use when designing multi-story buildings to be constructed with CLT panels.

Investigators
TallWood Design Institute

Timeline

Contact
Arijit Sinha, Oregon State University, arijit.sinha@oregonstate.edu

12. Development of Cross-Laminated Timber for Seismic Regions of the United States
Description
The research project will develop both analytical tools and methods to enable the use of CLT in seismic regions of the United States for new buildings and make CLT wall systems a viable seismic retrofit option for commercial wood structures.

Investigators
USDA Forest Service Forest Products Laboratory, University of Alabama, South Dakota State University, APA—The Engineered Wood Association

Timeline
September 2011 to January 2013

Contact
Douglas R. Rammer, Forest Products Laboratory, drammer@fs.fed.us
John van de Lindt, University of Alabama, jwvandelindt@eng.ua.edu
Shiling Pei, Colorado School of Mines, spei@mines.edu

13. Development of Heavy Timber Buckling Restrained Braced Frames
Description
The principal outcome of this project will be a BRB design methodology incorporating heavy timber. Additionally, cyclic performance data will be generated to allow both design and codification of the HT-BRBF system for use in high seismic and wind regions of the United States.

Investigators
USDA Forest Service Forest Products Laboratory, University of Utah, Arup USA, U.S. Endowment for Forestry & Communities

Timeline
January 2017 to December 2017

Contact
Douglas R. Rammer, Forest Products Laboratory, drammer@fs.fed.us
Chris P. Pantelides, University of Utah, c.pantelides@utah.edu

Description
The most important step towards the commercialization of novel hold-down solutions for mass-timber structures is to obtain reliable data about their structural performance. For this purpose, several hold-down configurations will be tested experimentally to evaluate their strength, stiffness and ductility.

Investigators
University of Northern British Columbia

Timeline
April 2018 to March 2019

Contact
Mark Barnes, University of Northern British Columbia, mark.barnes@unbc.ca
15. Development of Large Span CLT Floor/Roof System with Two-Way Plate Bending Action: Phase II

Description: A continuous CLT floor/roof system that has two way bending action across multiple CLT panels will create open floor space with long spans in both major and minor directions, making mass timber construction more competitive and cost-effective. A design guide on CLT two way floor/roof system, incorporating the results from the two phases of study, will be developed at the end.

Investigators: University of British Columbia
Timeline: April 2018 to March 2019
Contact: Frank Lam, University of British Columbia, frank.lam@ubc.ca


Description: A workable RTA safe room constructed from CLT will be verified to resist the forces of an EF-5 tornado and the requirements of the ICC-500 design standard.

Investigators: D.R. Johnson Wood Innovations Timber Engineering LLC, USDA Forest Service Forest Products Laboratory
Timeline: Completed by December 2017
Contact: Todd Black, D.R. Johnson Wood Innovations, tblack@drjlumber.com
Bob Falk, Forest Products Laboratory, rhfalk@fs.fed.us

17. Development of Seismic Performance Factors for Cross Laminated Timber—Phase II

Description: The ultimate outcome of the project will be broadly accepted seismic performance factors for CLT in the United States, which will then be available for use by engineering designers in seismic regions where seismic guidelines are mandated. A secondary outcome will be the methodology to follow on how future component changes can be incorporated into the design of CLT.

Investigators: Colorado State University, USDA Forest Service Forest Products Laboratory, South Dakota State University, American Wood Council, FPInnovations
Timeline: September 2012 to July 2014
Contact: John W. van de Lindt, Colorado State University, jlw@engr.colostate.edu
Douglas Rammer, Forest Products Laboratory, drammer@fs.fed.us
Shiling Pei, Colorado School of Mines, spei@mines.edu

18. Development of Seismic Performance Factors of Cross-Laminated Timber—Phase III

Description: The ultimate outcome of the project will be broadly accepted seismic performance factors for CLT in the United States, which will then be available for use by engineering designers in seismic regions where seismic guidelines are mandated. A secondary outcome will be the methodology to follow on how future component changes can be incorporated into the design of CLT.

Investigators: Colorado State University, USDA Forest Service Forest Products Laboratory, South Dakota State University, American Wood Council, FPInnovations
Timeline: September 2012 (phase I) to December 2015 (phase III)
Contact: John W. van de Lindt, Colorado State University, jlw@engr.colostate.edu
Douglas Rammer, Forest Products Laboratory, drammer@fs.fed.us
19. **Development of Seismic Performance Factors for Cross-Laminated Timber Shear Walls**

**Description**
This research will result in the following:

- Evaluation of seismic performance factors, including response modification factor (R-factor), system over strength factor, and deflection amplification factor for seismic design in the United States.
- Component tests data that are reported in accordance with the standards and are widely available to the engineering community, allowing application of P795 methodology to facilitate potential use for alternative fasteners and connectors by manufacturers.

**Investigators**
Colorado State University, USDA Forest Service Forest Products Laboratory, American Wood Council, Colorado School of Mines, FPInnovations

**Timeline**
Early 2017 to early 2018

**Contact**
John W. van de Lindt, Colorado State University, jwv@engr.colostate.edu
Douglas Rammer, Forest Products Laboratory, drammer@fs.fed.us

20. **Engineered Timber Structural Systems for Seismically Resilient Tall Buildings**

**Description**
Framework for a performance-based seismic design (PBSD) methodology and feasibility of three prototype systems to enable 8- to 14-story resilient CLT buildings in regions of high seismic hazard.

- Set of quantitative seismic PBSD targets for tall timber buildings.
- Core numerical model for seismic analysis of panelized CLT structure system.
- Cost-effective structural systems for resilient tall CLT buildings that are adequately detailed and experimentally verified at the component level.
- Outline of a PBSD process for tall CLT systems and an applicable building portfolio and educational NEES modules on CLT for engineers and the general public on NEES Academy.

**Investigators**
Colorado School of Mines, Lehigh University, Washington State University, University of Washington, Colorado State University, ARUP, USDA Forest Service Forest Products Laboratory, FPInnovations

**Timeline**
October 2014 to 2016 (two years)

**Contact**
Shiling Pei, Colorado School of Mines, spei@mines.edu
Douglas Rammer, Forest Products Laboratory, drammer@fs.fed.us

Description
The purpose of the technical guide is to confirm the use of nails, screws, bolts and rivets in combination with steel angle brackets, and self-tapping screws as “energy dissipative connections” in CLT structures that provide a level of performance equivalent to that intended in the National Building Code of Canada (NBC) 2015, or other applicable codes. It will outline the test protocol, the evaluation criteria and resulting design values to be used with equations within the design standard, CSA 086, Engineering Design in Wood. The technical guide will help to address the knowledge gaps surrounding the behavioural properties of CLT connections, offer a means for municipal building officials to validate the design of these connections and serve as a valuable resource for designers undertaking the design of CLT based seismic systems.

Investigators: National Research Council Canada, Canadian Construction Materials Centre
Timeline: February 2018 to March 2019
Contact: Philip Rizcallah, National Research Council, Philip.Rizcallah@nrc-cnrc.gc.ca


Description
Currently, only light frame wood-based shearwall and braced and moment-resisting frames are given in the NBC 2015 as acceptable solutions, with the height limit for these SFRSs in high seismic zones being 20 m (6 storeys). There is no acceptable solution for using Timber SFRS in buildings more than 20 m high in high seismic zones. The Tall Wood building projects in Canada have been following the “Alternative Solution” path with supporting test data and analysis that could demonstrate equivalent or better performance than building and fire code or local condition requirements, and were approved on a case-by-case basis by the Authority Having Jurisdiction (AHJ). The Tall Wood projects have been and will be faced with different level of difficulties and challenges depending on the familiarity of AHJ with tall wood construction. Furthermore, there are no consistent procedure and performance criteria to analyze and evaluate the Timber SFRS in tall mass timber buildings that could be referenced by the AHJ. This project is to undertake the work related to:
- Phase II: evaluation of an example solution of Mass Timber SFRS in accordance with the developed Technical Guide as a “Demo” project.

Investigators: National Research Council Canada
Timeline: Phase 1 (Technical Guide) due March 2019, Phase 2 planned for 2019/2020
Contact: Jasmine Wang, National Research Council, Jasmine.Wang@nrc-cnrc.gc.ca
23. **Living Lab at Peavy Hall: Structural Health Performance of Mass Timber Buildings**

**Description**
Building on the results of an earlier project that established protocols for post-occupancy building monitoring, this project aims to install a system in the new Peavy Hall building at Oregon State University to monitor moisture, relative humidity, vertical and slip movements due to shrinkage & deflection, post-tensioning losses, vibration and seismic activity. The monitoring system will establish a “living” laboratory that demonstrates in real time how the mass timber components of the building are affected by various internal and external phenomena. The data will be gathered and analyzed over the service life of the building.

**Investigators**
TallWood Design Institute

**Timeline**

**Contact**
Mariapaola Riggio, Oregon State University, mariapaola.riggio@oregonstate.edu

24. **Mechanically Fastened Cross-Laminated Timber System Feasibility**

**Description**
Our feasibility study will document how mechanically fastened CLT panels can be effectively produced to create structurally sound walls for residential construction and other suitable applications. This information will be useful to designers and builders interested in adopting the CLT system to create sustainable, energy-efficient, and cost-effective structures from material that would otherwise be unsuitable for construction.

**Investigators**
USDA Forest Service Forest Products Laboratory, University of Idaho, University of Utah, Brigham Young University, Euclid Timber Frames, Acute Engineering

**Timeline**
Mechanical results published, reports being prepared on hygrothermal performance.

**Contact**
David Kretschmann, Forest Products Laboratory, dekretsc@facstaff.wisc.edu
Thomas Gorman, University of Idaho, tgorman@uidaho.edu
Ryan Smith, University of Utah, rsmith@arch.utah.edu

25. **Monitoring Performance of Mass Timber Demonstration Buildings in Ontario**

**Description**
Set plans and requirements for monitoring vertical movement, energy efficiency, acoustics, and moisture management in demonstration buildings, and collaborate with the University of Ottawa for measuring structural characteristics of the demonstration buildings.

**Investigators**
FPInnovations, University of Ottawa

**Timeline**

**Contact**
Jean-Pierre Martel, FPInnovations, jean-pierre.martel@fpinnovations.ca

26. **Seismic Design Provisions and Commentary for Post-Tensioned Mass Timber Walls**

**Description**

**Investigators**
Colorado School of Mines

**Timeline**

**Contact**
27. Seismic Performance of Braced Mass Timber Frames
Expected outcomes  Maintain the category of timber braced frames in the National Building Code of Canada
Investigators  FPInnovations
Timeline  April 2018 to March 2019
Contact  Steven Kuan, FPInnovations, steven.kuan@fpinnovations.ca

Description  This project develops benchmark data needed to generate design guidelines for structural engineers to calculate strength & stiffness of CLT-diaphragms, with and without concrete toppings. The project includes a full-scale test of a two-story mass timber building at the UC San Diego shake table in collaboration with the larger project, “Development and Validation of a Resilience-based Seismic Design Methodology for Tall Wood Buildings” which features collaborators from throughout the western US and is funded by the Natural Hazards Engineering Research Infrastructure (NHERI) program of the National Science Foundation.
Investigators  TallWood Design Institute
Timeline  April 2018 to March 2019
Contact  André Barbosa, Oregon State University, andre.barbosa@oregonstate.edu

29. Seismic Performance of Platform- and Balloon-Type Mass Timber Buildings
Description  • Refine models developed for other mass timber products
• Facilitate design by engineers
• Allow acceptance of seismic design factors for mass timber buildings in the National Building Code of Canada (the factors will not be in the 2020 NBCC)
• Broaden the potential of this system by examining use of SCL (e.g., LVL)
• Alternative solution(s) to CLT
Investigators  FPInnovations
Timeline  April 2018 to March 2019
Contact  Steven Kuan, FPInnovations, steven.kuan@fpinnovations.ca

30. Structural Health Monitoring and Post-Occupancy Performance of Mass Timber Buildings
Description  A key question about new generation taller wood buildings is how they will perform over time in terms of durability and livability. This project will determine how best to measure these qualities by selecting sensors, determining testing and measurement protocols, and implementing testing assemblies in selected CLT buildings in Oregon. Future research will use the knowledge developed through this project to carry out post-occupancy monitoring, generating valuable new insights into building performance.
Investigators  TallWood Design Institute
Timeline
Contact  Mariapaola Riggio, Oregon State University, mariapaola.riggio@oregonstate.edu
31. **Utilization of Cross-Laminated Timber as a Soft Story Retrofit within the NEES-Soft Shake Table Test**

Description

CLT experimental results generated in cooperation with the NEES-Soft Project will be used to
- validate current FEMA P-807 retrofit procedures,
- validate CLT use as a viable retrofit option for soft story wood-frame buildings, and
- increase the visibility of CLT as a viable and sustainable building product in seismic regions of the United States.

Investigators

Colorado State University, USDA Forest Service Forest Products Laboratory, National Science Foundation NEES–Soft Project

Timeline

Spring 2013 to late 2014

Contact

John van de Lindt, Colorado State University, jwv@engr.colostate.edu
Douglas R. Rammer, Forest Products Laboratory, drammer@fs.fed.us

32. **Wind and Earthquake Design Framework for Tall Wood-Concrete Hybrid System**

Description

The objective is to develop wind and earthquake design guideline for tall mass-timber buildings in scope to 40-storey office or residential buildings. Outcome of this research can directly feed into the code through the National Research Council’s wood program.

Investigators

University of British Columbia

Timeline

April 2018 to March 2019

Contact

Solomon Tesfamariam, University of British Columbia, solomon.tesfamariam@ubc.ca

33. **Compartment Fire Testing of Cross-Laminated Timber Structures**

Description

Results of this testing will be shared with the ICC Ad Hoc Committee on Tall Wood Buildings. The ad hoc committee was created by the ICC Board to explore the building science of tall wood buildings and investigate the feasibility of developing code changes for tall wood buildings. The results of this testing will allow the committee to evaluate occupant and firefighter safety in realistic fire scenarios.

Investigators

Bureau of Alcohol, Tobacco, Firearms, and Explosives, American Wood Council, USDA Forest Service Forest Products Laboratory

Timeline

May 2017 to December 2017

Contact

David T. Sheppard, Bureau of Alcohol, Tobacco, Firearms, and Explosives, David.T.Sheppard@usdoj.gov
Kuma Sumathipala, American Wood Council, KSumathipala@awc.org
Samuel L. Zelinka, Forest Products Laboratory, szelinka@fs.fed.us
### 34. Concrete Composite Floors Using Radiant Panel Tests

**Description**
In many mass timber buildings, CLT or nail laminated timber (NLT) floors are designed with a concrete topping to improve acoustic separation, reduce vibration or act as a fire barrier. Little research has examined the fire behavior of these floor systems, but some preliminary tests involving LVL show that they may be able to meet three-hour fire resistance ratings, which could potentially open up the use of mass timber in Type I buildings, representing a large market opportunity. This project will test the behavior of composite floors under fire loading conditions considering the following parameters: shear connector type, mass timber panel types and thicknesses and concrete thicknesses. It will also test and validate an innovative fire research methodology using radiant panels.

**Investigators**
TallWood Design Institute

**Timeline**

**Contact**
Erica Fischer, Oregon State University, erica.fischer@oregonstate.edu

### 35. Evaluating Fire Performance of Nail Laminated Timber

**Description**
The results could be used to
- support the approval and construction of current projects in British Columbia, as well as update the Canadian NLT guide, and develop a fire resistance calculation methodology applicable to NLGA for inclusion in CSA O86
- support the development of a fire-resistance calculation method
- confirm that NLT has a lower Flame Spread Rating (FSR) than standard thickness of SPF board and achieve an official FSR

**Investigators**
FPInnovations

**Timeline**
April 2018 to March 2019, more detailed data analysis and modelling is anticipated in a separate project in 2019/20

**Contact**
Conroy Lum, FPInnovations, conroy.lum@fpinnovations.ca

### 36. Fire Penetration Testing

**Description**
In the U.S., there is limited published information about the performance of through-penetration fire seals in cross-laminated timber floors, where the CLT is unprotected, and exposed to the fire side. TDI has partnered with ARUP and the Framework project, a 12-story mass timber building project in Portland, to investigate and test through-penetrations to the ASTM E814 standard. Penetration seals were designed for five different types of penetrations–three-inch OD PVC pipe, four-inch OD stainless steel pipe, four-inch OD cast iron pipe, two-inch OD aquatherm (PP-R), and a one-and-three-fourths-inch threaded steel rod. The penetration seals were installed in five-ply CLT samples produced in the Pacific Northwest.

**Investigators**
Oregon State University

**Timeline**

**Contact**
David Barber, ARUP, David.Barber@arup.com
Lech Muszynski, Oregon State University, lech.muszynski@oregonstate.edu
37. Fire Performance of Custom CLT Layups Utilizing Pine from Logs Harvested in Western Forest Restoration Programs

Description
Investigators Oregon State University
Timeline
Contact

38. Fire-Retardant-Treated Structural Glued Laminated Timber (Glulam) and Laminated Veneer Lumber (LVL)

Description It is expected that the results from this study will provide test data to support the development of ASTM standards for FRT glulam and LVL.
Investigators USDA Forest Service Forest Products Laboratory, APA
Timeline July 2016 to December 2018
Contact B.J. Yeh, APA, borjen.yeh@apawood.org
Sam Zelinka, Forest Products Laboratory, szelinka@fs.fed.us


Description
• Allow Canadian CLT manufacturers to move forward with two new adhesives that would meet new adhesive requirements set forth in the manufacturing standard ANSI/PRG 320
• Provide greater confidence to officials by having CLT meet the new requirements that would eliminate heat delamination
Investigators FPInnovations
Timeline April 2018 – March 2019
Contact Sylvain Gagnon, FPInnovations, sylvain.gagnon@fpinnovations.ca

40. Fire Resistance of Mass Timber Laminated Elements – NLT, SLT and SCL

Description
• Generate first-time ever fire performance data on these types of elements/systems
• Provide greater confidence to officials by having CLT meet the new requirements that would eliminate heat delamination
• Serve as supporting information for new fire design provisions in CSA O86 standard
Investigators FPInnovations
Timeline April 2018 to March 2019
Contact Sylvain Gagnon, FPInnovations, sylvain.gagnon@fpinnovations.ca
41. Fire Resistance of Unprotected CLT Floors & Walls Manufactured in the U.S.

Description
This project will document the flammability of Douglas-fir and spruce-pine-fir CLT panel assemblies produced in the United States. Tests are being conducted on wall and floor panel assemblies with standard overlapping connections and produced with two different types of commonly-used adhesives. Sensors placed throughout panels will provide data about how fire affects the interior and exterior of a panel. A thermal imaging camera will provide information on how the structural integrity of panels is affected by fire and fire suppression activities.

Investigators
TallWood Design Institute

Timeline

Contact
Lech Muszynski, Oregon State University, lech.muszynski@oregonstate.edu

42. Fire Risk with Different Adhesives in Cross-Laminated Timber (CLT)

Description
This work will quantify the performance of CLT structural components with different adhesives under fire. A set of FE models for analyzing CLT components fire performance will be developed. A simplified approach to assess fire-related strength loss will be developed that can guide component level structural design. The project will quantify differences in risk of failure between adhesive types.

Investigators
Colorado School of Mines, USDA Forest Service Forest Products Laboratory

Timeline
September 2016 to August 2018

Contact
Shiling Pei, Colorado School of Mines, spei@mines.edu
Sam Zelinka, Forest Products Laboratory, szelinka@fs.fed.us

43. Fire Tests of Exposed NLT Walls / Ceilings

Description

Investigators
National Research Council Canada

Timeline
2018/19

Contact
Joseph Su, National Research Council, joseph.su@nrc-cnrc.gc.ca

44. Mitigating Fire Performance Concern through Fire Endurance Modeling

Description
The project will take the connection systems from the Composite CLT-Concrete Floor Systems for Tall Building Design project and test them over elevated temperatures to evaluate strength properties as well as how the stiffness and strength degrade at different levels of elevated temperatures. This information will be implemented into fire models and will help to predict things like failure time.

Investigators
TallWood Design Institute

Timeline

Contact
Arijit Sinha, Oregon State University, arijit.sinha@oregonstate.edu
Acoustics and Vibration

45. Acoustical Performance of Tall Wood Buildings
Description
Investigators: National Research Council Canada
Timeline
Contact: Jasmine Wang, National Research Council, Jasmine.Wang@nrc-cnrc.gc.ca

46. U.S. Mass Timber Floor Vibration Design Guide and Validation
Description
While it is widely recognized that floor vibration design is a primary driver of the framing system costs, little information is readily available to U.S. designers on how to design mass timber floors to best be competitive with the alternative material options (steel and concrete).
Investigators: KPFF, Inc (Portland Structural)
Timeline
Contact

47. Assessment and Monitoring of Building Vibrations
Description
- Help improve designs of wood buildings for better comfort of occupants and performance of sensitive equipment
- Advance the field of vibrations of wood buildings for the global timber engineering community
Investigators: FPInnovations
Timeline: April 2018 to March 2019
Contact: Sylvain Gagnon, FPInnovations, sylvain.gagnon@fpinnovations.ca

48. Solutions for Acoustic Control of Mass Timber Floors and Walls
Description
Advance the development of solutions to address the important issue of controlling and minimizing sound transmission through walls and floors in wood buildings
Investigators: FPInnovations
Timeline: April 2018 to March 2019
Contact: Sylvain Gagnon, FPInnovations, sylvain.gagnon@fpinnovations.ca
Durability

49. Building Science Guidelines for Mass Timber Buildings

Description: The University of Toronto is researching the scope and content of building science guidelines and how they may be applied to mass timber. Particular focus will be placed on protocols to ensure acceptable life-cycle performance of mass timber buildings, as they pose unfamiliar problems to architects and engineers in the absence of authoritative guidelines. Researchers will determine the current state of building science and identify knowledge gaps and special considerations. The university will deliver a digital guidance document with links to supporting documentation and critical references. The proposed research will encompass the performance of contemporary mass timber buildings, critical building enclosure methods, resilience strategies, systems integration factors, and consultant service engagement protocols.

Investigators: University of Toronto

Timeline

Contact: Ted Kesik, University of Toronto, ted.kesik@daniels.utoronto.ca

50. Control of Solar-Driven Moisture Diffusion in Cross-Laminated Timber Walls with Absorptive Claddings

Description: The laboratory research will be documented in a report that will provide insight into performance of CLT wall assemblies in regard to minimizing moisture accumulation from absorptive claddings. The report will assist building designers in specifying robust CLT exterior wall assemblies.

Investigators: USDA Forest Service Forest Products Laboratory

Timeline: June 2016 to early 2018

Contact: Samuel V. Glass, Forest Products Laboratory, svglass@fs.fed.us

51. Cross-Laminated Timber (CLT) Resistance to Infestation by Subterranean Termites

Description: Outcomes anticipated from the results of this project are biodegradation information for CLT products and an improved understanding of biodegradation differences between CLT products and comparable laminated and solid wood products. Results will benefit the emerging CLT industry and provide valuable information for market expansion into areas with high termite pressure.

Investigators: Mississippi State University, USDA Forest Service Forest Products Laboratory

Timeline: May 2016 to June 2019

Contact: C. Elizabeth Stokes, Mississippi State University, b.stokes@msstate.edu
Juliet Tang, Forest Products Laboratory, julietdtang@fs.fed.us
52. Durability and Protection of CLT in Parking Structures

**Description**
The City of Springfield, Oregon hired SRG Partnership to design a CLT parking structure slated to be built in a new redevelopment zone on the Willamette River. The concept started as an academic exercise in a University of Oregon architectural design studio course led by Professor Judith Sheine. Mayor Christine Lundberg saw an opportunity to connect Springfield’s historic roots in the timber industry to the burgeoning new mass timber sector, and the project became a reality. Before the structure is built, important technical questions must be addressed concerning how to protect the timber elements against the Pacific Northwest weather and long-term dynamic loading from vehicles. A technical team from OSU’s Department of Wood Science and Engineering and School of Civil and Construction Engineering are narrowing down combinations of materials for testing. Proposed solutions include an asphalt topping on the CLT decking, similar to those often used on timber bridge decks. Stress tests will be conducted, simulating forces from vehicles turning, starting and stopping and backing up. Simulated weather testing will also be conducted in OSU’s multi-chamber modular environmental conditioning chamber. The Energy Studies in Buildings Laboratory at University of Oregon has conducted wind-driven rain studies to inform SRG’s design of the roof and exterior screening elements.

**Investigators**
TallWood Design Institute

**Timeline**

**Contact**
Lech Muszynski, Oregon State University, lech.muszynski@oregonstate.edu

53. Evaluating Decay Resistance of Mass Timber

**Description**
Outcomes anticipated from the results of this project are increased knowledge of fungal degradation applied to mass timber composite products such as CLT and the development of more targeted standardized test methodologies for testing CLT.

**Investigators**
USDA Forest Service Forest Products Laboratory, Mississippi State University

**Timeline**
Fall 2016 to 2019

**Contact**
Grant Kirker, Forest Products Laboratory, gkirker@fs.fed.us
Katie Ohno, Forest Products Laboratory, kohno@fs.fed.us
C. Elizabeth Stokes, Mississippi State University, b.stokes@msstate.edu

54. Evaluating Hygrothermal Performance of Interlocking Cross-Laminated Timber Walls

**Description**
The modeling and laboratory research will provide insight to the performance of various ICLT wall designs in regard to their ability to avoid moisture accumulation and to dry out if wetting does occur. These results will guide designers on principles for specifying robust, moisture-tolerant ICLT wall assemblies.

**Investigators**
USDA Forest Service Forest Products Laboratory, University of Utah, University of Idaho, Euclid Timber Frames

**Timeline**
December 2011 to late 2013, research complete but reports not yet finished

**Contact**
Samuel V. Glass, Forest Products Laboratory, svglass@fs.fed.us
Ryan E. Smith, University of Utah, rsmith@arch.utah.edu
### 55. Expanding the Cross-Laminated Timber Market through Building Moisture Monitoring and Improved Modeling

**Description**
This project will generate three benchmark data sets for multistory CLT building moisture performance in different climate zones. Data will include moisture contents at key wood components and high moisture risk locations throughout the buildings. A relatively simple, but fully validated, numerical model for analyzing similar building moisture performance will be recommended. These results will be useful for structural engineers and architects to accurately consider moisture in their design of mass timber buildings.

**Investigators**
Colorado School of Mines, USDA Forest Service Forest Products Laboratory

**Timeline**
July 2016 to June 2019

**Contact**
Shiling Pei, Colorado School of Mines, spei@mines.edu
Samuel L. Zelinka, Forest Products Laboratory, szelinka@fs.fed.us

### 56. Hygrothermal Performance of Glued Cross-Laminated Timber Walls

**Description**
The modeling and laboratory research will provide insight to the performance of various CLT wall designs in regard to their ability to avoid moisture accumulation and to dry out if wetting does occur. These results will guide designers on principles for specifying robust, moisture-tolerant CLT wall assemblies.

**Investigators**
USDA Forest Service Forest Products Laboratory

**Timeline**
December 2011 to late 2013 – start delayed, research still in progress

**Contact**
Samuel V. Glass, Forest Products Laboratory, svglass@fs.fed.us

### 57. Impact of Moisture on Post-tensioned Rocking Walls

**Description**
Resilient structures are buildings designed not only to protect life safety in a seismic event but also to preserve the structural integrity of the major components of the buildings so that they can be reoccupied quickly and at minimal cost. An example is a CLT rocking wall system, utilizing post-tensioned cables and energy dissipating-connectors, which is being used for the first time in North America in OSU’s new Peavy Hall. CLT rocking walls borrow from concepts used in concrete and steel structures that were later adapted to LVL building systems in New Zealand. This project will examine the impacts of wetting at the base of the wall on the structural capacity and cyclic performance of the system. Identical rocking wall systems will undergo structural testing, with one being subjected to simulated moisture intrusion that may occur during construction. The findings will provide important information that can be later implemented in design and construction guidelines.

**Investigators**
TallWood Design Institute

**Timeline**

**Contact**
André Barbosa, Oregon State University, andre.barbosa@oregonstate.edu
58. **Increasing Durability of Mass Timber Products in Interior Applications**

**Description**
This research will determine how borate can improve decay, termite and fire performance of mass timber products with emphasis on exposed-glue lines whether starting with treated wood or the use of a spray solution to CLT. In addition, it will identify which adhesive formulations are more suitable for borate treated CLT.

**Investigators**
USDA Forest Service Forest Products Laboratory, Michigan State University

**Timeline**
January 2018 to end of 2018/early 2019

**Contact**
Mojgan Nejad, Michigan State University, nejad@msu.edu
Katie Ohno, Forest Products Laboratory, kohno@fs.fed.us
Rachel Arango, Forest Products Laboratory, rarango@fs.fed.us

59. **Mould and Service Life Risk of Tall Wood Buildings**

**Description**

**Investigators**
National Research Council Canada

**Timeline**

**Contact**
Jasmine Wang, National Research Council, Jasmine.Wang@nrc-cnrc.gc.ca

60. **Ontario’s Climate Resilient Tall Wood Buildings and Structures: An Evaluation of the Impacts of Climate Change on Mass Timber/Tall Wood**

**Description**
The research conducted will provide new climatic data which takes into account certain extreme weather events being attributed to climate change to minimize and/or prevent the risk of failure of tall wood buildings and mass timber structures. The project will offer guidance on the design for durability of tall wood building enclosures and fill existing gaps in knowledge about the extent of the effects of the future climate conditions and extreme weather events (e.g. heat waves, rainfalls, wind storms, etc.) on the resistances to deterioration of building materials, air leakage, vapour diffusion, and water ingress.

**Investigators**
National Research Council Canada, Canadian Construction Materials Centre

**Timeline**
January 2018 to September 2019

**Contact**
Philip Rizcallah, National Research Council, Philip.Rizcallah@nrc-cnrc.gc.ca


**Description**
Results of this project will increase our knowledge of coating performances on mass timber products, specifically CLT. We intend to use these data to identify factors influencing long-term performance of coatings in outdoor exposure. Finding correlations between measured coating properties and their performance will help producers formulate more durable coatings. In addition, this study has the potential to offer solutions to preserve the natural beauty of wood buildings while increasing their service life.

**Investigators**
Mississippi State University, USDA Forest Service Forest Products Laboratory

**Timeline**
June 2016 to May 2021

**Contact**
Mojgan Nejad, Mississippi State University, m.nejad@msstate.edu
C. Elizabeth Stokes, Mississippi State University, b.stokes@msstate.edu
Katie Ohno, Forest Products Laboratory, kohno@fs.fed.us
62. Rehabilitation of Mass Timber Following Fire and Sprinkler Activation
Description
- Generate new knowledge on how to rehabilitate a mass timber structure damaged by water and fire
- Develop practice guidelines to assist engineers, architects and contractors
- Generate confidence in developers and designers to build mass timber buildings

Investigators: FPInnovations
Timeline: April 2018 to March 2019
Contact: Sylvain Gagnon, FPInnovations, sylvain.gagnon@fpinnovations.ca

63. Water in Mass Timber
Description
This project will undertake a comprehensive analysis of the effects of water exposure, in various forms, on mass timber building elements. Water intrusion is mostly commonly seen during construction, but can also occur during failure of roofs or external facades or as a result of internal plumbing failures. The research team will employ CAT-scan imaging, vibrational testing, non-destructive and small-scale physical tests to assess the effects of moisture intrusion and any subsequent biodegradation on the structural performance and aesthetic characteristics of the building elements and connections. This analysis will include investigating the effects of cracking and delamination that may occur as a result of wetting and drying. The project will facilitate development of guidelines on moisture control during construction, help identify suitable methods for protecting mass timber products where required and highlight design features that can be used to mitigate the risk of fungal and insect attack.

Investigators: TallWood Design Institute
Timeline: 
Contact: Arijit Sinha, Oregon State University, arijit.sinha@oregonstate.edu

64. Water Misting Systems
Description

Investigators: National Research Council Canada
Timeline: 
Contact: Jasmine Wang, National Research Council, Jasmine.Wang@nrc-cnrc.gc.ca
65. Carbon Impacts of CLT

Description: CLT offers the potential to reduce greenhouse gas emissions by using timber, which requires much less energy to produce than steel or concrete and naturally sequesters carbon through its lifetime. However, there is a gap in the literature and a lack of general understanding about how much carbon CLT sequesters compared to the carbon emitted in the manufacturing process and in creating the adhesives used, as well as how the carbon value is calculated. This project will analyze and summarize relevant literature and will create six case studies to illustrate the embodied carbon impacts of various kinds of mass timber buildings. In doing so, it will reduce confusion in the sector and assist designers and developers in making informed decisions regarding future green buildings.

Investigators: TallWood Design Institute

Contact: Alison Kwok, University of Oregon, akwok@uoregon.edu

66. Environmental Assessment of MPP

Description: Mass timber products are often selected for their perceived sustainability advantages, and a lifecycle analysis for an Oregon-based CLT manufacturing facility is being completed. This project will assess the environmental impacts of mass plywood panel manufacturing, a new product that has become available commercially in Oregon in 2018. It will examine material flow, energy type and use, emissions to air and water, solid waste production and water impacts for the MPP manufacturing process on a per unit volume basis using a cradle-to-gate lifecycle assessment process. The data will be available for stakeholders to use for informational and learning purposes and to assist in determining the sustainability of mass timber building projects.

Investigators: TallWood Design Institute

Contact: Arjit Sinha, Oregon State University, arijit.sinha@oregonstate.edu

67. Life Cycle Analysis of Old- and New Peavy Hall

Description: This project assesses and compares the environmental impacts of forest products used in the old (1999) Peavy Hall teaching building at Oregon State University and the new mass timber building that will be completed in 2018. The findings will be incorporated in updated guidelines for life cycle analyses that fully take into account the role of reclaimable wood building products.

Investigators: TallWood Design Institute

Contact: Paul Frederik Laleicke, North Carolina State University, pflaleic@ncsu.edu
### 68. Net-Zero Energy TallWood Design

**Description**
This project aims to solve one of the biggest barriers to increased market adoption of mass-timber buildings - energy consumption. The project team will explore how to replace the concrete typically needed for night flush cooling of thermal mass. The goal is to provide results that will help mass-timber buildings achieve net-zero energy priorities for a larger range of use types and climate zones while also providing new insight into human perception of thermal comfort in mass-timber buildings.

**Investigators**
TallWood Design Institute

**Timeline**

**Contact**
Kevin Van Den Wymelenberg, University of Oregon, keinvdw@uoregon.edu

### 69. Potential for Tall Wood Buildings to Sequester Carbon, Support Forest Communities, and Create New Options for Forest Management

**Description**
The primary outcome of this work is to provide integrated analysis of the environmental, financial, and social benefits and costs of using CLT in tall wood buildings. Secondary outcomes will be (1) information, including a design team checkoff that can be used to inform the building community as they make decisions on specific, new building projects, and (2) an informational foundation for these stakeholders and others to begin to evaluate the complex tradeoffs between, and optimization of, environmental, financial, and social benefits and costs.

**Investigators**
USDA Forest Service Forest Products Laboratory, North Carolina State University

**Timeline**
January 2017 to January 2019

**Contact**
Richard Bergman, Forest Products Laboratory, rberman@fs.fed.us
Stephen S. Kelley, North Carolina State University, sskelley@ncsu.edu

### 70. Wood Innovation Research Laboratory – Phase 2 (Monitoring of Passive House Certified Laboratory Building)

**Description**
The WIRL has a footprint of 30m x 30m on a raft slab foundation and consists of shop space equipped with a concrete strong wall and floor and a crane bay, as well as a portion of the building that will consist of a two-storey office space. The structural system will be predominantly wood with glulam post and beam with a set of trusses for the middle span. The building envelope and mechanical systems is high performance in order to achieve Passive House certification. This phase 2 is for the data acquisition and analysis from the building sensors and energy meters. A data acquisition (DAQ) system will be created to monitor the performance of the building over the next few years and store the data in an accessible, organized fashion. The building temperature, relative humidity and metering data will be used to evaluate if all the models and calculations created for the WIRL during the design phase are reasonably close to reality and if the high performance wood structure is as energy efficient as predicted.

**Investigators**
University on Northern British Columbia

**Timeline**
July 2018 to March 2019

**Contact**
Guido Wimmers, University of Northern British Columbia, guido.wimmers@unbc.ca
Building Physics and Health

71. Development of Isocyanate-Free and Formaldehyde-Free Adhesives for CLT

Description: This project aims to develop a commercially-viable wood adhesive for CLT that is free of formaldehyde and isocyanates and possesses good cure speed properties. Li and his team have successfully developed adhesives for plywood manufacturing using abundant, inexpensive and renewable soy flour. This adhesive mimics the superior bonding properties of mussel additive proteins. Emission of hazardous air pollutants from plywood plants that use this adhesive has dropped 50-90 percent. Development of such an adhesive for CLT would address increasingly stringent air quality regulations in many places such as Oregon and California. The existing chemical formulation for the plywood adhesive will be adapted for use in a cold-pressing process. Specimens will be created at the OSU wood composites labs and first tested to verify conformance with the PRG320 product standard for CLT. Specimens passing the tests will be sent to the Energy Studies in Buildings Laboratory at the University of Oregon, Portland, where they will be conditioned and tested to determine emission characteristics.

Investigators: TallWood Design Institute
Timeline: Kaichang Li, Oregon State University, kaichang.li@oregonstate.edu

72. Low Emitting Structural Mass Timber Products: Formaldehyde

Description: Will study various surface materials in both the lab setting and occupied mass timber buildings to assess effects on occupants’ health and comfort as well as indoor air quality.

Investigators: National Research Council Canada
Timeline: Jasmine Wang, National Research Council, Jasmine.Wang@nrc-cnrc.gc.ca

73. Tall Wood Buildings and Indoor Air Quality

Description: New research is showing that wood buildings are more likely to harbor environmental microbes with beneficial health effects. This pilot project will study various surface materials in both the lab setting and occupied mass timber buildings to assess effects on occupants’ health and comfort as well as indoor air quality.

Investigators: TallWood Design Institute
Timeline: Kevin Van Den Wymelenberg, University of Oregon, kevinvdw@uoregon.edu
Cost, Market and Adoption

74. Affordable Housing Opportunities with Mass Timber
Description
Investigators: Spiritsos Properties LLC
Timeline
Contact

75. An Engineering Demonstration for a Mass Timber Affordable Housing Prototype for Large-Scale Urban Deployment
Description
Investigators: Massachusetts Institute of Technology
Timeline
Contact

76. BIM-VDC for Mass-Timber Construction
Description: The findings will inform British Columbia industry practitioners (design professionals and mass-timber manufacturers) on the use of building information modeling and virtual design and construction (BIM-VDC) in the context of Design for Manufacturing (DfMA) of mass-timber construction.
Investigators: University of British Columbia
Timeline: January 2018 to November 2018
Contact: Sheryl Staub-French, University of British Columbia, ssf@civil.ubc.ca

77. CLT Handbook 2nd Canadian edition
Description: The CLT Handbook update will take into account additional research has taken place globally and substantial regulatory changes since the first edition was published. Although the most current codes and standards will be referenced, the 2nd edition will include practices based on the state-of-the-art research that have been undertaken worldwide to fill the information gaps. These practices are being considered by the pertinent committees for inclusion in the next edition of the CSA O86 (likely to be released in 2019) and the next editions of the National Building and National Energy codes (NBCC and NECC, likely to be released in 2020). The CLT Handbook provides vital “How to” information on CLT for the design and construction community and is a great source of information for regulatory authorities, fire services and others. The CLT Handbook is also a good textbook for university level timber engineering courses.
Investigators: FPInnovations
Timeline: 2018 to March 2019
Contact: Erol Karacabeyli, FPInnovations, erol.karacabeyli@fpinnovations.ca

Description
Investigators: Michigan State University
Timeline
Contact
79. Cost Comparisons of Mass Timber versus Conventional Construction
Description Perhaps the first question that developers and designers ask about mass timber construction is “How much does it cost compared to the way I currently build?” In response, TDI has embarked upon a research project that will study mass timber building projects around North America and examine in detail the factors responsible for differences in cost. Once all of the data has been collected and analyzed, the team will formulate a set of guidelines and recommendations to help designers maximize the cost efficiency of these types of buildings.
Investigators TallWood Design Institute
Timeline
Contact Ingrid Arocho, Oregon State University, Ingrid.Arocho@oregonstate.edu

80. Cross-Laminated Timber Roof Panels at the Promega Corporation Facility: Documenting Installation and Monitoring In-Service Moisture Conditions
Description Photographic and video documentation of the construction project will provide value to the building design and construction community, showcasing CLT used in a commercial building application. The CLT panels, composing the structural roof deck, are expected to exhibit excellent performance as part of a well-designed and constructed building enclosure. Moisture and temperature conditions are expected to be stable and close to typical values for wood members in the building interior. Measurements will provide documentation of actual performance.
Investigators USDA Forest Service Forest Products Laboratory, Promega Corporation, Structural Wood Corporation, Structurlam Products LP
Timeline August 2012 to October 2012, moisture monitoring completed but report not finished
Contact Samuel V. Glass, Forest Products Laboratory, svglass@fs.fed.us
Jennifer Romanin, Promega Corporation, jennifer.romanin@promega.com
Jim Schumacher, Structural Wood Corporation, jim@structural-wood.com
Kris Spickler, Structurlam Products LP, kris@structurlam.com

81. Demonstrating Use and Performance of a CLT Modular Building Utilizing Low-Value Pine Lumber from Logs Harvested in Pacific NW Forest Restoration Programs
Description
Investigators Oregon State University
Timeline
Contact

82. Design, Engineering and Cost Estimation for a Demonstration CLT Townhouse
Description
Investigators Halevi Development Co.
Timeline
Contact
83. Establishing New Markets for CLT - Lessons Learned

Description
This project explored lessons learned from the original cross-laminated timber market in Europe, as well as interest in and use of CLT in North America so far. CLT was developed more than 20 years ago in Austria, and spread thereafter to Germany, Switzerland and northern Italy. The North American market is still young and can tend to ignore European knowledge of the product. Research was conducted through personal interviews with professionals in the architecture and construction industries in Europe and North America. The study found that, while much in-depth knowledge exists in the original market, this is largely ignored in North America. Despite many challenges—including a current lack of relevant education and training and inflexible planning processes—the potential for CLT in North America is large and growing. Standards development and building code acceptance will be critical to market development.

Investigators
TallWood Design Institute

Timeline
Contact
Eric Hansen, Oregon State University, Eric.Hansen@oregonstate.edu

84. Green Construction through Wood

Description
The Government of Canada created the Green Construction through Wood (GCWood) Program to encourage the long-term use of wood in non-traditional construction projects. The formal call for Expressions of Interest for the program focuses on tall wood building projects (10 storeys and above). It will also facilitate revisions to the 2020 and 2025 National Building Code of Canada to allow tall wood buildings beyond the current limit of six storeys, up to 12 storeys and even taller, and help develop design and costing tools to assist designers and builders. Knowledge and information developed using GCMWood funding will fall under a Creative Commons license to allow for knowledge sharing.

Investigators
Various

Timeline
April 2018 to March 2022

Contact
nrcan.gcwood-cvbois.rncan@canada.ca

85. Infrared Imaging for Fire Risks

Description
Complete development of an innovative infrared-imaging fire detection system to help alleviate concerns of developers, insurers and fire services regarding fire safety risks during construction.

Investigators
FPInnovations

Timeline
April 2018 to March 2019

Contact
Sylvain Gagnon, FPInnovations, sylvain.gagnon@fpinnovations.ca

86. Mass Timber and Wood Frame Study on Options for Schools in Metro Vancouver, British Columbia

Description
This study will develop the base outline and framework for a generic Alternative Solution for schools of a larger size and area than currently permitted under Division B of the Code. The outline will include the involvement of a fire engineer to confirm that there are no significant risks and provide a per project review.
87. Northern Forests to Timber Cities: Linking Urban Construction Demand to Northern Forest Mass Timber and Harvested Wood Products

Description
Investigators Gray Organschi Architecture, Yale University, Bensonwood
Timeline
Contact Alan Organschi

88. Overbuilds with Mass Timber - Building Preservation, Restoration and Growth

Description
Investigators Acme Timber LLC
Timeline
Contact

89. Proving Cross Laminated Timber Panels for Residential Homes

Description
Investigators North Carolina State University
Timeline
Contact

90. Tall Wood Building Demonstration Projects in Ontario

Description Through the funding support provided for the development of these four demonstration projects, the Ministry of Natural Resources and Forestry will help demonstrate the feasibility of tall wood building (seven storeys and higher) construction in Ontario and enable significant greenhouse gas emissions reduction in future years. These projects will serve as living laboratories for universities, colleges, building officials, and other interested parties to provide education on mass timber design and construction. The intellectual property that is created for each project will be in the public domain so that other design teams and municipalities can learn from these demonstrations.

Investigators Various
Timeline December 2017 to March 2021
Contact Masstimber@ontario.ca

91. The Pulse of the Global CLT Industry: Launching an Annual Survey as a Continuing Learning Tool

Description This project explores the emerging cross-laminated timber industry in other countries to learn the key success factors, challenges, business models and level of government support other countries receive in order to better implement the use of CLT in the U.S. The outcomes will include a database, annual reports on the CLT industry and specific guidelines for facilitating sustainable growth in the modern U.S. forest products industry.

Investigators TallWood Design Institute
Timeline
Contact Chris Knowles, Oregon State University, Chris.Knowles@oregonstate.edu
92. Workshop on Mass Timber Construction for Insurance, Lending and Leasing Industries
Description  The workshop will address questions and concerns by the financial and leasing industry about mass timber buildings. A summary report will capture the workshop findings and current industry stakeholder approaches as well as next steps needed to accelerate the adoption of innovative wood systems in British Columbia.
Investigators  Perkins+Will, Forestry Innovation Investment
Timeline  February 2018 to July 2018 COMPLETED
Contact  Antje Wahl, Forestry Innovation Investment, antje.wahl@bcfii.ca

Education, Training, Technical Support and Research Needs
93. Gaps in Tall Wood Building Research and Education & Training
Description  George Brown College is assessing gaps in tall wood building research and education & training in the construction and trades fields. This will be accomplished through workshops and meetings with partners in the construction sector, materials suppliers, and manufacturing. Moreover, external partners in construction, architecture, materials, manufacturing, and the trades will be engaged in order to understand and identify partnership opportunities. Finally, resources for future projects pertaining to the assessment of performance and constructability of tall wood buildings in the framework of current capacity and expertise will be identified and mobilized.
Investigators  George Brown College
Timeline
Contact  Rick Huijbregts, George Brown College, rick.huijbregts@georgebrown.ca

94. International Wood Educators’ Forum and Development in European Markets & Education
Description  Laurentian University’s McEwen School of Architecture is developing and delivering an International Wood Educators’ Forum (for which the Mass Timber Institute is also a sponsor) to be held in Sudbury September 11-14, 2019. The aim of the conference is to evaluate timber construction education frameworks in North America and Europe, and will include European lecturers, a call for peer-reviewed papers, and a design competition. An objective of the conference is to lead to the establishment of a permanent International Wood Educators’ Forum.
Investigators  Laurentian University McEwen School of Architecture
Timeline
Contact  Randall Kober, Laurentian University McEwen School of Architecture, rkober@laurentian.ca
95. Mass Timber Building Construction: Key Needs in Research and Teaching

Description: The University of Ottawa intends to identify key needs in research and teaching and fill knowledge gaps. They will identify and train highly qualified personnel for future projects, identify resources required to complete these projects, and compile a list of potential partners with whom the university can collaborate. Research and teaching strategies, which have been focused on the behaviour of wood and wood-hybrid structures in mid- and high-rise buildings, will be developed. A detailed literature review spanning North America, Europe, and Japan will be conducted to determine the current state of manufacturing and technologies that can be used in the construction of mass timber buildings and identify research areas where systems can be developed and improved, with a focus on systems that would resist extreme seismic, wind, and blast loads.

Investigators: University of Ottawa
Timeline: COMPLETED
Contact: Ghasan Doudak, University of Ottawa, gdoudak@uottawa.ca

96. Mass Timber Research and Educational Scan

Description: Cobden Strategies’ research and education environmental scan, and the interviews and collaboration that shaped it, serves to ensure that the voices of all appropriate stakeholders in the mass timber landscape were heard, ensuring that the Institute is effectively executing its mandate. It provides a snapshot of the present mass timber research & education landscape, identifying key knowledge gaps and the need to co-ordinate the delivery of research efforts and learning outcomes. Furthermore, it highlights the need for effective collaborations across academic and educational players to identify and bridge barriers that impede the acceleration of the mass timber market and supply chain.

Investigators: Cobden Strategies
Timeline: COMPLETED
Contact: Catherine Cobden, Cobden Strategies, catherine@cobden.ca
97. Supporting the Adoption of Ontario’s Tall Wood Building Reference and the Implementation of Ontario’s Mass Timber Program

Description
By undertaking research and offering direct technical support FPInnovations will enhance tall wood building knowledge and understanding.

1. Enhancing Tall Wood Building Knowledge and Understanding – will be achieved by investigation and compilation of a report highlighting current knowledge gaps in mass timber research and design and proposing a research roadmap to address these knowledge gaps, provision of guidance for codes and standards alignment through consultation with codes and standards bodies/committees, and undertaking research in collaboration with Ontario universities into the fire and structural performance of mass timber connectors and adhesives, resulting in technical notes and research papers with the ultimate goal of knowledge transfer to designers and industry at large.

2. Provision of Direct Technical Support – will utilize FPInnovations technical staff to engage with architects, engineers, researchers, manufacturers or any other parties involved in the development of mass timber products, buildings or bridge projects to offer expertise, testing services, knowledge transfer and general technical advice.

Investigators
FPInnovations

Timeline
December 2017 to March 2019

Contact
John Pineau, FPInnovations, John.Pineau@fpinnovations.ca

98. Wood Construction in British Columbia: Sector Engagement and Labour Market Information

Description
A final report will identify priorities and solutions for addressing sector skills gaps and recruitment/retention challenges, identify outstanding questions, and outline potential next steps. The project will help ensure a sufficient supply of professionals with the appropriate expertise and up-to-date knowledge and skills in engineered wood products manufacturing, digital fabrication and wood construction.

Investigators
Human Capital Strategies, Forestry Innovation Investment

Timeline
May 2018 to October 2018

Contact
Antje Wahl, Forestry Innovation Investment, antje.wahl@bcfii.ca