

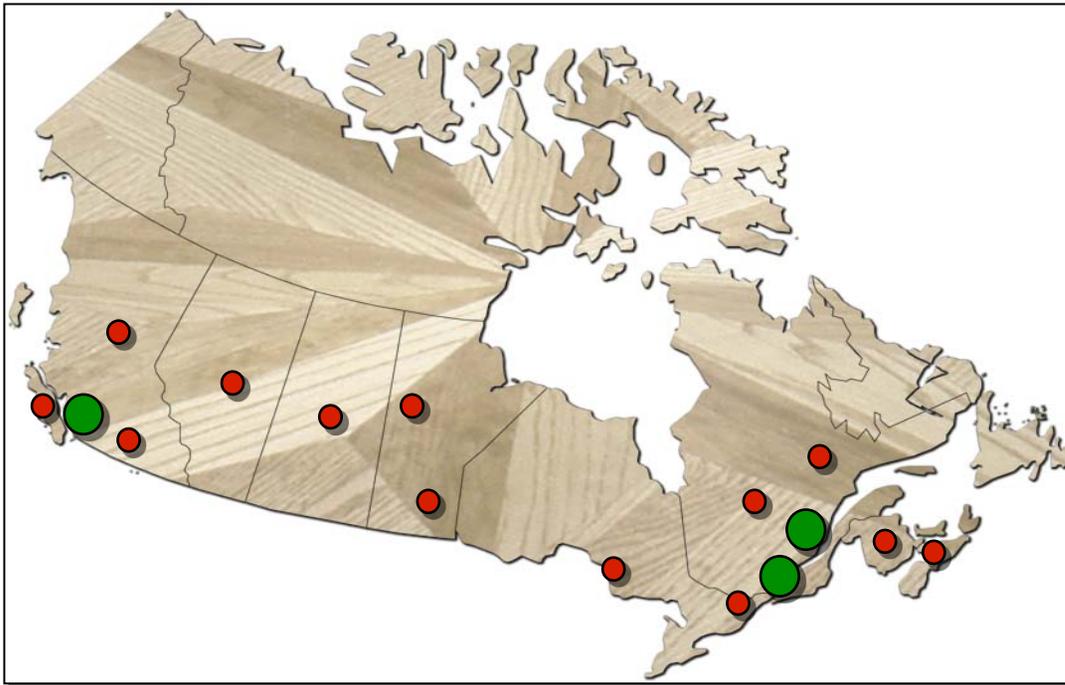


Renaissance in Wood Construction using innovation

Richard Desjardins and Erol Karacabeyli

Salt Lake City
March 2012

Canada's forest research institute; A Canadian Public-Private Partnership



Federal Government
Provinces & Territories
Industry Members

Main Laboratories:
Montréal
Québec City
Vancouver

More than 500 dedicated employees

An annual operating budget of approximately \$90 million

FPInnovations' Building Systems Research Program

- ▶ Provide impartial technical data and optimum solutions to grow and expand markets for Canadian wood products and systems in:

Existing Markets



New Markets



Wood building systems are making a comeback

Fondation Building, Québec
Wood-concrete-steel hybrid



Earth Science Building, UBC

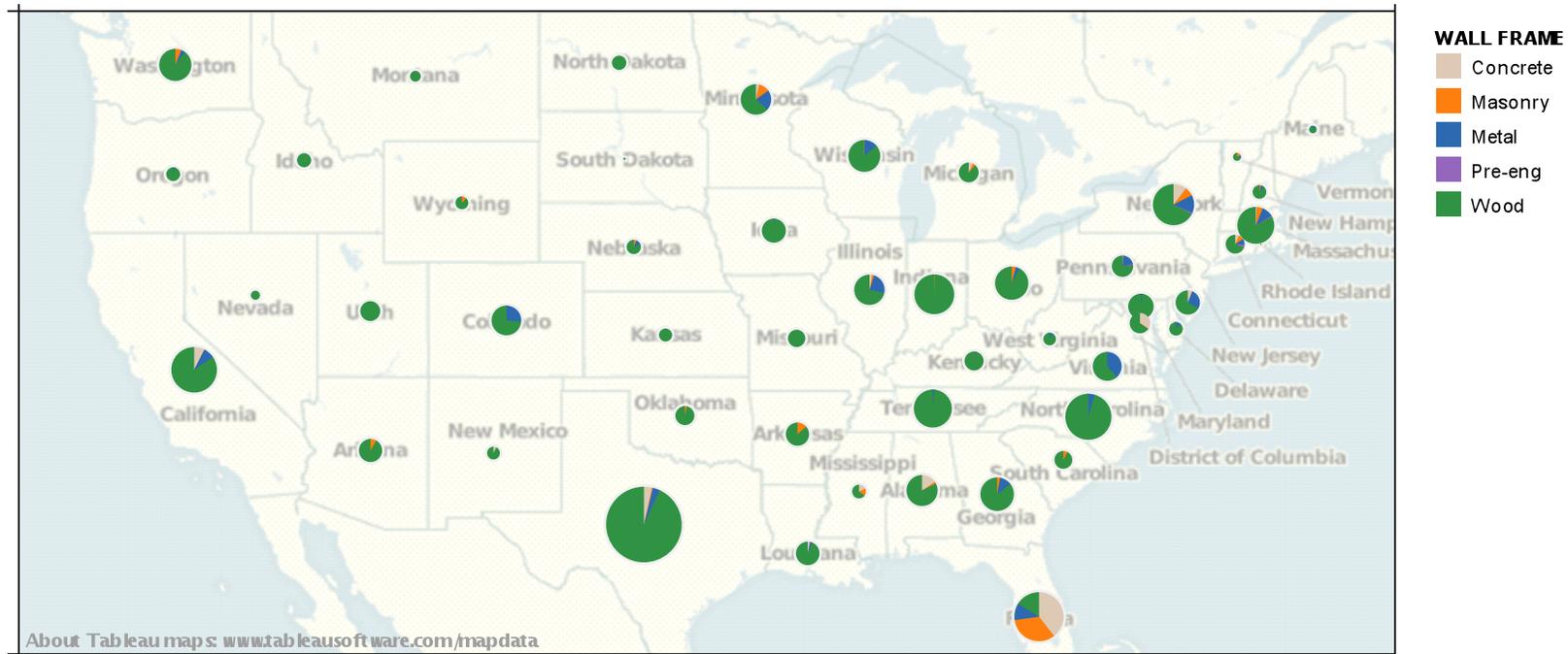
One of the Demonstration buildings
Wood-concrete-steel hybrid



Library Square, Kamloops BC

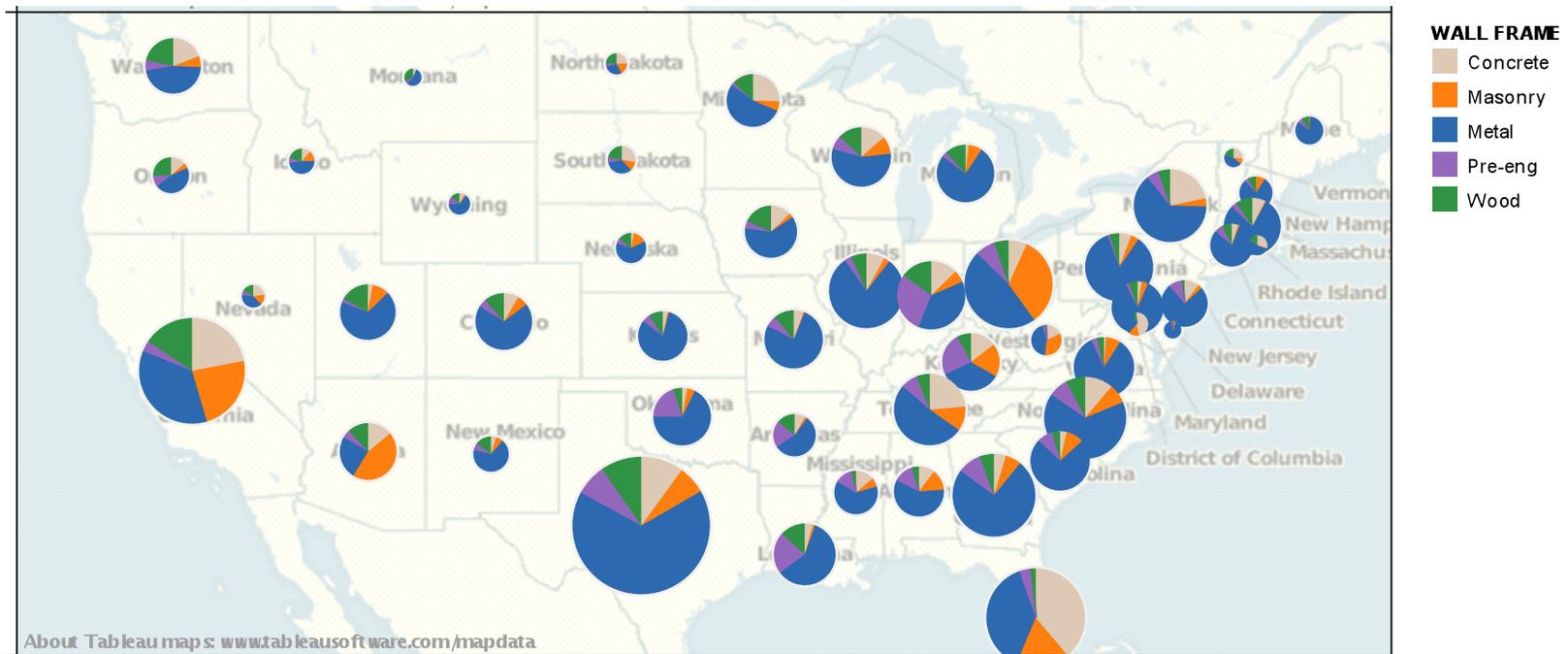
Wood Dominates the Multi-family Residential Construction Market

1-4 Storey Apartments (2010)

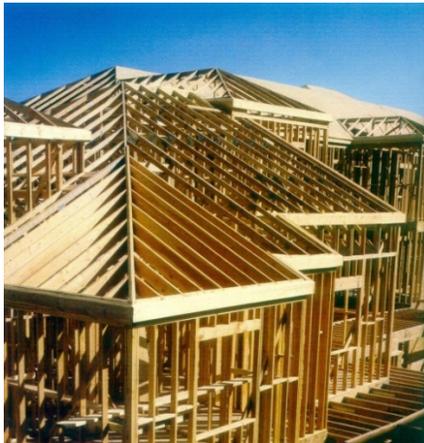
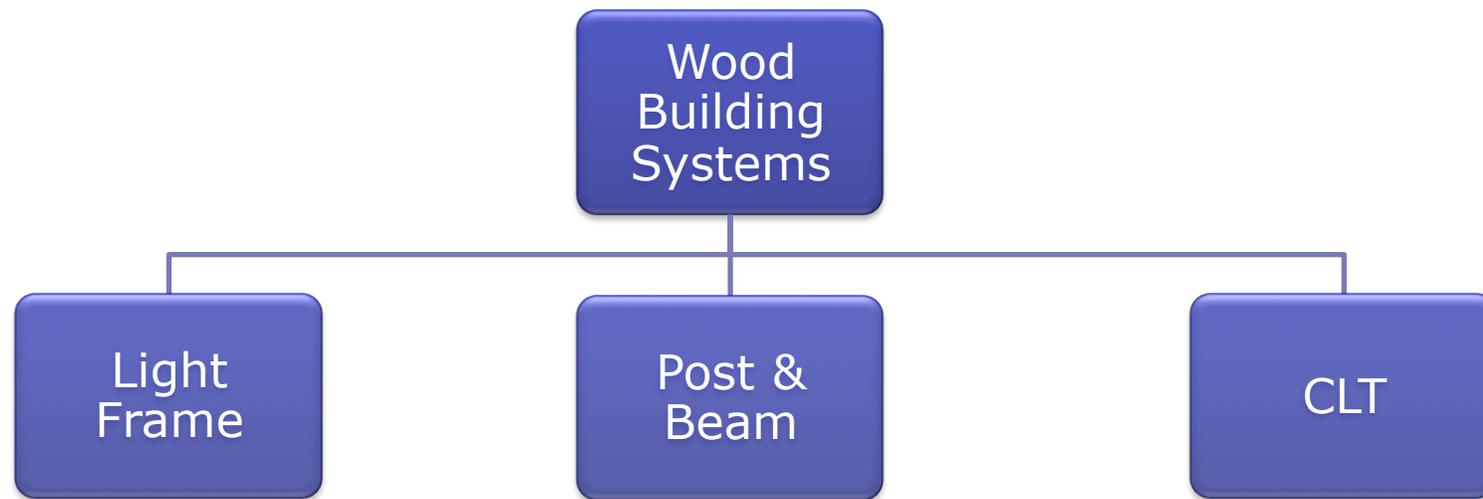


Steel, Concrete, and Masonry Dominates the Non-Residential Market

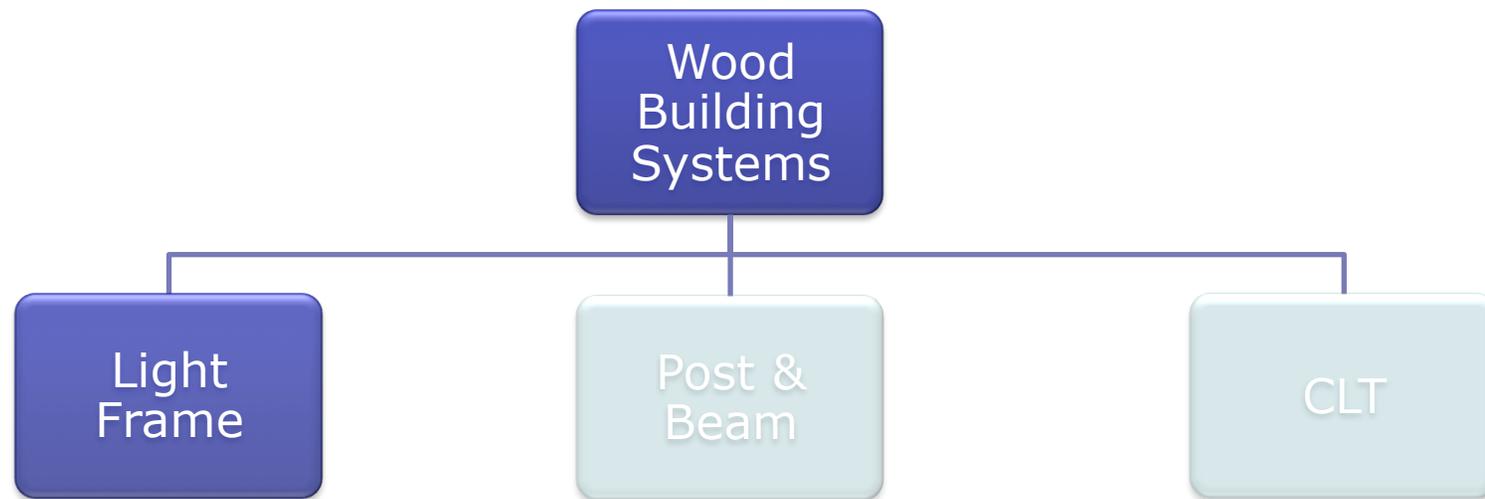
1-4 Storey Non-Residential (2010)



Wood-Based Building solutions



Wood-Based Building solutions



Light Wood Frame Construction (Platform Frame)

- ▶ Over 80% of residential buildings up to 4 storeys are built with this system
- ▶ Limited to 4-storeys in Canada
- ▶ BC is the first Province in Canada that allows wood-frame construction up to 6 storeys (since 2009) – over 90 projects underway
- ▶ A project between NRC/CWC/FPInnovations is underway to support the code change proposals for implementation of 6-storey wood-based buildings as an Acceptable solution in the National Building Code

1990 – Vancouver, BC



3 Storey Residential on 1 Storey Retail

2010 – Kamloops BC



5 Storey Residential on 1 Storey Library

Earthquake simulation test (NEESWood) at Miki, Japan

- ▶ FPIinnovations & Colorado State University conducted a parametric study on a number of 4 and 6 storey building designs which showed the proposed seismic provisions are adequate
- ▶ FPIinnovations signed an MOU with NEESWood project principals for a seismic test of a 6-storey building

Midply Walls



Earthquake simulation test (NEESWood) at Miki, Japan

Midply Walls

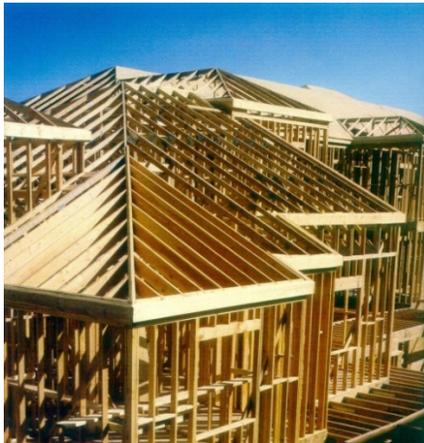
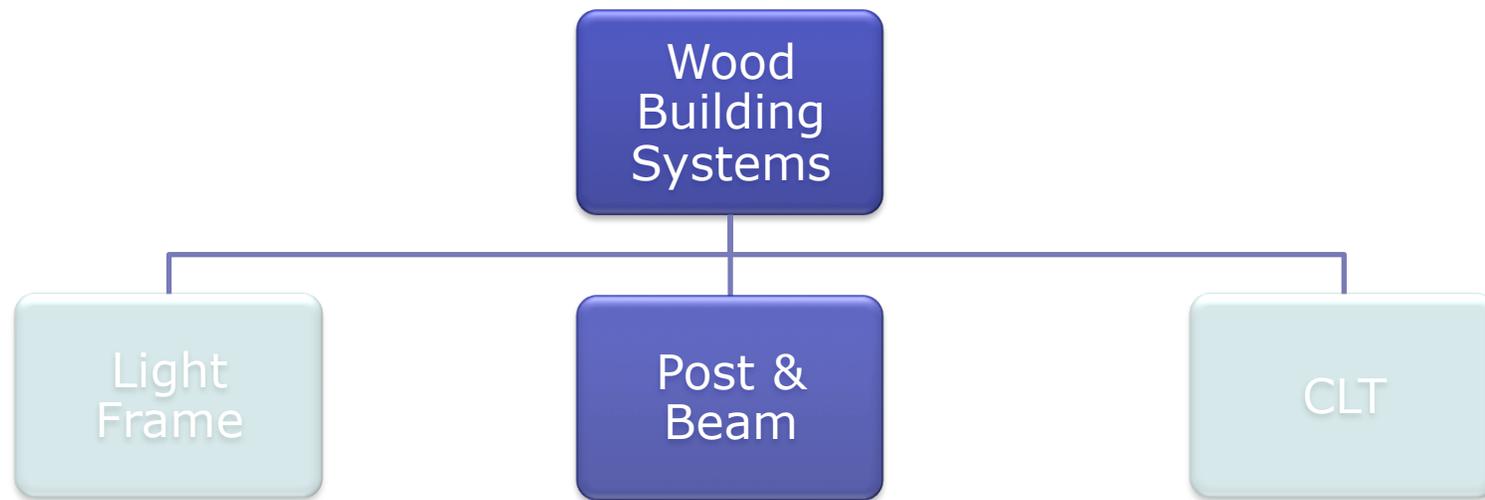
- ▶ 6-storey wood-frame building (constructed with lumber from Canada)
- ▶ Test conducted in July 2009
- ▶ Used high capacity Midply wall system developed by FPInnovations, Forintek and UBC
- ▶ NRCan, FII and CWEP funding



Midply wall system in NEESWood test building



Wood-Based Building solutions



Post and Beam Buildings

8 storey buildings - timber & masonry



Vancouver - 1905



Toronto - 1920s

Post and Beam Building - 2010

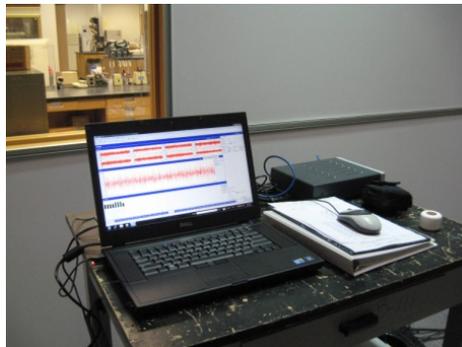


6 – Storey Office Building Quebec City

Highlights of Research Activities

► Wind-Induced Vibration of WF Buildings

- Field & laboratory testing and analysis:
develop a simple design methodology
- Guide for Wind-Vibration Design of Wood-Frame Buildings

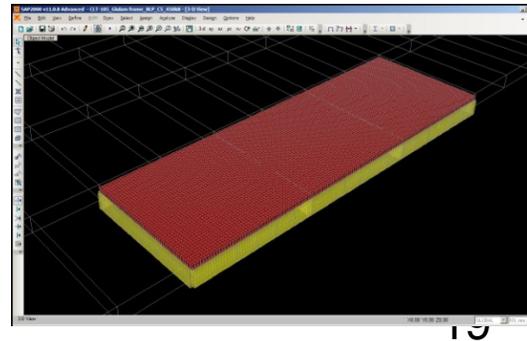


Highlights of Research Activities

► Stiffness of Floor and Roof Diaphragms in Wood and Wood-Hybrid Constructions

Investigate diaphragms action in wood-based & hybrid systems and develop stiffness/flexibility classes

➔ Develop design guidelines and code change proposals for diaphragms in res & non-residential mid-rise wood & hybrid buildings

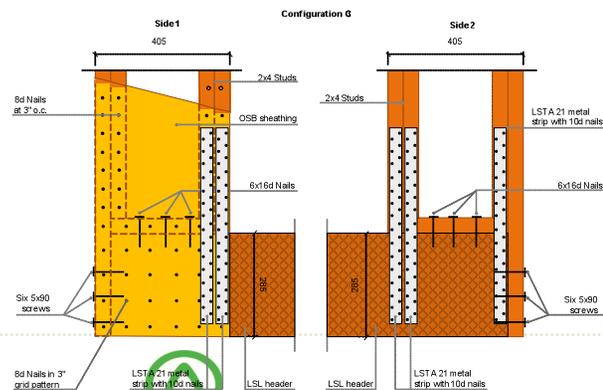


Highlights of Research Activities

Development of Alternative Bracing Systems for Light Wood Frame Buildings

To investigate and explore alternative lateral load resisting systems for small wood buildings

➔ Develop design guidelines that take into account the differential stiffness issues and how does that affect the overall system performance



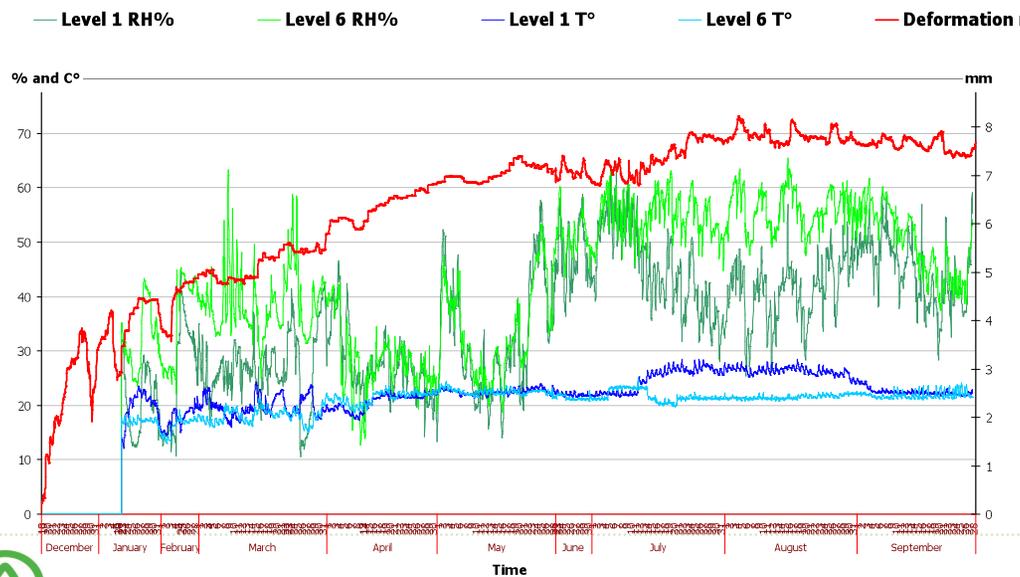
FPInnovations



Highlights of Research Activities

■ Controlling Movement of Wood in Tall Buildings

- Understand wood shrinkage in both light frame and heavy post & beam Hybrid mid-rise construction
- Develop design guidelines/calculation methodology to predict movement due to shrinkage



Innovative Timber Connections



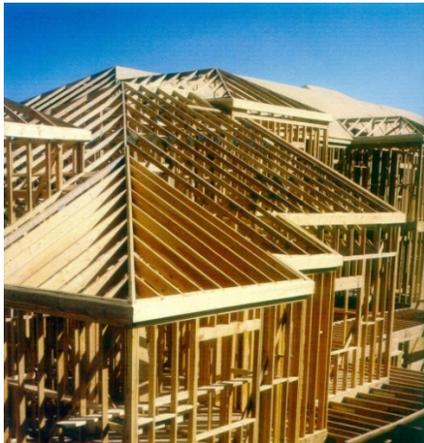
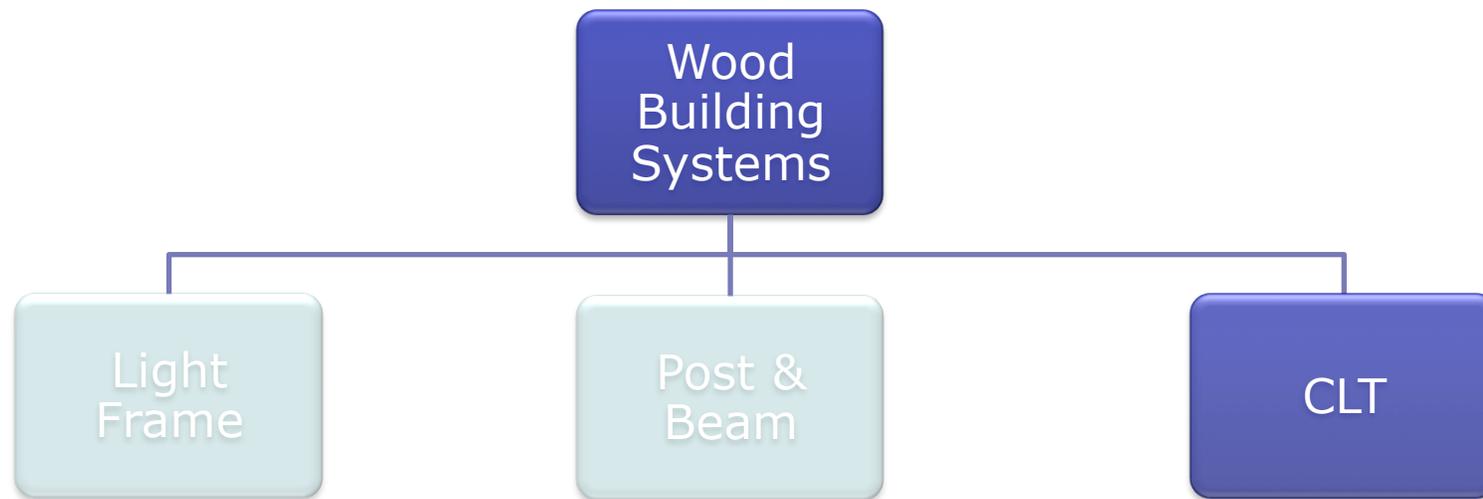
Timber connections require thorough attention of the designers



Active research on strength & stiffness of bolted and screwed connections in timber & other EWP: For CSA O86

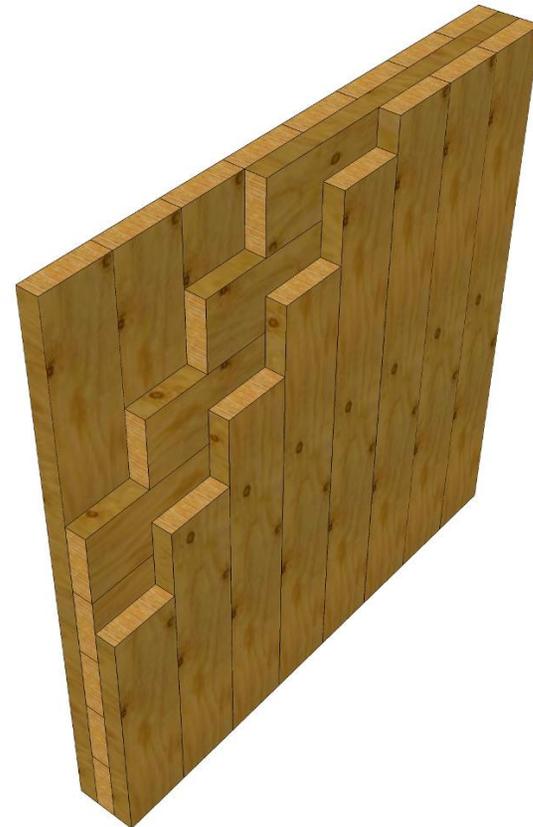


Wood-Based Building solutions



Cross Laminated Timber (CLT)

- ▶ Pre-fabricated structural wall, roof, floor panels
- ▶ Two producers in BC, one in Quebec



Cross Laminated Timber; A Great Addition to Wood's Tool Box

Residential



Non-Residential



Key Objective of CLT Research @ FPInnovations

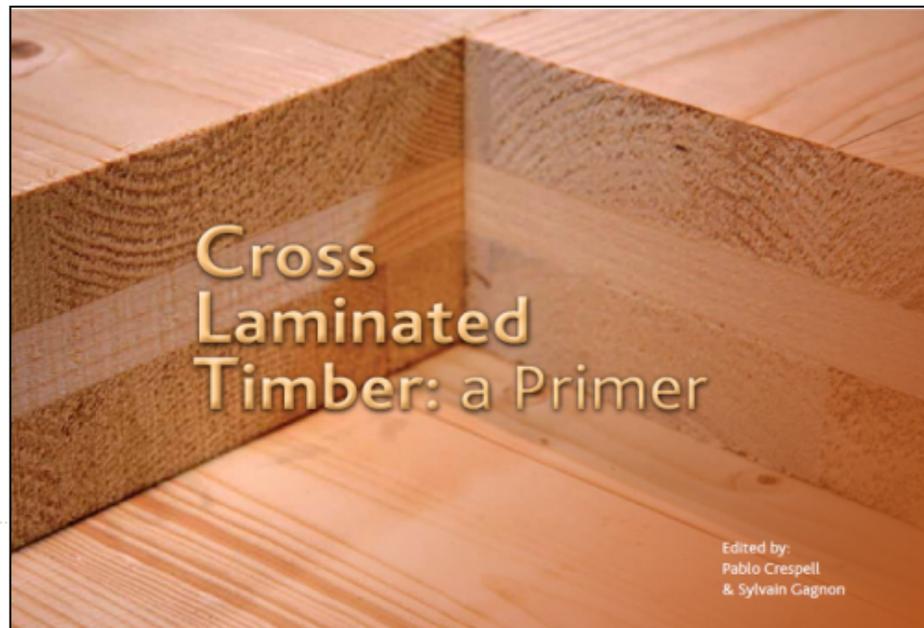
To provide alternative wood-based products and systems to Architects & Engineers which will:

- Expand the use of wood-based products to non-residential & multi-storey construction
- Enable an efficient use of wood fibre to maximize use of the resource & reduce environmental footprints



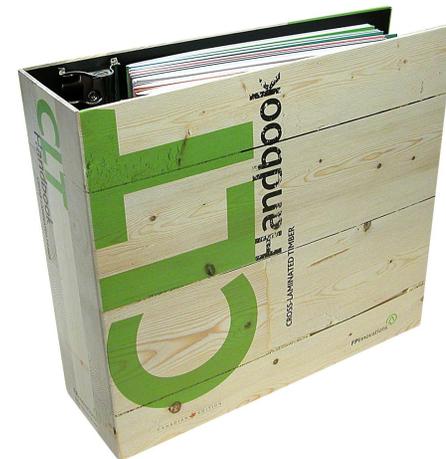
FPInnovations' CLT Primer

- ▶ *Identification of market niches for CLT*
 - *Preliminary cost-analysis CLT versus concrete*



Paradigm shift to accelerate implementation of innovative systems

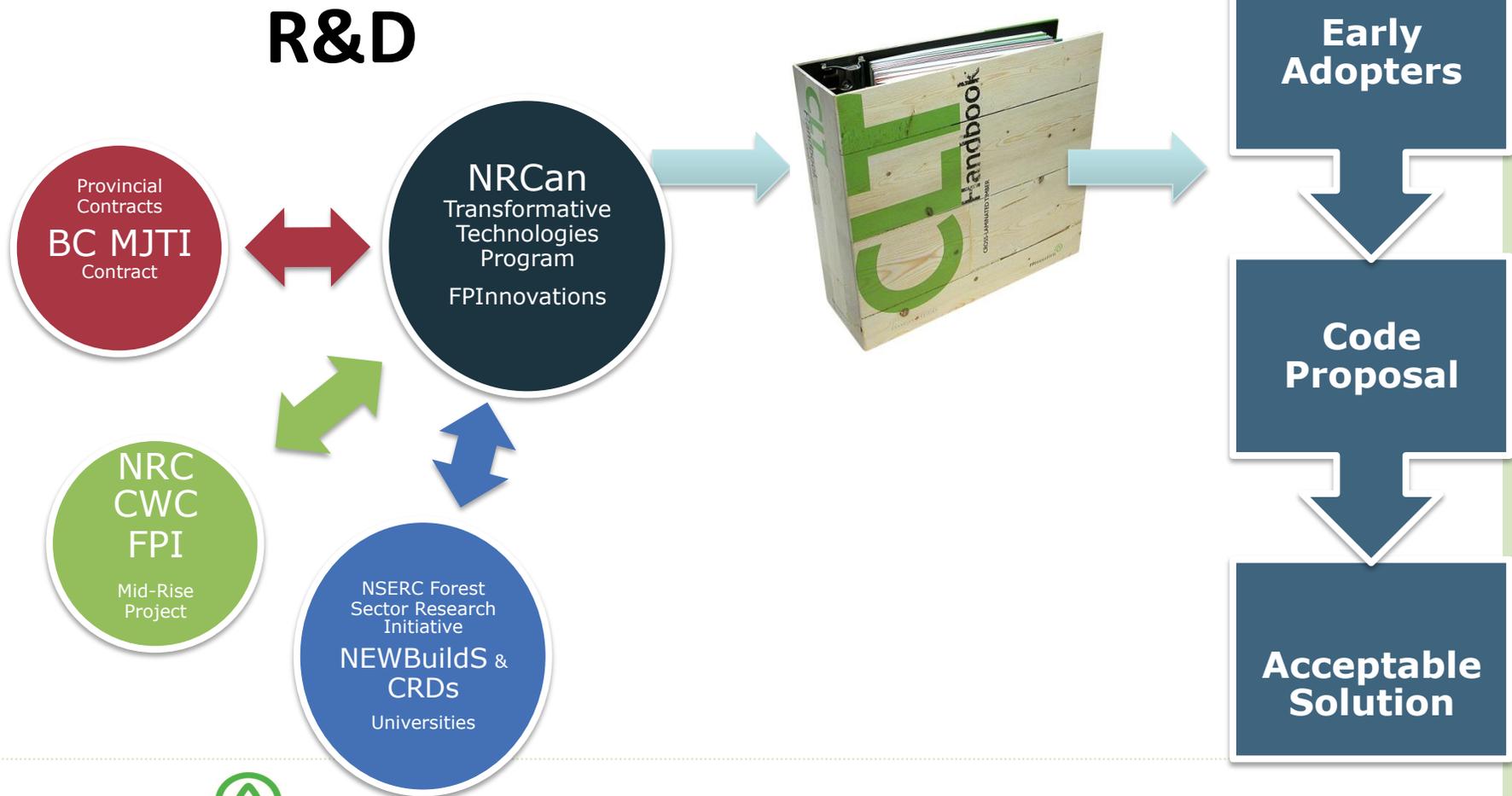
- ▶ Provide design and construction community with “Alternate Solutions”
 - Peer-reviewed credible technical information to satisfy building code objectives



- ▶ Foundation for code implementation

A Paradigm Shift in Introducing Next Generation Wood Building Systems

Alternate Solution



Continue Paradigm Shift in US

- FPInnovations, USFPL, AWC, APA, US WoodWorks prepared a proposal for the development of the **US Edition of CLT Handbook**
 - » Multi-disciplinary
 - » Peer-Reviewed
 - » Engages US Design and construction, and research communities
- Proposal received a conditional approval from the Bi-National Softwood Council

Alternate Solutions in use

UBC Earth Sciences Building

- ▶ Timber Steel Concrete Hybrid
- ▶ NRCan Demo project



Wood/Concrete Floor System Testing at FPInnovations



Seismic Test of CLT Structure

- ▶ Confirming seismic design procedures for CLT structures



Fire Test of a CLT Slab @ NRC



- ▶ Unprotected CLT floor slab meets 90 minutes Fire Resistance (5 plies)

Alternate Solutions in use CLT building, Chibougamau, Qc



A few CLT projects in North America



Collège Durocher – St-Lambert, Québec



Source: Nordic Structures Bois

Main Office of AGF – Longueuil, Québec

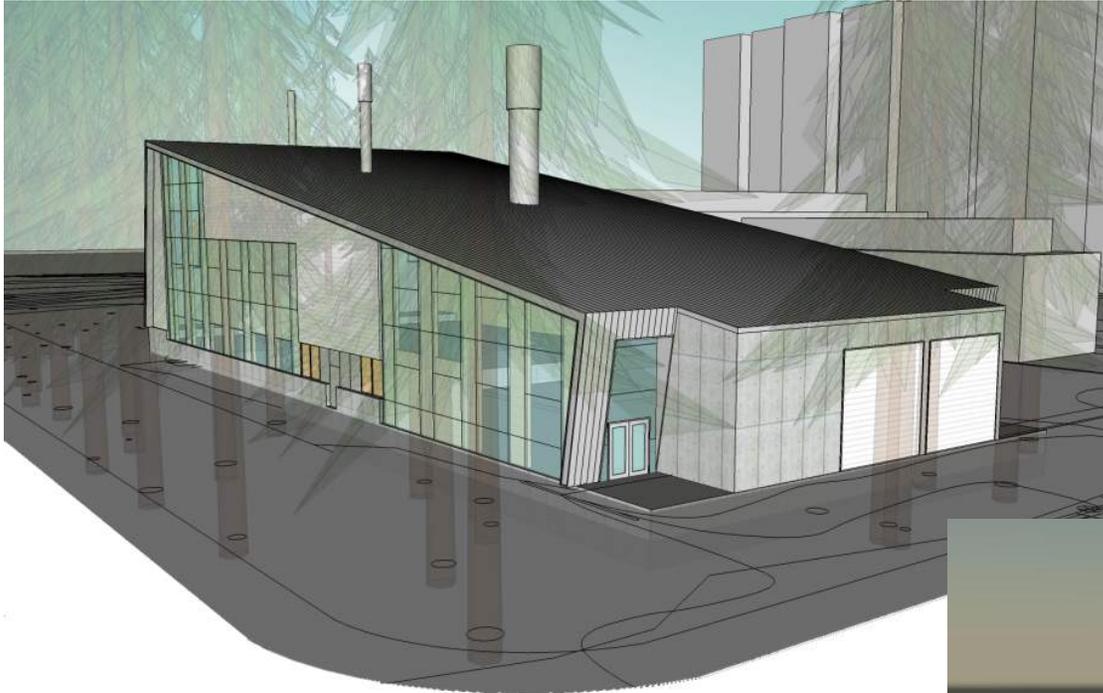


Source: KLH Élément

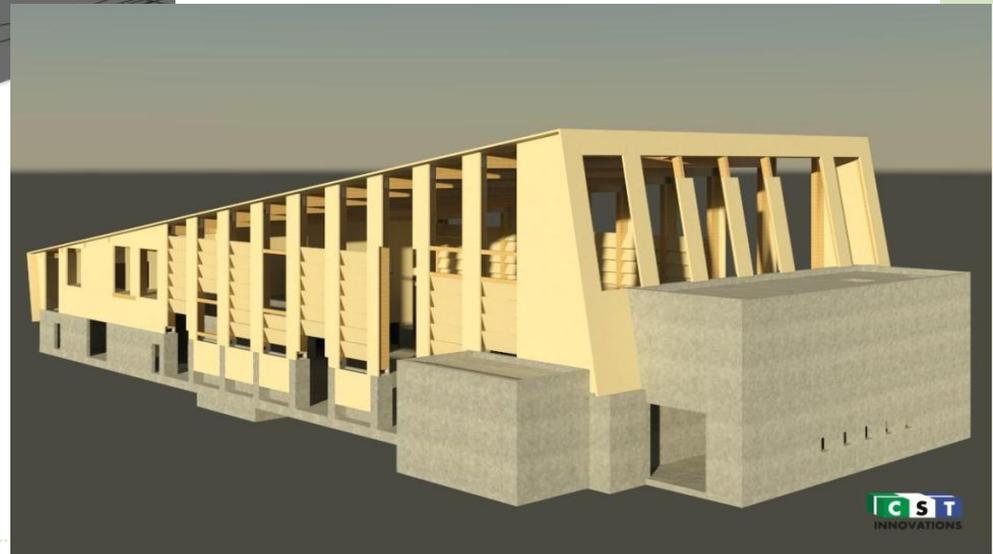
Earth Systems Science Building - Vancouver



UBC Bio-energy



Courtesy of McFarland Marceau
architects ltd



BC WEC Wood Demonstration Projects – Canadian CLT (Elkford, BC)



Myers Memorial UMC, Bell Tower, N. Carolina, USA



Courtesy of SCLT

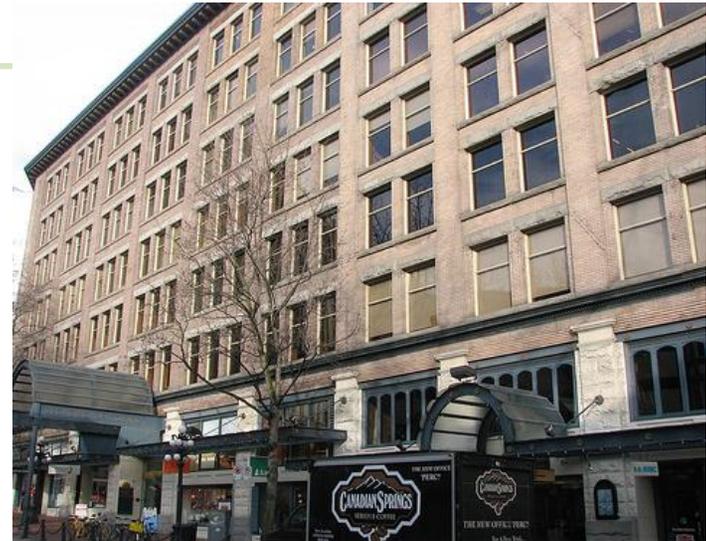
CLT North American Advisory Committee

- ▶ To move CLT forward in North America
- ▶ Research and Standards Sub-Committee
 - Chaired by Brad Douglas of AWC and Erol Karacabeyli
 - Product standards Approved under the ANSI process
 - » FPInnovations passed its drafts to US committee with intention to have one North American standard
 - » European committee proceeding with the European standard
 - » ISO TC 165 initiated the development of an international CLT standard
 - Design Standards; parallel approach envisioned
 - » CWC initiated the process in CSA O86
 - » AWC will be initiating a Supplement to NDS
 - Building Codes - Target date 2015 NBCC and IBC
 - Until then, designers will use credible information such as FPInnovations CLT Handbook

1905 to Present

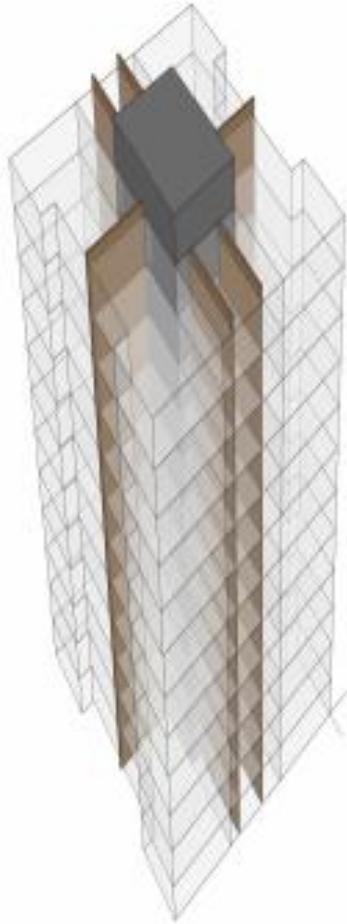
- ▶ **Warehouse; Vancouver – 1905**
- ▶ **Masonry/Heavy Timber Construction**
- ▶ **Height: 30 m**

- ▶ **Office building in Quebec City - 2010**
- ▶ **Concrete and Heavy Timber (Glulam)**
- ▶ **Height: 22 m**



Future: The Wood High Rise?

BC Wood Enterprise Coalition Research Report: The Case for Tall Wood Buildings*



- ▶ Business and technical case study covering: cost, fire, acoustic and structural performance of tall wood structures
- ▶ Report peer reviewed and published



Thank You!