ENGINEERING AND CONSTRUCTION BULLETIN

US Army Corps of Engineers

No. 2023-14 **Issuing Office:** CECW-EC **Issued:** 20 Sep 23 **Expires:** 20 Sep 25

SUBJECT: Mandatory Consideration of Mass Timber in Army Military Construction (MILCON) and Civil Works Vertical Construction Projects

CATEGORY: Directive and Policy

1. **References.**

a. Unified Facilities Criteria 1-200-02, High Performing and Sustainable Buildings. https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-1-200-02

b. Department of Defense Report, Potential Usage in Military Construction of Cross-Laminated Timber (CLT) a next Generation Mass Timber Construction System, July 2021. https://www.denix.osd.mil/sustainability/denix-files/sites/20/2021/09/Report-to-Congress-Cross-laminated-Timber-25-Aug-21_508.pdf

c. Protective Design Center Technical Report, Analysis Guidance for Cross-Laminated Timber Construction Exposed to Airblast Loading, September 2018.

d. Mass Timber Buildings and the IBC, 2021 Edition.

2. **Purpose.**

This Engineering and Construction Bulletin (ECB) establishes policy requiring Project Delivery Teams (PDTs) to consider mass timber solutions when designing Army MILCON and Civil Works vertical construction projects. It also highlights US Army Corps of Engineers (USACE) and industry mass timber design resources.

3. **Applicability.**

This ECB applies to all Army MILCON and Civil Works vertical construction projects starting in the FY27 program year and beyond. It is highly recommended for all other MILCON projects and work for others within the Directorate of Military Programs.

4. **Background.**

a. Mass timber refers to a category of engineered wood products, consisting of multiple solid wood panels nailed or glued together for strength and flexibility. Examples of products in the mass timber family include but are not limited to cross-laminated timber (CLT), glue-laminated timber (Glulam or GLT), dowel-laminated timber (DLT), nail-laminated timber (NLT), and laminated veneer lumber (LVL).

b. Mass timber is gaining momentum as a low-carbon alternative to energy intensive structural materials, such as steel and concrete. It is a widely accepted solution to lowering greenhouse gas (GHG) emissions in the built environment and, if disposed sustainably, can sequester more carbon than released during its life cycle. Like heavy timber, mass timber products have inherent fire resistance that allows them to be left exposed and still achieve fire resistance rating. Other benefits of mass timber construction include pleasing aesthetics, and ease and speed of construction while becoming increasingly available nationwide.

c. Presentations have been facilitated documenting the successes and lessons learned from the Candlewood Suites® hotels at Redstone Arsenal, AL to a cross section of groups and disciplines within USACE. USACE also published technical notes for both CLT in January 2016 and NLT in April 2019 to promulgate knowledge of these technologies, and the most advantageous building types and geographic regions for their utilization.

d. The industry and USACE continue to make progress in addressing barriers impeding mass timber use in buildings. The 2021 International Building Code introduced three new construction types to support a variety of exposed and protected mass timber design systems. In 2018, the Protective Design Center (PDC) published analysis guidance for CLT construction exposed to airblast loading. The USACE Engineer Research Development Center (ERDC) is actively working on addressing knowledge gaps and is assisting Army, Navy, and Air Force mass timber pilot projects.

5. **Policy.**

a. This ECB requires all Army MILCON and Civil Works vertical construction projects to consider at least one option where mass timber is a substantial structural component, when comparing structural systems during early design. If the use of mass timber increases square footage beyond an Army Standard gross square footage limitation, mass timber should not be considered for the project. However, if Mass Timber increases square footage beyond a Standard Design gross square footage limitation, the increase must be coordinated with the applicable COS and an approved Standard Design Waiver must be completed before the design can progress with the additional square footage. If an increase in square footage is needed for a non-standard facility type, the increase must be worked as a Scope Discrepancy through the Code 2 Process and be approved prior to design progressing with the additional square footage and Mass Timber. If a project is authorized and appropriated prior to scope validation, square footage increase is limited to <10%. While it is understood that there are multiple facility types within the Army and Civil Works portfolio that initially may not be conducive to mass timber systems, substantial portions of many facility types may. For example, the high bay areas of fire stations, hangars, and tactical equipment maintenance facilities may not be practical for implementation of mass timber however, the administrative portions of these facilities may. Refer to the IBC for height restrictions related to construction types that support the use of mass timber.

b. As both an equitable and practical means of comparing and selecting structural systems, all options considered during design must be documented via a Life Cycle Cost Analysis (LCCA). A description of all structural system options analyzed, results of the LCCA, and justifications detailing why a mass timber structural system was or was not selected for the

project must be included in the project Design Analysis. Refer to Attachment C for additional information and resources on the LCCA method. It is acknowledged that with regard to LCCA of structural systems, initial costs will likely be the determining factor and that in certain CONUS regions, mass timber may not be widely competitive at this time.

c. PDTs must coordinate the structural system analysis required by this ECB, with energy based LCCA studies for envelope systems required by UFC 1-200-02 High Performance and Sustainable Building Requirements.

d. While projects are highly encouraged to perform Life Cycle Assessment (LCA) calculations to evaluate environmental impacts of different structural systems, this ECB does not require LCA calculations to include these impacts as a factor. Attachment D provides more information on LCA resources and tools, as well as reasons why performing LCA may be beneficial.

6. **Resources.**

A number of mass timber design resources are available addressing topics such as protective design, IBC 2021 code updates, fire resistance, moisture mitigation, and sustainability. Refer to Attachment A USACE Resources and Attachment B Industry Organizations and Resources for additional information.

7. **Date of Applicability.** This ECB is effective immediately.

8. **Point of Contact.** HQUSACE point of contact for this ECB is Edward Citzler, CECW-EC, (817) 876-2294.

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PETE G. PEREZ, P.E., SES
Chief, Engineering and Construction
U.S. Army Corps of Engineers

Enclosures:
Attachment A – USACE Resources
Attachment B – Industry Organizations and Resources
Attachment C – Life Cycle Cost Analysis (LCCA)
Attachment D – Life Cycle Analysis (LCA) industry resources

ATTACHMENT A: USACE RESOURCES

USACE Engineer Research Development Center (ERDC)

The U.S. Army Engineer Research and Development Center (ERDC) conducts research and development in support of the Soldier, military installations, and the Corps of Engineers' civil works mission, as well as for other federal agencies, state and municipal authorities, and with U.S. industries through innovative work agreements. For more information about ERDC, visit https://www.erdc.usace.army.mil/About/

The following are primary efforts ERDC is undertaking on the subject of mass timber:

- **Army Research, Development, Test, and Evaluation (RDT&E)**
  Addressing material and structural knowledge gaps for Department of Defense applications. Topics include durability and fire performance, anti -terrorism/force protection design, and integrating Life Cycle Assessment (LCA) tools to assess sustainability metrics.

- **Guidance modernization**
  Working with HQUSACE Engineering and Construction and Military Programs on guidance modernization (criteria and specifications) to identify and eliminate barriers impeding mass timber use in MILCON.

- **FY22 National Defense Authorization Act (NDAA) Section 2861 pilot projects support**
  Supporting pilot projects in the Army, Navy and Air Force. Pilot projects utilizing mass timber technologies include the Navy FY24 Child Development Centre at Little Creek, Army FY25 Unaccompanied Enlisted Personnel Housing (UEPH) at Joint Base Lewis McChord (JBLM), and the Air Force FY26 Dormitory at Barksdale Air Force Base.

- **Broader engagements:**
  a. Coordination with Army Small Business Innovation Research program on new topics in sustainable building materials, including topics in bio-based building materials, such as mass timber.
  b. Coordination with United States Department of Agriculture Forest Products Laboratory and establishing Memorandum of Understanding for support to DOD.

- **Design Assistance**
  Project Delivery Teams (PDTs) needing assistance with MILCON projects utilizing mass timber can contact Dr. Peter Stynoski, peter.b.stynoski@usace.army.mil, 217-373-3484.

USACE Technical Resources

- **Protective Design Center Technical Report, Analysis Guidance for Cross-Laminated Timber Construction Exposed to Airblast Loading, September 2018** (https://www.nwo.usace.army.mil/Portals/23/docs/PDC/PDC-TR%2018-02%20CLT%20Design%20Guidance.pdf)

- **Cross Laminated Timber TechNote** (https://www.wbdg.org/FFC/ARMYCOE/TECHNOTE/technote23.pdf)

- **Nail Laminated Timber TechNote** (https://www.wbdg.org/FFC/ARMYCOE/TECHNOTE/technote30.pdf)

- **UFGS 06 17 19 Cross Laminated Timber** (https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-06-17-19)

- **UFGS 06 18 00 Glue-Laminated Construction** (https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-06-18-00)

- **USACE Webinars** (https://mrsi.erdc.dren.mil/sustain/webinars)

- **Department of Defense Report, Potential Usage in Military Construction of Cross-Laminated Timber (CLT) a next Generation Mass Timber Construction System, July 2021.** (https://www.denix.osd.mil/sustainability/denix-files/sites/20/2021/09/Report-to-Congress-Cross-laminated-Timber-25-Aug-21_508.pdf)

ATTACHMENT B: INDUSTRY ORGANIZATIONS AND RESOURCES

The following are industry organizations that provide design assistance, education, and resources related to mass timber. Notable publications and resources are linked below.

The American Wood Council (AWC)

www.awc.org

The American Wood Council (AWC) is the voice of North American traditional and engineered wood products. AWC develops state-of-the-art engineering data, technology, and standards on structural wood products for use by design professionals, building officials, and wood products manufacturers to assure the safe and efficient design and use of wood structural components. AWC also provides technical, legal and economic information on wood design, green building and manufacturing environmental regulations advocating for balanced government policies that sustain the wood products industry.

Resources:

- **MASS TIMBER IN THE IBC**
  AWC and International Code Council joint publication, providing an overview of requirements for mass timber construction as found in the 2015, 2018, and 2021 International Building Code (IBC). Can be obtained via the ICC Shop (https://shop.iccsafe.org/mass-timber-buildings-and-the-ibcr.html) and on IHS Markit (https://login.ihsmarkit.com).

- **AWC Resource Hub** (https://awc.org/resource-hub/)
  Includes numerous resources, such as Calculators, Tools, Design Aids, Design resources, Design Standards, Technical Report and Construction Data.

ThinkWood

www.thinkwood.com

ThinkWood is a communications campaign that provides commercial, multifamily and single-family home design and build resources to architects, developers, and contractors. Think Wood's primary funder is the Softwood Lumber Board. SLB is a check-off program and was established to promote the benefits and uses of softwood lumber products in outdoor, residential and non-residential construction. Programs and initiatives supported by the SLB focus on increasing the demand for softwood lumber products in the United States.

Resources:

- Mass Timber Design Manual, Vol.2
  (https://info.thinkwood.com/masstimberdesignmanual)

- Nail Laminated Timber US Design and Construction Guide
  (https://research.thinkwood.com/en/permalink/catalogue834)

- Thinkwood Research Library (https://research.thinkwood.com/)

- WoodAware (2022), "Understanding the Mass Timber Code Changes, A toolkit for Fire Officials" (https://awc.org/wp-content/uploads/2022/01/tmt_toolkit.pdf)

WoodWorks
www.woodworks.com

WoodWorks-Wood Products Council provides free one-on-one project assistance, as well as education and resources related to the code-compliant design, engineering, and construction of non-residential and multi-family wood buildings.

Resources:

- **Free one on one project assistance**
  Projects work with WoodWorks local representative on projects specific solutions.

- **WoodWorks Innovation Network** (https://www.woodworksinnovationnetwork.org)
  Provides a map of existing mass timber projects and teams.

- **Whole Building Life Cycle Assessment tools (**https://www.woodworks.org/why-wood/sustainability/)

- **Fire Design of Mass Timber Members: Code Applications, Construction Types and Fire Ratings** (https://www.woodworks.org/resources/fire-design-of-mass-timber-members-code-applications-construction-types-and-fire-ratings/)

- **Inventory of Fire Resistance-Tested Mass Timber Assemblies and Penetrations (**https://www.woodworks.org/resources/inventory-of-fire-resistance-tested-mass-timber-assemblies-penetrations/)

- **Protective Design** (https://www.woodworks.org/learn/mass-timber-clt/protective-design/)

- **Manufacturers** (https://www.woodworks.org/about/partners/)

- **Cost and Design Optimization Checklists (**https://www.woodworks.org/resources/mass-timber-cost-and-design-optimization-checklists/)

- **Business Case Studies** (https://www.woodworks.org/learn/mass-timber-clt/mass-timber-business-case/)

- **Mass Timber Case studies (**https://www.woodworks.org/search/?buildingSystems=Mass%20Timber%20%2F%20CLT&resourceTypes=Case%20Studies)

- **Free Video Training** (https://www.woodinstitute.org/?redirect=0)

- **Upcoming live training** (https://www.woodworks.org/events/)

- **CAD and REVIT Details (**https://www.woodworks.org/cad-revit/mass-timber/)

Timber Frame Engineering Council
www.tfguild.org/timber-frame-engineering

The Timber Frame Engineering Council (TFEC) formed in recognition of the need for systematic research, discussion, and coordination of timber frame joinery and structural practices. TFEC provides an open forum for discussion of engineering topics, promotes research to advance timber frame technology, produces technical publications, and advocates for changes in building codes.

Resources:

- **TFEC Publications** (https://www.tfguild.org/timber-frame-engineering-council/technical-bulletins) Includes multiple technical bulletins and other publications related to mass timber structural design, moisture considerations, fire resistance of mass timber structures, detailing, and more.

Other Industry Resources

- **FM Global Property Loss Prevention Data Sheets - 1-36 Mass Engineered Timber (July 2023): (**https://www.fmglobal.com/research-and-resources/fm-global-data-sheets)

  FM Global data sheet providing recommendations on the construction, fire protection, and moisture mitigation strategies for mass timber buildings.

ATTACHMENT C: LIFE CYCLE COST ANALYSIS (LCCA)

LCCA is an economic analysis that considers both initial investment costs and future costs over a specific time period. The goal of a LCCA is to compare the overall costs of project alternatives and to select the design that ensures the facility will have the lowest total cost of ownership.

ASTM standard E917- 02 "Standard Practice for Measuring Life-Cycle Costs of Buildings and Building Systems" is the standard industry procedure for analyzing life-cycle costs. The National Institute of Standards and Technology Handbook 135, Life-Cycle Costing Manual (http://www.bfrl.nist.gov/oae/publications/handbooks/135.pdf) provides detailed information about applying LCCA to Federal projects.

For the purpose of the structural system comparative analysis required by this ECB, the following costs shall be considered during the LCCA: investment cost, capital replacement costs, residual value less disposal costs, maintenance and repair costs, and any other costs. The evaluation period is to be set for 40 years.

The Building Life-Cycle Cost (BLCC) program

The Building Life-Cycle Cost (BLCC) program, developed by the National Institute of Standards and Technology (NIST), was designed to analyze energy and water savings. However, the program can accommodate any life-cycle cost analysis, such as the economic comparative analysis required by this ECB. To perform the structural system comparative analysis required by this ECB, PDTs can use NISTs module for MILCON Non-Energy Projects.

BLCC software can be downloaded here:
http://www1.eere.energy.gov/femp/information/download_blcc.html.

Additional Resources

For additional information related to LCCA and the LCCA method, refer to the following link on the Whole Building Design Guide: https://www.wbdg.org/resources/life-cycle-cost-analysis-lcca

ATTACHMENT D: LIFE CYCLE ASESSMENT (LCA)

Life Cycle Assessment (LCA) is an investigative method for calculating environmental impact of a system or a product over its lifetime.

Army MILCON projects required to achieve LEED Silver may consider performing whole building LCA of different structure and enclosure system alternatives in early design to determine which alternatives will result in maximum number of LEED points. The LEED v4 and v4.1 Rating Systems include up to four points for conducting a whole building LCA of the project's structure and enclosure, and meeting certain environmental thresholds. Refer to LEED BD+C v4 Building Life-Cycle Impact Reduction and LEED BD+C v4.1 Building Life-Cycle Impact Reduction credit language for additional detail.

A number of tools used to perform LCA calculations are commercially available. An example of an LCA tool approved for download on Government devices via the USACE App Portal is the Athena Impact Estimator for Buildings.

What is the difference between Life Cycle Cost Analysis (LCCA) and Life Cycle Assessment (LCA)?

LCA should not be confused with LCCA. LCA looks at the lifetime environmental impact of products or a service, LCCA looks at the direct monetary costs involved with a product or service.

	Life Cycle Assessment	Life Cycle Costing
Main Focus	ENVIRONMENT & HUMAN HEALTH Find options that reduce **environmental and human health impacts**	COST Find options with lowest **total ownership cost**
Scope	Typically, all life cycle stages	Typicaly, Construction to End of Life
Elements	Impacts on human health, ecosystem quality, and resource use	Costs
Metrics	Each area of protection has its own metric	Money only
Standards/ Methodology	ISO 14040 and 14044 High level, with room for interpretation	NIST Handbook 135* GAO Cost Estimating and Assessment Guide (2020) Prescriptive, formulaic

**As applied to the design of energy conservation measures for federal building projects, the LCC process is mandated by law and defined in the Code of Federal Regulations (CFR), Title 10, Part 436, Subpart A: Methodology and Procedures for Life Cycle Cost Analyses. See GSA's page on Life Cycle Costing.*

(Image courtesy of GSA Sustainable Facilities Tool: Life Cycle Perspective (Life Cycle Thinking) - GSA Sustainable Facilities Tool (sftool.gov))