Acoustics Summary: Sound Insulation in Mid-Rise Wood Building

https://research.thinkwood.com/en/permalink/catalogue750

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Organization:	National Research Council of Canada

Year of Publication:	2014
Country of Publication:	Canada
Format:	Report
Material:	CLT (Cross-Laminated Timber)
	Light Frame (Lumber+Panels)
Application:	Wood Building Systems
Topic:	Acoustics and Vibration
	Design and Systems
Keywords:	Mid-Rise
	Sound Insulation
	Impact Sound Transmission
	Airborne Sound Transmission
Language:	English
Research Status:	Complete

Summary:

This report summarizes the acoustics research component regarding sound insulation of elements and systems for the research project on mid-rise and larger wood buildings. The summary outlines the background, main research considerations, research conducted and major outcomes. Further details of the design and the results can found in the appendix of Client Report A1-100035-02.1 [1].

The goal of the acoustics research components was to develop design solutions for mid-rise wood and wood-hybrid buildings that comply both with the current National Building Code of Canada (NBCC) 2010 [2] requirements for direct sound insulation and with the anticipated requirements for flanking sound transmission in the proposed, 2015 version of the NBCC. In addition, the design solutions were to provide better impact sound insulation while still achieving code compliance for all other disciplines (interdependencies) as identified in the final report of the scoping study conducted in FY 2010/2011 [3]

Online Access: Free

Resource Link

http://doi.org/10.4224/21274554

Air-Borne Sound Transmission through Triple-Leaf Walls

https://research.thinkwood.com/en/permalink/catalogue2235

Author:	Eslami, Armin
Organization:	Carleton University
Year of Publication:	2015
Country of Publication:	Canada
Format:	Thesis
Material:	Light Frame (Lumber+Panels)
Application:	Walls
Topic:	Acoustics and Vibration
Keywords:	Mid-Rise Airborne Sound Model Sound Transmission Sound Insulation
Language:	English
Research Status:	Complete
Online Access:	Free

Resource Link

https://doi.org/10.22215/etd/2015-10914

Apparent Sound Insulation in Cross-Laminated Timber Buildings

https://research.thinkwood.com/en/permalink/catalogue1276

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	Mahn, Jeffrey
	Quirt, Dave
	Schoenwald, Stefan
	Zeitler, Berndt
Organization:	National Research Council of Canada
Year of Publication:	2017
Country of Publication:	Canada
Format:	Report
Material:	CLT (Cross-Laminated Timber)
Application:	Wood Building Systems
Topic:	Acoustics and Vibration
	Connections
Keywords:	Airborne Sound Transmission
	Adhesives
Language:	English
Research Status:	Complete

Summary:

This Report presents the results from experimental studies of airborne sound transmission, together with an explanation of calculation procedures to predict the apparent airborne sound transmission between adjacent spaces in a building whose construction is based on cross-laminated timber (CLT) panels.
There are several types of CLT constructions which are commercially available in Canada, but this study only focused on CLT panels that have adhesive between the faces of the timber elements in adjacent layers, but no adhesive bonding the adjacent timber elements within a given layer. There were noticeable gaps (up to 3 mm wide) between some of the timber elements comprising each layer of the CLT assembly. These CLT panels could be called "Face-Laminated CLT PAnels" but are simply referred to as CLT panels in this Report.
Another form of CLT panels has adhesive 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 are referred to as "Fully-Bonded CLT Panels" in this Report.

Online Access: Free

Resource Link

http://doi.org/10.4224/23002009

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

Correlation between Sound Insulation and Occupants' Perception – Proposal of Alternative Single Number Rating of Impact Sound

https://research.thinkwood.com/en/permalink/catalogue79

Author:	Ljunggren, Fredrik
	Simmons, Christian
	Hagberg, Klas
Publisher:	ScienceDirect
Year of Publication:	2014
Country of Publication:	Netherlands
Format:	Journal Article
Material:	CLT (Cross-Laminated Timber)
Application:	Floors
Topic:	Acoustics and Vibration
Keywords:	Airborne Sound
	Frequency
	Insulation
	Lightweight
	Sound
	Sweden
Language:	English
Research Status:	Complete
Series:	Applied Acoustics

Summary:

Traditionally, multi-family houses have been constructed using heavy, homogenous materials like concrete and masonry. But as a consequence of the progress of lightweight building systems during the last decades, it has been questioned whether standardized sound insulation evaluation methods still are appropriate.

An extensive measurement template has been applied in a field survey where several vibrational and acoustical parameters were determined in ten Swedish buildings of various constructions. In the same buildings, the occupants were asked to rate the perceived annoyance from a variety of natural sound sources. The highest annoyance score concerned impact sounds, mainly in the buildings with lightweight floors.

Statistical analyses between the measured parameters and the subjective ratings revealed a useful correlation between the rated airborne sound insulation and R0 w þ C50—3150 while the correlation between the rated impact sound insulation and L0 n;w þ CI;50—2500 was weak. The latter correlation was considerably improved when the spectrum adaptation term with an extended frequency range starting from 20 Hz was applied. This suggests that frequencies below 50 Hz should be considered when evaluating impact sound in lightweight buildings.

Online Access:	Free

Resource Link

https://www.traguiden.se/globalassets/forskning/akustik/applied-acoustics/ljunggren-et-al-correleation-between-sound-insulation.pdf

Development of Robust Design Details for Improved Acoustics in Mass Timber Construction

https://research.thinkwood.com/en/permalink/catalogue2249

Organization:	Université du Québec à Chicoutimi
Country of Publication:	Canada
Material:	CLT (Cross-Laminated Timber)
Application:	Wood Building Systems
Topic:	Acoustics and Vibration
Keywords:	Model
	Airborne Sound Transmission
	Impact Sound Transmission
Research Status:	In Progress
Notes:	Project contact is Sylvain Ménard at Université du Québec à Chicoutimi

Summary:

To ensure the acoustic performance of wood constructions, the research group at the Sustainable Building Institute at Napier University has established a series of proven solutions. The advantage of this approach is to provide designers with solutions that have been technically validated, thus allowing them to overcome the burden of proposing to the manufacturer an acoustic solution. The tools to develop this concept will involve an understanding of the propagation of impact and airborne noises in the main CLT building design typologies, validating the main solutions through laboratory testing and providing proven solutions. Many NRC (National Research Council of Canada) trials could have been avoided. Conducting tests is expensive, and it would be interesting to link the test results to the modeling results.

Elaboration of Robust Design Details for Increased Acoustics in Massive Timber Construction

https://research.thinkwood.com/en/permalink/catalogue2670

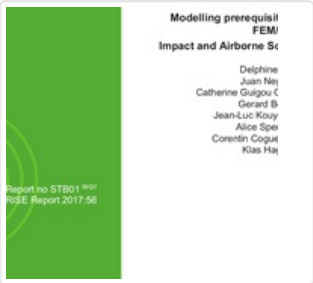
Organization:	Université Laval
Country of Publication:	Canada
Material:	CLT (Cross-Laminated Timber)
Topic:	Acoustics and Vibration
Keywords:	Airborne Sound Acoustic Performance Model
Research Status:	In Progress
Notes:	Project contact is Sylvain Ménard at Université Laval

Summary:

In order to ensure the acoustic performance of timber constructions, the research group of the Sustainable Building Institute at Napier University has established a series of proven solutions. These, called rugged construction details, are based on a series of designs that are most likely and proven for the performance they will bring into the building. The advantage of this approach is to provide designers with solutions that have been the subject of technical validations, thus allowing them to free themselves from the burden of offering the builder an acoustic solution. The tools to develop this concept will involve an understanding of the propagation of impact and airborne noise in the main building design typologies in CLT, to validate the main solutions through laboratory tests and to propose proven solutions. Many tests performed at NRC could have been avoided. Performing tests is expensive, and it would be interesting to make the link between the test results and the modeling results. Having a solution guide is great, but having a model that would predict the behavior of a design would be even better.

Resource Link

https://circerb.chaire.ulaval.ca/projets/phd-rdc-61-elaboration-de-details-robustes-de-conception-pour-une-acoustique-accrue-dans-la-construction-massive-en-bois/



Modelling Prerequisites – FEM/SEA Impact and Airborne Sound

https://research.thinkwood.com/en/permalink/catalogue840

Author:	Bard, Delphine Negreira, Juan Guigou-Carter, Catherine Borello, Gerard Kouyoumji, Jean-Luc Speranza, Alice Coguenanff, Corentin Hagberg, Klas
Organization:	Silent Timber Build
Year of Publication:	2017
Country of Publication:	Sweden

Format:	Report
Material:	Light Frame (Lumber+Panels)
Application:	Wood Building Systems
	Floors
	Walls
Topic:	Acoustics and Vibration
Keywords:	Europe
	Finite Element Model
	Frequencies
	SEA Model
	Prediction
	Impact Sound Insulation
	Airborne Sound Insulation
Language:	English
Research Status:	Complete

Summary:

This report comprises reslts from the work done within work package 1 in the WWN+ project "Silent Timber Build", WP 1: Prediction tools, low and high frequencies. The aim from this WP was to develop prediction tools applied for wooden constructions. Included in this is also to create necessary basis for enough accuracy for any European wood construction. It implies development of new methods but also to understand how input forces primarily from the tapping machine affects the resuts of impact sound levels. The WP also describes how models are developed, in order to provide expected accuracy and then how to further improve the models in order to optimize floor and wall assemblies. The Work Package has been closely linked to WP 2 but also WP3. Using the reults from WP 2, the prediction model results can be compared to expected values for any European construction. From that optimization of floor assemblies and refining of the model is possible.

Online Access:	Free

Resource Link

http://silent-timber-build.com/wp-content/uploads/sites/16/2018/01/wg1-report-db_171226.pdf

Sound Insulation Performance of Cross Laminated Timber Building Systems

https://research.thinkwood.com/en/permalink/catalogue342

Author:	Schoenwald, Stefan
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	Sabourin, Ivan
	King, Frances
Organization:	Inter-noise
Year of Publication:	2013
Country of Publication:	Austria
Format:	Conference Paper
Material:	CLT (Cross-Laminated Timber)
Application:	Wood Building Systems
Topic:	Acoustics and Vibration
Keywords:	Airborne Sound Insulation
	Acoustic Performance
Language:	English
Conference:	Inter-noise 2013
Research Status:	Complete
Notes:	September 15-18, 2013, Innsbruck, Austria

Summary:

In recent years Cross Laminated Timber (CLT) was introduced as an emerging building system in the North American market. CLT elements consist of multiple layers of wooden beams that are laid-out cross-wise and laminated together to form solid wood panels for floors and walls. As part of a multi-disciplinary research project a comprehensive study was conducted on the impact and airborne sound insulation of this type of elements in order to create a data base that allows building designers to predict the acoustic performance of CLT systems. Parametric studies were carried out on the direct impact airborne sound insulation of CLT floor assemblies (with/ without various floor topping and gypsum board ceiling variants), on the direct airborne sound insulation of CLT walls (with/without gypsum board linings), as well as on the structure-borne sound transmission on a series of CLT building junctions. The results were then used as input data for predictions of the apparent impact and airborne sound insulation in real CLT buildings using the ISO 15712 (EN12354) framework that was originally developed for concrete and masonry buildings. The paper presents the prediction approach as well as results of prediction and measurement series for apparent impact and airborne sound insulation.

Online Access: Free

Resource Link

https://nrc-publications.canada.ca/eng/view/object/?id=4ae707b4-6075-4376-bb30-9b42a039fa91