Timber within the Built Environment on College Campuses

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Executive Summary

Although the concept of building with wood is not new, mass timber offers a modern take on wooden construction. As a sustainable construction approach, mass timber utilizes the only renewable building material, wood, for structural components. Through employing engineered wood products, mass timber has proven itself to be competitive with other construction materials, such as steel and concrete on many fronts. In terms of fire and structural performance, mass timber meets all standards set by the International Building Code. Additionally, there are a host of benefits where mass timber sets itself apart. From environmental sustainability and health benefits to aesthetic and marketability value, mass timber is versatile in its applications and uses. College campuses offer a unique environment in which to capitalize on these features. As an increasing number of institutions of higher education embrace mass timber, its multifaceted nature and appeal are being realized.

This report provides an overview of current campus-based mass timber projects, highlighting select examples from North America. As a highly versatile product with distinct environmental benefits, colleges and universities can utilize this building technology to showcase their commitment to sustainability and generate interest and drive traffic to their campuses.

***Brock Commons**, located on the University of British Columbia campus, is an 18-story residential hall featuring hybrid mass timber technology.*

Photo credit: Steven Errico Photography, 2017

Introduction

Following development in Europe, mass timber[1] has started to break into US markets as more architects and engineers in North America explore its potential. Referring generally to buildings where large structural elements are composed of wood, as opposed to steel and concrete, mass timber represents a growing development in the construction industry. Mass timber is set apart from traditional wood construction due to advancements in engineered wood products. Multiple pieces of wood are chemically or mechanically attached, increasing their size and strength. These enhanced wood products are allowing wooden construction to compete with traditional construction materials and reach previously unimaginable heights.

Mass timber offers a dynamic solution to several growing concerns. Recent declines in domestic wood product demand have coincided with an increase in forest health problems, including increased wildfire risk. Mass timber provides a growing market for innovative timber products and supports expanded forest management and restoration. A common misconception holds that increased timber harvests and forest product production lead to deforestation and therefore is an environmental detriment. However, many North American forests respond well to responsible management activities and can emerge healthier[2] and other co-benefits to wildlife habitat, water quality, and wildfire risk reduction.

To learn more about how a properly managed forest brings mutual benefit of renewable forest products and improved forest health, view this webinar led by Kathryn Fernholz, Dovetail Partners President & CEO: https://vimeo.com/447847297

A common concern with wooden structures is the risk of fire, however, extensive testing[3] has shown that mass timber not only has inherent fire resistance,[4] but can offer adequate fire protection. Exposed wood will form an external layer of char in the event of fire, which allows it to burn predictably for an extended period of time while still maintaining its structural integrity.

Mass Timber Products

These innovative wood products are supported and enhanced with strategic uses of steel and concrete to create beautifully unique and environmentally conscious mass timber structures.

Cross-Laminated Timber (interior and exterior use: walls, floors, roofs): CLT consists of layering sets of wood boards, typically three, five, or seven layers. Each layer is set at a 90-degree angle to each other and secured with glue. CLT's strength and building applications have allowed for an increase in structures' height capabilities as well as growth in mass timber's popularity.

Glued-Laminated Timber (interior and exterior use: beams and columns): made from pieces of wood glued together with the grain running parallel, creates columns and beams with strength and versatility. The strength of glulam beams allows them to provide support over long structural spans.

Nail-Laminated Timber (interior and exterior use: floors, walls, roofs and decking, stair shafts): NLT is created from multiple pieces of dimensional lumber nailed together, creating strong structural elements. Plywood sheathing can be added along one side to allow for use in wall applications.

Dowel-Laminated Timber (interior and exterior use: floors, walls, and roofs): DLT maximizes wood use, using wooden dowels as fasteners and no adhesives. The wooden dowels are inserted into stacked softwood lumber panels.

Photos courtesy of WoodWorks, Wood Products Council: Design Tips for Mass Timber – https://www.woodworks.org/wp-content/uploads/presentation_slides-HARVEY-Mass-Timber-Overview-Virtual-CM-WS-200819.pdf.

Additional product resources found at ThinkWood – https://www.thinkwood.com/mass-timber.

The production of mass timber products is associated with lower emissions and environmental costs than those of other construction materials, allowing wood buildings to have lower embodied energy. Constructed out of wood, which is approximately 50% carbon by dry weight, mass timber buildings store large amounts of carbon, a notable benefit as society looks for ways to sequester carbon.

Life Cycle Assessment

Life cycle assessment (LCA) is a proven method for analyzing the comprehensive impact a product or material has on the environment. This concept is explained further in the report, A Review of Life Cycle Assessment Tools:[5]

"Sometimes referred to as 'cradle to grave' analysis, LCA provides a mechanism for systematically evaluating the environmental impacts linked to a product or process and in guiding process or product improvement efforts. LCA-based information also provides insights into the environmental impacts of raw material and product choices, and maintenance and end-of-product-life strategies. Because of the systematic nature of LCA and its power as an evaluative tool, the use of LCA is increasing as environmental performance becomes more and more important in society."

LCAs can be used to provide data-based evidence supporting the positive environmental benefits inherent in mass timber structures. Composed of four parts; goal and scope definition, life cycle inventory, life cycle impact assessment, and interpretation, an LCA offers a comprehensive study on how a building will interact with the natural environment.

Additional resources on LCAs, tools, applications, and case studies:

- A review of Life Cycle Assessment Tools
- Life Cycle Cost Analysis of Non-Residential Buildings[6]
- Athena Sustainable Materials Institute[7]

The Case for Mass Timber

Through a campus perspective, the environmental performance of mass timber[8] buildings alone make it a valuable innovation. As the urgency of the climate challenge grows, colleges are increasingly important places to equip their students with the tools and knowledge to address climate change. Mass timber offers a natural climate solution through storing carbon while promoting improved forest management. Mass timber buildings provide students with a living lab to learn about and engage with tools to approach climate change.

In addition to environmental benefits, mass timber buildings offer a host of unique positive features. Due to the prefabrication of mass timber products, such as CLT panels, and the modular construction approach, mass timber buildings offer impressive cost and time savings[9] during construction. In many regions, labor availability has been a limiting factor in construction and mass timber building can frequently use smaller crews to complete structures along with a shorter timeline.

Beyond favorable environmental and financial costs, mass timber offers unparalleled aesthetic value. Through the exposed wood allowed by mass timber, a warmth and natural atmosphere is created. In addition to the aesthetic value, wood buildings have been shown to provide health and wellness benefits[10] to occupants, such as lowering stress levels.

Mass timber structures on campus[11] are a strong marketing asset[12], as signaled by the US Forest Service's 2019 University Grant Program[13]. As institutions of higher education across the country strive to stay competitive, mass timber has the potential to set a campus distinctly apart. Being a physical testament of the school's commitment to sustainability, mass timber structures send a clear message to prospective students about what campus culture they could enter. Campus projects have shown mass timber to be highly versatile, producing a variety of structures and functions, including student residence halls, laboratories, athletic facilities, academic buildings and more.

Institutions across the country are choosing to include mass timber structures on their campuses for a myriad of reasons. They offer construction and environmental cost savings, a unique draw for prospective students and drive for visitor traffic, and a natural climate change mitigation solution that doubles as an educational strategy. As institutions strive to innovate and stay competitive, mass timber provides a dynamic approach to the future of college campuses.

Calculate carbon storage potential of mass timber projects through the Carbon Calculator[14], hosted by WoodWorks

Campus-Based Mass Timber Case Studies

Adohi Hall, University of Arkansas

Adohi Hall, completed in 2019, is currently one of the largest mass timber buildings in the U.S. Adohi Hall serves as a living-learning environment for the university campus and includes student housing and learning space, as well as community and gathering spaces. The building is in tune with its surroundings, drawing design inspiration from the natural environment around it. The name Adohi was chosen as a tribute to the Tribe who traveled near the site along the Trail of Tears, meaning "woods" in Cherokee. Mass timber allows buildings such as Adohi Hall to make an intentional and unique connection to the land on which the building is situated. Learn more at: https://www.woodworks.org/project/adohi-hall/.

Volume of wood products used: 4,100 m^3

U.S. and Canadian forests grow this much wood every **11 minutes**

Total potential carbon benefit: 4,433 metric tons of CO_2

Equivalent to **removing 937 cars** *from the road for a year*

Building Specs

Student Life Complex @ 202,027 ft^2 ($79 million)

Concrete podium with CLT floor and ceiling systems with glulam columns and beams

Architect: Leers Weinzapfel Associates, Boston; Mackey Mitchell Architects, St. Louis; Modus Studio, Fayetteville

Structural Engineer: Equilibrium Consulting, Vancouver, BC; Engineering Consultants, Inc., Little Rock

Contractor: Nabholz construction, Arkansas

Photos: https://www.lwa-architects.com/project/university-arkansas-stadium-drive-residence-halls/

Brock Commons, University of British Columbia

Completed in 2017, Brock Commons provides campus housing to around 400 students. At 18 stories, it is one of the tallest hybrid mass timber buildings in the world, showcasing the expanding potential for wood construction. The building includes a variety of housing units with several study spaces and gathering lounges. The University of British Columbia praises a simple design that allowed for streamlined construction, enhancing safety and efficiency. Learn more at: https://www.thinkwood.com/projects/brock-commons-tallwood-house

Volume of wood products used: 2,233 m^3

U.S. and Canadian forests grow this much wood every **6 minutes**

Total potential carbon benefit: 2,432 metric tons of CO_2

Equivalent to **removing 511 cars** *from the road for a year*

Building Specs

Student Residence @ 167,700 ft^2 ($51.5 million)

Concrete podium, CLT floors, glulam and parallel strand lumber columns

Architect: Acton Ostry Architects, Vancouver, BC

Structural Engineer: Fast & Epp Structural Engineers, Vancouver, BC

Tall Wood Advisor: Architekten Hermann Kaufmann, Germany

Photos: https://vancouver.housing.ubc.ca/residences/brock-commons/

Burwell Center for Career Achievement, University of Denver

The Burwell Center, completed in 2020, houses the university's career achievement resources. With work and gathering spaces, interview rooms, and event space, the Burwell Center focuses on engaging the campus with the external community. Conscious efforts in design and function foster community relations, and the use of mass timber enables and enhances those efforts.

Volume of wood products used: 482 m^3

U.S. and Canadian forests grow this much wood every **1 minutes**

Total potential carbon benefit: 579 metric tons of CO_2

Equivalent to **removing 122 cars** *from the road for a year*

Building Specs

Student Resources @ 23,000 ft^2
($10.5 million)

CLT floors and roof and lateral system, glulam beams and columns

Architect: Lake Flato, San Antonio; Shears Adkin Rockmore, Denver

Structural Engineer: KL&A Engineers & Builders, Golden, CO

General Contractor: PCL Construction, Denver

Mass Timber Supplier: Nordic Structures, Montreal

Photos: https://sararch.com/projects/in-progress/university-of-denver-career-achievement-center/

John W. Olver Design Building, University of Massachusetts, Amherst

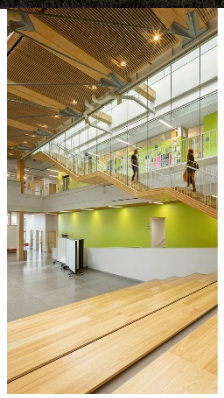
Completed in 2017, the Design Building is an interdisciplinary academic building, housing the Building and Construction program, the Department of Architecture, and the Department of Landscape Architecture and Regional Planning. In the classrooms, labs, meeting, and lounge spaces, the very building itself is connected to the work being done within. Learn more at: https://www.woodworks.org/project/john-w-olver-design-building-umass-amherst/.

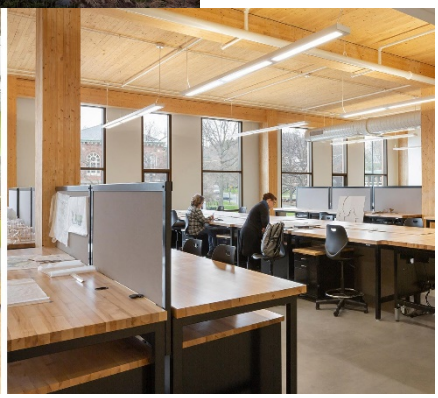
Volume of wood products used: 2,052 m^3

U.S. and Canadian forests grow this much wood every ***6*** **minutes**

Total potential carbon benefit: 2,532 metric tons of CO_2

Equivalent to **removing 535 cars** *from the road for a year*





Building Specs

Academic Building @ 87,000 ft^2 ($52 million)

CLT shear walls, timber-concrete composite floors, glulam brace frame, glulam beams and columns

Architect: Leers Weinzapfel Associates, Boston

Structural Engineer: Equilibrium Consulting, Vancouver, BC; Simpson Gumpertz & Heger, Boston

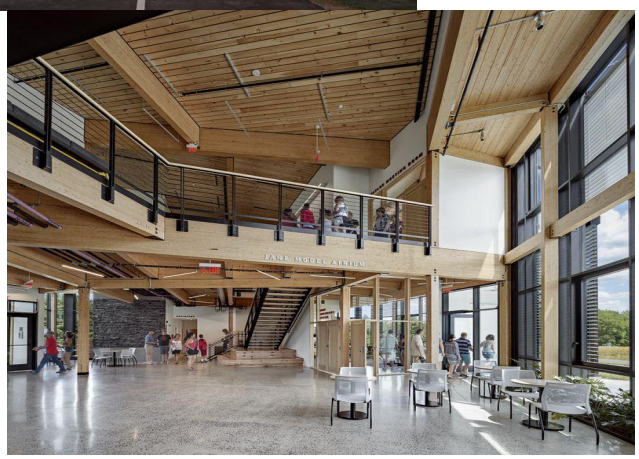
Contractor: Suffolk, Boston

Photos: https://www.nordic.ca/en/projects/structures/umass-design-building

R.W. Kern Center, Hampshire College, Massachusetts

Completed in 2016, the Kern Center is certified by the International Living Future Institute, and recognized as the largest higher education Living Certified project in the world. As a living building, the structure itself offers engaging educational opportunities as courses are developed around its sustainable practices. The building fosters campus relations as it houses a student welcome center, administrative offices, classrooms, a cafe, and gathering space. Learn more at: https://www.thinkwood.com/projects/the-r-w-kern-center-at-hampshire-college.

In addition to being certified by the International Living Future Institute, the Kern Center is a net-zero building in water, energy, and waste.



Building Specs

Administrative mixed use @ 17,000 ft^2 ($10.4 million)

Primarily column-free glulam structure, decking

Architect: Bruner/Cott & Associates, Boston

Structural Engineer: Foley Buhl Roberts & Associates, Newton, MA

Contractor: Wright Builders, Northampton, MA

Engineered wood fabricator: Nordic Structures, Montreal

Photos: https://www.thinkwood.com/our-projects/the-r-w-kern-center-at-hampshire-college

Discussion

Mass Timber Challenges

Mass timber is a relatively new and developing technology, and while progress and research are exploring its vast potential, the novelty of mass timber can create challenges. In the US especially, there is a learning curve associated with mass timber projects for architects and engineers. This tends to lead to higher price estimates, driving up initial project costs.

Mass timber expansion in the US has previously been confined by limiting code regulations. Wood construction has historically been used in the residential sector, however, recent changes to the 2021 International Building Code[15] now allows the expanded use of tall wood mass timber in construction types IV-A, IV-B, and IV-C. Additionally, the use of wood is allowed in up to 18 stories in IV-A construction for Residential and Business Occupancies. Ahead of these universal changes, many states and local municipalities[16] have already adopted code provisions for mass timber construction.

Although mass timber has proven its effectiveness in many applications, wood construction does have its limitations. Hybrid buildings, composed of mass timber elements in conjunction with steel and concrete components, offer expansive solution opportunities for construction or cost challenges.

Photo: Pollux Chung/Seagate Structures (https://www.bdcnetwork.com/mass-timber-what-heck-wow)

Further Resources

Education and Project Support

WoodWorks: As a nonprofit aimed at supporting wood buildings in the US, WoodWorks offers expertise and support for projects from initial designs through construction. WoodWorks provides free project assistance for one-on-one support related to various aspects of wood buildings. Extensive archives and resources provide further education. WoodWorks is founded through their partners, Softwood Lumber Board, United States Forest Service, and Forestry Innovative Investment.

Think Wood: As a marketing communications campaign, Think Wood supports wood buildings by providing resources to projects through design phase to construction. Research and case studies offer in-depth information on various aspects of wood buildings that supports architects, developers, and contractors involved in wood projects. Think Wood is primarily funded through the Softwood Lumber Board.

American Wood Council: The American Wood Council is a trade association representing wood product manufacturers and wood interests in North America. AWC is involved in a variety of development areas, from codes and regulations to guidelines and education. By representing industry players and providing structure, AWC considers itself the "leading voice for the wood products industry."

Canadian Wood Council: With a national federation of associations, the Canadian Wood Council represents the Canadian wood products industry. By maintaining close ties with stakeholders, CWC aims to advance sustainable wood culture by focusing on codes, standards, regulations, and education. CWC has been instrumental in developing code changes that reflect wood's abilities and has been involved in testing research.

Funding Support

The US Forest Service offers funding to projects that explore and expand the possibilities and positive influence of innovative wood products. The Wood Innovations Program provides grants to support "proposals that significantly stimulate or expand wood products and wood energy markets that support the long-term management of National Forest System and other forest lands."

Included in the Wood Innovations Program are discretionary grants, which in 2019 offered the Mass Timber University Grant Program This program supported research for and development of mass timber projects specifically on college and university campuses. Funds "support incremental activities that are institutional hurdles for new building projects using mass timber, and include design and engineering work, cost studies and construction code review support for a variety of building types."

Citations for links found in document, in order of appearance:

[1] Bowyer, et al. *Modern Tall Wood Buildings: Opportunities for Innovation*, Dovetail Report, January 2016: https://dovetailinc.org/portfoliodetail.php?id=5e28c33f3e165

[2] Bowyer, et al. *The Power of Silviculture: Employing thinning, partial cutting systems and other intermediate treatments to increase productivity, forest health and public support for forestry*, Dovetail Report, May 2009: https://dovetailinc.org/upload/tmp/1586802634.pdf

[3] American Wood Council. 2021 IBC Approved Code Change Resources. https://www.awc.org/tallmasstimber

[4] WoodWorks Wood Product Council. Why Wood? Designing for Fire Protection. https://www.woodworks.org/why-wood/#tabs-1-4

[5] Bowyer, et al. A Review of Life Cycle Assessment Tools, Dovetail Report, February 2017: https://www.dovetailinc.org/portfoliodetail.php?id=5e26267427df2

[6] Bowyer, et al. Life Cycle Cost Analysis of Non-Residential Buildings, Dovetail Report, October 2013: *Life Cycle Cost Analysis of Non-Residential Buildings*

[7] Athena Sustainable Materials Institute. LCA Resources. http://www.athenasmi.org/

[8] WoodWorks Wood Product Council. Why Wood? Sustainable Design. https://www.woodworks.org/why-wood/#tabs-1-8

[9] Think Wood. Benefits of Using Wood. https://www.thinkwood.com/benefits-of-using-wood

[10] Think Wood. Benefits of Using Wood: Wood and Well Being. https://www.thinkwood.com/benefits-of-using-wood/wood-and-well-being

[11] Busta, Hallie. Higher Ed Dive. *Is wood the future of campus construction?* 10 April 2019: https://www.highereddive.com/news/is-wood-the-future-of-campus-construction/552359/

[12] Personal interview with Tamara Lowney, President & CEO, Itasca Economic Development Corporation, 4 August 2020

[13] U.S. Forest Service. *Mass Timber University Grant Program Projects Support Forest Health and Vibrant Communities*. 20 August 2019: https://www.fs.usda.gov/news/releases/mass-timber-university-grant-program-projects-support-forest-health-and-vibrant

[14] WoodWorks Wood Products Council. Carbon Calculator Download Form. https://www.woodworks.org/carbon-calculator-download-form/

[15] WoodWorks Wood Products Council. *Tall Wood Buildings in the 2021 IBC: Up to 18 Stories of Mass Timber*. 2019: https://www.woodworks.org/wp-content/uploads/wood_solution_paper-TALL-WOOD.pdf

[16] American Wood Council. Codes & Standards – Code Adoption Map. https://www.awc.org/codes-standards/code-adoption-map