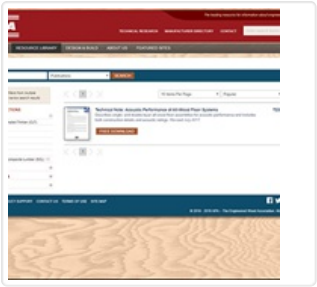
Acoustically-Tested Mass Timber Assemblies

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



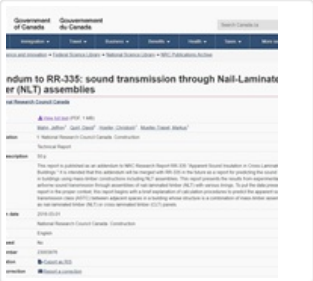
Acoustic Performance of All-Wood Floor Systems

https://research.thinkwood.com/en/permalink/catalogue1931

Organization:	APA
Year of Publication:	2017
Country of Publication:	United States
Format:	Report
Material:	Light Frame (Lumber+Panels)
Application:	Floors
Topic:	Acoustics and Vibration
Keywords:	Sound Transmission Class
	Impact Isolation Class
	Code
Language:	English
Research Status:	Complete
Online Access:	Free

Resource Link

https://www.apawood.org/publication-search?q=T230&tid=1



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: In-Situ Testing of the Origine 13-Storey Building for Vibration and Acoustic Performances

https://research.thinkwood.com/en/permalink/catalogue1474

Author:	Hu, Lin
	Cuerrier-Auclair, Samuel
Organization:	FPInnovations
Year of Publication:	2018
Country of Publication:	Canada
Format:	Report
Material:	CLT (Cross-Laminated Timber)

Application:	Wood Building Systems
	Floors
	Walls
Topic:	Acoustics and Vibration
	Serviceability
Keywords:	Origine
	Natural Frequencies
	Damping Ratios
	Sound Insulation
	Ambient Vibration Tests
	Static Deflection
	Apparent Sound Transmission Class
	Apparent Impact Insulation Class
Language:	English
Research Status:	Complete

Summary:

Serviceability performance studied covers three different performance attributes of a building. These attributes are 1) vibration of the whole building structure, 2) vibration of the floor system, typically in regards to motions in a localized area within the entire floor plate, and 3) sound insulation performance of the wall and floor assemblies. Serviceability performance of a building is important as it affects the comfort of its occupants and the functionality of sensitive equipment as well. Many physical factors influence these performances. Designers use various parameters to account for them in their designs and different criteria to manage these performances. Lack of data, knowledge and experience of sound and vibration performance of tall wood buildings is one of the issues related to design and construction of tall wood buildings.

In order to bridge the gaps in the data, knowledge, and experience of sound and vibration performance of tall wood buildings, FPInnovations conducted a three-phase performance testing on the Origine 13-storey CLT building of 40.9 m tall in Quebec city. It was the tallest wood building in Eastern Canada in 2017.

Online Access:	Free

Resource Link

https://www.bcfii.ca/sites/default/files/report/fpi/16795.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

Guide to Calculating Airborne Sound Transmission in Buildings: Fifth Edition, December 2019

https://research.thinkwood.com/en/permalink/catalogue2617

Author:	Hoeller, Christoph
	Quirt, David
	Mahn, Jeffrey
	Müller-Trapet, Markus
Organization:	National Research Council of Canada. Construction
Publisher:	National Research Council of Canada. Construction
Year of Publication:	2019
Country of Publication:	Canada
Format:	Book/Guide
Material:	CLT (Cross-Laminated Timber)
	Light Frame (Lumber+Panels)
Application:	Floors
	Walls
Topic:	Acoustics and Vibration
	Design and Systems
Keywords:	Apparent Sound Transmission Class
	Sound Insulation
	Sound Transmission
	Concrete
	Building Code
	Impact Sound
Language:	English
Research Status:	Complete

Summary:

In recent years, the science and engineering for controlling sound transmission in buildings have shifted from a focus on individual assemblies such as walls or floors, to a focus on performance of the complete system. Standardized procedures for calculating the overall transmission, combined with standardized measurements to characterize sub-assemblies, provide much better prediction of sound transmission between adjacent indoor spaces. The International Standards Organization (ISO) has published a calculation method, ISO 15712-1 that uses laboratory test data for sub-assemblies such as walls and floors as inputs for a detailed procedure to calculate the expected sound transmission between adjacent rooms in a building. This standard works very well for some types of construction, but to use it in a North American context one must overcome two obstacles – incompatibility with the ASTM standards used by our construction industry, and low accuracy of its predictions for lightweight wood or steel frame construction. To bypass limitations of ISO 15712-1, this Guide explains how to merge ASTM and ISO test data in the ISO calculation procedure, and provides recommendations for applying extended measurement and calculation procedures for specific common types of construction. This Guide was developed in a project established by the National Research Council of Canada to support the transition of construction industry practice to using apparent sound transmission class (ASTC) for sound control objectives in the National Building Code of Canada (NBCC). However, the potential range of application goes beyond the minimum requirements of the NBCC – the Guide also facilitates design to provide enhanced sound insulation, and should be generally applicable to construction in both Canada and the USA. This publication contains a limited set of examples for several types of construction, to provide an introduction and overview of the ASTC calculation procedure. Additional examples and measurement data can be found in the companion documents to this Guide, namely NRC Research Reports RR-333 to RR-337. Furthermore, the calculation procedure outlined and illustrated in this Guide is also used by the software web application soundPATHS, which is available for free on the website of the National Research Council of Canada (see the references in Section 7 of this Guide for access details).

Online Access: Free

Resource Link

https://doi.org/10.4224/40001814

In-Situ Testing of the Wood Innovation and Design Centre for Serviceability Performance

https://research.thinkwood.com/en/permalink/catalogue1183

Author:	Hu, Lin
	Cuerrier-Auclair, Samuel
Organization:	FPInnovations
Year of Publication:	2018
Country of Publication:	Canada
Format:	Report
Material:	CLT (Cross-Laminated Timber)
Application:	Wood Building Systems
Topic:	Serviceability
	Acoustics and Vibration
Keywords:	Vibration Performance
	Sound Insulation
	Natural Frequencies
	Damping Ratios
	Ambient Vibration Testing
	Apparent Sound Transmission Class
	Apparent Impact Insulation Class
Language:	English
Research Status:	Complete

Summary:

Three performance attributes of a building for serviceability performance are 1) vibration of the whole building structure, 2) vibration of the floor system, typically in regards to motions in a localized area within the entire floor plate, and 3) sound insulation performance of the wall and floor assemblies. Serviceability performance of a building is important as it affects the comfort of its occupants and the functionality of sensitive equipment as well. Many physical factors influence these performances. Designers use various parameters to account for them in their designs and different criteria to manage these performances.

The overall objectives of this stud were threefold:

1. The vibration performance tests were to experimentally determine the dynamic properties, e.g., natural frequencies (periods) and damping ratios of the WIDC building through ambient vibration testing on:

o the bare structure in 2014,

o the finished building upon completion of the construction with occupants in 2015, and

o the finished building after 3 years of service in 2017.

2. The floor vibration tests were to evaluate vibration performance of the innovative CLT floor based on the bare floor fundamental natural frequency, 1 kN static deflection, and subjective evaluation.

3. The sound transmission tests were to determine the Apparent Sound Transmision Class (ASTC) and Apparent Impact Insulation Class (AIIC) of selected innovative CLT floor assemblies.

Online Access: Free

Resource Link

https://library.fpinnovations.ca/en/permalink/fpipub49840

Mass Timber Hotel: Tuning CLT to Overcome Barriers to Adoption in the Hospitality Industry

https://research.thinkwood.com/en/permalink/catalogue2565

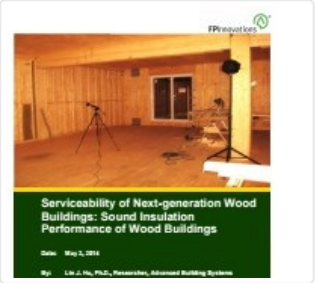
Organization:	University of Minnesota
Country of Publication:	United States
Material:	CLT (Cross-Laminated Timber)
Application:	Wood Building Systems
Topic:	Market and Adoption
Keywords:	Hospitality
	Hotel
	Acoustical Performance
	Sound Transmission Class
	MEP System
	Aesthetic Properties
Research Status:	In Progress
Notes:	Project contact is Jacob Mans at the University of Minnesota

Summary:

As the acceptance of cross-laminated timber (CLT) grows among commercial and institutional clients, the hospitality industry, in general, has been hesitant to adopt CLT. This reluctance is linked to several real and perceived factors. One, the industry has fire safety and fire rating concerns with the construction system; these concerns have been largely addressed through independent research and building code updates. Two, the industry is concerned with the acoustic rating of standard CLT panels, which do not currently meet the elevated performance standards of the hospitality industry – specifically the sound transmission class (STC) rating -- and will require additional design research. Three, the industry is concerned with the aesthetics of the system and the dual challenges of exposing wood and simultaneously integrating Mechanical Electrical and Plumbing (MEP) systems. Image, brand identity, and indoor air quality are all key variables that factor into whether this rapidly-growing industry adopts CLT as a viable system for hotel construction. There is an opportunity to reframe these individual challenges as a collection of assets in order to provide a holistic solution that can will demonstrate the feasibility of CLT within the hospitality industry.

This grant will address these barriers and to facilitate the increased utilization of CLT within the hospitality industry. Such utilization has the potential to divert a substantial amount of fuel from federal forest and timber lands and to sequester its embedded carbon in buildings. Market analysis estimates that 715 hotels of 8 floors or lower (the target size for this project) will be built in the United States in 2020. If constructed out of CLT, this market represents approximately 94 million board feet of potential wood utilization through CLT per year (over 1 million metric tons of sequestered CO2). The opportunity to capture a fragment of this market warrants feasibility research to prove the viability of CLT for the hospitality industry.

The University of Minnesota and DLR Group will work with CLT manufactures and established hospitality partners to construct a modular hotel room prototype that can test acoustical and MEP systems integration strategies – as well as spark future research projects. This experimental apparatus will also double as a show unit to educate possible users and developers of the potential for a mass timber hotel. In addition to developing, constructing, and testing the prototype, the team will develop informational materials and a detailed cost analysis of the project that will encourage hospitality partners to implement these ideas with confidence.



Serviceability of Next-Generation Wood Buildings: Sound Insulation Performance of Wood Buildings

https://research.thinkwood.com/en/permalink/catalogue402

Author:	Hu, Lin
Organization:	FPInnovations
Year of Publication:	2014
Country of Publication:	Canada
Format:	Report
Material:	CLT (Cross-Laminated Timber)
	Glulam (Glue-Laminated Timber)
	Timber-Concrete Composite
	Light Frame (Lumber+Panels)
Application:	Wood Building Systems
	Floors
	Walls
Topic:	Acoustics and Vibration
	Serviceability
Keywords:	Apparent Sound Insulation Class
	Field Sound Insulation Class
	Apparently Sound Transmission Class
	Field Sound Transmission Class
Language:	English
Research Status:	Complete

Summary:

This report documents apparent/field impact insulation class (AIIC/FIIC) ratings and apparent/field sound transmission class (ASTC/FSTC) ratings for a large number of light-frame wood-joisted floors, cross-laminated timber floors (CLT), massive glulam floors, and a wood-concrete composite floor. The report includes various construction details involving finishings, membranes under finishings, toppings, underlayment materials for toppings, and drywall ceilings. This report also documents ASTC/FSTC ratings for some light-frame wood stud walls and CLT walls.
The informal subjective evaluation of field floors and walls by FPInnovations staff, and by occupants, revealed that, if a FSTC or FIIC rating is below 45, occupants could clearly hear sound generated by their neighbor's normal activities. If a FSTC or FIIC rating is above 50, occupants could still hear "muffled" sound generated by their neighbor's normal activities, but do not hear it as clearly. If a FSTC or FIIC rating is above 60, occupants could not hear any sound generated by their neighbor's activities, except when there is a lightweight floor with a carpet. In that case, low frequency footsteps could be heard even if the FIIC was above 60.

Online Access: Free

Resource Link

https://library.fpinnovations.ca/en/permalink/fpipub43011