



**Assessing Cross Laminated Timber (CLT) as an Alternative Material for Mid-Rise Residential Buildings in Cold Regions in China—A Life-Cycle Assessment Approach**

<https://research.thinkwood.com/en/permalink/catalogue1209>

Author: Liu, Ying  
 Guo, Haibo  
 Sun, Cheng  
 Chang, Wen-Shao

Publisher: MDPI

Year of Publication: 2016

Country of Publication: Switzerland

Format: Journal Article

Material: CLT (Cross-Laminated Timber)

Application: Wood Building Systems

Topic: Energy Performance

Keywords: Life-Cycle Assessment  
 Cradle-to-Grave  
 China  
 Cold Regions  
 Severe Cold Regions  
 Energy Consumption  
 Mid-Rise  
 Residential

Language: English

Research Status: Complete

Series: Sustainability

**Abstract:**

Timber building has gained more and more attention worldwide due to it being a generic renewable material and having low environmental impact. It is widely accepted that the use of timber may be able to reduce the embodied energy of a building. However, the development of timber buildings in China...

Online Access: Free

**Resource Link**

<https://doi.org/10.3390/su8101047>



## Assessment of Carbon Footprint of Laminated Veneer Lumber Elements in a Six Story Housing - Comparison to a Steel and Concrete Solution

<https://research.thinkwood.com/en/permalink/catalogue2135>

Author: Tellnes, L.G.F.  
Eide, S.  
Kristjansdottir, T.F.  
Kron, M.

Year of Publication: 2013

Country of Publication: Portugal

Format: Conference Paper

Material: LVL (Laminated Veneer Lumber)  
Glulam (Glue-Laminated Timber)

Application: Wood Building Systems  
General Application

Topic: Environmental Impact  
Design and Systems

Keywords: GHG  
Carbon Footprint  
Life-Cycle Assessment  
Concrete

Language: English

Conference: Sustainable Built Environment Portugal

Research Status: Complete

Online Access: Free

### Resource Link

[http://www.irbnet.de/daten/iconda/CIB\\_DC26479.pdf](http://www.irbnet.de/daten/iconda/CIB_DC26479.pdf)



## Brock Commons Tallwood House, University of British Columbia: An Environmental Building Declaration According to EN 15978 Standard

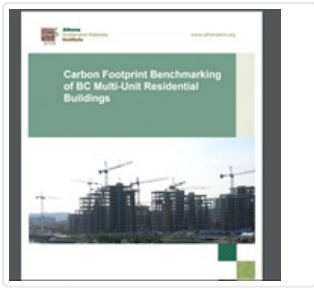
<https://research.thinkwood.com/en/permalink/catalogue2158>

Author: Bowick, Matt  
Organization: Athena Sustainable Materials Institute  
Year of Publication: 2018  
Country of Publication: Canada  
Format: Report  
Material: CLT (Cross-Laminated Timber)  
Glulam (Glue-Laminated Timber)  
Application: Hybrid Building Systems  
Topic: Environmental Impact  
Keywords: Life-Cycle Assessment  
Brock Commons  
Cradle-to-Grave  
Language: English  
Research Status: Complete  
Online Access: Free

### Resource Link

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[http://www.athenasmi.org/wp-content/uploads/2018/08/Tallwood\\_House\\_Environmental\\_Declaration\\_20180608.pdf](http://www.athenasmi.org/wp-content/uploads/2018/08/Tallwood_House_Environmental_Declaration_20180608.pdf) 



## Carbon Footprint Benchmarking of BC Multi-Unit Residential Buildings

<https://research.thinkwood.com/en/permalink/catalogue2159>

Author: Bowick, Matt  
O'Connor, Jennifer

Organization: Athena Sustainable Materials Institute

Year of Publication: 2017

Country of Publication: Canada

Format: Report

Material: Glulam (Glue-Laminated Timber)  
LVL (Laminated Veneer Lumber)  
Light Frame (Lumber+Panels)  
PSL (Parallel Strand Lumber)

Application: Hybrid Building Systems

Topic: Environmental Impact

Keywords: Carbon Footprint  
Residential Buildings  
Multi-Unit  
Embodied Carbon  
Life-Cycle Assessment  
Cradle-to-Grave

Language: English

Research Status: Complete

Online Access: Free

### Resource Link

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[http://www.athenasmi.org/wp-content/uploads/2017/09/BC\\_MURB\\_carbon\\_benchmarking\\_final\\_report.pdf](http://www.athenasmi.org/wp-content/uploads/2017/09/BC_MURB_carbon_benchmarking_final_report.pdf)

case study to investigate the life cycle carbon emissions and carbon storage capacity of a cross laminated timber, multi-storey residential building.

H. J. Darby<sup>1</sup>, A.A. Elmualim<sup>2</sup>, F. Kelly<sup>3</sup>

<sup>1</sup>Technologies for Sustainable Built Environments, University of Reading, UK  
<sup>2</sup>School of Construction Management and Engineering, University of Reading, UK  
<sup>3</sup>Pine Point Associates LLP, Reading, UK

<sup>\*</sup>Corresponding author: h.j.darby@rpgg.reading.ac.uk

#### ABSTRACT

Forests are a store of carbon and an eco-system that continually removes carbon dioxide from the atmosphere. If they are sustainably managed, the carbon store can be maintained at level, while the trees removed and converted to timber products can fix and long term carbon store. The total carbon store in the forest and associated wood products therefore increases over time, given appropriate management. This increasing store can be further enhanced with afforestation. The UK's forest area has increased since the early 1990s, although the rate of increase has declined since its peak in 1996, and it is a similar picture in the rest of Europe. The increased sustainability in construction is a key market incentive for afforestation, which can make a significant contribution to reducing carbon emissions. The case study presented in this paper states the carbon benefits of a Cross Laminated Timber (CLT) solution for a multi-storey residential building.

# A Case Study to Investigate the Life Cycle Carbon Emissions and Carbon Storage Capacity of a Cross Laminated Timber, Multi-Storey Residential Building

<https://research.thinkwood.com/en/permalink/catalogue2139>

Author: Darby, Howard  
Elmualim, Abbas  
Kelly, F.

Year of Publication: 2013

Country of Publication: Germany

Format: Conference Paper

Material: CLT (Cross-Laminated Timber)

Application: Wood Building Systems

Topic: Environmental Impact

Keywords: Embodied Carbon  
Life-Cycle Assessment  
Multi-Storey  
Multi-Family

Language: English

Conference: Sustainable Building Conference

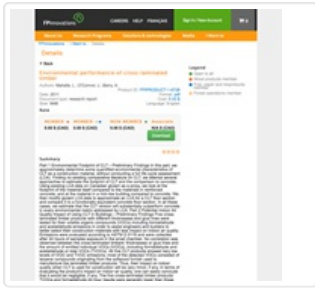
Research Status: Complete

Notes: 23-25 April 2013, Munich, Germany

Online Access: Free

## Resource Link

[http://www.reading.ac.uk/web/files/tsbe/Darby\\_TSBE\\_Conference\\_Paper\\_2012.pdf](http://www.reading.ac.uk/web/files/tsbe/Darby_TSBE_Conference_Paper_2012.pdf)



## Chapter 11: Environmental Performance of Cross-Laminated Timber

<https://research.thinkwood.com/en/permalink/catalogue817>

Author: Mahalle, Lal  
O'Connor, Jennifer  
Barry, Alpha

Organization: FPInnovations

Year of Publication: 2011

Country of Publication: Canada

Format: Book Section

Material: CLT (Cross-Laminated Timber)

Application: General Application  
Floors

Topic: Environmental Impact

Keywords: Concrete  
Floors  
Life-Cycle Assessment  
Volatile Organic Compounds  
Environmental Footprint  
Indoor Air Quality

Language: English

Research Status: Complete

Series: CLT Handbook - Canadian Edition

Notes: Report is currently not available due to the redevelopment of FPInnovations' publications website.

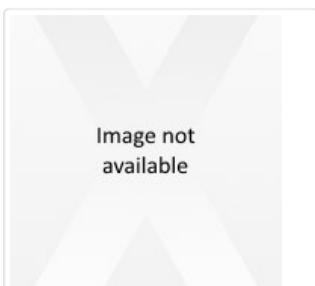
### Abstract:

Part 1 Environmental Footprint of CLT – Preliminary Findings In this part, we approximately determine some quantified environmental characteristics of CLT as a construction material, without conducting a full life cycle assessment (LCA). Finding no exi...

Online Access: Free

### Resource Link

<https://fpinnovations.ca/Extranet/Pages/AssetDetails.aspx?item=/Extranet/Assets/ResearchReportsWP/E4850.pdf#.Wmtt13anGUK>



## Chapter 11: Environmental Performance of Cross-Laminated Timber

<https://research.thinkwood.com/en/permalink/catalogue830>

Author: O'Connor, Jennifer  
Podesto, Lisa  
Barry, Alpha  
Grann, Blane

Organization: FPInnovations  
Binational Softwood Lumber Council

Year of Publication: 2013  
Country of Publication: Canada  
Publication: United States  
Format: Book Section  
Material: CLT (Cross-Laminated Timber)  
Application: General Application  
Topic: Environmental Impact  
Keywords: Life-Cycle Assessment  
Mid-Rise  
Volatile Organic Compounds  
Environmental Footprint  
North America  
Sustainable Forest Practices  
Indoor Air Quality  
Language: English  
Research Status: Complete  
Series: CLT Handbook - US Edition

**Abstract:**

The environmental footprint of CLT is frequently discussed as potentially beneficial when compared to functionally equivalent non-wood alternatives, particularly concrete systems. In this Chapter, the role of CLT in sustainable design is addressed. The embodied environmental impacts of CLT in a mid-rise building are discussed, with preliminary results from a comprehensive life cycle assessment (LCA) study. We also discuss other aspects of CLT's environmental profile, including impact on the forest resource and impact on indoor air quality from CLT emissions. The ability of the North American forest to sustainably support a CLT industry is an important consideration and is assessed from several angles, including a companion discussion regarding efficient use of material. Market projections and forest growth-removal are applied to reach a clear conclusion that CLT will not create a challenge to the sustainable forest practices currently in place in North America and safeguarded through legislation and/or third party certification programs. To assess potential impact on indoor air quality, CLT products with different thicknesses and glue lines were tested for their volatile organic compounds (VOCs) including formaldehyde and acetaldehyde emissions. CLT was found to be in compliance with European labeling programs as well as the most stringent CARB limits for formaldehyde emissions. Testing was done on Canadian species, as there was no U.S. supplier of CLT at the time of this writing; because VOC emissions are affected by species, this work should be repeated from products made from different species.

Online Access: Free

**Resource Link**

<https://info.thinkwood.com/clt-handbook> 

**A Comparative Cradle-To-Gate Life Cycle Assessment of Mid-Rise Office Building Construction Alternatives: Laminated Timber or Reinforced Concrete**

<https://research.thinkwood.com/en/permalink/catalogue52>



Author: Robertson, Adam  
Lam, Frank  
Cole, Raymond

Publisher: MDPI

Year of Publication: 2012

Country of Publication: Switzerland

Format: Journal Article

Material: CLT (Cross-Laminated Timber)  
Glulam (Glue-Laminated Timber)

Application: General Application

Topic: Energy Performance  
Environmental Impact

Keywords: Concrete  
Embodied Carbon  
Life-Cycle Assessment  
Mid-Rise  
National Building Code of Canada  
NBCC  
North America  
Office Buildings

Language: English

Research Status: Complete

Series: Buildings

ISSN: 2075-5309

**Abstract:**

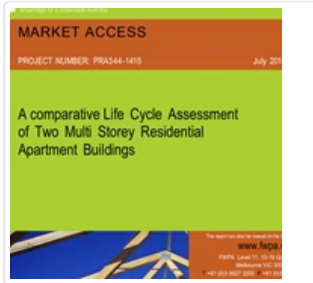
The objective of this project was to quantify and compare the environmental impacts associated with alternative designs for a typical North American mid-rise office building. Two scenarios were considered; a traditional cast-in-place, reinforced concrete frame and a laminated timber hybrid design, which utilized engineered wood products (cross-laminated timber (CLT) and glulam). The boundary of the quantitative analysis was cradle-to-construction site gate and encompassed the structural support system and the building enclosure. Floor plans, elevations, material quantities, and structural loads associated with a five-storey concrete-framed building design were obtained from issued-for-construction drawings. A functionally equivalent, laminated timber hybrid design was conceived, based on Canadian Building Code requirements. Design values for locally produced CLT panels were established from in-house material testing. Primary data collected from a pilot-scale manufacturing facility was used to develop the life cycle inventory for CLT, whereas secondary sources were referenced for other construction materials. The TRACI characterization methodology was employed to translate inventory flows into impact indicators. The results indicated that the laminated timber building design offered a lower environmental impact in 10 of 11 assessment categories. The cradle-to-gate process energy was found to be nearly identical in both design scenarios (3.5 GJ/m<sup>2</sup>), whereas the cumulative embodied energy (feedstock plus process) of construction materials was estimated to be 8.2 and 4.6 GJ/m<sup>2</sup> for the timber and concrete designs, respectively; which indicated an increased availability of readily accessible potential energy stored within the building materials of the timber alternative.

Online Access: Free

**Resource Link**

<https://doi.org/10.3390/buildings2030245>





## A Comparative Life Cycle Assessment of Two Multi Storey Residential Apartment Buildings

<https://research.thinkwood.com/en/permalink/catalogue403>

Author: Carre, Andrew  
Crossin, Enda

Organization: Forest and Wood Products Australia

Year of Publication: 2015

Country of Publication: Australia

Format: Report

Material: Light Frame (Lumber+Panels)

Application: Wood Building Systems

Topic: Environmental Impact  
Energy Performance

Keywords: Australia  
Life-Cycle Assessment  
Multi-Storey  
Residential  
Concrete

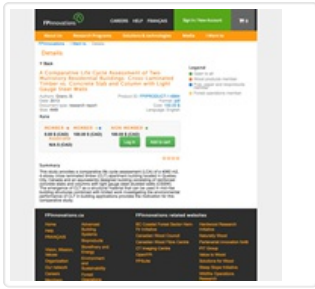
Language: English

Research Status: Complete

Online Access: Free

### Resource Link

<http://www.fwpa.com.au/images/marketaccess/PRA344-1415-Australand.pdf>



## A Comparative Life Cycle Assessment of Two Multistory Residential Buildings: Cross-Laminated Timber Vs. Concrete Slab and Column with Light Gauge Steel Walls

<https://research.thinkwood.com/en/permalink/catalogue339>

Author: Grann, Blane  
Organization: FPInnovations  
Year of Publication: 2013  
Country of Publication: Canada  
Format: Report  
Material: CLT (Cross-Laminated Timber)  
Application: Wood Building Systems  
Topic: Environmental Impact  
Keywords: Concrete  
Life-Cycle Assessment  
Mid-Rise  
Steel  
Canada  
Language: English  
Research Status: Complete  
Notes: Report is currently not available due to the redevelopment of FPInnovations' publications website.

### Abstract:

This study provides a comparative life cycle assessment (LCA) of a 4060 m<sup>2</sup>, 4-storey cross laminated timber (CLT) apartment building located in Quebec City, Canada and an equivalently designed building consisting of reinforced concrete slabs and columns with light gauge steel studded walls (CSSW)...

Online Access: Payment Required

### Resource Link

<https://fpinnovations.ca/Extranet/Pages/AssetDetails.aspx?item=/Extranet/Assets/ResearchReportsWP/3062.pdf>