



## Acoustically-Tested Mass Timber Assemblies

<https://research.thinkwood.com/en/permalink/catalogue2639>

Organization: WoodWorks  
 Year of Publication: 2020  
 Country of Publication: United States  
 Format: Report  
 Material: CLT (Cross-Laminated Timber)  
 NLT (Nail-Laminated Timber)  
 Glulam (Glue-Laminated Timber)  
 MPP (Mass Plywood Panel)  
 Application: Floors  
 Walls  
 Topic: Acoustics and Vibration  
 Keywords: Mass Timber  
 Sound Transmission Class  
 Impact Isolation Class  
 Assembly  
 Language: English  
 Research Status: Complete  
 Online Access: Free

### Resource Link

<https://www.woodworks.org/wp-content/uploads/Acoustically-Tested-Mass-Timber-Assemblies-WoodWorks.pdf>



## Acoustical Performance of Mass Timber Building Elements

<https://research.thinkwood.com/en/permalink/catalogue2553>

Country of Publication:	Canada
Material:	CLT (Cross-Laminated Timber) DLT (Dowel Laminated Timber) NLT (Nail-Laminated Timber)
Application:	Floors Walls
Topic:	Acoustics and Vibration
Keywords:	Sound Insulation Acoustic Membrane Acoustical Performance
Research Status:	In Progress
Notes:	Project contact is Jianhui Zhou at the University of Northern British Columbia
Summary:	

Building acoustics has been identified as one of the key subjects for the success of mass timber in the multi-storey building markets. The project will investigate the acoustical performance of mass timber panels produced in British Columbia. The apparent sound transmission class (ASTC) and impact insulation class (IIC) of bare mass timber elements as wall and/ or floor elements will be measured through a lab mock-up. It is expected that a database of the sound insulation performance of British Columbia mass timber products will be developed with guidance on optimal acoustical treatments to achieve different levels of performance.



# Addendum to RR-335: Sound Transmission Through Nail-Laminated Timber (NLT) Assemblies

<https://research.thinkwood.com/en/permalink/catalogue1868>

Author: Mahn, Jeffrey  
Quirt, David  
Hoeller, Christoph  
Mueller-Trapet, Markus

Organization: National Research Council of Canada

Publisher: National Research Council Canada. Construction

Year of Publication: 2018

Country of Publication: Canada

Format: Report

Material: NLT (Nail-Laminated Timber)

Application: Floors  
Walls

Topic: Acoustics and Vibration

Keywords: Sound Insulation  
Assembly  
Sound Transmission Class

Language: English

Research Status: Complete

Online Access: Free

## Resource Link

<https://nrc-publications.canada.ca/eng/view/object/?id=9e3b39be-e0ed-415b-9649-3e7ec228f52c>



## Advanced Wood-Based Solutions for Mid-Rise and High-Rise Construction: Exit Fire Separations in Mid-Rise Wood Buildings

<https://research.thinkwood.com/en/permalink/catalogue1879>

Author: Ranger, Lindsay  
Dagenais, Christian

Organization: FPInnovations

Year of Publication: 2018

Country of Publication: Canada

Format: Report

Material: CLT (Cross-Laminated Timber)  
NLT (Nail-Laminated Timber)

Application: Shafts and Chases

Topic: Fire

Keywords: National Building Code of Canada  
Combustible Material  
Mid-Rise  
Noncombustible Construction

Language: English

Research Status: Complete

### Summary:

FPInnovations initiated this project to demonstrate the ability of wood exit stairs in mid-rise buildings to perform adequately in a fire when NBCC requirements are followed, with the intent of changing perceptions of the fire safety of wood construction. The objective of this research is to investigate further the fire safety afforded by exit stair shafts of combustible construction, with the ultimate objective of better consistency between the provincial and national building codes with respect to fire requirements for exit stair shafts in mid-rise wood-frame construction.

Online Access: Free

### Resource Link

<https://www.bcfii.ca/sites/default/files/report/fpi/16796.pdf>



## Apparent Sound Insulation in Mass Timber Buildings

<https://research.thinkwood.com/en/permalink/catalogue2616>

Author: Mahn, Jeffrey  
Quirt, David  
Mueller-Trapet, Markus  
Hoeller, Christoph

Organization: National Research Council of Canada. Construction

Publisher: National Research Council of Canada. Construction

Year of Publication: 2020

Country of Publication: Canada

Format: Report  
Material: CLT (Cross-Laminated Timber)  
NLT (Nail-Laminated Timber)  
DLT (Dowel Laminated Timber)  
Application: Floors  
Walls  
Topic: Acoustics and Vibration  
Design and Systems  
Keywords: Airborne Sound Transmission  
Apparent Sound Transmission Class  
Sound Transmission  
Adhesive  
Language: English  
Research Status: Complete

Summary:


This Report presents the results from experimental studies of the airborne sound transmission of mass timber assemblies, together with an explanation of the calculation procedures to predict the apparent sound transmission class (ASTC) rating between adjacent spaces in a building constructed of mass timber assemblies.

The experimental data which is the foundation for this Report includes the laboratory measured sound transmission loss of wall and floor assemblies constructed of Cross Laminated Timber (CLT), Nail-Laminated Timber (NLT) and Dowel-Laminated Timber (DLT), and the laboratory measured vibration reduction index between assemblies of junctions between CLT assemblies. The presentation of the measured data is combined with the presentation of the appropriate calculation procedures to determine the ASTC rating in buildings comprised of such assemblies along with numerous worked examples.

Several types of CLT constructions are commercially available in Canada, but this study focused on CLT assemblies with an adhesive applied between the faces of the timber elements in adjacent layers, but no adhesive bonding between the adjacent timber elements within a given layer. These CLT assemblies could be called "Face-Laminated CLT Assemblies" but are simply referred to as CLT assemblies in this Report. Another form of CLT assemblies does have adhesive applied between the faces of the timber elements in adjacent layers as well as adhesive to bond the adjacent timber elements within a given layer. These assemblies are referred to as "Fully-Bonded CLT Assemblies" in this Report. Because fully-bonded CLT assemblies have different properties than face-laminated CLT assemblies, the sound transmission data and predictions in this Report do not apply to fully-bonded CLT assemblies.

Online Access: Free

**Resource Link**

<https://doi.org/10.4224/40001816> 



# Blast Testing of Loaded Mass Timber Structures

<https://research.thinkwood.com/en/permalink/catalogue1164>

Organization: WoodWorks  
 Year of Publication: 2018  
 Country of Publication: United States  
 Publication:  
 Format: Report  
 Material: CLT (Cross-Laminated Timber)  
 NLT (Nail-Laminated Timber)  
 Application: Walls  
 Topic: Mechanical Properties  
 Keywords: Airblast Loads  
 Static Testing  
 Dynamic Testing  
 Out-of-Plane Load  
 Military  
 Language: English  
 Research Status: Complete  
 Online Access: Free

## Resource Link

<http://www.woodworks.org/wp-content/uploads/WoodWorks-Wood-Products-Council-Blast-Testing-Report.pdf>



## Concrete Composite Floors Using Radiant Panel Tests

<https://research.thinkwood.com/en/permalink/catalogue2259>

Organization: TallWood Design Institute  
Country of: United States  
Publication:  
Material: CLT (Cross-Laminated Timber)  
NLT (Nail-Laminated Timber)  
LVL (Laminated Veneer Lumber)  
Application: Floors  
Topic: Fire  
Keywords: Mass Timber  
Acoustics  
Vibration  
Research Status: In Progress  
Notes: Contact: Erica Fischer, Oregon State University

### Summary:

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.



## Design Options for Three- and Four-Storey Wood School Buildings in British Columbia

<https://research.thinkwood.com/en/permalink/catalogue2373>

Author: Bevilacqua, Nick  
Dickof, Carla  
Wolfe, Ray  
Gan, Wei-Jie  
Embury-Williams, Lynn  
Organization: Fast + Epp  
Wood Works! BC  
Thinkspace  
Year of Publication: 2019  
Country of: Canada  
Publication:  
Format: Report

Material: CLT (Cross-Laminated Timber)  
NLT (Nail-Laminated Timber)  
DLT (Dowel Laminated Timber)  
Glulam (Glue-Laminated Timber)  
Other Materials

Application: Wood Building Systems

Topic: Design and Systems

Keywords: Construction  
Education  
School Buildings  
Mass Timber  
Multi-Storey  
Building Code  
Fire Protection

Language: English

Research Status: Complete

Summary:

This study illustrates the range of possible wood construction approaches for school buildings that are up to four storeys in height. As land values continue to rise, particularly in higher-density urban environments, schools with smaller footprints will become increasingly more necessary to satisfy enrollment demands. There are currently a number of planned new school projects throughout British Columbia that anticipate requiring either three- or four-storey buildings, and it is forecasted that the demand for school buildings of this size will continue to rise.

This study is closely related to the report Risk Analysis and Alternative Solution for Three- and Four-Storey Schools of Mass Timber and/or Wood-Frame Construction prepared by GHIL Consultants, which explores the building code related considerations of wood construction for school buildings that are up to four storeys in height. Though wood construction offers a viable structural material option for these buildings, the British Columbia Building Code (BCBC 2018) currently limits schools comprised of wood construction to a maximum of two storeys, while also imposing limits on the overall floor area. As such, the reader is referred to the GHIL report for further information regarding building code compliance (with a particular emphasis on fire protection) for wood school buildings.

Online Access: Free

Resource Link

<http://wood-works.ca/wp-content/uploads/2019/12/Design-Options-for-Three-and-Four-Storey-Wood-School-Buildings-in-BC-Final.pdf>



## Development of Mass Timber Wall System Based on Nail Laminated Timber

<https://research.thinkwood.com/en/permalink/catalogue2526>

Author: Zhang, Chao  
Lee, George  
Lam, Frank

Organization: Timber Engineering and Applied Mechanics (TEAM) Laboratory



Year of Publication: 2020  
Country of Publication: Canada  
Format: Report  
Material: NLT (Nail-Laminated Timber)  
Application: Walls  
Topic: Design and Systems  
Keywords: Shear  
Stiffness  
Fasteners  
Fastener Type  
Load  
Language: English  
Research Status: Complete

**Summary:**

This project studied the feasibility and performance of a mass timber wall system based on Nail Laminated Timber (NLT) for floor/wall applications, in order to quantify the effects of various design parameters. Thirteen 2.4 m × 2.4 m shear walls were manufactured and tested in this phase. Together with another five specimens tested before, a total eighteen shear wall specimens and ten configurations were investigated. The design variables included fastener type, sheathing thickness, number of sheathings, sheathing material, nailing pattern, wall opening, and lumber orientation. The NLT walls were made of SprucePine-Fir (SPF) No. 2 2×4 (38 mm × 89 mm) lumber and Oriented Strand Lumber (OSB) or plywood sheathing. They were tested under monotonic and reverse-cyclic loading protocols, in accordance with ASTM E564-06 (2018) and ASTM E2126-19, respectively.

Compared to traditional wood stud walls, the best performing NLT based shear wall had 2.5 times the peak load and 2 times the stiffness at 0.5-1.5% drift, while retaining high ductility. The advantage of these NLT-based wall was even greater under reverse-cyclic loading due to the internal energy dissipation of NLT.

The wall with ring nails had higher stiffness than the one with smooth nails. But the performance of ring nails deteriorated drastically under reverse-cyclic loading, leading to a considerably lower capacity. Changing the sheathing thickness from 11 mm to 15 mm improved the strength by 6% while having the same initial stiffness. Adding one more face of sheathing increased the peak load and stiffness by at least 50%. The wall was also very ductile as the load dropped less than 10% when the lateral displacement exceeded 150 mm. The difference created by sheathing material was not significant if they were of the same thickness. Reducing the nailing spacing by half led to a 40% increasing in the peak load and stiffness. Having an opening of 25% of the area at the center, the lateral capacity and stiffness reached 75% or more of the full wall.

A simplified method to estimate the lateral resistance of this mass timber wall system was proposed. The estimate was close to the tested capacity and was on the conservative side. Recommendations for design and manufacturing the system were also presented.

Online Access: Free

**Resource Link**

[https://www.bcfii.ca/system/files/reports/public/unbc\\_passive\\_house\\_performance\\_in\\_cold\\_climates.pdf](https://www.bcfii.ca/system/files/reports/public/unbc_passive_house_performance_in_cold_climates.pdf)



## Encapsulated Mass Timber Construction: Guidelines for Encapsulation Details and Techniques

<https://research.thinkwood.com/en/permalink/catalogue2600>

Author: Ranger, Lindsay  
Geraghty, Simon  
Jeske, Judy  
Rahmani, Alma  
Dorsey, Cheryl

Organization: FPInnovations

Year of Publication: 2019

Country of Publication: Canada

Format: Book/Guide

Material: CLT (Cross-Laminated Timber)  
DLT (Dowel Laminated Timber)  
Glulam (Glue-Laminated Timber)  
NLT (Nail-Laminated Timber)

Application: Wood Building Systems

Topic: Design and Systems  
Fire

Keywords: Encapsulated Mass Timber Construction  
EMTC  
Fire Protection  
Construction Safety

Language: English

Research Status: Complete

### Summary:

The purpose of this guide is to provide an introduction to the concept of encapsulated mass timber construction. This guide provides an overview of encapsulation techniques for mass timber construction, and other related fire protection measures, and summarizes some approved encapsulation materials and application methods and identifies additional requirements for safety during construction. This guide is intended to help architects, engineers and designers by reducing uncertainty and allowing for more confidence in design, as well as providing authorities having jurisdiction and inspectors with a reference for simple design review.

Online Access: Free

### Resource Link

<https://library.fpinnovations.ca/en/permalink/fpipub7689>