Integrating Cross-Laminated Timber Panels to Construct Buildings To 20 Levels

https://research.thinkwood.com/en/permalink/catalogue456

Author:	Chapman, John
Year of Publication:	2014
Country of Publication:	Canada
Format:	Conference Paper
Material:	CLT (Cross-Laminated Timber)
Application:	Wood Building Systems
Topic:	Design and Systems
Keywords:	Multi-Storey Integrated Elements
Language:	English
Conference:	World Conference on Timber Engineering
Research Status:	Complete
Notes:	August 10-14, 2014, Quebec City, Canada

Summary:

A worldwide interest in timber multi-storey buildings is expected due to the environmental advantages of timber construction when compared to buildings in concrete and steel. Cross-laminated Timber, or CLT, was developed in the early 1990's and glues and clamps timber planks in alternate layers to form large panels. The cross-laminating ensures reliable strength and stability. CLT construction has been used successfully for the nine storey Murray Grove Stadhaus building in London and the ten storey Forte building in Melbourne [1]. The paper proposes a new type of structural system that utilises CLT for buildings to twenty levels.
The floor plan with a central rectangular core and columns at the perimeter is similar to a typical RC commercial building. There are considerably more open spaces than for existing CLT multi-level buildings which rely on multiple shear walls.

Online Access: Free

Resource Link

http://schd.ws/hosted_files/wcte2014/ed/ABS392_Chapman_web.pdf

Nested Buildings: An Innovative Strategy for the Integrated Seismic and Energy Retrofit of Existing Masonry Buildings with CLT Panels

https://research.thinkwood.com/en/permalink/catalogue2770

Author:	Valluzzi, Maria Rosa
	Saler, Elisa
	Vignato, Alberto
	Salvalaggio, Matteo
	Croatto, Giorgio
	Dorigatti, Giorgia
	Turrini, Umberto
Publisher:	MDPI
Year of Publication:	2021
Format:	Journal Article
Material:	CLT (Cross-Laminated Timber)
Application:	Hybrid Building Systems
Topic:	Design and Systems
	Seismic
Keywords:	Nested Buildings
	Seismic Retrofitting
	Energy Efficiency
	Integrated Intervention
	Built Heritage
	Masonry Buildings
	Panels
	Hybrid Structures
	Italy
Language:	English
Research Status:	Complete
Series:	Sustainability

Summary:

The Italian building heritage is aged and inadequate to the high-performance levels required nowadays in terms of energy efficiency and seismic response. Innovative techniques are generating a strong interest, especially in terms of multi-level approaches and solution optimizations. Among these, Nested Buildings, an integrated intervention approach which preserves the external existing structure and provides a new structural system inside, aim at improving both energy and structural performances. The research presented hereinafter focuses on the strengthening of unreinforced masonry (URM) buildings with cross-laminated timber (CLT) panels, thanks to their lightweight, high stiffness, and good hygrothermal characteristics. The improvement of the hygrothermal performance was investigated through a 2D-model analyzed in the dynamic regime, which showed a general decreasing in the overall thermal transmittance for the retrofitted configurations. Then, to evaluate the seismic behavior of the coupled system, a parametric linear static analysis was implemented for both in-plane and out-of-plane directions, considering various masonry types and connector spacings. Results showed the efficiency of the intervention to improve the in-plane response of walls, thus validating possible applications to existing URM buildings, where local overturning mechanisms are prevented by either sufficient construction details or specific solutions. View Full-Text

Online Access:	Free

Resource Link

https://doi.org/10.3390/su13031188

Integrating CLT Panels for Building Cores: Introduction, Rocking Response, & Foundation Connection Testing

https://research.thinkwood.com/en/permalink/catalogue1732

Author:	Chapman, John Ma, Quincy Pham, Viet Whitehead, Jaimie
Year of Publication:	2016
Country of Publication:	Austria
Format:	Conference Paper
Material:	CLT (Cross-Laminated Timber)
Application:	Wood Building Systems
Topic:	Seismic Design and Systems
Keywords:	High-Rise
Language:	English
Conference:	World Conference on Timber Engineering
Research Status:	Complete
Notes:	August 22-25, 2016, Vienna, Austria p. 4764-4773

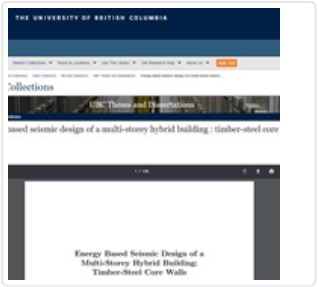
Summary:

This research involves testing for a new structural system based on CLT (cross-laminated timber) panels to provide taller, economical and more useful timber high-rise buildings. The point of difference of the system compared to recently constructed CLT high-rise buildings is a central core which is comprised of...

Online Access: Free

Resource Link

http://hdl.handle.net/20.500.12708/172



Energy Based Seismic Design of a Multi-Storey Hybrid Building: Timber-Steel Core Walls

https://research.thinkwood.com/en/permalink/catalogue1271

Author:	Goertz, Caleb
Organization:	University of British Columbia
Year of Publication:	2016
Country of Publication:	Canada
Format:	Thesis
Material:	CLT (Cross-Laminated Timber)
Application:	Hybrid Building Systems
Topic:	Seismic
	Design and Systems
Keywords:	Timber-Steel Hybrid
	Core Walls
	Multi-Storey
	High Seismic Regions
	Steel Plates
	Equivalent Static Force Procedure
	Nonlinear Time History Analysis
Language:	English
Research Status:	Complete

Summary:

This thesis discusses a novel timber-steel core wall system for use in multi-storey buildings in high seismic regions. This hybrid system combines Cross Laminated Timber (CLT) panels with steel plates and connections to provide the required strength and ductility to core walled buildings. The system is first derived from first principles and validated in SAP2000. In order to assess the feasibility of the system it is implemented in the design of a 7-storey building based off an already built concrete benchmark building. The design is carried out following the equivalent static force procedure (ESFP) outlined by the National Building Code of Canada for Vancouver, BC. To evaluate the design bi-directional nonlinear time history analysis (NLTHA) is carried out on the building using a set of 10 ground motions based on a conditional mean spectrum. To improve the applicability of the hybrid system an energy based design methodology is proposed to design the timber-core walled building. The methodology is proposed as it does not rely on empirical formulas and force modification factors to determine the final design of the structure. NLTHA is carried out on the proposed methodology using 10 ground motions to evaluate the suitability of the method and the results are discussed and compared to the ESFP results.

Online Access: Free

Resource Link

http://doi.org/10.14288/1.0228625

Performance Evaluation of Multi-Storey Cross-Laminated Timber Structures Under Different Earthquake Hazard Levels

https://research.thinkwood.com/en/permalink/catalogue1384

Author:	Sun, Xiaofeng
	He, Minjuan
	Li, Zheng
	Shu, Zhan
Publisher:	Springer Japan
Year of Publication:	2018
Country of Publication:	Japan
Format:	Journal Article
Material:	CLT (Cross-Laminated Timber)
Application:	Wood Building Systems
	Shear Walls
Topic:	Design and Systems
Keywords:	Equivalent Static Force Procedure
	Multi-Storey
	Seismic Performance
	Lateral Load Resisting System
	Inter-Story Drift
	Pinching4 Model
	Numerical Model
	Probability of Non-Exceedance
	Empirical Cumulative Distribution Functions
Language:	English
Research Status:	Complete
Series:	Journal of Wood Science
ISSN:	1611-4663

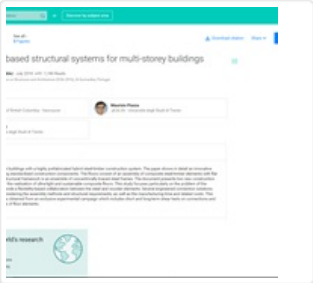
Summary:

The inter-storey drift limitations are meaningful reference values for structural seismic performance evaluation. This paper presents an analytical investigation into the seismic performance of multi-storey cross-laminated timber (CLT) structures to obtain the drift limitations under different earthquake hazard levels reasonably. The Pinching4 model was used to simulate the nonlinear mechanical behavior of three types of connections used in CLT structures, and a numerical model was further developed to capture the lateral load-resisting properties of CLT shear walls. Moreover, three benchmark multi-storey CLT apartment buildings were designed using the Equivalent Static Force Procedure according to National Building Code of Canada (NBCC), and simplified structural models were developed for these buildings. Depending on the results from numerous time-history dynamic analyses, the empirical cumulative distribution functions (CDFs) of the maximum inter-storey drifts were constructed for the three benchmark buildings. The probability of non-exceedance (PNE) of inter-storey drift thresholds under different earthquake hazard levels was proposed and validated. It is recommended that for low-rise CLT buildings within three stories, values of 0.30%, 0.75%, and 1.40% can be considered as the drift limitations for frequent, medium, and rare seismic hazard levels, respectively. For mid-rise or high-rise buildings without three stories, 0.25%, 0.70%, and 1.30% can be considered as drift limitations.

Online Access:	Free

Resource Link

https://doi.org/10.1007/s10086-017-1667-7



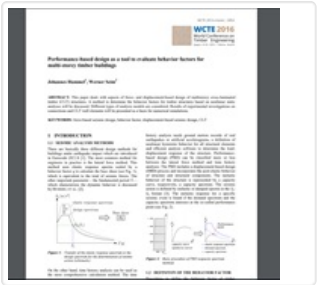
Hybrid Wood-Based Structural System for Multi-Storey Buildings

https://research.thinkwood.com/en/permalink/catalogue1894

Author:	Loss, Cristiano
	Piazza, Maurizio
	Zandonini, Riccardo
Year of Publication:	2016
Country of Publication:	Portugal
Format:	Conference Paper
Material:	CLT (Cross-Laminated Timber)
	Steel-Timber Composite
Application:	Floors
	Frames
Topic:	Design and Systems
Keywords:	Panels
	Prefabricated
	Shear Tests
	Connections
	Bending Tests
Language:	English
Conference:	International Conference on Structures and Architecture
Research Status:	Complete
Notes:	July 27-29, Guimaraes, Portugal
Online Access:	Free

Resource Link

https://www.researchgate.net/publication/304496608_Hybrid_wood-based_structural_systems_for_multi-storey_buildings



Performance-Based Design as a Tool to Evaluate Behavior Factors for Multi-Storey Timber Buildings

https://research.thinkwood.com/en/permalink/catalogue1684

Author:	Hummel, Johannes
	Seim, Werner
Year of Publication:	2016
Country of Publication:	Austria
Format:	Conference Paper
Material:	CLT (Cross-Laminated Timber)
Application:	Walls
Topic:	Design and Systems
Keywords:	Displacement-Based Design
	Force-Based Design
	Multi-Storey
	Behaviour Factors
Language:	English
Conference:	World Conference on Timber Engineering
Research Status:	Complete
Notes:	August 22-25, 2016, Vienna, Austria p. 4086-4095

Summary:

This paper deals with aspects of force- and displacement-based design of multistorey cross-laminated timber (CLT) structures. A method to determine the behavior factors for timber structures based on nonlinear static analyses will be discussed. Different types of analysis models are considered. Results of experimental investigations on connections and CLT wall elements will be presented as a basis for numerical simulations.

Online Access: Free

Resource Link

http://hdl.handle.net/20.500.12708/172

Seismic Design of Core-Walls for Multi-Storey Timber Buildings

https://research.thinkwood.com/en/permalink/catalogue134

Author:	Dunbar, Andrew
	Pampanin, Stefano
	Palermo, Alessandro
	Buchanan, Andrew
Year of Publication:	2013
Country of Publication:	New Zealand
Format:	Conference Paper
Material:	CLT (Cross-Laminated Timber)

Application:	Shafts and Chases
Topic:	Design and Systems
	Seismic
Keywords:	Multi-Storey
	Prefabrication
	Pres-Lam
	Residential
	Quasi-Static Loading
	Energy Dissipation
	U-Shaped Flexural Plates
Language:	English
Conference:	New Zealand Society for Earthquake Engineering Conference
Research Status:	Complete
Notes:	April 26-28, 2013, Wellington, New Zealand

Summary:

This paper describes options for seismic design of pre-fabricated timber core-wall systems, used as stairwells and lift shafts for lateral load resistance in multi-storey timber buildings. The use of Cross-Laminated Timber (CLT) panels for multi-storey timber buildings is gaining popularity throughout the world, especially for residential construction. This paper describes the possible use of CLT core-walls for seismic resistance in open-plan commercial office buildings in New Zealand. Previous experimental testing at the University of Canterbury has been done on the in-plane behaviour of single and coupled Pres-Lam post-tensioned timber walls. However there has been very little research done on the behaviour of timber walls that are orthogonal to each other and no research into CLT walls in the post-tensioned Pres-Lam system. This paper describes the proposed test regime and design detailing of two half-scale twostorey CLT stairwells to be tested under a bi-directional quasi-static loading. The test specimens will include a half-flight stair case with landings within the stairwell. The “High seismic option” consists of post-tensioned CLT walls coupled with energy dissipating U-shaped Flexural Plates (UFP) attached between wall panels and square hollow section steel columns at the corner junctions. An alternative “Low seismic option” uses the same post-tensioned CLT panels, with no corner columns or UFPs. The panels will be connected by screws to provide a semi-rigid connection, allowing relative movement between the panels producing some level of energy dissipation.

Online Access:	Free

Resource Link

http://www.nzsee.org.nz/db/2013/Poster_52.pdf

Seismic Design of Core-Wall Systems for Multi-Storey Timber Buildings

https://research.thinkwood.com/en/permalink/catalogue1149

Author:	Dunbar, Andrew
Organization:	University of Canterbury
Year of Publication:	2014
Country of Publication:	New Zealand

Format:	Thesis
Material:	CLT (Cross-Laminated Timber)
Application:	Wood Building Systems
	Shafts and Chases
Topic:	Seismic
	Design and Systems
Keywords:	Post-Tensioned
	Core-Walls
	Quasi-Static
	Seismic Loading
	Multi-Storey
	U-Shaped Flexural Plates
Language:	English
Research Status:	Complete

Summary:

This thesis discusses the results of experimental tests on two post-tensioned timber core-walls, tested under bi-directional quasi-static seismic loading. The half-scale two-storey test specimens included a stair with half-flight landings. Multi-storey timber structures are becoming increasingly desirable for architects and building owners due to their aesthetic and environmental benefits. In addition, there is increasing public pressure to have low damage structural systems with minimal business interruption after a moderate to severe seismic event. Timber has been used extensively for low-rise residential structures in the past, but has been utilised much less for multi-storey structures, traditionally limited to residential type building layouts which use light timber framing and include many walls to form a lateral load resisting system. This is undesirable for multi-storey commercial buildings which need large open spaces providing building owners with versatility in their desired floor plan. The use of Cross-Laminated Timber (CLT) panels for multi-storey timber buildings is gaining popularity throughout the world, especially for residential construction. Previous experimental testing has been done on the in-plane behaviour of single and coupled post-tensioned timber walls at the University of Canterbury and elsewhere. However, there has been very little research done on the 3D behaviour of timber walls that are orthogonal to each other and no research to date into post-tensioned CLT walls. The “high seismic option” consisted of full height post-tensioned CLT walls coupled with energy dissipating U-shaped Flexural Plates (UFPs) attached at the vertical joints between coupled wall panels and between wall panels and the steel corner columns. An alternative “low seismic option” consisted of post-tensioned CLT panels connected by screws, to provide a semi-rigid connection, allowing relative movement between the panels, producing some level of frictional energy dissipation.

Online Access: Free

Resource Link

http://hdl.handle.net/10092/9047

Timber Core-Walls for Lateral Load Resistance of Multi-Storey Timber Buildings

https://research.thinkwood.com/en/permalink/catalogue1858

Author:	Dunbar, Andrew
	Moroder, Daniel
	Pampanin, Stefano
	Buchanan, Andrew
Publisher:	New Zealand Timber Design Society
Year of Publication:	2018
Country of Publication:	New Zealand
Format:	Journal Article
Material:	CLT (Cross-Laminated Timber)
Application:	Walls
Topic:	Design and Systems
	Seismic
Keywords:	Pres-Lam
	Earthquake
	Post-Tensioned
	Core-Walls
	Multi-Storey
	Panels
Language:	English
Research Status:	Complete
Series:	New Zealand Timber Design Journal
Online Access:	Free

Resource Link

http://www.timberdesign.org.nz/wp-content/uploads/2018/05/2014Vol22Iss3-Dunbar-Paper.pdf