NSERC Alliance Grant 'Next-generation Wood Construction'

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Top News

Program Expansion: Five new sub-projects added

Project Updates: Recent developments in CWCRN research

Upcoming Events: The 3rd NextGen Wood Construction Conference (NGWC 2026) will take place in Edmonton from **May 4–6, 2026**. More details to follow.

A Note from the NSERC Project Coordinator

Dear Wood Construction Community,

As we reflect on the first half of 2025, I want to extend my sincere thanks to all members of the Canadian Wood Construction Research Network (CWCRN) for your continued commitment and contributions.

The 2nd Next-Generation Wood Conference and Timber Connections Workshop, held in Ottawa this May, brought together researchers, students, industry professionals, and government partners from across the country. The event served as an important platform for sharing emerging research, exchanging technical perspectives, and strengthening collaboration across our network. I am grateful to everyone who contributed their time, insights, and energy to its success.

With several new subprojects launched and cross-university collaborations expanding, the Network continues to make tangible progress on advancing mass timber construction in Canada. Our collective work is informing future standards, improving design methodologies, and supporting the broader adoption of sustainable building practices. I am especially encouraged by the active engagement of our highly qualified personnel (HQPs), whose research and leadership are critical to the long-term impact of this program.

Looking ahead, I invite all members to stay involved through upcoming workshops, technical meetings, and dissemination efforts. Your input and collaboration remain essential as we continue building momentum toward our shared goals.

Thank you for your continued support, and please stay connected through our website and our LinkedIn page as we shape the future of wood construction together.

Warm regards,

Dr. Ying Hei Chui
Program Director, CWCRN

NGWC2025 & Timber Connections Workshop
A Sincere Thank You to All Who Joined Us

The **2nd Next Generation Wood Conference NGWC) & Timber Connections Workshop** took place from **May 25–28, 2025**, in **Ottawa**, bringing together colleagues from across academia, industry, and government to share ongoing work and ideas in advancing wood construction in Canada

Attendance Snapshot
- **120+ registrants**
- **100** conference attendees
- **70** workshop participants
- **60** welcome reception guests

Presentations
- **30+ oral presentations**
- **7 poster presentations**
- Researchers from **14 Canadian universities**

Guest Speakers
- **Mary Alexander** (Moses Structural Engineers Inc.) – Conference Keynote
- **Hon. Kevin Holland** (MPP, Thunder Bay)– Featured Talk
- **Steve Pryor** (Simpson Strong-Tie) – Workshop Keynote

We sincerely appreciate the contributions of everyone involved—our speakers, panelists, session chairs, and students. Your thoughtful engagement helped make this a meaningful event. We look forward to building on these conversations in the future.

New Projects Launched At a Glance

The Next-Generation Wood Construction program has launched five new projects tackling seismic safety, energy efficiency, and material reuse. These include:

- Mass Timber Composite Floor Systems: Fire Performance, Residual Capacity, and Rehabilitation – Daniel Lacroix (UWaterloo)
- Seismic Performance of Balloon MT Walls and Cores – Tony Yang (UBC)
- Encapsulation of Timber Elements Subjected to Fire – Hamzeh Hajiloo (Carleton U)
- Unified Methodology for Establishing Over-Strength Factors for Capacity-Based Design of Mass Timber Seismic Force Resisting Systems – Hossein Daneshvar (UAlberta)
- Vibration Performance of Mass Timber Buildings – Jianhui Zhou (UNBC)

These projects reflect CWCRN's continued focus on practical, code-informing research in sustainable wood construction.

HQP Spotlight - Biniam Tekle Teweldebrhan

Position:
PhD graduate, University of British Columbia (Okanagan), Kelowna, BC, Canada
Visiting Scholar, University of Waterloo, Waterloo, ON, Canada

Role and Contributions:
Biniam has made significant contributions to seismic design in mass timber, including proposing new structural systems and developing a resilience-based seismic design framework enhanced through multi-objective optimization—advancing tall timber building design in seismic regions under Prof. Solomon Tesfamariam's supervision.

Personal Insights:
He holds a BSc from the Eritrea Institute of Technology and an MSc in Sustainable Critical Infrastructure from Khalifa University. Over the past six years, Biniam has combined academic and industry experience, including teaching, design, and project supervision, and has authored several journal publications in timber structures.

Research Highlights and Impact:
Biniam investigated the mechanics of CLT coupled wall systems and timber-based wall-frame systems, proposing seismic design procedures for both. He further advanced this work by developing a damage-control seismic design approach using multi-objective optimization for a dual system that integrates CLT coupled walls with glulam moment-resisting frames. Building on this, he established a resilience-based seismic design methodology tailored for these integrated systems.

Future Directions:
Biniam will continue at the University of Waterloo as a postdoctoral fellow, advancing research in performance-based and resilience-based seismic design of timber-based structural systems. He aims to contribute to the widespread adoption of high-performance timber buildings in seismic-prone regions.

Awards and Recognition:

- UBC Okanagan Graduate Fellowship Scholarships for the years 2021-2024.
- Catherine Lalonde Memorial Scholarships for Wood Related Research, CWC - 2021.
- UBC Okanagan Graduate Research Assistantship for the years 2021-2024.
- UBC International Doctoral Partial Tuition Award for the years 2021-2024.

Project Updates

Project T1-2-C: Resilient Timber Buildings – Structural Performance

Biniam Tekle Teweldebrhan (UBC Okanagan, U Waterloo) and Dr. Solomon Tesfamariam (U Waterloo)

Research Overview:

This research develops and optimizes a dual structural system combining Cross-Laminated Timber Coupled Walls (CLTCWs) and Glulam Moment Resisting Frames (GMRF) for tall buildings. A multi-objective optimization (MOO) framework, integrating deep learning (DL) surrogate models and genetic algorithms, is used to design a 20-storey system for enhanced seismic resilience.

Progress Update:

A baseline 20-storey CLTCWs-GMRF system (**Fig. 1**) was designed using linear static procedures and evaluated through nonlinear analysis in OpenSees under 50 bi-directional ground motions representative of Vancouver's seismic hazard. Key design variables, objectives, and constraints were identified. Dynamic DL surrogate models were trained, and a genetic algorithm was used for MOO, focusing on minimizing system-level damage and component strength demands. Summary of the research along with key findings of this study are provided as follows:

- The proposed MOO-based design framework outperformed traditional approaches, ensuring code compliance and enhanced resilience.
- The optimized system achieved lower inter-storey drift ratios and more uniform, reduced damage states in coupling beams and hold-downs compared to the baseline design.
- The study investigated the interaction between coupled walls and moment resisting frame systems, resulting in the determination of optimal coupling beam force profiles and hold-down design forces in the presence of frame-wall interaction.
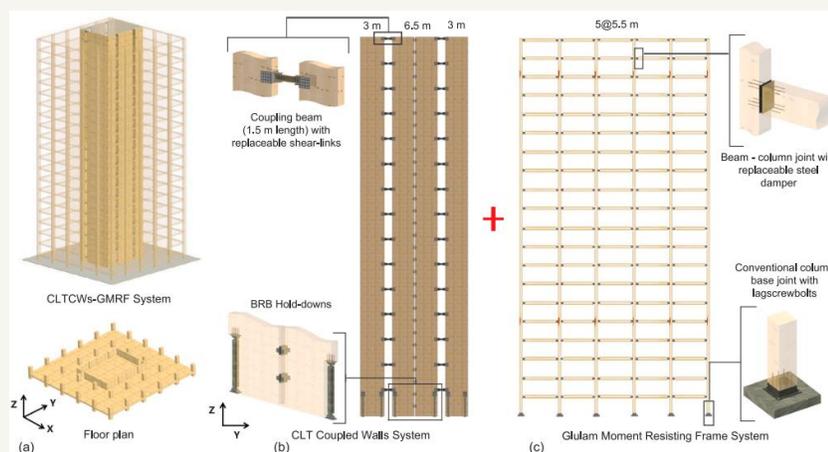

Publication:

Teweldebrhan, B. T., Das, S., & Tesfamariam, S. (2025). Multi-objective optimization based seismic design of CLT coupled wall and Glulam Moment Resisting Frame System. *Engineering Structures*, 337, 120437. https://doi.org/10.1016/j.engstruct.2025.120437

Fig. 1. Building detail: (a) CLTCWs-GMRF system, (b) CLTCWs system, (c) GMRF system.

Project Updates

T1-1-G: Seismic performance evaluation of timber moment resisting frames
Ali Yazdi Moghaddam and Dr. Hossein Daneshvar (U Alberta)

Research Overview:
This research aims to enhance the seismic design framework for Timber Moment Resisting Frames (TMRFs), one of the least-studied Seismic Force Resisting Systems (SFRSs). Moment connection details satisfying the National Building Code of Canada (NBCC 2020) ductility requirements will be developed, along with corresponding design provisions for consideration in the next cycle of CSA O86 revision. Furthermore, the seismic force modification factors (Rd and Ro) outlined in Part 4 of the NBCC will be validated through numerical modelling of various archetypes. The outcomes aim to establish TMRF as a viable option, supporting its continued inclusion in NBCC Part 4.

Progress Update:
- **Data Collection & Analysis:**
As part of phase one of the research project, an in-depth literature review was conducted on various potential timber beam-to-column moment-resisting connections. Based on conventional fasteners, as well as practical design and construction considerations, the most suitable connection type was identified. A conference paper entitled "Seismic Performance Evaluation of Timber Moment Frames with Reinforced Dowel-Type Connections" was submitted to the World Conference on Timber Engineering (WCTE 2025), accepted, and will be published in the proceedings. An analytical approach for evaluating the moment capacity of timber moment connections has been developed, and a comprehensive test matrix was designed and submitted to the supervisory committee's technical and industry members for feedback. In phase two of the project, which is dedicated to numerical modelling and the development of archetypes, an optimisation package was created to extract hysteresis parameters from experimental data. Additionally, a ground motion scaling tool was developed to support nonlinear time history analyses and the generation of fragility curves for TMRF archetypes.

- **Key Findings:**

A portion of the performance evaluation framework is presented in Figure 1.

- **Next Steps:**

The immediate next steps include publishing a journal paper based on the extended findings of the WCTE conference paper, drafting the research proposal, and completing the candidacy examination. The specimen drawings have been issued for final review by the supervisory committee and industry partners. Upon receiving their feedback and implementing any necessary revisions—or obtaining their approval—the drawings will be re-.

Project Updates (Contd.)

issued for quotation, followed by fabrication. Testing is scheduled to be completed before 2026. In parallel, analytical and design tools required for the development and evaluation of archetypes will be finalized
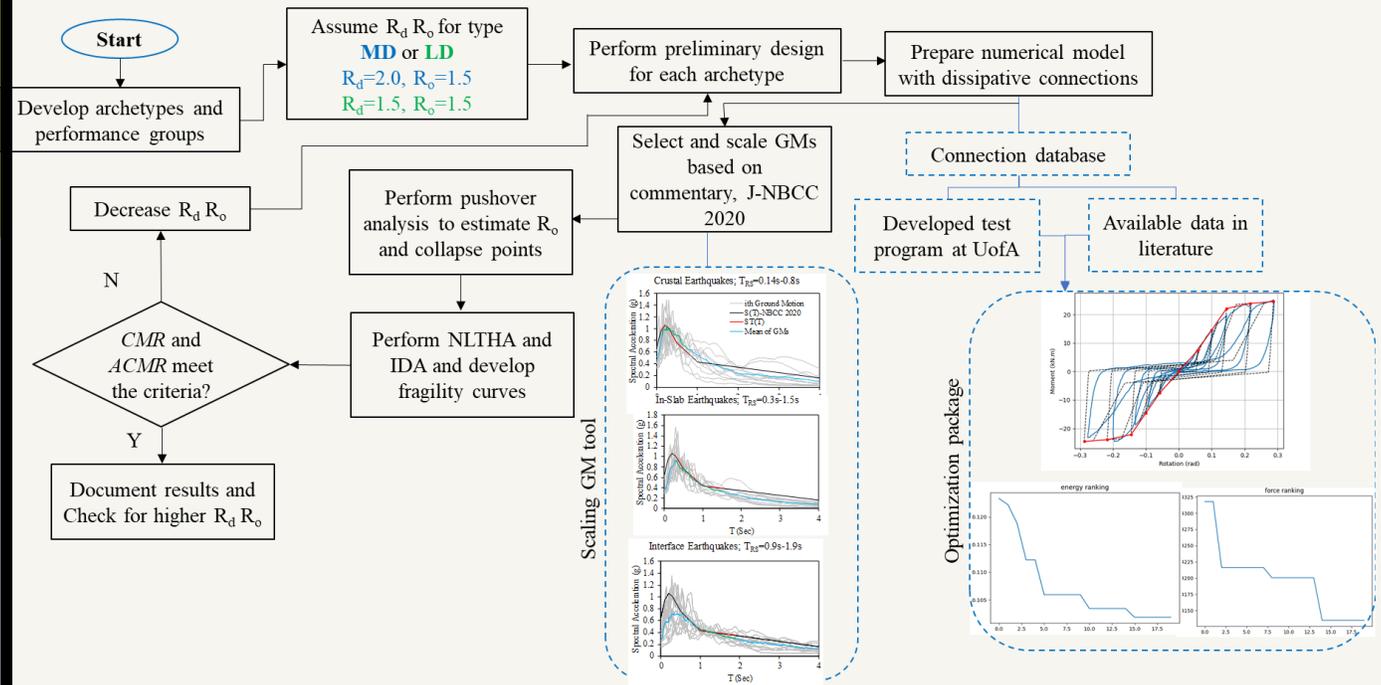

Figure 1. Seismic performance evaluation framework of TMRFs

Project Updates

Project T1-3-C: Analysis and calibration of timber parameters for the design, modelling, and analysis of timber structures

Dac Hoang Nguyen and Dr. Ying Hei Chui (U Alberta)

Research Overview:

This project aims to support the transitioning of structural design of timber structures from simple analysis to more sophisticated analysis using computer models. The specific objectives of the project are:

- To establish a reliable database on mechanical properties of timber members and connections that have been evaluated through testing and/or modelling.
- To recommend a set of model input properties for selected timber products and connection types.

Progress Update:

Data Collection & Analysis:

- Developed a comprehensive spreadsheet for various timber products. The database includes mechanical properties such as elastic constants and strength parameters in different directions, tailored to the use of 1D, 2D, or 3D elements.
- Influence factors (e.g., Kd, Ks, KT) are incorporated to adjust mechanical properties. As a result, the database provides specified, adjusted, and mean values.
- Created spreadsheets for different connection types (e.g., nails, bolts, self-tapping screws), detailing stiffness, yield/peak strength, ductility, displacement characteristics, and failure modes.
- Initiated assembly-level spreadsheets, including deflection analysis for CLT diaphragms and combined deflection and resistance evaluation for balloon-type CLT shear walls.
- Compiled dynamic property data for timber floors and full timber structural systems.

Key Findings (if applicable):

- A comprehensive, standardized database is established to support the modelling, analysis, and design of timber systems.
- Unavailable input parameters for timber products, connections, and assemblies are derivable from the current database.

Next Steps:

- Develop statistical methods to extrapolate test data to untested configurations.
- Finalize web-based interface and technical documentation for user-friendly access to the database.

Project Updates

Project T3-1-C: Field monitoring of whole building performance of mass timber buildings

Dipendra Paneru and Dr. Phalguni Mukhopadhyaya (U Victoria)

Research Overview:
This research explores the long-term hygrothermal performance of mass timber buildings with a focus on Cross-Laminated Timber (CLT) assemblies exposed to diverse climates. By addressing the critical issue of moisture management in CLT construction, the study aims to enhance the durability, energy efficiency, and indoor environmental quality of mass timber structures. Through a comprehensive investigation of moisture behavior under real-world conditions, the project seeks to advance design practices, inform code development, and support the broader adoption of mass timber in sustainable and resilient construction.

Progress Update:
The research employs a three-pronged comparative framework to evaluate the moisture performance of CLT in mass timber construction. Long-term field measurements of moisture content (MC) and temperature are collected from CLT floor/roof assemblies. These empirical observations are used as a reference to assess the accuracy of two predictive approaches: (1) Numerical modeling using WUFI 1D and 2D simulations, and (2) Machine Learning Models trained in environmental and structural features. A systematic comparison is conducted among the field data, simulation outputs, and machine learning predictions to validate model performance, identify discrepancies, and improve the reliability of predictive tools for hygrothermal behavior in CLT systems as described in figure 1.

Key Findings (if applicable):
- End-grain exposure had the highest moisture uptake → highlights the need for proper sealing at floor-to-wall transitions.
- Insufficient joint sealing increases the risk of deep moisture penetration.
- Cracked concrete toppings can allow water to penetrate and expose the underlying CLT to moisture intrusion.
- CLT samples with cracks showed higher moisture accumulation and slower drying.
- WUFI simulations captured overall drying trends but showed deviations due to modelling limitations such as cracks and material variability.
- WUFI 2D validation was more complex due to multidirectional transport and sensitivity to input conditions.

Next Steps:
Identify the key factors influencing the drying capacity of CLT floor assemblies following incidental indoor water leakage and propose effective strategies to improve their moisture resilience.

Project Updates

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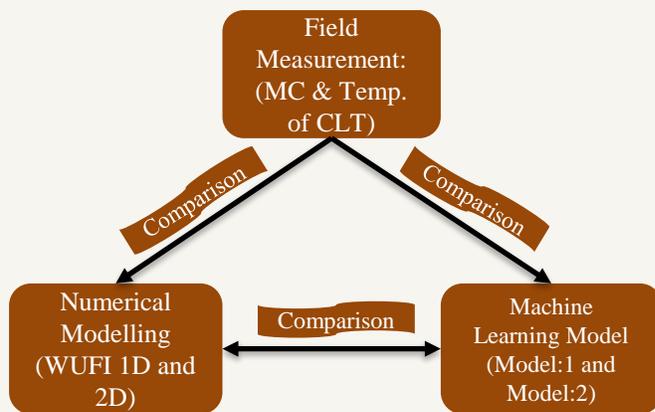

Figure 1: Overview of Research Methodology

Figure 2: Moisture and Temperature Probes in CLT floor (NICL Building, Victoria)

Project Updates

Moisture content, temperature, and relative humidity data have been collected from embedded sensors installed in the CLT floor/roof assemblies of the buildings, covering multiple floors and sensor depths as shown in figure 2. The dataset spans several years and captures seasonal hygrothermal variations across various building zones. This field data has been used to validate hygrothermal simulations. In parallel, environmental and geometric features have been extracted to train machine learning models (Model-1 and Model-2), incorporating parameters such as depth in CLT, distance from façade, floor height, and climate variables (e.g., HDD, CDD, WDR). Machine learning models, including Polynomial Regression, Support Vector Regression, Decision Tree Regression, Random Forest, and Artificial Neural Networks, have been developed and evaluated based on R^2, RMSE, and MAE values described in flowchart of work in figure 3..
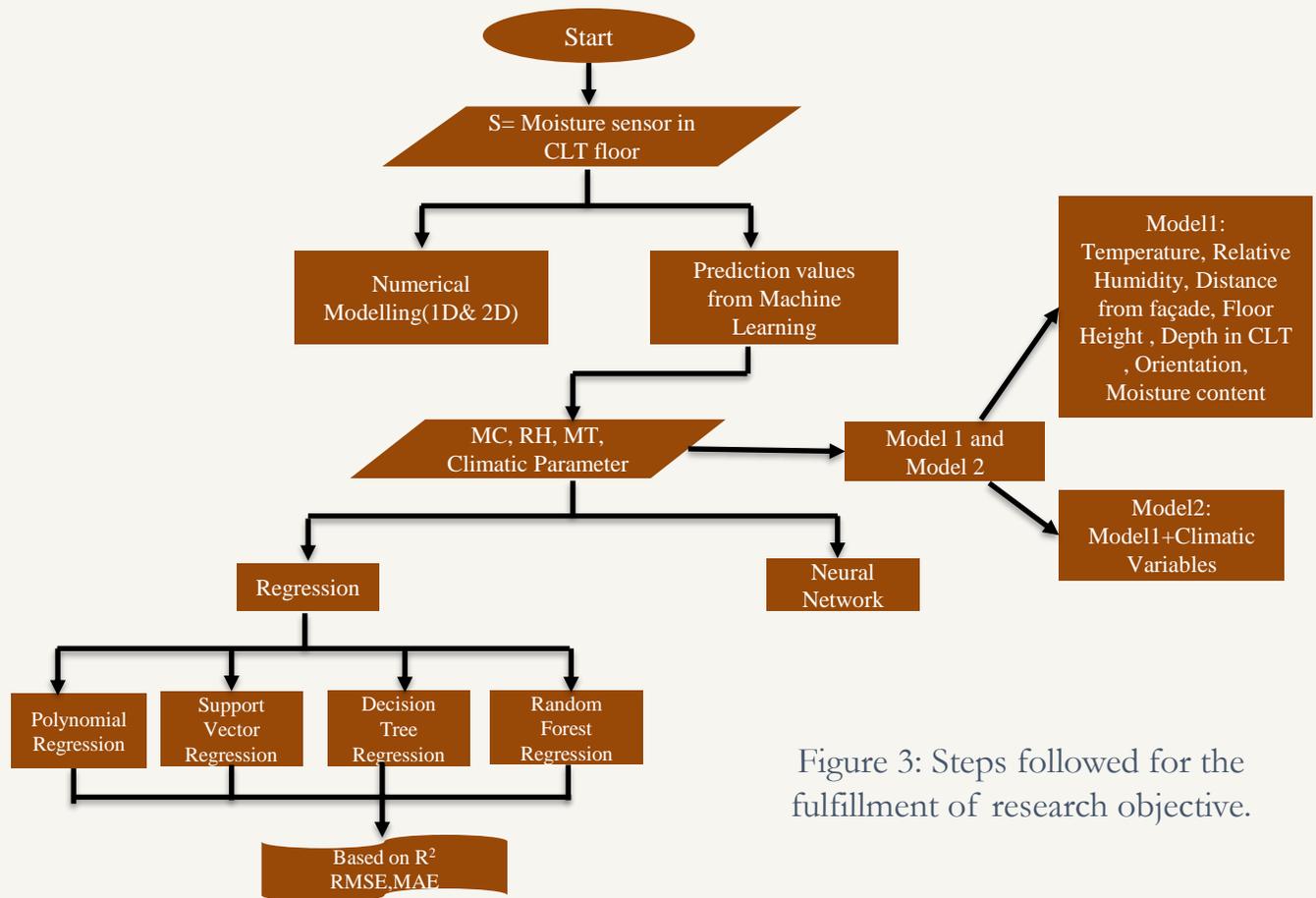

Figure 3: Steps followed for the fulfillment of research objective.

Next Steps:

The next phase of the research will focus on assessing the indoor environmental performance of mass timber buildings by evaluating the influence of hygrothermal behavior on indoor air quality and comfort. This will include integrating IAQ sensors (Carbon-dioxide, TVOCs, VOCs and RH) and occupant feedback with moisture data to establish correlations between material response and indoor conditions.

Project Updates

Project T3-2-C: Improved Resiliency Against Water Damage Caused by Indoor Leakage

Bisrat H. Tariku and Dr. Phalguni Mukhopadhyaya (U Victoria)

Research Overview:
This study investigates the moisture response of CLT floor assemblies under indoor water leakage conditions. Laboratory experiments on six configurations were validated by WUFI 1D and 2D simulations to evaluate moisture accumulation and drying trends.

Progress Update:
Data Collection & Analysis:
Laboratory testing for six CLT floor assembly configurations has been completed, with embedded moisture sensors capturing surface and depth-based moisture content over time. Preliminary findings indicate that end-grain exposure and unsealed joints result in significantly higher moisture accumulation and slower drying.

Key Findings (if applicable):
- End-grain exposure had the highest moisture uptake → highlights the need for proper sealing at floor-to-wall transitions.
- Insufficient joint sealing increases the risk of deep moisture penetration.
- Cracked concrete toppings can allow water to penetrate and expose the underlying CLT to moisture intrusion.
- CLT samples with cracks showed higher moisture accumulation and slower drying.
- WUFI simulations captured overall drying trends but showed deviations due to modelling limitations such as cracks and material variability.
- WUFI 2D validation was more complex due to multidirectional transport and sensitivity to input conditions.

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Project Updates

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Progress Update:

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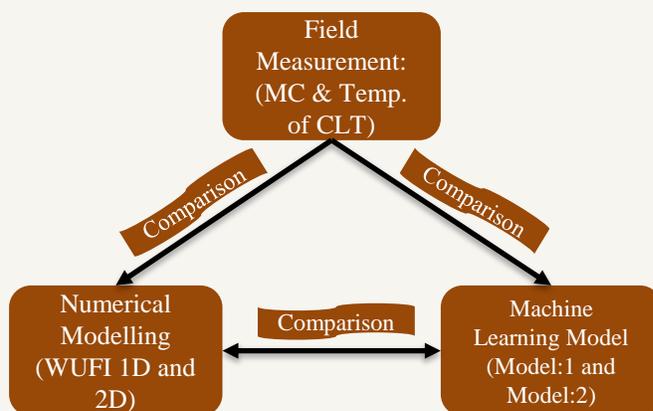

Figure 1: Overview of Research Methodology

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Outreach Activities

Past Events

HQP Seminar Series

In the first half of this year, the Highly Qualified Personnel (HQP) Seminar Series continued to foster thought-provoking conversations on emerging topics in timber engineering, fire safety, climate resilience, and career development in engineering.

HQP Seminar XVI: *Fire Safety for Timber Structures: The Intersection of Fire Resistance and Reaction to Fire*
Speaker: Dr. Felix Wiesner, University of British Columbia

HQP Seminar XVII: *When Structures Face Fire: Engineering Challenges and Solutions*
Speaker: Dr. Hamzeh Hajiloo, Carleton University

HQP Seminar XVIII: *The Role of the Forest Sector for Climate Change Mitigation*
Speaker: Dr. Evelyne Thiffault, Université Laval

HQP Seminar XIX: *The Future of Engineering Careers and Skills in the Next Decade*
Speaker: Ms. Abla Krouma, University of Ottawa

HQP Seminar XX: *Climate Resiliency and Its Impact on Infrastructure*
Speaker: Ms. Lauren Kembi, Sustainable Building + Carbon Analyst, Entuitive

HQP Seminar XXI: *Timber-Steel Composite Beams*
Speaker: Dr. Joshua Woods, Queen's University

Theme-Specific Workshops

Four virtual workshops were hosted in early 2025 under the NSERC Alliance Grant Next-Generation Wood Construction, focusing on core research themes. Each session featured presentations by HQPs and expert discussions with partners from academia, industry, and government.

Theme 1 – Structural and Serviceability Performance
February 12, 2025 | 71 attendees | 16 presentations

Theme 2 – Fire Safety
February 18, 2025 | 59 attendees | 10 presentations

Theme 3 – Building Envelope and Energy Performance
February 25, 2025 | 34 attendees | 10 presentations

Theme 4 – Sustainable Construction Technologies and Practices
March 11, 2025 | 33 attendees | 9 presentations

Thank you to everyone who participated and contributed to the success of these workshops.

Upcoming Events

Annual Conference and Workshop 2026

Thank you for your presence and support at this year's NextGen Wood Conference in Ottawa, held May 26–27, 2025, followed by the special workshop on timber connections. We truly appreciate your continued engagement in advancing the goals of the NSERC Alliance Grant.

We are pleased to announce that our **next conference (NGWC2026) will be held in Edmonton from May 4–6, 2026.** More details will be shared in the latter half of the year.

For updates on NGWC2026, HQP Seminar Series, workshops, and other events, please follow us on LinkedIn or visit our website.

Richmond Olympic Oval, Richmond, BC (Source: Wikipedia)

Thank you for reading!

As we reflect on the ongoing progress of the **Canadian Wood Construction Research Network (CWCRN)**, we are inspired by the commitment and collaboration of our partners, researchers, and students. Together, we are advancing innovation in sustainable wood construction, driving impactful research, and fostering meaningful connections within the industry and academia.

We encourage you to stay engaged with CWCRN through our events, workshops, and seminars. Your contributions and active participation are integral to our shared success.

For updates, resources, and event details, stay connected:
•LinkedIn: *Follow us on LinkedIn*
•Website: *Visit our Website*
•Email: Contact us at *cwcrn@ualberta.ca* or reach out directly to our Program Manager at *tshamsi@ualberta.ca*.

Thank you for being a part of this journey. Let's continue building a stronger, more sustainable future with wood.

Warm regards,

The CWCRN Team