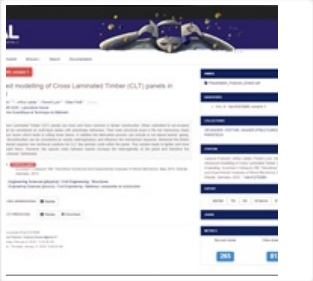


Advanced Modelling of Cross Laminated Timber (CLT) Panels in Bending

https://research.thinkwood.com/en/permalink/catalogue1796

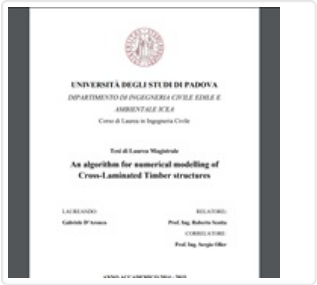
Author:	Franzoni, Lorenzo
	Lebée, Arthur
	Lyon, Florent
	Forêt, Gilles
Publisher:	HAL archives-ouvertes.fr
Year of Publication:	2015
Country of Publication:	Germany
Format:	Presentation
Material:	CLT (Cross-Laminated Timber)
Application:	Wood Building Systems
Topic:	Mechanical Properties
Keywords:	Bending
	Model
	Panels
	Shear
	Stiffness
	Failure Behavior
	Shear Force
	Reference Test
Language:	English
Conference:	Euromech Colloquim 556 Theoretical Numerical and Experimental Analyses of Wood Mechanics
Research Status:	Complete
Notes:	May 2015, Dresde, Germany
Online Access:	Free

Resource Link

https://hal.archives-ouvertes.fr/hal-01270289

An Algorithm for Numerical Modelling of Cross-Laminated Timber Structures

https://research.thinkwood.com/en/permalink/catalogue2362



Author:	D'Aronco, Gabriele
Publisher:	Università di Padova
Year of Publication:	2015
Country of Publication:	Italy
Format:	Thesis
Material:	CLT (Cross-Laminated Timber)
Application:	Wood Building Systems
Topic:	Design and Systems
Keywords:	Connections Panels Model
Language:	English
Research Status:	Complete

Summary:

Cross-laminated timber, also known as X-Lam or CLT, is well established in Europe as a construction material. Recently, implementation of X-Lam products and systems has begun in countries such as Canada, United States, Australia and New Zealand. So far, no relevant design codes for X-Lam construction were published in Europe, therefore an extensive research on the field of cross-laminated timber is being performed by research groups in Europe and overseas. Experimental test results are required for development of design methods and for verification of design models accuracy.

This thesis is part of a large research project on the development of a software for the modelling of CLT structures, including analysis, calculation, design and verification of connections and panels. It was born as collaboration between Padua University and Barcelona"s CIMNE (International Centre for Numerical Methods in Engineering). The research project started with the thesis “Una procedura numerica per il progetto di edifici in Xlam” by Massimiliano Zecchetto, which develops a software, using MATLAB interface, only for 2D linear elastic analysis. Follows the phase started in March 2015, consisting in extending the 2D software to a 3D one, with the severity caused by modelling in three dimensions. This phase is developed as a common project and described in this thesis and in “Pre-process for numerical analysis of Cross Laminated Timber Structures” by Alessandra Ferrandino.

The final aim of the software is to enable the modelling of an X-Lam structure in the most efficient and reliable way, taking into account its peculiarities. Modelling of CLT buildings lies into properly model the connections between panels. Through the connections modelling, the final aim is to enable the check of preliminarily designed connections or to find them iteratively, starting from hypothetical or random connections.

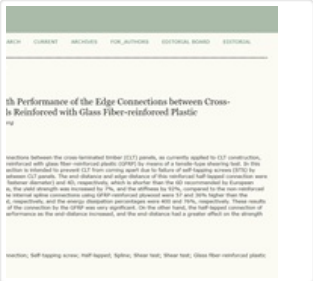
This common project develops the pre-process and analysis phases of the 3D software that allows the automatic modelling of connections between X-Lam panels. To achieve the goal, a new problem type for GiD interface and a new application for KRATOS framework have been performed. The problem type enables the user to model a CLT structure, starting from the creation of the geometry and the assignation of numeric entities (beam, shell, etc.) to geometric ones, having defined the material, and assigning loads and boundary conditions. The user does not need to create manually the connections, as conversely needs for all commercial FEM software currently available; he just set the connection properties to the different sides of the panels. The creation of the connections is made automatically, keeping into account different typologies of connections and assembling of Cross-Lam panels. The problem type is special for XLam structures, meaning that all features are intentionally studied for this kind of structures and the software architecture is planned for future developments of the postprocess phase.

It can be concluded that sound bases for the pre-process and analysis phases of the software have been laid. However, future research is required to develop the postprocess and verification phases of the research project.

Online Access: Free

Resource Link

http://tesi.cab.unipd.it/49750/1/Tesi_D'Aronco_Gabriele.pdf



An Evaluation of Strength Performance of the Edge Connections between Cross-laminated Timber Panels Reinforced with Glass Fiber-reinforced Plastic

https://research.thinkwood.com/en/permalink/catalogue2424

Author:	Song, Yo-Jin
	Lee, In-Hwan
	Hong, Soon-Il
Publisher:	North Carolina State University
Year of Publication:	2019
Country of Publication:	United States
Format:	Journal Article
Material:	CLT (Cross-Laminated Timber)
Application:	Wood Building Systems
Topic:	Connections
Keywords:	Strength
	Panels
	Glass Fiber-Reinforced Plastic
	Tensile-Type Shearing Test
	Self-Tapping Screws
	Stiffness
	Larch
Language:	English
Research Status:	Complete
Series:	BioResources
Online Access:	Free

Resource Link

https://ojs.cnr.ncsu.edu/index.php/BioRes/article/view/BioRes_14_4_7719_Song_Strength_Performance_Cross_Laminated

Bending, Shear, and Compressive Properties of Three- and Five-Layer Cross-Laminated Timber Fabricated with Black Spruce

https://research.thinkwood.com/en/permalink/catalogue2589

Author:	He, Minjuan
	Sun, Xiaofeng
	Li, Zheng
	Feng, Wei
Publisher:	SpringerOpen
Year of Publication:	2020
Format:	Journal Article
Material:	CLT (Cross-Laminated Timber)

Topic:	Design and Systems
	Mechanical Properties
Keywords:	Black Spruce
	Panels
	Bending
	Thickness
Language:	English
Research Status:	Complete
Series:	Journal of Wood Science

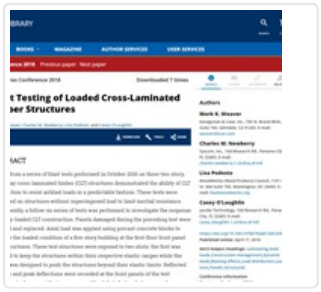
Summary:

Cross-laminated timber (CLT) is an innovative engineering wood product made by gluing layers of solid-sawn lumber at perpendicular angles. The commonly used wood species for CLT manufacturing include spruce-pine-fir (SPF), douglas fir-larch, and southern pine lumber. With the hope of broadening the wood species for CLT manufacturing, the purposes of this study include evaluating the mechanical properties of black spruce CLT and analyzing the influence of CLT thickness on its bending or shear properties. In this paper, bending, shear, and compressive tests were conducted respectively on 3-layer CLT panels with a thickness of 105 mm and on 5-layer CLT panels with a thickness of 155 mm, both of which were fabricated with No. 2-grade Canadian black spruce. Their bending or shear resisting properties as well as the failure modes were analyzed. Furthermore, comparison of mechanical properties was conducted between the black spruce CLT panels and the CLT panels fabricated with some other common wood species. Finally, for both the CLT bending panels and the CLT shear panels, their numerical models were developed and calibrated with the experimental results. For the CLT bending panels, results show that increasing the CLT thickness whilst maintaining identical span-to-thickness ratios can even slightly reduce the characteristic bending strength of the black spruce CLT. For the CLT shear panels, results show that increasing the CLT thickness whilst maintaining identical span-to-thickness ratios has little enhancement on their characteristic shear strength. For the CLT bending panels, their effective bending stiffness based on the Shear Analogy theory can be used as a more accurate prediction on their experiment-based global bending stiffness. The model of the CLT bending specimens is capable of predicting their bending properties; whereas, the model of the CLT shear specimens would underestimate their ultimate shear resisting capacity due to the absence of the rolling shear mechanism in the model, although the elastic stiffness can be predicted accurately. Overall, it is attested that the black spruce CLT can provide ideal bending or shear properties, which can be comparable to those of the CLT fabricated with other commonly used wood species. Besides, further efforts should focus on developing a numerical model that can consider the influence of the rolling shear mechanism.

Online Access: Free

Resource Link

https://jwoodscience.springeropen.com/articles/10.1186/s10086-020-01886-z



Blast Testing of Loaded Cross-Laminated Timber Structures

https://research.thinkwood.com/en/permalink/catalogue1234

Author:	Weaver, Mark
	Newberry, Charles
	Podesto, Lisa
	O'Laughlin, Casey
Organization:	Structures Congress
Publisher:	American Society of Civil Engineers
Year of Publication:	2018
Country of Publication:	United States
Format:	Conference Paper
Material:	CLT (Cross-Laminated Timber)
Application:	Wood Building Systems
Topic:	Mechanical Properties
	Design and Systems
Keywords:	Blast Tests
	Airblast Loads
	Axial Load
	Panels
	Load Distribution
	Quasi-Static
Language:	English
Conference:	Structures Conference 2018
Research Status:	Complete
Notes:	April 19–21, 2018, Fort Worth, Texas

Summary:

Results from a series of blast tests performed in October 2016 on three two-story, single-bay cross-laminated timber (CLT) structures demonstrated the ability of CLT construction to resist airblast loads in a predictable fashion. These tests were performed on structures without superimposed load to limit inertial resistance. Subsequently, a follow-on series of tests...

Online Access:	Payment Required

Resource Link

https://doi.org/10.1061/9780784481349.039

Bonding Strength Test Method Assessment for Cross-Laminated Timber Derived Stressed-Skin Panels (CLT SSP)

https://research.thinkwood.com/en/permalink/catalogue1404

Author:	Luengo, Emilio
	Hermoso, Eva
	Cabrero, Juan Carlos
	Arriaga, Francisco
Publisher:	Springer Netherlands
Year of Publication:	2017
Country of Publication:	Netherlands
Format:	Journal Article
Material:	CLT (Cross-Laminated Timber)
Topic:	Mechanical Properties
Keywords:	Stressed-Skin Panels
	Shear Strength
	Glue Lines
	Shear Tests
	Bending Tests
	Bonding
Language:	English
Research Status:	Complete
Series:	Materials and Structures
ISSN:	1871-6873
Online Access:	Free

Resource Link

https://www.researchgate.net/profile/Eva_Hermoso/publication/318641605_Bonding_strength_test_method_assessment_for_Cross-Laminated_Timber_Derived_Stressed-Skin_Panels_CLT_SSP/links/59dc790aaca2728e201f79a9/Bonding-strength-test-method-assessment-for-Cross-Laminated-Timber-Derived-Stressed-Skin-Panels-CLT-SSP.pdf

Checking in CLT Panels: An Exploratory Study

https://research.thinkwood.com/en/permalink/catalogue2625

Author:	Casilla, Romulo
	Lum, Conroy
	Pirvu, Ciprian
	Wang, Brad
Organization:	FPInnovations
Year of Publication:	2011
Country of Publication:	Canada
Format:	Report
Material:	CLT (Cross-Laminated Timber)
Topic:	Moisture
Keywords:	Panels
	Testing Methods
	Surface Checks
	Moisture Content
	Gaps
Language:	English
Research Status:	Complete

Summary:

A study was conducted with the primary objective of gathering information for the development of a protocol for evaluating the surface quality of cross-laminated timber (CLT) products. The secondary objectives were to examine the effect of moisture content (MC) reduction on the development of surface checks and gaps, and find ways of minimizing the checking problems in CLT panels. The wood materials used for the CLT samples were rough-sawn Select grade Hem-Fir boards 25 x 152 mm (1 x 6 inches). Polyurethane was the adhesive used. The development of checks and gaps were evaluated after drying at two temperature levels at ambient relative humidity (RH).

The checks and gaps, as a result of drying to 6% to 10% MC from an initial MC of 13%, occurred randomly depending upon the characteristics of the wood and the manner in which the outer laminas were laid up in the panel. Suggestions are made for minimizing checking and gap problems in CLT panels. The checks and gaps close when the panels are exposed to higher humidity.

Guidelines were proposed for the development of a protocol for classifying CLT panels into appearance grades in terms of the severity of checks and gaps. The grades can be based on the estimated dimensions of the checks and gaps, their frequency, and the number of laminas in which they appear.

Online Access: Free

Resource Link

https://library.fpinnovations.ca/en/permalink/fpipub2772

Commentary on Closure Penetration Tests on CLT Fire Separations

https://research.thinkwood.com/en/permalink/catalogue2602

Author:	Lum, Conroy
	Thomas, Tony
Organization:	FPInnovations
Year of Publication:	2017
Country of Publication:	Canada
Format:	Report
Material:	CLT (Cross-Laminated Timber)
Application:	Walls
Topic:	Fire
	Design and Systems
Keywords:	Fire Resistance
	Fire Tests
	Panels
Language:	English
Research Status:	Complete

Summary:

Fire tests on a double egress fire door installed in two Cross Laminated Timber (CLT) wall panels were conducted. The purpose of the testing was to identify design consideration for detailing the interface between a 90 min. listed door assembly and a CLT wall with a 2-hr fire resistance. See also QAI Laboratories test reports: T895-6a Rev.2, and T895-6b Rev. 1

Online Access:	Free

Resource Link

https://library.fpinnovations.ca/en/permalink/fpipub7306

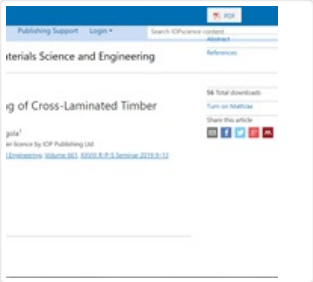
Comparison of Bending Stiffness of Cross-Laminated Solid Timber Derived by Modal Analysis of Full Panels and by Bending Tests of Strip-Shaped Specimens

https://research.thinkwood.com/en/permalink/catalogue445

Author:	Steiger, René
	Gülzow, Arne
	Czaderski, Christoph
	Howald, Martin
	Niemz, Peter
Publisher:	Springer-Verlag
Year of Publication:	2012
Country of Publication:	Germany
Format:	Journal Article
Material:	CLT (Cross-Laminated Timber)
Topic:	Mechanical Properties
Keywords:	Elastic Properties
	Stiffness Properties
	Bending Test
	Bending Stiffness
	Panels
Language:	English
Research Status:	Complete
Series:	European Journal of Wood and Wood Products
ISSN:	1436-736X
Online Access:	Free

Resource Link

http://doc.rero.ch/record/310855/files/107_2011_Article_521.pdf



Computational Modelling of Cross-Laminated Timber Panels

https://research.thinkwood.com/en/permalink/catalogue2421

Author:	Gilewski, Wojciech
	Glegola, Aleksander
Publisher:	IOP Publishing Ltd
Year of Publication:	2019
Format:	Journal Article
Material:	CLT (Cross-Laminated Timber)
Application:	Wood Building Systems
	Walls
	Floors
Topic:	Design and Systems
Keywords:	Panels
	Qualitative Analysis
	Quantitative Analysis
	Orthotropic Laminated Plate Theory
	Abaqus
Language:	English
Research Status:	Complete
Series:	IOP Conference Series: Materials Science and Engineering
Online Access:	Free

Resource Link

https://iopscience.iop.org/article/10.1088/1757-899X/661/1/012063/meta