

## An Application of the CEN/TC350 Standards to an Energy and Carbon LCA of Timber Used in Construction, and the Effect of End-of-Life Scenarios

<https://research.thinkwood.com/en/permalink/catalogue2376>

Author: Symons, Katie  
Moncaster, Alice  
Symons, Digby

Year of Publication: 2013

Country of Publication: United Kingdom

Format: Conference Paper

Material: CLT (Cross-Laminated Timber)

Application: Wood Building Systems

Topic: Energy Performance

Keywords: Embodied Carbon  
Life-Cycle Assessment  
Built Environment  
End of Life  
LCA  
Europe

Language: English

Conference: Australian Life Cycle Assessment Society conference

Research Status: Complete

### Summary:

The use of timber construction products and their environmental impacts is growing in Europe. This paper examines the LCA approach adopted in the European CEN/TC350 standards, which are expected to improve the comparability and availability of Environmental Product Declarations (EPDs). The embodied energy and carbon (EE and EC) of timber products is discussed quantitatively, with a case study of the Forte building illustrating the significance of End-of-Life (EoL) impacts. The relative importance of timber in the context of all construction materials is analysed using a new LCA tool, Butterfly. The tool calculates EE and EC at each life cycle stage, and results show that timber products are likely to account for the bulk of the EoL impacts for a typical UK domestic building.

Online Access: Free

### Resource Link

[https://www.researchgate.net/profile/Alice\\_Moncaster/publication/260122306\\_An\\_Application\\_of\\_the\\_CENTC350\\_standards\\_to\\_an\\_Energy\\_and\\_Carbon\\_LCA\\_of\\_timber\\_used\\_in\\_construction\\_and\\_the\\_effect\\_of\\_end-of-life\\_scenarios/links/559a5d7308ae793d13808ffd/An-Application-of-the-CEN-TC350-standards-to-an-Energy-and-Carbon-LCA-of-timber-used-in-construction-and-the-effect-of-end-of-life-scenarios.pdf](https://www.researchgate.net/profile/Alice_Moncaster/publication/260122306_An_Application_of_the_CENTC350_standards_to_an_Energy_and_Carbon_LCA_of_timber_used_in_construction_and_the_effect_of_end-of-life_scenarios/links/559a5d7308ae793d13808ffd/An-Application-of-the-CEN-TC350-standards-to-an-Energy-and-Carbon-LCA-of-timber-used-in-construction-and-the-effect-of-end-of-life-scenarios.pdf)

## 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

**Summary:**

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 is not as rapid as in some other countries. This may be because of the limitations of building regulations and technological development. Several new policies have been or are being implemented in China in order to encourage the use of timber in building construction and this could lead to a revolutionary change in the building industry in China. This paper is the first one to examine the feasibility of using Cross Laminated Timber (CLT) as an alternative solution to concrete by means of a cradle-to-grave life-cycle assessment in China. A seven-storey reference concrete building in Xi'an was selected as a case study in comparison with a redesigned CLT building. Two cities in China, in cold and severe cold regions (Xi'an and Harbin), were selected for this research. The assessment includes three different stages of the life span of a building: materialisation, operation, and end-of-life. The inventory data used in the materialisation stage was mostly local, in order to ensure that the assessment appropriately reflects the situation in China. Energy consumption in the operation stage was obtained from simulation by commercialised software IESTM, and different scenarios for recycling of timber material in the end-of-life are discussed in this paper. The results from this paper show that using CLT to replace conventional carbon intensive material would reduce energy consumption by more than 30% and reduce CO<sub>2</sub> emission by more than 40% in both cities. This paper supports, and has shown the potential of, CLT being used in cold regions with proper detailing to minimise environmental impact.

Online Access: Free

**Resource Link**

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



## Assessing Life-Cycle Environmental Impacts of CLT Mass Timber Buildings in the U.S. Northeast Region

<https://research.thinkwood.com/en/permalink/catalogue2535>

Organization: Forest Products Laboratory  
The Nature Conservancy  
University of Washington  
Consortium for Research on Renewable Industrial Materials  
Atelierjones

Country of Publication: United States

Material: CLT (Cross-Laminated Timber)

Topic: Environmental Impact

Keywords: Life-Cycle Assessment  
GHG emission reduction

Research Status: In Progress

Notes: Project contact is Hongmei Gu at the Forest Products Laboratory

### Summary:

The FPL team is in charge of developing a full comparative LCA study for three multiple-story mass timber buildings and their concrete alternatives in the U.S. Northeast region, with Boston as the point location. Using these three comparative LCAs, this research will determine the GHG emissions reduction potential from mass timber use in the building sector for the U.S. region. This may increase potential for growth in wood utilization, timber harvest, and forest management practices through the market demands.

### Resource Link

<https://www.fpl.fs.fed.us/documnts/rips/fplrip-4851-023-NatureConservancy-Wishnie-Gu.pdf>



## 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, Lars  
Eide, S.  
Kristjansdottir, Torhildur  
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

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

---

[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) 



## Building Affordable Housing with Mass Timber

<https://research.thinkwood.com/en/permalink/catalogue2783>

Organization: Sustainable Northwest  
Hacienda Community Development Group

Country of Publication: United States

Application: Wood Building Systems

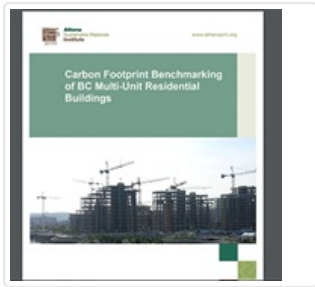
Topic: Market and Adoption

Keywords: Mass Timber  
Residential Buildings  
Life Cycle Analysis  
Project Financing  
Affordable Housing

Research Status: In Progress

### Summary:

Sustainable Northwest (SNW) and Hacienda Community Development Group (HCDC), both based in Oregon, have proposed a plan to demonstrate pathways for building affordable housing with regionally sourced mass timber. In response to the region's housing shortage, the partners' proposal demonstrates the use of mass timber products while supporting efforts to educate stakeholders on wood product companies and forest restoration. The project outlines a plan to explore financing options, build one or more prototypes, and perform a structural material life cycle analysis.



## 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

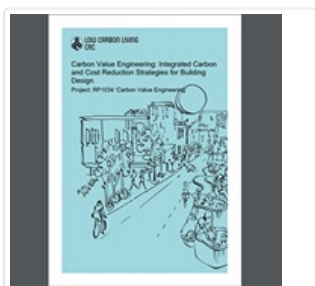
Language: English

Research Status: Complete

Online Access: Free

### Resource Link

[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)



## Carbon Value Engineering: Integrated Carbon and Cost Reduction Strategies for Building Design

<https://research.thinkwood.com/en/permalink/catalogue2268>

Author: Robati, Mehdi  
Oldfield, Philip F.  
Nezhad, Ali Akbar  
Carmichael, David

Organization: UNSW Sydney  
Multiplex Australasia

Publisher: Cooperative Research for Low Carbon Living

Year of Publication: 2019



Country of Publication: Australia

Format: Report

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

Application: Floors  
Walls  
Beams

Topic: Environmental Impact  
Cost

Keywords: Value Engineering  
Embodied Carbon  
Hybrid Life Cycle Assessment  
Capital Cost  
Environmentally-extended Input-Output Analysis

Language: English

Research Status: Complete

Summary:

The research presents a Carbon Value Engineering framework. This is a quantitative value analysis method, which not only estimates cost but also considers the carbon impact of alternative design solutions. It is primarily concerned with reducing cost and carbon impacts of developed design projects; that is, projects where the design is already a completed to a stage where a Bill of Quantity (BoQ) is available, material quantities are known, and technical understanding of the building is developed.

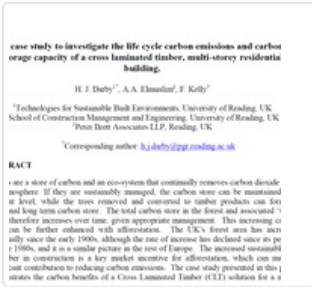
This research demonstrates that adopting this integrated carbon and cost method was able to reduce embodied carbon emissions by 63-267 kgCO<sub>2</sub>-e/m<sup>2</sup> (8-36%) when maintaining a concrete frame, and 72-427 kgCO<sub>2</sub>-e/m<sup>2</sup> (10-57%) when switching to a more novel whole timber frame. With a GFA of 43,229 m<sup>2</sup> these savings equate to an overall reduction of embodied carbon in the order of 2,723 – 18,459 tonnes of CO<sub>2</sub>-e. Costs savings for both alternatives were in the order of \$127/m<sup>2</sup> which equates to a 10% reduction in capital cost.

For comparison purposes the case study was also tested with a high-performance façade. This reduced lifecycle carbon emissions in the order of 255 kgCO<sub>2</sub>-e/m<sup>2</sup>, over 50 years, but at an additional capital cost, due to the extra materials. What this means is strategies to reduce embodied carbon even late in the design stage can provide carbon savings comparable, and even greater than, more traditional strategies to reduce operational emissions over a building's effective life.

Online Access: Free

**Resource Link**

<http://www.lowcarbonlivingcrc.com.au/resources/crc-publications/crcicl-project-reports/rp1034-carbon-value-engineering-integrated-carbon>



## 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)



## 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)

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

Summary:

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> 