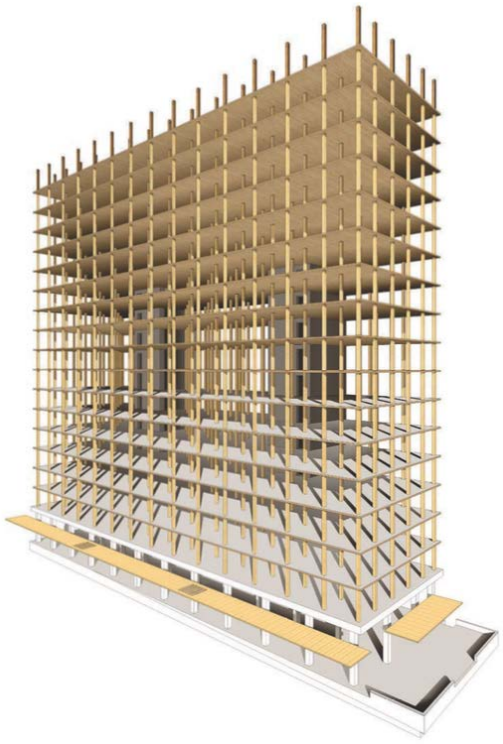
Wood Frame Building Monitoring Case Studies

Structure Monitoring Technology (SMT) has been providing advanced building monitoring solutions since 2006 and presently works closely with various firms and institutions to analyze and improve building designs and construction materials. SMT has worked closely with the National Research Council – Institute for Research in Construction (NRC-IRC), Forest Products Innovations (FPInnovations) and various Engineering firms and academic institutions to perform analysis and research on advanced wood structures and timber frame buildings.

The most recent project undertaken by SMT is the 18-storey student residence at UBC slated to be one of the tallest wood buildings in the world standing 53 meters tall. In addition to its primary function as a student residence, the building will serve as an academic site for students and researchers, who will be able to study and monitor its performance and durability during and after construction.

Two areas undergoing research by SMT in this building are vertical movement monitoring which includes wood compression and settling and the second is a study of the moisture performance of pre-fabricated cross laminate timber (CLT).



UBC Tall Wood Building Frame
(rendering by Acton Ostry)

Vertical Movement Monitoring and Analytics

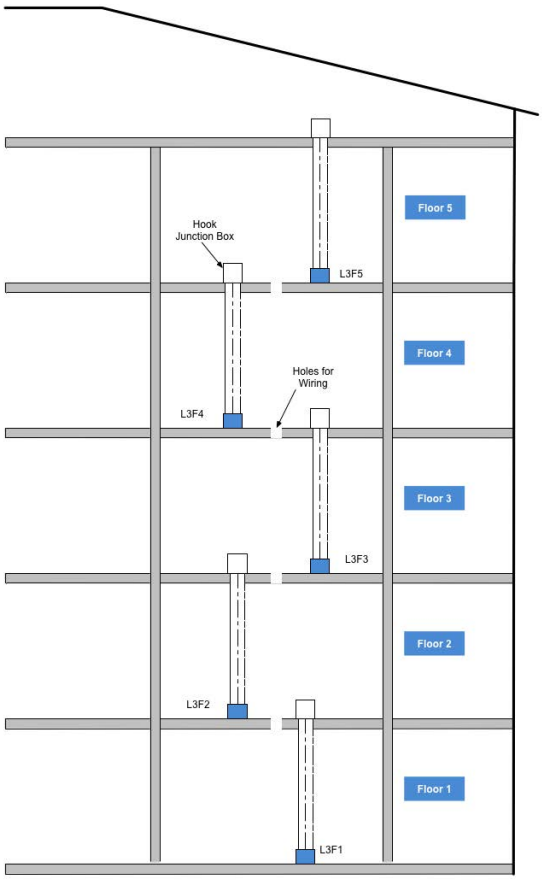
Canadian building codes have been revised to permit multi-unit residential and office buildings to be built up to six storeys compared with four storeys in most jurisdictions. FPInnovations and SMT have instrumented several buildings constructed in BC to determine the vertical movement during and after construction in various conditions including rainy, cold and dry conditions.

One of the most recent buildings instrumented is the 29.5 meter high six-storey wood frame building in Prince George, BC that serves as the Wood Innovation and Design Centre (WIDC) and is presently one of the tallest contemporary wood buildings in North America.

Installation and first year report is available here: http://www.smtresearch.ca/content/widc

FPInnovations and SMT published the methodology and results for Vertical Movement monitoring in ASTM publication Volume 41, Issue 4 (July 2013) titled Monitoring of Vertical Movement in Four-Story Wood-Frame Building in Coastal British Columbia.

Sensor installation uses a string pot sensor connected to a non-stretch cable suspended from the bottom of one floor to the top of the next floor. The assembly is repeated on each floor allowing a floor by floor comparison to be achieved.



Life Cycle Moisture Performance of Prefabricated CLT

The 18-storey Tall Wood Building at UBC is constructed of prefabricated Cross Laminated Timber (CLT) panels where each panel is pre-cut and drilled according to a computer designed model. All penetrations, notches and holes have been precut and drilled and ready to be installed systematically into the building.

CLT panels offer several benefits over standard concrete and steel construction as prefabrication allows for better quality and efficiency during construction. A rigorous manufacturing quality process is in place to ensure optimal planks are selected and moisture levels fall within specific ranges.

Figure 1. Installation of moisture probes in panels at Structurlam

Transportation, storage and construction of CLT materials in the BC climate introduces several challenges and factors investigated in this study . The purpose of this project is to monitor the moisture content of CLT panels produced in Penticton, BC and transported to UBC for installation in the Brock Commons 18 storey Tall Wood Building. Understanding what the materials endure during this process is important to ensure the CLT is in good condition before, during and after construction.

Point Moisture Measurement (PMM) probes of various lengths are inserted from the bottom of the panels and monitor the various layers individually.

The image of the left has a cut-out in the wood so that you can see that an insulated probes is inserted through the panels and only comes into contact with the specific layer in the CLT stack.

On-site Moisture Probe Installation

A new set of moisture probes were installed into the CLT panels in the Tall Wood Building on-site at UBC. Point Moisture Measurement Sensors (PMMs) were installed in alternating East-West and North-South panels on every second floor. The orientation of the PMMs is shown below.

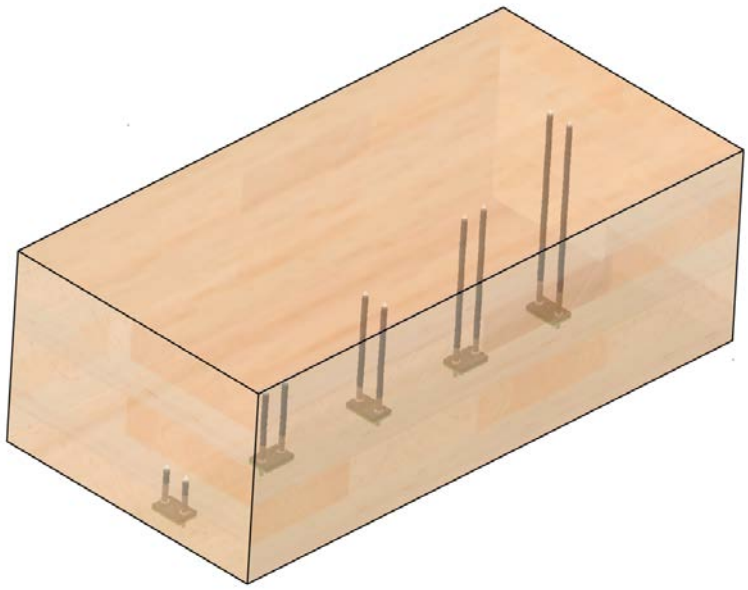


Figure 2. Moisture Probes Installed in CLT Panel

CLT Life Cycle

Moisture of the CLT Panels has been recorded at every stage, from manufacturing to storage, through transport and during installation.

Figure 3. Covered panels monitored during storage at Structurlam Factory

Figure 4. CLTs Transported from Penticton, BC to UBC

Figure 5. Storage on Site at UBC

Figure 6. Installed during typical BC weather conditions