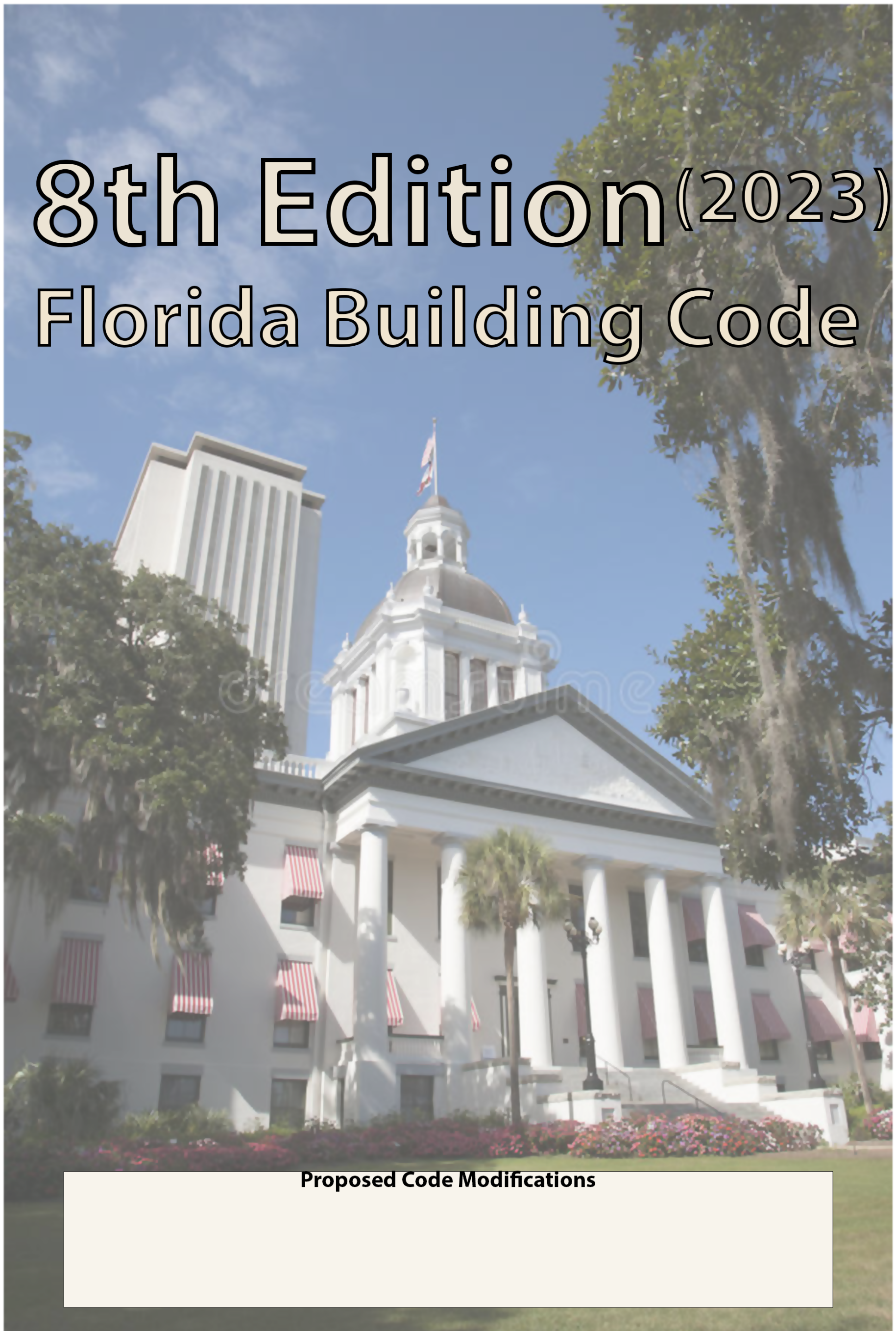


This document created by the Florida Department of Business and Professional Regulation -

850-487-1824

TAC: Fire

Total Mods for **Fire** in **Approved as Submitted : 1**

Total Mods for report: 33

Sub Code: Building

F10427

1

Date Submitted	02/15/2022	**Section**	1010.1.7	**Proponent**	Jennifer Hatfield
Chapter	10	**Affects HVHZ**	No	**Attachments**	No
TAC Recommendation	Approved as Submitted				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

Summary of Modification

Modifies Exception 2 in Section 1010.1.7 to clarify that a higher door threshold height may be allowed in order to meet the water testing requirements of Section 1709.5.

Rationale

This proposal is being submitted on behalf of the Fenestration & Glazing Industry Alliance (formerly AAMA). This code modification is intended to clear up only Exception 2 to Section 1010.1.7. Exception 2 in Section 1010.1.7 as currently written is confusing and this proposal is intended to clarify that a higher door threshold may be allowed as required to meet the water testing requirements in Section 1709.5 of the code. Exception 2 indicates a higher door threshold height is allowed in order to meet "water resistance testing" of NAFS or TAS 202 or "the maximum allowable height difference between interior floors". It is not clear what exactly the second option means and why only interior floor levels are being referenced and not exterior floor or surface levels. The intent of a higher threshold is to meet the water testing requirements of Section 1709.5 in the code, yet that seems to be negated by other language in the exception, particularly where "exterior floor levels shall comply with Table 1010.1.7". Three of the four exterior floor levels in the table are ½" which negates the intent of allowing a higher door threshold height in order to meet with water testing requirements in the code. The modification to Exception 2 in Section 1010.1.7 will clarify that a higher door threshold height may be allowed in order to meet the water testing requirements of Section 1709.5.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Could lessen costs associated with misinterpretations and confusion around the existing code language.

Impact to building and property owners relative to cost of compliance with code

Could lessen costs associated with misinterpretations and confusion around the existing code language.

Impact to industry relative to the cost of compliance with code

Could lessen costs associated with misinterpretations and confusion around the existing code language.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Will provide for less confusion and misinterpretation of what the code intended, providing better end results for the general public.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Improves the code by addressing language that currently is confusing and misinterpreted.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

It does not.

Does not degrade the effectiveness of the code

It does not.

2nd Comment Period

F10427-G1

Proponent Scott McAdam Submitted 8/26/2022 7:25:43 PM Attachments No

Comment:

removal of exception number 2 would remove addressing exterior dwelling unit exit door which is the primary door. An exit door needs to comply with Table 1010.1.7. Accessible doors would still need to comply with the FBC, Accessibility. This MOD indicates it does not affect HVHZ but the exception specifically includes HVHZ which would now be removed. MOD remove requirements for exit doors and directly lessens the code and allows raised thresholds at exterior exits doors

1010.1.7 Thresholds.

Thresholds at doorways shall not exceed $^{3}/_{4}$ inch (19.1 mm) in height above the finished floor or landing for sliding doors serving *dwelling units* or $^{1}/_{2}$ inch (12.7 mm) above the finished floor or landing for other doors. Raised thresholds and floor level changes greater than $^{1}/_{4}$ inch (6.4 mm) at doorways shall be beveled with a slope not greater than one unit vertical in two units horizontal (50-percent slope).

Exceptions:

1. In occupancy Group R-2 or R-3, threshold heights for sliding and side-hinged exterior doors shall be permitted to be up to $7^{3}/_{4}$ inches (197 mm) in height if all of the following apply:
    1.1. The door is not part of the required *means of egress*.
    1.2. The door is not part of an *accessible route* as required by Chapter 11.
2. For exterior doors serving dwelling units, or sleeping units, thresholds at doorways shall be allowed at a height necessary to comply with the water resistance requirements of Section 1709.5. ~~not exceed the height required to pass the water resistance test of AAMA/WDMA/CSA 101/I.S.2/ A440, or TAS 202 for high-velocity hurricane zones, or the maximum allowable height difference between interior floor levels. Exterior floor level shall comply with Table 1010.1.7.~~

~~TABLE 1010.1.7 EXTERIOR FLOOR LEVEL DIFFERENCE~~

(Delete table without substitution)

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F10334

2

Date Submitted	02/13/2022	**Section**	110	**Proponent**	Greg Johnson
Chapter	1	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

Type IV mass timber package of changes; Mods# 10098, 10099, 10161, 10162, 10163, 10167, 10169, 10174, 10248, 10254, 10255, 10328, and 10331.

Summary of Modification

Adds inspection requirements for fire resistance cover protection of mass timber connectors

Rationale

see uploaded rationale

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Minimal; inspection done concurrently with other framing or sheathing inspections.

Impact to building and property owners relative to cost of compliance with code

None; inspection done concurrently with other framing or sheathing inspections.

Impact to industry relative to the cost of compliance with code

None; inspection done concurrently with other framing or sheathing inspections.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This is a fire resistive construction provision

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Improves the code by providing a fire resistive construction provision for mass timber connectors.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No material is required or prohibited by this modification.

Does not degrade the effectiveness of the code

Improves the code by providing a fire resistive construction provision for mass timber connectors.

2nd Comment Period

F10334-G1

Proponent	Greg Johnson	Submitted	8/17/2022 3:49:56 PM	Attachments	No

Comment:

Nothing in the FL Building code prohibits mass timber construction. In fact, Sec. 602.4 provides requirements for mass timber elements, including Sec. 602.4.2 which addresses cross-laminated timber, a form of mass timber. Also, Sec. 104.11, Alternative materials, design and methods of construction and equipment permits AHJs to accept mass timber construction types as an alternate method of construction. Modification 10334 provides requirements for inspection of fire resistive elements. These provisions should already be available in the FL Building Code for already permissible buildings and those that may be accepted under Sec. 104.11.

2nd Comment Period

F10334-G2

Proponent	ashley ong	Submitted	8/26/2022 4:04:10 PM	Attachments	No

Comment:

Building Officials Association of Florida (BOAF) supports this modification.

2nd Comment Period

F10334-G3

Proponent	Sam Francis	Submitted	8/26/2022 10:18:43 PM	Attachments	No

Comment:

I urge the adoption of the original modification

•
1.

- **[A]110.3 Required inspections.**

  The building official upon notification from the permit holder or his or her agent shall make the following inspections, and shall either release that portion of the construction or shall notify the permit holder or his or her agent of any violations which must be corrected in order to comply with the technical codes. The building official shall determine the timing and sequencing of when inspections occur and what elements are inspected at each inspection.

- **Building**

1. 1.Foundation inspection. To be made after trenches are excavated and forms erected and shall at a minimum include the following building components:
   - •Stem-wall
   - •Monolithic slab-on-grade
   - •Piling/pile caps
   - •Footers/grade beams
   1. 1.1.In flood hazard areas, upon placement of the lowest floor, including basement, and prior to further vertical construction, the elevation certification shall be submitted to the authority having jurisdiction.
2. 2.Framing inspection. To be made after the roof, all framing, fireblocking and bracing is in place, all concealing wiring, all pipes, chimneys, ducts and vents are complete and shall at a minimum include the following building components:
   - •Window/door framing
   - •Vertical cells/columns
   - •Lintel/tie beams
   - •Framing/trusses/bracing/connectors
   - •Draft stopping/fire blocking
   - •Curtain wall framing
   - •Energy insulation
   - •Accessibility
   - •Verify rough opening dimensions are within tolerances.

   2.1 In buildings of Types IV-A, IV-B, and IV-C construction, where connection fire-resistance ratings are provided by wood cover calculated to meet the requirements of Section 2304.10.1, inspection of the wood cover shall be made after the cover is installed, but before any other coverings or finishes are installed.

ADM35-19 Type IV-A, IV-B, and IV-C connection protection inspection

ICC Ad Hoc Committee on Tall Wood Buildings (TWB) determined that the proper construction of the fire resistance rating of mass timber structural elements was important enough, as demonstrated in a series of TWB proposals including this one, to warrant a specific requirement to inspect mass timber connections. The proposal complements the other code change submissions (e.g. Chapters, 7 "Fire and Smoke Protection Features", 17 "Special Inspections and Tests", and 23 "Wood"), and recognizes that building officials have the ability to inspect the protection of connections as part of the normal permit inspection process (e.g. footing and foundations, slabs, framing, etc.). The TWB, following input by code officials, did not feel this provision warranted being incorporated into Chapter 17 "Special Inspections and Tests" as this field inspection process did not require any special expertise for inspection nor tools for testing that were outside the capabilities of building officials today. However, the TWB did believe that some form of inspection should take place since the connections of the structural members, and their protection to achieve a fire resistance rating, represent a significant component to the entire design of mass timber buildings.

The Ad Hoc Committee for Tall Wood Buildings (AHC-TWB) was created by the ICC Board of Directors to explore the building science of tall wood buildings with the scope to investigate the feasibility of and take action on developing code changes for these buildings. Members of the AHC-TWB were appointed by the ICC Board of Directors. Since its creation in January, 2016, the AHC-TWB has held multiple open meetings and numerous Work Group conference calls. Related documentation and reports of the TWB are posted on the AHC-TWB website at https://www.iccsafe.org/codes-tech-support/cs/icc-ad-hoc-committee-on-tall-wood-buildings/ (accessed 02-12-2022)

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F10337

Date Submitted	02/13/2022	**Section**	202	**Proponent**	Greg Johnson
Chapter	2	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

New Type IV mass timber modifications; #10098, 10099, 10161, 10162, 10163, 10167, 10169, 10174, 10248, 10254, 10255, 10328, 10331

Summary of Modification

Definitions needed regulate mass timber are added; mass timber supporters added in rationale

Rationale

These definitions are needed to administer requirements for new proposed Type IV-A, Type IV-B, and Type IV-C construction types. See also mass timber supporters rationales in uploaded documents

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None; these are definitions.

Impact to building and property owners relative to cost of compliance with code

None; these are definitions.

Impact to industry relative to the cost of compliance with code

None; these are definitions.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Provides definitions needed to appropriately regulate Type IV mass timber buildings.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Improves the code by supporting new alternative methods of construction.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No materials are required or prohibited by this modification.

Does not degrade the effectiveness of the code

Improves the code by supporting new alternative methods of construction.

2nd Comment Period

F10337-G1

Proponent	Greg Johnson	Submitted	8/17/2022 2:43:45 PM	Attachments	No

Comment:

Mass timber construction is a rapidly expanding construction method; particularly in locations, like FL, with abundant forestry resources. The FL Building Code does not prohibit mass timber construction and mass timber buildings have already been permitted and constructed in FL. Designers and code officials who will be working with mass timber buildings are entitled to have all necessary guidance and criteria in the building code so that those projects can be designed and regulated for acceptable performance. Adding these definitions facilitates common understanding between designers and code officials of the issues associated with this construction method. It's good to all agree on what we we're speaking of; this modification helps make that work and is therefore needed.

2nd Comment Period

F10337-G2

Proponent	Sam Francis	Submitted	8/25/2022 3:48:32 PM	Attachments	No

Comment:

At the first Comment Period hearing, after the TAC voted to deny the first of the Tall Mass Timber and one or two more proposed modifications , no testimony was offered by opponents or supporters to the subsequent proposed modifications. When we reached out to opponents of the mods which were hotly debated, they offered thoughts on those and on subsequent items which received no debate in the first Comment hearing. After significant discussion on the issue, we have agreed that the definitions need to be approved as originally proposed. They are essential to make sense of the new technology. This technology is permitted for use in other types of construction so the inclusion of these definitions is important independent of the disposition of the other modifications. I urge the TAC to approve the modification as proposed originally.

2nd Comment Period

F10337-G3

Proponent	ashley ong	Submitted	8/26/2022 3:53:22 PM	Attachments	No

Comment:

Building Officials Association of Florida (BOAF) supports this modification.

SECTION 202 Definitions

Revise as follows:

[BS] WALL, LOAD-BEARING. Any wall meeting either of the following classifications:

1. Any metal or wood stud wall that supports more than 100 pounds per linear foot (1459 N/m) of vertical load in addition to its own weight.

2. Any masonry**,** or concrete <u>or mass timber</u>wall that supports more than 200 pounds per linear foot (2919 N/m) of vertical load in addition to its own weight.

Add new definitions as follows:

<u>**MASS TIMBER**. Structural elements of Type IV construction primarily of solid, built-up, panelized or engineered wood products that meet minimum cross section dimensions of Type IV construction.</u>

<u>**NONCOMBUSTIBLE PROTECTION (FOR MASS TIMBER).**</u>

<u>Noncombustible material, in accordance with Section 703.5, designed to increase the fire-resistance rating and delay the combustion of mass timber.</u>

West Fraser

9022 Southeast 186th Place
Lake Butler, FL.
32054
Phone: (904) 290-6460
www.westfraser.com

February 4, 2022

To: Florida Building Commission

RE: Adoption of Mass Timber Code Proposals into the 2023 FBC

West Fraser is a diversified wood products company with more than 60 facilities in Canada, the United States, the United Kingdom, and Europe. In the state of Florida, West Fraser owns and operates five sawmills, where we support the communities of Lake Butler, Maxville, McDavid, Perry, and Whitehouse. As North America's largest lumber producer, we directly employ more than 640 people at our Florida facilities and support more than 875 indirect/induced jobs in the state as a result of our mill operations.

West Fraser provides renewable building products for the world, contributing to a more sustainable future. Therefore, we are committed to reducing the environmental impact of new construction by encouraging the environmentally responsible choices of wood-based building materials. As a manufacturer of sustainable products that makes use of renewable forest resources that sequester carbon, we support the adoption of mass timber (MT) construction, (Types IVA, IVB, and IVC), and related requirements, as contained in the 2021 edition of the International Building Code (IBC), into the 2023 Florida Building Code (FBC) for the following reasons:

- Sequestering carbon in long-lived building materials manufactured from renewable, sustainably managed forests, mitigates drivers of climate change and worsening wildland fire seasons and intensities. Sequestering carbon in MT buildings also helps mitigate other issues associated with climate change like the intensity of storms and flooding events.

- Sustainably managed and harvested forests capture more carbon than forests left unmanaged and provide habitat for a greater range of species.

- Updating the FBC to permit MT buildings will stimulate investment in manufacturing and supply chains in Florida and put downward pressure on cost and pricing.

- Adding these new types of construction to the FBC provides designers with greater flexibility when specifying building systems in the 8 – 12 story multifamily market.

For these reasons, we encourage the Florida Building Commission to adopt the package of MT proposals as incorporated in the 2021 IBC and proposed through the 2023 FBC update process.

Sincerely,

DocuSigned by:
615E5CB649BF41B...
Jerome Worthy
General Manager
West Fraser
Whitehouse - Lumber Mill
109 Halsema Road S.
Whitehouse, FL
32220

DocuSigned by:
05084FCE9A37440...
Al Cleghorn
General Manager
West Fraser
Maxville Lumber - Mill
6640 County Road 218
Jacksonville, FL
32234

DocuSigned by:
E53094EB4D554EE...
Joshua Crawford
General Manager
West Fraser
Lake Butler Lumber - Mill
9022 Southeast 186th Pl.
Lake Butler, FL
32054

DocuSigned by:
1715B74F0526449...
Stephen Baxley
General Manager
West Fraser
Perry - Lumber Mill
1509 S. Byron Butler Pkwy
Perry, FL
32348

DocuSigned by:
D1DCB7B96E704AD...
Jeff Hondorp
General Manager
West Fraser
McDavid - Lumber Mill
401 Champion Drive
McDavid, FL
32568

DocuSigned by:
622C1ECFFE02438...
Matt Goodin
Procurement Manager FL
West Fraser
Lake Butler - Lumber Mill
9022 Southeast 186th Pl.
Lake Butler, FL
32054

February 10, 2022

To: Florida Building Commission

The signatory parties support the adoption of mass timber (MT) construction types, (Types IVA, IVB, and IVC), and related requirements, as contained in the 2021 edition of the International Building Code (IBC), into the 2023 Florida Building Code (FBC) for the following reasons:

- In 2016 the ICC Board of Directors appointed the Ad Hoc Committee on Tall Wood Buildings (AHC-TWB) to explore the science of tall wood buildings. Committee and work group members consisted of code officials, fire officials, construction material interests, designers, builders, and other interested parties.

  After studying MT for hundreds of hours, and reviewing extensive fire-testing of the material, the AHC-TWB developed and submitted a package of code-change proposals for the 2021 edition of the IBC through the ICC's rigorous code development process. In that process the voting number of ICC governmental member representatives, ranging from 542 to 729 members, and averaging 646 members, voted to adopt all proposed MT changes by margins ranging from 68 percent to 94 percent and averaging 83 percent.

  Interests, experts, and associations that testified in support of adding the MT provisions to the IBC included local government building code officials, fire marshals and fire chiefs, materials scientists, fire science researchers and testing agencies, fire protection engineers, structural engineers, multifamily contractors, the United States Forest Service, the International Association of Building Officials, the National Association of Home Builders, the American Institute of Architects, the American Wood Council, APA-the Engineered Wood Association, and Underwriters Laboratories.

- Updating the FBC to permit MT buildings will stimulate investment in its manufacturing and supply chain in FL and put downward pressure on cost and pricing. Investment in MT production is projected to have significant economic benefits for the FL economy because of the state's extensive timber resources. Florida's forest industry contributes $25 billion to the state's economy, providing more than 124,000 jobs. There are 17 million acres of forestland covering almost half of Florida's total land area. Almost 2/3 of the forestland is privately owned. https://www.flforestry.org/resources/2017-economic-impact-study/

- Because of repetitive building layouts in residential multifamily buildings, and the speed of constructing MT buildings, it is predicted that MT will compete successfully with other materials used for multifamily buildings in the 8 -12 story height range. In addition to construction efficiencies, expanded use of MT in these applications can reduce the potential of large construction site fires.

- MT construction sites are safer for workers. Construction sites are also quieter and are less disruptive in the communities where projects occur. MT projects are completed substantially faster than traditional methods of construction, minimizing waste and community impacts while maximizing both worker productivity and developers' returns on investment. In addition, building with pre-manufactured MT panels broadens the available labor pool and will likely alleviate a national shortfall in skilled construction labor.

- Wildland fire safety on both the regional and global scale will benefit from increased use of MT. Low value wood, thinnings, and dead standing trees, can be used for MT, thereby creating a financial incentive for wildland fuels reduction, particularly of ladder fuels, improving regional fire safety and conserving federal and state resources.

- Sequestering carbon in long-lived building materials manufactured from renewable, sustainably managed forests mitigates drivers of climate change and worsening wildland fire seasons and intensities. Sequestering carbon in MT buildings also helps mitigate other issues associated with climate change like the intensity of storms and flooding events.

- Sustainably managed and harvested forests capture more carbon than forests left unmanaged and provide habitat for a greater range of species.
- As a panelized building product, fastened together on-site, MT panels are ideal for buildings designed for disassembly. This means panels, which are easily restored after prior use, can be re-used in new building applications. Carbon stored in MT panels can be sequestered indefinitely as the panels are re-used in future buildings.

For these reasons we encourage the FL Building Commission to adopt the package of MT proposals as incorporated in the 2021 IBC and proposed through the 2023 FBC update process.

Sincerely:

The Conservation Fund
www.conservationfund.org

FAA FLORIDA APARTMENT ASSOCIATION

Florida Forestry Association
www.flforestry.org

Forest Landowners Association
www.forestlandowners.com

Forestry Association of South Carolina
www.scforestry.org

Georgia Forestry Association
gfagrow.org

Keeping Forests
keepingforests.org

Louisiana Forestry Association
www.laforestry.com

National Association of State Foresters
www.stateforesters.org

North Carolina Forestry Association
www.ncforestry.org

Packaging Corporation of America
www.packagingcorp.com

Rayonier
1 Rayonier Way
Wildlight, Florida
www.rayonier.com

Southeastern Lumber Manufacturers Association
www.slma.org

Southern Group of State Foresters
southernforests.org

Tennessee Forestry Association
www.tnforestry.com

Dr. Patricia Layton
Clemson University
Director
Wood Utilization + Design Institute
www.clemson.edu/centers-institutes/wud/

Christopher Meyer, AIA
Assistant Professor of Architecture
University of Miami School of Architecture
Director, LU_Lab
www.arc.miami.edu
Principal, Atelier Mey
ateliermey.net

Shawna Meyer, AIA
Lecturer, University of Miami School of Architecture
www.arc.miami.edu
Principal, Atelier Mey
https://ateliermey.net

F10337Rationale

AIA Florida

Florida Building Commission
2601 Blair Stone Road
Tallahassee FL 32399

January 31, 2022

To Whom it May Concern:

AIA Florida supports the adoption of the International Code Council family of model building codes including the adoption of mass timber (MT) construction types, (Types IVA, IVB, and IVC), and related requirements, as contained in the 2021 edition of the International Building Code (IBC), into the 2023 Florida Building Code (FBC).

AIA Florida supports regulation by a single set of comprehensive, coordinated and contemporary codes and standards to establish sound threshold values of health, safety and protection of the public.

In 2016 the International Code Council (ICC) Board of Directors appointed the Ad Hoc Committee on Tall Wood Buildings (AHC-TWB) to explore the science of tall wood buildings. Committee and work group members consisted of code officials, fire officials, construction material interests, designers, builders, and other interested parties.

After studying MT for hundreds of hours, and reviewing extensive fire-testing of the material, the AHC-TWB developed and submitted a package of code-change proposals for the 2021 edition of the IBC through the ICC's rigorous code development process. In that process the voting number of ICC governmental member representatives, ranging from 542 to 729 members, and averaging 646 members, voted to adopt all proposed MT changes by margins ranging from 68 percent to 94 percent and averaging 83 percent.

As the package of MT proposals are part of the 2021 IBC, we encourage the Florida Building Commission to adopt the proposals through the 2023 FBC update process.

Sincerely,

Lourdes Solera, FAIA
President

Becky Magdaleno, CAE
Executive Vice President/CEO

AIA Florida
104 E. Jefferson St.
Tallahassee, FL 32301

T (850) 222-7590
F (850) 224-8048

www.aiafla.org

Building Officials Association of Florida, Inc.

February 4, 2022

James R. Schock, Chairman
Florida Building Commission
2601 Blair Stone Street
Tallahassee, FL 32399

Re: Support of Mass Timber Proposals

Dear Chairman Schock:

The signatory parties support the adoption of mass timber (MT) construction types, (Types IVA, IVB, and IVC), and related requirements, as contained in the 2021 edition of the International Building Code (IBC), into the 2023 Florida Building Code (FBC) for the following reasons:

In 2016 the ICC Board of Directors appointed the Ad Hoc Committee on Tall Wood Buildings (AHC-TWB) to explore the science of tall wood buildings. Committee and work group members consisted of code officials, fire officials, construction material interests, designers, builders, and other interested parties.

After studying MT for hundreds of hours, and reviewing extensive fire-testing of the material, the AHC-TWB developed and submitted a package of code-change proposals for the 2021 edition of the IBC through the ICC's rigorous code development process.In that process the voting number of ICC governmental member representatives, ranging from 542 to 729 members, and averaging 646 members, voted to adopt all proposed MT changes by margins ranging from 68 percent to 94 percent and averaging 83 percent.

Interests, experts, and associations that testified in support of adding the MT provisions to the IBC included local government building code officials, fire marshals and fire chiefs, materials scientists, fire science researchers and testing agencies, fire protection engineers, structural engineers, multifamily contractors, the United States Forest Service, the International Association of Building Officials, the National Association of Home Builders, the American Institute of Architects, the American Wood Council, APA-the Engineered Wood Association, and Underwriters Laboratories.

Updating the FBC to permit MT buildings will stimulate investment in its manufacturing and supply chain in Florida and put downward pressure on cost and pricing. Investment in MT production is projected to have significant economic benefits for the Florida economy because of the state's extensive timber resources. Florida's forest industry contributes $25 billion to the state's economy, providing more than 124,000 jobs. There are 17 million acres of forestland covering almost half of Florida's total land area. Almost 2/3 of the forestland is privately owned.

https://www.flforestry.org/resources/2017-economic-impact-study/

- Because of repetitive building layouts in residential multifamily buildings, and the speed of constructing MT buildings, it is predicted that MT will compete successfully with other materials used for multifamily buildings in the 8 -12 story height range. In addition to construction efficiencies, expanded use of MT in these applications can reduce the potential of large construction site fires.
- MT construction sites are safer for workers. Construction sites are also quieter and are less disruptive in the communities where projects occur. MT projects are completed substantially faster than traditional methods of construction, minimizing waste and community impacts while maximizing both worker productivity and developers' returns on investment. In addition, building with pre-manufactured MT panels broadens the available labor pool and will likely alleviate a national shortfall in skilled construction labor.
- Wildland fire safety on both the regional and global scale will benefit from increased use of MT. Low value wood, thinnings, and dead standing trees, can be used for MT, thereby creating a financial incentive for wildland fuels reduction, particularly of ladder fuels, improving regional fire safety and conserving federal and state resources.
- Sequestering carbon in long-lived building materials manufactured from renewable, sustainably managed forests mitigates drivers of climate change and worsening wildland fire seasons and intensities. Sequestering carbon in MT buildings also helps mitigate other issues associated with climate change like the intensity of storms and flooding events.
- Sustainably managed and harvested forests capture more carbon than forests left unmanaged and provide habitat for a greater range of species.
- As a panelized building product, fastened together on-site, MT panels are ideal for buildings designed for disassembly.This means panels, which are easily restored after prior use, can be re-used in new building applications.Carbon stored in MT panels can be sequestered indefinitely as the panels are re-used in future buildings.

For these reasons we encourage the Florida Building Commission to adopt the package of MT proposals as incorporated in the 2021 IBC and proposed through the 2023 FBC update process.

Sincerely,

Kathleen Croteau, CBO

President

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F10160

4

Date Submitted	02/10/2022	**Section**	404.6	**Proponent**	Richard Logan
Chapter	4	**Affects HVHZ**	Yes	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

Summary of Modification

Add exceptions 4 and 5 to 404.6 for floor openings for escalators and exit access stairways and ramps

Rationale

Floor openings for escalators and exit access stairways and ramps meeting the sections identified in the proposal are protected. The protection consists of draft curtains around the floor opening and additional sprinklers. The size of the floor opening is also limited. The provision of the draft curtain and sprinklers limit the potential of smoke spread through the opening and that communicate via these types of openings should not be considered to be part of the atrium.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

The proposed code modification will not have an impact to local entity relative to enforcement of code

Impact to building and property owners relative to cost of compliance with code

The proposed code modification will not have an impact to building and property owners relative to cost of compliance with code. The code change proposal will decrease the cost of construction.

Impact to industry relative to the cost of compliance with code

The proposed code modification will not have an impact to industry relative to the cost of compliance with code.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

The proposed code modification has a reasonable and substantial connection with the health, safety, and welfare of the general public

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

The proposed code modification improves the code, and provides equivalent or better methods of construction

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

The proposed code modification does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not degrade the effectiveness of the code

The proposed code modification does not degrade the effectiveness of the code.

2nd Comment Period

F10160-G1

Proponent Richard Logan Submitted 8/15/2022 10:40:33 AM Attachments No

Comment:

This proposed code modification was not approved at the June 22, 2022 Fire TAC Meeting with an explanation that it is not necessary. The 2 added cross refences for escalators and exit stairs help users that are not familiar with the locations of exceptions in the code that would not require a horizontal assembly around those elements. Respectfully request reconsideration.

404.6Enclosure of atriums.

Atrium spaces shall be separated from adjacent spaces by a 1-hour *fire barrier* constructed in accordance with Section 707 or a *horizontal assembly* constructed in accordance with Section 711, or both.

Exceptions:

1. A *fire barrier* is not required where a glass wall forming a smoke partition is provided. The glass wall shall comply with all of the following:

   1.1 Automatic sprinklers are provided along both sides of the separation wall and doors, or on the room side only if there is not a walkway on the *atrium* side. The sprinklers shall be located between 4 inches and 12 inches (102 mm and 305 mm) away from the glass and at intervals along the glass not greater than 6 feet (1829 mm). The sprinkler system shall be designed so that the entire surface of the glass is wet upon activation of the sprinkler system without obstruction;

   1.2 The glass wall shall be installed in a gasketed frame in a manner that the framing system deflects without breaking (loading) the glass before the sprinkler system operates; and

   1.3 Where glass doors are provided in the glass wall, they shall be either *self-closing* or automatic-closing.

2. A *fire barrier* is not required where a glass-block wall assembly complying with Section 2110 and having a $^3/_4$-hour *fire protection rating* is provided.

3. A *fire barrier* is not required between the *atrium* and the adjoining spaces of any three floors of the *atrium* provided such spaces are accounted for in the design of the smoke control system.

4. A horizontal assembly is not required between the atrium and openings for escalators complying with Section 712.1.3.

5. A horizontal assembly is not required between the atrium and openings for exit access stairways and ramps complying with Item4 of Section 1019.3.

404.6Enclosure of atriums.

Atrium spaces shall be separated from adjacent spaces by a 1-hour *fire barrier* constructed in accordance with Section 707 or a *horizontal assembly* constructed in accordance with Section 711, or both.

Exceptions:

1. A *fire barrier* is not required where a glass wall forming a smoke partition is provided. The glass wall shall comply with all of the following:
   - 1.1. Automatic sprinklers are provided along both sides of the separation wall and doors, or on the room side only if there is not a walkway on the *atrium* side. The sprinklers shall be located between 4 inches and 12 inches (102 mm and 305 mm) away from the glass and at intervals along the glass not greater than 6 feet (1829 mm). The sprinkler system shall be designed so that the entire surface of the glass is wet upon activation of the sprinkler system without obstruction;
   - 1.2. The glass wall shall be installed in a gasketed frame in a manner that the framing system deflects without breaking (loading) the glass before the sprinkler system operates; and
   - 1.3. Where glass doors are provided in the glass wall, they shall be either *self-closing* or automatic-closing.
2. A *fire barrier* is not required where a glass-block wall assembly complying with Section 2110 and having a $^3/_4$-hour *fire protection rating* is provided.
3. A *fire barrier* is not required between the *atrium* and the adjoining spaces of any three floors of the *atrium* provided such spaces are accounted for in the design of the smoke control system.
4. A horizontal assembly is not required between the atrium and openings for escalators complying with Section712.1.3.
5. A horizontal assembly is not required between the atrium and openings for exit access stairways and rampscomplying with Item 4 of Section 1019.3.

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

5

F10161

Date Submitted	02/10/2022	**Section**	403.3.2	**Proponent**	Greg Johnson
Chapter	4	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

The package of modifications that bring mass timber construction types (Type IVA, Type IVB, & Type IVC) into the code.

Summary of Modification

This modification requires dual water supplies for Type IVA and Type IVB buildings that are taller than 120 feet.

Rationale

See the uploaded rationale

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None; the same requirements for fire-sprinkler plan review and inspection that apply to any comparable building will apply to these construction types.

Impact to building and property owners relative to cost of compliance with code

None; this is an optional compliance path. Like any compliance path it has specific requirements that must be met, but only where the owner chooses the option.

Impact to industry relative to the cost of compliance with code

None; this is an optional compliance path. Like any compliance path it has specific requirements that must be met, but only where the owner chooses the option.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This is a fire safe construction issue.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This improves the code by providing appropriate fire-sprinkler protection for specifc building types and heights.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No material is required or prohibited by this modification.

Does not degrade the effectiveness of the code

This is a new requirement; existing requirements are not modified.

2nd Comment Period

F10161-G1

Proponent	Greg Johnson	Submitted	8/17/2022 2:58:29 PM	Attachments	No

Comment:

The requirement for dual water supplies to the fire sprinkler system is an important fire safety provision which provides a very stringent requirement for the construction of mass timber buildings taller than 120 feet.

2nd Comment Period

F10161-G2

Proponent	Sam Francis	Submitted	8/25/2022 3:55:04 PM	Attachments	No

Comment:

Comment on MOD 10161 At the first Comment Period hearing, after the TAC voted to deny the first of the Tall Mass Timber and one or two more proposed modifications , no testimony was offered by opponents or supporters to the subsequent proposed modifications. When we reached out to opponents of the mods which were hotly debated, they offered thoughts on those and on subsequent items which received no debate in the first Comment hearing. When we reached out to opponents to seek input on properly amending the proposals, this was one of those which was not debated. The opponents do not oppose this change because of the increased level of reliability and robustness this adds to the package of safety requirements. This is a good change and important part of the package. We support this change as originally submitted with the modification to the original language. I strongly urge the TAC approve the MOD as originally submitted with the further modification.

2nd Comment Period

F10161-G3

Proponent	ashley ong	Submitted	8/26/2022 3:55:25 PM	Attachments	No

Comment:

Building Officials Association of Florida (BOAF) supports this modification.

403.3.2 Water supply to required fire pumps.
In all buildings that are more than 420 feet (128 000 mm) in building height and buildings of Type IVA and IVB construction that are more than 120 feet (36 576 mm) in *building height*, required fire pumps shall be supplied by connections to no fewer than two water mains located in different streets. Separate supply piping shall be provided between each connection to the water main and the pumps. Each connection and the supply piping between the connection and the pumps shall be sized to supply the flow and pressure required for the pumps to operate.

Exception: Two connections to the same main shall be permitted provided the main is valved such that an interruption can be isolated so that the water supply will continue without interruption through no fewer than one of the connections.

Reason: Sec 403.3.2 dual water supplies for Type IV highrise buildings (G28-18)

AWC proposes this code change as part of a package which, when taken together, as a group, creates the safety and reliability requirements necessary for the regulation of large mass timber (MT) buildings by the Florida Building Code. The following statement was offered by the Ad Hoc Committee on Tall Wood Buildings (TWB) for this proposal (IBC-G28-18) in the ICC Code Development monograph 2018 Group A:

The Ad Hoc Committee on Tall Wood Buildings (TWB) was created by the ICC Board to explore the science of tall wood buildings and take action on developing code changes for tall wood buildings. The TWB has created several code change proposals with respect to the concept of tall buildings of mass timber and the background information is at the end of this Statement. Within the statement are important links to information, including documents and videos, used in the deliberations which resulted in these proposals.

The Ad Hoc Committee has discussed a number of proposals to potentially increase the permitted height and area for Type IV structures, specifically mass timber buildings adding additional Types IVA, IVB & IVC. One of the basic requirements incorporated into these proposed increased heights and areas is the added active and passive protection features to these structures.

The Code Technology Committee, in response to the events of September 11, 2001, submitted proposals for water supply to super high-rise buildings of 420’ and higher. This requirement was adopted due to the recognized importance of insuring a continuous water supply to the active fire protection systems in the event of a fire in these structures. This recommendation was highlighted in the National Institute of Standards and Technology’s (NIST) report on the structural collapses on September 11th.

This code change proposal brings this same concept to Type IV structures of 120’ and higher. This added protection feature would be unique to Type IVA and IVB construction (as proposed in a related code change – see table below) due to the potential contribution of the mass timber to the fuel load in the event of a fire. Due to the limitations of fire service aerial apparatus’ ability to apply water to elevated floors the Ad Hoc Committee felt 120’ was an appropriate height to initiate the requirement. Another consideration is that currently the code permits structures up to 85’ so the committee identified the next level within the codes for additional requirements. Considerations were also given to the difficulty of fire service companies accessing elevated floors under fire conditions.

The Ad Hoc Committee for Tall Wood Buildings (AHC-TWB) was created by the ICC Board of Directors to explore the building science of tall wood buildings with the scope to investigate the feasibility of and take action on developing code changes for these buildings. Members of the AHC-TWB were appointed by the ICC Board of Directors. Since its creation in January 2016, the AHC-TWB has held 8 open meetings and numerous Work Group conference calls. Four Work Groups were established to address over 80 issues and concerns and review over 60 code proposals for consideration by the AHC-TWB. Members of the Work Groups included AHC-TWB members and other interested parties. Related documentation and reports are posted on the AHC-TWB website at https://www.iccsafe.org/codes-tech-support/cs/icc-ad-hoc-committee-on-tall-wood-buildings/ .

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F10486

Date Submitted	02/15/2022	**Section**	407.2.6	**Proponent**	Richard Logan
Chapter	4	**Affects HVHZ**	Yes	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments No

Alternate Language Yes

Related Modifications

Summary of Modification

The intent of this proposal is not for a technical change but is to separate the requirements for domestic cooking appliances and exhaust from the allowance for that area to be open to the corridor in a nursing home.

Rationale

The intent of this proposal is for no technical change but is to separate the requirements for domestic cooking appliances and exhaust from the allowance for that area to be open to the corridor in a nursing home. If someone wants to provide a domestic cooking area in a room in a nursing home or hospital, such as for therapy or nutrition training purposes, they would still have to follow all the domestic cooking regulations for the equipment. This is not intended to change any of the provisions for the commercial cooking areas. This is a joint effort between ICC and the American Society for Healthcare Engineering (ASHE), a subsidiary of the American Hospital Association, to eliminate duplication and conflicts in healthcare regulation. In 2017 the CHC held 2 open meetings and numerous conference calls, which included members of the committees as well as any interested parties, to discuss and debate the proposed changes. Information on the CHC, including: meeting agendas; minutes; reports; resource documents; presentations; and all other materials developed in conjunction with the CHC effort can be downloaded from the CHC website at: https://www.iccsafe.org/codes-tech-support/cs/icc-committee-on-healthcare/.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

There is no Impact to local entity relative to enforcement of code

Impact to building and property owners relative to cost of compliance with code

The code change proposal will not impact the cost of construction. This is an editorial separation with no technical changes. This clarifies domestic cooking appliances within a room in a Group I-2 – currently some code officials would ask for commercial hoods, others would ask for domestic hoods.

Impact to industry relative to the cost of compliance with code

There is no Impact to industry relative to the cost of compliance with code

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This proposed modification Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposed modification Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposed modification Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not degrade the effectiveness of the code

This proposed modification Does not degrade the effectiveness of the code

Alternate Language

2nd Comment Period

F10486-A1

Proponent Richard Logan **Submitted** 8/15/2022 11:23:00 AM **Attachments** Yes

Rationale:

This now contains a revision in 407.2.6 that clarifies this is for Group I-2, Condition 1 only. The intent of this proposal is for no technical change, but is to separate the requirements for domestic cooking appliances and exhaust from the allowance for that area to be open to the corridor in a nursing home. If someone wants to do a domestic cooking area in a room in a nursing home or hospital, such as for therapy or nutrition training purposes, they would still have to follow all the domestic cooking regulations for the equipment. This is not intended to change any of the provisions for the commercial cooking area. This is a joint effort between ICC and the American Society for Healthcare Engineering (ASHE), a subsidiary of the American Hospital Association, to eliminate duplication and conflicts in healthcare regulation

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

There is no Impact to local entity relative to enforcement of code

Impact to building and property owners relative to cost of compliance with code

The code change proposal will not impact the cost of construction. This is editorial with no technical changes. This clarifies domestic cooking appliances within a room in a Group I-2, Condition 1. Currently some code officials would ask for commercial hoods, others would ask for domestic hoods.

Impact to industry relative to the cost of compliance with code

There is no Impact to industry relative to the cost of compliance with code

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This proposed modification Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposed modification Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposed modification Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not degrade the effectiveness of the code

This proposed modification Does not degrade the effectiveness of the code

407.2.6 Nursing home cooking facilities.

In Group I-2, Condition 1, occupancies, rooms or spaces that contain a cooking facility with domestic cooking appliances shall be permitted to be open to the corridor where all of the following criteria are met:

1. The number of care recipients housed in the smoke compartment is not greater than 30.
2. The number of care recipients served by the cooking facility is not greater than 30.
3. Only one cooking facility area is permitted in a smoke compartment.

~~4. The types of domestic cooking appliances permitted are limited to ovens, cooktops, ranges, warmers and microwaves.~~

4. The corridor is a clearly identified space delineated by construction or floor pattern, material or color.
5. The space containing the domestic cooking facility shall be arranged so as not to obstruct access to the required exit.
6. ~~A domestic cooking hood installed and constructed in accordance with Section 505 of the *Florida Building Code, Mechanical* is provided over the cooktop or range.~~ The cooking appliances shall comply with Section 407.2.7

~~7. The domestic cooking hood provided over the cooktop or range shall be equipped with an automatic fire-extinguishing system of a type recognized for protection of domestic cooking equipment. Preengineered automatic extinguishing systems shall be tested in accordance with UL 300A and *listed* and *labeled* for the intended application. The system shall be installed in accordance with this code, its listing and the manufacturer's instructions.~~

~~8. A manual actuation device for the hood suppression system shall be installed in accordance with Sections 904.12.1 and 904.12.2.~~

~~9. An interlock device shall be provided such that upon activation of the hood suppression system, the power or fuel supply to the cooktop or range will be turned off.~~

~~10. A shut-off for the fuel and electrical power supply to the cooking equipment shall be provided in a location that is accessible only to staff.~~

~~11. A timer shall be provided that automatically deactivates the cooking appliances within a period of not more than 120 minutes.~~

~~12. A portable fire extinguisher shall be installed in accordance with the *Florida Fire Prevention Code.*~~

Add new text as follows:

407.2.7 Domestic cooking appliances

In Group I-2, Condition 1, occupancies, installation of cooking appliances used in domestic cooking facilities shall comply with all of the following:

The types of domestic cooking appliances permitted are limited to ovens, cooktops, ranges, warmers and microwaves.

2. A domestic cooking hood installed and constructed in accordance with Section 505 of the *Florida Building Code, Mechanical* is provided over the cooktop or range.
3. The domestic cooking hood provided over the cooktop or range shall be equipped with an automatic fire-extinguishing system of a type recognized for protection of domestic cooking equipment. Pre-engineered automatic extinguishing systems shall be tested in accordance with UL 300A and *listed* and *labeled* for the intended application. The system shall be installed in accordance with this code, its listing and the manufacturer's instructions.
4. A manual actuation device for the hood suppression system shall be installed in accordance with Sections 904.12.1 and 904.12.2.

5. An interlock device shall be provided such that upon activation of the hood suppression system, the power or fuel supply to the cooktop or range will be turned off.

6. A shut-off for the fuel and electrical power supply to the cooking equipment shall be provided in a location that is accessible only to staff.

7. A timer shall be provided that automatically deactivates the cooking appliances within a period of not more than 120 minutes.

8. A portable fire extinguisher shall be installed in accordance with the *Florida Fire Prevention Code*.

407.2.6 Nursing home cooking facilities.

In Group I-2, Condition 1, occupancies, rooms or spaces that contain a cooking facility with domestic cooking appliances shall be permitted to be open to the corridor where all of the following criteria are met:

1. The number of care recipients housed in the smoke compartment is not greater than 30.
2. The number of care recipients served by the cooking facility is not greater than 30.
3. Only one cooking facility area is permitted in a smoke compartment.

~~4. The types of domestic cooking appliances permitted are limited to ovens, cooktops, ranges, warmers and microwaves.~~

4. The corridor is a clearly identified space delineated by construction or floor pattern, material or color.
5. The space containing the domestic cooking facility shall be arranged so as not to obstruct access to the required exit.
6. ~~A domestic cooking hood installed and constructed in accordance with Section 505 of the *Florida Building Code, Mechanical* is provided over the cooktop or range.~~ The cooking appliances shall comply with Section 407.2.7
7. ~~The domestic cooking hood provided over the cooktop or range shall be equipped with an automatic fire extinguishing system of a type recognized for protection of domestic cooking equipment. Preengineered automatic extinguishing systems shall be tested in accordance with UL 300A and *listed* and *labeled* for the intended application. The system shall be installed in accordance with this code, its listing and the manufacturer's instructions.~~
8. ~~A manual actuation device for the hood suppression system shall be installed in accordance with Sections 904.12.1 and 904.12.2.~~
9. ~~An interlock device shall be provided such that upon activation of the hood suppression system, the power or fuel supply to the cooktop or range will be turned off.~~
10. ~~A shut-off for the fuel and electrical power supply to the cooking equipment shall be provided in a location that is accessible only to staff.~~
11. ~~A timer shall be provided that automatically deactivates the cooking appliances within a period of not more than 120 minutes.~~
12. ~~A portable fire extinguisher shall be installed in accordance with the *Florida Fire Prevention Code*.~~

Add new text as follows:

407.2.7 Domestic cooking appliances

In Group I-2, Condition 1, occupancies, installation of cooking appliances used in domestic cooking facilities shall comply with all of the following:

1. The types of domestic cooking appliances permitted are limited to ovens, cooktops, ranges, warmers and microwaves.
2. A domestic cooking hood installed and constructed in accordance with Section 505 of the *Florida Building Code, Mechanical* is provided over the cooktop or range.
3. The domestic cooking hood provided over the cooktop or range shall be equipped with an automatic fire-extinguishing system of a type recognized for protection of domestic cooking equipment. Pre-engineered automatic extinguishing systems shall be tested in accordance with UL 300A and *listed* and *labeled* for the intended application. The system shall be installed in accordance with this code, its listing and the manufacturer's instructions.

4. A manual actuation device for the hood suppression system shall be installed in accordance with Sections 904.12.1 and 904.12.2.
5. An interlock device shall be provided such that upon activation of the hood suppression system, the power or fuel supply to the cooktop or range will be turned off.
6. A shut-off for the fuel and electrical power supply to the cooking equipment shall be provided in a location that is accessible only to staff.
7. A timer shall be provided that automatically deactivates the cooking appliances within a period of not more than 120 minutes.
8. A portable fire extinguisher shall be installed in accordance with the *Florida Fire Prevention Code*.

407.2.6 Nursing home cooking facilities.

In Group I-2, Condition 1, occupancies, rooms or spaces that contain a cooking facility with domestic cooking appliances shall be permitted to be open to the corridor where all of the following criteria are met:

1. The number of care recipients housed in the smoke compartment is not greater than 30.
2. The number of care recipients served by the cooking facility is not greater than 30.
3. Only one cooking facility area is permitted in a smoke compartment.

~~4. The types of domestic cooking appliances permitted are limited to ovens, cooktops, ranges, warmers and microwaves.~~

4. The corridor is a clearly identified space delineated by construction or floor pattern, material or color.
5. The space containing the domestic cooking facility shall be arranged so as not to obstruct access to the required exit.
6. ~~A domestic cooking hood installed and constructed in accordance with Section 505 of the *Florida Building Code, Mechanical* is provided over the cooktop or range.~~ <u>The cooking appliances shall comply with Section 407.2.7</u>

~~7. The domestic cooking hood provided over the cooktop or range shall be equipped with an automatic fire-extinguishing system of a type recognized for protection of domestic cooking equipment. Preengineered automatic extinguishing systems shall be tested in accordance with UL 300A and *listed* and *labeled* for the intended application. The system shall be installed in accordance with this code, its listing and the manufacturer's instructions.~~

~~8. A manual actuation device for the hood suppression system shall be installed in accordance with Sections 904.12.1 and 904.12.2.~~

~~9. An interlock device shall be provided such that upon activation of the hood suppression system, the power or fuel supply to the cooktop or range will be turned off.~~

~~10. A shut-off for the fuel and electrical power supply to the cooking equipment shall be provided in a location that is accessible only to staff.~~

~~11. A timer shall be provided that automatically deactivates the cooking appliances within a period of not more than 120 minutes.~~

~~12. A portable fire extinguisher shall be installed in accordance with the *Florida Fire Prevention Code.*~~

Add new text as follows:

<u>**407.2.7 Domestic cooking appliances**</u>

<u>In Group I-2 occupancies, installation of cooking appliances used in domestic cooking facilities shall comply with all of the following:</u>

The types of domestic cooking appliances permitted are limited to ovens, cooktops, ranges, warmers and microwaves.

<u>2. A domestic cooking hood installed and constructed in accordance with Section 505 of the *Florida Building Code, Mechanical* is provided over the cooktop or range.</u>

<u>3. The domestic cooking hood provided over the cooktop or range shall be equipped with an automatic fire-extinguishing system of a type recognized for protection of domestic cooking equipment. Pre-engineered automatic extinguishing systems shall be tested in accordance with UL 300A and *listed* and *labeled* for the intended application. The system shall be installed in accordance with this code, its listing and the manufacturer's instructions.</u>

4. A manual actuation device for the hood suppression system shall be installed in accordance with Sections 904.12.1 and 904.12.2.

5. An interlock device shall be provided such that upon activation of the hood suppression system, the power or fuel supply to the cooktop or range will be turned off.

6. A shut-off for the fuel and electrical power supply to the cooking equipment shall be provided in a location that is accessible only to staff.

7. A timer shall be provided that automatically deactivates the cooking appliances within a period of not more than 120 minutes.

8. A portable fire extinguisher shall be installed in accordance with the *Florida Fire Prevention Code*.

407.2.6 Nursing home cooking facilities.

In Group I-2, Condition 1, occupancies, rooms or spaces that contain a cooking facility with domestic cooking appliances shall be permitted to be open to the corridor where all of the following criteria are met:

1. The number of care recipients housed in the smoke compartment is not greater than 30.
2. The number of care recipients served by the cooking facility is not greater than 30.
3. Only one cooking facility area is permitted in a smoke compartment.

~~4. The types of domestic cooking appliances permitted are limited to ovens, cooktops, ranges, warmers and microwaves.~~

4. The corridor is a clearly identified space delineated by construction or floor pattern, material or color.
5. The space containing the domestic cooking facility shall be arranged so as not to obstruct access to the required exit.
6. ~~A domestic cooking hood installed and constructed in accordance with Section 505 of the *Florida Building Code, Mechanical* is provided over the cooktop or range.~~ The cooking appliances shall comply with Section 407.2.7

~~7. The domestic cooking hood provided over the cooktop or range shall be equipped with an automatic fire-extinguishing system of a type recognized for protection of domestic cooking equipment. Preengineered automatic extinguishing systems shall be tested in accordance with UL 300A and *listed* and *labeled* for the intended application. The system shall be installed in accordance with this code, its listing and the manufacturer's instructions.~~

~~8. A manual actuation device for the hood suppression system shall be installed in accordance with Sections 904.12.1 and 904.12.2.~~

~~9. An interlock device shall be provided such that upon activation of the hood suppression system, the power or fuel supply to the cooktop or range will be turned off.~~

~~10. A shut-off for the fuel and electrical power supply to the cooking equipment shall be provided in a location that is accessible only to staff.~~

~~11. A timer shall be provided that automatically deactivates the cooking appliances within a period of not more than 120 minutes.~~

12. ~~A portable fire extinguisher shall be installed in accordance with the *Florida Fire Prevention Code*.~~

Add new text as follows:

407.2.7 Domestic cooking appliances

In Group I-2 occupancies, installation of cooking appliances used in domestic cooking facilities shall comply with all of the following:

1. The types of domestic cooking appliances permitted are limited to ovens, cooktops, ranges, warmers and microwaves.
2. A domestic cooking hood installed and constructed in accordance with Section 505 of the *Florida Building Code*, *Mechanical* is provided over the cooktop or range.
3. The domestic cooking hood provided over the cooktop or range shall be equipped with an automatic fire-extinguishing system of a type recognized for protection of domestic cooking equipment. Pre-engineered automatic extinguishing systems shall be tested in accordance with UL 300A and *listed* and *labeled* for the intended application. The system shall be installed in accordance with this code, its listing and the manufacturer's instructions.

4. A manual actuation device for the hood suppression system shall be installed in accordance with Sections 904.12.1 and 904.12.2.
5. An interlock device shall be provided such that upon activation of the hood suppression system, the power or fuel supply to the cooktop or range will be turned off.
6. A shut-off for the fuel and electrical power supply to the cooking equipment shall be provided in a location that is accessible only to staff.
7. A timer shall be provided that automatically deactivates the cooking appliances within a period of not more than 120 minutes.
8. A portable fire extinguisher shall be installed in accordance with the *Florida Fire Prevention Code*.

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

7

F10162

Date Submitted	02/10/2022	**Section**	508.4	**Proponent**	Greg Johnson
Chapter	5	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

Type IV mass timber package; Mod #10161 & others

Summary of Modification

This modification requires thermal barriers for mass timber elements in Type IVB and IVC construction.

Rationale

See uploaded rationale

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None; this is a typical plan review& inspection item.

Impact to building and property owners relative to cost of compliance with code

None, this is an optional construction method. Any cost can be avoided by using a different method of construction.

Impact to industry relative to the cost of compliance with code

None, this is an optional construction method. Any cost can be avoided by using a different method of construction.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This is a fire-resistive construction issue.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This improves the code by supporting new construction methods.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No material is required or prohibited by this code change.

Does not degrade the effectiveness of the code

No existing provisions are modified.

2nd Comment Period

F10162-G1

Proponent	Greg Johnson	Submitted	8/11/2022 6:28:58 PM	Attachments	No

Comment:

No provision of the FL Building Code prohibits the use of mass timber, and no provision of the FBC prohibits the use of mass timber elements in fire barriers or horizontal assemblies. This modification requires mass timber, that is used in a fire barrier or horizontal assembly to separate occupancies, to be protected with a thermal barrier of 1/2 inch gypsum board or equivalent material tested to NFPA 275.

2nd Comment Period

F10162-G2

Proponent	Sam Francis	Submitted	8/25/2022 4:32:49 PM	Attachments	No

Comment:

This modification is one of several mods that the TAC voted to Deny. after hearing testimony on the first one, and several subsequent ones, the TAC consistently voted to Deny the modifications. After seeing this occur several times, both proponents and opponents stood on their previous statements. The TAC voted to deny each subsequent item without further testimony. This was one of those modifications. When we reached out to opponents to seek input on properly amending the proposals, this was one of those which was not debated I strongly urge the TAC approve the MOD as originally submitted.

2nd Comment Period

F10162-G3

Proponent	ashley ong	Submitted	8/26/2022 4:00:42 PM	Attachments	No

Comment:

Building Officials Association of Florida (BOAF) supports this modification.

508.4.4.1 Construction.

Required separations shall be fire barriers constructed in accordance with Section 707 or horizontal assemblies constructed in accordance with Section 711, or both, so as to completely separate adjacent occupancies. Mass timber elements serving as fire barriers or horizontal assemblies to separate occupancies in Type IV-B or IV-C construction shall be separated from the interior of the building with an approved thermal barrier consisting of gypsum board that is not less than 1/2 inch (12.7 mm) in thickness or a material that is tested in accordance with and meets the acceptance criteria of both the Temperature Transmission Fire Test and the Integrity Fire Test of NFPA 275.

Reason: Sec. 508.4.4.1 thermal barrier for mass timber separating occupancies

AWC proposes this code change as part of a package which, when taken together, as a group, creates the safety and reliability requirements necessary for the regulation of large mass timber (MT) buildings by the Florida Building Code. The following statement was offered by the Ad Hoc Committee on Tall Wood Buildings (TWB) for this proposal (IBC-G89-18) in the ICC Code Development monograph 2018 Group A:

The Ad Hoc Committee on Tall Wood Buildings (TWB) was created by the ICC Board to explore the science of tall wood buildings and take action on developing code changes for tall wood buildings. The TWB has created several code change proposals with respect to the concept of tall buildings of mass timber and the background information is at the end of this Statement. Within the statement are important links to information, including documents and videos, used in the deliberations which resulted in these proposals.

This code change proposal represents one of many submitted designed to address a new type of construction called mass timber (e.g. new construction types IV-A, IV-B, and IV-C).

On this subject of "fire barriers," the committee determined that additional measures were necessary to address cases where mass timber is serving as a fire barrier or horizontal assembly. Section 508.4 describes the third option for separating mixed occupancies within a building.

The concern is that without any modifications to these provisions regulating separated occupancies and incidental uses, a fire barrier or horizontal assembly could be designed using mass timber that would comply with the fire resistance rating, but which would allow any exposed mass timber to contribute to the fuel load. This can occur in Types IV-B and IV-C construction.

The committee applied professional judgment by choosing to emulate the existing thermal barrier requirements by applying those requirements to this section. The intent of this proposal is to have the thermal barrier delay or prevent the ignition of the mass timber, thus delaying or preventing the mass timber's contribution to the fuel load.

This will also allow additional time for fire and life safety measures to be executed as well as allow first responders additional time to perform their services.

The committee's intent is that the thermal barrier only needs to cover an exposed wood surface. The thermal barrier is not required in addition to any noncombustible protection that is required in Section 602.4, nor does it add to the fire resistance rating of the mass timber.

Mass timber walls or floors serving as fire barriers for separated uses (Section 508.4) would need to have a thermal barrier on both faces of the assembly.

It should be noted that this proposal is only addressing the contribution of exposed mass timber's face to the fuel load of a fire, and is not recommending any modifications to the fire resistance requirements of Section 508 or to the other mass timber provisions.

The Ad Hoc Committee for Tall Wood Buildings (AHC-TWB) was created by the ICC Board of Directors to explore the building science of tall wood buildings with the scope to investigate the feasibility of and take action on developing code changes for these buildings. Members of the AHC-TWB were appointed by the ICC Board of Directors. Since its creation in January 2016, the AHC-TWB has held 8 open meetings and numerous Work Group conference calls. Four Work Groups were established to address over 80 issues and concerns and review over 60 code proposals for consideration by the AHC-TWB. Members of the Work Groups included AHC-TWB members and other interested parties. Related documentation and reports are posted on the AHC-TWB website at:

https://www.iccsafe.org/codes-tech-support/cs/icc-ad-hoc-committee-on-tall-wood-buildings/ .

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F10163

8

Date Submitted	02/10/2022	**Section**	509.4	**Proponent**	Greg Johnson
Chapter	5	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

New Type IV mass timber package; Mods# 10161, 10162, and more

Summary of Modification

Requires thermal barriers for fire barriers and horizontal assemblies in Type IVB and IVC construction.

Rationale

See uploaded rationale

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None, typical plan review and inspections would be required.

Impact to building and property owners relative to cost of compliance with code

None. This is an optional method of construction; no cost accrues unless selected by the owner.

Impact to industry relative to the cost of compliance with code

None. This is an optional method of construction; no cost accrues unless selected by the owner.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This provides requirements for fire-resistive construction.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Improves the code by supporting new construction methods.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No material is required or prohibited by this change.

Does not degrade the effectiveness of the code

The code is improved by supporting new methods of construction.

2nd Comment Period

F10163-G1

Proponent Greg Johnson Submitted 8/11/2022 6:31:51 PM Attachments No

Comment:

No provision of the FL Building Code prohibits the use of mass timber, and no provision of the FBC prohibits the use of mass timber elements in fire barriers or horizontal assemblies. This modification requires mass timber, that is used in a fire barrier or horizontal assembly to separate incidental uses, to be protected with a thermal barrier of 1/2 inch gypsum board or equivalent material tested to NFPA 275.

2nd Comment Period

F10163-G2

Proponent ashley ong Submitted 8/26/2022 4:01:35 PM Attachments No

Comment:

Building Officials Association of Florida (BOAF) supports this modification.

2nd Comment Period

F10163-G3

Proponent Sam Francis Submitted 8/26/2022 10:06:37 PM Attachments No

Comment:

This modification is one of several mods that the TAC voted to Deny. after hearing testimony on the first one, and several subsequent ones, the TAC consistently voted to Deny the modifications. After seeing this occur several times, both proponents and opponents stood on their previous statements. The TAC voted to deny each subsequent item without further testimony. This was one of those modifications. When we reached out to opponents to seek input on properly amending the proposals, this was one of those which was not debated I strongly urge the TAC approve the MOD as originally submitted.

509.4.1 Separation.
Where Table 509 specifies a fire-resistance-rated separation, the incidental uses shall be separated from the remainder of the building by a fire barrier constructed in accordance with Section 707 or a horizontal assembly constructed in accordance with Section 711, or both. Construction supporting 1-hour fire barriers or horizontal assemblies used for incidental use separations in buildings of Type IIB, IIIB and VB construction is not required to be fire-resistance rated unless required by other sections of this code.

509.4.1.1 Type IV-B and IV-C construction. Where Table 509.1 specifies a fire-resistance-rated separation, mass timber elements serving as fire barriers or horizontal assemblies in Type IV-B or IV-C construction shall be separated from the interior of the incidental use with an approved thermal barrier consisting of gypsum board that is not less than 1/2 inch (12.7mm) in thickness or a material that is tested in accordance with and meets the acceptance criteria of both the Temperature Transmission Fire Test and the Integrity Fire Test of NFPA 275.

Reason:

AWC proposes this code change as part of a package which, when taken together, as a group, creates the safety and reliability requirements necessary for the regulation of large mass timber (MT) buildings by the Florida Building Code. The following statement was offered by the Ad Hoc Committee on Tall Wood Buildings (TWB) for this proposal (IBC-G89-18) in the ICC Code Development monograph 2018 Group A:

The Ad Hoc Committee on Tall Wood Buildings (TWB) was created by the ICC Board to explore the science of tall wood buildings and take action on developing code changes for tall wood buildings. The TWB has created several code change proposals with respect to the concept of tall buildings of mass timber and the background information is at the end of this Statement. Within the statement are important links to information, including documents and videos, used in the deliberations which resulted in these proposals.

This code change proposal represents one of many submitted designed to address a new type of construction called mass timber (e.g. new construction types IV-A, IV-B, and IV-C).

On this subject of "fire barriers," the committee determined that additional measures were necessary to address cases where mass timber is serving as a fire barrier or horizontal assembly

Section 509.4 discusses the fire-resistance rated separation that is required for incidental uses within a larger use group. Section 509 also permits, when stated, protection by an automatic sprinkler system without fire barriers, however the construction enclosing the incidental use must resist the passage of smoke in accordance with Section 509.4.2.

The concern is that without any modifications to these provisions regulating separated occupancies and incidental uses, a fire barrier or horizontal assembly could be designed using mass timber that would comply with the fire resistance rating, but which would allow any exposed mass timber to contribute to the fuel load. This can occur in Types IV-B and IV-C construction.

The committee applied professional judgment by choosing to emulate the existing thermal barrier requirements by applying those requirements to these two sections. The intent of this proposal is to have the thermal barrier delay or prevent the ignition of the mass timber, thus delaying or preventing the mass timber's contribution to the fuel load.

This will also allow additional time for fire and life safety measures to be executed as well as allow first responders additional time to perform their services.

The committee's intent is that the thermal barrier only needs to cover an exposed wood surface. The thermal barrier is not required in addition to any noncombustible protection that is required in Section 602.4, nor does it add to the fire resistance rating of the mass timber.

Mass timber walls or floors serving as fire barriers for separated uses (Section 508.4) would need to have a thermal barrier on both faces of the assembly.

For Section 509.4 (incidental use separations) the intent is to provide the thermal barrier only on the side where the hazard exists, that is, the side facing the incidental use. For example, if a mass timber floor assembly of the incidental use contains a noncombustible topping this provision would not require the addition of a thermal barrier on mass timber surfaces not facing the incidental use area. In addition, the thermal barrier would not be required if the sprinkler option is exercised.

It should be noted that this proposal is only addressing the contribution of exposed mass timber's face to the fuel load of a fire, and is not recommending any modifications to the fire resistance requirements of Sections 508 or 509 or to the other mass timber provisions.

The Ad Hoc Committee for Tall Wood Buildings (AHC-TWB) was created by the ICC Board of Directors to explore the building science of tall wood buildings with the scope to investigate the feasibility of and take action on developing code changes for these buildings. Members of the AHC-TWB were appointed by the ICC Board of Directors. Since its creation in January 2016, the AHC-TWB has held 8 open meetings and numerous Work Group conference calls. Four Work Groups were established to address over 80 issues and concerns and review over 60 code proposals for consideration by the AHC-TWB. Members of the Work Groups included AHC-TWB members and other interested parties. Related documentation and reports are posted on the AHC-TWB website at:

https://www.iccsafe.org/codes-tech-support/cs/icc-ad-hoc-committee-on-tall-wood-buildings/ .

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F10254

9

Date Submitted	02/11/2022	**Section**	504	**Proponent**	Greg Johnson
Chapter	5	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

Type IV mass timber changes including mods# 10098, 10099, 10161, 10162, 10163, 10167, 10169, 10174, 10248 and others

Summary of Modification

Adds Type IVA, IVB, and IVC height limits in feet

Rationale

See uploaded rationale

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None; typical plan review and inspection are required.

Impact to building and property owners relative to cost of compliance with code

This may lower the cost of construction generally by providing new alternatives which should stimulate competition.

Impact to industry relative to the cost of compliance with code

This may lower the cost of construction generally by providing new alternatives which should stimulate competition.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This modification limits the heights of new construction types.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This improves the code by supporting new alternative methods of construction.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No materials are required or prohibited by this modification.

Does not degrade the effectiveness of the code

This improves the code by supporting new alternative methods of construction.

2nd Comment Period

F10254-G1

Proponent	Greg Johnson	Submitted	8/11/2022 6:19:39 PM	Attachments	No

Comment:

This modification provides appropriate limits on the height in feet of Type IV mass timber buildings.

2nd Comment Period

F10254-G2

Proponent	ashley ong	Submitted	8/26/2022 3:58:38 PM	Attachments	No

Comment:

Building Officials Association of Florida (BOAF) supports this modification.

2nd Comment Period

F10254-G3

Proponent	Sam Francis	Submitted	8/26/2022 10:02:49 PM	Attachments	No

Comment:

This modification is one of several mods that the TAC voted to Deny. After hearing testimony on the first modification, the TAC consistently voted to Deny the modifications. After seeing this occur several times, both proponents and opponents stood on their previous statements. The TAC voted to deny each subsequent item without further testimony. This was one of those modifications. When we reached out to opponents to seek input on properly amending the proposals, this was one of those not previously debated before the TAC and which was not in dispute during those discussions. I strongly urge the TAC approve the MOD as originally submitted.

TABLE 504.3ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE

OCCUPANCYCLASSIFICATION	See Footnotes	TYPEOFCONSTRUCTION											
		TypeI		TypeII		TypeIII		TypeIV				TypeV	
		A	B	A	B	A	B	A	B	C	HT	A	B
A, B,E,F,M,S,U	NS[b]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	270	180	85	85	70	60
H-1,H-2,H-3,H-5	NS[c,d]	UL	160	65	55	65	55	-	-	-	65	50	40
	S							120	90	65			
H-4	NS[c,d]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	140	100	85	85	70	60
I-1Condition 1,I-3	NS[d,e]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
I-1Condition 2,I-2	NS[d,e,f]	UL	160	65	55	65	55	65	-	-	65	50	40
	S	UL	180	85					65	65			
I-4	NS[d,g]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
R[h]	NS[d]	UL	160	65	55	65	55	65	65	65	65	50	40
	S13D	60	60	60	60	60	60	60	60	60	60	50	40
	S13R	60	60	60	60	60	60	60	60	60	60	60	60
	S	UL	180	85	75	85	75	270	180	85	85	70	60

Table 504.3 Allowable Building Height in Feet rationale

AWC proposes this code change as part of a package which, when taken together, as a group, creates the safety and reliability requirements necessary for the regulation of large mass timber (MT) buildings by the Florida Building Code. The following statement was offered by the Ad Hoc Committee on Tall Wood Buildings (TWB) for this proposal (IBC-G75-18) in the ICC Code Development monograph 2018 Group A:

The Ad Hoc Committee on Tall Wood Buildings (TWB) was created by the ICC Board to explore the science of tall wood buildings and take action on developing code changes for tall wood buildings. The TWB has created several code change proposals with respect to the concept of tall buildings of mass timber and the background information is at the end of this Statement. Within the statement are important links to information, including documents and videos, used in the deliberations which resulted in these proposals.

The TWB and it various WGs held meetings, studied issues and sought input from various expert sources around the world. The TWB has posted those documents and input on its website for interested parties to follow its progress and to allow those parties to, in turn, provide input to the TWB.

At its first meeting, the TWB discussed a number of performance objectives to be met with the proposed criteria for tall wood buildings:

1. No collapse under reasonable scenarios of complete burn-out of fuel without automatic sprinkler protection being considered.

2. No unusually high radiation exposure from the subject building to adjoining properties to present a risk of ignition under reasonably severe fire scenarios.

3. No unusual response from typical radiation exposure from adjacent properties to present a risk of ignition of the subject building under reasonably severe fire scenarios.

4. No unusual fire department access issues.

5. Egress systems designed to protect building occupants during the design escape time, plus a factor of safety.

6. Highly reliable fire suppression systems to reduce the risk of failure during reasonably expected fire scenarios. The degree of reliability should be proportional to evacuation time (height) and the risk of collapse.

The comprehensive package of proposals from the TWB meet these performance objectives. The TWB also determined that fire testing was necessary to validate these concepts. At its first meeting, members discussed the nature and intention of fire testing so as to ensure meaningful results for the TWB and, more specifically, for the fire service.

Subsequently a test plan was developed. The fire tests consisted of one-bedroom apartments on two levels, with both apartments having a corridor leading to a stair. The purpose of the tests was to address the contribution of mass timber to a fire, the performance of connections, the performance of joints, and to evaluate conditions for responding fire personnel. The Fire WG then refined the test plan, which was implemented with a series of five, full-scale, multiple-story building tests at the Alcohol, Tobacco and

Firearms (ATF) laboratories in Beltsville, MD. The results of those tests, as well as testing conducted by others, helped form the basis upon which the Codes WG developed its code change proposals.

This code change proposal is one of those developed by the Codes WG and approved by the TWB.

To review a summary of the fire tests, please visit:

http://bit.ly/ATF-firetestreport (accessed 02-11-2022)

To watch summary videos of the fire tests, which are accelerated to run in 3-1/2 minutes each, please visit:

http://bit.ly/ATF-firetestvideos (accessed 02-11-2022)

Allowable Height

This proposal addresses the allowable building height, in terms of feet, for the three new construction types proposed by the TWB. As set forth in the proposal to Section 602.4, the three new types of construction are Types IV-A, IV-B, and IV-C.

The Committee examined each proposed type of construction for its safety and efficacy with regard to each occupancy type.

The following approach was used to develop proposed allowable heights of the new construction types, based on the conclusions of the Committee:

1. Based upon TWB review of fire safety and structural integrity performance, Type IV-B is equated to Type I-B for height (in feet). A noteworthy item to remember is that, per Section 403.2.1.1 of the IBC, Type IB construction is permitted to be reduced to 1-hour Fire Resistance rating; however, the TWB does not propose to allow the same reduction for Type IV-B. As a result, the comparison is between 2-hr mass timber construction that is partially exposed, versus 1-hr Type IB construction, and the Committee believes that 2-hr mass timber construction that is partially exposed per the limits of proposed Section 602.4 warrants the same heights as allowed for 1-hr Type I-B construction. It should be noted that the unprotected mass timber also needs to meet the 2 hour FRR, thus the protected area will likely be conservatively higher FRR than actually required;

2. Type IV-A should be somewhat larger than IV-B, as Type IV-A construction is entirely protected (no exposed mass timber permitted) and the required rating of the structure is equivalent to those required of Type I-A construction (3-hr rating for structural frame). However, the Committee did not find it acceptable to allow the unlimited heights of Type I-A to be applied to Type IV-A. Instead, the Committee applied a multiplier of 1.5 to the heights proposed for Type IV-B construction, in order to propose reasonable height allowances for IV-A construction;

3. The Committee viewed Type IV-C as similar to existing HT construction with the exception that IV-C has a 2 hour FRR where HT is acceptably fire resistant based on the large sizes of the members. As such, the height in feet is proposed to be equal to the height in feet of Type IV-HT. In terms of stories, however, the Committee proposed an additional number of stories for IV-C in recognition of its greater FRR.

4. While the base code seems to allow significant heights for buildings without sprinklers (e.g., Table 504.3 currently allows a height of 160 feet for NS Type I-B construction for many occupancy classifications), the

Committee believes that no additional heights over what is already permitted for Type IV-HT would be proposed for the NS (non sprinklered) rows.

As such, where separate rows are provided for heights for the NS situation, the proposed heights for Types IV-A, IV-B, and IV-C are the same as those heights already permitted for Type IV for the NS condition.

This methodology explains the majority of the recommendations here. Specifically, for occupancy groups A, B, E, F, M, R, S, U, the methodology described above accurately reflects how the height proposals were developed.

The I-4 heights, for sprinklered buildings, were modified by the ICC hearing committee to be 180 feet for a Type IVA building and 120 feet for a Type IVB building.

After undergoing this methodology to develop initial height recommendations, the Committee then applied professional judgment (from both a fire safety and a structural perspective), to develop a working draft table, cell by cell, for all occupancy types.

The exercise for establishing the allowable number of stories for the three new types of construction started with setting Type I-B allowances equivalent to Type IV-B. The tabular fire resistance ratings of building elements for these two types of construction is identical (not including the reduction permitted by 403.2.1.1), so the identical number of stories was deemed a reasonable starting point. From this point, the TWB Committee reviewed each occupancy classification to see if the Type I-B story allowance required adjustment.

Following is a summary of how allowable number of stories for sprinklered I-B were adjusted for IV-B:

A-1, A-2, A-3, A-4, A-5, B, E, H-1, H-5, I-1(1), I-1(2), I-2, I-3, R-1, R-2, R-3, R-4, U: no adjustment, same number of allowable stories as Type I-B.

F-1 and S-1: reduced from 12 to 7 (2 story increase from Type IV-HT)

F-2, M, S-2: reduced from 12 to 8 (2 story increase from Type IV-HT)

H-2: reduced from 3 to 2 (same as Type IV-HT)

H-3: reduced from 6 to 4 (same as IV-Type HT)

H-4: reduced from 8 to 7 (1 story increase from Type IV-HT)

Similarly, to establish the height in feet for Type IV-B:

A-1, A-2, A-3, A-4, A-5, B, E, F-1, F-2, M, R-1, R-2, R-3, R-4, S-1, S-2, U: same allowable height as I-B.

H-1, H-2, H-3: reduced from 180’ to 90’

H-4: reduced from 180’ to 100’

H-5: reduced from 160’ to 90’

I-1(1): reduced from 180’ to 120’

I-1(2): reduced from 180’ to 65’

I-2: reduced from 180’ to 65’

I-3: reduced from 180’ to 120’

Adjusting IV-B up to IV-A for allowable number of stories:

A-1, A-2, A-3, A-4, A-5, B, E, F-2, I-4, M, R-1, R-2, R-3, R-4, S-1, S-2, U – 1.5 x IV-B number of stories

F-1, S-1 increase by 3 stories

H-1, H-3 same as IV-HT

H-2, H-4, H-5 increase by 1 story

I-1(1), I-1(2), I-2, I-3 increase by 2 stories

H-3 reduced from 6 to 4 (same as IV-HT)

H-4 reduced from 8 to 7 (1 story increase from IV-HT)

I-l(1), I-1(2), I-2, I-3, same as IV-HT

Adjusting IV-B to IV-A for building height:

A-1, A-2, A-3, A-4, A-5, B, E, F-1, F-2, H-1, H-5, I-1(1), I-3, I-4, M, R-1, R-2, R-3, R-4, S-1, S-2, U: multiply 1.5 x Type IV-B

(180 ft.)

H-1, H-2 H-3, H-5: increase by 30 ft.

H-4: increase by 40 ft.

I-1(2), I-2: same as Type IV-HT

For instance, for Groups H-1, H-2, H-3, and H-5, while the table allows 160 feet for Type I-B construction, the Committee proposed a height of 90 feet for Type IV-B construction, and is using a multiplier of 1.33 to propose a height for Type IV-A construction of 120 feet height, intentionally made equal to the existing Heavy Timber heights.

For H-4, corrosives represent a health hazard (but not necessarily a fire hazard) to building occupants and first responders, the Committee believed that reduced heights were warranted. These are slightly greater than discussed above for the H-occupancy groups (140 feet versus 120 feet for IV-A construction, and 100 feet versus 90 feet for IV-B construction), but these still are far below what is permitted for Type I-B construction (180 feet permitted for the sprinklered condition), and is in recognition of the particular type of Hazardous occupancy covered by the H-4 occupancy group.

For Group I occupancies, there are two rows in the table, one being a row that includes I-1 Condition 1 and I-3 occupants (more capable of self-preservation) and the other being a row that includes I-1 Condition 2 and I-2 occupants (less capable of self-preservation). For I-1 Condition 1 and I-3 occupants, the Committee proposed a height of 120 feet for Type IV-B (versus 180 feet from the general methodology summarized above) and a height of 180 feet for Type IV-A (versus 270 feet from the general methodology summarized above). For those I-1 Condition 2 and I-2 occupants, the Committee took a very conservative approach and will only allow the heights that are already permitted by code for traditional Type IV construction.

Background information: The ICC Board approved the establishment of an ad hoc committee for tall wood buildings in December of 2015. The purpose of the ad hoc committee is to explore the science of tall wood buildings and to investigate the feasibility and take action on developing code changes for tall wood buildings. The committee is comprised of a balance of stakeholders with additional opportunities for interested parties to participate in the four Work Groups established by the ad hoc committee, namely: Code; Fire; Standards/Definitions; and Structural. For more information, be sure to visit the ICC website https://www.iccsafe.org/codes-tech-support/cs/icc-ad-hoc-committee-on-tall-wood-buildings/ (accessed 02-11-2022)

As seen in the “Meeting Minutes and Documents” and “Resource Documents” sections of the committee web page, the ad hoc committee reviewed a substantial amount of information in order to provide technical justification for code proposals.

The ad hoc committee developed proposals for the followings code sections. The committee believes this package of code changes will result in regulations that adequately address the fire and life safety issues of tall mass timber buildings.

AWC’s public comment in support of As Modified by the ICC hearing committee. Commenter's Reason: AWC was appointed to be a member of the ICC Tall Wood Building Ad Hoc Committee (TWB), the single wood industry representative on the TWB. AWC is not speaking for TWB on this issue. It simply is relaying information regarding the development of the proposals. Other members of the 16-member TWB included representation from architects, engineers, fire protection engineers, fire marshals, testing laboratories, and fire fighters, as well as the major materials industries. After two years of study, listening to testimony, reviewing documents, reviewing public input, conducting an extensive test program, and reviewing test results from tests around the world, the TWB made this proposal to ICC for the membership s consideration.

Early in the process, the TWB heard proposals from four different commentors suggesting maximum stories of 20, 24, 40, and 42 stories. The TWB worked through dozens of drafts of the proposed new types of construction, dozens more pertaining to the building height in stories, nearly a dozen pertaining to building height in feet and nearly a dozen regarding maximum permitted building area per floor. These documents were all posted to the TWB page of the ICC website. Comments were solicited for all drafts.

The first aspect of height and area taken up by the TWB was height in stories. That seemed to be the easiest to get at with the information gleaned from the testimony and documentation presented to the TWB. Experts from around the world presented a case to the TWB that mass timber was equivalent to types I-A and I-B in every way other than the combustibility of the base material. They outlined various strategies for overcoming that combustibility issue. The TWB relied upon this concept of equivalent performance to determine its maximum permitted height in stories. The Reason Statement provided by the TWB Chairman, Steve DiGiovanni, clearly laid out the background for, and the process of, the deliberation on Height in Stories. That is a must read to understand this process and its outcomes.

Next, based upon comments submitted, TWB tried to assign height in feet to its chosen maximum stories. In its first drafts, the maximum number of stories for proposed type IV-A was 24 for a few occupancy groups. Similarly, IV-B was proposed to be limited to 12 stories based on the equivalency mentioned above. Thus, IV-B was assigned the same maximum height in feet as type I-B, 180 feet. Regarding the fire service's ability to address fires in mass timber buildings at these heights, the following rationale was used:

The height limit, in feet, proposed for Type IV-B is even more conservative when considering that Type IV-B requires a greater degree of fire resistance than that of I-B when the fire-resistance rating of the building elements in Type IB construction are reduced to only the fire-resistance ratings required for Type IIA as permitted by Section 403.2.1 of the IBC. In effect, the proposed 2-hour fire resistance ratings required for Type IV-B will be twice that allowed by the IBC, since its inception, for those buildings under 420 feet whose building elements are permitted to be of only 1 hour fire resistance in accordance with the high rise provisions of Chapter 4, which will not apply to the proposed mass timber construction types.

Type I-A is, in most cases unlimited in height. The TWB agreed that the performance of IV-A was equivalent, but its conservative approach meant that they chose not to permit IV-A to enjoy the unlimited height that I-A does. In fact, the approach was so conservative that it considered only increasing the height in feet by 50% over type IV-B. So a modest increase of 50% was chosen. This is infinitely less than the unlimited height in feet permitted in type I-A for nearly every use group.

The reason statement offered by the TWB for this proposal clearly explains that the allowable height in feet was determined by assessing the overall performance of the new types of construction and equating them to existing types of construction. It also clearly defines the acceptable performance which it found to be equivalent to the higher types.

From the beginning, the TWB has been committed to criteria which result in acceptable performance.

The fire test program, drafted by the Fire Work Group of the TWB may be seen as videos of each of the five tests. They can be found at this link or on the ICC TWB web page.

https://www.youtube.com/playlist?list=PL_sDiz8JiMlwby77vfpPSPucEhBuEK22P (accessed 02/11/2022)

This proposal is thoroughly conservative. The following points address claims made by opponents in the ICC code development process:

Concerns about exterior fire testing:

The TWB proposals significantly reduce the risk of exterior building surface flame propagation by prohibiting all combustibles on the exterior side of exterior walls (except for the required water resistive barrier). Continuous insulation on the exterior, where provided, will be non-combustible. In addition, protection with at least 40 minutes of noncombustible material (typically a layer of 5/8-inch type X gypsum wallboard) is required on the outside of mass timber exterior walls.

What is proposed therefore is more conservative than any other construction type, including Types I and II, virtually eliminating the possibility of fire spread on exterior walls due to combustible materials.

Concerns about the testing's relevance to tall wood buildings:

The testing was designed by fire service representation on the TWB committee to directly address potential tall wood buildings, regardless of height. Rather than rely on standardized testing of building assemblies alone, with fire service input the TWB committee chose to undertake full-scale, multistory compartment testing, with high residential fuel loads for which no standardized test exists. Furthermore, in four of the five tests, the normal operation of the required automatic fire suppression system (sprinklers) was not allowed. The fires in tests applicable to the proposed 18 and 12 story limits (Types IV-A and IV-B respectively) were allowed to continue throughout the decay phase and well past burn-out, Type I-A is, in most cases unlimited in height. The TWB agreed that the performance of IV-A was equivalent, but its conservative approach meant that they chose not to permit IV-A to enjoy the unlimited height that I-A does. In fact, the approach was so conservative that it considered only increasing the height in feet by 50% over type IV-B. So a modest increase of 50% was chosen. This is infinitely less than the unlimited height in feet permitted in type I-A for nearly every use group.

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F10255

10

Date Submitted	02/11/2022	**Section**	504.4	**Proponent**	Greg Johnson
Chapter	5	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

Type IV mass timber changes including mods# 10098, 10099, 10161, 10162, 10163, 10167, 10169, 10174, 10248, 10254 and more

Summary of Modification

Addition of Type IV-A, IV-B, and IV-C construction types to allowable number of stories table

Rationale

See uploaded rationale

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None. Typical plan review and inspection.

Impact to building and property owners relative to cost of compliance with code

As a new construction alternative, this should generally put downward pressure on cost because of competition.

Impact to industry relative to the cost of compliance with code

As a new construction alternative, this should generally put downward pressure on cost because of competition.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This limits new construction types by number of stories above grade - a fire safety issue.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Improves the code by providing a new alternative method of construction.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This modification does not require or prohibit any material.

Does not degrade the effectiveness of the code

Improves the code by providing a new alternative method of construction.

2nd Comment Period

F10255-G1

Proponent	Greg Johnson	Submitted	8/11/2022 6:20:45 PM	Attachments	No

Comment:

This modification provides appropriate limits on the height in stories of Type IV mass timber buildings.

2nd Comment Period

F10255-G2

Proponent	ashley ong	Submitted	8/26/2022 3:59:14 PM	Attachments	No

Comment:

Building Officials Association of Florida (BOAF) supports this modification.

2nd Comment Period

F10255-G3

Proponent	Sam Francis	Submitted	8/26/2022 10:15:34 PM	Attachments	No

Comment:

This modification is one of several mods that the TAC voted to Deny. after hearing testimony on the first modification, the TAC consistently voted to Deny the modifications. After seeing this occur several times, both proponents and opponents stood on their previous statements. The TAC voted to deny each subsequent item without further testimony. This was one of those modifications. When we reached out to opponents to seek input on properly amending the proposals, this was one of those which was not debated. As may be seen in the attached Word table, the opponents agreed this is a worthy change. The required wall test, NFPA 285 was incorporated into Section 602.4 so the comment in the Word Table attached is satisfied and we support this change as originally submitted. I strongly urge the TAC approve the MOD as originally submitted.

TABLE 504.4 ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE

OCCUPANCY CLASSIFICATION	See Foot-notes	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A-1	NS	UL	5	3	2	3	2	3	3	3	3	2	1
	S	UL	6	4	3	4	3	9	6	4	4	3	2
A-2	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-3	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-4	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-5	NS	UL	UL	UL	UL	UL	UL	1	1	1	UL	UL	UL
	S	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
B	NS	UL	11	5	3	5	3	5	5	5	5	3	2
	S	UL	12	6	4	6	4	18	12	9	6	4	3
E	NS	UL	5	3	2	3	2	3	3	3	3	1	1
	S	UL	6	4	3	4	3	9	6	4	4	2	2
F-1	NS	UL	11	4	2	3	2	3	3	3	4	2	1
	S	UL	12	5	3	4	3	10	7	5	5	3	2
F-2	NS	UL	11	5	3	4	3	5	5	5	5	3	2
	S	UL	12	6	4	5	4	12	8	6	6	4	3
H-1	NSc,d							NP	NP	NP			
	S	1	1	1	1	1	1	1	1	1	1	1	NP
H-2	NSc,d							1	1	1			
	S	UL	3	2	1	2	1	2	2	2	2	1	1
H-3	NSc,d							3	3	3			
	S	UL	6	4	2	4	2	4	4	4	4	2	1
H-4	NSc,d	UL	7	5	3	5	3	5	5	5	5	3	2
	S	UL	8	6	4	6	4	8	7	6	6	4	3
H-5	NSc,d							2	2	2			
	S	4	4	3	3	3	3	3	3	3	3	3	2
I-1 Condition1	NSd,e	UL	9	4	3	4	3	4	4	4	4	3	2
	S	UL	10	5	4	5	4	10	7	5	5	4	3
I-1 Condition2	NSd,e	UL	9	4				3	3	3			
	S	UL	10	5	3	4	3	10	6	4	4	3	2
I-2	NSd,f	UL	4	2				NP	NP	NP			
	S	UL	5	3	1	1	NP	7	5	1	1	1	NP
I-3	NSd,e	UL	4	2	1	2	1	2	2	2	2	2	1
	S	UL	5	3	2	3	2	7	5	3	3	3	2
I-4	NSd,g	UL	5	3	2	3	2	3	3	3	3	1	1
	S	UL	6	4	3	4	3	9	6	4	4	2	2
M	NS	UL	11	4	2	4	2	4	4	4	4	3	1
	S S	UL	12	5	3	5	3	12	8	6	5	4	2
	NSd	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4									4	3

R-1[h]	S	UL	12	5	5	5	5	18	12	8	5	4	3
R-2[h]	NS[d]	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4	4								4	3
	S	UL	12	12	5	5	5	18	12	8	5	4	3
R-3[h]	NS[d]	UL	11	4	4	4	4	4	4	4	4	3	3
	S13D	4	4									3	3
	S13R	4	4									4	4
	S	UL	12	5	5	5	5	18	12	5	5	4	4
R-4[h]	NS[d]	UL	11	4	4	4	4	4	4	4	4	3	2
	S13D	4	4									3	2
	S13R	4	4									4	3
	S	UL	12	5	5	5	5	18	12	5	5	4	3
S-1	NS	UL	11	4	2	3	2	4	4	4	4	3	1
	S	UL	12	5	3	4	3	10	7	5	5	4	2
S-2	NS	UL	11	5	3	4	3	4	4	4	5	4	2
	S	UL	12	6	4	5	4	12	8	5	5	5	3
U	NS	UL	5	4	2	3	2	4	4	4	4	2	1
	S	UL	6	5	3	4	3	9	6	5	5	3	2

Table 504.4 Allowable number of stories rationale

AWC proposes this code change as part of a package which, when taken together, as a group, creates the safety and reliability requirements necessary for the regulation of large mass timber (MT) buildings by the Florida Building Code. The following statement was offered by the Ad Hoc Committee on Tall Wood Buildings (TWB) for this proposal (IBC-G80-18) in the ICC Code Development monograph 2018 Group A:

Reason: The Ad Hoc Committee on Tall Wood Buildings (TWB) was created by the ICC Board to explore the science of tall wood buildings and take action on developing code changes for tall wood buildings. The TWB has created several code change proposals with respect to the concept of tall buildings of mass timber and the background information is at the end of this Statement. Within the statement are important links to information, including documents and videos, used in the deliberations which resulted in these proposals.

The TWB and it various WGs held meetings, studied issues and sought input from various expert sources around the world. The TWB has posted those documents and input on its website for interested parties to follow its progress and to allow those parties to, in turn, provide input to the TWB.

At its first meeting, the TWB discussed a number of performance objectives to be met with the proposed criteria for tall wood buildings:

1. No collapse under reasonable scenarios of complete burn-out of fuel without automatic sprinkler protection being considered.

2. No unusually high radiation exposure from the subject building to adjoining properties to present a risk of ignition under reasonably severe fire scenarios.

3. No unusual response from typical radiation exposure from adjacent properties to present a risk of ignition of the subject building under reasonably severe fire scenarios.

4. No unusual fire department access issues.

5. Egress systems designed to protect building occupants during the design escape time, plus a factor of safety.

6. Highly reliable fire suppression systems to reduce the risk of failure during reasonably expected fire scenarios. The degree of reliability should be proportional to evacuation time (height) and the risk of collapse.

The TWB also determined that fire testing was necessary to validate these concepts. At its first meeting, members discussed the nature and intention of fire testing so as to ensure meaningful results for the TWB and, more specifically, for the fire service. Subsequently a test plan was developed. The fire tests consisted of one-bedroom apartments on two levels, with both apartments having a corridor leading to a stair. The purpose of the tests was to address the contribution of mass timber to a fire, the performance of connections, the performance of joints, and to evaluate conditions for responding fire personnel. The Fire WG then refined the test plan, which was implemented with a series of five, full-scale, multiple-story building tests at the Alcohol, Tobacco and Firearms (ATF) laboratories in Beltsville, MD.

The results of those tests, as well as testing conducted by others, helped form the basis upon which the Codes WG developed its code change proposals. This code change proposal is one of those developed by the Codes WG and approved by the TWB.

To review a summary of the fire tests, please visit: http://bit.ly/ATF-firetestreport (accessed 02-11-2022)

To watch summary videos of the fire tests, which are accelerated to run in 3-1/2 minutes each, please visit: http://bit.ly/ATF-firetestvideos (accessed 02-11-2022)

Number of Stories

This proposal addresses the building height, in terms of the number of stories, for the three new construction types proposed by the TWB. As set forth in the proposal to Section 602.4, the three new types of construction are Types IVA, IV-B, and IV-C. The Committee examined each proposed type of construction for its safety and efficacy with regard to each occupancy.

The following approach was considered appropriate for the heights of the new construction types, based on the conclusions of the Committee:

Based upon TWB review of fire safety and structural integrity performance, Type IV-B is equated to Type I-B for height (in number of stories). A noteworthy item is that, per Section 403.2.1.1 of the IBC, Type I-B construction is permitted to be reduced to 1-hour Fire Resistance Rating (FRR); however, the TWB does not propose to allow the same reduction for Type IV-B. As a result, the comparison is between 2-hr mass timber construction that is permitted to be partially unprotected, versus 1-hr Type IB construction, and the Committee believes that 2-hr mass timber construction that is partially exposed per the limits of proposed Section 602.4 warrants the same heights as allowed for 1-hr Type I-B construction;

Type IV-A should be somewhat larger than IV-B, as Type IV-A construction is entirely protected (no exposed mass timber permitted) and the required rating of the structure is equivalent to those required of Type I-A construction (3-hr rating for structural frame). However, the Committee did not find it acceptable to allow the scale of heights (many of which are unlimited) of Type I-A to be applied to Type IV-A. Instead, the Committee applied a multiplier of 1.5 to the heights proposed for Type IV-B construction (rounded up or down based on judgment) in order to propose reasonable height allowances for IV-A construction;

The Committee viewed Type IV-C as sufficiently similar to existing HT construction, especially in terms of the percentage of exposed wood (it is permitted to be entirely unprotected), and the resulting contribution to fire. While the height in feet for Type IV-C is proposed to be equal to the height in feet of Type IV-HT, the Committee felt that additional stories was warranted in some cases. Therefore, in terms of stories, the Committee proposes additional number of stories for Type IV-C construction when compared to traditional Type IV heavy timber construction. The Committee feels that some recognition is warranted for the fire resistance rating requirements (Type IV-C has 2-hour rating on structural elements, whereas traditional Type IV Heavy Timber used dimensional wood, which is understood to yield an approximate fire resistance rating equivalent to about 1-hour construction) and provided that flexibility when developing height, in terms of stories, for Type IV-C construction. A multiplier of 1.5 was applied from the Type IV-HT heights to develop reasonable numbers of stories for Type IV-C construction.

While the base code seems to allow significant heights for buildings without sprinklers (e.g., Table 504.4 currently allows 11 stories for NS Type I-B construction for many occupancy classifications), the Committee believes that no additional heights over what is already permitted for Type IV should be proposed for the NS (non sprinklered) rows. As such, where separate rows are provided for heights for the NS condition, the proposed heights for Types IV-A, IV-B, and IV-C are the same as those heights already permitted for Type IV for the NS condition.

This methodology explains the majority of the recommendations included in this proposal. Specifically, for occupancy groups A, B, E, R, and U, the methodology described above accurately reflects how the height proposals were developed.

The Committee applied professional judgment (from both a fire safety and a structural perspective) to develop a draft table, cell by cell, for all occupancy types. After further examination, reduced heights were proposed for F, H, I, M, and S occupancy classifications.

For F-1 occupancies, the Committee proposed a height of 7 stories for Type IV-B construction (versus the 12 stories currently permitted for I-B construction). A multiplier of 1.5 was used to propose a height of 10 stories for Type IV-A construction (when rounded down). No additional height was proposed for Type IV-C construction (Type IV-C proposed at 5 stories, and 5 stories is already permitted by code for Type IV-HT).

For F-2 occupancies, again the Committee is proposing a reduced number of stories, with 8 stories for Type IV-B construction (versus 12 stories that would be derived from the methodology). Again, a multiplier of 1.5 was used to propose a height of 12 stories for Type IV-A construction. No additional height is proposed for Type IV-C construction (Type IV-C proposed at 6 stories, and 6 stories is already permitted by code for Type IV-HT).

A conservative approach also explains the proposed heights for Group H occupancies. For Group H-1, only 1 story buildings are permitted by Table 504.4 for all construction types, so the proposal was adjusted to also limit all of the new Type IV construction types to 1 story as well.

For Groups H-2, H-3, and H-5, heights were intentionally made equal to the existing Heavy Timber heights. In other words, there is no proposal to any increased heights over what is already allowed by code for these use groups.

Group H-4, being corrosives which represents a health hazard (but not necessarily a fire hazard) to occupants and first responders, was also reduced, slightly. The TWB proposes 7 stories for Type IV-B construction (equivalency to Type I-B would have yielded 8 stories). The proposal allows only 8 stories for Type IV-A construction. No additional height is proposed for Type IV-C construction (Type IV-C proposed at 6 stories, and 6 stories is already permitted by code for Type IV-HT).

For Group I, the Committee took a more conservative approach and proposed an equivalent number of stories for Type IV-A construction, as is provided for Type I-B construction (10 stories for both construction types and occupancy types). The allowable heights for Type IV-B construction were selected to fall between the 10 stories for Type IV-A and the number of stories for Type IV-C construction. The Committee proposed a height of 7 stories for I-1, and 6 stories for I-2. No additional height was proposed for Type IV-C construction (IV-C construction heights in floors is equal to the number of floors already allowed for Type IV-HT, 5 stories for I-1, 4 stories for I-2).

For Group M occupancies, the Committee again took a conservative approach, and proposed an equivalent number of stories for Type IV-A construction, as is provided for Type I-B construction (12 stories for both construction types). The proposal for Type IV-B construction is 8 stories which is based on the use of the multiplier of 1.5 with respect to the Type IV-A proposal. A modest increase (from 5 to 6 stories) is proposed for Type IV-C construction due to the higher requirement for structural fire-resistance.

For Group S, while the base code does not differentiate between S-1 and S-2 in Type I-B construction (both 12 stories), the Committee recognized that the base code does provide a difference for Group F (10 stories for F-1, 12 stories for F-2). As explained above, this led the Committee to propose lower heights for F-1, than for F-2. The Committee felt this was appropriate with respect to the hazard differences between F-1 and F-2. Rather than basing our proposal for S occupancies on the same starting point of 12 stories, the Committee decided to simply copy the proposed heights for Group F into the rows for Group S for both IV-A and IV-B construction types. No additional height is proposed for IV-C construction (IV-C proposed at 5 stories for both S-1 and S-2, same as existing Type IV-HT heights).

Background information: The ICC Board approved the establishment of an ad hoc committee for tall wood buildings in December of 2015. The purpose of the ad hoc committee is to explore the science of tall wood buildings and to investigate the feasibility and take action on developing code changes for tall wood buildings. The committee is comprised of a balance of stakeholders with additional opportunities for interested parties to participate in the four Work Groups established by the ad hoc committee, namely: Code; Fire; Standards/Definitions; and Structural. For more information, be sure to visit the ICC website https://www.iccsafe.org/codes-tech-support/cs/icc-ad-hoc-committee-ontall-wood-buildings/ (accessed 02-11-2022).

As seen in the “Meeting Minutes and Documents” and “Resource Documents” sections of the committee web page, the ad hoc committee reviewed a substantial amount of information in order to provide technical justification for code proposals.

The ad hoc committee developed proposals for the followings code sections. The committee believes this package of code changes will result in regulations that adequately address the fire and life safety issues of tall mass timber buildings In addition, fire tests designed to simulate the three new construction types (Types IVA, IVB and IVC) in the ad hoc committee proposals were conducted at the Alcohol Tobacco and Firearms test lab facility. The TWB was involved in the design of the tests, and many members witnessed the test in person or online. The results of the series of 5 fire tests provide additional support for these proposals, and validate the fire performance for each of the types of construction proposed by the committee. The fire tests consisted of one-bedroom apartments on two levels, with both apartments having a corridor leading to a stair. The purpose of the tests was to address the contribution of mass timber to a fire, the performance of connections, the performance of through-penetration fire stops, and to evaluate conditions for responding fire personnel.

To review a summary of the fire tests, please visit: http://bit.ly/ATF-firetestreport (accessed 02-11-2022)

To watch summary videos of the fire tests, which are accelerated to run in 3 ½ minutes, please visit:

http://bit.ly/ATF-firetestvideos (accessed 02-11-2022)

AWC’s public comment in support the committee action for As Submitted:

WC was appointed to be a member of the ICC Tall Wood Building Ad Hoc Committee (TWB), the single wood industry representative on the TWB. AWC is not speaking for TWB on this issue. It simply is relaying information regarding the development of the proposals. Other members of the 16- member TWB included representation from architects, engineers, fire protection engineers, fire marshals, testing laboratories, and fire fighters, as well as the major materials industries. After two years of study, listening to testimony, reviewing documents, reviewing public input, conducting an extensive test program, and reviewing test results from tests around the world, the TWB made this proposal to ICC for membership consideration.

Early in the process, the TWB heard proposals from four different commenters suggesting maximum stories of 20, 24, 40, and 42 stories. The TWB worked through dozens of drafts of the proposed new types of construction, dozens more pertaining to the building height in stories, nearly a dozen pertaining to building height in feet and nearly a dozen regarding maximum permitted building area per floor. These documents were all posted to the TWB page of the ICC website. Comments were solicited for all drafts.

The first draft of Table 504.4 (allowable stories) was based on the discussions by the TWB at its November, 2016 meeting and considered by the Codes Work Group (Codes WG) in February, 2017. In March, 2017, comments to the February draft were considered by the Codes WG. In May, 2017, the Codes WG reported to the TWB its recommendations for a maximum number of stories for Type IV-A of 24 for many use groups, including B and R.

In June the TWB considered reducing the recommended number of stories for several occupancies, including B and R, due to reported opposition to the higher limits. Thus, as a result, the maximum number of stories was reduced from 24 to 18 for many occupancies including R, and from 24 to 20 for Group B because of the lower fuel load and increased occupant awareness in Group B. These drafts were also posted by the TWB on the ICC website. No one publicly commented on the original recommendations nor on the TWB reductions in maximum stories to accommodate what was believed to be opposition to its position.

Finally, the TWB held its last meeting (by video conference) December 27, 2017 to finalize all proposals before the January 6, 2018 submittal deadline. In that meeting it was suggested that continuing to allow Group B to be 20 stories seemed to be an outlier and, for that reason alone, the TWB again reduced Group B to the current 18 story limit.

The reason statement offered by the TWB for this proposal clearly explains that the allowable stories was determined by assessing the overall performance of the new types of construction and equating them to existing types of construction. From the beginning of this process, the TWB considered the body of data and fire protection engineering principles, deliberated the issue and concluded that because of the complete package of extensive features such as the required fire resistance ratings, the extensive noncombustible protection required on the surface of the mass timber elements, the prohibition of light frame wood assemblies altogether, and many other restrictive features, the performance of IV-B was indeed equivalent to I-B in every way. This concept was presented by several researchers who had been invited to present to the TWB at its initial face-to-face meeting.

Similarly, due to the even more extensive required features in Type IV-A, including redundant water supply, they concluded that the performance of Type IV-A was equivalent to I-A. The TWB agreed that the performance was equivalent, but its conservative approach meant that they chose not to permit IV-A to enjoy the unlimited number of stories that I-A does. In fact, it was so conservative that it initially considered only doubling of the number of stories, which is infinitely less than the unlimited number of stories permitted in type I-A for nearly every use group. They ultimately proposed even fewer stories than that.

Moreover, the number of stories proposed for Type IV-B are even more conservative when considering that Type IV-B requires a greater degree of fire resistance than that of I-B when the fire resistance rating of the building elements in Type IB construction are reduced to only the fire-resistance ratings required for Type IIA as permitted by Section 403.2.1 of the IBC. In effect, the proposed 2 hour fire resistance ratings required for Type IV-B will be twice that allowed by the IBC, since its inception, for those buildings under 420 feet whose building elements are permitted to be of only 1 hour fire resistance in accordance with the highrise provisions of Chapter 4, which will not apply to the proposed mass timber construction types.

From the beginning, the TWB has been committed to criteria which result in acceptable performance. Critics of the proposed allowable number of stories have been heard to comment that 18 stories will not be the end of increased story limits, but, indeed, 18 stories was not the beginning of it, either! Rather, 18 stories is a conservative limit that was reduced, by concession, not evidence, from 24 stories, to 20 stories, and finally to 18 stories.

Finally, much has been said about the proposed heights, but it s important to consider this: unlike noncombustible construction types I-A and I-B, which for most use groups are unlimited in allowable area per story no matter how tall, these proposed mass timber construction types will be increasingly limited in allowable area per floor as the building gets higher. This is because Equations 5-2 and 5-3 in the IBC limit the total allowable area of the building to no more than three times the allowable area of a single story. (Story areas for most use groups in Types I-A and I-B are never limited no matter how tall because their single-story areas are unlimited.) As a result, in the proposed mass timber construction types the compartmentalization of building areas between fire resistance rated and protected assemblies is vastly increased, and the allowable area between fire resistance rated and protected elements is vastly reduced, compared to Types I-A and I-B construction. See Tables 1 and 2 below for a comparison.

This proposal is thoroughly conservative. The following points address claims made by opponents:

Concerns about exterior fire testing:

The TWB proposals significantly reduce the risk of exterior building surface flame propagation by prohibiting all combustibles on the exterior side of exterior walls (except for the required water resistive barrier). Continuous insulation on the exterior, where provided, will be non-combustible. In addition, protection with at least 40 minutes of noncombustible material (typically a layer of 5/8-inch type X gypsum wallboard) is required on the outside of mass timber exterior walls. What is proposed therefore is more conservative than any other construction type, including Types I and II, virtually eliminating the possibility of fire spread on exterior walls due to combustible materials.

Concerns about the testing s relevance to tall wood buildings:

The testing was designed by fire service representation on the TWB committee to directly address potential tall wood buildings, regardless of height. Rather than rely on standardized testing of building assemblies alone, with fire service input the TWB committee chose to undertake full-scale, multistory compartment testing, with high residential fuel loads for which no standardized test exists.

Furthermore, in four of the five tests, the normal operation of the required automatic fire suppression system (sprinklers) was not allowed. The fires in tests applicable to the proposed 18 and 12 story limits (Types IV-A and IV-B respectively) were allowed to continue throughout the decay phase and well past burn-out, the most conservative approach possible. In other words, because the fire tests were specifically designed to address tall wood buildings of any height, the absolute worst circumstances were assumed: sprinklers not working, no active suppression of any kind, and the fire allowed to burn until self-extinguishment after the burning room contents are consumed (a tiny percentage of all possible fire scenarios). This parallels expectations for Type I buildings.

Concerns that wind has not been addressed in the testing:

There are no current test standards for exterior exposure that includes wind as a component. This means that even Types I and II buildings--which may have combustible materials on the exterior of the exterior walls, such as foam plastic insulation--are not tested to specific wind criteria. The new construction types proposed for tall wood building do not permit combustible materials on the exterior of exterior walls (as opposed to all other construction types), and in addition all mass timber building elements in exterior walls are required to be protected on the exterior side by noncombustible material equaling at least 40 minutes of fire resistance (typically 5/8-inch Type X gypsum wallboard). This very conservative criteria is intended to take the possibility of exterior fire spread completely out of the question.

In regard to wind reaching the interior of the building, since the extensive noncombustible protection of the interior in building over 12 stories is designed to allow complete burn-out of contents in the case of sprinkler malfunction, if wind were to cause contents to burn faster, there is no negative impact on fire performance of the protected building elements themselves. Fire scientists believe that protected mass timber will respond favorably to a more severe fire that is flamed by wind, since burn-out of contents may be achieved sooner. In regard to Type IV-C which permits totally exposed mass timber throughout, the allowable height in feet from grade is not increased from what is allowed for current Type IV heavy timber construction, and 2-hour fire resistance ratings of building elements are required throughout (as opposed to heavy timber dimensions only in current Type IV).

Finally, combustible light frame walls are not permitted in the proposed new construction types, only mass timber elements.

Concerns that loads from upper stories were not considered in the fire testing:

Structural loads will in large part govern the size of mass timber members, as it does concrete and steel members. As the loads from upper stories increase, the structural design requires loadbearing mass timber walls and columns to get bigger or more numerous. In buildings over 12 stories, these mass timber elements are required to be protected by at least three layers of 5/8 type X gypsum, as part of the 3-hour rating. This is an extremely conservative approach for all buildings ranging from 12 to 18 stories. The intent is to prevent the mass timber building elements from becoming involved in the fire even in the extremely small percentage of fire that are not controlled by the sprinkler system or eventually put out by the fire department.

Concerns that increased hazards from storage and mercantile occupancies, and their effect on firefighting, were not considered:

The TWB committee specifically addressed mercantile (M) and storage occupancies (typically S-1) and the hazards associated with their higher fuel loads. They did this by placing stricter limits on their height. M and S-1 occupancies groups are not allowed over 12 and 10 stories respectively even in Type IV-A, which has 3-hour walls and columns and 2-hour floors, and is required incorporate noncombustible protection equal to 2/3 of the required rating (three layers of 5/8 Type X gypsum wall board on loadbearing walls and columns). By comparison, Groups M and S-1 in Type I-A construction with the same ratings are unlimited in height. Type I-B allows both Groups M and S-1 up to 12 stories with only 2-hour walls and columns, whereas Type IV-B with equal ratings and required noncombustible protection is limited to eight stories (M) and seven stories (S-1).

Concerns about fire sealants and connections during the testing:

Researchers noted inconsistencies in some installations during the testing at ATF, but this has no bearing on the efficacy of the tests, which were successful in spite of these irregularities. Even so, to address this and undesirable results at the FPRF tests at NIST, a proposed requirement for all splices and intersections to have adhesive sealant followed by a proposed modification requiring special inspection of sealant installation was proposed by the TWB committee at the Committee Action Hearing. The sealant requirement was approved but the modification for its special inspection was ruled beyond the scope of the original proposal, but has been reconstituted as a Public Comment which can be put forward at the public comment hearings this fall.

Concerns that there is only limited information available about how CLT performs or can be used with other materials:

There is extensive information available about CLT construction from many sources, including the increasing number of manufacturers of CLT. For example, a CLT Handbook, addressing structural design, lateral design, connections, fire performance, sound performance, building envelope design, environmental performance, and handling during construction has been available for free for several years. The American Wood Council s National Design Specification for Wood Construction, an ANSI accredited standard, has been updated to incorporate structural and fire design provisions for CLT.

There are other guidelines for structural and fire resistance issues published by AWC and other organizations, including information on hybrid systems with steel and concrete. Among the other advantages of CLT are that it does not distort, loose its strength, or explosively spall when exposed to high temperatures. It has inherently high fire resistance due to its mass, and when protected with gypsum wallboard protection performs improves. Early testing of a highly loaded CLT exterior wall by AWC yielded a 3-hour rating with only one layer of 5/8 Type X gypsum wallboard. Also, in general, CLT responds well to flame impingement by remaining strong and stable when the gypsum is cracked or losing integrity. It is much less heat sensitive than certain noncombustible materials.

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F10328

11

Date Submitted	02/12/2022	**Section**	506	**Proponent**	Greg Johnson
Chapter	5	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

Type IV mass timber construction proposals including Mods# 10098, 10099, 10161, 10162, 10163, 10167, 10169, 10174, 10248, 10254, 10255, and more

Summary of Modification

Adds Types IV-A, IV-B, and IV-C to the allowable area table 506.2

Rationale

See uploaded rationale

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None; typical plan review and inspection

Impact to building and property owners relative to cost of compliance with code

No impact; this is an optional method of construction. As a new construction method Type IV mass timber should generally lower the cost of construction by stimulating competition

Impact to industry relative to the cost of compliance with code

No impact; this is an optional method of construction. As a new construction method Type IV mass timber should generally lower the cost of construction by stimulating competition

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Allowable areas are a fire resistive construction issue.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Improves the code by providing alternative methods of construction.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No material is required or prohibited by this change.

Does not degrade the effectiveness of the code

Improves the code by providing alternative methods of construction.

2nd Comment Period

F10328-G1

Proponent	Greg Johnson	Submitted	8/11/2022 6:21:50 PM	Attachments	No

Comment:

This modification provides appropriate limits on the area of Type IV mass timber buildings.

2nd Comment Period

F10328-G2

Proponent	Sam Francis	Submitted	8/25/2022 4:30:46 PM	Attachments	No

Comment:

This modification is one of several mods that the TAC voted to Deny. After hearing testimony on the first modification, the TAC consistently voted to Deny the modifications. After seeing this occur several times, both proponents and opponents stood on their previous statements. The TAC voted to deny each subsequent item without further testimony. This was one of those modifications. When we reached out to opponents to seek input on properly amending the proposals, this was one of those not previously debated before the TAC and which was not in dispute during those discussions. This mod is an essential piece of the complete package of requirements as developed by the ICC Ad Hoc Committee on Tall Wood Buildings. This table was created by the TWB through comparative examination of allowable areas for existing types of construction of comparable fire and structural safety. I strongly urge the TAC approve the MOD as originally submitted.

2nd Comment Period

F10328-G3

Proponent	ashley ong	Submitted	8/26/2022 3:59:58 PM	Attachments	No

Comment:

Building Officials Association of Florida (BOAF) supports this modification.

TABLE 506.2 ALLOWABLE AREA FACTOR (At = NS, S1, S13R, or SM, as applicable) IN SQUARE FEET

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION									
		TYPE I		TYPE II		TYPE III		TYPE IV			
		A	B	A	B	A	B	A	B	C	HT
A-1	NS	UL	UL	15,500	8,500	14,000	8,500	45,000	30,000	18,750	15,000
	S1	UL	UL	62,000	34,000	56,000	34,000	180,000	120,000	75,000	60,000
	SM	UL	UL	46,500	25,500	42,000	25,500	135,000	90,000	56,250	45,000
A-2	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000
A-3	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000
A-4	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000
A-5	NS										
	S1	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
	SM										
B	NS	UL	UL	37,500	23,000	28,500	19,000	108,000	72,000	45,000	36,000
	S1	UL	UL	150,000	92,000	114,000	76,000	432,000	288,000	180,000	144,000
	SM	UL	UL	112,500	69,000	85,500	57,000	324,000	216,000	135,000	108,000
E	NS	UL	UL	26,500	14,500	23,500	14,500	76,500	51,000	31,875	25,500
	S1	UL	UL	106,000	58,000	94,000	58,000	306,000	204,000	127,500	102,000
	SM	UL	UL	79,500	43,500	70,500	43,500	229,500	153,000	95,625	76,500
F-1	NS	UL	UL	25,000	15,500	19,000	12,000	100,500	67,000	41,875	33,500
	S1	UL	UL	100,000	62,000	76,000	48,000	402,000	268,000	167,500	134,000
	SM	UL	UL	75,000	46,500	57,000	36,000	301,500	201,000	125,625	100,500
F-2	NS	UL	UL	37,500	23,000	28,500	18,000	151,500	101,000	63,125	50,500
	S1	UL	UL	150,000	92,000	114,000	72,000	606,000	404,000	252,500	202,000
	SM	UL	UL	112,500	69,000	85,500	54,000	454,500	303,000	189,375	151,500
H-1	NSc										
	S1	21,000	16,500	11,000	7,000	9,500	7,000	10,500	10,500	10,500	10,500
H-2	NSc										
	S1	21,000	16,500	11,000	7,000	9,500	7,000	10,500	10,500	10,500	10,500
	SM										
H-3	NSc										
	S1	UL	60,000	26,500	14,000	17,500	13,000	25,500	25,500	25,500	25,500
	SM										
H-4	NSc,d	UL	UL	37,500	17,500	28,500	17,500	72,000	54,000	40,500	36,000
	S1	UL	UL	150,000	70,000	114,000	70,000	288,000	216,000	162,000	144,000
	SM	UL	UL	112,500	52,500	85,500	52,500	216,000	162,000	121,500	108,000
H-5	NSc,d	UL	UL	37,500	23,000	28,500	19,000	72,000	54,000	40,500	36,000
	S1	UL	UL	150,000	92,000	114,000	76,000	288,000	216,000	162,000	144,000
	SM	UL	UL	112,500	69,000	85,500	57,000	216,000	162,000	121,500	108000
I-1	NSd,e	UL	55,000	19,000	10,000	16,500	10,000	54,000	36,000	18,000	18,000
	S1	UL	220,000	76,000	40,000	66,000	40,000	216,000	144,000	72,000	72,000
	SM	UL	165,000	57,000	30,000	49,500	30,000	162,000	108,000	54,000	54,000

I-2	NSd,f	UL	UL	15,000	11,000	12,000	NP	36,000	24,000	12,000	12,000
	S1	UL	UL	60,000	44,000	48,000	NP	144,000	96,000	48,000	48,000
	SM	UL	UL	45,000	33,000	36,000	NP	108,000	72,000	36,000	36,000
I-3	NSd,e	UL	UL	15,000	10,000	10,500	7,500	36,000	24,000	12,000	12,000
	S1	UL	UL	45,000	40,000	42,000	30,000	144,000	96,000	48,000	48,000
	SM	UL	UL	45,00	30,000	31,500	22,500	108,000	72,000	36,000	36,000
I-4	NS	UL	60,500	26,500	13,000	23,500	13,000	76,500	51,000	25,500	25,500
	S1	UL	121,000	106,000	52,000	94,000	52,000	306,000	204,000	102,000	102,000
	SM	UL	181,500	79,500	39,000	70,500	39,000	229,500	153,000	76,500	76,500
M	NS	UL	UL	21,500	12,500	18,500	12,500	61,500	41,000	26,625	20,500
	S1	UL	UL	86,000	50,000	74,000	50,000	246,000	164,000	102,500	82,000
	SM	UL	UL	64,500	37,500	55,500	37,500	184,500	123,000	76,875	61,500
R-1	NS	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500
	S13R	UL	UL								
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500
R-2	NS	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500
	S13R	UL	UL								
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500
R-3	NS	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S13D										
	S13R										
	S1										
	SM										
R-4	NS	UL	UL	24,000	16,000	24,000	6,000	61,500	41,000	25,625	20,500
	S13D	UL	UL								
	S13R	UL	UL								
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500
S-1	NS	UL	48,000	26,000	17,500	26,000	17,500	76,500	51,000	31,875	25,500
	S1	UL	192,000	104,000	70,000	104,000	70,000	306,000	204,000	127,500	102,000
	SM	UL	144,000	78,000	52,500	78,000	52,500	229,500	153,000	95,625	76,500
S-2	NS	UL	79,000	39,000	26,000	39,000	26,000	115,500	77,000	48,125	38,500
	S1	UL	316,000	156,000	104,000	156,000	104,000	462,000	308,000	192,500	154,000
	SM	UL	237,000	117,000	78,000	117,000	78,000	346,500	231,000	144,375	115,500
U	NS	UL	35,500	19,000	8,500	14,000	8,500	54,000	36,000	22,500	18,000
	S1	UL	142,000	76,000	34,000	56,000	34,000	216,000	144,000	90,000	72,000
	SM	UL	106,500	57,000	25,500	42,000	25,500	162,000	108,000	67,500	54,000

Table 506.2 Allowable Area Type IV mass timber rationale

AWC proposes this code change as part of a package which, when taken together, as a group, creates the safety and reliability requirements necessary for the regulation of large mass timber (MT) buildings by the Florida Building Code. The following statement was offered by the Ad Hoc Committee on Tall Wood Buildings (TWB) for this proposal (IBC-G84-18) in the ICC Code Development monograph 2018 Group A:

The Ad Hoc Committee on Tall Wood Buildings (TWB) was created by the ICC Board to explore the science of tall wood buildings and take action on developing code changes for tall wood buildings. The TWB has created several code change proposals with respect to the concept of tall buildings of mass timber and the background information is at the end of this Statement. Within the statement are important links to information, including documents and videos, used in the deliberations which resulted in these proposals.

The TWB and it various WGs held meetings, studied issues and sought input from various expert sources around the world. The TWB has posted those documents and input on its website for interested parties to follow its progress and to allow those parties to, in turn, provide input to the TWB.

At its first meeting, the TWB discussed a number of performance objectives to be met with the proposed criteria for tall wood buildings:

1. No collapse under reasonable scenarios of complete burn-out of fuel without automatic sprinkler protection being considered.

2. No unusually high radiation exposure from the subject building to adjoining properties to present a risk of ignition under reasonably severe fire scenarios.

3. No unusual response from typical radiation exposure from adjacent properties to present a risk of ignition of the subject building under reasonably severe fire scenarios.

4. No unusual fire department access issues.

5. Egress systems designed to protect building occupants during the design escape time, plus a factor of safety.

6. Highly reliable fire suppression systems to reduce the risk of failure during reasonably expected fire scenarios. The degree of reliability should be proportional to evacuation time (height) and the risk of collapse.

The comprehensive package of proposals from the TWB meet these performance objectives.

Allowable Area

In addressing this topic, it was necessary to develop height and area criteria to address each new type of construction being proposed. Relying upon each new type of construction proposed for tall wood buildings (Types IV-A, IV-B and IVC), the committee examined each type of construction for its safety and efficacy with regard to each occupancy type.

This proposal on allowable areas should be considered as a companion proposal to the height proposals. The three proposals were developed with regard to one another as well as with regard to the new types of construction.

The TWB also determined that fire testing was necessary to validate these concepts. At its first meeting, members discussed the nature and intention of fire testing so as to ensure meaningful results for the TWB and, more specifically, for the fire service. Subsequently a test plan was developed.

The fire tests consisted of one-bedroom apartments on two levels, with both apartments having a corridor leading to a stair. The purpose of the tests was to address the contribution of mass timber to a fire, the performance of connections, the performance of joints, and to evaluate conditions for responding fire personnel. The Fire WG then refined the test plan, which was implemented with a series of five, full-scale, multiple-story building tests at the Alcohol, Tobacco and Firearms (ATF) laboratories in Beltsville, MD. The results of those tests, as well as testing conducted by others, helped form the basis upon which the Codes WG developed its code change proposals.

This code change proposal is one of those developed by the Codes WG and approved by the TWB.

To review a summary of the fire tests, please visit:

http://bit.ly/ATF-firetestreport (accessed 02-11-2022)

To watch summary videos of the fire tests, which are accelerated to run in 3-1/2 minutes each, please visit:

http://bit.ly/ATF-firetestvideos (accessed 02-11-2022)

Each proposed new type of construction was examined for its fire safety characteristics and compared to the existing, long-standing type of construction known as Heavy Timber. The committee found that it was reasonable to develop a multiplier which could be applied to the traditional HT areas. This was done for each new type of construction. Thus, the proposed new Type IV-C was 1.25 times the HT allowable area, IV-B was 2.00 times the HT allowable area and IV-A was 3.00 times the HT allowable area.

These multipliers were examined in terms of relative performance compared to traditional HT. They were reexamined on a case-by-case basis based upon relative hazard and occupancy classification. Some hazards were perceived to be greater and, thus, areas were adjusted downward to reflect the hazard. Other situations were similarly considered. For example, Hazardous and Institutional occupancies do not fully follow the multiplier method, as most areas for those occupancies were reduced from what the multiplier method would suggest.

Also, the committee reconsidered this proposal with respect to the companion height proposal. This review was to be sure that allowable areas were commensurate with the risk posed by being allowed on some particular story or at some height above grade plane.

Background information: The ICC Board approved the establishment of an ad hoc committee for tall wood buildings in December of 2015. The purpose of the ad hoc committee is to explore the science of tall wood buildings and to investigate the feasibility and take action on developing code changes for tall wood buildings. The committee is comprised of a balance of stakeholders with additional opportunities for interested parties to participate in the four Work Groups established by the ad hoc committee, namely: Code; Fire; Standards/Definitions; and Structural. For more information, be sure to visit the ICC website https://www.iccsafe.org/codes-tech-support/cs/icc-ad-hoc-committee-ontall-wood-buildings/ (link accessed 02-11-2022). As seen in the "Meeting Minutes and Documents" and "Resource Documents" sections of the committee web page, the ad hoc committee reviewed a substantial amount of information in order to provide technical justification for code proposals.

AWC's (Sam Francis) Public comment in support of G84-18 As Submitted:

AWC was appointed to be a member of the ICC Tall Wood Building Ad Hoc Committee (TWB), the single wood industry representative on the TWB. AWC is not speaking for TWB on this issue. It simply is relaying information regarding the development of the proposals. Other members of the 16-member TWB included representation from architects, engineers, fire protection engineers, fire marshals, testing laboratories, and fire fighters, as well as the major materials industries. After two years of study, listening to testimony, reviewing documents, reviewing public input, conducting an extensive test program, and reviewing test results from tests around the world, the TWB made this proposal to ICC for the membership s consideration.

Early in the process, the TWB heard proposals from four different commentors suggesting maximum stories of 20, 24, 40, and 42 stories. The TWB worked through dozens of drafts of the proposed new types of construction, dozens more pertaining to the building height in stories, nearly a dozen pertaining to building height in feet and nearly a dozen regarding maximum permitted building area per floor. These documents were all posted to the TWB page of the ICC website. Comments were solicited for all drafts.

The first aspect of height and area taken up by the TWB was height in stories. That seemed to be the easiest to get at with the information gleaned from the testimony and documentation presented to the TWB. Experts from around the world presented a case to the TWB that mass timber was equivalent to types I-A and I-B in every way other than the combustibility of the base material. They outlined various strategies for overcoming that combustibility issue. The TWB relied upon this concept of equivalent performance to determine its maximum permitted height in stories. The Reason Statement provided by the TWB Chairman, Steve DiGiovanni, clearly laid out the background for, and the process of, the deliberation on Height in Stories. That is a must read to understand this process and its outcomes.

Next, based upon comments submitted, TWB tried to assign height in feet to its chosen maximum stories. In its first drafts, the maximum number of stories for proposed type IV-A was 24 for a few occupancy groups. Similarly, IV-B was proposed to be limited to 12 stories based on the equivalency mentioned above. Thus, IV-B was assigned the same maximum height in feet as type I-B, 180 feet. My Public Comment on G75 explains the TWB s rationale for assigning the stories in its proposal.

The TWB took up the allowable area issue. The Reason Statement of its proposal G84-18 describes in great detail the process by which the TWB created a draft H A table, reviewed it cell by cell for efficacy, reasonable fire safety and so on. Based on that review, the TWB modified results using professional judgment and input from commenters. Thus the H A proposal saw many cells of reduced allowable area. This is a well prepared package, well thought out, with good documentation which is all available on the ICC website, TWB page. It is the product of the performance approach the TWB chose to use in following the ICC Board of Directors instructions to study the issues. The technical support for the proposal is the criteria that these construction types meet the fire resistance required of other existing construction. The TWB then developed a fire test plan which validated the concepts.

Of equal importance here is that the TWB recognizes that **mass timber is NOT wood frame**, light weight construction, or stick built construction. In fact, in order to ensure that its performance objectives would be correctly interpreted and that any building constructed to these requirements would meet, and probably exceed, its performance expectations.

Some observers have the mistaken belief that the permitted areas of this proposal will allow larger areas than those permitted for concrete or steel construction. The TWB insists that since these types of construction are based on equivalent performance, they are a great decrease from I-A or I-B construction s allowable areas. See the tables attached at the end of this comment for a comparison of the allowable areas. Clearly, Unlimited area is considerably larger than the finite, limits of the TWB proposal.

The fire test program, drafted by the Fire Work Group of the TWB to validate these concepts, may be seen as videos of each of the five tests. They can be found at this link or on the ICC TWB web page.

https://www.youtube.com/playlist?list=PL_sDiz8JiMlwby77vfpPSPucEhBuEK22P (accessed 02-11-2022)

This proposal is thoroughly conservative. Mass timber buildings are completely different from conventional wood construction of studs and joists. Besides the automatic fire suppression and other life safety systems required for all high rises (including enhanced water supply), all loadbearing walls in mass timber buildings will be solid wood slabs typically between 6 and 20 inches thick, fire resistance rated, and directly protected with noncombustible protection equally at least 2/3 of the required rating. Light frame wood stud construction is prohibited. Nonbearing partitions will be solid mass timber slabs or noncombustible (steel) studs. All loadbearing horizontal assemblies will be solid mass timber slabs between 4 and 12 inches thick, fire resistance rated, protected on the underside with noncombustible protection equaling at least 2/3 of the required rating, and on the upper side with not less than one inch of noncombustible material. Light frame wood joist construction is prohibited. All construction enclosing concealed spaces will be noncombustible (steel) framing or mass timber protected with noncombustible materials. Full scale compartments fire tests for this new construction system reflecting Types IV-A and IV-B construction have shown that conservative residential fuel loads will completely burn out without the mass timber becoming involved in the fire, or will self-extinguish following burn-out, all without the sprinkler system operating.

The following points respond to misleading claims made by opponents:

Measures to prevent exterior fire propagation exceed current tall building code requirements

Proposed code requirements to prevent exterior fire spread on tall mass timber buildings are significantly more restrictive than what is permitted for non-combustible construction. Simply put; no combustible materials are permitted on the exterior side of exterior walls (except for a required water-resistive barrier). What is proposed for tall mass timber buildings is more conservative than any other construction type, including non-combustible Types I and II. Exterior walls of these buildings will require:

• Continuous insulation on the exterior, where provided, must be non-combustible.

• Protection with at least 40 minutes of fire resistance from noncombustible materials.

• Additional testing to an exterior fire propagation standard

Tall wood building fire tests expand beyond standard testing and consider severe real fire demonstrations

No other building elements have been tested in fires as severe as those used to substantiate the building code proposals. Fire testing for mass timber exposed timber building elements to extreme fires, which, in reality, will be extremely rare in sprinklered tall wood buildings. In addition to reviewing results of standardized testing of mass timber building elements, the ICC Tall Wood Building (TWB) committee, which included members of the fire service, developed and witnessed full-scale, multistory building compartment fire testing. In the tests, in addition to having typical residential furnishings as a fuel load, a number of wood cribs were added to provide additional fuel to increase the challenge on the building. **The three un-sprinklered tests resulted in the fire self-extinguishing, and in the two tests that included sprinklers, the fire was easily contained immediately after sprinkler activation.**

• These real fire scenarios with high fire loads proved the integrity of a typical building constructed with cross-laminated timber (CLT).

• Tests representing fires in buildings of proposed 18- and 12-story heights (Types IV-A and IV-B, respectively) were allowed to continue to burn for hours, throughout the decay phase and well past burn-out, the most conservative approach possible.

• In the tests, the absolute worst circumstances were presented: sprinklers not working, no fire suppression of any kind, and fires burning without any intervention until self-extinguishment. This parallels the expected performance of non-combustible Type I buildings.

Wind-driven fire is not a code requirement for any building, but precautionary requirements for mass timber ensure a lower risk factor

There are no current fire test standards for exterior building exposure or vertical flame propagation that includes wind as a test element. Even Type I and II buildings -- which are allowed to have combustible materials on exterior walls, such as foam plastic insulation -- are not tested with added wind.

• Even in high wind, the new tall wood construction types will require non-combustible materials on the exterior, limiting the possibility of wind-driven exterior fire spread. [SH1]

• Interiors of buildings over 12 stories will require additional layers of interior non-combustible protection, providing protection against wind penetrating the exterior.

• Non-combustible protection of mass timber elements is designed to allow complete burn-out of contents in the case of sprinkler malfunction. If wind were to cause contents to burn faster, there is no negative impact on fire performance of the protected building elements themselves.

• Mass timber buildings, as proposed, would exclude the use of traditional light frame wood walls and floors, and mass timber elements would need to be completely protected with noncombustible materials for any building greater than 12 stories in height.

Massive timber building elements can carry heavy loads for extended time periods under fire exposure

Like their concrete and steel counterparts, as loads from upper stories increase, structural design requires loadbearing mass timber walls and columns to get bigger.

• As required for steel, in buildings over 12 stories mass timber elements will be required to have at least three layers of 5/8 type X gypsum wallboard as additional protection, as part of a required 3-hour fire-resistance rating. This is an extremely conservative approach for all buildings ranging from 12 to 18 stories.

• The established objective was to ensure that mass timber building elements do not become involved in a fire, even in the extremely rare circumstance where there is no control by a sprinkler system or extinguishment by the fire service.

Greater hazards from storage and mercantile occupancies are recognized

The ICC committee chose to specifically address mercantile (M) and storage occupancies (typically S-1), and the hazards associated with their higher fuel loads, by placing stricter limits on the height of buildings containing these occupancies.

M and S-1 occupancy groups will not be allowed over 12 and 10 stories, respectively, in building Types IV-B and IV-A, which have the greatest additional fire resistance requirements. By comparison, Groups M and S-1 in non-combustible Type I-A construction are allowed to be unlimited in height, and beams and bearing walls can be reduced to a 2 hour fire resistance rating.

The enforcement community readily understands the code and the measures necessary to inspect tall mass timber buildings

As with any new structural system, there will be a learning curve, and the wood products industry is committed to providing education. There is already an abundance of training available, and much of it is free. Many code officials have already taken advantage of these extensive training opportunities.

Fire sealants, fasteners, and connections contribute to overall performance

In some cases during fire testing, sealants were not used at all and all fire tests were nonetheless very successful.

If seen as important, a proposed modification requiring special inspection of a sealant installation could be put forward at the public comment hearings this fall. Multiple connection configurations were incorporated into the multi-story fire test structure. Floors of CLT were supported by wood and steel ledgers that were properly protected from heat exposure. Wood columns and beams were connected with steel, which was protected from fire as would be required by the code.

Tall mass timber buildings have been successfully built in North America, Europe, and Australia and are in use with great success

There is extensive information available about CLT construction from many sources, including the increasing number of CLT manufacturers.

The published CLT Handbook addresses structural and lateral design, connections, fire performance, sound performance, building envelope design, environmental performance, and handling during construction, and is available for free. The American Wood Council's National Design Specification for Wood Construction, an ANSI accredited standard referenced in the International Building Code, now includes structural and fire design provisions for CLT. There are other guidelines for mass timber structural and fire resistance published by AWC and other organizations, including information on hybrid systems with steel and concrete. Among the advantages of CLT are:

o It does not distort, twist, rapidly loose strength, or explosively spall when exposed to high temperatures from fires.

o It has inherent high fire resistance due to its mass, and when protected with gypsum wallboard performance even improves. ASTM E119 testing of a loaded CLT exterior wall by AWC resulted in a 3-hour fire resistance rating when protected with only a single layer of 5/8 Type X gypsum wallboard.

o Mass timber responds well to flame and heat impingement by remaining strong and stable, providing continuous support for gypsum wallboard, allowing it to remain in place for a longer period of time.

o Mass timber is much less sensitive than certain noncombustible materials when subject to elevated temperature.

The enforcement community readily understands the code and the measures necessary to inspect tall mass timber buildings

As with any new structural system, there will be a learning curve, and the wood products industry is committed to providing education. There is already an abundance of training available, and much of it is free. Many code officials have already taken advantage of these extensive training opportunities.

Adhesives used in CLT have excellent performance at elevated temperatures

The adhesives used in CLT have been standardized and requirements are mandated by the ANSI/APA standard PRG 320-18, which is also proposed for adoption in the 2021 International Building Code.

Variations in adhesive performance in early testing conducted by the National Fire Protection Research Foundation led to important revisions of PRG 320-18 that mandate required adhesive integrity under fire exposure, eliminating the possibility of delamination, fire regrowth or secondary flashover. CLT manufactured to APA PRG 320-18 requirements must demonstrate that the adhesive has been tested to these protocols. Qualifying adhesives are required in all proposed mass timber construction types.

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F10110

12

Date Submitted	02/07/2022	**Section**	602.4	**Proponent**	Greg Johnson
Chapter	6	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language Yes**

Related Modifications

Changes to 2304.11

Summary of Modification

This change provides clear requirement options for the treatment of concealed spaces in Type IV construction.

Rationale

The option of having protected concealed spaces in Type IV buildings is important to encourage the adaptive re-use of existing heavy timber buildings as well as to provide for the installation of mechanicals in Type IV cross laminated timber (CLT) construction. In addition to the current requirements for all concealed spaces in combustible construction, this change would require additional protection of the concealed spaces with sprinkler coverage, or eliminating all air space with noncombustible insulation, or covering all combustible surfaces with gypsum. These alternatives are the same protection required for concealed spaces in NFPA 13, except they are slightly more restrictive since 5/8-inch Type X gypsum is required in the one case. In addition, because the provisions are taken from NFPA 13, in order to use these provisions, the entire building must be protected by a sprinkler system complying with NFPA 13. A similar change was recently successful in NFPA 220 and NFPA 5000. This proposal is more conservative in that it requires 5/8-inch Type X gypsum instead of ½ -inch gypsum in the alternative for sheathing combustible concealed spaces with gypsum in proposed section 602.4.3. The change from “rating” to “rated” in Section 602.4 is editorial for good grammar.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

No impact; no additional inspections or plan review required.

Impact to building and property owners relative to cost of compliance with code

None; the change provides options that may reduce the cost of construction.

Impact to industry relative to the cost of compliance with code

None; the change provides options that may reduce the cost of construction.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

The modification provides alternate methods addressing concealed spaces to ensure fire-safe Type IV buildings.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

It improves the code by providing flexibility in the treatment of concealed spaces in Type IV construction.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No material is required or prohibited by this change.

Does not degrade the effectiveness of the code

It improves the code by providing flexibility in the treatment of concealed spaces in Type IV construction while maintaining equivalent or better fire-resistance.

Alternate Language

2nd Comment Period

10110-A4

Proponent Sam Francis **Submitted** 8/26/2022 10:13:27 PM **Attachments** Yes

Rationale:

consensus of parties discussing issues was use this. Makes it consistent with 10174

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

same as original

Impact to building and property owners relative to cost of compliance with code

same as original

Impact to industry relative to the cost of compliance with code

same as original

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

same as original

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

same as original

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

same as original

Does not degrade the effectiveness of the code

same as original

2nd Comment Period

10110-A3

Proponent Sam Francis **Submitted** 8/26/2022 3:36:11 PM **Attachments** Yes

Rationale:

this is necessary to be consistent with the changes in 10174.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

same as original

Impact to building and property owners relative to cost of compliance with code

same as original

Impact to industry relative to the cost of compliance with code

same as original

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

same as original

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

same as original

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

same as original

Does not degrade the effectiveness of the code

same as original

2nd Comment Period

F10110-G1

Proponent	Greg Johnson	Submitted	8/22/2022 4:38:13 PM	Attachments	No

Comment:

This modification is applicable to current Type IV Heavy Timber buildings, already designated as Type IV buildings in the FL Building Code. It is not a 'mass timber' (part of the tall wood package of new Type IV construction) proposed modification. This modification provides extremely stringent requirements for the protection of concealed spaces in Type IV heavy timber buildings. This creates flexibility in the re-use of older heavy timber buildings.

2nd Comment Period

10110-G2

Proponent	ashley ong	Submitted	8/26/2022 4:06:28 PM	Attachments	No

Comment:

Building Officials Association of Florida (BOAF) supports this modification.

see attached file substitute this for the original proposal.

602.4.4 Type IV-HT. Type IV-HT (Heavy Timber) construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid wood, laminated heavy timber or structural composite lumber (SCL), without concealed spaces or with concealed spaces complying with Section 602.4.4.3. The minimum dimensions for permitted materials including solid timber, glued-laminated timber, SCL and cross-laminated timber (CLT) and the details of Type IV construction shall comply with the provisions of this section and Section 2304.11. Exterior walls complying with Section 602.4.4.1 or 602.4.4.2 shall be permitted. Interior walls and partitions not less than 1-hour fire-resistance rated or heavy timber conforming with Section 2304.11.2.2 shall be permitted.

602.4.4.3 Concealed spaces. Concealed spaces shall not contain combustible materials other than building elements and electrical, mechanical, fire protection, or plumbing materials and equipment permitted in plenums in accordance with Section 602 of the International Mechanical Code. Concealed spaces shall comply with applicable provisions of Section 718. Concealed spaces shall be protected in accordance with one or more of the following:

1. The building shall be sprinklered throughout in accordance with Section 903.3.1.1 and automatic sprinklers shall also be provided in the concealed space.
2. The concealed space shall be completely filled with noncombustible insulation.
3. Combustible surfaces within the concealed space shall be protected with noncombustible protection that has an assigned protection contribution time of not less than 40 minutes as determined in accordance with Section 703.6 or material complying with Section 722.7.1.

Exception: Concealed spaces within interior walls and partitions with a 1-hour or greater fire-resistance rating complying with Section 2304.11.2.2 shall not require additional protection.

Replace 602.4.4.3 Item #3 with the following:

3. Combustible surfaces within the concealed space shall be protected with noncombustible protection that has an assigned protection contribution time of not less than 40 minutes as determined in accordance with Section 703.6 or material complying with Section 722.7.1.

602.4 Type IV.
Type IV construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid wood, laminated wood, heavy timber (HT) or structural composite lumber (SCL) without concealed spaces or with concealed spaces complying with Section 602.4.4. The minimum dimensions for permitted materials including solid timber, glued-laminated timber, structural composite lumber (SCL) and cross-laminated timber and details of Type IV construction shall comply with the provisions of this section and Section 2304.11. Exterior walls complying with Section 602.4.1 or 602.4.2 shall be permitted. Interior walls and partitions not less than 1-hour fire-resistance ~~rating~~ rated or heavy timber complying with Section 2304.11.2.2 shall be permitted.

602.4.4 Concealed spaces.
Concealed spaces shall not contain combustible materials other than building elements and electrical, mechanical, fire protection, or plumbing materials and equipment. Concealed spaces shall comply with applicable provisions of Section 718. Concealed spaces shall be protected in accordance with one or more of the following:

1. The building shall be sprinklered throughout in accordance with Section 903.3.1.1 and automatic sprinklers shall also be provided in the concealed space.
2. The concealed space shall be completely filled with noncombustible insulation.
3. Surfaces within the concealed space shall be fully sheathed with not less than 5/8 inch Type X gypsum board.

Exception: Concealed spaces within interior walls and partitions with a one hour or greater fire resistance rating complying Section 2304.11.2.2 shall not require additional protection.

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F10113

13

Date Submitted	02/08/2022	**Section**	602.4.2	**Proponent**	Greg Johnson
Chapter	6	**Affects HVHZ**	No	**Attachments**	No
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

Summary of Modification

Explicitly provides for the use of heavy timber members as boundary elements within a cross laminated timber wall.

Rationale

The code currently does not recognize that heavy timber members could be used as a beam, header, column or other boundary element within a wall of CLT. Glued laminated, SCL, or solid sawn heavy timber elements having the same rating, thickness, and protection as required for the CLT will have no significant difference in fire performance. This is a common sense approach to the current code, but should be made explicit. The ICC General hearing committee approved this by a vote of 13-1. There was no public comment in opposition.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None; no additional plan review or inspection is required. This resolves an interpretation question.

Impact to building and property owners relative to cost of compliance with code

None, it may lower the cost of construction by resolving an interpretation question.

Impact to industry relative to the cost of compliance with code

None, it may lower the cost of construction by resolving an interpretation question.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This is related to materials and fire resistant construction.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Improves the code by resolving an interpretation question.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No material is prohibited or required by this change. The use of mass timber elements in cross laminated timber walls is specifically allowed, thereby resolving an interpretive question.

Does not degrade the effectiveness of the code

The use of mass timber elements in cross laminated timber walls is specifically allowed, thereby resolving an interpretive question and making the code more effective.

2nd Comment Period

F10113-G1

Proponent	Greg Johnson	Submitted	8/11/2022 6:10:08 PM	Attachments	No

Comment:

The TAC mistakenly identified this as one of the modifications in the package of mass timber changes. It is not; it stands alone and is merely a clarification of the intent of the code. CLT exterior walls are already permitted. This mod says that a heavy timber member appurtenant to a CLT wall requires the same protection as the CLT elements. Opposing this because you oppose mass timber makes as much sense as kicking a dog because you don't like coyotes. It's not the same.

2nd Comment Period

10113-G2

Proponent	ashley ong	Submitted	8/26/2022 4:05:53 PM	Attachments	No

Comment:

Building Officials Association of Florida (BOAF) supports this modification.

602.4.2 Cross-laminated timber in exterior walls. Cross-laminated timber not less than 4 inches (102 mm) in thickness complying with Section 2303.1.4 shall be permitted within exterior wall assemblies with a 2-hour rating or less. ~~, provided the~~ Heavy timber structural members appurtenant to the CLT exterior wall shall meet the requirements of Table 2304.11 and be fire-resistance rated as required for the exterior wall. The ~~provided the~~ exterior surface of the cross-laminated ~~timberis~~ timber and heavy timber elements shall be protected by one the following:

1. 1.*Fire-retardant-treated wood* sheathing complying with Section 2303.2 and not less than 15/32 inch (12 mm) thick;
2. 2.*Gypsum board* not less than 1/2 inch (12.7 mm) thick; or
3. 3.A noncombustible material.

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F10157

Date Submitted	02/10/2022	**Section**	602	**Proponent**	Hamid Bahadori
Chapter	6	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments No

Alternate Language Yes

Related Modifications

N/A

Summary of Modification

Modify Table 601 to include footnote "b" in the first row (Primary Structural Frame) for Construction Types I, II, III, and IV. This will make it consistent with IBC Table 601.

Rationale

IBC updated Table 601 in the 2018 Edition. FBC did not update to match IBC in the 7th Edition of FBC.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None

Impact to building and property owners relative to cost of compliance with code

This will result in cost reduction when certain conditions are met. It will not result in any cost increase.

Impact to industry relative to the cost of compliance with code

No negative cost impact

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

It updates the code to what the rest of Country is using.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

It improves the code by providing clarity.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not discriminate against materials, products, methods, or systems of construction.

Does not degrade the effectiveness of the code

It updates the code to what the rest of Country is using.

Alternate Language

2nd Comment Period

10157-A1

Proponent Hamid Bahadori **Submitted** 7/22/2022 2:25:26 PM **Attachments** Yes

Rationale:

Providing more detail as asked by the Fire TAC

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Does not have impact on local code enforcement entity.

Impact to building and property owners relative to cost of compliance with code

Does not increase cost. In some cases it will reduce cost.

Impact to industry relative to the cost of compliance with code

Does not increase cost. In some cases it will reduce cost.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Makes it consistent with International Building Code.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Makes it consistent with International Building Code.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not discriminate against materials, products, methods, or systems .

Does not degrade the effectiveness of the code

Does not degrade the effectiveness of the code. Makes it consistent with International Building Code.

Modify Table 601 to include footnote "b" in the first row (Primary Structural Frame) for Construction Types I, II, III, and IV. This will make it consistent with IBC Table 601. Updating footnote b.

TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A	B	A	B	HT	A	B
Primary structural frame[f] (see Section 202)	3[a] b	2[a] b	1 b	0	1 b	0	HT	1 b	0
Bearing walls Exterior[e, f] Interior	 3 3[a]	 2 2[a]	 1 1	 0 0	 2 1	 2 0	 2 1/HT	 1 1	 0 0
Nonbearing walls and partitions Exterior	See Table 602								
Nonbearing walls and partitions Interior[d]	0	0	0	0	0	0	See Section 602.4.6	0	0
Floor construction and associated secondary members (see Section 202)	2	2	1	0	1	0	HT	1	0
Roof construction and associated secondary members (see Section 202)	$1^1/_2$[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	HT	1[b,c]	0

For SI: 1 foot = 304.8 mm.

a. Roof supports: Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.

~~b. Except in Group F-1, H, M and S-1 occupancies, fire protection of structural members shall not be required, including protection of roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.~~

c. In all occupancies, heavy timber shall be allowed where a 1-hour or less fire-resistance rating is required.

d. Not less than the fire-resistance rating required by other sections of this code.

e. Not less than the fire-resistance rating based on fire separation distance (see Table 602).

f. Not less than the fire-resistance rating as referenced in Section 704.10.

b.Except in Group F-1, H, M and S-1 occupancies, fire protection of structural members in roof construction shall not be required, including protection of primary structural frame members, roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below.
Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.

Please see attached

TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A	B	A	B	HT	A	B
Primary structural frame[f] (see Section 202)	3[a] b	2[a] b	1 b	0	1 b	0	HT	1 b	0
Bearing walls Exterior[e, f] Interior	 3 3[a]	 2 2[a]	 1 1	 0 0	 2 1	 2 0	 2 1/HT	 1 1	 0 0
Nonbearing walls and partitions Exterior	See Table 602								
Nonbearing walls and partitions Interior[d]	0	0	0	0	0	0	See Section 602.4.6	0	0
Floor construction and associated secondary members (see Section 202)	2	2	1	0	1	0	HT	1	0
Roof construction and associated secondary members (see Section 202)	$1^1/_2$[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	HT	1[b,c]	0

For SI: 1 foot = 304.8 mm.

a. Roof supports: Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.

b. Except in Group F-1, H, M and S-1 occupancies, fire protection of structural members shall not be required, including protection of roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.

c. In all occupancies, heavy timber shall be allowed where a 1-hour or less fire-resistance rating is required.

d. Not less than the fire-resistance rating required by other sections of this code.

e. Not less than the fire-resistance rating based on fire separation distance (see Table 602).

f. Not less than the fire-resistance rating as referenced in Section 704.10.

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F10174

15

Date Submitted	02/11/2022	**Section**	602.4	**Proponent**	Greg Johnson
Chapter	6	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language Yes**

Related Modifications

Type IV construction mass timber package including mods #10098, 10099, 10161, 10162, 10163, 10167, 10169, and more

Summary of Modification

Adds new mass timber Types of Construction IVA, IVB, and IVC provisions and renames existing Type IV heavy timber as Type IV-HT.

Rationale

See attached rationale and additional supporters' rationales

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

No significant difference. More training may be needed, but code officials always need continuing education. AWC has provided training on this subject matter in FL already and will continue to do so. Note that this training has been provided free of cost to code official chapters.

Impact to building and property owners relative to cost of compliance with code

Positive impact; this is an optional method of construction. An owner who wishes to avoid any associated expense does not have to use this method. This will lower the cost of construction generally by stimulating competition.

Impact to industry relative to the cost of compliance with code

Positive impact; this is an optional method of construction. An owner who wishes to avoid any associated expense does not have to use this method. This will lower the cost of construction generally by stimulating competition.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This provides for the safe use of buildings constructed in a new methodology.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Improves the code by providing an alternative method of construction.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No existing material options are changed. Materials options in the new proposal are based strictly on performance, i.e., combustibility.

Does not degrade the effectiveness of the code

Improves the code by providing an alternative method of construction.

Alternate Language

2nd Comment Period

F10174-A5

Proponent	Sam Francis	**Submitted**	8/26/2022 11:15:03 AM	**Attachments**	Yes

Rationale:

See attached file Comment to MOD 10174 by SWF

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

same as original

Impact to building and property owners relative to cost of compliance with code

same as original

Impact to industry relative to the cost of compliance with code

same as original

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

same as original

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

same as original

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

same as original

Does not degrade the effectiveness of the code

same as original

2nd Comment Period

F10174-G1

Proponent	William Telligman	Submitted	8/10/2022 9:55:46 AM	Attachments	Yes

Comment:

Comments in support of including tall mass timber buildings in the Florida Building Code are attached.

2nd Comment Period

F10174-G2

Proponent	Alan Shelby	Submitted	8/11/2022 3:25:13 PM	Attachments	No

Comment:

The Florida Forestry Association represents all aspects of our state's forest community. We fully support the inclusion in the 2023 Florida Building Code of all mass timber provisions adopted by the 2021 International Building Code. In addition to safety and labor benefits, the inclusion of mass timber construction in the Florida Building Code will represent an important factor in the future health and sustainability of Florida's forests. Creating a vital new market, the growth of MT will provide the financial resources needed to keep lands forested and managed. This is important on the environmental level because sustainably managed and harvested forests capture more carbon and provide habitat for a greater range of species than forests left unmanaged. Using building materials that are manufactured from sustainably managed forests also plays an important role in carbon sequestration and mitigates drivers of climate change. Because of the state's extensive timber assets, investment in MT production is projected to yield significant positive impacts for Florida’s economy as well.

2nd Comment Period

F10174-G3

Proponent	Philip Donovan	Submitted	8/12/2022 7:53:09 AM	Attachments	No

Comment:

I am in support of the modifications proposed and ask they be adopted in the next code cycle. It is imperative that the code continues to evolve and adopt modifications to support the building industry as technologies and building materials, especially ones dealing directly with carbon reduction in our built environment, are developed and tested to ensure life safety is maintained, are fiscally responsible, and ecologically restorative.

2nd Comment Period

F10174-G4

Proponent	Caroline Dauzat	Submitted	8/15/2022 3:22:32 PM	Attachments	Yes

Comment:

Please see attached comments in support of Mass Timber.

2nd Comment Period

F10174-G5

Proponent	Steve Marshall	Submitted	8/15/2022 3:57:02 PM	Attachments	No

Comment:

In my former role working for the Federal Government I aided the International Code Council in its consideration of whether to pass code updates for mass timber. In that role I was able to witness the considerable rigor that went into that process including the extensive fire testing. I am convinced the resulting provisions are safe and strongly encourage that you use them in Florida as a key part of addressing the embodied carbon of our built environment. Thank you for considering these measures and for providing the opportunity to comment on them.

2nd Comment Period

F10174-G6

Proponent	Bill Crittenden	Submitted	8/17/2022 3:18:52 PM	Attachments	No

Comment:

I am a state Certified General Contractor who recognizes and supports the use of wood members. The sustainablity, versatility, and cost-effectiveness are not only realized by the Contractor but translates down to the end user.

2nd Comment Period

F10174-G7

Proponent	Craig Rawlings	Submitted	8/17/2022 5:36:00 PM	Attachments	No

Comment:

I would respectfully like to encourage the State of Florida to adopt the mass timber provisions of the 2021 International Building Code into the 2023 FL building code the State of California recently did.

2nd Comment Period

F10174-G8

Proponent	Katz Andrew	Submitted	8/19/2022 5:16:20 PM	Attachments	No

Comment:
I am a developer focused on reducing carbon footprint in the built environment. Mass timber is the sustainable alternative to concrete and steel construction. It has been rigorously fire-tested and is an approved construction type in a rapidly growing list of states. Buildings are responsible for 40% of global carbon emissions. Mass timber construction is our path to reducing that carbon footprint. I would respectfully like to encourage the State of Florida to adopt the mass timber provisions of the 2021 International Building Code into the 2023 FL building code the State of California recently did.

2nd Comment Period

F10174-G9

Proponent	Greg Johnson	Submitted	8/22/2022 3:53:17 PM	Attachments	Yes

Comment:
A comment file supporting materials innovation and new technology, which provide equivalent or better products or methods or systems of construction, and which supports eliminating discrimination against materials, products, methods, or systems of construction of demonstrated capabilities, has been uploaded.

2nd Comment Period

F10174-G10

Proponent	Stephanie Thomas-Rees	Submitted	8/23/2022 7:43:24 AM	Attachments	No

Comment:
Thank you for the opportunity to comment on Modification #F10174-G10 APA – The Engineered Wood Association (APA) is a nonprofit trade association representing North American manufacturers of structural engineered wood products, such as plywood, oriented strand board, I-joists, glulam and cross-laminated timber. Based in Tacoma, Washington, APA represents about 175 mills throughout North America including in the state of Florida. Member manufacturers range from small, independently owned and operated companies to large integrated corporations. APA’s primary functions are quality auditing and testing, applied research and market support and development. APA supports the adoption of mass timber construction types and related requirements, as contained in the 2021 edition of the International Building Code (IBC), into the 2023 Florida Building Code (FBC). Including mass timber buildings in the 2021 FBC will provide a viable, safe alternative method for the advancement of the construction industry. Mass timber use in multifamily projects represents an economical construction option that can help address Florida’s deficit of affordable housing. The panelized process of erecting mass timber also results in faster construction without compromising worker safety. For these, and many other reasons, APA encourages the Florida Building Commission to adopt the package of mass timber proposals as incorporated in the 2021 IBC and proposed through the 2023 FBC update process.

2nd Comment Period

F10174-G11

Proponent	Johnson Lauderdale	Submitted	8/23/2022 10:06:18 AM	Attachments	No

Comment:
I highly recommend that Florida adopts this Code Modification. As a licensed Architect in the State of Alabama, I can whole-heartedly say that Mass timber is the next big thing in design and construction. States in the Pacific Northwest and the South East are already thriving in mass timber construction. Not adopting this code modification would be a mistake on Florida's part that would hurt the development of the state as a whole.

2nd Comment Period

F10174-G12

Proponent Kevin Warkentin Submitted 8/23/2022 5:15:26 PM Attachments No

Comment:

The Composite Panel Association supports the modifications. Sequestering carbon in long-lived structural and non-structural building materials is critical for the mitigating the drivers of climate change and associated issues.

2nd Comment Period

F10174-G13

Proponent Troy Bishop P.E. Submitted 8/23/2022 5:23:12 PM Attachments No

Comment:

The State of Florida should support the adoption of mass timber (MT) construction types, (Types IVA, IVB, and IVC), and related requirements, as contained in the 2021 edition of the International Building Code (IBC), into the 2023 Florida Building Code (FBC) for the following reasons: • After studying MT for hundreds of hours, and reviewing extensive fire-testing of the material, the AHC-TWB developed and submitted a package of code-change proposals for the 2021 edition of the IBC through the ICC's rigorous code development process. In that process the voting number of ICC governmental member representatives voted to adopt all proposed MT changes. • Updating the FBC to permit MT buildings will stimulate investment in its manufacturing and supply chain in FL and put downward pressure on cost and pricing. • Because of repetitive building layouts in residential multifamily buildings, and the speed of constructing MT buildings, it is predicted that MT will compete successfully with other materials used for multifamily buildings in the 8 -12 story height range. • MT construction sites are safer for workers. • Wildland fire safety on both the regional and global scale will benefit from increased use of MT. • Sustainably managed and harvested forests capture more carbon than forests left unmanaged and provide habitat for a greater range of species.

2nd Comment Period

F10174-G14

Proponent Gregory Kingsley Submitted 8/23/2022 11:06:57 PM Attachments No

Comment:

As a professional engineer in Colorado (and also in Florida) representing the Structural Engineers Association of Colorado (SEAC), I submitted an identical modification to the City and County of Denver. It was approved, and since that time local engineers, developers, architects, building officials and fire marshals have been able to learn and utilize the new provisions well ahead of most of the rest of the nation. This has energized innovative development in a positive way, very much to the advantage of the local community here. I recommend that Florida do the same.

2nd Comment Period

F10174-G15

Proponent Patrick Schleisman Submitted 8/24/2022 8:46:50 AM Attachments No

Comment:

Heavy Timber designs are a proven method of construction. The benefits are many and include: Local products, Sustainable, the greenest product options, materials are grown from solar energy, low carbon footprint. Heavy timber products will not decay as might other methods next to the sea air and weather.

2nd Comment Period

Proponent Rick Cantrell Submitted 8/24/2022 1:22:59 PM Attachments Yes

Comment:

Comments in attached PDF

2nd Comment Period

F10174-G17

Proponent	Michael Savage	Submitted	8/24/2022 1:29:14 PM	Attachments	No

Comment:

The inclusion of Tall Mass Timber provisions in the Florida Building Code only makes sense, this type of construction is currently on the rise nationally, and denial of this construction type would lead to BCA's being put in the position of reviewing their inclusion as an alternative method or material. The FBC should not be used as a method to be prejudicial against a type of construction, but provide guidance for such, as in Chapter 6.

2nd Comment Period

F10174-G18

Proponent	Brittany Varn	Submitted	8/24/2022 1:48:24 PM	Attachments	No

Comment:

The FL-SIC Committee fully supports the inclusion in the 2023 Florida Building Code of all mass timber provisions adopted by the 2021 International Building Code. In addition to safety and labor benefits, the inclusion of mass timber construction in the Florida Building Code will represent an important factor in the future health and sustainability of Florida's forests. Creating a vital new market, the growth of MT will provide the financial resources needed to keep lands forested and managed. This is important on the environmental level because sustainably managed and harvested forests capture more carbon and provide habitat for a greater range of species than forests left unmanaged. Using building materials that are manufactured from sustainably managed forests also plays an important role in carbon sequestration and mitigates drivers of climate change. Because of the state's extensive timber assets, investment in MT production is projected to yield significant positive impacts for Florida's economy as well.

2nd Comment Period

F10174-G19

Proponent	Anthony Harvey	Submitted	8/24/2022 3:26:38 PM	Attachments	No

Comment:

I support this proposal of additional Types of Construction as outlined. This will be a positive impact on local community giving builders/developers more sustainable building material options for larger/taller projects.

2nd Comment Period

F10174-G20

Proponent	Gainesville FL Florida Farm Bureau Federation	Submitted	8/24/2022 4:35:41 PM	Attachments	Yes

Comment:

Dear Florida Department of Business and Professional Regulation, The Florida Farm Bureau Federation (FFBF) is a grassroots organization representing 134,000+ member-families. We are the largest, general agricultural membership organization in the state, representing farmers and ranchers of over 300 various commodities; many of whom are forest landowners and producers. We appreciate the opportunity to express our strong support of the proposed changes to the 2023 Florida Building Code to include all mass timber provisions as adopted by the 2021 International Building Code. There are more than 17 million acres of forest land in Florida. The majority of these lands are working forests that are privately owned. These lands provide critical habitat for wildlife, while also playing an important environmental role as they filter air and water. Florida's forestry industry employs more than 124,000 citizens and infuses $25 billion into the state's economy. Growth of the mass timber market will undoubtedly create new markets and financial resources for producers to continue the successful management of forest lands and growth of this strong agricultural industry. FFBF policy "supports the exploration and development of new markets for forestry and forest products," and we will advocate at the local, state and national levels to provide access to these markets for Florida's producers. Respectfully, Jeb S. Smith President Florida Farm Bureau Federation

2nd Comment Period

F10174-G21

Proponent	John Dooner	Submitted	8/24/2022 9:25:34 PM	Attachments	No

Comment:

I'm commenting in an effort to support wood and wood products and the inclusion of such products in any new or updated code modifications. Not only are wood products generally a cheaper option from the construction perspective, they offer a sustainable, climate friendly, source for building materials. The trickle down effect of a strong market for wood products will ensure that responsibly managed forests thrive. The positive impacts generated by the use of wood products positively affect everyone from the producer to the end user and society in general.

2nd Comment Period

F10174-G22

Proponent	Chase Faircloth	Submitted	8/25/2022 9:11:21 AM	Attachments	No

Comment:

I would like to express my support for tall mass timber and this proposal supporting the transition to sustainable building

2nd Comment Period

F10174-G23

Proponent	Maureen Puettmann	Submitted	8/25/2022 12:01:49 PM	Attachments	Yes

Comment:

Mass timber buildings can reduce the embodied carbon (CO_2e emissions) up 50% over traditional concrete buildings (Puettmann et al. 2021). These results are based on buildings designed to IBC code IV-A-C. In addition the likely hood of re-use is very high for mass timber buildings, reducing the need for harvesting new trees and lowering the embodied carbon for material production in a second life building. This keeps forests as forests while as the same time storing carbon in buildings for decades.

2nd Comment Period

F10174-G24

Proponent	Cordell Van Nostrand	Submitted	8/25/2022 5:22:21 PM	Attachments	No

Comment:

I am a Structural Engineer in Sarasota, who performs work along the US east coast and mid-west. I support this addition. Mass Timber is getting traction around the world and the issue isn't whether is can or should be used, it is when. Wood is already being used frequently to 5 stories. Mass Timber is the next logical step. We are already getting questions regarding mass timber design. However, without design criteria, the jurisdictions will be running blind. There are mid-rise structures being designed in other countries, specifically in Europe; it's about time we include it in our codes.

2nd Comment Period

Proponent	Craig Stevenson	Submitted	8/26/2022 8:53:53 AM	Attachments	No

Comment:

I am a registered structural engineer in the state of Florida, and I support including mass timber in the FBC.

2nd Comment Period

F10174-G26

Proponent	James Karels	Submitted	8/26/2022 9:47:14 AM	Attachments	No

Comment:
I would like to take this opportunity to comment in support of mass timber use in Florida. Mass timber is not only a sustainable green wood product, it also helps Florida's largest agricultural economy which is forest products. By utilizing Florida's wood products, we continue to keep Florida's rural economy strong and vibrant. Keeping forests in forest in Florida is critical to our environment, our citizens health and the visual aspects of this magnificent state. Mass timber has shown to stand up to the wind conditions of our state and the potential hurricane force winds as well as being extremely fire resistant.

2nd Comment Period

F10174-G27

Proponent	David Brabham	Submitted	8/26/2022 3:20:17 PM	Attachments	No

Comment:
Georgia-Pacific supports the adoption of mass timber (MT) construction types, and related requirements, as contained in the 2021 edition of the International Building Code (IBC), into the 2023 Florida Building Code (FBC). We believe that that updating the FBC to permit mass timber buildings may create positive impacts to the economy and support healthy working forest across the US southeast.

2nd Comment Period

10174-G28

Proponent	ashley ong	Submitted	8/26/2022 3:51:11 PM	Attachments	No

Comment:

Building Officials Association of Florida (BOAF) supports this modification.

see attached file Text 10174 general comment 08-24-2022-SWF

Comment on MOD 10174

Opponents cited perceived flaws in the language proposed by AWC in MOD 10174. AWC reached out to those opponents and discussed the issues. I believe that the issues raised by opponents are, to mutual satisfaction taken care of by this Comment. It is attached as a Word document.

In addition to these issues, the proposed modification 10174, submitted by the American Wood Council to enable the Florida Building Code to reflect the most recent technical information available, had embedded links which failed to properly connect. The mod Reason Statement included reference to various documents which supported the mod, videos and reports of tests which supported the mod and details on the ICC Ad Hoc Committee on Tall Wood Buildings (TWB) deliberations and decisions which resulted in the text in the 2021 IBC.

The TWB had the opportunity to review literature on the subject. Among the items in that review, some were compiled in a Literature Review by the Fire Protection Research Foundation at NFPA. They can be seen here: https://awc.org/wp-content/uploads/2022/02/TMT-LiteratureReviewTallWoodFire-1811.pdf .

The TWB Fire Work Group, chaired by Sean DeCrane, developed a test plan which it, the Fire WG, deemed to be an adequate multistory test of fire in mass timber buildings. This testing program was funded by the Forest Products Laboratories of the U.S. Department of Agriculture. The full test program was carried out at the Alcohol, Tobacco, Firearms and Explosives (ATF) laboratories in Maryland. The full report of the tests, including the test plan from the Fire WG can be found here: https://awc.org/wp-content/uploads/2022/02/fpl_gtr247.pdf. A video record of each test was made and they can be viewed here: https://www.youtube.com/playlist?list=PL_sDiz8JiMIwby77vfpPSPucEhBuEK22P .

Prior to the ATF testing, Daniel Brandon, researcher at Research Institute of Sweden (RI.SE) developed a predictive model of fire behavior in mass timber structures. He used the test conditions developed in the Fire Work Group plan for implementation at ATF, and applied his model. A report of the results of this modeling compared to the actual fire performance is available in a Report from the Institute and can be found here: https://awc.org/wp-content/uploads/2022/02/Predictive-models-for-fires-in-modern-CLT-and-glulam-structures-.pdf .

Among the questions raised in the debate of MOD 10174, questions were raised about the effect of wind on a fire in a multistory building. The testing and modeling report by RI.SE can be found here: https://awc.org/wp-content/uploads/2022/02/TMT-WindEffectOnCompartmentFires-181220.pdf .

Another topic was protection of penetrations through mass timber assemblies. This can be found here: https://awc.org/wp-content/uploads/2022/02/AWC-E814_Penetration_Firestop_in_CLT-Final_Report.pdf .

Questions were raised about repairability of mass timber following a fire. The video of the research into repair can be found here: https://www.youtube.com/watch?v=h4NGo6UZzks

and the report of the testing into repairs of mass timber can be found here: https://awc.org/wp-content/uploads/2022/02/Rehabilitation-of-fire-exposed-CLT-A-case-study-FINAL.pdf .

A number of other videos and reports are available at the American Wood Council website by clicking on the "MENU" button, using the Resource Hub and looking for Mass Timber.

602.4 Type IV.

~~Type IV construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid wood, laminated wood, heavy timber (HT) or structural composite lumber (SCL) without concealed spaces. The minimum dimensions for permitted materials including solid timber, glued-laminated timber, structural composite lumber (SCL), and cross-laminated timber and details of Type IV construction shall comply with the provisions of this section and Section 2304.11. Exterior walls complying with Section 602.4.4.1 or 602.4.4.2 shall be permitted. Interior walls and partitions not less than 1-hour fire-resistance rating or heavy timber complying with Section 2304.11.2.2 shall be permitted.~~ Type IV construction is that type of construction in which the building elements are mass timber or noncombustible materials and have fire-resistance ratings in accordance with Table 601. Mass timber elements shall meet the fire-resistance-rating requirements of this section based on either the fire-resistance rating of the noncombustible protection, the mass timber, or a combination of both and shall be determined in accordance with Section 703.2. The minimum dimensions and permitted materials for building elements shall comply with the provisions of this section and Section 2304.11. Mass timber elements of Types IV-A, IV-B and IV-C construction shall be protected with noncombustible protection applied directly to the mass timber in accordance with Sections 602.4.1 through 602.4.3. The time assigned to the noncombustible protection shall be determined in accordance with Section 703.6 and comply with Section 722.7.

Cross-laminated timber shall be labeled as conforming to ANSI/APA PRG 320 as referenced in Section 2303.1.4.

Exterior load-bearing walls and nonload-bearing walls shall be mass timber construction, or shall be of noncombustible construction.

Exception: Exterior load-bearing walls and nonload-bearing walls of Type IV-HT Construction in accordance with Section 602.4.4.

The interior building elements, including nonload-bearing walls and partitions, shall be of mass timber construction or of noncombustible construction.

Exception: Interior building elements and nonload-bearing walls and partitions of Type IV-HT construction in accordance with Section 602.4.4.

Concealed spaces with combustible surfaces are not permitted except as otherwise indicated in Sections 602.4.1 through 602.4.4. Combustible stud spaces within light frame walls of Type IV-HT construction shall not be considered concealed spaces, but shall comply with Section 718.

In buildings of Type IV-A, IV-B, and IV-C construction with an occupied floor located more than 75 feet (22 860 mm) above the lowest level of fire department access, up to and including 12 stories or 180 feet (54 864 mm) above grade plane, mass timber interior exit and elevator hoistway enclosures shall be protected in accordance with Section 602.4.1.2. In buildings greater than 12 stories or 180 feet (54 864 mm) above grade plane, interior exit and elevator hoistway enclosures shall be constructed of noncombustible materials.

602.4.1 Type IV-A. Building elements in Type IV-A construction shall be protected in accordance with Sections 602.4.1.1 through 602.4.1.6. The required fire-resistance rating of noncombustible elements and protected mass timber elements shall be determined in accordance with Section 703.2.

602.4.1.1 Exterior protection. The outside face of exterior walls of mass timber construction shall be protected with noncombustible protection that has an assigned protection contribution time of not less than 40 minutes, as determined in accordance with Section 703.6 or material complying with Section 722.7.1. Components of the exterior wall covering shall be of noncombustible material except water-resistive barriers having a peak heat release rate of less than 150kW/m2, a total heat release of less than 20 MJ/m 2 and an effective heat of combustion of less than 18MJ/kg as determined in accordance with ASTM E1354 and having a flame spread index of 25 or less and a smoke-developed index of 450 or less as determined in accordance with ASTM E84 or UL 723. The ASTM E1354 test shall be conducted on specimens at the thickness intended for use, in the horizontal orientation and at an incident radiant heat flux of 50 kW/m2. Mass timber exterior walls that are greater than 40 feet in height above grade plane shall also be tested in accordance with and comply with the acceptance criteria of NFPA 285.

602.4.1.2 Interior protection. Interior faces of all mass timber elements, including the inside faces of exterior mass timber walls and mass timber roofs, shall be protected with materials complying with Section 703.6.

602.4.1.2.1 Protection time. Noncombustible protection shall contribute a time equal to or greater than times assigned in Table 722.7.1(1), but not less than 80 minutes. The use of materials and their respective protection contributions specified in Table 722.7.1(2) shall be permitted to be used for compliance with Section 722.7.1.

602.4.1.3 Floors. The floor assembly shall contain a noncombustible material not less than 1 inch (25 mm) in thickness above the mass timber. Floor finishes in accordance with Section 804 shall be permitted on top of the noncombustible material. The underside of floor assemblies shall be protected in accordance with Section 602.4.1.2.

602.4.1.4 Roofs. The interior surfaces of roof assemblies shall be protected in accordance with Section 602.4.1.2. Roof coverings in accordance with Chapter 15 shall be permitted on the outside surface of the roof assembly.

602.4.1.5 Concealed spaces Concealed spaces shall not contain combustible materials other than building elements and electrical, mechanical, fire protection, or plumbing materials and equipment. Concealed spaces shall comply with applicable provisions of Section 718. Concealed spaces shall be protected in accordance with one or more of the following:

1. The building shall be sprinklered throughout in accordance with Section 903.3.1.1 and automatic sprinklers shall also be provided in the concealed space.
2. The concealed space shall be filled with noncombustible insulation.
3. Combustible surfaces within the concealed space shall be protected with noncombustible protection that has an assigned protection contribution time of not less than 40 minutes as determined in accordance with

Section 703.6 or material complying with Section 722.7.1.

602.4.1.6 Shafts. Shafts shall be permitted in accordance with Sections 713 and 718. Both the shaft side and room side of mass timber elements shall be protected in accordance with Section 602.4.1.2.

602.4.2 Type IV-B. Building elements in Type IV-B construction shall be protected in accordance with Sections 602.4.2.1 through 602.4.2.6. The required fire-resistance rating of noncombustible elements or mass timber elements shall be determined in accordance with Section 703.2.

602.4.2.1 Exterior protection. The outside face of exterior walls of mass timber construction shall be protected with noncombustible protection that has an assigned protection contribution time of not less than 40 minutes, as determined in accordance with Section 703.6 or material complying with Section 722.7.1.. Components of the exterior wall covering shall be of noncombustible material except water-resistive barriers having a peak heat release rate of less than 150kW/m2, a total heat release of less than 20 MJ/m 2 and an effective heat of combustion of less than 18MJ/kg as determined in accordance with ASTM E1354, and having a flame spread index of 25 or less and a smoke-developed index of 450 or less as determined in accordance with ASTM E84 or UL 723. The ASTM E1354 test shall be conducted on specimens at the thickness intended for use, in the horizontal orientation and at an incident radiant heat flux of 50 kW/m2. Mass timber exterior walls that are greater than 40 feet (12192 mm) in height shall be tested in accordance with and comply with the acceptance criteria of NFPA 285.

602.4.2.2 Interior protection. Interior faces of all mass timber elements, including the inside face of exterior mass timber walls and mass timber roofs, shall be protected, as required by this section, with materials complying with Section 703.6.

602.4.2.2.1 Protection time. Noncombustible protection shall contribute a time equal to or greater than times assigned in Table 722.7.1(1), but not less than 80 minutes. The use of materials and their respective protection contributions specified in Table 722.7.1(2) shall be permitted to be used for compliance with Section 722.7.1.

602.4.2.2.2 Protected area. Interior faces of mass timber elements, including the inside face of exterior mass timber walls and mass timber roofs, shall be protected in accordance with Section 602.4.2.2.1.

Exceptions: Unprotected portions of mass timber ceilings and walls complying with Section 602.4.2.2.4 and the following:

1. Unprotected portions of mass timber ceilings and walls complying with one of the following:

1.1. Unprotected portions of mass timber ceilings, including attached beams, shall be permitted and shall be limited to an area equal to 20 percent of the floor area in any dwelling unit or fire area.

1.2. Unprotected portions of mass timber walls, including attached columns, shall be permitted and shall be limited to an area equal to 40 percent of the floor area in any dwelling unit or fire area.

1.3. Unprotected portions of both walls and ceilings of mass timber, including attached columns and beams, in any dwelling unit or fire area shall be permitted in accordance with Section 602.4.2.2.3.

2. Mass timber columns and beams that are not an integral portion of walls or ceilings, respectively, shall be permitted to be unprotected without restriction of either aggregate area or separation from one another.

602.4.2.2.3 Mixed unprotected areas. In each dwelling unit or fire area, where both portions of ceilings and portions of walls are unprotected, the total allowable unprotected area shall be determined in accordance with Equation 6-1.

$$(U_{tc}/\ U_{ac})+(U_{tw}/U_{aw})<\ 1$$

Equation 6-1

where:

Utc = Total unprotected mass timber ceiling areas.

Uac = Allowable unprotected mass timber ceiling area conforming to Exception 1.1 of Section 602.4.2.2.2.

Utw = Total unprotected mass timber wall areas.

Uaw = Allowable unprotected mass timber wall area conforming to Exception 1.2 of Section 602.4.2.2.2.

602.4.2.2.4 Separation distance between unprotected mass timber elements. In each dwelling unit or fire area, unprotected portions of mass timber walls and ceilings shall be not less than 15 feet (4572 mm) from unprotected portions of other walls and ceilings, measured horizontally along the ceiling and from other unprotected portions of walls measured horizontally along the floor.

602.4.2.3 Floors. The floor assembly shall contain a noncombustible material not less than 1 inch (25 mm) in thickness above the mass timber. Floor finishes in accordance with Section 804 shall be permitted on top of the noncombustible material. The underside of floor assemblies shall be protected in accordance with Section 602.4.1.2.

602.4.2.4 Roofs. The interior surfaces of roof assemblies shall be protected in accordance with Section 602.4.2.2 except, in nonoccupiable spaces, they shall be treated as a concealed space with no portion left unprotected. Roof coverings in accordance with Chapter 15 shall be permitted on the outside surface of the roof assembly.

602.4.3.5 Concealed spaces Concealed spaces shall not contain combustible materials other than building elements and electrical, mechanical, fire protection, or plumbing materials and equipment. Concealed spaces shall comply with applicable provisions of Section 718. Concealed spaces shall be protected in accordance with one or more of the following:

1. The building shall be sprinklered throughout in accordance with Section 903.3.1.1 and automatic sprinklers shall also be provided in the concealed space.
2. The concealed space shall be filled with noncombustible insulation.
3. Combustible surfaces within the concealed space shall be protected with noncombustible protection that has an assigned protection contribution time of not less than 40 minutes as determined in accordance with Section 703.6 or material complying with Section 722.7.1.

602.4.2.6 Shafts. Shafts shall be permitted in accordance with Sections 713 and 718. Both the shaft side and room side of mass timber elements shall be protected in accordance with Section 602.4.1.2.

602.4.3 Type IV-C. Building elements in Type IV-C construction shall be protected in accordance with Sections 602.4.3.1 through 602.4.3.6. The required fire-resistance rating of building elements shall be determined in accordance with Section 703.2.

602.4.3.1 Exterior protection. The outside face of exterior walls of mass timber construction shall be protected with noncombustible protection that has an assigned protection contribution time of not less than 40 minutes, as determined in accordance with Section 703.6 or material complying with Section 722.7.1. Components of the exterior wall covering shall be of noncombustible material except water-resistive barriers having a peak heat release rate of less than 150 kW/m^2, a total heat release of less than 20 MJ/m^{-2} and an effective heat of combustion of less than 18 MJ/kg as determined in accordance with ASTM E1354 and having a flame spread index of 25 or less and a smoke-developed index of 450 or less as determined in accordance with ASTM E84 or UL 723. The ASTM E1354 test shall be conducted on specimens at the thickness intended for use, in the horizontal orientation and at an incident radiant heat flux of 50 kW/m^2. Mass timber exterior walls that are greater than 40 feet (12192 mm) in height shall be tested in accordance with and comply with the acceptance criteria of NFPA 285.

602.4.3.2 Interior protection. Mass timber elements are permitted to be unprotected.

602.4.3.3 Floors. Floor finishes in accordance with Section 804 shall be permitted on top of the floor construction.

602.4.3.4 Roof coverings. Roof coverings in accordance with Chapter 15 shall be permitted on the outside surface of the roof assembly.

602.4.3.5 Concealed spaces Concealed spaces shall not contain combustible materials other than building elements and electrical, mechanical, fire protection, or plumbing materials and equipment. Concealed spaces shall comply with applicable provisions of Section 718. Concealed spaces shall be protected in accordance with one or more of the following:

1. The building shall be sprinklered throughout in accordance with Section 903.3.1.1 and automatic sprinklers shall also be provided in the concealed space.
2. The concealed space shall be filled with noncombustible insulation.
3. Combustible surfaces within the concealed space shall be protected with noncombustible protection that has an assigned protection contribution time of not less than 40 minutes as determined in accordance with

Section 703.6 or material complying with Section 722.7.1.

602.4.3.6 Shafts. Shafts shall be permitted in accordance with Sections 713 and 718. Shafts and elevator hoistway and interior exit stairway enclosures shall be protected with noncombustible protection with a minimum assigned time of 40 minutes, as specified in Table 722.7.1(1), on both the inside of the shaft and the outside of the shaft.

602.4.4 Type IV-HT. Type IV-HT (Heavy Timber) construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid wood, laminated heavy timber or structural composite lumber (SCL), without concealed spaces or with concealed spaces complying with Section 602.4.4.3. The minimum dimensions for permitted materials including solid timber, glued-laminated timber, SCL and cross-laminated timber (CLT) and the details of Type IV construction shall comply with the provisions of this section and Section 2304.11. Exterior walls complying with Section 602.4.4.1 or 602.4.4.2 shall be permitted. Interior walls and partitions not less than 1-hour fire-resistance rated or heavy timber conforming with Section 2304.11.2.2 shall be permitted.

~~**602.4.1**~~ **602.4.4.1 Fire-retardant-treated wood in exterior walls.** Fire-retardant-treated wood framing and sheathing complying with **Section 2303.2** shall be permitted within exterior wall assemblies ~~not less than 6 inches (152 mm) in thickness~~ with a 2-hour rating or less.

~~**602.4.2**~~ **602.4.4.2 Cross-laminated timber in exterior walls.** Cross-laminated timber **(CLT) not less than 4 inches (102 mm) in thickness** complying with **Section 2303.1.4** shall be permitted within exterior wall assemblies ~~not less than 6 inches (152 mm) in thickness~~ with a 2-hour rating or less, ~~provided the~~ Heavy timber structural members appurtenant to the CLT exterior wall shall meet the requirements of Table 2304.11 and be fire-resistance rated as required for the exterior wall . The exterior surface of the cross-laminated timber ~~is~~ and heavy timber elements shall be protected by one the following:

1. Fire-retardant-treated wood sheathing complying with **Section 2303.2** and not less than 15/32 inch (12 mm) thick.
2. Gypsum board not less than 1/2 inch (12.7 mm) thick.
3. A noncombustible material.

602.4.4.3 Concealed spaces Concealed spaces shall not contain combustible materials other than building elements and electrical, mechanical, fire protection, or plumbing materials and equipment. Concealed spaces shall comply with applicable provisions of Section 718. Concealed spaces shall be protected in accordance with one or more of the following:

1. The building shall be sprinklered throughout in accordance with Section 903.3.1.1 and automatic sprinklers shall also be provided in the concealed space.
2. The concealed space shall be completely filled with noncombustible insulation.

3. Combustible surfaces within the concealed space shall be protected with noncombustible protection that has an assigned protection contribution time of not less than 40 minutes as determined in accordance with Section 703.6 or material complying with Section 722.7.1.

Exception: Concealed spaces within interior walls and partitions with a 1-hour or greater fire-resistance rating complying with Section 2304.11.2.2 shall not require additional protection.

~~602.4.3~~ **602.4.4.4 Exterior structural members.** Where a horizontal separation of 20 feet (6096 mm) or more is provided, wood columns and arches conforming to heavy timber sizes complying with Section 2304.11 shall be permitted to be used externally.

SECTION 202 Definitions

Revise as follows:

[BS] WALL, LOAD-BEARING. Any wall meeting either of the following classifications:

1. Any metal or wood stud wall that supports more than 100 pounds per linear foot (1459 N/m) of vertical load in addition to its own weight.

2. Any masonry, or concrete or mass timberwall that supports more than 200 pounds per linear foot (2919 N/m) of vertical load in addition to its own weight.

Add new definitions as follows:

MASS TIMBER. Structural elements of Type IV construction primarily of solid, built-up, panelized or engineered wood products that meet minimum cross section dimensions of Type IV construction.

NONCOMBUSTIBLE PROTECTION (FOR MASS TIMBER).

Noncombustible material, in accordance with Section 703.5, designed to increase the fire-resistance rating and delay the combustion of mass timber.

Section 602.4 revise as follows:

602.4 Type IV.

~~Type IV construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid wood, laminated wood, heavy timber (HT) or structural composite lumber (SCL) without concealed spaces. The minimum dimensions for permitted materials including solid timber, glued laminated timber, structural composite lumber (SCL), and cross laminated timber and details of Type IV construction shall comply with the provisions of this section and **Section 2304.11**. Exterior walls complying with **Section 602.4.4.1** or **602.4.4.2** shall be permitted. Interior walls and partitions not less than 1-hour fire resistance rating or heavy timber complying with **Section 2304.11.2.2** shall be permitted.~~ Type IV construction is that type of construction in which the building elements are mass timber or noncombustible materials and have fire-resistance ratings in accordance with Table 601. Mass timber elements shall meet the fire-resistance-rating requirements of this section based on either the fire-resistance rating of the noncombustible protection , the mass timber , or a combination of both and shall be determined in accordance with Section 703.2. The minimum dimensions and permitted materials for building elements shall comply with the provisions of this section and Section 2304.11. Mass timber elements of Types IV-A, IV-B and IV-C construction shall be protected with noncombustible protection applied directly to the mass timber in accordance with Sections 602.4.1 through 602.4.3. The time assigned to the noncombustible protection shall be determined in accordance with Section 703.6 and comply with Section 722.7.

-

Cross-laminated timber shall be labeled as conforming to ANSI/APA PRG 320 as referenced in Section 2303.1.4.

-

Exterior load-bearing walls and nonload-bearing walls shall be mass timber construction, or shall be of noncombustible construction.

Exception: Exterior load-bearing walls and nonload-bearing walls of Type IV-HT Construction in accordance with Section 602.4.4.

The interior building elements , including nonload-bearing walls and partitions, shall be of mass timber construction or of noncombustible construction.

Exception: Interior building elements and nonload-bearing walls and partitions of Type IV-HT construction in accordance with Section 602.4.4.

-

Combustible concealed spaces are not permitted except as otherwise indicated in Sections 602.4.1 through 602.4.4. Combustible stud spaces within light frame walls of Type IV-HT construction shall not be considered concealed spaces, but shall comply with Section 718.

-

In buildings of Type IV-A, IV-B, and IV-C construction with an occupied floor located more than 75 feet (22 860 mm) above the lowest level of fire department access, up to and including 12 stories or 180 feet (54 864 mm) above grade plane, mass timber interior exit and elevator hoistway enclosures shall be protected in accordance with Section 602.4.1.2. In buildings greater than 12 stories or 180 feet (54 864 mm) above grade plane, interior exit and elevator hoistway enclosures shall be constructed of noncombustible materials. 602.4.1 Type IV-A. Building elements in Type IV-A construction shall be protected in accordance with Sections 602.4.1.1 through 602.4.1.6. The required fire-resistance rating of noncombustible elements and protected mass timber elements shall be determined in accordance with Section 703.2.

602.4.1.1 Exterior protection. The outside face of exterior walls of mass timber construction shall be protected with noncombustible protection with a minimum assigned time of 40 minutes, as specified in Table 722.7.1(1). Components of the exterior wall covering shall be of noncombustible material except water-resistive barriers having a peak heat release rate of less than 150kW/m2, a total heat release of less than 20 MJ/m 2 and an effective heat of combustion of less than 18MJ/kg as determined in accordance with ASTM E1354 and having a flame spread index of 25 or less and a smoke-developed index of 450 or less as determined in accordance with ASTM E84 or UL 723. The ASTM E1354 test shall be conducted on specimensat the thickness intended for use, in the horizontal orientation and at an incident radiant heat flux of 50 kW/m2.

-

602.4.1.2 Interior protection. Interior faces of all mass timber elements, including the inside faces of exterior mass timber walls and mass timber roofs, shall be protected with materials complying with Section 703.3.

602.4.1.2.1 Protection time. *Noncombustible protection*shall contribute a time equal to or greater than times assigned in Table 722.7.1(1), but not less than 80 minutes. The use of materials and their respective protection contributions specified in Table 722.7.1(2) shall be permitted to be used for compliance with Section 722.7.1.

-

602.4.1.3 Floors. The floor assembly shall contain a noncombustible material not less than 1 inch (25 mm) in thickness above the mass timber. Floor finishes in accordance with Section 804 shall be permitted on top of the noncombustible material. The underside of floor assemblies shall be protected in accordance with Section 602.4.1.2.

-

602.4.1.4 Roofs. The interior surfaces of roof assemblies shall be protected in accordance with Section 602.4.1.2. Roof coverings in accordance with Chapter 15 shall be permitted on the outside surface of the roof assembly.

-

602.4.1.5 Concealed spaces. Concealed spaces shall not contain combustibles other than electrical, mechanical, fire protection, or plumbing materials and equipment permitted in plenums in accordance with Section 602 of the International Mechanical Code, and shall comply with all applicable provisions of Section 718. Combustible construction forming concealed spaces shall be protected in accordance with Section 602.4.1.2.

602.4.1.6 Shafts. Shafts shall be permitted in accordance with Sections 713 and 718. Both the shaft side and room side of mass timber elements shall be protected in accordance with Section 602.4.1.2.

602.4.2 Type IV-B. Building elements in Type IV-B construction shall be protected in accordance with Sections 602.4.2.1 through 602.4.2.6. The required fire-resistance rating of noncombustible elements or mass timber elements shall be determined in accordance with Section 703.2.

602.4.2.1 Exterior protection. The outside face of exterior walls of mass timber construction shall be protected with noncombustible protection with a minimum assigned time of 40 minutes, as specified in Table 722.7.1(1). Components of the exterior wall covering shall be of noncombustible material except water-resistive barriers having a peak heat release rate of less than 150kW/m2, a total heat release of less than 20 MJ/m 2 and an effective heat of combustion of less than 18MJ/kg as determined in accordance with ASTM E1354, and having a flame spread index of 25 or less and a smoke-developed index of 450 or less as determined in accordance with ASTM E84 or UL 723. The ASTM E1354 test shall be conducted on specimens at the thickness intended for use, in the horizontal orientation and at an incident radiant heat flux of 50 kW/m2.

602.4.2.2 Interior protection. Interior faces of all mass timber elements, including the inside face of exterior mass timber walls and mass timber roofs, shall be protected, as required by this section, with materials complying with Section 703.3.

602.4.2.2.1 Protection time. Noncombustible protection shall contribute a time equal to or greater than times assigned in Table 722.7.1(1), but not less than 80 minutes. The use of materials and their respective protection contributions specified in Table 722.7.1(2) shall be permitted to be used for compliance with Section 722.7.1.

602.4.2.2.2 Protected area. Interior faces of mass timber elements, including the inside face of exterior mass timber walls and mass timber roofs, shall be protected in accordance with Section 602.4.2.2.1.

Exceptions: Unprotected portions of mass timber ceilings and walls complying with Section 602.4.2.2.4 and the following:

1. Unprotected portions of mass timber ceilings and walls complying with one of the following:
   - 1.1. Unprotected portions of mass timber ceilings, including attached beams, shall be permitted and shall be limited to an area equal to 20 percent of the floor area in any dwelling unit or fire area.
   - 1.2. Unprotected portions of mass timber walls, including attached columns, shall be permitted and shall be limited to an area equal to 40 percent of the floor area in any dwelling unit or fire area.
   - 1.3. Unprotected portions of both walls and ceilings of mass timber, including attached columns and beams, in any dwelling unit or fire area shall be permitted in accordance with Section 602.4.2.2.3.
2. Mass timber columns and beams that are not an integral portion of walls or ceilings, respectively, shall be permitted to be unprotected without restriction of either aggregate area or separation from one another.

602.4.2.2.3 Mixed unprotected areas. In each dwelling unit or fire area , where both portions of ceilings and portions of walls are unprotected, the total allowable unprotected area shall be determined in accordance with Equation 6-1.

$$(U_{tc}/ U_{ac})+(U_{tw}/U_{aw})< 1 \quad \text{Equation 6-1}$$

where:

U_{tc} = Total unprotected mass timber ceiling areas.

U_{ac} = Allowable unprotected mass timber ceiling area conforming to Exception 1.1 of Section 602.4.2.2.2.

U_{tw} = Total unprotected mass timber wall areas.

U_{aw} = Allowable unprotected mass timber wall area conforming to Exception 1.2 of Section 602.4.2.2.2.

602.4.2.2.4 Separation distance between unprotected mass timber elements. In each dwelling unit or fire area, unprotected portions of mass timber walls and ceilings shall be not less than 15 feet (4572 mm) from unprotected portions of other walls and ceilings, measured horizontally along the ceiling and from other unprotected portions of walls measured horizontally along the floor.

602.4.2.3 Floors. The floor assembly shall contain a noncombustible material not less than 1 inch (25 mm) in thickness above the mass timber. Floor finishes in accordance with Section 804 shall be permitted on top of the noncombustible material. The underside of floor assemblies shall be protected in accordance with Section 602.4.1.2.

-

602.4.2.4 Roofs. The interior surfaces of roof assemblies shall be protected in accordance with Section 602.4.2.2 except, in nonoccupiable spaces, they shall be treated as a concealed space with no portion left unprotected. Roof coverings in accordance with Chapter 15 shall be permitted on the outside surface of the roof assembly.

-

602.4.2.5 Concealed spaces. Concealed spaces shall not contain combustibles other than electrical, mechanical, fire protection, or plumbing materials and equipment permitted in plenums in accordance with Section 602 of the International Mechanical Code, and shall comply with all applicable provisions of Section 718. Combustible construction forming concealed spaces shall be protected in accordance with Section 602.4.1.2.

-

602.4.2.6 Shafts. Shafts shall be permitted in accordance with Sections 713 and 718. Both the shaft side and room side of mass timber elements shall be protected in accordance with Section 602.4.1.2.

602.4.3 Type IV-C. Building elements in Type IV-C construction shall be protected in accordance with Sections 602.4.3.1 through 602.4.3.6. The required fire-resistance rating of building elements shall be determined in accordance with Section 703.2.

602.4.3.1 Exterior protection. The exterior side of walls of combustible construction shall be protected with noncombustible protection with a minimum assigned time of 40 minutes, as determined in Table 722.7.1(1). Components of the exterior wall covering shall be of noncombustible material except water-resistive barriers having a peak heat release rate of less than 150 kW/m2, a total heat release of less than 20 MJ/m 2 and an effective heat of combustion of less than 18 MJ/kg as determined in accordance with ASTM E1354 and having a flame spread index of 25 or less and a smoke-developed index of 450 or less as determined in accordance with ASTM E84 or UL 723. The ASTM E1354 test shall be conducted on specimens at the thickness intended for use, in the horizontal orientation and at an incident radiant heat flux of 50 kW/m2.

602.4.3.2 Interior protection. Mass timber elements are permitted to be unprotected.

602.4.3.3 Floors. Floor finishes in accordance with Section 804 shall be permitted on top of the floor construction.

602.4.3.4 Roof coverings. Roof coverings in accordance with Chapter 15 shall be permitted on the outside surface of the roof assembly.

602.4.3.5 Concealed spaces. Concealed spaces shall not contain combustibles other than electrical, mechanical, fire protection, or plumbing materials and equipment permitted in plenums in accordance with Section 602 of the International Mechanical Code, and shall comply with all applicable provisions of Section 718. Combustible construction forming concealed spaces shall be protected with noncombustible protection with a minimum assigned time of 40 minutes, as specified in Table 722.7.1(1).

602.4.3.6 Shafts. Shafts shall be permitted in accordance with Sections 713 and 718. Shafts and elevator hoistway and interior exit stairway enclosures shall be protected with noncombustible protection with a minimum assigned time of 40 minutes, as specified in Table 722.7.1(1), on both the inside of the shaft and the outside of the shaft.

602.4.4 Type IV-HT. Type IV-HT (Heavy Timber) construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid wood, laminated heavy timber or structural composite lumber (SCL), without concealed spaces or with concealed spaces complying with Section 602.4.4.3. The minimum dimensions for permitted materials including solid timber, glued-laminated timber, SCL and cross-laminated timber (CLT) and the details of Type IV construction shall comply with the provisions of this section and Section 2304.11. Exterior walls complying with Section 602.4.4.1 or 602.4.4.2 shall be permitted. Interior walls and partitions not less than 1-hour fire-resistance rated or heavy

timber conforming with Section 2304.11.2.2 shall be permitted.

~~602.4.1~~602.4.4.1. **Fire-retardant-treated wood in exterior walls.** Fire-retardant-treated wood framing and sheathing complying with **Section 2303.2** shall be permitted within exterior wall assemblies not less than 6 inches (152 mm) in thickness with a 2-hour rating or less.

602.4.2 602.4.4.2**Cross-laminated timber in exterior walls.** Cross-laminated timber (CLT) not less than 4 inches (102 mm) in thicknesscomplying with Section 2303.1.4shall be permitted within *exterior wall assemblies*~~not less than 6 inches (152 mm) in thickness~~with a 2-hour rating or less.~~, provided the~~ Heavy timber structural members appurtenant to the CLT exterior wall shall meet the requirements of Table 2304.11 and be fire-resistance rated as required for the exterior wall. Theexterior surface of the cross-laminated timber ~~is~~and heavy timber elements shall beprotected by one the following:

1. Fire-retardant-treated wood sheathing complying with **Section 2303.2** and not less than 15/32 inch (12 mm) thick.

2. Gypsum board not less than 1/2 inch (12.7 mm) thick.

3. A noncombustible material.

602.4.4.3 Concealed spaces. Concealed spaces shall not contain combustible materials other than building elements and electrical, mechanical, fire protection, or plumbing materials and equipment permitted in plenums in accordance with Section 602 of the International Mechanical Code. Concealed spaces shall comply with applicable provisions of Section 718.

Concealed spaces shall be protected in accordance with one or more of the following:

1. The building shall be sprinklered throughout in accordance with Section 903.3.1.1 and automatic sprinklers shall also be provided in the concealed space.
2. The concealed space shall be completely filled with noncombustible insulation.
3. Surfaces within the concealed space shall be fully sheathed with not less than 5/8-inch Type X gypsum board.

Exception: Concealed spaces within interior walls and partitions with a 1-hour or greater fire-resistance rating complying with Section 2304.11.2.2 shall not require additional protection.

-

~~602.4.3~~602.4.4.4**Exterior structural members.** Where a horizontal separation of 20 feet (6096 mm) or more is provided, wood columns and arches conforming to heavy timber sizes complying with **Section 2304.11** shall be permitted to be used externally.

~~602.4.3~~602.4.4.4**Exterior structural members.** Where a horizontal separation of 20 feet (6096 mm) or more is provided, wood columns and arches conforming to heavy timber sizes complying with **Section 2304.11** shall be permitted to be used externally.

sustainability

MDPI

Article

Comparative LCAs of Conventional and Mass Timber Buildings in Regions with Potential for Mass Timber Penetration

Maureen Puettmann [1,*], Francesca Pierobon [2], Indroneil Ganguly [2], Hongmei Gu [3], Cindy Chen [4], Shaobo Liang [3], Susan Jones [5], Ian Maples [5] and Mark Wishnie [6]

1 The Consortium for Research on Renewable Industrial Materials, Corvallis, OR 97330, USA
2 College of the Environment, University of Washington, Seattle, WA 98105, USA; pierobon@uw.edu (F.P.); indro@uw.edu (I.G.)
3 USDA Forest Service, Forest Products Laboratory, Madison, WI 53726, USA; Hongmei.gu@usda.gov (H.G.); sshliang@gmail.com (S.L.)
4 Population Research Center, Portland State University, Portland, OR 97201, USA; cxc2@pdx.edu
5 atelierjones LLC, Seattle, WA 98101, USA; Susan@atelierjones.com (S.J.); ian@atelierjones.com (I.M.)
6 BTG Pactual Timberland Investment Group, Seattle, WA 98107, USA; mark.wishnie@btgpactual.com
* Correspondence: maureen@corrim.org; Tel.: +1-54-1231-2627

Abstract: Manufacturing of building materials and construction of buildings make up 11% of the global greenhouse gas emission by sector. Mass timber construction has the potential to reduce greenhouse gas emissions by moving wood into buildings with designs that have traditionally been dominated by steel and concrete. The environmental impacts of mass timber buildings were compared against those of functionally equivalent conventional buildings. Three pairs of buildings were designed for the Pacific Northwest, Northeast and Southeast regions in the United States to conform to mass timber building types with 8, 12, or 18 stories. Conventional buildings constructed with concrete and steel were designed for comparisons with the mass timber buildings. Over all regions and building heights, the mass timber buildings exhibited a reduction in the embodied carbon varying between 22% and 50% compared to the concrete buildings. Embodied carbon per unit of area increased with building height as the quantity of concrete, metals, and other nonrenewable materials increased. Total embodied energy to produce, transport, and construct A1–A5 materials was higher in all mass timber buildings compared to equivalent concrete. Further research is needed to predict the long-term carbon emissions and carbon mitigation potential of mass timber buildings to conventional building materials.

Keywords: mass timber; buildings; life cycle assessment; embodied carbon; embodied energy; Pacific Northwest; Northeast and Southeast

Citation: Puettmann, M.; Pierobon, F.; Ganguly, I.; Gu, H.; Chen, C.; Liang, S.; Jones, S.; Maples, I.; Wishnie, M. Comparative LCAs of Conventional and Mass Timber Buildings in Regions with Potential for Mass Timber Penetration. *Sustainability* **2021**, *13*, 13987. https://doi.org/10.3390/su132413987

Academic Editor: Adriana Del Borghi

Received: 15 November 2021
Accepted: 10 December 2021
Published: 18 December 2021

1. Introduction

Atmospheric carbon dioxide is the major contributor to global warming, making carbon emissions one of the world's most urgent environmental challenges. Recent research has indicated that afforestation can offer the single greatest opportunity for carbon mitigation [1–3]. However, delivering on this potential implies the afforestation of hundreds of millions of hectares in the next decade [4]. Forests have the ability to take up carbon dioxide and release oxygen back into the atmosphere through photosynthesis while storing carbon for decades or centuries in trees. For each metric ton (ton) of carbon stored in trees, 3.67 tons of carbon dioxide emission is removed. As forests age, their initially high carbon sequestration rates decrease, and eventually, carbon flux (i.e., sequestration and release) reaches a balance [3]. After disturbances, much of the stored carbon may be released back into the atmosphere relatively quickly via increased mortality, fire, or decomposition. Recent controversies about how forests best can offset carbon emissions have focused on the question of whether or not forests can increase their positive contribution to the carbon

sustainability

MDPI

Article

Comparative LCAs of Conventional and Mass Timber Buildings in Regions with Potential for Mass Timber Penetration

Maureen Puettmann [1,*], Francesca Pierobon [2], Indroneil Ganguly [2], Hongmei Gu [3], Cindy Chen [4], Shaobo Liang [3], Susan Jones [5], Ian Maples [5] and Mark Wishnie [6]

1 The Consortium for Research on Renewable Industrial Materials, Corvallis, OR 97330, USA
2 College of the Environment, University of Washington, Seattle, WA 98105, USA; pierobon@uw.edu (F.P.); indro@uw.edu (I.G.)
3 USDA Forest Service, Forest Products Laboratory, Madison, WI 53726, USA; Hongmei.gu@usda.gov (H.G.); sshliang@gmail.com (S.L.)
4 Population Research Center, Portland State University, Portland, OR 97201, USA; cxc2@pdx.edu
5 atelierjones LLC, Seattle, WA 98101, USA; Susan@atelierjones.com (S.J.); ian@atelierjones.com (I.M.)
6 BTG Pactual Timberland Investment Group, Seattle, WA 98107, USA; mark.wishnie@btgpactual.com
* Correspondence: maureen@corrim.org; Tel.: +1-54-1231-2627

Abstract: Manufacturing of building materials and construction of buildings make up 11% of the global greenhouse gas emission by sector. Mass timber construction has the potential to reduce greenhouse gas emissions by moving wood into buildings with designs that have traditionally been dominated by steel and concrete. The environmental impacts of mass timber buildings were compared against those of functionally equivalent conventional buildings. Three pairs of buildings were designed for the Pacific Northwest, Northeast and Southeast regions in the United States to conform to mass timber building types with 8, 12, or 18 stories. Conventional buildings constructed with concrete and steel were designed for comparisons with the mass timber buildings. Over all regions and building heights, the mass timber buildings exhibited a reduction in the embodied carbon varying between 22% and 50% compared to the concrete buildings. Embodied carbon per unit of area increased with building height as the quantity of concrete, metals, and other nonrenewable materials increased. Total embodied energy to produce, transport, and construct A1–A5 materials was higher in all mass timber buildings compared to equivalent concrete. Further research is needed to predict the long-term carbon emissions and carbon mitigation potential of mass timber buildings to conventional building materials.

Keywords: mass timber; buildings; life cycle assessment; embodied carbon; embodied energy; Pacific Northwest; Northeast and Southeast

check for updates

Citation: Puettmann, M.; Pierobon, F.; Ganguly, I.; Gu, H.; Chen, C.; Liang, S.; Jones, S.; Maples, I.; Wishnie, M. Comparative LCAs of Conventional and Mass Timber Buildings in Regions with Potential for Mass Timber Penetration. *Sustainability* **2021**, *13*, 13987. https://doi.org/10.3390/su132413987

Academic Editor: Adriana Del Borghi

Received: 15 November 2021
Accepted: 10 December 2021
Published: 18 December 2021

1. Introduction

Atmospheric carbon dioxide is the major contributor to global warming, making carbon emissions one of the world's most urgent environmental challenges. Recent research has indicated that afforestation can offer the single greatest opportunity for carbon mitigation [1–3]. However, delivering on this potential implies the afforestation of hundreds of millions of hectares in the next decade [4]. Forests have the ability to take up carbon dioxide and release oxygen back into the atmosphere through photosynthesis while storing carbon for decades or centuries in trees. For each metric ton (ton) of carbon stored in trees, 3.67 tons of carbon dioxide emission is removed. As forests age, their initially high carbon sequestration rates decrease, and eventually, carbon flux (i.e., sequestration and release) reaches a balance [3]. After disturbances, much of the stored carbon may be released back into the atmosphere relatively quickly via increased mortality, fire, or decomposition. Recent controversies about how forests best can offset carbon emissions have focused on the question of whether or not forests can increase their positive contribution to the carbon cycle if trees are harvested and the sequestered carbon is stored in long-term products, such as buildings [3,5–7].

Over the next decades, economies will grow because of an increase in population, resulting in a construction surge of buildings, bridges, and other structures. Particular attention has been given to the potential impact of mass timber (MT) penetration into these markets. Awareness of this comes from the expected increase in demand for wood products and the ability of forests to sustainably support the demand using carbon mitigation strategies, such as MT storing carbon in structures for decades. Mass timber is a defined category of engineered wood products (e.g., cross-laminated timber (CLT), glued laminated timber (glulam), mass plywood, and others) that enables the construction of tall buildings with wood [8–10]. Mass timber construction can have a greater carbon displacement benefit because it moves wood into building designs that traditionally have been dominated by steel and concrete materials.

Cross-laminated timber is at the forefront of the MT movement, enabling designers, engineers, and other stakeholders to build taller wood buildings. CLT panels are made by laminating dimension lumber orthogonally in alternating layers. Cross-laminated timber and other MT products store carbon and generate virtually no waste at a building site, as panels and beams are generally prefabricated before delivery.

Life-cycle assessment (LCA) has evolved as an internationally accepted method to objectively evaluate a product by identifying and quantifying energy and materials used and wastes released to the environment. Life-cycle assessment studies can evaluate full product life cycles, often referred to as “cradle-to-grave” or incorporate only a portion of the product’s life cycle, referred to as “cradle-to-gate” or “gate-to-gate”.

Life-cycle assessment studies of engineered timber products such as glued laminated timber (glulam) and CLT in construction have highlighted their environmental advantages over conventional materials such as concrete and steel [11–14]. However, no studies have yet compared the environmental impacts of MT buildings and conventional buildings for different building heights and across different United States (U.S.) regions. Cradle-to-gate product LCAs indicated net negative carbon emissions for MT products, which positions them with a high environmental advantage over nonwood materials [15–18].

The impacts that increased wood product utilization might have on forests and climate are complex. The current increase in wood demand from the MT movement is minimal. The maximum annual production capacity of North American MT manufacturers is 1.67 million m^3, consuming about 2.2% of the total softwood lumber production in North America [8]. However, because of the COVID pandemic, which put a lot of MT projects on hold, and the high cost of lumber in the U.S. relative to that in Europe and resulting increased imports of CLT, the softwood lumber usage in North American MT products was only 20% of the maximum capacity in 2020 [19].

The production of concrete and steel currently represents approximately 11% of annual global building greenhouse gas (GHG) emissions [20]. The global building stock, which primarily uses concrete and steel, is projected to double over the next 40 years, with most of that growth expected to occur in the southern hemisphere. To reduce the impact of this building expansion, MT buildings may offer a potentially appealing alternative to concrete and steel [11,21–29].

Whole-building LCA (WBLCA) studies have quantified and compared the environmental impact of MT buildings with that of traditional concrete and steel structures [11–13,21,22,25–28]. In one case study of midrise buildings [11], total carbon emissions for a five-story MT building were dominated by the manufacturing stage (77%), while the construction stage represented only 3% of the total carbon emissions. Total carbon emissions for the CLT building showed emissions of +1153 tons carbon dioxide equivalents (CO_2e) and storage of a total of −5315 tons of CO_2e, resulting in a net negative emission of −3847 tons CO_2e. Carbon emissions for an equivalent steel and concrete designs were +1372 tons CO_2e and +1718 tons CO_2e, respectively [11]. In summary, the CLT building cycle if trees are harvested and the sequestered carbon is stored in long-term products, such as buildings [3,5–7].

Over the next decades, economies will grow because of an increase in population, resulting in a construction surge of buildings, bridges, and other structures. Particular attention has been given to the potential impact of mass timber (MT) penetration into these markets. Awareness of this comes from the expected increase in demand for wood products and the ability of forests to sustainably support the demand using carbon mitigation strategies, such as MT storing carbon in structures for decades. Mass timber is a defined category of engineered wood products (e.g., cross-laminated timber (CLT), glued laminated timber (glulam), mass plywood, and others) that enables the construction of tall buildings with wood [8–10]. Mass timber construction can have a greater carbon displacement benefit because it moves wood into building designs that traditionally have been dominated by steel and concrete materials.

Cross-laminated timber is at the forefront of the MT movement, enabling designers, engineers, and other stakeholders to build taller wood buildings. CLT panels are made by laminating dimension lumber orthogonally in alternating layers. Cross-laminated timber and other MT products store carbon and generate virtually no waste at a building site, as panels and beams are generally prefabricated before delivery.

Life-cycle assessment (LCA) has evolved as an internationally accepted method to objectively evaluate a product by identifying and quantifying energy and materials used and wastes released to the environment. Life-cycle assessment studies can evaluate full product life cycles, often referred to as “cradle-to-grave” or incorporate only a portion of the product’s life cycle, referred to as “cradle-to-gate” or “gate-to-gate”.

Life-cycle assessment studies of engineered timber products such as glued laminated timber (glulam) and CLT in construction have highlighted their environmental advantages over conventional materials such as concrete and steel [11–14]. However, no studies have yet compared the environmental impacts of MT buildings and conventional buildings for different building heights and across different United States (U.S.) regions. Cradle-to-gate product LCAs indicated net negative carbon emissions for MT products, which positions them with a high environmental advantage over nonwood materials [15–18].

The impacts that increased wood product utilization might have on forests and climate are complex. The current increase in wood demand from the MT movement is minimal. The maximum annual production capacity of North American MT manufacturers is 1.67 million m^3, consuming about 2.2% of the total softwood lumber production in North America [8]. However, because of the COVID pandemic, which put a lot of MT projects on hold, and the high cost of lumber in the U.S. relative to that in Europe and resulting increased imports of CLT, the softwood lumber usage in North American MT products was only 20% of the maximum capacity in 2020 [19].

The production of concrete and steel currently represents approximately 11% of annual global building greenhouse gas (GHG) emissions [20]. The global building stock, which primarily uses concrete and steel, is projected to double over the next 40 years, with most of that growth expected to occur in the southern hemisphere. To reduce the impact of this building expansion, MT buildings may offer a potentially appealing alternative to concrete and steel [11,21–29].

Whole-building LCA (WBLCA) studies have quantified and compared the environmental impact of MT buildings with that of traditional concrete and steel structures [11–13,21,22,25–28]. In one case study of midrise buildings [11], total carbon emissions for a five-story MT building were dominated by the manufacturing stage (77%), while the construction stage represented only 3% of the total carbon emissions. Total carbon emissions for the CLT building showed emissions of +1153 tons carbon dioxide equivalents (CO_2e) and storage of a total of −5315 tons of CO_2e, resulting in a net negative emission of −3847 tons CO_2e. Carbon emissions for an equivalent steel and concrete designs were +1372 tons CO_2e and +1718 tons CO_2e, respectively [11]. In summary, the CLT building produced 33% less carbon emission than the equivalent steel building and 16% less carbon emissions than the concrete.

In another case study on a midrise northwest building, the environmental benefits of using CLT in hybrid midrise structures compared to using concrete resulted in a 26.5% reduction in carbon emissions and an 8% reduction in nonrenewable fuels [25]. The hybrid CLT building stored −1556 tons of CO_2, offsetting the emissions from product manufacturing and construction and resulting in a net negative emission of −1222 tons of CO_2e.

Cross-laminated timber is a relatively new product, and research is ongoing to track how production changes and building designs result in lower embodied carbon than conventional materials and designs [12–14,25]. Clearly, CLT buildings have potentially greater benefits if efficient reprocessing at the end of building service life is implemented for reuse and recycle [3]. Increased benefits are also manifested when the timing of emissions is considered [12,27].

Building with wood provides an important climate change mitigation opportunity by storing carbon for decades and displacing emissions from nonrenewable materials together with reducing dependence on nonrenewable resources. Taking advantage of this opportunity requires sustainable forest management, which ensures that carbon sequestration is optimized in the forest while increasing carbon pools in harvested wood products for long-term storage [3,5,30–33] (Gu Johnston perez). This study is the first step in filling the knowledge gap on comparing functionally equivalent conventional buildings to those constructed using MT. The goal of this study was to determine the embodied carbon and energy contribution for three building heights, in three U.S. regions, using both conventional materials and MT products in the buildings' assemblies (structure, envelope, and interior walls).

2. Materials and Methods

Architectural Building Designs and Assumptions

The whole-building life-cycle assessment (WBLCA) was designed to compare MT buildings with functionally equivalent conventional concrete structures for their cradle-to-gate environmental impacts. A total of eighteen different modeling conditions were selected for the comparative building LCAs in the U.S., composed of three geographic locations: (1) the Pacific Northwest (PNW), (2) the Northeast (NE), and (3) the Southeast (SE). The building designs covered three building heights under the ICC TallWood Building Code, Type IV-A for 18-story buildings, Type IV-B for 12-story buildings, and Type IV-C for 8–9-story buildings (Supplementary Materials S1) (Table 1), and two building materials (MT and conventional concrete-and-steel) (Figure 1). It should be noted that all of these mid-and high-rise buildings were in fact hybrid buildings. The concrete buildings utilized both steel and concrete, just as the MT buildings utilized both concrete and steel for certain building elements as well as CLT and glulam. Other key assumptions (Supplementary Materials S1) included the different structural and constructability requirements for the PNW's seismic region (Supplementary Materials S1). All buildings were designed with mixed usage in mind. Floor-to-floor dimensions were 4.11 m for the commercial floors and 2.95 m for all residential floors. The basic building type was a simple rectangular shaped building with a central elevator and stair core with a floorplate of 25.91 m × 45.72 m (1185 m^2). For complete descriptions of the architectural plans and materials takeoffs for all building designs and regions, see Supplementary Materials S1.

produced 33% less carbon emission than the equivalent steel building and 16% less carbon emissions than the concrete.

In another case study on a midrise northwest building, the environmental benefits of using CLT in hybrid midrise structures compared to using concrete resulted in a 26.5% reduction in carbon emissions and an 8% reduction in nonrenewable fuels [25]. The hybrid CLT building stored −1556 tons of CO_2, offsetting the emissions from product manufacturing and construction and resulting in a net negative emission of −1222 tons of CO_2e.

Cross-laminated timber is a relatively new product, and research is ongoing to track how production changes and building designs result in lower embodied carbon than conventional materials and designs [12–14,25]. Clearly, CLT buildings have potentially greater benefits if efficient reprocessing at the end of building service life is implemented for reuse and recycle [3]. Increased benefits are also manifested when the timing of emissions is considered [12,27].

Building with wood provides an important climate change mitigation opportunity by storing carbon for decades and displacing emissions from nonrenewable materials together with reducing dependence on nonrenewable resources. Taking advantage of this opportunity requires sustainable forest management, which ensures that carbon sequestration is optimized in the forest while increasing carbon pools in harvested wood products for long-term storage [3,5,30–33] (Gu Johnston perez). This study is the first step in filling the knowledge gap on comparing functionally equivalent conventional buildings to those constructed using MT. The goal of this study was to determine the embodied carbon and energy contribution for three building heights, in three U.S. regions, using both conventional materials and MT products in the buildings' assemblies (structure, envelope, and interior walls).

2. Materials and Methods

Architectural Building Designs and Assumptions

The whole-building life-cycle assessment (WBLCA) was designed to compare MT buildings with functionally equivalent conventional concrete structures for their cradle-to-gate environmental impacts. A total of eighteen different modeling conditions were selected for the comparative building LCAs in the U.S., composed of three geographic locations: (1) the Pacific Northwest (PNW), (2) the Northeast (NE), and (3) the Southeast (SE). The building designs covered three building heights under the ICC TallWood Building Code, Type IV-A for 18-story buildings, Type IV-B for 12-story buildings, and Type IV-C for 8–9-story buildings (Supplementary Materials S1) (Table 1), and two building materials (MT and conventional concrete-and-steel) (Figure 1). It should be noted that all of these mid-and high-rise buildings were in fact hybrid buildings. The concrete buildings utilized both steel and concrete, just as the MT buildings utilized both concrete and steel for certain building elements as well as CLT and glulam. Other key assumptions (Supplementary Materials S1) included the different structural and constructability requirements for the PNW's seismic region (Supplementary Materials S1). All buildings were designed with mixed usage in mind. Floor-to-floor dimensions were 4.11 m for the commercial floors and 2.95 m for all residential floors. The basic building type was a simple rectangular shaped building with a central elevator and stair core with a floorplate of 25.91 m × 45.72 m (1185 m^2). For complete descriptions of the architectural plans and materials takeoffs for all building designs and regions, see Supplementary Materials S1.

Table 1. Mixed-use building program distribution for 8-, 12-, and 18-story buildings with mass timber or concrete designs constructed in the PNW, NE, and SE regions of the U.S.

	Stories	Floor Occupancy Ratio	Building Height	Total Floor Area
IBC [1/] for MT buildings		Residential–Commercial	m	m^2
Type IV-C	8	6:2	26	9476
Type IV-B	12	8:4	48	14,214
Type IV-A	18	12:6	71	21,321 [1/]

[1/] International Building Code (https://www.awc.org/pdf/education/des/AWC-DES607A-TallWood2021IBC-190619-color.pdf, accessed on 10 December 2021).

Figure 1. Examples of 8-, 12-, and 18-story PNW mass timber buildings with commercial floors and residential floors.

The buildings were not designed with any particular site in mind, except for their broad geographic regional differences. However, for some of the structural analysis, certain site assumptions had to be made given the need for appropriate soil analysis for soil pressure. Based on potential markets and production of MT the following three building sites were chosen for the WBLCA: (1) Seattle, Washington, (2) Boston, Massachusetts, and (3) Atlanta, Georgia.

Life-cycle inventory (LCI) datasets for the building materials used a combination of primary data [34] (CORRIM) and public databases [35–37] for the WBLCA modeling in this study. The study followed international standards for LCA methods and WBLCA analysis (ISO 14044, EN 15978, and ISO 21930) [38–40] as well as the building designs and assumptions in Supplementary Materials S1. Datasets and methodology were described further by Gu et al. [41]. The declared unit was 1 m^2 of the total floor area of the building. The system boundary for this assessment was cradle-to-gate and included modules A1—resource extraction, A2—transportation of materials to product manufacturing, A3—product manufacturing, A4—transportation of materials to construction site, and A5—construction energy use (Figure 2). Excluded from the study were modules B, C, and D [41].

Each region represents different energy mixes and timber species, and in the case of the PNW, additional seismic considerations drove differences in the building designs from those in the other two regions [41]. The species and MT production sites (actual and assumed) are listed in Table 2. For timber buildings, the density of the wood species influences the weight contribution of MT [12,41] (Table 3).

Table 1. Mixed-use building program distribution for 8-, 12-, and 18-story buildings with mass timber or concrete designs constructed in the PNW, NE, and SE regions of the U.S.

	Stories	Floor Occupancy Ratio	Building Height	Total Floor Area
IBC [1/] for MT buildings		Residential–Commercial	m	m^2
Type IV-C	8	6:2	26	9476
Type IV-B	12	8:4	48	14,214
Type IV-A	18	12:6	71	21,321 [1/]

[1/] International Building Code (https://www.awc.org/pdf/education/des/AWC-DES607A-TallWood2021IBC-190619-color.pdf, accessed on 10 December 2021).

Figure 1. Examples of 8-, 12-, and 18-story PNW mass timber buildings with commercial floors and residential floors.

The buildings were not designed with any particular site in mind, except for their broad geographic regional differences. However, for some of the structural analysis, certain site assumptions had to be made given the need for appropriate soil analysis for soil pressure. Based on potential markets and production of MT the following three building sites were chosen for the WBLCA: (1) Seattle, Washington, (2) Boston, Massachusetts, and (3) Atlanta, Georgia.

Life-cycle inventory (LCI) datasets for the building materials used a combination of primary data [34] (CORRIM) and public databases [35–37] for the WBLCA modeling in this study. The study followed international standards for LCA methods and WBLCA analysis (ISO 14044, EN 15978, and ISO 21930) [38–40] as well as the building designs and assumptions in Supplementary Materials S1. Datasets and methodology were described further by Gu et al. [41]. The declared unit was 1 m^2 of the total floor area of the building. The system boundary for this assessment was cradle-to-gate and included modules A1—resource extraction, A2—transportation of materials to product manufacturing, A3—product manufacturing, A4—transportation of materials to construction site, and A5—construction energy use (Figure 2). Excluded from the study were modules B, C, and D [41].

Each region represents different energy mixes and timber species, and in the case of the PNW, additional seismic considerations drove differences in the building designs from those in the other two regions [41]. The species and MT production sites (actual and assumed) are listed in Table 2. For timber buildings, the density of the wood species influences the weight contribution of MT [12,41] (Table 3).

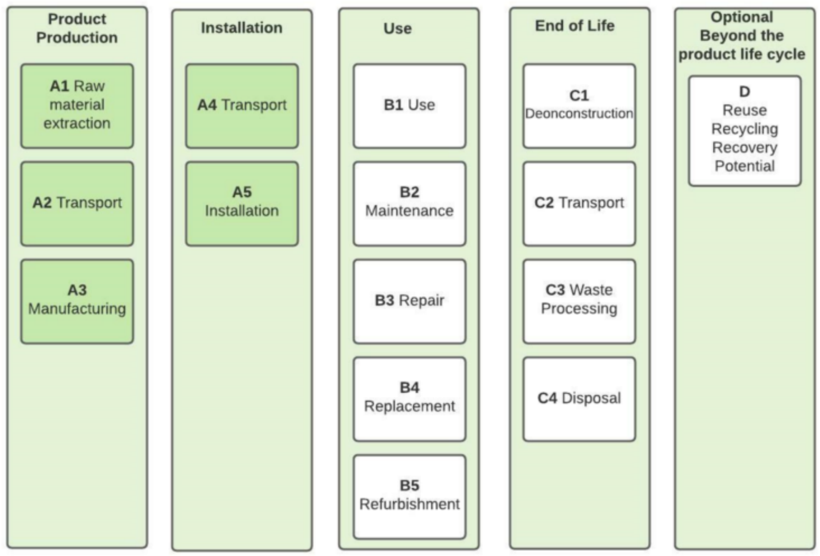


Figure 2. Life-cycle modules included in this study.

Table 2. Geographical regions, species, and mass timber production sites.

Geographic Regions	Species	CLT Production	Glulam Production
Pacific Northwest	Douglas fir and western hemlock	Spokane, Washington [2/]	Veneta, Oregon [2/]
Northeast	Eastern spruce and white pine	Lincoln, Maine	Lincoln, Maine
Southeast	Southern pine [1/]	Dothan, Alabama [2/]	Greenville, Alabama [2/]

[1/] Southern pines are a mixture of several species of longleaf (*Pinus palustris*), loblolly (*P. taeda*), short leaf (*P. chinate*), and slash (*P. elliottii*)) pines with similar characteristics. [2/] Actual production facilities for either CLT or glulam.

Fire protection of the MT structural elements was a critical factor in determining the allowable heights and uses for MT in mid- and high-rise buildings (Supplementary Materials S1). All MT building designs followed the new approved codes set by the International Code Council [42], which were adopted in the 2021 International Building Code. All MT elements in Type IV require some level of fire protection (Table 1). Type IV-A (up to 18 stories) requires noncombustible protection over all MT elements. Types IV-B and -C allow some exposure to MT [42]. The noncombustible material used in this study was either $\frac{1}{2}$″ gypsum or 5/8″ Type X gypsum sheathing (Supplementary Materials S2) [41].

Table 3. Wood density and species by region and global warming potential (GWP kg CO_2e for one cubic meter of lumber in the PNW, NE, and SE regions [43–45].

Region	Species	Wood Density [1/]	GWP
		kg/m^3	kg CO_2e/m^3
Pacific Northwest	Douglas fir and western hemlock	467	60.97
Northeast	Eastern spruce and white pine	434	46.78
Southeast	Southern pine	510	85.03

[1/] Wood only, input lamstock, oven-dry.

Reporting of embodied carbon was based on the Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI) evaluation method [46],

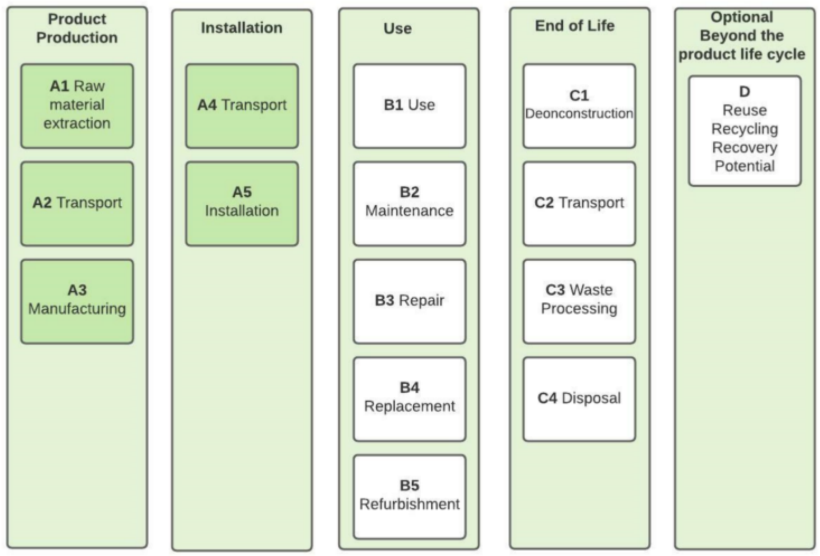


Figure 2. Life-cycle modules included in this study.

Table 2. Geographical regions, species, and mass timber production sites.

Geographic Regions	Species	CLT Production	Glulam Production
Pacific Northwest	Douglas fir and western hemlock	Spokane, Washington [2/]	Veneta, Oregon [2/]
Northeast	Eastern spruce and white pine	Lincoln, Maine	Lincoln, Maine
Southeast	Southern pine [1/]	Dothan, Alabama [2/]	Greenville, Alabama [2/]

[1/] Southern pines are a mixture of several species of longleaf (*Pinus palustris*), loblolly (*P. taeda*), short leaf (*P. chinate*), and slash (*P. elliottii*)) pines with similar characteristics. [2/] Actual production facilities for either CLT or glulam.

Fire protection of the MT structural elements was a critical factor in determining the allowable heights and uses for MT in mid- and high-rise buildings (Supplementary Materials S1). All MT building designs followed the new approved codes set by the International Code Council [42], which were adopted in the 2021 International Building Code. All MT elements in Type IV require some level of fire protection (Table 1). Type IV-A (up to 18 stories) requires noncombustible protection over all MT elements. Types IV-B and -C allow some exposure to MT [42]. The noncombustible material used in this study was either $\frac{1}{2}$″ gypsum or 5/8″ Type X gypsum sheathing (Supplementary Materials S2) [41].

Table 3. Wood density and species by region and global warming potential (GWP kg CO_2e for one cubic meter of lumber in the PNW, NE, and SE regions [43–45].

Region	Species	Wood Density [1/]	GWP
		kg/m^3	kg CO_2e/m^3
Pacific Northwest	Douglas fir and western hemlock	467	60.97
Northeast	Eastern spruce and white pine	434	46.78
Southeast	Southern pine	510	85.03

[1/] Wood only, input lamstock, oven-dry.

Reporting of embodied carbon was based on the Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI) evaluation method [46], manufacturing of materials, transportation, and installation. Embodied energy is the sum of all energy consumed (renewable and nonrenewable) by all of the processes (including electricity use) associated with each building, from the mining and processing of natural resources to manufacturing, transport, product delivery, and construction. The WBLCA was modeled using the SimaPro LCA software [41,47] equipped with the USLCI [35], EcoInvent [36], and DATASMART 2019 [37] databases.

All materials used in buildings were assumed to be produced and sold domestically; therefore, only road and rail transportation modes were used. For distances shorter than 805 km (500 miles), the materials were assumed to be transported by truck, while for distances longer than 805 km, they were assumed to use a combination of truck and rail transport [41].

3. Results

The WBLCA results demonstrated the embodied carbon and embodied energy of using MT in mid- to high-rise buildings when compared to those of using conventional concrete. Highlights of the building differences in embodied carbon and energy demands by life cycle stage, regions, building height, materials, and assembly are presented in this paper. Since carbon emissions were the main focus of the study, global warming potential (GWP) expressed in carbon dioxide equivalents (CO_2e) is the main metric reported for embodied carbon and megajoules (MJ) for CED. Additional environmental impact indicators (smog, acidification, eutrophication, ozone waste, and fossil fuel depletion) are reported in Supplementary Materials S3 for all building heights and regions.

3.1. Building Mass

For both MT and concrete building designs, concrete represented the largest contribution by mass (Figure 3). In the MT building designs, concrete representation of total building mass was as low as 35% in the SE 8-story building and as high as 46% in the 18-story building in the PNW (Figure 3a). In the concrete building designs, concrete accounted for over 90% of the total mass of all the buildings (Figure 3b). The 8-story buildings had the largest contributions of CLT at 23%, 315, and 35% for the PNW, NE, and SE, respectively. Glulam contributed to under 10% in the 8-story buildings. Cross-laminated timber represented 22–31% of the mass for the 12-story buildings and 16–24% of the mass in the 18-story buildings. Glulam was below 10% of the mass in the 12-story and 6–10% in the 18-story buildings. Glulam had the highest representation in the PNW buildings, representing 10% of the mass in all building heights.

The mass contribution of MT was highest in the 8-story buildings and lowest in the 18-story buildings in all regions because the building code for taller buildings requires greater use of gypsum as an interior fire protectant. As a result of the strict fire codes, the 18-story building required over 11 times more gypsum than the 8-story MT design and over 2 times more gypsum than the 12-story MT design.

manufacturing of materials, transportation, and installation. Embodied energy is the sum of all energy consumed (renewable and nonrenewable) by all of the processes (including electricity use) associated with each building, from the mining and processing of natural resources to manufacturing, transport, product delivery, and construction. The WBLCA was modeled using the SimaPro LCA software [41,47] equipped with the USLCI [35], EcoInvent [36], and DATASMART 2019 [37] databases.

All materials used in buildings were assumed to be produced and sold domestically; therefore, only road and rail transportation modes were used. For distances shorter than 805 km (500 miles), the materials were assumed to be transported by truck, while for distances longer than 805 km, they were assumed to use a combination of truck and rail transport [41].

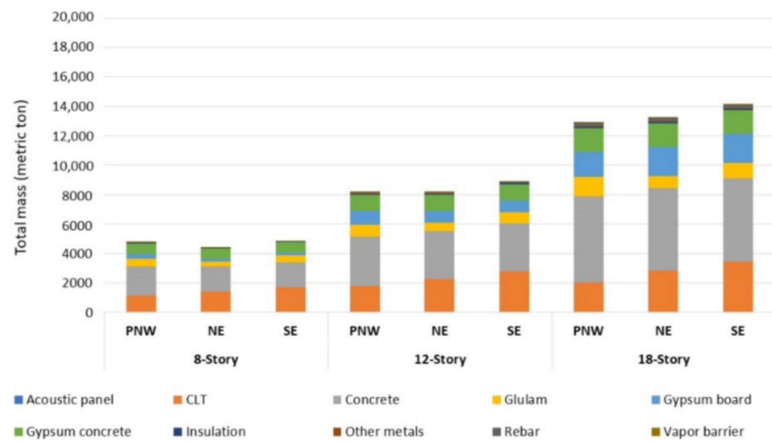
3. Results

The WBLCA results demonstrated the embodied carbon and embodied energy of using MT in mid- to high-rise buildings when compared to those of using conventional concrete. Highlights of the building differences in embodied carbon and energy demands by life cycle stage, regions, building height, materials, and assembly are presented in this paper. Since carbon emissions were the main focus of the study, global warming potential (GWP) expressed in carbon dioxide equivalents (CO_2e) is the main metric reported for embodied carbon and megajoules (MJ) for CED. Additional environmental impact indicators (smog, acidification, eutrophication, ozone waste, and fossil fuel depletion) are reported in Supplementary Materials S3 for all building heights and regions.

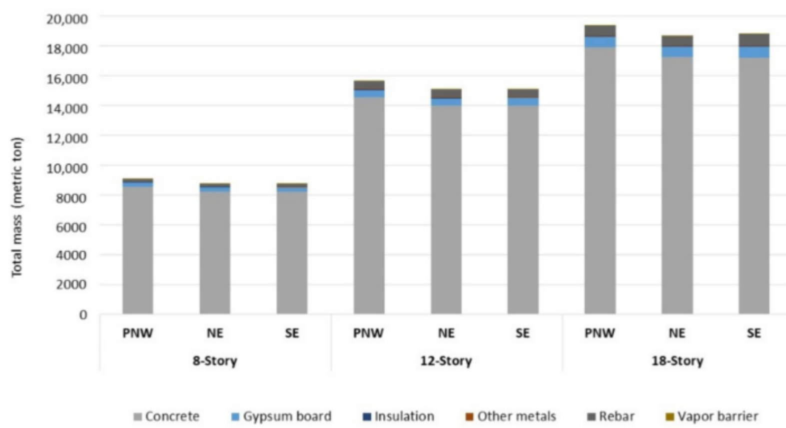
3.1. Building Mass

For both MT and concrete building designs, concrete represented the largest contribution by mass (Figure 3). In the MT building designs, concrete representation of total building mass was as low as 35% in the SE 8-story building and as high as 46% in the 18-story building in the PNW (Figure 3a). In the concrete building designs, concrete accounted for over 90% of the total mass of all the buildings (Figure 3b). The 8-story buildings had the largest contributions of CLT at 23%, 315, and 35% for the PNW, NE, and SE, respectively. Glulam contributed to under 10% in the 8-story buildings. Cross-laminated timber represented 22–31% of the mass for the 12-story buildings and 16–24% of the mass in the 18-story buildings. Glulam was below 10% of the mass in the 12-story and 6–10% in the 18-story buildings. Glulam had the highest representation in the PNW buildings, representing 10% of the mass in all building heights.

The mass contribution of MT was highest in the 8-story buildings and lowest in the 18-story buildings in all regions because the building code for taller buildings requires greater use of gypsum as an interior fire protectant. As a result of the strict fire codes, the 18-story building required over 11 times more gypsum than the 8-story MT design and over 2 times more gypsum than the 12-story MT design.



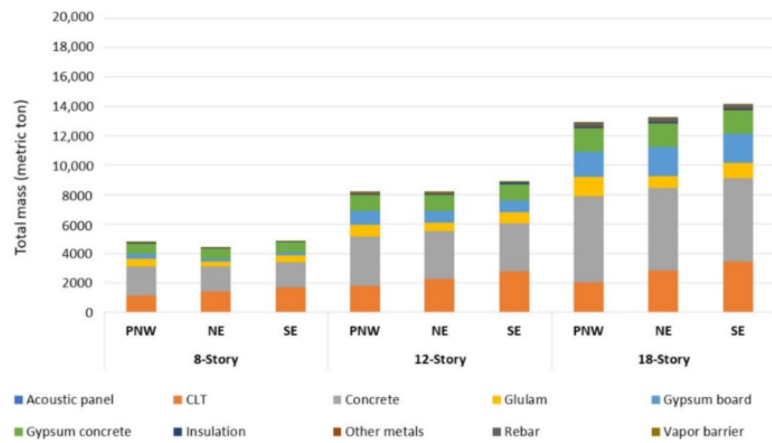
(**a**)



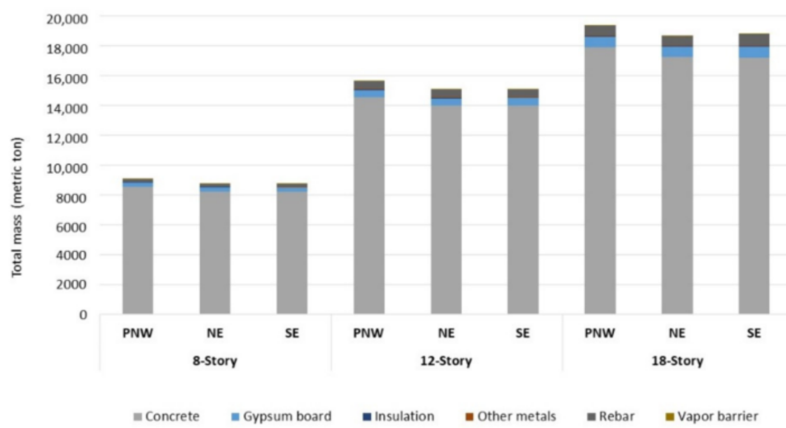
(**b**)

Figure 3. Mass of materials in 8-, 12-, and 18-story (**a**) mass timber and (**b**) concrete buildings in the Pacific Northwest (PNW), Northeast (NE), and Southeast (SE) United States.

Floors represented the largest mass contribution in the 8-story MT buildings, representing about half the total mass of these buildings, while the foundations had the highest mass contributions for the 12-story buildings, ranging from 38 to 42% depending on the region (Figure 4). In the 18-story buildings, the largest mass contribution was the interior wall assembly, which represented 42–52% of the MT whole-building mass. Gypsum wallboard represented about 29% of interior wall mass (Table 4), while for the whole building system, the gypsum wall contributed 14% to the total building mass, including the gypsum used in the exterior wall.



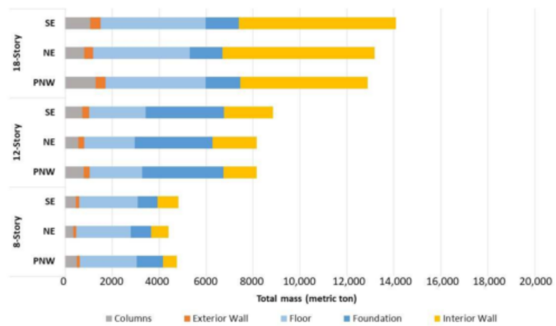
(**a**)



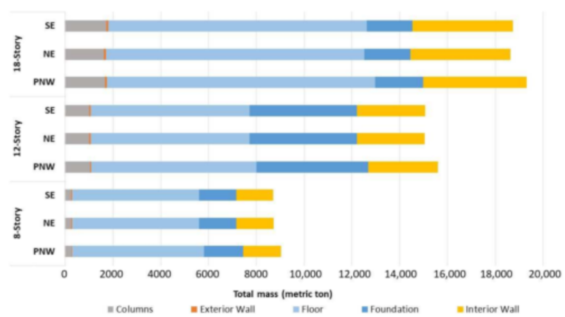
(**b**)

Figure 3. Mass of materials in 8-, 12-, and 18-story (**a**) mass timber and (**b**) concrete buildings in the Pacific Northwest (PNW), Northeast (NE), and Southeast (SE) United States.

Floors represented the largest mass contribution in the 8-story MT buildings, representing about half the total mass of these buildings, while the foundations had the highest mass contributions for the 12-story buildings, ranging from 38 to 42% depending on the region (Figure 4). In the 18-story buildings, the largest mass contribution was the interior wall assembly, which represented 42–52% of the MT whole-building mass. Gypsum wallboard represented about 29% of interior wall mass (Table 4), while for the whole building system, the gypsum wall contributed 14% to the total building mass, including the gypsum used in the exterior wall.



(**a**)

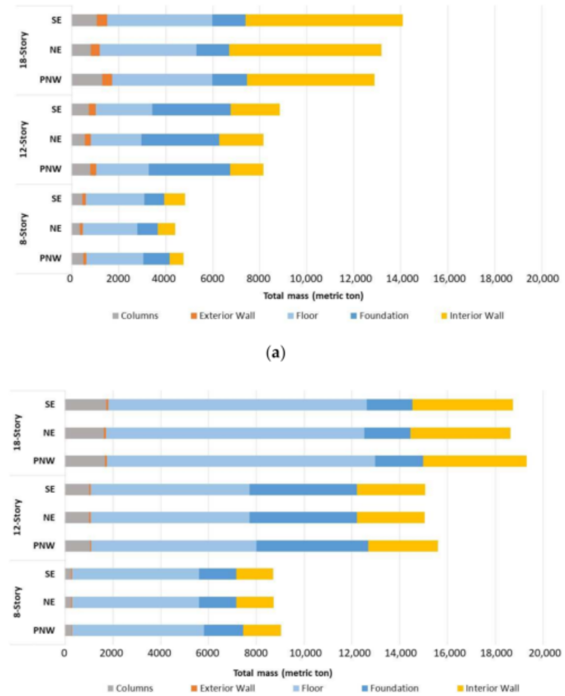


(**b**)

Figure 4. Mass of materials by building assembly (columns, exterior walls, floors, foundation, interior walls) for 8-, 12-, and 18-story buildings from the Pacific Northwest (PNW), Northeast (NE), and Southeast (SE) United States for (**a**) mass timber buildings and (**b**) concrete buildings.

Table 4. Material contribution of the interior wall assembly for mass timber 18-story buildings from the Pacific Northwest, Northeast, and Southeast United States.

Material Used the Interior Walls	Mass of Materials kg/m^2 of Floor Area	Composition by Mass	Contribution to Embodied Carbon
	Pacific Northwest		
Concrete	165.4	65.0%	32.8%
CLT	0.0	0.0%	0.0%
Gypsum wall board	75.3	29.6%	31.5%
Insulation	1.5	0.6%	5.7%
Other metals	2.9	1.1%	10.6%
Rebar	9.5	3.7%	19.4%
	Northeast		
Concrete	145.3	52.3%	32.9%
CLT	39.4	14.2%	11.0%
Gypsum wall board	81.6	29.4%	32.7%
Insulation	1.8	0.6%	3.3%
Other metals	0.8	0.3%	3.1%
Rebar	8.7	3.1%	17.0%
	Southeast		
Concrete	158.7	50.7%	30.2%
CLT	53.0	16.9%	17.3%
Gypsum wall board	89.3	28.5%	30.1%
Insulation	1.9	0.6%	3.1%
Other metals	0.9	0.3%	3.0%
Rebar	9.5	3.0%	16.3%



(a)

(b)

Figure 4. Mass of materials by building assembly (columns, exterior walls, floors, foundation, interior walls) for 8-, 12-, and 18-story buildings from the Pacific Northwest (PNW), Northeast (NE), and Southeast (SE) United States for (**a**) mass timber buildings and (**b**) concrete buildings.

Table 4. Material contribution of the interior wall assembly for mass timber 18-story buildings from the Pacific Northwest, Northeast, and Southeast United States.

Material Used the Interior Walls	Mass of Materials kg/m^2 of Floor Area	Composition by Mass	Contribution to Embodied Carbon
	Pacific Northwest		
Concrete	165.4	65.0%	32.8%
CLT	0.0	0.0%	0.0%
Gypsum wall board	75.3	29.6%	31.5%
Insulation	1.5	0.6%	5.7%
Other metals	2.9	1.1%	10.6%
Rebar	9.5	3.7%	19.4%
	Northeast		
Concrete	145.3	52.3%	32.9%
CLT	39.4	14.2%	11.0%
Gypsum wall board	81.6	29.4%	32.7%
Insulation	1.8	0.6%	3.3%
Other metals	0.8	0.3%	3.1%
Rebar	8.7	3.1%	17.0%
	Southeast		
Concrete	158.7	50.7%	30.2%
CLT	53.0	16.9%	17.3%
Gypsum wall board	89.3	28.5%	30.1%
Insulation	1.9	0.6%	3.1%
Other metals	0.9	0.3%	3.0%
Rebar	9.5	3.0%	16.3%

3.2. Embodied Carbon

Over all regions and building heights, the MT buildings held lower embodied carbon than their functionally equivalent concrete buildings (Figure 5). In general, embodied carbon per unit of area increased with building height in MT buildings as the quantity of concrete, metals, and other nonrenewable materials increased. The NE MT buildings had the largest reduction in embodied carbon compared to the corresponding concrete buildings, with the SE MT buildings showing the smallest reduction, because of the regional electricity grid, wood species, and transportation differences. Across all the building heights and regions, MT buildings exhibited reductions in embodied carbon varying between 22% and 50% compared to the corresponding concrete buildings (Figure 5).

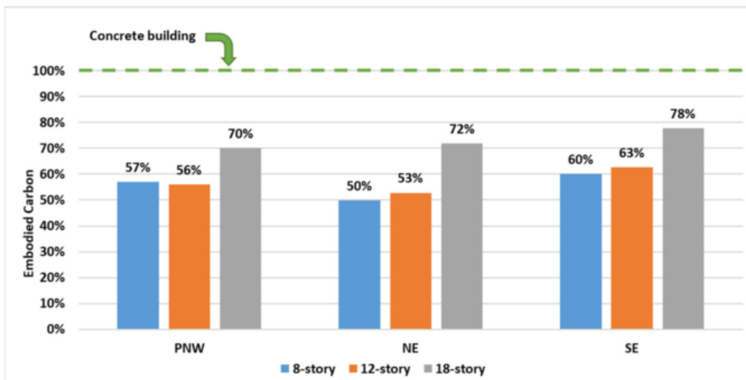


Figure 5. Embodied carbon (relative basis) of mass timber buildings compared to the corresponding concrete buildings of 8, 12, and 18 stories in the Pacific Northwest (PNW), Northeast (NE), and Southeast (SE) United States.

The results of the whole-building embodied carbon analysis are shown in Figure 6. The PNW concrete 12-story buildings had the highest embodied carbon per unit area of all building designs and regions (Figure 6b). This was attributed to the components needed to meet the PNW building code requirements for seismic protection, as well as the mat footing foundation design used only for the 12-story buildings (Supplementary Materials S1). The equivalent 12-story MT building in the PNW had a 44% reduction in embodied carbon. The largest reductions in embodied carbon were in all 8-story MT buildings, for which the results showed reductions of 40–50% compared to the equivalent concrete buildings (Figures 5 and 6).

Embodied carbon of the MT buildings was greatest in the A1–A3 life cycle stages, which represented 85–91% of the carbon emissions. Transportation (A4) accounted for 5–11% and construction (A5) for 3–4% (Table 5). For concrete designs, the A1–A3 life cycle stage represented 94–96% of the carbon emissions. The biggest difference was in the A4 modules. For concrete buildings, the A4-transportation accounted for about 2%, 1%, and 0.5% of carbon emissions in the PNW, NE, and SE, respectively.

3.2. Embodied Carbon

Over all regions and building heights, the MT buildings held lower embodied carbon than their functionally equivalent concrete buildings (Figure 5). In general, embodied carbon per unit of area increased with building height in MT buildings as the quantity of concrete, metals, and other nonrenewable materials increased. The NE MT buildings had the largest reduction in embodied carbon compared to the corresponding concrete buildings, with the SE MT buildings showing the smallest reduction, because of the regional electricity grid, wood species, and transportation differences. Across all the building heights and regions, MT buildings exhibited reductions in embodied carbon varying between 22% and 50% compared to the corresponding concrete buildings (Figure 5).

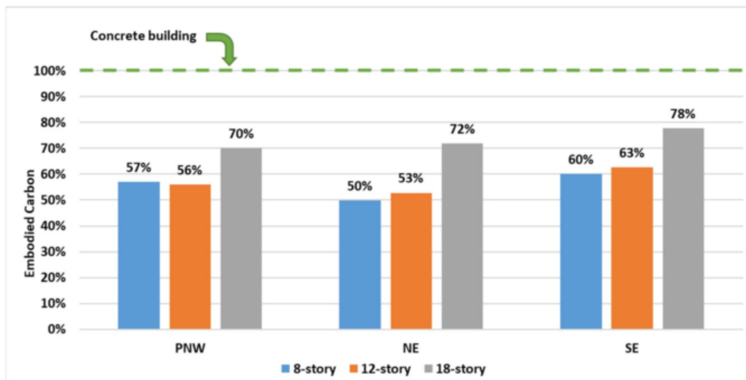


Figure 5. Embodied carbon (relative basis) of mass timber buildings compared to the corresponding concrete buildings of 8, 12, and 18 stories in the Pacific Northwest (PNW), Northeast (NE), and Southeast (SE) United States.

The results of the whole-building embodied carbon analysis are shown in Figure 6. The PNW concrete 12-story buildings had the highest embodied carbon per unit area of all building designs and regions (Figure 6b). This was attributed to the components needed to meet the PNW building code requirements for seismic protection, as well as the mat footing foundation design used only for the 12-story buildings (Supplementary Materials S1). The equivalent 12-story MT building in the PNW had a 44% reduction in embodied carbon. The largest reductions in embodied carbon were in all 8-story MT buildings, for which the results showed reductions of 40–50% compared to the equivalent concrete buildings (Figures 5 and 6).

Embodied carbon of the MT buildings was greatest in the A1–A3 life cycle stages, which represented 85–91% of the carbon emissions. Transportation (A4) accounted for 5–11% and construction (A5) for 3–4% (Table 5). For concrete designs, the A1–A3 life cycle stage represented 94–96% of the carbon emissions. The biggest difference was in the A4 modules. For concrete buildings, the A4-transportation accounted for about 2%, 1%, and 0.5% of carbon emissions in the PNW, NE, and SE, respectively.

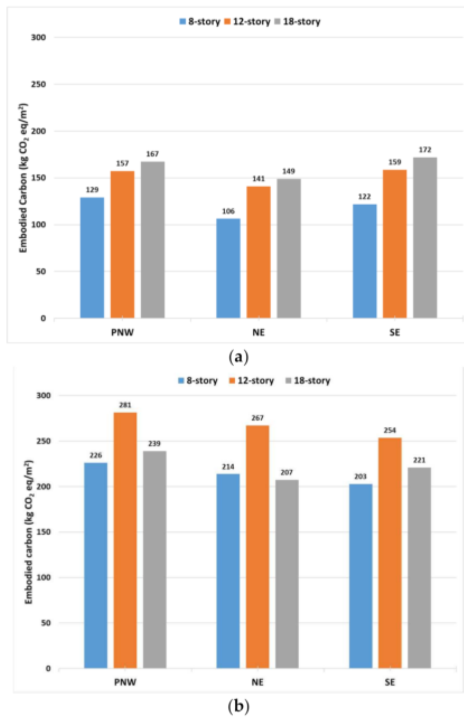
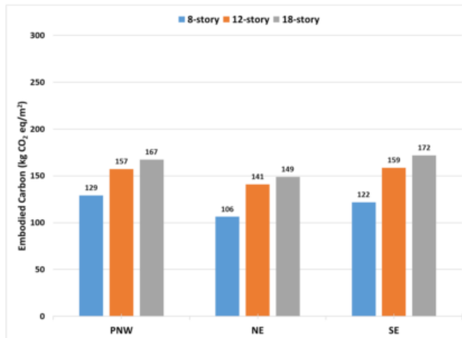


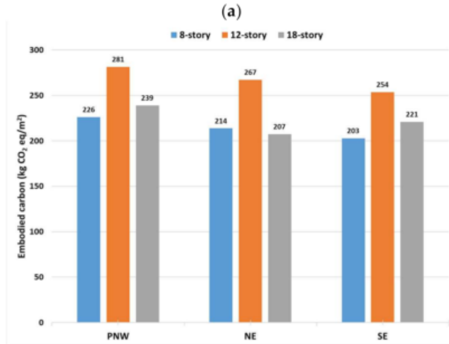
Figure 6. Embodied carbon of 8-, 12-, and 18-story (**a**) mass timber and (**b**) concrete buildings in the Pacific Northwest (PNW), Northeast (NE), and Southeast (SE) United States.

Table 5. Total embodied carbon by life cycle stage (A1–A5) for all mass timber and concrete building designs.

PNW Embodied Carbon kg CO_2e/m^2									
Building System		**A1–A3**		**A4**		**A5**		**Total**	
8-story	Mass timber building	113.4	87.9%	11.6	9.0%	4.0	3.1%	129.1	100.0%
	Concrete building	212.5	94.0%	5.5	2.5%	8.0	3.5%	226.0	100.0%
12-story	Mass timber building	139.2	88.5%	12.8	8.1%	5.3	3.4%	157.3	100.0%
	Concrete building	264.5	94.0%	6.3	2.2%	10.7	3.8%	281.4	100.0%
18-story	Mass timber building	146.1	87.3%	14.8	8.8%	6.5	3.9%	167.3	100.0%
	Concrete building	223.4	93.5%	5.3	2.2%	10.1	4.2%	238.9	100.0%
NE Embodied Carbon kg CO_2e/m^2									
		A1–A3		**A4**		**A5**		**Total**	
8-story	Mass timber building	90.7	85.2%	12.0	11.2%	3.7	3.5%	106.3	100.0%
	Concrete building	203.7	95.3%	2.7	1.3%	7.4	3.5%	213.8	100.0%
12-story	Mass timber building	121.4	86.1%	14.2	10.1%	5.3	3.8%	141.0	100.0%
	Concrete building	254.0	95.1%	3.1	1.2%	9.9	3.7%	267.0	100.0%
18-story	Mass timber building	130.0	87.2%	13.0	8.7%	6.1	4.1%	149.1	100.0%
	Concrete building	196.3	94.6%	2.6	1.2%	8.6	4.1%	207.4	100.0%
SE Embodied Carbon kg CO_2e/m^2									
		A1–A3		**A4**		**A5**		**Total**	
8-story	Mass timber building	110.0	90.4%	7.62	6.3%	4.09	3.4%	121.7	100.0%
	Concrete building	194.5	95.9%	0.96	0.5%	7.37	3.6%	202.8	100.0%
12-story	Mass timber building	144.0	90.8%	8.76	5.5%	5.81	3.7%	158.6	100.0%
	Concrete building	242.6	95.7%	1.12	0.4%	9.86	3.9%	253.5	100.0%
18-story	Mass timber building	157.2	91.4%	7.68	4.5%	7.09	4.1%	172.0	100.0%
	Concrete building	210.5	95.3%	0.96	0.4%	9.43	4.3%	220.9	100.0%



(**a**)



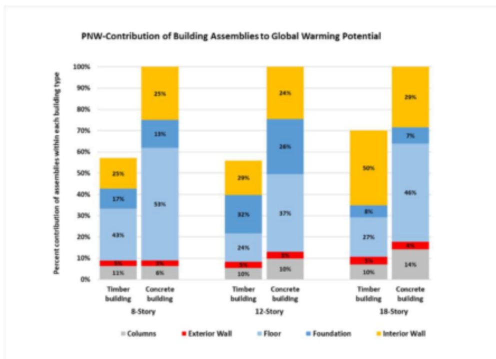
(**b**)

Figure 6. Embodied carbon of 8-, 12-, and 18-story (**a**) mass timber and (**b**) concrete buildings in the Pacific Northwest (PNW), Northeast (NE), and Southeast (SE) United States.

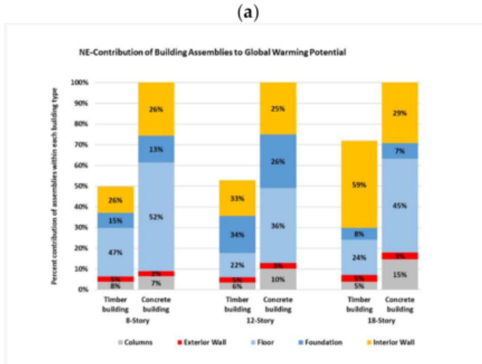
Table 5. Total embodied carbon by life cycle stage (A1–A3) for all mass timber and concrete building designs.

PNW Embodied Carbon kg CO_2e/m^2									
Building System		**A1–A3**		**A4**		**A5**		**Total**	
8-story	Mass timber building	113.4	87.9%	11.6	9.0%	4.0	3.1%	129.1	100.0%
	Concrete building	212.5	94.0%	5.5	2.5%	8.0	3.5%	226.0	100.0%
12-story	Mass timber building	139.2	88.5%	12.8	8.1%	5.3	3.4%	157.3	100.0%
	Concrete building	264.5	94.0%	6.3	2.2%	10.7	3.8%	281.4	100.0%
18-story	Mass timber building	146.1	87.3%	14.8	8.8%	6.5	3.9%	167.3	100.0%
	Concrete building	223.4	93.5%	5.3	2.2%	10.1	4.2%	238.9	100.0%
NE Embodied Carbon kg CO_2e/m^2									
		A1–A3		**A4**		**A5**		**Total**	
8-story	Mass timber building	90.7	85.2%	12.0	11.2%	3.7	3.5%	106.3	100.0%
	Concrete building	203.7	95.3%	2.7	1.3%	7.4	3.5%	213.8	100.0%
12-story	Mass timber building	121.4	86.1%	14.2	10.1%	5.3	3.8%	141.0	100.0%
	Concrete building	254.0	95.1%	3.1	1.2%	9.9	3.7%	267.0	100.0%
18-story	Mass timber building	130.0	87.2%	13.0	8.7%	6.1	4.1%	149.1	100.0%
	Concrete building	196.3	94.6%	2.6	1.2%	8.6	4.1%	207.4	100.0%
SE Embodied Carbon kg CO_2e/m^2									
		A1–A3		**A4**		**A5**		**Total**	
8-story	Mass timber building	110.0	90.4%	7.62	6.3%	4.09	3.4%	121.7	100.0%
	Concrete building	194.5	95.9%	0.96	0.5%	7.37	3.6%	202.8	100.0%
12-story	Mass timber building	144.0	90.8%	8.76	5.5%	5.81	3.7%	158.6	100.0%
	Concrete building	242.6	95.7%	1.12	0.4%	9.86	3.9%	253.5	100.0%
18-story	Mass timber building	157.2	91.4%	7.68	4.5%	7.09	4.1%	172.0	100.0%
	Concrete building	210.5	95.3%	0.96	0.4%	9.43	4.3%	220.9	100.0%

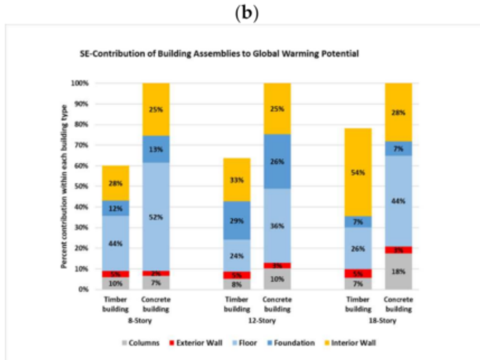
In the 18-story MT buildings, the interior wall represented 50–59% of the total embodied carbon impact of the whole building depending on the region (Figure 7). Gypsum wall board was used in both interior and exterior wall systems. Within the interior wall assembly of the 18-story MT buildings, gypsum wall board represented about 29–30% of the interior wall mass and 30–33% of the embodied carbon depending on the region (Table 4). For the 18-story MT building systems in all regions, gypsum wall board contributed 13–15% of the mass (Figure 3a) and 16–21% of the total embodied carbon (Figure 8), while the two MT structure components (CLT and glulam) contributed 28–39% and concrete (including gypsum–concrete) 30–35% of the whole-building embodied carbon. This included the gypsum in the exterior wall.



(**a**)



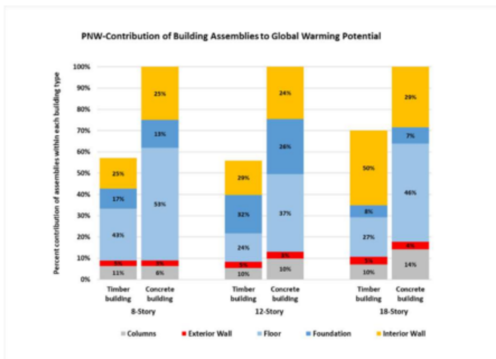
(**b**)



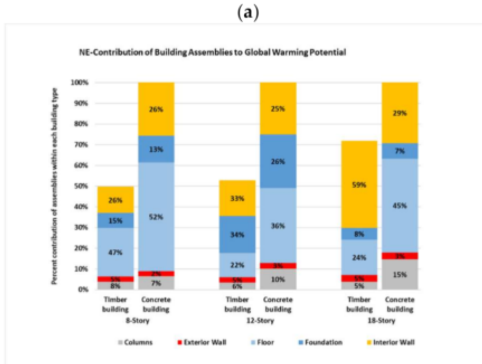
(**c**)

Figure 7. Contribution of building assemblies to total embodied carbon of 8-, 12-buildings in the (**a**) Pacific Northwest (PNW), (**b**) Northeast (NE), and (**c**) Southeast (SE) United States.

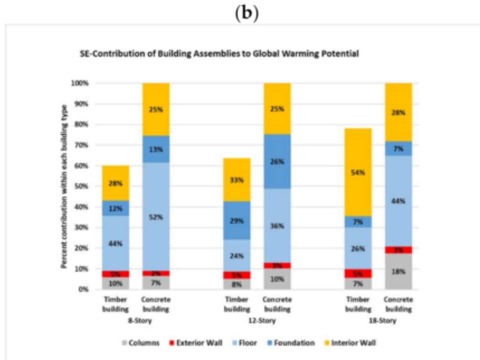
In the 18-story MT buildings, the interior wall represented 50–59% of the total embodied carbon impact of the whole building depending on the region (Figure 7). Gypsum wall board was used in both interior and exterior wall systems. Within the interior wall assembly of the 18-story MT buildings, gypsum wall board represented about 29–30% of the interior wall mass and 30–33% of the embodied carbon depending on the region (Table 4). For the 18-story MT building systems in all regions, gypsum wall board contributed 13–15% of the mass (Figure 3a) and 16–21% of the total embodied carbon (Figure 8), while the two MT structure components (CLT and glulam) contributed 28–39% and concrete (including gypsum–concrete) 30–35% of the whole-building embodied carbon. This included the gypsum in the exterior wall.



(**a**)

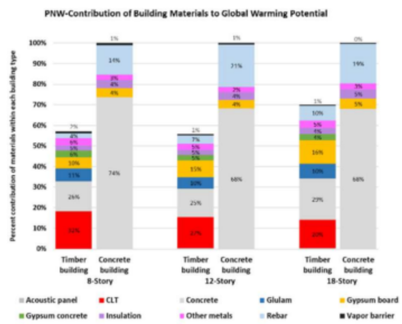


(**b**)

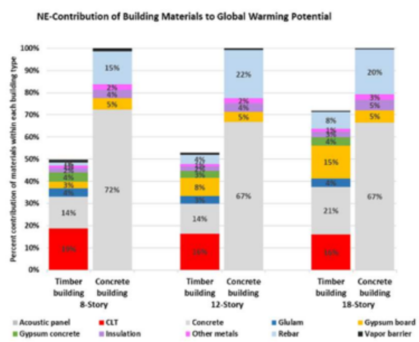


(**c**)

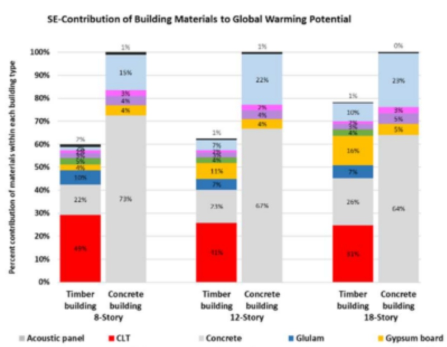
Figure 7. Contribution of building assemblies to total embodied carbon of 8-, 12-buildings in the (**a**) Pacific Northwest (PNW), (**b**) Northeast (NE), and (**c**) Southeast (SE) United States.



(**a**)



(**b**)



(**c**)

Figure 8. Contribution of building materials to total embodied carbon of 8-, 12-, and 18-story buildings in the (**a**) Pacific Northwest (PNW), (**b**) Northeast (NE) and (**c**) Southeast (SE) US.

3.3. Energy Use

Both renewable and nonrenewable energy were consumed during extraction, production, transport, and manufacture of the materials used in all building designs. In all building designs, total embodied energy was higher for the MT buildings compared to the equivalent concrete buildings (Table 6), independently of the region.

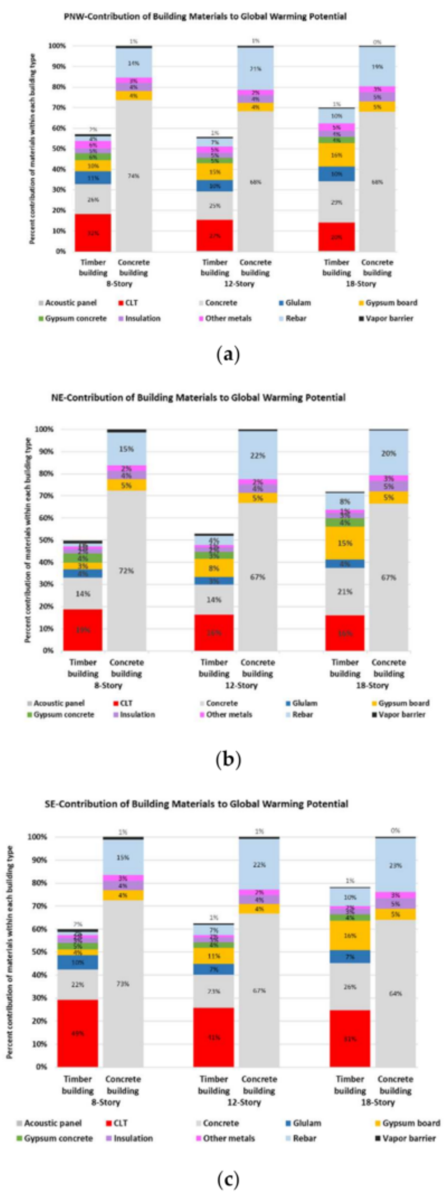


Figure 8. Contribution of building materials to total embodied carbon of 8-, 12-, and 18-story buildings in the (**a**) Pacific Northwest (PNW), (**b**) Northeast (NE) and (**c**) Southeast (SE) US.

3.3. Energy Use

Both renewable and nonrenewable energy were consumed during extraction, production, transport, and manufacture of the materials used in all building designs. In all building designs, total embodied energy was higher for the MT buildings compared to the equivalent concrete buildings (Table 6), independently of the region.

Table 6. Cradle-to-gate embodied energy (absolute basis and relative basis) for 8-, 12-, and 18-story mass timber and concrete building designs in the PNW, NE, and SE regions.

		A1–A3		A4		A5		Total		Total
PNW Embodied Energy MJ/m^2										
Building Design		**Renewable**	**Nonrenewable**	**Renewable**	**Nonrenewable**	**Renewable**	**Nonrenewable**	**Renewable**	**Nonrenewable**	**Energy**
8-story	Mass timber	1145	1526	0	148	0	55	1146	1729	2875
	Concrete	62	1857	0	71	0	109	62	2037	2099
12-story	Mass timber	1217	1852	0	163	0	73	1217	2088	3305
	Concrete	78	2405	0	80	0	146	78	2631	2709
18-story	Mass timber	1090	1892	0	188	0	89	1091	2169	3260
	Concrete	67	2016	0	68	0	139	67	2222	2289
NE Embodied Energy MJ/m^2										
8-story	Mass timber	799	1448	0	152	0	51	800	1651	2451
	Concrete	57	1816	0	34	0	101	58	1952	2010
12-story	Mass Timber	875	1878	0	181	0	73	875	2132	3007
	Concrete	72	2355	0	40	0	135	72	2530	2602
18-story	Mass timber	698	1829	0	165	0	83	698	2077	2775
	Concrete	56	1806	0	32	0	118	56	1956	2012
SE Embodied Energy MJ/m^2										
8-story	Mass timber	869	1489	0	98	0	56	869	1643	2512
	Concrete	53	1735	0	12	0	101	53	1848	1901
12-story	Mass timber	952	1917	0	113	0	79	952	2109	3061
	Concrete	63	2236	0	14	0	135	64	2385	2449
18-story	Mass timber	827	1991	0	99	0	97	827	2186	3014
	Concrete	55	1962	0	12	0	129	55	2104	2158

		A1–A3		A4		A5		Total		Total
PNW Embodied Energy, Relative Basis										
Building Design		**Renewable**	**Nonrenewable**	**Renewable**	**Nonrenewable**	**Renewable**	**Nonrenewable**	**Renewable**	**Nonrenewable**	**Energy**
8-story	Mass timber	39.83%	53.08%	0.01%	5.13%	0.00%	1.92%	39.86%	60.14%	100%
	Concrete	2.95%	88.47%	0.01%	3.37%	0.01%	5.18%	2.95%	97.05%	100%
12-story	Mass Timber	36.82%	56.04%	0.01%	4.93%	0.00%	2.21%	36.82%	63.18%	100%
	Concrete	2.88%	88.78%	0.01%	2.95%	0.01%	5.39%	2.88%	97.12%	100%
18-story	Mass Timber	33.44%	58.04%	0.01%	5.77%	0.01%	2.73%	33.47%	66.53%	100%
	Concrete	2.93%	88.07%	0.01%	2.97%	0.01%	6.07%	2.93%	97.07%	100%
NE Embodied Energy, Relative basis										
8-story	Mass timber	32.60%	59.08%	0.01%	6.19%	0.00%	2.09%	32.64%	67.36%	100%
	Concrete	2.84%	90.35%	0.00%	1.71%	0.01%	5.04%	2.89%	97.11%	100%
12-story	Mass Timber	29.10%	62.45%	0.01%	6.01%	0.01%	2.44%	29.10%	70.90%	100%
	Concrete	2.77%	90.51%	0.00%	1.53%	0.01%	5.19%	2.77%	97.23%	100%
18-story	Mass Timber	25.15%	65.91%	0.01%	5.95%	0.01%	3.00%	25.15%	74.85%	100%
	Concrete	2.78%	89.76%	0.00%	1.61%	0.01%	5.84%	2.78%	97.22%	100%
SE Embodied Energy, Relative basis										
8-story	Mass timber	34.59%	59.28%	0.00%	3.91%	0.00%	2.23%	34.59%	65.41%	100%
	Concrete	2.79%	91.27%	0.00%	0.65%	0.01%	5.30%	2.79%	97.21%	100%
12-story	Mass timber	31.10%	62.63%	0.00%	3.68%	0.01%	2.60%	31.10%	68.90%	100%
	Concrete	2.57%	91.30%	0.00%	0.59%	0.01%	5.51%	2.61%	97.39%	100%
18-story	Mass Timber	27.44%	66.06%	0.00%	3.28%	0.01%	3.22%	27.44%	72.56%	100%
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 6. Cradle-to-gate embodied energy (absolute basis and relative basis) for 8-, 12-, and 18-story mass timber and concrete building designs in the PNW, NE, and SE regions.

PNW Embodied Energy MJ/m²										
		A1–A3		**A4**		**A5**		**Total**		**Total**
Building Design		**Renewable**	**Nonrenewable**	**Renewable**	**Nonrenewable**	**Renewable**	**Nonrenewable**	**Renewable**	**Nonrenewable**	**Energy**
8-story	Mass timber	1145	1526	0	148	0	55	1146	1729	2875
	Concrete	62	1857	0	71	0	109	62	2037	2099
12-story	Mass timber	1217	1852	0	163	0	73	1217	2088	3305
	Concrete	78	2405	0	80	0	146	78	2631	2709
18-story	Mass timber	1090	1892	0	188	0	89	1091	2169	3260
	Concrete	67	2016	0	68	0	139	67	2222	2289
NE Embodied Energy MJ/m²										
8-story	Mass timber	799	1448	0	152	0	51	800	1651	2451
	Concrete	57	1816	0	34	0	101	58	1952	2010
12-story	Mass Timber	875	1878	0	181	0	73	875	2132	3007
	Concrete	72	2355	0	40	0	135	72	2530	2602
18-story	Mass timber	698	1829	0	165	0	83	698	2077	2775
	Concrete	56	1806	0	32	0	118	56	1956	2012
SE Embodied Energy MJ/m²										
8-story	Mass timber	869	1489	0	98	0	56	869	1643	2512
	Concrete	53	1735	0	12	0	101	53	1848	1901
12-story	Mass timber	952	1917	0	113	0	79	952	2109	3061
	Concrete	63	2236	0	14	0	135	64	2385	2449
18-story	Mass timber	827	1991	0	99	0	97	827	2186	3014
	Concrete	55	1962	0	12	0	129	55	2104	2158
PNW Embodied Energy, Relative Basis										
		A1–A3		**A4**		**A5**		**Total**		**Total**
Building Design		**Renewable**	**Nonrenewable**	**Renewable**	**Nonrenewable**	**Renewable**	**Nonrenewable**	**Renewable**	**Nonrenewable**	**Energy**
8-story	Mass timber	39.83%	53.08%	0.01%	5.13%	0.00%	1.92%	39.86%	60.14%	100%
	Concrete	2.95%	88.47%	0.01%	3.37%	0.01%	5.18%	2.95%	97.05%	100%
12-story	Mass Timber	36.82%	56.04%	0.01%	4.93%	0.00%	2.21%	36.82%	63.18%	100%
	Concrete	2.88%	88.78%	0.01%	2.95%	0.01%	5.39%	2.88%	97.12%	100%
18-story	Mass Timber	33.44%	58.04%	0.01%	5.77%	0.01%	2.73%	33.47%	66.53%	100%
	Concrete	2.93%	88.07%	0.01%	2.97%	0.01%	6.07%	2.93%	97.07%	100%
NE Embodied Energy, Relative basis										
8-story	Mass timber	32.60%	59.08%	0.01%	6.19%	0.00%	2.09%	32.64%	67.36%	100%
	Concrete	2.84%	90.35%	0.00%	1.71%	0.01%	5.04%	2.89%	97.11%	100%
12-story	Mass Timber	29.10%	62.45%	0.01%	6.01%	0.01%	2.44%	29.10%	70.90%	100%
	Concrete	2.77%	90.51%	0.00%	1.53%	0.01%	5.19%	2.77%	97.23%	100%
18-story	Mass Timber	25.15%	65.91%	0.01%	5.95%	0.01%	3.00%	25.15%	74.85%	100%
	Concrete	2.78%	89.76%	0.00%	1.61%	0.01%	5.84%	2.78%	97.22%	100%
SE Embodied Energy, Relative basis										
8-story	Mass timber	34.59%	59.28%	0.00%	3.91%	0.00%	2.23%	34.59%	65.41%	100%
	Concrete	2.79%	91.27%	0.00%	0.65%	0.01%	5.30%	2.79%	97.21%	100%
12-story	Mass timber	31.10%	62.63%	0.00%	3.68%	0.01%	2.60%	31.10%	68.90%	100%
	Concrete	2.57%	91.30%	0.00%	0.59%	0.01%	5.51%	2.61%	97.39%	100%
18-story	Mass Timber	27.44%	66.06%	0.00%	3.28%	0.01%	3.22%	27.44%	72.56%	100%
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Total (A1–A5) nonrenewable energy (fossil and nuclear) was lower in the MT than in the concrete designs for the 8- and 12-story buildings (Table 6), while the 18-story MT buildings (NE and SE regions) consumed more nonrenewable fuels than the equivalent concrete designs. This higher nonrenewable fuel consumption in these two regions and not the PNW was primarily from electricity use for regional production of building components (e.g., CLT and glulam). The PNW regional grids use a higher percentage of renewable fuels.

The transportation distances of the CLT and glulam from the manufacturers to the building site over all regions ranged from 332 to 490 km [41]. The transportation of MT components was the driver in the A4 stage. Transportation (A4) from production to construction accounted for 5–8% of nonrenewable energy use for MT buildings and 1–3% for concrete buildings. Construction (A5) energy used only diesel fuel and accounted for 3–5% on the nonrenewable fuel use for MT buildings and 5–6% for concrete buildings.

Renewable energy use originated mainly from the production of the lumber that was the feedstock for both CLT and glulam. For MT, most of the renewable energy was generated by combustion of biomass such as bark, sawdust, chips, and other waste generated during the milling processes [43–45]. The total renewable energy used, from A1–A5, in the MT buildings represented 25–40% of the total energy, depending on the region and building height (Table 6). The percentage of renewable energy decreased with height; it represented 33–40% in the 8-story buildings and 25–33% in the 18-story buildings, wherein there was greater use of on nonrenewable materials such as gypsum.

4. Discussion

4.1. Embodied Carbon (A1–A5)

Mass timber buildings had lower overall embodied carbon than equivalent concrete buildings within the cradle-to-construction gate system boundary. There were also differences in regional buildings' embodied carbon discovered in this study, which could be attributed to differences in electricity grids, the distance of transporting materials, and wood species. In addition, the upstream impacts of producing the softwood lumber used to make CLT and glulam were transferred downstream with the lumber inputs for the production of MT [43–45]. Most of the regional differences came from softwood lumber, which was primarily a result of species density, green moisture content, and type of energy used for drying the lumber with different kiln-drying schedules. These upstream impacts were seen in the overall results in MT buildings over the three regions.

While MT buildings produce carbon emissions during their production and installation, MT buildings also offset their carbon emissions by storing carbon for the time of building is in use (Figure 9). In all three MT designs in all regions, more carbon was stored in the building than was released during production and installation (Figure 9), with results similar to those of earlier published studies [11,13,14,25] in which net carbon (storage minus emission) ranged from −1222 to −5315 tons CO_2e [11,25] for the whole buildings. By life-cycle stage, 88–90% of the embodied carbon was generated during A1–A3 (extraction through manufacturing), 6–11% during product transportation (A4) and 3–4% during construction (A5). Salazar and Puettmann [11] reported 87%, 8%, and 5% for A1–A3, A4, and A5, respectively, results comparable to this study. Current standards on the reporting of embodied carbon (global warming potential) do not include biogenic carbon emissions released from the combustion of renewable fuels as emissions under sustainable forestry practices.

Total (A1–A5) nonrenewable energy (fossil and nuclear) was lower in the MT than in the concrete designs for the 8- and 12-story buildings (Table 6), while the 18-story MT buildings (NE and SE regions) consumed more nonrenewable fuels than the equivalent concrete designs. This higher nonrenewable fuel consumption in these two regions and not the PNW was primarily from electricity use for regional production of building components (e.g., CLT and glulam). The PNW regional grids use a higher percentage of renewable fuels.

The transportation distances of the CLT and glulam from the manufacturers to the building site over all regions ranged from 332 to 490 km [41]. The transportation of MT components was the driver in the A4 stage. Transportation (A4) from production to construction accounted for 5–8% of nonrenewable energy use for MT buildings and 1–3% for concrete buildings. Construction (A5) energy used only diesel fuel and accounted for 3–5% on the nonrenewable fuel use for MT buildings and 5–6% for concrete buildings.

Renewable energy use originated mainly from the production of the lumber that was the feedstock for both CLT and glulam. For MT, most of the renewable energy was generated by combustion of biomass such as bark, sawdust, chips, and other waste generated during the milling processes [43–45]. The total renewable energy used, from A1–A5, in the MT buildings represented 25–40% of the total energy, depending on the region and building height (Table 6). The percentage of renewable energy decreased with height; it represented 33–40% in the 8-story buildings and 25–33% in the 18-story buildings, wherein there was greater use of on nonrenewable materials such as gypsum.

4. Discussion

4.1. Embodied Carbon (A1–A5)

Mass timber buildings had lower overall embodied carbon than equivalent concrete buildings within the cradle-to-construction gate system boundary. There were also differences in regional buildings' embodied carbon discovered in this study, which could be attributed to differences in electricity grids, the distance of transporting materials, and wood species. In addition, the upstream impacts of producing the softwood lumber used to make CLT and glulam were transferred downstream with the lumber inputs for the production of MT [43–45]. Most of the regional differences came from softwood lumber, which was primarily a result of species density, green moisture content, and type of energy used for drying the lumber with different kiln-drying schedules. These upstream impacts were seen in the overall results in MT buildings over the three regions.

While MT buildings produce carbon emissions during their production and installation, MT buildings also offset their carbon emissions by storing carbon for the time of building is in use (Figure 9). In all three MT designs in all regions, more carbon was stored in the building than was released during production and installation (Figure 9), with results similar to those of earlier published studies [11,13,14,25] in which net carbon (storage minus emission) ranged from −1222 to −5315 tons CO_2e [11,25] for the whole buildings. By life-cycle stage, 88–90% of the embodied carbon was generated during A1–A3 (extraction through manufacturing), 6–11% during product transportation (A4) and 3–4% during construction (A5). Salazar and Puettmann [11] reported 87%, 8%, and 5% for A1–A3, A4, and A5, respectively, results comparable to this study. Current standards on the reporting of embodied carbon (global warming potential) do not include biogenic carbon emissions released from the combustion of renewable fuels as emissions under sustainable forestry practices.

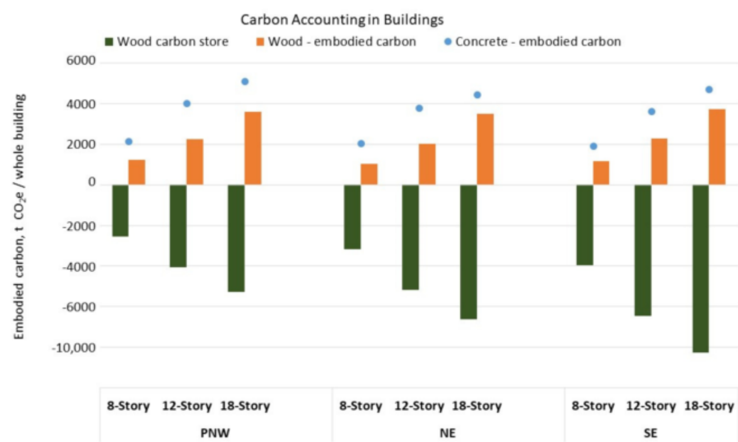


Figure 9. Cradle-to-gate (A1–A5) carbon accounting of MT buildings and embodied carbon of concrete buildings (blue dot).

4.2. Embodied Carbon—Assemblies

In MT and concrete 12-story buildings in all three regions, the foundation had the highest embodied carbon contribution. This was due to the mat footing design for the 12-story MT buildings. This required more cement and rebars than the spread footing design for the 8-story buildings and the pile foundation design for the 18-story buildings (Supplementary Materials S2) [41].

Following the requisite code performances as required under the new building codes for mass timber buildings (Supplementary Materials S1), there was additional consideration given to the fire and life safety code requirements. Interior walls represented the largest contribution to embodied carbon for the 18-story buildings because of strict fire codes requiring nearly 11 times more gypsum than for the 8-story buildings and 2 times more gypsum than for the 12-story buildings. Gypsum wall board was assumed as the requisite noncombustible protection and was required only for the MT assemblies and not for the equivalent noncombustible concrete assemblies [41] (Supplementary Materials S1 and S2).

4.3. Embodied Energy

All MT buildings used more energy to produce than the equivalent concrete buildings. As mentioned earlier, the energy requirement to produce lumber was transferred to MT production and again to the whole-building cradle-to-gate energy use. Energy consumption was not directly in line with embodied carbon, and energy content of the fuels used was not equal. Wood fuels have a lower heating value than fossil fuels. Recently produced life-cycle assessment reports [43,44] on the production of softwood lumber in the United States showed that nearly 100% of the energy was from renewable biomass, mostly generated at the facilities. When these burdens were transferred with the quantity of MT used in the whole buildings along with all the materials used in the buildings, the use of renewable energy ranged from 33–40% in the 8-story buildings, to 25–33% in the 12-story buildings, to 27–35% in the 18-story buildings. Over all regions, 88–91% of nonrenewable fuels used in the MT designs were from modules A1–A3. In the concrete buildings, the maximum amount of renewable energy use was only 3%.

Transportation of MT to construction sites (A4) had minimal impact on the total whole-building energy use (5–8%). On the other hand, concrete transportation to the construction site was limited to only 1–3% of the buildings' total nonrenewable energy. This was due to the short local transport of concrete and the fact that CLT is a customized product and is more difficult to be sourced locally. Current regional production facilities for MT are

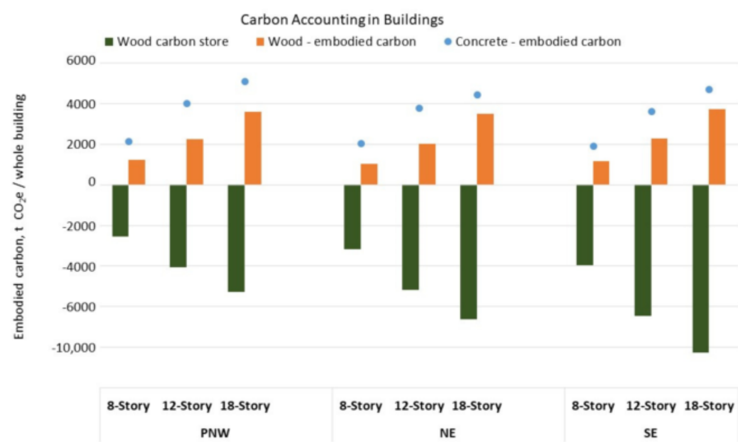


Figure 9. Cradle-to-gate (A1–A5) carbon accounting of MT buildings and embodied carbon of concrete buildings (blue dot).

4.2. Embodied Carbon—Assemblies

In MT and concrete 12-story buildings in all three regions, the foundation had the highest embodied carbon contribution. This was due to the mat footing design for the 12-story MT buildings. This required more cement and rebars than the spread footing design for the 8-story buildings and the pile foundation design for the 18-story buildings (Supplementary Materials S2) [41].

Following the requisite code performances as required under the new building codes for mass timber buildings (Supplementary Materials S1), there was additional consideration given to the fire and life safety code requirements. Interior walls represented the largest contribution to embodied carbon for the 18-story buildings because of strict fire codes requiring nearly 11 times more gypsum than for the 8-story buildings and 2 times more gypsum than for the 12-story buildings. Gypsum wall board was assumed as the requisite noncombustible protection and was required only for the MT assemblies and not for the equivalent noncombustible concrete assemblies [41] (Supplementary Materials S1 and S2).

4.3. Embodied Energy

All MT buildings used more energy to produce than the equivalent concrete buildings. As mentioned earlier, the energy requirement to produce lumber was transferred to MT production and again to the whole-building cradle-to-gate energy use. Energy consumption was not directly in line with embodied carbon, and energy content of the fuels used was not equal. Wood fuels have a lower heating value than fossil fuels. Recently produced life-cycle assessment reports [43,44] on the production of softwood lumber in the United States showed that nearly 100% of the energy was from renewable biomass, mostly generated at the facilities. When these burdens were transferred with the quantity of MT used in the whole buildings along with all the materials used in the buildings, the use of renewable energy ranged from 33–40% in the 8-story buildings, to 25–33% in the 12-story buildings, to 27–35% in the 18-story buildings. Over all regions, 88–91% of nonrenewable fuels used in the MT designs were from modules A1–A3. In the concrete buildings, the maximum amount of renewable energy use was only 3%.

Transportation of MT to construction sites (A4) had minimal impact on the total whole-building energy use (5–8%). On the other hand, concrete transportation to the construction site was limited to only 1–3% of the buildings' total nonrenewable energy. This was due to the short local transport of concrete and the fact that CLT is a customized product and is more difficult to be sourced locally. Current regional production facilities for MT are region. Distances ranged from 354 to 473 km for CLT and 332 to 490 km for glulam [41]. Concrete transport distances were short, limited to under 52 km to the construction site.

As an example of the potential impact of A4, when the transportation distance for CLT and glulam was doubled for the 8-story MT building, the A4 energy use contribution increased to 15% for the whole building. We mention this because some of the current whole-building design embodied carbon models available use environmental product declarations that might not include the A4 module in the total embodied carbon of the product. Therefore, preferred purchasing based solely on A1–A3 embodied carbon could have unintended consequences on the overall embodied carbon of MT buildings.

5. Conclusions

Manufacturing of all building materials and construction of buildings consume energy and emit carbon. Sustainable use of wood products gives the opportunity for reducing global greenhouse gas emissions by: (1) growing more trees; (2) managing forests sustainably for yield; (3) using local wood sources and products to reduce transportation impacts; (4) producing wood products used in long-term service; (5) building for deconstruction with reuse and recycling potential of all wood elements; (6) replacing fossil-based, energy-intensive materials with wood products in low-, mid-, and high-rise buildings; and (7) using wood residues for energy generation during wood product manufacturing which displaces fossil carbon emissions.

This study demonstrated embodied carbon (global warming potential) reductions when replacing concrete and steel with MT in all three levels of building, 8, 12, and 18 stories, in all three U.S. regions studied. Reductions of 22% to 50% in carbon emissions were achieved compared to the functionally equivalent concrete buildings based on cradle-to-construction gate assessment. Regional differences in the embodied carbon of buildings were due to the regional building code requirements for MT building designs, MT feedstock production differences, and regional electricity grid differences. Mass timber products, if sourced from local forest resources and produced locally, can keep the whole-building embodied carbon impacts lower and avoid unintended consequences as a result of long transportations.

This study clearly showed the potential of carbon emission reductions that could be achieved in MT construction compared to the construction of traditional concrete mid- to high-rise buildings. However, it also indicated the need for updates and improvements in research and testing so that building codes and materials use can reflect actual risk, as we showed with the impact of gypsum wall board on the 18-story buildings.

A plethora of data exist on the favorable environmental performance of wood as a building material and its role in carbon mitigation. The opportunities for improvement in the use of wood as a building material are endless, including improving material and building designs, innovative products, building codes that allow the use of MT for high-rise buildings and displace fossil-intensive alternatives, and better communication and education on how to improve the efficiency of wood use and avoid unintended consequences.

Supplementary Materials: The following are available online https://www.mdpi.com/article/10.3390/su132413987/s1. Figure S1. Building designs in three regions of the United States—Pacific Northwest, Northeast, and Southeast. Figure S2. Required noncombustible protection on mass timber elements by construction type (source: https://www.woodworks.org/wp-content/uploads/wood_solution_paper-TALL-WOOD.pdf) (accessed on 14 December 2014). Figure S3. Foundation types for (a) 8-story, (b) 12-story, and (c) 18-story mass timber buildings. Table S1. Foundation approach for each building design for all regions. Table S2. Glazing and opaque percent of wall area for 8-, 12-, and 18-story buildings for all regions. Table S3. Resulting mixed use building program distribution for 8-, 12-, and 18-story buildings. Table S4. Whole-building bill of materials, PNW. Table S5 Whole-building bill of materials, NE. Table S6. Whole-building bill of materials, SE. Table S7. Cradle-to-gate (A1–A5) life cycle impacts of mass timber and concrete buildings from the Pacific region. Distances ranged from 354 to 473 km for CLT and 332 to 490 km for glulam [41]. Concrete transport distances were short, limited to under 52 km to the construction site.

As an example of the potential impact of A4, when the transportation distance for CLT and glulam was doubled for the 8-story MT building, the A4 energy use contribution increased to 15% for the whole building. We mention this because some of the current whole-building design embodied carbon models available use environmental product declarations that might not include the A4 module in the total embodied carbon of the product. Therefore, preferred purchasing based solely on A1–A3 embodied carbon could have unintended consequences on the overall embodied carbon of MT buildings.

5. Conclusions

Manufacturing of all building materials and construction of buildings consume energy and emit carbon. Sustainable use of wood products gives the opportunity for reducing global greenhouse gas emissions by: (1) growing more trees; (2) managing forests sustainably for yield; (3) using local wood sources and products to reduce transportation impacts; (4) producing wood products used in long-term service; (5) building for deconstruction with reuse and recycling potential of all wood elements; (6) replacing fossil-based, energy-intensive materials with wood products in low-, mid-, and high-rise buildings; and (7) using wood residues for energy generation during wood product manufacturing which displaces fossil carbon emissions.

This study demonstrated embodied carbon (global warming potential) reductions when replacing concrete and steel with MT in all three levels of building, 8, 12, and 18 stories, in all three U.S. regions studied. Reductions of 22% to 50% in carbon emissions were achieved compared to the functionally equivalent concrete buildings based on cradle-to-construction gate assessment. Regional differences in the embodied carbon of buildings were due to the regional building code requirements for MT building designs, MT feedstock production differences, and regional electricity grid differences. Mass timber products, if sourced from local forest resources and produced locally, can keep the whole-building embodied carbon impacts lower and avoid unintended consequences as a result of long transportations.

This study clearly showed the potential of carbon emission reductions that could be achieved in MT construction compared to the construction of traditional concrete mid- to high-rise buildings. However, it also indicated the need for updates and improvements in research and testing so that building codes and materials use can reflect actual risk, as we showed with the impact of gypsum wall board on the 18-story buildings.

A plethora of data exist on the favorable environmental performance of wood as a building material and its role in carbon mitigation. The opportunities for improvement in the use of wood as a building material are endless, including improving material and building designs, innovative products, building codes that allow the use of MT for high-rise buildings and displace fossil-intensive alternatives, and better communication and education on how to improve the efficiency of wood use and avoid unintended consequences.

Supplementary Materials: The following are available online https://www.mdpi.com/article/10.3390/su132413987/s1. Figure S1. Building designs in three regions of the United States—Pacific Northwest, Northeast, and Southeast. Figure S2. Required noncombustible protection on mass timber elements by construction type (source: https://www.woodworks.org/wp-content/uploads/wood_solution_paper-TALL-WOOD.pdf) (accessed on 14 December 2014). Figure S3. Foundation types for (a) 8-story, (b) 12-story, and (c) 18-story mass timber buildings. Table S1. Foundation approach for each building design for all regions. Table S2. Glazing and opaque percent of wall area for 8-, 12-, and 18-story buildings for all regions. Table S3. Resulting mixed use building program distribution for 8-, 12-, and 18-story buildings. Table S4. Whole-building bill of materials, PNW. Table S5 Whole-building bill of materials, NE. Table S6. Whole-building bill of materials, SE. Table S7. Cradle-to-gate (A1–A5) life cycle impacts of mass timber and concrete buildings from the Pacific

Author Contributions: Conceptualization, M.P., F.P., I.G., M.W., C.C., H.G., S.J., I.M. and S.L.; methodology, M.P., F.P., I.G., C.C., H.G., S.J., I.M. and S.L.; software, M.P., F.P., C.C. and S.L., validation, M.P., F.P., C.C., H.G., I.M. and S.L.; formal analysis, M.P., F.P., C.C., S.L. and H.G; investigation, M.P., F.P., C.C., S.L. and H.G.; data curation, M.P., F.P., C.C., I.M. and S.L.; writing—original draft preparation, M.P.; writing—review and editing, M.P., F.P., H.G. and I.G; supervision, M.P., I.G., M.W. and H.G.; project administration, M.W.; funding acquisition, M.W. All authors have read and agreed to the published version of the manuscript.

Funding: External funding was received by the Nature Conservancy.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: This article makes up part of a larger five-phased project that was initiated by the Nature Conservancy (nature.org) through generous support from the Climate and Land Use Alliance and the Doris Duke Charitable Foundation (DDCF). The work on which this project was based was also funded in whole or in part through a cooperative agreement with the USDA Forest Service, Forest Products Laboratory, Forest Products Marketing Unit (17-CA-11111169-031) *. The Nature Conservancy initiated this project to further the collective understanding of the potential benefits and risks of increasing demand for forest products. The Conservancy is focused on delivering critical safeguard frameworks to mitigate any potential risks to forest ecosystems as mass timber demand increases. * In accordance with Federal Law and U.S. Department of Agriculture policy, this institution is prohibited from discriminating on the basis of race, color, national origin, sex, age, or disability. (Not all prohibited bases apply to all programs.) To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 1400 Independence Avenue, SW, Washington, DC 20250-9410, or call (202) 720-5964 (voice and TDD). USDA is an equal opportunity provider, employer, and lender.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

References

1. Bastin, J.-F.; Finegold, Y.; Garcia, C.; Mollicone, D.; Rezende, M.; Routh, D.; Zohner, C.M.; Crowther, T.W. The global tree restoration potential. *Science* **2019**, *365*, 76–79. [CrossRef]
2. Griscom, B.W.; Adams, J.; Ellis, P.W.; Houghton, R.A.; Lomax, G.; Miteva, D.A.; Schlesinger, W.H.; Shoch, D.; Siikamäki, J.V.; Smith, P.; et al. Natural climate solutions. *Proc. Natl. Acad. Sci. USA* **2017**, *114*, 11645–11650. [CrossRef]
3. Lippke, B.; Puettmann, M.; Oneil, E.; Oliver, C.D. The plant a trillion trees campaign to reduce global warming—Fleshing out the concept. *J. Sustain. For.* **2021**, *40*, 1–31. [CrossRef]
4. Food and Agriculture Organization of the United Nations (FAO). *FAO Statistics Division (FAOSTAT)*; FOA: Rome, Italy, 2015. Available online: https://www.fao.org/faostat/en/#home (accessed on 15 December 2021).
5. Ganguly, I.; Pierobon, F.; Sonne Hall, E. Global warming mitigating role of wood products from Washington State's private forests. *Forests* **2020**, *11*, 194. [CrossRef]
6. Hudiburg, T.W.; Law, B.E.; Moomaw, W.R.; Harmon, M.E.; Stenzel, J.E. Meeting GHG reduction targets requires accounting for all forest sector emissions. *Environ. Res. Lett.* **2019**, *14*, 095005. [CrossRef]
7. Stewart, W.C.; Nakamura, G.M. Documenting the full climate benefits of harvested wood products in Northern California: Linking harvests to the US greenhouse gas inventory. *For. Prod. J.* **2012**, *62*, 340–353. [CrossRef]
8. Anderson, R.; Atkins, D.; Beck, B.; Dawson, E.; Gayle, C. *State of the Industry North American Mass Timber*; Self-Publishing Services LLC: Missoula, MT, USA, 2020; p. 156.
9. Bengston, D.N. The Revolutionary Role of Wood in Our Future. 2021. Available online: https://www.usda.gov/media/blog/2018/01/05/revolutionary-role-wood-our-future (accessed on 15 December 2021).
10. Zelinka, S.L.; Williamson, T.; Martinson, K.L.; Ritter, M.A. Research needs assessment for the mass timber industry. In Proceedings of the 2nd North American Mass Timber Research Needs Workshop, Madison, WI, USA, 13–14 November 2018.
11. Salazar, J.; Puettmann, M.E. *Whole-Building LCA Case Study of a Mid-Rise Office Building in New England*; Unpublished Work; New England Forestry Foundations: Littleton, MA, USA, 2019; p. 58.
12. Chen, C.X.; Pierobon, F.; Ganguly, I. Life cycle assessment (LCA) of cross-laminated timber (CLT) produced in western Washington: The role of logistics and wood species mix. *Sustainability* **2019**, *11*, 1278. [CrossRef]

Author Contributions: Conceptualization, M.P., F.P., I.G., M.W., C.C., H.G., S.J., I.M. and S.L.; methodology, M.P., F.P., I.G., C.C., H.G., S.J., I.M. and S.L.; software, M.P., F.P., C.C. and S.L., validation, M.P., F.P., C.C., H.G., I.M. and S.L.; formal analysis, M.P., F.P., C.C., S.L. and H.G; investigation, M.P., F.P., C.C., S.L. and H.G.; data curation, M.P., F.P., C.C., I.M. and S.L.; writing—original draft preparation, M.P.; writing—review and editing, M.P., F.P., H.G. and I.G; supervision, M.P., I.G., M.W. and H.G.; project administration, M.W.; funding acquisition, M.W. All authors have read and agreed to the published version of the manuscript.

Funding: External funding was received by the Nature Conservancy.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: This article makes up part of a larger five-phased project that was initiated by the Nature Conservancy (nature.org) through generous support from the Climate and Land Use Alliance and the Doris Duke Charitable Foundation (DDCF). The work on which this project was based was also funded in whole or in part through a cooperative agreement with the USDA Forest Service, Forest Products Laboratory, Forest Products Marketing Unit (17-CA-11111169-031) *. The Nature Conservancy initiated this project to further the collective understanding of the potential benefits and risks of increasing demand for forest products. The Conservancy is focused on delivering critical safeguard frameworks to mitigate any potential risks to forest ecosystems as mass timber demand increases. * In accordance with Federal Law and U.S. Department of Agriculture policy, this institution is prohibited from discriminating on the basis of race, color, national origin, sex, age, or disability. (Not all prohibited bases apply to all programs.) To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 1400 Independence Avenue, SW, Washington, DC 20250-9410, or call (202) 720-5964 (voice and TDD). USDA is an equal opportunity provider, employer, and lender.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

References

1. Bastin, J.-F.; Finegold, Y.; Garcia, C.; Mollicone, D.; Rezende, M.; Routh, D.; Zohner, C.M.; Crowther, T.W. The global tree restoration potential. *Science* **2019**, *365*, 76–79. [CrossRef]
2. Griscom, B.W.; Adams, J.; Ellis, P.W.; Houghton, R.A.; Lomax, G.; Miteva, D.A.; Schlesinger, W.H.; Shoch, D.; Siikamäki, J.V.; Smith, P.; et al. Natural climate solutions. *Proc. Natl. Acad. Sci. USA* **2017**, *114*, 11645–11650. [CrossRef]
3. Lippke, B.; Puettmann, M.; Oneil, E.; Oliver, C.D. The plant a trillion trees campaign to reduce global warming—Fleshing out the concept. *J. Sustain. For.* **2021**, *40*, 1–31. [CrossRef]
4. Food and Agriculture Organization of the United Nations (FAO). *FAO Statistics Division (FAOSTAT)*; FOA: Rome, Italy, 2015. Available online: https://www.fao.org/faostat/en/#home (accessed on 15 December 2021).
5. Ganguly, I.; Pierobon, F.; Sonne Hall, E. Global warming mitigating role of wood products from Washington State's private forests. *Forests* **2020**, *11*, 194. [CrossRef]
6. Hudiburg, T.W.; Law, B.E.; Moomaw, W.R.; Harmon, M.E.; Stenzel, J.E. Meeting GHG reduction targets requires accounting for all forest sector emissions. *Environ. Res. Lett.* **2019**, *14*, 095005. [CrossRef]
7. Stewart, W.C.; Nakamura, G.M. Documenting the full climate benefits of harvested wood products in Northern California: Linking harvests to the US greenhouse gas inventory. *For. Prod. J.* **2012**, *62*, 340–353. [CrossRef]
8. Anderson, R.; Atkins, D.; Beck, B.; Dawson, E.; Gayle, C. *State of the Industry North American Mass Timber*; Self-Publishing Services LLC: Missoula, MT, USA, 2020; p. 156.
9. Bengston, D.N. The Revolutionary Role of Wood in Our Future. 2021. Available online: https://www.usda.gov/media/blog/2018/01/05/revolutionary-role-wood-our-future (accessed on 15 December 2021).
10. Zelinka, S.L.; Williamson, T.; Martinson, K.L.; Ritter, M.A. Research needs assessment for the mass timber industry. In Proceedings of the 2nd North American Mass Timber Research Needs Workshop, Madison, WI, USA, 13–14 November 2018.
11. Salazar, J.; Puettmann, M.E. *Whole-Building LCA Case Study of a Mid-Rise Office Building in New England*; Unpublished Work; New England Forestry Foundations: Littleton, MA, USA, 2019; p. 58.
12. Chen, C.X.; Pierobon, F.; Ganguly, I. Life cycle assessment (LCA) of cross-laminated timber (CLT) produced in western Washington: The role of logistics and wood species mix. *Sustainability* **2019**, *11*, 1278. [CrossRef]

14. Liang, S.; Gu, H.; Bergman, R.; Kelley, S. Comparative life-cycle assessment of a mass timber building and concrete alternative. *Wood Fiber Sci.* **2020**, *52*, 217–229. [CrossRef]
15. ASTM. Freres Lumber Environmental Product Declaration Mass Ply Panels. 2020. Available online: https://www.astm.org/CERTIFICATION/DOCS/563.EPD_For_FinalFreres_Lumber_Company.pdf (accessed on 5 October 2021).
16. ASTM. Structurlam Mass Timber Environmental Product Declaration. 2020. Available online: https://www.astm.org/CERTIFICATION/DOCS/480.EPD_FOR_Structurlam_CLT_20200113.pdf (accessed on 5 October 2021).
17. Puettmann, M.E.; Sinha, A.; Ganguly, I. Life cycle energy and environmental impacts of cross laminated timber made with coastal Douglas-fir. *J. Green Build.* **2020**, *14*, 17–33. [CrossRef]
18. Bowers, T.; Puettmann, M.E.; Ganguly, I.; Eastin, I. Cradle-to-gate life-cycle impact analysis of glued-laminated (glulam) timber: Environmental impacts from glulam produced in the US Pacific Northwest and southeast. *For. Prod. J.* **2017**, *17*, 368–380. [CrossRef]
19. Anderson, R. (The Beck Group, Portland, OR, USA). Personal communication, 2021.
20. United Nations Environment Programme. Emissions Gap Report 2020. 2020. Available online: www.unenvironment.org/emissionsgap (accessed on 15 December 2021).
21. Buchanan, A.H.; John, S.; Love, S. LCA and carbon footprint of multi-story timber buildings compared with steel and concrete buildings. *N. Z. J. For.* **2013**, *54*, 9–18.
22. Milaj, K.; Sinha, A.; Miller, T.H.; Tokarczyk, J.S. Environmental utility of wood substitution in commercial buildings using life-cycle analysis. *Wood Fiber Sci.* **2017**, *49*, 338–358.
23. Meil, J.; Lippke, B.; Perez-Garcia, J.; Bowyer, J.; Wilson, J. *Environmental Impacts of a Single Family Building Shell—From Harvest to Construction*; CORRIM: Corvallis, OR, USA, 2004; p. 44.
24. Perez-Garcia, J.; Lippke, B.; Briggs, D.; Wilson, J.B.; Bowyer, J.; Meil, J. The environmental performance of renewable building materials in the context of residential construction. *Wood Fiber Sci.* **2005**, *37*, 3–17.
25. Pierobon, F.; Huang, M.; Simonen, K.; Ganguly, I. Environmental benefits of using hybrid CLT structure in midrise non-residential construction: An LCA comparative case study in the US PNW. *J. Build. Eng.* **2019**, *26*, 100862. [CrossRef]
26. Robertson, A.B.; Lam, F.C.F.; Cole, R.J. A comparative cradle-to-gate lifecycle assessment of mid-rise office building construction alternatives: Laminated timber or reinforced concrete. *Buildings* **2012**, *2*, 245–270. [CrossRef]
27. Liang, S.; Gu, H.; Bergman, R. Environmental life-cycle assessment and life-cycle cost analysis of a high-rise mass timber building: A case study in Pacific Northwestern United States. *Sustainability* **2021**, *13*, 7831. [CrossRef]
28. Forterra. Mass Timber: The Innovative Future of Our Built Environment. 2018. Available online: https://forterra.org/editorial/mass-timber (accessed on 11 August 2021).
29. Upton, B.; Miner, R.; Spinney, M.; Heath, L.S. The greenhouse gas and energy impacts of using wood instead of alternatives in residential construction in the United States. *Biomass Bioenergy* **2008**, *32*, 1–10. [CrossRef]
30. Schmidt, J.; Griffin, C.T. Barriers to the design and use of cross-laminated timber structures in high-rise multi-family housing in the United States. In *Structures and Architecture*, 1st ed.; Cruz, P.J., Ed.; CRC Press: Boca Raton, FL, USA, 2013; pp. 2225–2231.
31. Gu, H.; Nepal, P.; Arvanitis, M.; Alderman, D. Carbon impacts of engineered wood products in construction. In *Engineered Wood Products for Construction*; InTech Open: London, UK, 2021.
32. Johnston, C.M.T.; Radeloff, V.C. Global mitigation potential of carbon stored in harvested wood products. *Proc. Natl. Acad. Sci. USA* **2019**, *116*, 14526–14531. [CrossRef]
33. Perez-Garcia, J.; Lippke, B.; Comnick, J.; Manriquez, C. An assessment of carbon pools, storage, and wood products market substitution using life-cycle analysis results. *Wood Fiber Sci.* **2005**, *37*, 140–148.
34. The Consortium for Research on Renewable Industrial Materials. Available online: www.corrim.org (accessed on 10 August 2021).
35. National Renewable Energy Laboratory. *U.S. Life Cycle Inventory Database*. Available online: http://www.nrel.gov/lci/LTS (accessed on 11 August 2021).
36. Wernet, G.; Bauer, C.; Steubing, B.; Reinhard, J.; Moreno-Ruiz, E.; Weidema, B. The ecoinvent database version 3 (Part I): Overview and methodology. *Int. J. Life Cycle Assess.* **2016**, *21*, 1218–1230. [CrossRef]
37. LTS. DataSmart. Available online: https://ltsexperts.com/services/software/datasmart-life-cycle-inventory (accessed on 5 October 2021).
38. ISO. *Environmental Management—Life Cycle Assessment—Requirement and Guidelines*; International Organization for Standardization: Geneva, Switzerland, 2006.
39. European Committee. *EN 15978:2011—Sustainability of Construction Works—Assessment of Environmental Performance of Buildings—Calculation Method*; European Committee for Standardization: Brussels, Belgium, 2011; 60p.
40. ISO. Sustainability in buildings and civil engineering works. In *Core Rules for Environmental Product Declarations of Construction Products and Services*; International Organization for Standardization: Geneva, Switzerland, 2006.
41. Gu, H.; Liang, S.; Puettmann, M.; Pierobon, F.; Ganguly, I.; Chen, C.; Pasternack, R.; Wishnie, M.; Jones, S.; Maples, I. Mass timber building Life Cycle Assessment methodology for the US regional case studies. Sustainability special issue -Mass Timber and Sustainable Building Construction. *Sustainability* **2021**, in press.

14. Liang, S.; Gu, H.; Bergman, R.; Kelley, S. Comparative life-cycle assessment of a mass timber building and concrete alternative. *Wood Fiber Sci.* **2020**, *52*, 217–229. [CrossRef]
15. ASTM. Freres Lumber Environmental Product Declaration Mass Ply Panels. 2020. Available online: https://www.astm.org/CERTIFICATION/DOCS/563.EPD_For_FinalFreres_Lumber_Company.pdf (accessed on 5 October 2021).
16. ASTM. Structurlam Mass Timber Environmental Product Declaration. 2020. Available online: https://www.astm.org/CERTIFICATION/DOCS/480.EPD_FOR_Structurlam_CLT_20200113.pdf (accessed on 5 October 2021).
17. Puettmann, M.E.; Sinha, A.; Ganguly, I. Life cycle energy and environmental impacts of cross laminated timber made with coastal Douglas-fir. *J. Green Build.* **2020**, *14*, 17–33. [CrossRef]
18. Bowers, T.; Puettmann, M.E.; Ganguly, I.; Eastin, I. Cradle-to-gate life-cycle impact analysis of glued-laminated (glulam) timber: Environmental impacts from glulam produced in the US Pacific Northwest and southeast. *For. Prod. J.* **2017**, *17*, 368–380. [CrossRef]
19. Anderson, R. (The Beck Group, Portland, OR, USA). Personal communication, 2021.
20. United Nations Environment Programme. Emissions Gap Report 2020. 2020. Available online: www.unenvironment.org/emissionsgap (accessed on 15 December 2021).
21. Buchanan, A.H.; John, S.; Love, S. LCA and carbon footprint of multi-story timber buildings compared with steel and concrete buildings. *N. Z. J. For.* **2013**, *54*, 9–18.
22. Milaj, K.; Sinha, A.; Miller, T.H.; Tokarczyk, J.S. Environmental utility of wood substitution in commercial buildings using life-cycle analysis. *Wood Fiber Sci.* **2017**, *49*, 338–358.
23. Meil, J.; Lippke, B.; Perez-Garcia, J.; Bowyer, J.; Wilson, J. *Environmental Impacts of a Single Family Building Shell—From Harvest to Construction*; CORRIM: Corvallis, OR, USA, 2004; p. 44.
24. Perez-Garcia, J.; Lippke, B.; Briggs, D.; Wilson, J.B.; Bowyer, J.; Meil, J. The environmental performance of renewable building materials in the context of residential construction. *Wood Fiber Sci.* **2005**, *37*, 3–17.
25. Pierobon, F.; Huang, M.; Simonen, K.; Ganguly, I. Environmental benefits of using hybrid CLT structure in midrise non-residential construction: An LCA comparative case study in the US PNW. *J. Build. Eng.* **2019**, *26*, 100862. [CrossRef]
26. Robertson, A.B.; Lam, F.C.F.; Cole, R.J. A comparative cradle-to-gate lifecycle assessment of mid-rise office building construction alternatives: Laminated timber or reinforced concrete. *Buildings* **2012**, *2*, 245–270. [CrossRef]
27. Liang, S.; Gu, H.; Bergman, R. Environmental life-cycle assessment and life-cycle cost analysis of a high-rise mass timber building: A case study in Pacific Northwestern United States. *Sustainability* **2021**, *13*, 7831. [CrossRef]
28. Forterra. Mass Timber: The Innovative Future of Our Built Environment. 2018. Available online: https://forterra.org/editorial/mass-timber (accessed on 11 August 2021).
29. Upton, B.; Miner, R.; Spinney, M.; Heath, L.S. The greenhouse gas and energy impacts of using wood instead of alternatives in residential construction in the United States. *Biomass Bioenergy* **2008**, *32*, 1–10. [CrossRef]
30. Schmidt, J.; Griffin, C.T. Barriers to the design and use of cross-laminated timber structures in high-rise multi-family housing in the United States. In *Structures and Architecture*, 1st ed.; Cruz, P.J., Ed.; CRC Press: Boca Raton, FL, USA, 2013; pp. 2225–2231.
31. Gu, H.; Nepal, P.; Arvanitis, M.; Alderman, D. Carbon impacts of engineered wood products in construction. In *Engineered Wood Products for Construction*; InTech Open: London, UK, 2021.
32. Johnston, C.M.T.; Radeloff, V.C. Global mitigation potential of carbon stored in harvested wood products. *Proc. Natl. Acad. Sci. USA* **2019**, *116*, 14526–14531. [CrossRef]
33. Perez-Garcia, J.; Lippke, B.; Comnick, J.; Manriquez, C. An assessment of carbon pools, storage, and wood products market substitution using life-cycle analysis results. *Wood Fiber Sci.* **2005**, *37*, 140–148.
34. The Consortium for Research on Renewable Industrial Materials. Available online: www.corrim.org (accessed on 10 August 2021).
35. National Renewable Energy Laboratory. *U.S. Life Cycle Inventory Database*. Available online: http://www.nrel.gov/lci/LTS (accessed on 11 August 2021).
36. Wernet, G.; Bauer, C.; Steubing, B.; Reinhard, J.; Moreno-Ruiz, E.; Weidema, B. The ecoinvent database version 3 (Part I): Overview and methodology. *Int. J. Life Cycle Assess.* **2016**, *21*, 1218–1230. [CrossRef]
37. LTS. DataSmart. Available online: https://ltsexperts.com/services/software/datasmart-life-cycle-inventory (accessed on 5 October 2021).
38. ISO. *Environmental Management—Life Cycle Assessment—Requirement and Guidelines*; International Organization for Standardization: Geneva, Switzerland, 2006.
39. European Committee. *EN 15978:2011—Sustainability of Construction Works—Assessment of Environmental Performance of Buildings—Calculation Method*; European Committee for Standardization: Brussels, Belgium, 2011; 60p.
40. ISO. Sustainability in buildings and civil engineering works. In *Core Rules for Environmental Product Declarations of Construction Products and Services*; International Organization for Standardization: Geneva, Switzerland, 2006.
41. Gu, H.; Liang, S.; Puettmann, M.; Pierobon, F.; Ganguly, I.; Chen, C.; Pasternack, R.; Wishnie, M.; Jones, S.; Maples, I. Mass timber building Life Cycle Assessment methodology for the US regional case studies. Sustainability special issue -Mass Timber and Sustainable Building Construction. *Sustainability* **2021**, in press.

42. Breneman, S.; Timmers, M.; Richardson, D. Tall Wood Buildings in the 2021 IBC Up to 18 Stories of Mass Timber 12. 2019. Available online: https://www.woodworks.org/wp-content/uploads/wood_solution_paper-TALL-WOOD.pdf (accessed on 11 August 2021).
43. Milota, M. Life Cycle Assessment for the Production of Pacific Northwest Softwood Lumber. 2020. Available online: https://corrim.org/wp-content/uploads/2020/06/CORRIM-AWC-PNW-Lumber.pdf (accessed on 10 August 2021).
44. Milota, M. Life Cycle Assessment for the Production of Southeastern Softwood Lumber. 2020. Available online: https://corrim.org/wp-content/uploads/2020/06/CORIRM-AWC-SE-Lumber.pdf (accessed on 10 August 2021).
45. Puettmann, M.E. Life Cycle Assessment for the Production of Northeast–Northcentral Softwood Lumber. 2020. Available online: https://corrim.org/wp-content/uploads/2020/06/CORRIM-AWC-NENC-Lumber.pdf (accessed on 10 August 2021).
46. Bare, J. TRACI 2.0: The tool for the reduction and assessment of chemical and other environmental impacts 2.0. *Clean Technol. Environ. Policy* **2011**, *13*, 687–696. [CrossRef]
47. SimaPro. *Simapro 9.1.1.1 Life-Cycle Assessment Software Package*; SimaPro: Amersfoort, The Netherlands, 2020.

42. Breneman, S.; Timmers, M.; Richardson, D. Tall Wood Buildings in the 2021 IBC Up to 18 Stories of Mass Timber 12. 2019. Available online: https://www.woodworks.org/wp-content/uploads/wood_solution_paper-TALL-WOOD.pdf (accessed on 11 August 2021).
43. Milota, M. Life Cycle Assessment for the Production of Pacific Northwest Softwood Lumber. 2020. Available online: https://corrim.org/wp-content/uploads/2020/06/CORRIM-AWC-PNW-Lumber.pdf (accessed on 10 August 2021).
44. Milota, M. Life Cycle Assessment for the Production of Southeastern Softwood Lumber. 2020. Available online: https://corrim.org/wp-content/uploads/2020/06/CORIRM-AWC-SE-Lumber.pdf (accessed on 10 August 2021).
45. Puettmann, M.E. Life Cycle Assessment for the Production of Northeast–Northcentral Softwood Lumber. 2020. Available online: https://corrim.org/wp-content/uploads/2020/06/CORRIM-AWC-NENC-Lumber.pdf (accessed on 10 August 2021).
46. Bare, J. TRACI 2.0: The tool for the reduction and assessment of chemical and other environmental impacts 2.0. *Clean Technol. Environ. Policy* **2011**, *13*, 687–696. [CrossRef]
47. SimaPro. *Simapro 9.1.1.1 Life-Cycle Assessment Software Package*; SimaPro: Amersfoort, The Netherlands, 2020.

FLORIDA FARM BUREAU FEDERATION

THE VOICE OF AGRICULTURE

August 24, 2022

Dear Florida Department of Business and Professional Regulation,

The Florida Farm Bureau Federation (FFBF) is a grassroots organization representing 134,000+ member-families. We are the largest, general agricultural membership organization in the state, representing farmers and ranchers of over 300 various commodities; many of whom are forest landowners and producers. We appreciate the opportunity to express our strong support of the proposed changes to the 2023 Florida Building Code to include all mass timber provisions as adopted by the 2021 International Building Code.

There are more than 17 million acres of forest land in Florida. The majority of these lands are working forests that are privately owned. These lands provide critical habitat for wildlife, while also playing an important environmental role as they filter air and water. Florida's forestry industry employs more than 124,000 citizens and infuses $25 billion into the state's economy. Growth of the mass timber market will undoubtedly create new markets and financial resources for producers to continue the successful management of forest lands and growth of this strong agricultural industry.

FFBF policy "supports the exploration and development of new markets for forestry and forest products," and we will advocate at the local, state and national levels to provide access to these markets for Florida's producers.

Respectfully,

Jeb S. Smith
President
Florida Farm Bureau Federation

FLORIDA FARM BUREAU FEDERATION

THE VOICE OF AGRICULTURE

August 24, 2022

Dear Florida Department of Business and Professional Regulation,

The Florida Farm Bureau Federation (FFBF) is a grassroots organization representing 134,000+ member-families. We are the largest, general agricultural membership organization in the state, representing farmers and ranchers of over 300 various commodities; many of whom are forest landowners and producers. We appreciate the opportunity to express our strong support of the proposed changes to the 2023 Florida Building Code to include all mass timber provisions as adopted by the 2021 International Building Code.

There are more than 17 million acres of forest land in Florida. The majority of these lands are working forests that are privately owned. These lands provide critical habitat for wildlife, while also playing an important environmental role as they filter air and water. Florida's forestry industry employs more than 124,000 citizens and infuses $25 billion into the state's economy. Growth of the mass timber market will undoubtedly create new markets and financial resources for producers to continue the successful management of forest lands and growth of this strong agricultural industry.

FFBF policy "supports the exploration and development of new markets for forestry and forest products," and we will advocate at the local, state and national levels to provide access to these markets for Florida's producers.

Respectfully,

Jeb S. Smith
President
Florida Farm Bureau Federation

P.O. Box 147030, Gainesville, Florida, 32614 - 7030 • 352.378.1321 • www.FloridaFarmBureau.org

Keeping Forests supports the adoption of mass timber (MT) construction types, (Types IVA, IVB, and IVC), and related requirements, as contained in the 2021 edition of the International Building Code (IBC), into the 2023 Florida Building Code (FBC).

If the U.S. South continues to develop at its current rate, our forests and the benefits they provide will pay the price. Urbanization and land use change data shows that 23 million acres of southern forests are facing immense pressure for development.

Keeping Forests brings together a diverse coalition of scientists, forest advocates, conservation experts and business leaders to develop innovative, market-based approaches to support private landowners, who are actively managing over 86% of the region's 245 million acres of timberlands including 11 million acres of privately-owned forests in Florida. Forestry's economic impact outdrives the economic footprint of golf in Florida, the country's #1 destination for the sport ($25B vs. $17b).

Our goal is simple, by illuminating the economic and environmental benefits that southern forests provide and by increasing the value of privately owned forests, we are empowering the next generation of landowners, conservationists, consumers and citizens to keep forests as forests.

Wood provides a deeper connection to nature in the built environment, while adding warmth and comfort to the places we live, work and play. It connects us to the outside world while invoking a sense of social responsibility. The use of wood in buildings has many benefits:

SUSTAINABLE

When comparing life cycle analysis of wood to other materials, using wood lowers greenhouse gas emissions during construction, decreases air and water pollution and lowers the volume of solid waste material.

HEALTHY

Researchers have discovered that wood contributes to the health and well-being of building occupants. Exposed wood can reduce stress, improve cognitive and creative functions and increase productivity.

CLIMATE-FRIENDLY

When wood as a construction material, the carbon absorbed by the tree as it grew is effectively locked away. Maximizing wood use could remove an estimated 21 million tons of C02 from the atmosphere annually – equal to taking 4.4 million cars off the road.

COST-EFFECTIVE

Research shows that one-to-four story office buildings can cost 20-30% less per square foot than their non-wood counterparts. Building with wood is efficient, often completed faster than other systems, and can be done year-round in almost any climate.

Keeping Forests supports the adoption of mass timber (MT) construction types, (Types IVA, IVB, and IVC), and related requirements, as contained in the 2021 edition of the International Building Code (IBC), into the 2023 Florida Building Code (FBC).

If the U.S. South continues to develop at its current rate, our forests and the benefits they provide will pay the price. Urbanization and land use change data shows that 23 million acres of southern forests are facing immense pressure for development.

Keeping Forests brings together a diverse coalition of scientists, forest advocates, conservation experts and business leaders to develop innovative, market-based approaches to support private landowners, who are actively managing over 86% of the region's 245 million acres of timberlands including 11 million acres of privately-owned forests in Florida. Forestry's economic impact outdrives the economic footprint of golf in Florida, the country's #1 destination for the sport ($25B vs. $17b).

Our goal is simple, by illuminating the economic and environmental benefits that southern forests provide and by increasing the value of privately owned forests, we are empowering the next generation of landowners, conservationists, consumers and citizens to keep forests as forests.

Wood provides a deeper connection to nature in the built environment, while adding warmth and comfort to the places we live, work and play. It connects us to the outside world while invoking a sense of social responsibility. The use of wood in buildings has many benefits:

SUSTAINABLE

When comparing life cycle analysis of wood to other materials, using wood lowers greenhouse gas emissions during construction, decreases air and water pollution and lowers the volume of solid waste material.

HEALTHY

Researchers have discovered that wood contributes to the health and well-being of building occupants. Exposed wood can reduce stress, improve cognitive and creative functions and increase productivity.

CLIMATE-FRIENDLY

When wood as a construction material, the carbon absorbed by the tree as it grew is effectively locked away. Maximizing wood use could remove an estimated 21 million tons of C02 from the atmosphere annually – equal to taking 4.4 million cars off the road.

COST-EFFECTIVE

Research shows that one-to-four story office buildings can cost 20-30% less per square foot than their non-wood counterparts. Building with wood is efficient, often completed faster than other systems, and can be done year-round in almost any climate.

KEEPING FORESTS

Privately-owned working forests are growing 52% more wood annually than they remove. By choosing wood products, landowners can make investments in replanting and reforestation, forest health treatments and regular maintenance that keep forests strong and resilient.

The adoption of mass timber construction types into the 2023 Florida Building Code (FBC) is an important step to ensure the longevity of forest resources and the benefits that they provide while simultaneously expanding market opportunities for the state.

Respectfully submitted on behalf of:

Laura Calandrella
Executive Director
Keeping Forests

KEEPING FORESTS

Privately-owned working forests are growing 52% more wood annually than they remove. By choosing wood products, landowners can make investments in replanting and reforestation, forest health treatments and regular maintenance that keep forests strong and resilient.

The adoption of mass timber construction types into the 2023 Florida Building Code (FBC) is an important step to ensure the longevity of forest resources and the benefits that they provide while simultaneously expanding market opportunities for the state.

Respectfully submitted on behalf of:

Laura Calandrella
Executive Director
Keeping Forests

Building codes are founded on principles of acceptance of new technologies and equivalent performing methods of construction. Florida statute, in multiple sections, supports this philosophy:

- Section 553.73(9)(a)(3) gives the FL Building commission the responsibility to adopt technical amendments to the FL Building Code *"in the case of innovation or new technology, will provide equivalent or better products or methods or systems of construction."*
- Moreover, Section 553.73(9)(a)(4) of Florida statutes explicitly says that amendments to the code should "*not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities*." The intent of the statute is clearly that the code is not intended protect one material interest at the expense of another.
- The enabling statute of the FL Building Code further recognizes this by twice giving guidance in Section 553.73(9)(d) to the acceptability of alternatives that *"provide an equivalent degree of lifesafety and an equivalent method of construction."* It repeats that direction in Sections 553.73(11)(a), 553.73(11)(b), and 553.73(11)(c).
- The sentiment is further repeated within the FL Building Code itself, in Section 104.11, Alternative materials, design and methods of construction and equipment, which states: *"An alternative material, design or method of construction* ***shall be approved where*** *the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that* ***the material, method or work offered is****, for the purpose intended,* ***not less than the equivalent of that prescribed in this code*** *in quality, strength, effectiveness, fire resistance, durability and safety*." <emphasis added>

Mass timber types of construction are the most tested and studied construction type technology ever to demonstrate its suitability for inclusion in the code. The proposed new Type IV A, B, and C construction types have the code's most stringent fire-resistance requirements; they are better than the requirements currently prescribed in the FL Building Code for permissible buildings of the same size and area.

Table 1 on the following page provides an example of a sprinklered B occupancy to demonstrate that the new 2021 International Building Code Type IV construction types provide not less than the equivalent of the fire-resistance prescribed in the 2020 FL Building Code for buildings of equivalent height and area. The stringency of fire-resistive requirements decreases as Table 1 is read from left to right. Columns with equivalent fire-resistance requirements are colored identically.

Table 2 on the last page summarizes the fire-resistance rating requirement of Table 601 of the 2021 IBC. It also demonstrates the higher degree of fire-resistance required of Type IV mass timber buildings.

Nothing in the current FL Building Code prohibits construction using mass timber material. Nothing in the FL Building Code currently prevents a building official from approving a mass timber building **without** the height and area limits and fire-resistance requirements determined by the nation's leading experts in these matters in the IBC development process.

To ensure that mass timber construction in FL communities has the appropriate height and area limits, and fire-resistance requirements, the State of FL needs to adopt Modification 10174 and its related mass timber modifications. This will permit local building officials to apply codified limits and fire-protection features, thereby protecting the residents of their communities.

Approving Modification 10174 eliminates barriers to an "*innovation or new technology,* [which] *will provide equivalent or better products or methods or systems of construction."*

Building codes are founded on principles of acceptance of new technologies and equivalent performing methods of construction. Florida statute, in multiple sections, supports this philosophy:

- Section 553.73(9)(a)(3) gives the FL Building commission the responsibility to adopt technical amendments to the FL Building Code *"in the case of innovation or new technology, will provide equivalent or better products or methods or systems of construction."*
- Moreover, Section 553.73(9)(a)(4) of Florida statutes explicitly says that amendments to the code should "*not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities*." The intent of the statute is clearly that the code is not intended protect one material interest at the expense of another.
- The enabling statute of the FL Building Code further recognizes this by twice giving guidance in Section 553.73(9)(d) to the acceptability of alternatives that *"provide an equivalent degree of lifesafety and an equivalent method of construction."* It repeats that direction in Sections 553.73(11)(a), 553.73(11)(b), and 553.73(11)(c).
- The sentiment is further repeated within the FL Building Code itself, in Section 104.11, Alternative materials, design and methods of construction and equipment, which states: *"An alternative material, design or method of construction* ***shall be approved where*** *the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that* ***the material, method or work offered is****, for the purpose intended,* ***not less than the equivalent of that prescribed in this code*** *in quality, strength, effectiveness, fire resistance, durability and safety*." <emphasis added>

Mass timber types of construction are the most tested and studied construction type technology ever to demonstrate its suitability for inclusion in the code. The proposed new Type IV A, B, and C construction types have the code's most stringent fire-resistance requirements; they are better than the requirements currently prescribed in the FL Building Code for permissible buildings of the same size and area.

Table 1 on the following page provides an example of a sprinklered B occupancy to demonstrate that the new 2021 International Building Code Type IV construction types provide not less than the equivalent of the fire-resistance prescribed in the 2020 FL Building Code for buildings of equivalent height and area. The stringency of fire-resistive requirements decreases as Table 1 is read from left to right. Columns with equivalent fire-resistance requirements are colored identically.

Table 2 on the last page summarizes the fire-resistance rating requirement of Table 601 of the 2021 IBC. It also demonstrates the higher degree of fire-resistance required of Type IV mass timber buildings.

Nothing in the current FL Building Code prohibits construction using mass timber material. Nothing in the FL Building Code currently prevents a building official from approving a mass timber building **without** the height and area limits and fire-resistance requirements determined by the nation's leading experts in these matters in the IBC development process.

To ensure that mass timber construction in FL communities has the appropriate height and area limits, and fire-resistance requirements, the State of FL needs to adopt Modification 10174 and its related mass timber modifications. This will permit local building officials to apply codified limits and fire-protection features, thereby protecting the residents of their communities.

Approving Modification 10174 eliminates barriers to an "*innovation or new technology,* [which] *will provide equivalent or better products or methods or systems of construction."*

Table 1
Heights, Area, and Fire-resistance Requirements Comparison B Occupancy, Sprinklered

	← More stringent FIRE-RESISTANCE & PROTECTION Less stringent →							
	Construction Type							
IBC 2021	**I-A**	**IV-A**	**I-B**	**IV-B**	**IV-C**	**IV-HT**	**II-A**	**II-B**
Allowable height in feet	UL	270	180	180	85	85	85	75
Allowable height in Stories	UL	18	12	12	9	6	6	4
Allowable area in square feet	UL	432,000	UL	288,000	180,000	144,000	150,000	92,000
Exterior Walls	**3 Hrs[1]**	**3 Hrs**	**2 Hrs[2]**	**2 Hrs**	**2 Hrs**	**2 Hrs**	**1 Hr**	**0**
Structural Frame	**3 Hrs[1]**	**3 Hrs**	**2 Hrs[2]**	**2 Hrs**	**2 Hrs**	**HT or 1 Hr**	**1 Hr**	**0**
Floor Protection	**2 Hrs[1]**	**2 Hrs**	**2 Hrs[2]**	**2 Hrs**	**2 Hrs**	**HT**	**1 Hr**	**0**
Roof Protection	**1 ½ Hrs[1]**	**1 ½ Hrs**	**1 Hrs[2]**	**1 Hr**	**1 Hr**	**HT**	**1 Hr**	**0**
Interior building elements, including nonload-bearing walls and partitions, are of **noncombustible construction** or **fire-resistance protected mass timber**	No	**Yes**	No	**Yes**	**Yes,** except mass timber elements are permitted to be exposed	Interior walls and partitions not less than 1-hour fire-resistance rated or heavy timber are permitted.	No	No
Other than weather-resistive barriers, are **combustible components permitted in exterior wall assembly?**	Yes	**No**	Yes	**No**	**No**	Yes	Yes	Yes
Dual H2O supplies required for fire-sprinkler systems required?	**At 420 feet**	**At 120 feet**	No	No	No	No	No	No

[1] Permitted to be reduced by 1 Hr. with certain fire sprinkler controls for buildings less than 420 feet high.
[2] Permitted to be reduced by 1 Hr. with certain fire sprinkler controls for less hazardous uses, smaller fuel loads.

Table 1
Heights, Area, and Fire-resistance Requirements Comparison B Occupancy, Sprinklered

	← More stringent FIRE-RESISTANCE & PROTECTION Less stringent →							
	Construction Type							
IBC 2021	**I-A**	**IV-A**	**I-B**	**IV-B**	**IV-C**	**IV-HT**	**II-A**	**II-B**
Allowable height in feet	UL	270	180	180	85	85	85	75
Allowable height in Stories	UL	18	12	12	9	6	6	4
Allowable area in square feet	UL	432,000	UL	288,000	180,000	144,000	150,000	92,000
Exterior Walls	**3 Hrs[1]**	**3 Hrs**	**2 Hrs[2]**	**2 Hrs**	**2 Hrs**	**2 Hrs**	**1 Hr**	**0**
Structural Frame	**3 Hrs[1]**	**3 Hrs**	**2 Hrs[2]**	**2 Hrs**	**2 Hrs**	**HT or 1 Hr**	**1 Hr**	**0**
Floor Protection	**2 Hrs[1]**	**2 Hrs**	**2 Hrs[2]**	**2 Hrs**	**2 Hrs**	**HT**	**1 Hr**	**0**
Roof Protection	**1 ½ Hrs[1]**	**1 ½ Hrs**	**1 Hrs[2]**	**1 Hr**	**1 Hr**	**HT**	**1 Hr**	**0**
Interior building elements, including nonload-bearing walls and partitions, are of **noncombustible construction** or **fire-resistance protected mass timber**	No	**Yes**	No	**Yes**	**Yes,** except mass timber elements are permitted to be exposed	Interior walls and partitions not less than 1-hour fire-resistance rated or heavy timber are permitted .	No	No
Other than weather-resistive barriers, are **combustible components permitted in exterior wall assembly?**	Yes	**No**	Yes	**No**	**No**	Yes	Yes	Yes
Dual H2O supplies required for fire-sprinkler systems required?	**At 420 feet**	**At 120 feet**	No	No	No	No	No	No

[1] Permitted to be reduced by 1 Hr. with certain fire sprinkler controls for buildings less than 420 feet high.
[2] Permitted to be reduced by 1 Hr. with certain fire sprinkler controls for less hazardous uses, smaller fuel loads.

Table 2
Building Construction Types and Required Fire Resistance of Building Elements in Hours

Current construction types	**TYPE I-A--Fire Resistive Protected Non-Combustible** (concrete; fire-protected steel)			
	Exterior Walls 3 Hrs.*	Structural Frame 3 Hrs.*	Floor Protection 2 Hrs.*	Roof Protection 1 ½ Hrs.*
	Note: Dual water supply for fire suppression systems required at **420** feet elevation and above. *Permitted to be reduced by 1 Hr. with certain fire sprinkler controls for buildings less than 420 feet high.			
	TYPE I-B--Fire Resistive Protected Non-Combustible (concrete; fire- protected steel)			
	Exterior Walls 2 Hrs.*	Structural Frame 2 Hrs.*	Floor Protection 2 Hrs.*	Roof Protection 1 Hrs.*
	Note: *Permitted to be reduced by 1 Hr. with certain fire sprinkler controls for less hazardous uses, smaller fuel loads			
	TYPE II-A--Protected Non-Combustible (fire-protected steel)			
	Exterior Walls 1 Hr.	Structural Frame 1 Hr.	Floor Protection 1 Hr.	Roof Protection 1 Hr.
	TYPE II-B--Unprotected Non-Combustible (bare steel)			
	Non-combustible materials, but no fire resistance required			
	TYPE III-A--Protected Combustible (protected light wood frame or masonry exterior walls)			
	Exterior Walls 2 Hrs.	Structural Frame 1 Hr.	Floor Protection 1 Hr.	Roof Protection 1 Hr.
	TYPE III-B--Unprotected Combustible (protected light wood frame or masonry exterior walls)			
	Exterior Walls 2 Hrs.	Structural Frame None	Floor Protection None	Roof Protection None
Proposed new construction types	**TYPE IV-A—Fully Protected, exterior and interior**			
	Exterior Walls **3 Hrs.**	Structural Frame **3 Hrs.**	Floor Protection **2 Hrs.**	Roof Protection **1 ½ Hrs.**
	Note: Dual water supply for fire suppression systems required at **120** feet elevation and above. **No reductions in protection permitted.**			
	TYPE IV-B- Mass timber protected exterior, limited exposed timber interior			
	Exterior Walls **2 Hrs.**	Structural Frame **2 Hrs.**	Floor Protection **2 Hrs.**	Roof Protection **1 Hr.**
	Note: Dual water supply for fire suppression systems required at 120 feet elevation and above. **No reductions in protection permitted.**			
	TYPE IV-C—Mass timber protected exterior, exposed timber interior			
	Exterior Walls **2 Hrs.**	Structural Frame **2 Hrs.**	Floor Protection **2 Hrs.**	Roof Protection **1 Hr.**
	Note: **No reductions in protection permitted.**			
Current const. types	**TYPE IV--Heavy Timber**			
	Exterior Walls 2 Hr.	Structural Frame Heavy Timber or 1 Hr.	Floor Protection Heavy Timber	Roof Protection Heavy Timber
	TYPE V-A--Protected Wood Frame			
	Exterior Walls 1 Hr.	Structural Frame 1 Hr.	Floor Protection 1 Hr.	Roof Protection 1 Hr.
	TYPE V-B--Unprotected wood frame: No Fire Resistance			

Table 2
Building Construction Types and Required Fire Resistance of Building Elements in Hours

Current construction types	**TYPE I-A--Fire Resistive Protected Non-Combustible** (concrete; fire-protected steel)			
	Exterior Walls 3 Hrs.*	Structural Frame 3 Hrs.*	Floor Protection 2 Hrs.*	Roof Protection 1 ½ Hrs.*
	Note: Dual water supply for fire suppression systems required at **420** feet elevation and above. *Permitted to be reduced by 1 Hr. with certain fire sprinkler controls for buildings less than 420 feet high.			
	TYPE I-B--Fire Resistive Protected Non-Combustible (concrete; fire- protected steel)			
	Exterior Walls 2 Hrs.*	Structural Frame 2 Hrs.*	Floor Protection 2 Hrs.*	Roof Protection 1 Hrs.*
	Note: *Permitted to be reduced by 1 Hr. with certain fire sprinkler controls for less hazardous uses, smaller fuel loads			
	TYPE II-A--Protected Non-Combustible (fire-protected steel)			
	Exterior Walls 1 Hr.	Structural Frame 1 Hr.	Floor Protection 1 Hr.	Roof Protection 1 Hr.
	TYPE II-B--Unprotected Non-Combustible (bare steel)			
	Non-combustible materials, but no fire resistance required			
	TYPE III-A--Protected Combustible (protected light wood frame or masonry exterior walls)			
	Exterior Walls 2 Hrs.	Structural Frame 1 Hr.	Floor Protection 1 Hr.	Roof Protection 1 Hr.
	TYPE III-B--Unprotected Combustible (protected light wood frame or masonry exterior walls)			
	Exterior Walls 2 Hrs.	Structural Frame None	Floor Protection None	Roof Protection None
Proposed new construction types	**TYPE IV-A—Fully Protected, exterior and interior**			
	Exterior Walls **3 Hrs.**	Structural Frame **3 Hrs.**	Floor Protection **2 Hrs.**	Roof Protection **1 ½ Hrs.**
	Note: Dual water supply for fire suppression systems required at **120** feet elevation and above. **No reductions in protection permitted.**			
	TYPE IV-B- Mass timber protected exterior, limited exposed timber interior			
	Exterior Walls **2 Hrs.**	Structural Frame **2 Hrs.**	Floor Protection **2 Hrs.**	Roof Protection **1 Hr.**
	Note: Dual water supply for fire suppression systems required at 120 feet elevation and above. **No reductions in protection permitted.**			
	TYPE IV-C—Mass timber protected exterior, exposed timber interior			
	Exterior Walls **2 Hrs.**	Structural Frame **2 Hrs.**	Floor Protection **2 Hrs.**	Roof Protection **1 Hr.**
	Note: **No reductions in protection permitted.**			
Current const. types	**TYPE IV--Heavy Timber**			
	Exterior Walls 2 Hr.	Structural Frame Heavy Timber or 1 Hr.	Floor Protection Heavy Timber	Roof Protection Heavy Timber
	TYPE V-A--Protected Wood Frame			
	Exterior Walls 1 Hr.	Structural Frame 1 Hr.	Floor Protection 1 Hr.	Roof Protection 1 Hr.
	TYPE V-B--Unprotected wood frame: No Fire Resistance			

REX LUMBER

August 15, 2022

To Whom It May Concern:

As an owner of Rex Lumber, I encourage the State of Florida to support the adoption of mass timber (MT) construction types, (Types IVA, IVB, and IVC), and related requirements, as contained in the 2021 edition of the International Building Code (IBC), into the 2023 Florida Building Code (FBC) for the following reasons:

- In 2016 the ICC Board of Directors appointed the Ad Hoc Committee on Tall Wood Buildings (AHC-TWB) to explore the science of tall wood buildings. Committee and work group members consisted of code officials, fire officials, construction material interests, designers, builders, and other interested parties. After studying MT for hundreds of hours, and reviewing extensive fire-testing of the material, the AHC-TWB developed and submitted a package of code-change proposals for the 2021 edition of the IBC through the ICC's rigorous code development process. In that process the voting number of ICC governmental member representatives, ranging from 542 to 729 members, and averaging 646 members, voted to adopt all proposed MT changes by margins ranging from 68 percent to 94 percent and averaging 83 percent.

- Interested parties, experts, and associations that testified in support of adding the MT provisions to the IBC included local government building code officials, fire marshals and fire chiefs, materials scientists, fire science researchers and testing agencies, fire protection engineers, structural engineers, multifamily contractors, the United States Forest Service, the International Association of Building Officials, the National Association of Home Builders, the American Institute of Architects, the American Wood Council, APA-the Engineered Wood Association, and Underwriters Laboratories.

- Updating the FBC to permit MT buildings will support and stimulate investment in its manufacturing and supply chain in Florida as well as put downward pressure on cost and pricing. Investment in MT production is projected to have significant economic benefits for the FL economy because of the state's extensive timber resources. Florida's forest industry contributes $25 billion to the state's economy, providing more than 124,000 jobs. There is 17 million acres of forestland covering almost half of Florida's total land area. Almost 2/3 of the forestland is privately owned. https://www.flforestry.org/resources/2017-economic-impact-study/

- Because of repetitive building layouts in residential multifamily buildings, and the speed of constructing MT buildings, it is predicted that MT will compete successfully with other materials used for multifamily buildings in the 8 -12 story height range. In addition to construction efficiencies, expanded use of MT in these applications can reduce the potential of large construction site fires.

Graceville
850.263.2056

Bristol
850.643.2238

Brookhaven
601.833.1990

Corporate
850.263.4457

Post Office Box 7
Graceville, Florida 32440

REX-LUMBER.COM

REX LUMBER

August 15, 2022

To Whom It May Concern:

As an owner of Rex Lumber, I encourage the State of Florida to support the adoption of mass timber (MT) construction types, (Types IVA, IVB, and IVC), and related requirements, as contained in the 2021 edition of the International Building Code (IBC), into the 2023 Florida Building Code (FBC) for the following reasons:

- In 2016 the ICC Board of Directors appointed the Ad Hoc Committee on Tall Wood Buildings (AHC-TWB) to explore the science of tall wood buildings. Committee and work group members consisted of code officials, fire officials, construction material interests, designers, builders, and other interested parties. After studying MT for hundreds of hours, and reviewing extensive fire-testing of the material, the AHC-TWB developed and submitted a package of code-change proposals for the 2021 edition of the IBC through the ICC's rigorous code development process. In that process the voting number of ICC governmental member representatives, ranging from 542 to 729 members, and averaging 646 members, voted to adopt all proposed MT changes by margins ranging from 68 percent to 94 percent and averaging 83 percent.

- Interested parties, experts, and associations that testified in support of adding the MT provisions to the IBC included local government building code officials, fire marshals and fire chiefs, materials scientists, fire science researchers and testing agencies, fire protection engineers, structural engineers, multifamily contractors, the United States Forest Service, the International Association of Building Officials, the National Association of Home Builders, the American Institute of Architects, the American Wood Council, APA-the Engineered Wood Association, and Underwriters Laboratories.

- Updating the FBC to permit MT buildings will support and stimulate investment in its manufacturing and supply chain in Florida as well as put downward pressure on cost and pricing. Investment in MT production is projected to have significant economic benefits for the FL economy because of the state's extensive timber resources. Florida's forest industry contributes $25 billion to the state's economy, providing more than 124,000 jobs. There is 17 million acres of forestland covering almost half of Florida's total land area. Almost 2/3 of the forestland is privately owned. https://www.flforestry.org/resources/2017-economic-impact-study/

- Because of repetitive building layouts in residential multifamily buildings, and the speed of constructing MT buildings, it is predicted that MT will compete successfully with other materials used for multifamily buildings in the 8 -12 story height range. In addition to construction efficiencies, expanded use of MT in these applications can reduce the potential of large construction site fires.

Graceville
850.263.2056

Bristol
850.643.2238

Brookhaven
601.833.1990

Corporate
850.263.4457

Post Office Box 7
Graceville, Florida 32440

REX-LUMBER.COM

- MT construction sites are safer for workers. Construction sites are also quieter and are less disruptive than in the communities where projects occur. MT projects are completed substantially faster than traditional methods of construction, minimizing waste and community impacts while maximizing both worker productivity and developers' returns on investment. In addition, building with pre-manufactured MT panels broadens the available labor pool and will likely alleviate a national shortfall in skilled construction labor.

- Wildland fire safety on both the regional and global scale will benefit from increased use of MT. Low value wood, thinnings, and dead standing trees, can be used for MT, thereby creating a financial incentive for wildland fuels reduction, particularly of ladder fuels, improving regional fire safety and conserving federal and state resources.

- Sequestering carbon in long-lived building materials manufactured from renewable, sustainably managed forests mitigates drivers of climate change and worsening wildland fire seasons and intensities. Sequestering carbon in MT buildings also helps mitigate other issues associated with climate change like the intensity of storms and flooding events.

- Sustainably managed and harvested forests capture more carbon than forests left unmanaged and provide habitat for a greater range of species.

- As a panelized building product, fastened together on-site, MT panels are ideal for buildings designed for disassembly. This means panels, which are easily restored after prior use, can be re-used in new building applications. Carbon stored in MT panels can be sequestered indefinitely as the panels are re-used in future buildings.

Thank you for your consideration.

Sincerely,

CAMDauzat

Caroline Dauzat

- MT construction sites are safer for workers. Construction sites are also quieter and are less disruptive than in the communities where projects occur. MT projects are completed substantially faster than traditional methods of construction, minimizing waste and community impacts while maximizing both worker productivity and developers' returns on investment. In addition, building with pre-manufactured MT panels broadens the available labor pool and will likely alleviate a national shortfall in skilled construction labor.

- Wildland fire safety on both the regional and global scale will benefit from increased use of MT. Low value wood, thinnings, and dead standing trees, can be used for MT, thereby creating a financial incentive for wildland fuels reduction, particularly of ladder fuels, improving regional fire safety and conserving federal and state resources.

- Sequestering carbon in long-lived building materials manufactured from renewable, sustainably managed forests mitigates drivers of climate change and worsening wildland fire seasons and intensities. Sequestering carbon in MT buildings also helps mitigate other issues associated with climate change like the intensity of storms and flooding events.

- Sustainably managed and harvested forests capture more carbon than forests left unmanaged and provide habitat for a greater range of species.

- As a panelized building product, fastened together on-site, MT panels are ideal for buildings designed for disassembly. This means panels, which are easily restored after prior use, can be re-used in new building applications. Carbon stored in MT panels can be sequestered indefinitely as the panels are re-used in future buildings.

Thank you for your consideration.

Sincerely,

CMDauzat

Caroline Dauzat

SLMA SOUTHEASTERN LUMBER MANUFACTURERS ASSOCIATION, INC.

August 10, 2022

Florida Department of Business and Professional Regulation
2601 Blair Stone Road
Tallahassee FL 32399

RE: Proposed Florida Building Code Modification #F10174-G1

To Whom It May Concern:

The Southeastern Lumber Manufacturers Association (SLMA) membership footprint spans from Texas to Maryland and includes sawmills, lumber treaters and lumber remanufacturers. In total, there are 87 member companies operating over 130 locations. The mills directly employ nearly 10,000 people, in addition to the countless secondary jobs that are supported in the rural economies across the Southeast. Our members also manage over 2 million acres of timberland. In Florida, SLMA has five members in Florida that directly employ roughly 500 people at six different locations.

The State of Florida should support the adoption of mass timber (MT) construction types, (Types IVA, IVB, and IVC), and related requirements, as contained in the 2021 edition of the International Building Code (IBC), into the 2023 Florida Building Code (FBC) for the following reasons:

- In 2016 the ICC Board of Directors appointed the Ad Hoc Committee on Tall Wood Buildings (AHC-TWB) to explore the science of tall wood buildings. Committee and work group members consisted of code officials, fire officials, construction material interests, designers, builders, and other interested parties.

- After studying MT for hundreds of hours, and reviewing extensive fire-testing of the material, the AHC-TWB developed and submitted a package of code-change proposals for the 2021 edition of the IBC through the ICC's rigorous code development process. In that process the voting number of ICC governmental member representatives, ranging from 542 to 729 members, and averaging 646 members, voted to adopt all proposed MT changes by margins ranging from 68 percent to 94 percent and averaging 83 percent.

- Interests, experts, and associations that testified in support of adding the MT provisions to the IBC included local government building code officials, fire marshals and fire chiefs, SLMA

SOUTHEASTERN LUMBER
MANUFACTURERS ASSOCIATION, INC.

August 10, 2022

Florida Department of Business and Professional Regulation
2601 Blair Stone Road
Tallahassee FL 32399

RE: Proposed Florida Building Code Modification #F10174-G1

To Whom It May Concern:

The Southeastern Lumber Manufacturers Association (SLMA) membership footprint spans from Texas to Maryland and includes sawmills, lumber treaters and lumber remanufacturers. In total, there are 87 member companies operating over 130 locations. The mills directly employ nearly 10,000 people, in addition to the countless secondary jobs that are supported in the rural economies across the Southeast. Our members also manage over 2 million acres of timberland. In Florida, SLMA has five members in Florida that directly employ roughly 500 people at six different locations.

The State of Florida should support the adoption of mass timber (MT) construction types, (Types IVA, IVB, and IVC), and related requirements, as contained in the 2021 edition of the International Building Code (IBC), into the 2023 Florida Building Code (FBC) for the following reasons:

- In 2016 the ICC Board of Directors appointed the Ad Hoc Committee on Tall Wood Buildings (AHC-TWB) to explore the science of tall wood buildings. Committee and work group members consisted of code officials, fire officials, construction material interests, designers, builders, and other interested parties.

- After studying MT for hundreds of hours, and reviewing extensive fire-testing of the material, the AHC-TWB developed and submitted a package of code-change proposals for the 2021 edition of the IBC through the ICC's rigorous code development process. In that process the voting number of ICC governmental member representatives, ranging from 542 to 729 members, and averaging 646 members, voted to adopt all proposed MT changes by margins ranging from 68 percent to 94 percent and averaging 83 percent.

- Interests, experts, and associations that testified in support of adding the MT provisions to the IBC included local government building code officials, fire marshals and fire chiefs, materials scientists, fire science researchers and testing agencies, fire protection engineers, structural engineers, multifamily contractors, the United States Forest Service, the International Association of Building Officials, the National Association of Home Builders, the American Institute of Architects, the American Wood Council, APA-the Engineered Wood Association, and Underwriters Laboratories.

- Updating the FBC to permit MT buildings will stimulate investment in its manufacturing and supply chain in FL and put downward pressure on cost and pricing. Investment in MT production is projected to have significant economic benefits for the FL economy because of the state's extensive timber resources. Florida's forest industry contributes $25 billion to the state's economy, providing more than 124,000 jobs. There is 17 million acres of forestland covering almost half of Florida's total land area. Almost 2/3 of the forestland is privately owned. https://www.flforestry.org/resources/2017-economic-impact-study/

- Because of repetitive building layouts in residential multifamily buildings, and the speed of constructing MT buildings, it is predicted that MT will compete successfully with other materials used for multifamily buildings in the 8 -12 story height range. In addition to construction efficiencies, expanded use of MT in these applications can reduce the potential of large construction site fires.

- MT construction sites are safer for workers. Construction sites are also quieter and are less disruptive than in the communities where projects occur. MT projects are completed substantially faster than traditional methods of construction, minimizing waste and community impacts while maximizing both worker productivity and developers' returns on investment. In addition, building with pre-manufactured MT panels broadens the available labor pool and will likely alleviate a national shortfall in skilled construction labor.

- Wildland fire safety on both the regional and global scale will benefit from increased use of MT. Low value wood, thinnings, and dead standing trees, can be used for MT, thereby creating a financial incentive for wildland fuels reduction, particularly of ladder fuels, improving regional fire safety and conserving federal and state resources.

- Sequestering carbon in long-lived building materials manufactured from renewable, sustainably managed forests mitigates drivers of climate change and worsening wildland fire seasons and intensities. Sequestering carbon in MT buildings also helps mitigate other issues associated with climate change like the intensity of storms and flooding events.

- Sustainably managed and harvested forests capture more carbon than forests left unmanaged and provide habitat for a greater range of species.

200 Greencastle Road • Tyrone, GA 30290
Phone: (770) 631-6701 • Fax: (770) 631-6720
www.slma.org

materials scientists, fire science researchers and testing agencies, fire protection engineers, structural engineers, multifamily contractors, the United States Forest Service, the International Association of Building Officials, the National Association of Home Builders, the American Institute of Architects, the American Wood Council, APA-the Engineered Wood Association, and Underwriters Laboratories.

- Updating the FBC to permit MT buildings will stimulate investment in its manufacturing and supply chain in FL and put downward pressure on cost and pricing. Investment in MT production is projected to have significant economic benefits for the FL economy because of the state's extensive timber resources. Florida's forest industry contributes $25 billion to the state's economy, providing more than 124,000 jobs. There is 17 million acres of forestland covering almost half of Florida's total land area. Almost 2/3 of the forestland is privately owned. https://www.flforestry.org/resources/2017-economic-impact-study/

- Because of repetitive building layouts in residential multifamily buildings, and the speed of constructing MT buildings, it is predicted that MT will compete successfully with other materials used for multifamily buildings in the 8 -12 story height range. In addition to construction efficiencies, expanded use of MT in these applications can reduce the potential of large construction site fires.

- MT construction sites are safer for workers. Construction sites are also quieter and are less disruptive than in the communities where projects occur. MT projects are completed substantially faster than traditional methods of construction, minimizing waste and community impacts while maximizing both worker productivity and developers' returns on investment. In addition, building with pre-manufactured MT panels broadens the available labor pool and will likely alleviate a national shortfall in skilled construction labor.

- Wildland fire safety on both the regional and global scale will benefit from increased use of MT. Low value wood, thinnings, and dead standing trees, can be used for MT, thereby creating a financial incentive for wildland fuels reduction, particularly of ladder fuels, improving regional fire safety and conserving federal and state resources.

- Sequestering carbon in long-lived building materials manufactured from renewable, sustainably managed forests mitigates drivers of climate change and worsening wildland fire seasons and intensities. Sequestering carbon in MT buildings also helps mitigate other issues associated with climate change like the intensity of storms and flooding events.

- Sustainably managed and harvested forests capture more carbon than forests left unmanaged and provide habitat for a greater range of species.

- As a panelized building product, fastened together on-site, MT panels are ideal for buildings designed for disassembly. This means panels, which are easily restored after prior use, can be re-used in new building applications. Carbon stored in MT panels can be sequestered indefinitely as the panels are re-used in future buildings.

Please contact me with questions at will@slma.org.

Sincerely,

Director of Government Affairs

200 Greencastle Road • Tyrone, GA 30290
Phone: (770) 631-6701 • Fax: (770) 631-6720
www.slma.org

- As a panelized building product, fastened together on-site, MT panels are ideal for buildings designed for disassembly. This means panels, which are easily restored after prior use, can be re-used in new building applications. Carbon stored in MT panels can be sequestered indefinitely as the panels are re-used in future buildings.

Please contact me with questions at will@slma.org.

Sincerely,

Director of Government Affairs

200 Greencastle Road • Tyrone, GA 30290
Phone: (770) 631-6701 • Fax: (770) 631-6720
www.slma.org

West Fraser

9022 Southeast 186th Place
Lake Butler, FL.
32054
Phone: (904) 290-6460
www.westfraser.com

February 4, 2022

To: Florida Building Commission

RE: Adoption of Mass Timber Code Proposals into the 2023 FBC

West Fraser is a diversified wood products company with more than 60 facilities in Canada, the United States, the United Kingdom, and Europe. In the state of Florida, West Fraser owns and operates five sawmills, where we support the communities of Lake Butler, Maxville, McDavid, Perry, and Whitehouse. As North America's largest lumber producer, we directly employ more than 640 people at our Florida facilities and support more than 875 indirect/induced jobs in the state as a result of our mill operations.

West Fraser provides renewable building products for the world, contributing to a more sustainable future. Therefore, we are committed to reducing the environmental impact of new construction by encouraging the environmentally responsible choices of wood-based building materials. As a manufacturer of sustainable products that makes use of renewable forest resources that sequester carbon, we support the adoption of mass timber (MT) construction, (Types IVA, IVB, and IVC), and related requirements, as contained in the 2021 edition of the International Building Code (IBC), into the 2023 Florida Building Code (FBC) for the following reasons:

- Sequestering carbon in long-lived building materials manufactured from renewable, sustainably managed forests, mitigates drivers of climate change and worsening wildland fire seasons and intensities. Sequestering carbon in MT buildings also helps mitigate other issues associated with climate change like the intensity of storms and flooding events.

- Sustainably managed and harvested forests capture more carbon than forests left unmanaged and provide habitat for a greater range of species.

- Updating the FBC to permit MT buildings will stimulate investment in manufacturing and supply chains in Florida and put downward pressure on cost and pricing.

- Adding these new types of construction to the FBC provides designers with greater flexibility when specifying building systems in the 8 – 12 story multifamily market.

For these reasons, we encourage the Florida Building Commission to adopt the package of MT proposals as incorporated in the 2021 IBC and proposed through the 2023 FBC update process.

Sincerely,

Jerome Worthy
General Manager
West Fraser
Whitehouse - Lumber Mill
109 Halsema Road S.
Whitehouse, FL
32220

Al Cleghorn
General Manager
West Fraser
Maxville Lumber - Mill
6640 County Road 218
Jacksonville, FL
32234

Joshua Crawford
General Manager
West Fraser
Lake Butler Lumber - Mill
9022 Southeast 186th Pl.
Lake Butler, FL
32054

Stephen Baxley
General Manager
West Fraser
Perry - Lumber Mill
1509 S. Byron Butler Pkwy
Perry, FL
32348

Jeff Hondorp
General Manager
West Fraser
McDavid - Lumber Mill
401 Champion Drive
McDavid, FL
32568

Matt Goodin
Procurement Manager FL
West Fraser
Lake Butler - Lumber Mill
9022 Southeast 186th Pl.
Lake Butler, FL
32054

Sec 604.2 Type IV mass timber and related definitions

AWC proposes this code change as part of a package which, when taken together, as a group, creates the safety and reliability requirements necessary for the regulation of large mass timber (MT) buildings by the Florida Building Code. The following statement was offered by the Ad Hoc Committee on Tall Wood Buildings (TWB) for this proposal (IBC-G108-18, S100) in the ICC Code Development monograph 2018 Group A:

The Ad Hoc Committee on Tall Wood Buildings (TWB) was created by the ICC Board to explore the science of tall wood buildings and take action on developing code changes for tall wood buildings. The TWB has created several code change proposals with respect to the concept of tall buildings of mass timber and the background information is at the end of this Statement. Within the statement are important links to information, including documents and videos, used in the deliberations which resulted in these proposals.

The TWB and it various WGs held meetings, studied issues and sought input from various expert sources around the world. The TWB has posted those documents and input on its website for interested parties to follow its progress and to allow those parties to, in turn, provide input to the TWB.

At its first meeting, the TWB discussed a number of performance objectives to be met with the proposed criteria for tall wood buildings:

- No collapse under reasonable scenarios of complete burn-out of fuel without automatic sprinkler protection being considered.
- No unusually high radiation exposure from the subject building to adjoining properties to present a risk of ignition under reasonably severe fire scenarios.
- No unusual response from typical radiation exposure from adjacent properties to present a risk of ignition of the subject building under reasonably severe fire scenarios.
- No unusual fire department access issues.
- Egress systems designed to protect building occupants during the design escape time, plus a factor of safety.
- Highly reliable fire suppression systems to reduce the risk of failure during reasonably expected fire scenarios. The degree of reliability should be proportional to evacuation time (height) and the risk of collapse.

The comprehensive package of proposals from the TWB meet these performance objectives.

Definitions

Included in the proposal for Section 602.4 are three new/revised definitions; Wall, Load-Bearing; Mass Timber; and Noncombustible protection (for mass timber). They are important to understanding the subsequent proposed change to Section 602.4.

Load-bearing wall: The modification to the term “load-bearing wall” has been updated to include “mass timber” as a category equivalent to that of masonry or concrete. Based on the research done by the wood trade associations, mass timber walls (e.g. sawn, glued-laminated, cross-laminated timbers) have the ability to support the minimum 200 pounds per linear foot vertical load requirement.

Mass Timber: The term “mass timber” is being proposed to represent both the legacy heavy timber (a.k.a. Type IV construction) and the three (3) new construction types that are proposed for Chapter 6 of the IBC. The purpose of creating this term and definition was to establish a single term which represented the

various sawn and engineered timber products that are referenced in IBC Chapter 23 (Wood) and in PRG-320 "Standard for Performance-rated Crosslaminated Timber."
"Noncombustible Protection (For Mass Timber): The definition of "Noncombustible Protection (For Mass Timber)" is created to address the passive fire protection of mass timber. Mass timber is permitted to have its own fire-resistance rating (e.g., Mass Timber only) or have a fire resistance rating based on the fire resistance through a combination of the mass timber fire-resistance plus protection by non-combustible materials as defined in Section 703.5 (e.g., additional materials that delay the combustion of mass timber, such as gypsum board). While it is not common to list a code section number within a definition it was felt necessary in this case to ensure that the user was able to understand the intent. The protection by a non-combustible material will act to delay the combustion of the Mass Timber.

Types of Construction

The Committee recognized that tall, mass timber buildings around the world generally fell into three categories: one in which the mass timber was fully protected by noncombustible protection, a second type in which the protection was permitted to be omitted to expose the wood in certain limited amounts of walls or ceilings, and a third type in which the mass timber for the structure was permitted to be unprotected.

The TWB also determined that fire testing was necessary to validate these concepts. At its first meeting, members discussed the nature and intention of fire testing so as to ensure meaningful results for the TWB and, more specifically, for the fire service. Subsequently a test plan was developed. The fire tests consisted of one-bedroom apartments on two levels, with both apartments having a corridor leading to a stairway. The purpose of the tests was to address the contribution of mass timber to a fire, the performance of connections, the performance of joints, and to evaluate conditions for responding fire personnel. The Fire WG then refined the test plan, which was implemented with a series of five, full-scale, multiple-story building tests at the Alcohol, Tobacco and Firearms (ATF) laboratories in Beltsville, MD.
The results of those tests, as well as testing conducted by others, helped form the basis upon which the Codes WG developed its code change proposals. This code change proposal is one of those developed by the Codes WG and approved by the TWB.

To review a summary of the fire tests, please visit: http://bit.ly/ATF-firetestreport

To watch summary videos of the fire tests, which are accelerated to run in 3-1/2 minutes each, please visit: http://bit.ly/ATF-firetestvideos .

Both of these links were confirmed active on 1/14/22.

The completely protected type of construction, as noted above, is identified as Type IV-A. The protection is defined by a new section, 722.7, proposed in a separate code change. Testing has shown that mass timber construction protected with noncombustible protection, primarily multiple layers of 5/8-inch Type X gypsum board, can survive a complete burnout of a residential fuel load without engaging the mass timber in the fire. (See video or report above.) In considering this type of construction and its potential height and/or allowable area, the TWB wanted to make sure that code users realize that the protection specified in the text applies to all building elements. Thus, the text clearly requires protection for the floor surface, all wall and ceiling surfaces, the inside roof surfaces, the underside of floor surfaces, and shafts.

In addition, Type IV-A construction is proposed to have the same fire resistance rating requirements as the existing Type I-A construction, which sets forth requirements for 2-hour and 3-hour structural elements. The specified fire resistance rating for Type IV-A construction is conservative in that the fire resistance rating of the structural elements was selected to be able to passively sustain the fuel loads associated with the various occupancies without the benefit of automatic sprinkler protection, and without involving the contribution of the structural members, similar to the strategy employed in the IBC for Type I construction.

Type IV-B allows some exposed wood surfaces of the ceiling, the walls or columns and beams. The amount of exposed surface permitted to be installed, as well as the required separation between unprotected portions, is clearly specified to limit the contribution of the structure in an interior fire. For example, two different walls may share the unprotected area but the two walls must be separated by a distance of 15 feet. Type IV-B has been subjected to the same fire tests under the same conditions as Type IV-A and the results demonstrate that a predictable char layer develops on mass timber in the same fashion as traditional sawn lumber, provided that substantial delamination is avoided. (See video or report above.) It should be noted that, while portions of the mass timber may be unprotected, concealed spaces, shafts and other specified areas are required to be fully protected by noncombustible protection. Type IV-B is provided with the same base fire resistance requirements as the existing Type I-B construction, which sets forth requirements for 2-hour structural elements. Please note that the allowance per IBC Section 403.2.1.1 to reduce I-B construction to 1-hour structural elements is not proposed for Type IV-B construction. Essentially, where a building is permitted to be constructed of I-B construction and has 1-hour protection, that same building will still require 2-hour structural elements for Type IV-B construction.

Type IV-C construction permits fully exposed mass timber. Important caveats are that concealed spaces, shafts, elevator hoistways, and interior exit stairway enclosures are not permitted to be exposed, but instead are required to have noncombustible protection. The IV-C construction is differentiated from traditional Heavy Timber construction in that Type IV-C construction is required to be 2-hour fire rated. While the added fire rating is required, the committee does not propose any additional height, in terms of feet, for Type IV-C buildings; in other words, the height in feet for Type IV-C and Type IV-HT are identical. However, due to the added fire resistance ratings, the committee has proposed added floors for some occupancy groups of Type IV-C construction.

Tables 601 and 602: Included in the proposal are modification of Tables 601 and 602. This is necessary to set the performance requirement for these new types of construction based upon mass timber. It should be noted that these Fire Resistance Ratings are set to have the requirements similar to those of Type I construction. In other words, IV-A has the same FRR as I-A; IV-B has the same FRR as I-B. Because there is no Type I corollary to IV-C, it was set the same as IV-B. The IV-C has to achieve all its fire resistance by the performance of the mass timber itself because no noncombustible protection is required. This is reflected in greatly reduced permitted height, in both feet and stories, in other TWB proposals to Table 504.3, 504.4 and 506.2.

Background information: The ICC Board approved the establishment of an ad hoc committee for tall wood buildings in December of 2015. The purpose of the ad hoc committee is to explore the science of tall wood buildings and to investigate the feasibility and take action on developing code changes for tall wood buildings. The committee is comprised of a balance of stakeholders with additional opportunities for interested parties to participate in the four Work Groups established by the ad hoc committee, namely: Code; Fire; Standards/Definitions; and Structural. For more information, be sure to visit the ICC website https://www.iccsafe.org/codes-tech-support/cs/icc-ad-hoc-committee-on-tall-wood-buildings/ (link active and up to date as of 1/14/22). As seen in the “Meeting Minutes and Documents” and

"Resource Documents" sections of the committee web page, the ad hoc committee reviewed a substantial amount of information to provide technical justification for code proposals.

The Ad Hoc Committee for Tall Wood Buildings (AHC-TWB) was created by the ICC Board of Directors to explore the building science of tall wood buildings with the scope to investigate the feasibility of and take action on developing code changes for these buildings. Members of the AHC-TWB were appointed by the ICC Board of Directors. Since its creation in January 2016, the AHC-TWB has held 8 open meetings and numerous Work Group conference calls. Four Work Groups were established to address over 80 issues and concerns and review over 60 code proposals for consideration by the AHC-TWB. Members of the Work Groups included AHC-TWB members and other interested parties. Related documentation and reports are posted on the AHC-TWB website at https://www.iccsafe.org/codes-tech-support/cs/icc-ad-hoc-committee-on-tall-wood-buildings/ .

February 10, 2022

To: Florida Building Commission

The signatory parties support the adoption of mass timber (MT) construction types, (Types IVA, IVB, and IVC), and related requirements, as contained in the 2021 edition of the International Building Code (IBC), into the 2023 Florida Building Code (FBC) for the following reasons:

- In 2016 the ICC Board of Directors appointed the Ad Hoc Committee on Tall Wood Buildings (AHC-TWB) to explore the science of tall wood buildings. Committee and work group members consisted of code officials, fire officials, construction material interests, designers, builders, and other interested parties.

  After studying MT for hundreds of hours, and reviewing extensive fire-testing of the material, the AHC-TWB developed and submitted a package of code-change proposals for the 2021 edition of the IBC through the ICC's rigorous code development process. In that process the voting number of ICC governmental member representatives, ranging from 542 to 729 members, and averaging 646 members, voted to adopt all proposed MT changes by margins ranging from 68 percent to 94 percent and averaging 83 percent.

  Interests, experts, and associations that testified in support of adding the MT provisions to the IBC included local government building code officials, fire marshals and fire chiefs, materials scientists, fire science researchers and testing agencies, fire protection engineers, structural engineers, multifamily contractors, the United States Forest Service, the International Association of Building Officials, the National Association of Home Builders, the American Institute of Architects, the American Wood Council, APA-the Engineered Wood Association, and Underwriters Laboratories.

- Updating the FBC to permit MT buildings will stimulate investment in its manufacturing and supply chain in FL and put downward pressure on cost and pricing. Investment in MT production is projected to have significant economic benefits for the FL economy because of the state's extensive timber resources. Florida's forest industry contributes $25 billion to the state's economy, providing more than 124,000 jobs. There are 17 million acres of forestland covering almost half of Florida's total land area. Almost 2/3 of the forestland is privately owned. https://www.flforestry.org/resources/2017-economic-impact-study/

- Because of repetitive building layouts in residential multifamily buildings, and the speed of constructing MT buildings, it is predicted that MT will compete successfully with other materials used for multifamily buildings in the 8 -12 story height range. In addition to construction efficiencies, expanded use of MT in these applications can reduce the potential of large construction site fires.

- MT construction sites are safer for workers. Construction sites are also quieter and are less disruptive in the communities where projects occur. MT projects are completed substantially faster than traditional methods of construction, minimizing waste and community impacts while maximizing both worker productivity and developers' returns on investment. In addition, building with pre-manufactured MT panels broadens the available labor pool and will likely alleviate a national shortfall in skilled construction labor.

- Wildland fire safety on both the regional and global scale will benefit from increased use of MT. Low value wood, thinnings, and dead standing trees, can be used for MT, thereby creating a financial incentive for wildland fuels reduction, particularly of ladder fuels, improving regional fire safety and conserving federal and state resources.

- Sequestering carbon in long-lived building materials manufactured from renewable, sustainably managed forests mitigates drivers of climate change and worsening wildland fire seasons and intensities. Sequestering carbon in MT buildings also helps mitigate other issues associated with climate change like the intensity of storms and flooding events.

- Sustainably managed and harvested forests capture more carbon than forests left unmanaged and provide habitat for a greater range of species.

- As a panelized building product, fastened together on-site, MT panels are ideal for buildings designed for disassembly. This means panels, which are easily restored after prior use, can be re-used in new building applications. Carbon stored in MT panels can be sequestered indefinitely as the panels are re-used in future buildings.

For these reasons we encourage the FL Building Commission to adopt the package of MT proposals as incorporated in the 2021 IBC and proposed through the 2023 FBC update process.

Sincerely:

The Conservation Fund
www.conservationfund.org

FAA
FLORIDA
APARTMENT
ASSOCIATION

Florida Forestry Association
www.flforestry.org

Forest Landowners Association
www.forestlandowners.com

Forestry Association of South Carolina
www.scforestry.org

Georgia Forestry Association
gfagrow.org

Keeping Forests
keepingforests.org

Louisiana Forestry Association
www.laforestry.com

National Association of State Foresters
www.stateforesters.org

North Carolina Forestry Association
www.ncforestry.org

Packaging Corporation of America
www.packagingcorp.com

Rayonier
1 Rayonier Way
Wildlight, Florida
www.rayonier.com

Southeastern Lumber Manufacturers Association
www.slma.org

Southern Group of State Foresters
southernforests.org

Tennessee Forestry Association
www.tnforestry.com

Dr. Patricia Layton
Clemson University
Director
Wood Utilization + Design Institute
www.clemson.edu/centers-institutes/wud/

Christopher Meyer, AIA
Assistant Professor of Architecture
University of Miami School of Architecture
Director, LU_Lab
www.arc.miami.edu
Principal, Atelier Mey
ateliermey.net

Shawna Meyer, AIA
Lecturer, University of Miami School of Architecture
www.arc.miami.edu
Principal, Atelier Mey
https://ateliermey.net

Building Officials Association of Florida, Inc.

PRESIDENT
Kathleen Croteau
kroteau@capfla.com
CAP Government, Inc.
Building Official

VICE PRESIDENT
Dean Hall
dhall@ocoee.org
City of Ocoee
Building Official

TREASURER
Sean Flanagan
sflanagan@coconutcreek.net
City of Coconut Creek
Deputy Building Official

SECRETARY
Glenn Dodson
glenn.dodson@galgov.com
City of Tallahassee
Building Official

IMMEDIATE PAST PRESIDENT
Mickey Matison
municipalcodeservices@gmail.com
Municipal Code Services
President/CEO

EXECUTIVE DIRECTOR
Ann Russo
arusso@boaf.net
BOAF
P.O. Box 5247
Deltona, FL 32728
V 407-804-1001
boaf.net

February 4, 2022

James R. Schock, Chairman
Florida Building Commission
2601 Blair Stone Street
Tallahassee, FL 32399

Re: Support of Mass Timber Proposals

Dear Chairman Schock:

The signatory parties support the adoption of mass timber (MT) construction types, (Types IVA, IVB, and IVC), and related requirements, as contained in the 2021 edition of the International Building Code (IBC), into the 2023 Florida Building Code (FBC) for the following reasons:

In 2016 the ICC Board of Directors appointed the Ad Hoc Committee on Tall Wood Buildings (AHC-TWB) to explore the science of tall wood buildings. Committee and work group members consisted of code officials, fire officials, construction material interests, designers, builders, and other interested parties.

After studying MT for hundreds of hours, and reviewing extensive fire-testing of the material, the AHC-TWB developed and submitted a package of code-change proposals for the 2021 edition of the IBC through the ICC's rigorous code development process.In that process the voting number of ICC governmental member representatives, ranging from 542 to 729 members, and averaging 646 members, voted to adopt all proposed MT changes by margins ranging from 68 percent to 94 percent and averaging 83 percent.

Interests, experts, and associations that testified in support of adding the MT provisions to the IBC included local government building code officials, fire marshals and fire chiefs, materials scientists, fire science researchers and testing agencies, fire protection engineers, structural engineers, multifamily contractors, the United States Forest Service, the International Association of Building Officials, the National Association of Home Builders, the American Institute of Architects, the American Wood Council, APA-the Engineered Wood Association, and Underwriters Laboratories.

Updating the FBC to permit MT buildings will stimulate investment in its manufacturing and supply chain in Florida and put downward pressure on cost and pricing. Investment in MT production is projected to have significant economic benefits for the Florida economy because of the state's extensive timber resources. Florida's forest industry contributes $25 billion to the state's economy, providing more than 124,000 jobs. There are 17 million acres of forestland covering almost half of Florida's total land area. Almost 2/3 of the forestland is privately owned.

https://www.flforestry.org/resources/2017-economic-impact-study/

- Because of repetitive building layouts in residential multifamily buildings, and the speed of constructing MT buildings, it is predicted that MT will compete successfully with other materials used for multifamily buildings in the 8 -12 story height range. In addition to construction efficiencies, expanded use of MT in these applications can reduce the potential of large construction site fires.
- MT construction sites are safer for workers. Construction sites are also quieter and are less disruptive in the communities where projects occur. MT projects are completed substantially faster than traditional methods of construction, minimizing waste and community impacts while maximizing both worker productivity and developers' returns on investment. In addition, building with pre-manufactured MT panels broadens the available labor pool and will likely alleviate a national shortfall in skilled construction labor.
- Wildland fire safety on both the regional and global scale will benefit from increased use of MT. Low value wood, thinnings, and dead standing trees, can be used for MT, thereby creating a financial incentive for wildland fuels reduction, particularly of ladder fuels, improving regional fire safety and conserving federal and state resources.
- Sequestering carbon in long-lived building materials manufactured from renewable, sustainably managed forests mitigates drivers of climate change and worsening wildland fire seasons and intensities. Sequestering carbon in MT buildings also helps mitigate other issues associated with climate change like the intensity of storms and flooding events.
- Sustainably managed and harvested forests capture more carbon than forests left unmanaged and provide habitat for a greater range of species.
- As a panelized building product, fastened together on-site, MT panels are ideal for buildings designed for disassembly.This means panels, which are easily restored after prior use, can be re-used in new building applications.Carbon stored in MT panels can be sequestered indefinitely as the panels are re-used in future buildings.

For these reasons we encourage the Florida Building Commission to adopt the package of MT proposals as incorporated in the 2021 IBC and proposed through the 2023 FBC update process.

Sincerely,

Kathleen Croteau, CBO

President

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F10436

Date Submitted	02/14/2022	**Section**	601	**Proponent**	Richard Walke
Chapter	6	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

Summary of Modification

The National Fireproofing Contractors Association Requests Modification of Table 601 to Add New Footnote on Rating Required on Occupiable Roofs

Rationale

The National Fireproofing Contractors Association (NFCA) submitted Proposal No. G135-21 during the Group A cycle of the current ICC 2021-2022 Code Development Cycle to clarify the requirements of Table 601 for roofs used as occupiable spaces. The proposal combined two thought processes. First, include a new Footnote b under Table 601 relating to the required rating of roofs used as occupiable spaces. Second, update the existing footnote b to preclude its use in conjunction with roofs used as occupiable space. That original proposal was disapproved by the committee due to clumsy language. A public comment was submitted. The public comment was ultimate disapproved by 1 vote in our opinion due to a misunderstanding of what we were attempting to achieve. NFCA believes both thought processes of the original proposal are sound. We also believe both thought processes are significant enough to warrant consideration by the Florida Building Commission for inclusion in the 2023 FBC. Rooftop assembly occupancies are becoming increasingly popular for relaxation, dining and drinking purposes. Folks frequenting these rooftop venues deserve the same protection as those on the floors below. The proposal submitted to ICC has been be split into two separate proposals. This proposal addresses the addition of a new Footnote b which requires roofs used as occupiable spaces to have a fire-resistance rating equal to or greater than the floor below. Providing the same degree of fire-resistance for the complete roof assembly gives occupants protection regardless of changes in the size of the venue and the occupant load during the life cycle of the building. We know the size of the venue and the occupant load can and does change – and might expand after the building is occupied. This proposal protects those on the rooftop just as if they were standing on a floor below. We request your approval of this proposal for inclusion in the 2023 FBC.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

The local entity will now be required to inspect the fire protection on roofs where the roof assembly is being used as an occupiable space.

Impact to building and property owners relative to cost of compliance with code

Roofs being used as an occupiable space will now require fire protection. This will increase the cost for building with occupiable roofs.

Impact to industry relative to the cost of compliance with code

There will be no impact to industry.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This proposal reduces the risk to occupants of occupiable roofs by requiring the roofs be fire-resistance-rated.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposal strengthens the code by requiring occupiable roofs to be fire-resistance-rated.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposal does not discriminate against any materials, products, methods, or systems of construction.

Does not degrade the effectiveness of the code

This proposal strengthens the requirements of the code as it provides additional protection for roof assemblies uses as occupiable roofs.

2nd Comment Period

10436-G1

Proponent	Joe Bigelow	Submitted	9/1/2022 3:04:14 PM	Attachments	Yes

Comment:

Submitted by Staff on behalf of the Commenter due to verified system glitch

August 26, 2022

Proposed Change to the 2023 Florida Building Code

F10436 – Occupiable Roofs – Roof Rating Equals Floor Rating

Original Proposal:

Revise as follows:

TABLE 601 FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

BUILDING ELEMENT	TYPE!		TYPE II		TYPE 111		TYPE IV	TYPEV	
	A	B	A	B	A	B	HT	A	B
Primary structural frame [f,g] (see Section 202)	3 [a]	2 [a]	1	0	1	0	HT	1	0
Bearing walls Exterior [~~e~~,f,g] Interior	3 3 [a]	2 2 [a]	1 1	0 0	2 1	2 0	2 1/HT	1 1	0 0
Nonbearing walls and partitions Exterior	See Table 602								
Nonbearing walls and partitions Interior'	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary members (see Section 202)	2	2	1	0	1	0	HT	1	0
Roof construction and associated secondary members (see Section 202)	1-1/2 [b,c]	1 [b,c,d]	1 [b,c,d]	0 [~~c~~,d]	1 [b,c,d]	0	HT	1 [b,c,d]	0

For SI: 1 foot = 304.8 mm.

a. Roof supports: Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.

b. Where a roof is an occupiable space, the fire-resistance rating of the roof assembly shall be equal to or greater than the floor below.

~~b~~c. Except in Group F-1, H, M and S-1 occupancies, fire protection of structural members shall not be required, including protection of roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.

~~c~~d. In all occupancies, heavy timber complying with Section 2304.11 shall be allowed where a 1-hour or less fire-resistance rating is required.

~~d~~e. Not less than the fire-resistance rating required by other sections of this code.

August 26, 2022

Proposed Change to the 2023 Florida Building Code

F10436 – Occupiable Roofs – Roof Rating Equals Floor Rating

Original Proposal:

Revise as follows:

TABLE 601 FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

BUILDING ELEMENT	TYPE!		TYPE II		TYPE 111		TYPE IV	TYPEV	
	A	B	A	B	A	B	HT	A	B
Primary structural frame [fg](see Section 202)	3 [a]	2 [a]	1	0	1	0	HT	1	0
Bearing walls Exterior [~~e~~,f,g] Interior	3 3 [a]	2 2 [a]	1 1	0 0	2 1	2 0	2 1/HT	1 1	0 0
Nonbearing walls and partitions Exterior	See Table 602								
Nonbearing walls and partitions Interior'	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary members (see Section 202)	2	2	1	0	1	0	HT	1	0
Roof construction and associated secondary members (see Section 202)	1-1/2 [b,c]	1 [b,c,d]	1 [b,c,d]	0 [~~c~~,d]	1 [b,c,d]	0	HT	1 [b,c,d]	0

For SI: 1 foot = 304.8 mm.

a. Roof supports: Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.

b. Where a roof is an occupiable space, the fire-resistance rating of the roof assembly shall be equal to or greater than the floor below.

~~b~~c. Except in Group F-1, H, M and S-1 occupancies, fire protection of structural members shall not be required, including protection of roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.

~~c~~d. In all occupancies, heavy timber complying with Section 2304.11 shall be allowed where a 1-hour or less fire-resistance rating is required.

~~d~~e. Not less than the fire-resistance rating required by other sections of this code.

~~e~~f. Not less than the fire-resistance rating based on fire separation distance (see Table 602).
~~f~~g. Not less than the fire-resistance rating as referenced in Section 704.10.

Original Reason Statement:

The National Fireproofing Contractors Association (NFCA) submitted Proposal No. G135-21 during the Group A cycle of the current ICC 2021-2022 Code Development Cycle to clarify the requirements of Table 601 for roofs used as occupiable spaces. The proposal combined two thought processes. First, include a new Footnote b under Table 601 relating to the required rating of roofs used as occupiable spaces. Second, update the existing footnote b to preclude its use in conjunction with roofs used as occupiable space. That original proposal was disapproved by the committee due to clumsy language.

A public comment was submitted. The public comment was ultimate disapproved by 1 vote in our opinion due to a misunderstanding of what we were attempting to achieve.

NFCA believes both thought processes of the original proposal are sound. We also believe both thought processes are significant enough to warrant consideration by the Florida Building Commission for inclusion in the 2023 FBC.

Rooftop assembly occupancies are becoming increasingly popular for relaxation, dining and drinking purposes. Folks frequenting these rooftop venues deserve the same protection as those on the floors below.

The proposal submitted to ICC has been split into two separate proposals. This proposal addresses the addition of a new Footnote b which requires roofs used as occupiable spaces to have a fire-resistance rating equal to or greater than the floor below.

Providing the same degree of fire-resistance for the complete roof assembly gives occupants protection regardless of changes in the size of the venue and the occupant load during the life cycle of the building. We know the size of the venue and the occupant load can and does change – and might expand after the building is occupied. This proposal protects those on the rooftop just as if they were standing on a floor below.

We request your approval of this proposal for inclusion in the 2023 FBC.

Public Comment:

As the proponent of F10436, I would like to request reconsideration of the TAC's recommendation for Denial. In my opinion, their decision was made based on confusion between the intent of this modification versus F10451.

The use of rooftops as occupiable space is becoming increasingly popular for relaxation, dining and drinking purposes. Folks frequenting these rooftop venues deserve a reasonable level of protection in the event of a fire.

~~e~~f. Not less than the fire-resistance rating based on fire separation distance (see Table 602).
~~f~~g. Not less than the fire-resistance rating as referenced in Section 704.10.

Original Reason Statement:

The National Fireproofing Contractors Association (NFCA) submitted Proposal No. G135-21 during the Group A cycle of the current ICC 2021-2022 Code Development Cycle to clarify the requirements of Table 601 for roofs used as occupiable spaces. The proposal combined two thought processes. First, include a new Footnote b under Table 601 relating to the required rating of roofs used as occupiable spaces. Second, update the existing footnote b to preclude its use in conjunction with roofs used as occupiable space. That original proposal was disapproved by the committee due to clumsy language.

A public comment was submitted. The public comment was ultimate disapproved by 1 vote in our opinion due to a misunderstanding of what we were attempting to achieve.

NFCA believes both thought processes of the original proposal are sound. We also believe both thought processes are significant enough to warrant consideration by the Florida Building Commission for inclusion in the 2023 FBC.

Rooftop assembly occupancies are becoming increasingly popular for relaxation, dining and drinking purposes. Folks frequenting these rooftop venues deserve the same protection as those on the floors below.

The proposal submitted to ICC has been split into two separate proposals. This proposal addresses the addition of a new Footnote b which requires roofs used as occupiable spaces to have a fire-resistance rating equal to or greater than the floor below.

Providing the same degree of fire-resistance for the complete roof assembly gives occupants protection regardless of changes in the size of the venue and the occupant load during the life cycle of the building. We know the size of the venue and the occupant load can and does change – and might expand after the building is occupied. This proposal protects those on the rooftop just as if they were standing on a floor below.

We request your approval of this proposal for inclusion in the 2023 FBC.

Public Comment:

As the proponent of F10436, I would like to request reconsideration of the TAC's recommendation for Denial. In my opinion, their decision was made based on confusion between the intent of this modification versus F10451.

The use of rooftops as occupiable space is becoming increasingly popular for relaxation, dining and drinking purposes. Folks frequenting these rooftop venues deserve a reasonable level of protection in the event of a fire.

F10436 and F10451 are two modifications from the National Fireproofing Contractors Association intended to improve passive fire protection to occupants of occupiable roofs. Each of the two modifications are separate and distinct proposals, each of which can stand on its own merits or be used concurrently. Modification F10451 assumes you are in an occupancy which requires a rated roof-ceiling assembly by the last line item of Table 601. It then negates the use of “20 ft rule” contained in existing Footnote b of Table 601 in the 2020 FBC when the roof is used as occupiable space. In other words, when the rooftop is occupiable space, you must protect the occupants using that occupiable space by protecting the roof-ceiling assembly regardless of the height of the ceiling of the top story. That modification was approved by the Committee in June. Obviously by approving F10451, the committee agreed it was appropriate to provide passive fire protection to the occupants of the rooftop venues. We now need to complete that thought process by likewise approving F10436. Modification F10436 covers the scenario where the last line item of Table 601 does not require a fire-resistance rating on the roof construction or requires a lesser rating than required for the floor-ceiling below. In either of these situations, F10436 requires the roof-ceiling creating the occupiable space be protected to a rating equal or greater than the rating of the floor-ceiling below. The specific application of these two modifications is different, but the concept is the same – provide passive fire protection to the occupants on occupiable roofs.

Thank you.

DID NOT INCLUDE DUE TO WORD COUNT ISSUES:

I believe the confusion between these two modifications during the June hearings involved the scenario where the two modifications result in different rating requirements. For example, with Type IB construction. In that scenario, the currently approved Modification F10451 would require a 1 hr rating on the occupiable roof regardless of the floor to ceiling height, whereas F10436 would require a 2 hr rating. But that is OK, as the code states that where requirements “conflict”, the more stringent requirement applies. In his example, a 2 hr rating would apply.

This public comment is suggesting one very minor change from the original proposal. The reference to “floor” in new footnote b of Table 601 is being changed to “floor or floor-ceiling assembly” to more appropriately define the assembly in question. (Keep?)

NOTE:

Not sure if we should make the modification of the original proposal. It may confuse the committee.

F10436 and F10451 are two modifications from the National Fireproofing Contractors Association intended to improve passive fire protection to occupants of occupiable roofs. Each of the two modifications are separate and distinct proposals, each of which can stand on its own merits or be used concurrently. Modification F10451 assumes you are in an occupancy which requires a rated roof-ceiling assembly by the last line item of Table 601. It then negates the use of "20 ft rule" contained in existing Footnote b of Table 601 in the 2020 FBC when the roof is used as occupiable space. In other words, when the rooftop is occupiable space, you must protect the occupants using that occupiable space by protecting the roof-ceiling assembly regardless of the height of the ceiling of the top story. That modification was approved by the Committee in June. Obviously by approving F10451, the committee agreed it was appropriate to provide passive fire protection to the occupants of the rooftop venues. We now need to complete that thought process by likewise approving F10436. Modification F10436 covers the scenario where the last line item of Table 601 does not require a fire-resistance rating on the roof construction or requires a lesser rating than required for the floor-ceiling below. In either of these situations, F10436 requires the roof-ceiling creating the occupiable space be protected to a rating equal or greater than the rating of the floor-ceiling below. The specific application of these two modifications is different, but the concept is the same – provide passive fire protection to the occupants on occupiable roofs.

Thank you.

DID NOT INCLUDE DUE TO WORD COUNT ISSUES:

I believe the confusion between these two modifications during the June hearings involved the scenario where the two modifications result in different rating requirements. For example, with Type IB construction. In that scenario, the currently approved Modification F10451 would require a 1 hr rating on the occupiable roof regardless of the floor to ceiling height, whereas F10436 would require a 2 hr rating. But that is OK, as the code states that where requirements "conflict", the more stringent requirement applies. In his example, a 2 hr rating would apply.

This public comment is suggesting one very minor change from the original proposal. The reference to "floor" in new footnote b of Table 601 is being changed to "floor or floor-ceiling assembly" to more appropriately define the assembly in question. (Keep?)

NOTE:

Not sure if we should make the modification of the original proposal. It may confuse the committee.

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F9945

17

Date Submitted	01/22/2022	**Section**	704.2	**Proponent**	Greg Johnson
Chapter	7	**Affects HVHZ**	No	**Attachments**	No
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

Building Code Section 704.4.1

Summary of Modification

In the 2018 & 2021 IBC columns in light-frame walls, which are located entirely between the top and bottom plates, are permitted to have required fire-resistance ratings provided by the membrane protection provided for the wall. This modification makes the FBC consistent.

Rationale

Note that a correlated modification is being proposed to Section 704.4.1. Since the 2018 edition of the IBC, in Section 704.4.1, columns in light frame construction have been permitted to have required fire-resistance ratings provided by the membrane protection provided for the wall rather than through individual encasement. This is a significant cost-savings for builders because it eliminates a requirement for individual encasement of columns, including built up wood stud columns. Note that no fire loss data relevant to this modification was provided in the ICC's code development process in opposition to this change and no relevant fire loss data since the IBC was changed 6 years ago has been subsequently brought forward.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

There should be no additional impact to code enforcing entities. Installation is verified as part of normal framing inspection processes. There may be reduced inspection expense for jurisdictions that are making specific inspection stops to verify individual encasement of columns within walls.

Impact to building and property owners relative to cost of compliance with code

The change could significantly reduce the cost of compliance by eliminating the need for individual encasement of columns within light-frame walls.

Impact to industry relative to the cost of compliance with code

The change could significantly reduce the cost of compliance by eliminating the need for individual encasement of columns within light-frame walls.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

The modification addresses fire-resistance and cost of construction which relate to the safety and welfare of the public.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

The modification provides an equivalent degree of fire-resistive construction at less expense.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

The modification is material neutral, applicable to both metal and wood framing.

Does not degrade the effectiveness of the code

The modification provides an equivalent degree of fire-resistive construction at less expense. The code will be equally effective.

2nd Comment Period

F9945-G1

Proponent Greg Johnson Submitted 8/11/2022 2:38:35 PM Attachments No

Comment:

The added reference to Sec. 704.4.1 in the exception to Sec. 704.2 and the addition of columns (either wood or steel) to Sec. 704.4.1 was approved in the 2015 ICC code development cycle. The proponent gave the following reason: Elements within fire-resistance rated walls of light-frame construction are addressed directly in Section 704.4.1 (Light-frame construction) and can be a part of a fire-resistance rated wall assembly without additional fire protection. Many buildings are built out of typical light frame construction; the concentrated loads from trusses or beams must have a continuous load path to the foundation. Some jurisdictions are interpreting that those construction boundary elements, such as, built-up and solid structural elements, are columns and are requiring them to be provided with individual fire protection. It is the intent of this provision, which has been verified by ICC staff, that it was never the intent to require individual fire protection of these elements, as they are not considered a portion of the primary structural frame." The committee agreed: "The committee agreed that built-up solid structural elements, such as 2 or more vertical framing members, within fire-resistance rated walls of light-frame construction that meet the limitations of Section 704.4.1 can be a part of a fire-resistance rated wall assembly without requiring the individual encasement protection of Section 704.2.

704.2 Column protection.

Where columns are required to have protection to achieve a fire-resistance rating, the entire column shall be provided individual encasement protection by protecting it on all sides for the full column height, including connections to other structural members, with materials having the required fire-resistance rating. Where the column extends through a ceiling, the encasement protection shall be continuous from the top of the foundation or floor/ceiling assembly below through the ceiling space to the top of the column.

Exception: Columns that meet the limitations of Section 704.4.1.

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F9946

18

Date Submitted	01/22/2022	**Section**	704.4.1	**Proponent**	Greg Johnson
Chapter	7	**Affects HVHZ**	Yes	**Attachments**	No
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

Building Code Section 704.2

Summary of Modification

In the 2018 & 2021 IBC columns in light-frame walls, which are located entirely between the top and bottom plates, are permitted to have required fire-resistance ratings provided by the membrane protection provided for the wall. This modification makes the FBC consistent.

Rationale

Note that a correlated modification is being proposed to Section 704.2 Since the 2018 edition of the IBC, in Section 704.4.1, columns in light frame construction have been permitted to have required fire-resistance ratings provided by the membrane protection provided for the wall rather than through individual encasement. This is a significant cost-savings for builders because it eliminates a requirement for individual encasement of columns, including built up wood stud columns. Note that no fire loss data relevant to this modification was provided in the ICC's code development process in opposition to this change and no relevant fire loss data since the IBC was changed 6 years ago has been subsequently brought forward.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

There should be no additional impact to code enforcing entities. Installation is verified as part of normal framing inspection processes. There may be reduced inspection expense for jurisdictions that are making specific inspection stops to verify individual encasement of columns within walls.

Impact to building and property owners relative to cost of compliance with code

The change could significantly reduce the cost of compliance by eliminating the need for individual encasement of columns within light-frame walls.

Impact to industry relative to the cost of compliance with code

The change could significantly reduce the cost of compliance by eliminating the need for individual encasement of columns within light-frame walls.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

The modification addresses fire-resistance and cost of construction which relate to the safety and welfare of the public.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

The modification provides an equivalent degree of fire-resistive construction at less expense.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

The modification is material neutral, applicable to both metal and wood framing.

Does not degrade the effectiveness of the code

The modification provides an equivalent degree of fire-resistive construction at less expense. The code will be equally effective and will match the provisions of the 2021 IBC.

2nd Comment Period

F9946-G1

Proponent Greg Johnson Submitted 8/11/2022 1:08:05 PM Attachments No

Comment:

The addition of columns (either wood or steel) to Section 704.4.1 was approved in the 2015 ICC code development cycle. The proponent gave the following reason: Elements within fire-resistance rated walls of light-frame construction are addressed directly in Section 704.4.1 (Light-frame construction) and can be a part of a fire-resistance rated wall assembly without additional fire protection. Many buildings are built out of typical light frame construction; the concentrated loads from trusses or beams must have a continuous load path to the foundation. Some jurisdictions are interpreting that those construction boundary elements, such as, built-up and solid structural elements, are columns and are requiring them to be provided with individual fire protection. It is the intent of this provision, which has been verified by ICC staff, that it was never the intent to require individual fire protection of these elements, as they are not considered a portion of the primary structural frame." The committee agreed: "The committee agreed that built-up solid structural elements, such as 2 or more vertical framing members, within fire-resistance rated walls of light-frame construction that meet the limitations of Section 704.4.1 can be a part of a fire-resistance rated wall assembly without requiring the individual encasement protection of Section 704.2. This clarification of the intent of the code will save owners and builders money by keeping them from having to provide unneeded encapsulation of framing members.

704.4.1 Light-frame construction.

Studs, columns, and boundary elements that are integral elements in ~~load-bearing~~ *walls* of light-frame construction and are located entirely between the top and bottom plates or tracks shall be permitted to have required fire-resistance ratings provided by the membrane protection provided for the load-bearing wall.

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

19

F10099

Date Submitted	02/10/2022	**Section**	703	**Proponent**	Greg Johnson
Chapter	7	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language Yes**

Related Modifications

Type IV Mass timber package; mods 10098, 10099, 10161, 10162, 10163, and more

Summary of Modification

This modification provides a performance path for determining the time contribution of noncombustible protection to mass timber fire resistance.

Rationale

See uploaded rationale

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
None; this requires no additional plan review or inspection.
Impact to building and property owners relative to cost of compliance with code
None; this is an optional method of construction. The owner chooses whether or not to build by this method.
Impact to industry relative to the cost of compliance with code
None; this is an optional method of construction. The owner chooses whether or not to build by this method.
Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
This is a fire-resistance calculation procedure.
Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
Improves the code by supporting a new method of construction.
Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No material is required or prohibited by this modification.

Does not degrade the effectiveness of the code

Improves the code by supporting a new method of construction.

Alternate Language

2nd Comment Period

F10099-A2

Proponent Sam Francis **Submitted** 8/26/2022 11:22:11 AM **Attachments** Yes

Rationale:

I met with opponents of the set of proposals to resolve differences. in the process of coming to a resolution, they suggested that this section ought to go in but as Section 703.6 rather than the proposed number becuase it makes sense in this location.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

same as original.

Impact to building and property owners relative to cost of compliance with code

same as original.

Impact to industry relative to the cost of compliance with code

same as original.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

same as original.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

same as original.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

same as original.

Does not degrade the effectiveness of the code

same as original.

2nd Comment Period

F10099-G1

Proponent Greg Johnson Submitted 8/17/2022 3:33:51 PM Attachments No

Comment:

Nothing in the FL Building code prohibits mass timber construction. In fact, Sec. 602.4 provides requirements for mass timber elements, including Sec. 602.4.2 which addresses cross-laminated timber, a form of mass timber. Modification F10099 provides a performance path for determining the time contribution of noncombustible protection to mass timber fire resistance. These provisions should already be available in the FL Building Code for already permissible buildings and those that may be accepted under Sec. 104.11, Alternative materials, design and methods of construction and equipment.

2nd Comment Period

F10099-G2

Proponent Sam Francis Submitted 8/25/2022 4:06:12 PM Attachments No

Comment:

I am recommending this be Accepted as originally submitted. At the first Comment Period hearing, after the TAC voted to deny the first of the Tall Mass Timber proposed modifications and one or two more, no testimony was offered by opponents or supporters to the subsequent proposed modifications. When we reached out to opponents of the mods which were hotly debated, they offered thoughts on those and on subsequent items which received no debate in the first Comment hearing. When we reached out to opponents to seek input on properly amending the proposals, this was one of those which was not debated This modification is the section which has the protocol for the tests which are required to determine the protection time assigned to a particular noncombustible protection material. This is a key element of the new types of construction described in Section 602.4. It is absolutely necessary to make the whole system work. When we discussed this and its relationship to the whole of the package, those opponents agreed that this was worthy of support

2nd Comment Period

10099-G3

Proponent	ashley ong	Submitted	8/26/2022 3:56:33 PM	Attachments	No

Comment:

Building Officials Association of Florida (BOAF) supports this modification.

~~703.8~~703.6 Determinationofnoncombustibleprotectiontimecontribution.

Thetime,in minutes, contributed tothe fire-resistancerating by the noncombustible protection of mass timber buildingelements,components,orassemblies,shallbeestablishedthroughacomparisonofassembliestestedusing procedures set forthin ASTM E119 or UL 263.The testassemblies shall be identicalin construction, loadingand materials, other than the noncombustible protection.The twotestassembliesshall be tested to the same criteria of structural failure with the following conditions:

1.TestAssembly1shallbewithoutprotection.

2. Test Assembly2 shall include the representative noncombustible protection.The protection shall be fully defined in terms of configurationdetails,attachmentdetails,jointsealingdetails,accessoriesandallotherrelevant details.

Thenoncombustibleprotectiontimecontributionshallbedeterminedbysubtractingthefire-resistancetime,in minutes, ofTest Assembly 1 from the fire-resistancetime, in minutes, ofTest Assembly2.

703.8 Determination of noncombustible protection time contribution.

The time, in minutes, contributed to the fire-resistance rating by the noncombustible protection of mass timber building elements, components, or assemblies, shall be established through a comparison of assemblies tested using procedures set forth in ASTM E119 or UL 263. The test assemblies shall be identical in construction, loading and materials, other than the noncombustible protection. The two test assemblies shall be tested to the same criteria of structural failure with the following conditions:

1. Test Assembly 1 shall be without protection.

2. Test Assembly 2 shall include the representative noncombustible protection. The protection shall be fully defined in terms of configuration details, attachment details, joint sealing details, accessories and all other relevant details.

The noncombustible protection time contribution shall be determined by subtracting the fire-resistance time, in minutes, of Test Assembly 1 from the fire-resistance time, in minutes, of Test Assembly 2.

Rationale: New Sec 703.8 determining noncombustible protection contribution for mass timber

AWC proposes this code change as part of a package which, when taken together, as a group, creates the safety and reliability requirements necessary for the regulation of large mass timber (MT) buildings by the Florida Building Code. The following statement was offered by the Ad Hoc Committee on Tall Wood Buildings (TWB) for this proposal (IBC-FS5-18) in the ICC Code Development monograph 2018 Group A:

The Ad Hoc Committee on Tall Wood Buildings (TWB) was created by the ICC Board to explore the science of tall wood buildings and take action on developing code changes for tall wood buildings. The TWB has created several code change proposals with respect to the concept of tall buildings of mass timber and the background information is at the end of this Statement. Within the statement are important links to information, including documents and videos, used in the deliberations which resulted in these proposals.

The TWB determined that the fire resistance rating of mass timber structural elements, embodied in a series of proposals including this one, shall consist of the inherent fire resistance rating of the mass timber and the additional fire resistance rating of the Noncombustible Protection described in new definitions proposals. The TWB determined that at least 2/3 of the required fire resistance rating should come from the Noncombustible Protection. The TWB decided to provide both a performance path, as embodied in this proposal, and a prescriptive path, embodied in another proposal for Section 722.7.

This proposal constitutes the performance path for determining the contribution of noncombustible protection for mass timber elements. The proposal outlines a protocol to accomplish this. This proposal should be considered as a companion proposal to the proposals creating new types of mass timber construction in Section 602.4 and the code proposal in Section 722.7. The proposed new Section 602.4 requires the use of noncombustible protection on most mass timber elements in most of the proposed new types of construction.

This proposal, new section 703.8, is created to provide the method by which any material not contained in the prescriptive Table in Section 722.7 may be tested to show the time, in minutes, which it contributes as noncombustible protection. This procedure is representative of the procedure used in the past to determine the protection times for various membranes in Section 722.6 Component Additive Method for wood construction. It is neither new nor ambiguous in its use. Recent testing by AWC confirms the values derived from historic testing. A report is available at the following link: http://bit.ly/WFC-firetestofGWBonCLT . This link was confirmed active on 1/14/22.

This procedure should not be confused with “membrane protection” which is based on temperature rise on the unexposed side of a membrane attached to construction elements. Noncombustible construction is, instead, noncombustible material meeting the requirements of Section 703.5. Its contribution to the fire resistance rating of any building element is determined by this proposed new section. Simply put, it is determined by measuring the fire resistance time, in minutes and determined by structural failure, of a mass timber building element and then conducting a second test measuring the fire resistance time, in minutes and determined by structural failure, of the identical mass timber element with identical load, construction and condition, but with the proposed noncombustible protection applied to it. The difference in time between the two samples is the contribution, in minutes, of the noncombustible protection.

The Ad Hoc Committee for Tall Wood Buildings (AHC-TWB) was created by the ICC Board of Directors to explore the building science of tall wood buildings with the scope to investigate the feasibility of and take action on developing code changes for these buildings. Members of the AHC-TWB were appointed by the ICC Board of Directors. Since its creation in January 2016, the AHC-TWB has held 8 open meetings and numerous Work Group conference calls. Four Work Groups were established to address over 80 issues and concerns and review over 60 code proposals for consideration by the AHC-TWB. Members of the Work Groups included AHC-TWB members and other interested parties. Related documentation and reports are posted on the AHC-TWB website at

https://www.iccsafe.org/codes-tech-support/cs/icc-ad-hoc-committee-on-tall-wood-buildings/ .

G146-18 as proposed:

3102.3 Type of construction.

Noncombustible membrane structures shall be classified as Type IIB construction. Noncombustible frame or cable-supported structures covered by an *approved* membrane in accordance with Section 3102.3.1 shall be classified as Type IIB construction. Heavy timber frame-supported structures covered by an approved membrane in accordance with Section 3102.3.1 shall be classified as Type IV-HT construction. Other membrane structures shall be classified as Type V construction.

> **Exception:** Plastic less than 30 feet (9144 mm) above any floor used in *greenhouses* , where occupancy by the general public is not authorized, and for aquaculture pond covers is not required to meet the fire propagation performance criteria of Test Method 1 or Test Method 2, as appropriate, of NFPA 701.

3102.6.1.1 Membrane. A membrane meeting the fire propagation performance criteria of Test Method 1 or Test Method 2, as appropriate, of NFPA 701 shall be permitted to be used as the roof or as a skylight on buildings of Type IIB, III, IV-HT and V construction, provided that the membrane is not less than 20 feet (6096 mm) above any floor, balcony or gallery.

Reason:

AWC proposes this code change as part of a package which, when taken together, as a group, creates the safety and reliability requirements necessary for the regulation of large mass timber (MT) buildings by the Florida Building Code. The following statement was offered by the Ad Hoc Committee on Tall Wood Buildings (TWB) for this proposal (IBC-G146-18) in the ICC Code Development monograph 2018 Group A:

The Ad Hoc Committee on Tall Wood Buildings (TWB) was created by the ICC Board to explore the science of tall wood buildings and take action on developing code changes for tall wood buildings. The TWB has created several code change proposals with respect to the concept of tall buildings of mass timber and the background information is at the end of this Statement. Within the statement are important links to information, including documents and videos, used in the deliberations which resulted in these proposals.

This code change will result in consistency with the purpose and scope which was to leave intact the current Type IV heavy timber provisions. The HT category was created to differentiate the three (3) new categories of “mass timber”, where HT represents the long-established heavy timber category that has been in the ICC family of codes, and the predecessor legacy codes, for decades.

The Ad Hoc Committee for Tall Wood Buildings (AHC-TWB) was created by the ICC Board of Directors to explore the building science of tall wood buildings with the scope to investigate the feasibility of and act on developing code changes for these buildings. Members of the AHC-TWB were appointed by the ICC Board of Directors. Since its creation in January 2016, the AHC-TWB has held 8 open meetings and numerous Work Group conference calls. Four Work Groups were established to address over 80 issues and concerns and review over 60 code proposals for consideration by the AHC-TWB. Members of the Work Groups included AHC-TWB members and other interested parties. Related documentation and reports are posted on the AHC-TWB website at:

https://www.iccsafe.org/codes-tech-support/cs/icc-ad-hoc-committee-on-tall-wood-buildings/ .

G152

D102.2 Other specific requirements.
D102.2.1 Exterior walls. Exterior walls of buildings located in the fire district shall comply with the requirements in Table 601 except as required in Section D102.2.6.
D102.2.2 Group H prohibited. Group H occupancies shall be prohibited from location within the fire district.
D102.2.3 Construction type. Every building shall be constructed as required based on the type of construction indicated in Chapter 6.
D102.2.4 Roof covering. Roof covering in the fire district shall conform to the requirements of Class A or B roof coverings as defined in Section 1505.
D102.2.5 Structural fire rating. Walls, floors, roofs and their supporting structural members shall be not less than 1-hour fire-resistance-rated construction.

Exceptions:

1. Buildings of Type IV-HT construction.
2. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.
3. Automobile parking structures.
4. Buildings surrounded on all sides by a permanently open space of not less than 30 feet (9144 mm).
5. Partitions complying with Section 603.1, Item 11.

AWC proposes this code change as part of a package which, when taken together, as a group, creates the safety and reliability requirements necessary for the regulation of large mass timber (MT) buildings by the Florida Building Code. The following statement was offered by the Ad Hoc Committee on Tall Wood Buildings (TWB) for this proposal (IBC-G152-18) in the ICC Code Development monograph 2018 Group A:

This code change proposal will result in consistency with the purpose and scope which was to leave intact the current Type IV heavy timber provisions. The HT category was created to differentiate the three (3) new categories of "mass timber", where HT represents the long-established heavy timber category that has been in the ICC family of codes, and the predecessor legacy codes for decades.

The Ad Hoc Committee for Tall Wood Buildings (AHC-TWB) was created by the ICC Board of Directors to explore the building science of tall wood buildings with the scope to investigate the feasibility of and act on developing code changes for these buildings. Members of the AHC-TWB were appointed by the ICC Board of Directors. Since its creation in January 2016, the AHC-TWB has held 8 open meetings and numerous Work Group conference calls. Four Work Groups were established to address over 80 issues and concerns and review over 60 code proposals for consideration by the AHC-TWB. Members of the Work Groups included AHC-TWB members and other interested parties. Related documentation and reports are posted on the AHC-TWB website at:

https://www.iccsafe.org/codes-tech-support/cs/icc-ad-hoc-committee-on-tall-wood-buildings/ .

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F10167

Date Submitted	02/10/2022	**Section**	703	**Proponent**	Greg Johnson
Chapter	7	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

Mass timber Type IV package; mods # 10098, 10099, 10161, 10162, 10163, and more

Summary of Modification

Provides requirements for sealing of adjacent mass timber elements.

Rationale

see uploaded rationale

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Where this method of construction is chosen by the owner, inspections of the sealing of mass timber elements will be required. This expense is typically borne by the owner similar to special or third party inspections.

Impact to building and property owners relative to cost of compliance with code

None. This is an optional construction method. Owners can choose not to bear this cost.

Impact to industry relative to the cost of compliance with code

None. This is an optional construction method. Owners can choose not to bear this cost.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This is a fire-resistive construction provision.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Improves the code by supporting a new construction method.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No material is required or prohibited.

Does not degrade the effectiveness of the code

Improves the code by supporting a new construction method.

2nd Comment Period

F10167-G1

Proponent	Greg Johnson	Submitted	8/17/2022 3:43:26 PM	Attachments	No

Comment:

Nothing in the FL Building code prohibits mass timber construction. In fact, Sec. 602.4 provides requirements for mass timber elements, including Sec. 602.4.2 which addresses cross-laminated timber, a form of mass timber. Also, Sec. 104.11, Alternative materials, design and methods of construction and equipment permits AHJs to accept mass timber construction types as an alternate method of construction.. Modification F10167 provides requirements for sealing of adjacent mass timber elements. These provisions should already be available in the FL Building Code for already permissible buildings and those that may be accepted under Sec. 104.11.

2nd Comment Period

F10167-G2

Proponent	Sam Francis	Submitted	8/25/2022 4:20:12 PM	Attachments	No

Comment:

I am recommending this be Accepted as originally submitted. At the first Comment Period hearing, after the TAC voted to deny the first of the Tall Mass Timber proposed modifications and one or two more, no testimony was offered by opponents or supporters to the subsequent proposed modifications. When we reached out to opponents of the mods which were hotly debated, they offered thoughts on those and on subsequent items which received no debate in the first Comment hearing. This modification as proposed was not found contentious. I recommend that the TAC approve the original proposed modification.

2nd Comment Period

F10167-G3

Proponent	Sam Francis	Submitted	8/25/2022 4:39:20 PM	Attachments	No

Comment:

I am recommending this be Accepted as originally submitted. At the first Comment Period hearing, after the TAC voted to deny the first of the Tall Mass Timber proposed modifications and one or two more, no testimony was offered by opponents or supporters to the subsequent proposed modifications. When we reached out to opponents of the mods which were hotly debated, they offered thoughts on those and on subsequent items which received no debate in the first Comment hearing. This modification as proposed was not found contentious. It is another example of important fire safety built into the package of proposals. The ICC Ad Hoc Tall Wood Building committee deemed it an important part of the fire and structural safety being placed into this new type of construction. I recommend that the TAC approve the original proposed modification.

2nd Comment Period

10167-G4

Proponent	ashley ong	Submitted	8/26/2022 3:57:53 PM	Attachments	No

Comment:

Building Officials Association of Florida (BOAF) supports this modification.

703.9 Sealing of adjacent mass timber elements.

In buildings of Types IV-A, IV-B and IV-C construction, sealant or adhesive shall be provided to resist the passage of air in the following locations:

1. At abutting edges and intersections of mass timber building elements required to be fire-resistance rated.
2. At abutting intersections of mass timber building elements and building elements of other materials where both are required to be fire-resistance rated.

Sealants shall meet the requirements of ASTM C920. Adhesives shall meet the requirements of ASTM D3498.

Exception: Sealants or adhesives need not be provided where they are not a required component of a tested fire-resistance-rated assembly.

Rationale: Sec. 703.9 Sealing of adjacent mass timber elements

AWC proposes this code change as part of a package which, when taken together, as a group, creates the safety and reliability requirements necessary for the regulation of large mass timber (MT) buildings by the Florida Building Code. The following statement was offered by the Ad Hoc Committee on Tall Wood Buildings (TWB) for this proposal (IBC-FS6-18, S100) in the ICC Code Development monograph 2018 Group A:

The Ad Hoc Committee on Tall Wood Buildings (TWB) was created by the ICC Board to explore the science of tall wood buildings and take action on developing code changes for tall wood buildings. The TWB has created several code change proposals with respect to the concept of tall buildings of mass timber and the background information is at the end of this Statement. Within the statement are important links to information, including documents and videos, used in the deliberations which resulted in these proposals.

Mass timber has inherent properties of fire resistance, serving both to provide structural fire resistance and to safeguard against the spread of fire and smoke within a building or the spread of fire between structures.

When mass timber panels are connected together, fire tests have demonstrated that it is important for the abutting edges and intersections in the plane of and between the different planes of panels that form a separation to be sealed. The structures tested as part of the fire tests supporting this submittal were constructed with this sealing.

To review a summary of the fire tests, please visit: http://bit.ly/ATF-firetestreport

To watch summary videos of the fire tests, which are accelerated to run in 3-1/2 minutes each, please visit: http://bit.ly/ATF-firetestvideos.

Both of these links were confirmed active on 1/14/22.

The US CLT manual recommends a bead of construction adhesive. Construction adhesive or other sealant can be used to prevent air flow. When a wall or horizontal assembly serves as the separation between two atmospheres, a fire creates differential pressure where heated gasses raise the pressure and work to drive fire and hot gasses through the structure. Voids that are not properly sealed can serve as a conduit for air movement during a fire, so abutting edges and intersections are recommended to be sealed.

Periodic inspections during construction are required to make that the appropriate sealant or adhesive is used and to establish inspections to verify for ongoing quality control.

Some panels are manufactured under proprietary processes to ensure there are no voids at these intersections.

Where this proprietary process is incorporated and tested, there is no requirement for sealant or adhesive and an exception is provided for this instance. Where the sealant is not required and is not specifically excluded it is still considered to be a good practice covered by this section.

This code change proposal does not apply to “joints” as defined in Section 202 of the IBC as joints have their own requirements for the placement and inspection of fire resistant joint systems in IBC Section 715. Joints are defined as having an opening that is designed to accommodate building tolerances or to allow independent movement. Panels and members that are connected together as covered by this code change proposal do not meet the definition of a joint since they are rigidly connected and do not have an opening.

The Ad Hoc Committee for Tall Wood Buildings (AHC-TWB) was created by the ICC Board of Directors to explore the building science of tall wood buildings with the scope to investigate the feasibility of and take action on developing code changes for these buildings. Members of the AHC-TWB were appointed by the ICC Board of Directors. Since its creation in January 2016, the AHC-TWB has held 8 open meetings and numerous Work Group conference calls. Four Work Groups were established to address over 80 issues and concerns and review over 60 code proposals for consideration by the AHC-TWB. Members of the Work Groups included AHC-TWB members and other interested parties. Related documentation and reports are posted on the AHC-TWB website at

https://www.iccsafe.org/codes-tech-support/cs/icc-ad-hoc-committee-on-tall-wood-buildings/ .

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F10169

Date Submitted	02/10/2022	**Section**	722	**Proponent**	Greg Johnson
Chapter	7	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

Mass timber Type IV package; mods 10098, 10099, 10161, 10163, 10167 and more

Summary of Modification

Prescriptive method of determining required fire protection of mass timber elements

Rationale

See uploaded rationale

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None; no additional inspection or plan review is required.

Impact to building and property owners relative to cost of compliance with code

None; this is an optional construction method. the owner can choose not to incur this cost.

Impact to industry relative to the cost of compliance with code

None; this is an optional construction method. the owner can choose not to incur this cost.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This is a fire-resistant construction provision.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Improves the code by supporting a new construction option.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No material is required or prohibited by this change.

Does not degrade the effectiveness of the code

Improves the code by supporting a new construction option.

2nd Comment Period

F10169-G1

Proponent Greg Johnson Submitted 8/17/2022 3:36:43 PM Attachments No

Comment:

Nothing in the FL Building code prohibits mass timber construction. In fact, Sec. 602.4 provides requirements for mass timber elements, including Sec. 602.4.2 which addresses cross-laminated timber, a form of mass timber. Modification F10169 provides a prescriptive path for determining the time contribution of noncombustible protection to mass timber fire resistance. These provisions should already be available in the FL Building Code for already permissible buildings and those that may be accepted under Sec. 104.11, Alternative materials, design and methods of construction and equipment.

2nd Comment Period

F10169-G2

Proponent Sam Francis Submitted 8/25/2022 4:12:36 PM Attachments No

Comment:

At the first Comment Period hearing, after the TAC voted to deny the first of the Tall Mass Timber and one or two more proposed modifications , no testimony was offered by opponents or supporters to the subsequent proposed modifications. When we reached out to opponents of the mods which were hotly debated, they offered thoughts on those and on subsequent items which received no debate in the first Comment hearing. This proposal constitutes a “prescriptive path” for compliance with all the mass timber requirements. It is complete, including screw size and spacing, stagger of joints, covering of screws, etc.. This compliments the more performance oriented path in Chapters 6, 7 and 14. I strongly urge the TAC approve the MOD as originally submitted.

2nd Comment Period

F10169-G3

Proponent ashley ong Submitted 8/26/2022 3:57:13 PM Attachments No

Comment:

Building Officials Association of Florida (BOAF) supports this modification.

722.7.1 Minimum required protection. Where required by Sections 602.4.1 through 602.4.3, noncombustible protection shall be provided for mass timber building elements in accordance with Table 722.7.1(1). The rating, in minutes, contributed by the noncombustible protection of mass timber building elements, components or assemblies, shall be established in accordance with Section 703.6. The protection contributions indicated in Table 722.7.1(2) shall be deemed to comply with this requirement where installed and fastened in accordance with Section 722.7.2.

-

TABLE 722.7.1(1)

PROTECTION REQUIRED FROM NONCOMBUSTIBLE COVERING MATERIAL

REQUIRED FIRE-RESISTANCE RATING OF BUILDING ELEMENT PER Table 601 AND Table 705.5 (hours)	MINIMUM PROTECTION REQUIRED FROM NONCOMBUSTIBLE PROTECTION (minutes)
1	40
2	80
3 or more	120

-

TABLE 722.7.1(2)

PROTECTION PROVIDED BY NONCOMBUSTIBLE COVERING MATERIAL

-

NONCOMBUSTIBLE PROTECTION	PROTECTION CONTRIBUTION (minutes)
1/2-inch Type X gypsum board	25
5/8-inch Type X gypsum board	40

-

-

-

722.7.2 Installation of gypsum board noncombustible protection. Gypsum board complying with Table 722.7.1(2) shall be installed in accordance with this section.

-

722.7.2.1 Interior surfaces. Layers of Type X gypsum board serving as noncombustible protection for interior surfaces of wall and ceiling assemblies determined in accordance with Table 722.7.1(1) shall be installed in accordance with the following:

1. Each layer shall be attached with Type S drywall screws of sufficient length to penetrate the mass timber at least 1 inch (25 mm) when driven flush with the paper surface of the gypsum board.
Exception: The third layer, where determined necessary by Section 722.7, shall be permitted to be attached with 1-inch (25 mm) No. 6 Type S drywall screws to furring channels in accordance with AISI S220.
2. Screws for attaching the base layer shall be 12 inches (305 mm) on center in both directions.
3. Screws for each layer after the base layer shall be 12 inches (305 mm) on center in both directions and offset from the screws of the previous layers by 4 inches (102 mm) in both directions.
4. All panel edges of any layer shall be offset 18 inches (457 mm) from those of the previous layer.
5. All panel edges shall be attached with screws sized and offset as in Items 1 through 4 and placed at least 1 inch (25 mm) but not more than 2 inches (51 mm) from the panel edge.

6. All panels installed at wall-to-ceiling intersections shall be installed such that ceiling panels are installed first and the wall panels are installed after the ceiling panel has been installed and is fitted tight to the ceiling panel. Where multiple layers are required, each layer shall repeat this process.
7. All panels installed at a wall-to-wall intersection shall be installed such that the panels covering an exterior wall or a wall with a greater fire-resistance rating shall be installed first and the panels covering the other wall shall be fitted tight to the panel covering the first wall. Where multiple layers are required, each layer shall repeat this process.
8. Panel edges of the face layer shall be taped and finished with joint compound. Fastener heads shall be covered with joint compound.
9. Panel edges protecting mass timber elements adjacent to unprotected mass timber elements in accordance with Section 602.4.2.2 shall be covered with 11/4-inch (32 mm) metal corner bead and finished with joint compound.

722.7.2.2 Exterior surfaces. Layers of Type X gypsum board serving as noncombustible protection for the outside of the exterior mass timber walls determined in accordance with Table 722.7.1(1) shall be fastened 12 inches (305 mm) on center each way and 6 inches (152 mm) on center at all joints or ends. All panel edges shall be attached with fasteners located at least 1 inch (25 mm) but not more than 2 inches (51 mm) from the panel edge. Fasteners shall comply with one of the following:

1. Galvanized nails of minimum 12 gage with a 7/16-inch (11 mm) head of sufficient length to penetrate the mass timber a minimum of 1 inch (25 mm).
2. Screws that comply with ASTM C1002 (Type S, W or G) of sufficient length to penetrate the mass timber a minimum of 1 inch (25 mm).

Sec. 722 fire protection of mass timber

AWC proposes this code change as part of a package which, when taken together, as a group, creates the safety and reliability requirements necessary for the regulation of large mass timber (MT) buildings by the Florida Building Code. The following statement was offered by the Ad Hoc Committee on Tall Wood Buildings (TWB) for this proposal (IBC-FS81-18) in the ICC Code Development monograph 2018 Group A:

The Ad Hoc Committee on Tall Wood Buildings (TWB) was created by the ICC Board to explore the science of tall wood buildings and take action on developing code changes for tall wood buildings. The TWB has created several code change proposals with respect to the concept of tall buildings of mass timber and the background information is at the end of this Statement. Within the statement are important links to information, including documents and videos, used in the deliberations which resulted in these proposals.

Typically, mass timber elements will be large due to structural requirements. In addition, CLT panels typically are utilized in odd number laminations. This typically results in excess capacity which means better fire endurance. Thus, mass timber elements are conservative in their fire resistance rating. Furthermore, the TWB decided to provide both a prescriptive path, as embodied in this proposal, and a performance path, embodied in another proposal.

This proposal outlines a method to calculate the fire resistance rating of a protected wood element by adding the fire resistance rating of the unprotected wood member together with the protection time provided by the noncombustible protection applied to the exposed wood.

This proposal should be considered as a companion proposal to the proposals creating new types of mass timber construction in Section 602.4 and the code proposal for Section 703.8 outlining a testing protocol to determine the contribution of noncombustible protection. This code proposal allows the user to select a prescriptive solution utilizing Type X gypsum wall board, which is deemed to comply with the basic requirements of this section and those of the proposed Section 602.4. Since this is a prescriptive solution, conditions of use such as attachment, finishing and edge treatment when bordering exposed mass timber areas, are also included in this section.

A proposal in Section 703.8 both forms the performance path for this determination and is the basis by which the contribution of the Noncombustible Protection to the fire resistance rating is determined. Testing of beams, columns, walls and ceiling panels has been used to establish the values found in table 722.7.1(b) for 1/2-inch Type X and 5/8-inch Type X gypsum board as well. Recent testing by AWC confirms the values derived from historic testing. A report is available at the following link: http://bit.ly/WFC-firetestofGWBonCLT . This link was confirmed active on 02-10-2022.

Tests proposed in Section 703.8 may be used in the future to justify additional materials added to this table and should not be confused with “membrane protection” which is based on temperature rise on the unexposed side of a membrane attached to construction elements. Noncombustible construction is, instead, noncombustible material meeting the requirements of Section 703.5. Its contribution to the fire resistance rating of any building element is determined by this proposed new section. Simply put, it is determined by measuring the fire resistance time in minutes to the point of structural failure of a mass timber building element and then conducting a second test measuring the fire resistance time in minutes taken to the same point of structural failure. Each test is to be conducted with identical mass timber element with identical load, construction and condition, but with the proposed noncombustible protection applied to the second assembly. The difference in time between the two samples is the contribution, in minutes, of the noncombustible protection.

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F10461

Date Submitted	02/15/2022	**Section**	707.8	**Proponent**	Richard Walke
Chapter	7	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

ICC FS43-21

Summary of Modification

The Firestop Contractors International Association Requests Expansion of Applications Where Joints Adjacent to Fire Barriers Require Protection

Rationale

This proposal replicates a proposal which was submitted by the Fire Code Action Committee during the current ICC Code Development Cycle under Proposal No. FS43-21. FS43-21 was approved by the Committee at the Committee Action Hearing by a vote of 11-2. Subsequently there were no public comments so the above language is what will appear in the 2024 IBC. This proposal clarifies the requirements to protect joints apply to the intersection of fire barriers and all other fire-resistance-rated wall assemblies (e.g. a smoke barrier wall) and not solely to exterior wall assemblies. As revised, this Section addresses only fire-resistance-rated walls. Intersections with nonfire-resistance-rated wall assemblies are covered in Section 707.9. FCIA believes this code change is significant enough to warrant consideration by the Florida Building Commission for inclusion in the 2023 FBC. We request your approval of this proposal so as to include the latest language for this provision in the 2023 FBC.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

This proposal will increase the number of fire-resistant joints systems in a building and as such, increase the cost of inspections by the local entity.

Impact to building and property owners relative to cost of compliance with code

This proposal will increase the number of fire-resistant joints systems in a building and as such, increase the cost of construction for the building and property owners.

Impact to industry relative to the cost of compliance with code

This proposal will have no impact to industry.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This proposal reduces the risk to occupants by increasing the scope of joints which require protection.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposal strengthens the code by increasing the scope of joints which require protection.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposal does not discriminate against any materials, products, methods, or systems of construction.

Does not degrade the effectiveness of the code

This proposal strengthens the code by increasing the scope of joints which require protection.

2nd Comment Period

10461-G1

Proponent	Joe Bigelow	Submitted	9/1/2022 3:03:02 PM	Attachments	Yes

Comment:

Submitted by Staff on behalf of the Commenter due to verified system glitch

Revise as follows:

707.8 Joints.

Joints made in or between *fire barriers*, and joints made at the intersection of *fire barriers* with the underside of a fire-resistance-rated floor or roof sheathing, slab or deck above, and ~~the exterior vertical wall intersection 715~~with other fire-resistance-rated wall assemblies shall comply with Section 715.

August 26, 2022

Proposed Change to the 2023 Florida Building Code

F10461 – Joint Systems Required Between All Rated Walls

Original Proposal:

707.8 Joints.

Joints made in or between *fire barriers*, and joints made at the intersection of *fire barriers* with the underside of a fire-resistance-rated floor or roof sheathing, slab or deck above, and ~~the exterior vertical wall intersection 715~~with other fire-resistance-rated wall assemblies shall comply with Section 715.

Original Reason Statement:

This proposal replicates a proposal which was submitted by the Fire Code Action Committee during the current ICC Code Development Cycle under Proposal No. FS43-21. FS43-21 was approved by the Committee at the Committee Action Hearing by a vote of 11-2. Subsequently there were no public comments so the above language is what will appear in the 2024 IBC.

This proposal clarifies the requirements to protect joints apply to the intersection of fire barriers and all other fire-resistance-rated wall assemblies (e.g. a smoke barrier wall) and not solely to exterior wall assemblies.

As revised, this Section addresses only fire-resistance-rated walls. Intersections with nonfire-resistance-rated wall assemblies are covered in Section 707.9.

FCIA believes this code change is significant enough to warrant consideration by the Florida Building Commission for inclusion in the 2023 FBC. We request your approval of this proposal so as to include the latest language for this provision in the 2023 FBC.

Public Comment:

As the proponent of F10461, I would like to request reconsideration of the TAC's recommendation for Denial. In my opinion, the decision was made based on an incorrect assumption of the meaning of existing language of Sections 707.8 and 707.9 of the 2020 FBC.

This modification replicates a proposal which was Approved as Submitted by ICC under Proposal No. FS43-21 and as such, reflects the 2024 IBC language.

The current 2020 FBC language is confusing at best. The confusion is two-fold. First, it relates to whether the phrase "fire-resistance-rated" in Section 707.8 applies to **both** the "floor or roof sheathing, slab or deck above, **and** the exterior vertical wall", or **just** the "floor or roof sheathing, slab or deck above". Second, it relates to what is a joint versus a void. During their deliberation, the TAC reached the conclusion that the phrase "fire-resistance-rated" only applies to the "floor or roof sheathing, slab or deck above". As

August 26, 2022

Proposed Change to the 2023 Florida Building Code

F10461 – Joint Systems Required Between All Rated Walls

Original Proposal:

707.8 Joints.

Joints made in or between *fire barriers*, and joints made at the intersection of *fire barriers* with the underside of a fire-resistance-rated floor or roof sheathing, slab or deck above, and ~~the exterior vertical wall intersection 715~~with other fire-resistance-rated wall assemblies shall comply with Section 715.

Original Reason Statement:

This proposal replicates a proposal which was submitted by the Fire Code Action Committee during the current ICC Code Development Cycle under Proposal No. FS43-21. FS43-21 was approved by the Committee at the Committee Action Hearing by a vote of 11-2. Subsequently there were no public comments so the above language is what will appear in the 2024 IBC.

This proposal clarifies the requirements to protect joints apply to the intersection of fire barriers and all other fire-resistance-rated wall assemblies (e.g. a smoke barrier wall) and not solely to exterior wall assemblies.

As revised, this Section addresses only fire-resistance-rated walls. Intersections with nonfire-resistance-rated wall assemblies are covered in Section 707.9.

FCIA believes this code change is significant enough to warrant consideration by the Florida Building Commission for inclusion in the 2023 FBC. We request your approval of this proposal so as to include the latest language for this provision in the 2023 FBC.

Public Comment:

As the proponent of F10461, I would like to request reconsideration of the TAC's recommendation for Denial. In my opinion, the decision was made based on an incorrect assumption of the meaning of existing language of Sections 707.8 and 707.9 of the 2020 FBC.

This modification replicates a proposal which was Approved as Submitted by ICC under Proposal No. FS43-21 and as such, reflects the 2024 IBC language.

The current 2020 FBC language is confusing at best. The confusion is two-fold. First, it relates to whether the phrase "fire-resistance-rated" in Section 707.8 applies to **both** the "floor or roof sheathing, slab or deck above, **and** the exterior vertical wall", or **just** the "floor or roof sheathing, slab or deck above". Second, it relates to what is a joint versus a void. During their deliberation, the TAC reached the conclusion that the phrase "fire-resistance-rated" only applies to the "floor or roof sheathing, slab or deck above". As such, their conclusion was the need to protect the joint between the fire barrier and a non-rated exterior wall was being removed from the code. That is not the case. Within Chapter 7, a joint is a linear opening in or between rated construction, and a void is a linear opening between a rated and non-rated construction. So Section 707.9, covering voids, directly addresses the need to protect the fire barrier / non-rated exterior wall assembly intersection.

Having clarified that, the net impact of this modification is to require joints between fire barriers and all other fire-resistance-rated wall assemblies, included rated exterior walls to be protected. For example, the joint between a fire barrier and a smoke barrier. The required protection based on Section 715.2 is a fire-resistant joint system tested to ASTM E1966 or UL 2079. And to be clear, the scope of both these standards covers rated-to-rated construction.

The Firestop Contractors International Association believes this code change is significant enough to warrant consideration for inclusion in the 2023 FBC. We request your approval of this modification so as to require protection of all joints between rated-to-rated construction in the 2023 FBC.

Thank you.

NOTE:

The language of the modification has an extraneous “715” in the text being deleted. Since it is being deleted, do not bother to submit modified language as part of this Public Comment. It will only confuse the committee.

such, their conclusion was the need to protect the joint between the fire barrier and a non-rated exterior wall was being removed from the code. That is not the case. Within Chapter 7, a joint is a linear opening in or between rated construction, and a void is a linear opening between a rated and non-rated construction. So Section 707.9, covering voids, directly addresses the need to protect the fire barrier / non-rated exterior wall assembly intersection.

Having clarified that, the net impact of this modification is to require joints between fire barriers and all other fire-resistance-rated wall assemblies, included rated exterior walls to be protected. For example, the joint between a fire barrier and a smoke barrier. The required protection based on Section 715.2 is a fire-resistant joint system tested to ASTM E1966 or UL 2079. And to be clear, the scope of both these standards covers rated-to-rated construction.

The Firestop Contractors International Association believes this code change is significant enough to warrant consideration for inclusion in the 2023 FBC. We request your approval of this modification so as to require protection of all joints between rated-to-rated construction in the 2023 FBC.

Thank you.

NOTE:

The language of the modification has an extraneous “715” in the text being deleted. Since it is being deleted, do not bother to submit modified language as part of this Public Comment. It will only confuse the committee.

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F10512

23

Date Submitted	02/15/2022	**Section**	704.6.1	**Proponent**	Richard Walke
Chapter	7	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

ICC FS8-18, FS11-21 and FBC Modification No. F9238

Summary of Modification

The National Fireproofing Contractors Association Requests Further Changes to new Section 704.6.1 Developed under FBC Modification No. F9238

Rationale

A new Section 704.6.1 was added to the 2021 International Building Code (IBC) based on Proposal No. FS8-18. The original intent of the FS8-18 proposal was to address secondary non-structural tubular steel attachments to the primary and secondary structural steel members. Through the code development process, the provisions of this new section were expanded to cover all secondary steel attachments to the primary and secondary structural steel members. Now that the 2021 IBC is being adopted, this provision is proving to be problematic. It is being interpreted that any attachment to the primary and secondary steel members require protection. This includes threaded rod hangers secured using beam clamps, Unistrut®, and even acoustical ceiling hanger wires. Clearly that was not the intent. The National Fireproofing Contractors Association submitted Proposal No. F11-21 during the Group A cycle of the current ICC 2021-2022 Code Development Cycle to clarify Section 704.6.1. The language contained in this proposal reflects what was approved by the Committee at the Committee Action Hearing with a vote of 13-0. Subsequently there were no public comments so the above language is what will appear in the 2024 IBC. The Florida Building Commission has approved F9238/FS8-18 which incorporates the language from the 2021 IBC. If approved, we believe this would be problematic in the state of Florida, as it has been elsewhere. As such this proposal is intended to jump ahead to the language already approved for inclusion in the 2024 IBC. We request your approval of this proposal so as to present an all-inclusive list of attachments requiring protection. We request your approval of this proposal so as to include the latest language for this provision in the 2023 FBC.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

This proposal will now require the inspection of the protection applied to structural steel members attached to the primary or secondary steel frame.

Impact to building and property owners relative to cost of compliance with code

Since this proposal will now require protection of structural steel members attached to the primary or secondary steel frame, there will be additional costs. However, the additional cost will be minimal since only 12 in. of protection is required.

Impact to industry relative to the cost of compliance with code

There will be no impact to the industry.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This proposal strengthens the life safety provisions of the code with respect to protection required for attachments to primary and secondary structural steel members.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposal strengthens the code by requiring structural steel attachments to primary and secondary structural steel members to be protected.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposal does not discriminate against any materials.

Does not degrade the effectiveness of the code

This proposal does not degrade the code.

2nd Comment Period

F10512-G1

Proponent	Joe Bigelow	Submitted	9/1/2022 3:03:37 PM	Attachments	Yes

Comment:

Submitted by Staff on behalf of the Commenter due to verified system glitch

Revise new Section 704.6.1 developed under Modification No. 9238 as follows:

704.6.1 Secondary attachments to structural members. Where primary and secondary structural steel members require fire protection, ~~secondary steel attachments to those structural members~~ any additional structural steel members having direct connection to the primary structural frame or secondary structural members shall be protected with the same fire-resistive material and thickness as required for the structural member. The protection shall extend away from the structural member a distance of not less than 12 inches (305 mm), or shall be applied to the entire length where the attachment is less than 12 inches (305 mm) long. Where an attachment is hollow and the ends are open, the fire-resistive material and thickness shall be applied to both exterior and interior of the hollow steel attachment.

August 26, 2022

Proposed Change to the 2023 Florida Building Code
F10512 – Structural Attachments

Original Proposal:

Add new text as follows:

704.6.1 Secondary attachments to structural members. Where primary and secondary structural steel members require fire protection, ~~secondary steel attachments to those structural members~~ any additional structural steel members having direct connection to the primary structural frame or secondary structural members shall be protected with the same fire-resistive material and thickness as required for the structural member. The protection shall extend away from the structural member a distance of not less than 12 inches (305 mm), or shall be applied to the entire length where the attachment is less than 12 inches (305 mm) long. Where an attachment is hollow and the ends are open, the fire-resistive material and thickness shall be applied to both exterior and interior of the hollow steel attachment.

Original Reason Statement:

A new Section 704.6.1 was added to the 2021 International Building Code (IBC) based on Proposal No. FS8-18. The original intent of the FS8-18 proposal was to address secondary non-structural tubular steel attachments to the primary and secondary structural steel members. Through the code development process, the provisions of this new section were expanded to cover all secondary steel attachments to the primary and secondary structural steel members.

Now that the 2021 IBC is being adopted, this provision is proving to be problematic. It is being interpreted that any attachment to the primary and secondary steel members requires protection. This includes threaded rod hangers secured using beam clamps, Unistrut®, and even acoustical ceiling hanger wires. Clearly that was not the intent.

The National Fireproofing Contractors Association submitted Proposal No. FS11-21 during the Group A cycle of the current ICC 2021-2022 Code Development Cycle to clarify Section 704.6.1. The language contained in this proposal reflects what was approved by the Committee at the Committee Action Hearing with a vote of 13-0. Subsequently there were no public comments so the above language is what will appear in the 2024 IBC.

The Florida Building Commission has approved F9238/FS8-18 which incorporates the language from the 2021 IBC. If approved, we believe this would be problematic in the state of Florida, as it has been elsewhere. As such this proposal is intended to jump ahead to the language already approved for inclusion in the 2024 IBC.

We request your approval of this proposal so as to include the latest language for this provision in the 2023 FBC.

August 26, 2022

Proposed Change to the 2023 Florida Building Code
F10512 – Structural Attachments

Original Proposal:

Add new text as follows:

704.6.1 Secondary attachments to structural members. Where primary and secondary structural steel members require fire protection, ~~secondary steel attachments to those structural members~~ any additional structural steel members having direct connection to the primary structural frame or secondary structural members shall be protected with the same fire-resistive material and thickness as required for the structural member. The protection shall extend away from the structural member a distance of not less than 12 inches (305 mm), or shall be applied to the entire length where the attachment is less than 12 inches (305 mm) long. Where an attachment is hollow and the ends are open, the fire-resistive material and thickness shall be applied to both exterior and interior of the hollow steel attachment.

Original Reason Statement:

A new Section 704.6.1 was added to the 2021 International Building Code (IBC) based on Proposal No. FS8-18. The original intent of the FS8-18 proposal was to address secondary non-structural tubular steel attachments to the primary and secondary structural steel members. Through the code development process, the provisions of this new section were expanded to cover all secondary steel attachments to the primary and secondary structural steel members.

Now that the 2021 IBC is being adopted, this provision is proving to be problematic. It is being interpreted that any attachment to the primary and secondary steel members requires protection. This includes threaded rod hangers secured using beam clamps, Unistrut®, and even acoustical ceiling hanger wires. Clearly that was not the intent.

The National Fireproofing Contractors Association submitted Proposal No. FS11-21 during the Group A cycle of the current ICC 2021-2022 Code Development Cycle to clarify Section 704.6.1. The language contained in this proposal reflects what was approved by the Committee at the Committee Action Hearing with a vote of 13-0. Subsequently there were no public comments so the above language is what will appear in the 2024 IBC.

The Florida Building Commission has approved F9238/FS8-18 which incorporates the language from the 2021 IBC. If approved, we believe this would be problematic in the state of Florida, as it has been elsewhere. As such this proposal is intended to jump ahead to the language already approved for inclusion in the 2024 IBC.

We request your approval of this proposal so as to include the latest language for this provision in the 2023 FBC.

Public Comment:

As the original proponent of F10512, I would like to request reconsideration of the TAC's recommendation for Denial. This modification was submitted to address a real-world problem that is occurring in jurisdictions now using the 2021 IBC.

New Section 704.6.1 was added to the 2021 IBC based on Proposal No. FS8-18. The original intent of FS8-18 was to require protection of secondary non-structural tubular steel attachments to the primary and secondary structural steel members. Through the code development process, the provisions of this new section were expanded to cover all secondary steel attachments to the primary and secondary structural steel members.

Now that the 2021 IBC is being adopted, Section 704.6.1 is proving problematic. The phrase "secondary steel attachments" is not defined or understood by the code users. It is being interpreted as any attachment to the primary and secondary steel members including threaded rod secured using beam clamps, Unistrut®, and even acoustical ceiling hanger wires. That was not the intent of FS8-18.

This modification replicates a proposal which was Approved as Submitted by ICC under Proposal No. FS11-21 and as such, reflects the 2024 IBC language.

In my opinion, the Technical Advisory Committee's denial of this modification in June was due to a misunderstanding of what was being proposed. During the committee discussion, the concern was the need to protect structural items is being deleted. That is not the case. The new language replacing the deleted text states "any additional structural steel members having direct attachment to the primary structural frame or secondary structural members shall be protected". So the net impact of this modification is to clarify that the phase "secondary steel attachments" means "structural steel members". As such, it directly addresses what the committee thought was needed.

The NFCA strongly suggests the Florida Building Commission follow ICC's lead and approve F10512 in order to avoid the confusion which is now occurring in other parts of the country where the 2021 IBC has been adopted.

Thank you.

NOTE:

No changes in the text of the modification are needed.

Public Comment:

As the original proponent of F10512, I would like to request reconsideration of the TAC's recommendation for Denial. This modification was submitted to address a real-world problem that is occurring in jurisdictions now using the 2021 IBC.

New Section 704.6.1 was added to the 2021 IBC based on Proposal No. FS8-18. The original intent of FS8-18 was to require protection of secondary non-structural tubular steel attachments to the primary and secondary structural steel members. Through the code development process, the provisions of this new section were expanded to cover all secondary steel attachments to the primary and secondary structural steel members.

Now that the 2021 IBC is being adopted, Section 704.6.1 is proving problematic. The phrase "secondary steel attachments" is not defined or understood by the code users. It is being interpreted as any attachment to the primary and secondary steel members including threaded rod secured using beam clamps, Unistrut®, and even acoustical ceiling hanger wires. That was not the intent of FS8-18.

This modification replicates a proposal which was Approved as Submitted by ICC under Proposal No. FS11-21 and as such, reflects the 2024 IBC language.

In my opinion, the Technical Advisory Committee's denial of this modification in June was due to a misunderstanding of what was being proposed. During the committee discussion, the concern was the need to protect structural items is being deleted. That is not the case. The new language replacing the deleted text states "any additional structural steel members having direct attachment to the primary structural frame or secondary structural members shall be protected". So the net impact of this modification is to clarify that the phase "secondary steel attachments" means "structural steel members". As such, it directly addresses what the committee thought was needed.

The NFCA strongly suggests the Florida Building Commission follow ICC's lead and approve F10512 in order to avoid the confusion which is now occurring in other parts of the country where the 2021 IBC has been adopted.

Thank you.

NOTE:

No changes in the text of the modification are needed.

Code Change No: FS8-18

Original Proposal

Section(s): 704.6.1 (New)

Proponents: Crystal Sujeski, representing Crystal Sujeski (crystal.sujeski@fire.ca.gov)

2018 International Building Code

704.6 Attachments to structural members. The edges of lugs, brackets, rivets and bolt heads attached to structural members shall be permitted to extend to within 1 inch (25 mm) of the surface of the fire protection.

Add new text as follows:

704.6.1 Secondary (non-structural) attachments to structural members. Where primary and secondary structural steel members require fire protection, secondary (non-structural) tubular steel attachments to those structural members shall be protected with the same fire resistive rating as required for the structural member. The protection shall extend from the structural member a distance of not less than 12 inches. An open tubular attachment shall be filled with an equivalent fire protection method for a distance of 12-inch length from the structural member, or the entire length of the open tube, whichever is less.

Reason: Primary structural frame members shall comply with Table 601 for fire resistance rating. Secondary (non-structural) steel tubes provide support for a building's exterior curtain wall and are thereby considered to be unrated members that do not require any fire protection. The connection of non-structural tubes to primary structural members has potentially adverse thermal effects on the required fire resistance rating of the primary steel frame members.

Building attachments for miscellaneous non-structural items (hangers, braces, framing tracks, erection lifting lugs, wall supports, etc.) are typically not required to be individually fire protected. In addition, fire resistance rated assemblies are tested without attachments, and with a homogeneous and continuous protection system or material. Thus, rated assemblies are explicitly limited to only the tested or approved components given in the published listing, which does not include bare steel attachments or discontinuous member protection. If such secondary steel attachments are connected to a fire resistance rated steel assembly, they may jeopardize the assembly's rating and protection system by the introduction of "thermal shorts", which can cause unexpected and excessive heat conduction, convection, or radiation through the attachment or its connection to the primary assembly.

The proposal to require a 12-inch extension of fireproofing on all non-structural attachments is based on a general industry practice as described in ANSI/UL 263 BXUV (exhibit C). Attached in the documentation is exhibit A, a letter from Steve Unser, a chief building official from the City of Creve Coeur, MO stating a policy to address the "12- inch rule" of fireproofing structural attachments to fireproofed beams and columns.

Moreover, in cases where an open tubular steel connection is utilized it is vital that the interior surfaces of the tube walls are fireproofed and the bottom ends of the tubes are closed. Without this protection, this condition results in bare (unprotected) steel areas at the attachment that could be directly exposed to radiant and convective heat from a fire source.

Attached (exhibit B1 and B2) is a modeling analysis of a high-rise project in Stockton, CA prepared by Jensen Hughes Senior Engineers Nestor Iwankiw and Thomas Forsythe. Their analysis further supports the proposed code change that would require fire proofing of secondary non-structural attachments.

Under the current code, fire-proofing requirements for non-structural attachments and their connections remain ambiguous. This lack of clarity makes fire protection enforcement difficult due to increased construction costs for contractors, builders and owners. Furthermore, special inspectors, fire and building officials are not taught to look for these deficiencies, resulting in numerous buildings with unprotected steel that can potentially have serious implications on public safety and welfare.

The proposal establishes a legal basis for requiring the additional fire protection as described herein.
The 'attached' documentation can be viewed at this link established 2/21/18
https://www.dropbox.com/sh/t0hlmrxf63gejfh/AABEvqgYih_QPK928kuUwazKa?dl=0

Cost Impact: The code change proposal will increase the cost of construction
This code change will increase the cost of construction; however, without additional fire protection the structural integrity of the building may be compromised.

Report of Committee Action Hearings

Committee Action: **Approved as Modified**

Committee Modification:

704.6.1 Secondary ~~(non-structural)~~ attachments to structural members. Where primary and secondary structural steel members require fire protection, secondary ~~(non-structural)~~ tubular steel attachments to those structural members shall be protected with the same fire resistive ~~rating~~ material and thickness as required for the structural member. The protection shall extend away from the structural member a distance of not less than 12 inches, or shall be applied to the entire length when the attachment is less than 12 inches long. ~~An~~ When the ends are open, the fire resistive material and thickness shall be applied to both exterior and interior of the tubular steel attachment. ~~shall be filled with an equivalent fire protection method for a distance of 12-inch length from the structural member, or the entire length of the open tube, whichever is less.~~

Committee Reason: The modification refines the language to better reflect the intent of the proposal. The change clarifies an area of framing and the appropriate level of protection. Structural tubing has been a question of the years and there is evidence of heat transferring into the structure from such tubing. Perhaps a public comment expanding this solution to other attachments of shapes other than tubular. (Vote 11-3)

Assembly Action: **None**

Public Comments

Public Comment 1:

Crystal Sujeski, representing Crystal Sujeski (crystal.sujeski@fire.ca.gov) requests As Modified by Public Comment

Modify as follows:

2018 International Building Code

704.6.1 Secondary attachments to structural members. Where primary and secondary structural members require fire protection, secondary ~~tubular~~ steel attachments to those structural members shall be protected with the same fire resistive material and thickness as required for the structural member. The protection shall extend away from the structural member a distance of not less than 12 inches, or shall be applied to the entire length when the attachment is less than 12 inches long. When an attachment is hollow and the ends are open, the fire resistive material and thickness shall be applied to both the exterior and interior of the ~~tubular~~ hollow steel attachment.

Commenter's Reason: This public comment has modified the proposal FS-8 to address the committee comments to expand the requirements for fire protection to be all inclusive of secondary steel attachments and not just limited to tubular steel.

Cost Impact: The net effect of the public comment and code change proposal will increase the cost of construction
The cost of construction will be increased minimally, however without additional fire protection the structural integrity of the building may be compromised.

Final Action

FS8-18 **AMPC1**

FS11-21

IBC: 704.6.1

Proponents: Bill McHugh, representing National Fireproofing Contractors Association (billmchugh-jr@att.net)

2021 International Building Code

Revise as follows:

704.6.1 Secondary attachments to structural members. Where primary and secondary structural steel members require fire protection, secondary tubular steel attachments to those structural members shall be protected with the same fire-resistive material and thickness as required for the structural member. The protection shall extend away from the structural member a distance of not less than 12 inches (305 mm), or shall be applied to the entire length where the attachment is less than 12 inches (305 mm) long. Where an attachment is hollow and the ends are open, the fire-resistive material and thickness shall be applied to both exterior and interior of the hollow steel attachment.

Reason Statement: We applaud the proponent that added this new section for fire-resistance-rated protection of secondary steel attachments to structural steel building elements. While we supported the original proposal that dealt with only tubular steel secondary attachments, we believe the approved Public Comment far exceeds the 2018/2019 Fire Safety Committee's Action to protect only tubular - substantial attachments - to the secondary structural frame. It extends the protection to ANY steel attachments to the primary and secondary structural frame of the building. The new code language means that thin hanger wire that holds up ceiling grid and other items such as ½" or less threaded rod that also holds up items above ceilings must be protected with fire-resistive materials of thickness equal to or greater than the attachments.

Experts in fire resistance testing from a major testing laboratory and suspended ceiling manufacturer have stated "heat transfer from hanger wires or small rods have never melted or caused failure of the secondary members to which they are attached. The wires and rods elongate during the fire test, but remain through the end of the fire-tests." These experts also state that in fire tests of assembles where ceiling panels or gypsum panels are used, the wires and rods melt when the assembly eventually fails. These attachments are not substantial steel items that make a difference to the building fire safety - but are now are required to have 12" of protection.

To protect wires and rods for 12" means some kind of wire mesh cage must be fabricated around the wire or rod to allow the fireproofing thickness to build and provide required protection. This new requirement – that does extend to thin 12ga. hanger wire and small threaded rods – adds unjustified cost to the project without proof that it adds to safety.

Finally, there is no tested and listed system design in the UL Product iQ currently that requires 12" protection of threaded rods or ceiling hanger wire. That's why we request reverting back to the original proposal prior to the PCH last cycle, which refers to only tubular attachments that can cause problems on the structure.

Cost Impact: The code change proposal will decrease the cost of construction
The cost impact will be that the small attachments defined in the proposal will not require protection, reducing costs significantly. The amount of reduction varies based on the number of small attachments, the presence of a hanging ceiling with metal grid and ceiling tiles, or other building service items such as ducts, cables and pipes, that might hang from a fire-resistance-rated assembly. .

FS11-21

FS11-21

Committee Action: **As Modified**

Committee Modification:

704.6.1 Secondary attachments to structural members

Where primary and secondary structural steel members require fire protection, ~~secondary tubular steel attachments to those structural members~~ any additional structural steel members having direct connection to the primary structural frame or secondary structural members shall be protected with the same fire-resistive material and thickness as required for the structural member. The protection shall extend away from the structural member a distance of not less than 12 inches (305 mm), or shall be applied to the entire length where the attachment is less than 12 inches (305 mm) long. Where an attachment is hollow and the ends are open, the fire-resistive material and thickness shall be applied to both exterior and interior of the hollow steel attachment.

Committee Reason: The committee deemed the modification is capturing what was missing from the original proposal. The committee also concluded that the reason statement is convincing that a modifier is needed before steel attachments. The committee encouraged the proponent to work with other suggested additions in the public comment phase, including addressing the word "structural" and addressing the heat transfer issue. (Vote: 13-0)

No Public Comments Received

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F9979

24

Date Submitted	01/28/2022	**Section**	1010.1.9.9	**Proponent**	John Woestman
Chapter	10	**Affects HVHZ**	Yes	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

F9162

Summary of Modification

Emergency lighting required on egress side of sensor release electrically locked egress doors. Mod F9162 was denied with the reason: “Original text of this code change is not consistent with that of ?the 2020 FBC-B.” This proposal resolves the inconsistencies.?

Rationale

Mod F9162 was denied with the reason: “Original text of this code change is not consistent with that of the 2020 FBC-B.” This proposal resolves the inconsistencies. The requirement for egress side emergency lighting provides all occupants with minimum egress illumination levels at the door for operation and to read the sign. This proposed requirement is aligned with current delayed egress and controlled egress locking conditions.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Minor impact to enforcement with requirement for emergency lighting on the egress side of these "shall be permitted" doors.

Impact to building and property owners relative to cost of compliance with code

The code change proposal will not increase or decrease the cost of construction. Sensor release ?electrically locked doors are not required by the code. However, if this locking system is installed, added cost may ?be incurred where emergency lighting is not currently in place.?

Impact to industry relative to the cost of compliance with code

The code change proposal will not increase or decrease the cost of construction. Sensor release ?electrically locked doors are not required by the code. However, if this locking system is installed, added cost may ?be incurred where emergency lighting is not currently in place.?

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Yes

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Yes

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not.

Does not degrade the effectiveness of the code

Does not.

2nd Comment Period

F9979-G1

Proponent John Woestman Submitted 7/29/2022 5:03:41 PM Attachments No

Comment:

We ask the TAC to reconsider Mod F9979. Mod F9979 was disapproved with the reason "Life Safety Code 7.2.1.6.2(7) already requires this." We agree, the Life Safety Code includes this proposed requirement. Perhaps that may be the best reason to reconsider the mod. Installing emergency lighting at a door is significantly lower cost during the construction of the building compared to installing emergency lighting later to comply with the requirements of the Florida Life Safety Code. Background info: the original proposal for the IBC was proposed by the ICC Committee on Healthcare. One of the goals of this committee has been to update and revise the IBC to eliminate differences between the IBC and NFPA 101 to reduce the costs and hassle of complying with NFPA 101 after the COO.

1010.1.9.9 Sensor release of electrically locked egress doors.
Sensor release of electric locking systems shall be permitted on doors located in the means of egress with an occupancy in Group A, B, E, I-1, I-2, I-4, M, R-1 or R-2 where installed and operated in accordance with all of the following criteria:

1. The sensor shall be installed on the egress side, arranged to detect an occupant approaching the doors, and shall cause the electric locking system to unlock.
2. The electric locks shall be arranged to unlock by a signal from or loss of power to the sensor.
3. Loss of power to the lock or locking system shall automatically unlock the electric lock.
4. The doors shall be arranged to unlock from a manual unlocking device located 40 inches to 48 inches (1016 mm to 1219 mm) vertically above the floor and within 5 feet (1524 mm) of the secured doors. Ready access shall be provided to the manual unlocking device and the device shall be clearly identified by a sign that reads "PUSH TO EXIT." When operated, the manual unlocking device shall result in direct interruption of power to the electric lock—independent of other electronics—and the electric lock shall remain unlocked for not less than 30 seconds.
5. Activation of the building fire alarm system, where provided, shall automatically unlock the electric lock, and the electric lock shall remain unlocked until the fire alarm system has been reset.
6. Activation of the building automatic sprinkler system or fire detection system, where provided, shall automatically unlock the electric lock. The electric lock shall remain unlocked until the fire alarm system has been reset.
7. Emergency lighting shall be provided on the egress side of the door.
8. The door locking system units shall be listed in accordance with UL 294.

2020 Florida Building Code, Building, 7th Edition
Potential Revisions for 2023 Florida Building Code, Building, 8th Edition, per E61-18, approved as submitted, for the 2021 IBC
John Woestman, BHMA, Jan. 28, 2022

Revise as follows:

1010.1.9.9 Sensor release of electrically locked egress doors.
Sensor release of electric locking systems shall be permitted on doors located in the *means of egress* with an occupancy in Group A, B, E, I-1, I-2, I-4, M, R-1 or R-2 where installed and operated in accordance with all of the following criteria:

1. The sensor shall be installed on the egress side, arranged to detect an occupant approaching the doors, and shall cause the electric locking system to unlock.
2. The electric locks shall be arranged to unlock by a signal from or loss of power to the sensor.
3. Loss of power to the lock or locking system shall automatically unlock the electric lock.
4. The doors shall be arranged to unlock from a manual unlocking device located 40 inches to 48 inches (1016 mm to 1219 mm) vertically above the floor and within 5 feet (1524 mm) of the secured doors. Ready access shall be provided to the manual unlocking device and the device shall be clearly identified by a sign that reads "PUSH TO EXIT." When operated, the manual unlocking device shall result in direct interruption of power to the electric lock—independent of other electronics—and the electric lock shall remain unlocked for not less than 30 seconds.
5. Activation of the building *fire alarm system*, where provided, shall automatically unlock the electric lock, and the electric lock shall remain unlocked until the *fire alarm system* has been reset.
6. Activation of the building *automatic sprinkler system* or *fire detection system*, where provided, shall automatically unlock the electric lock. The electric lock shall remain unlocked until the *fire alarm system* has been reset.
7. Emergency lighting shall be provided on the egress side of the door.
8. The door locking system units shall be listed in accordance with UL 294.

Reason (copied from ICC IBC proposal E61-18):
Mod F9162 was denied with the reason: "Original text of this code change is not consistent with that of the 2020 FBC-B." This proposal resolves the inconsistencies.

The requirement for egress side emergency lighting provides all occupants with minimum egress illumination levels at the door for operation and to read the sign. This proposed requirement is aligned with current delayed egress and controlled egress locking conditions.

Cost Impact
The code change proposal will not increase or decrease the cost of construction. Sensor release electrically locked doors are not required by the code. If this locking system is installed, added cost may be incurred where emergency lighting is not currently in place.

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

25

F10061

Date Submitted	02/01/2022	**Section**	1010.1.9.13	**Proponent**	John Woestman
Chapter	10	**Affects HVHZ**	Yes	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

Summary of Modification

This proposal for the Florida Building Code, Building, is the result of the actions taken on ICC IBC proposal E55-21, approved as modified, for the 2024 IBC, which permits enclosed elevator lobbies.

Rationale

Reason (edited from ICC IBC proposal E55-21): This proposal for the Florida Building Code, Building, is the result of the actions taken on ICC IBC proposal E55-21, approved as modified, for the 2024 IBC, which permits enclosed elevator lobbies. A number of jurisdictions across the country are including modifications in their building code to permit locking of exit access doors in elevator lobbies. These jurisdictions include California, Massachusetts, Houston, and Seattle. The provisions proposed were developed through reviewing currently adopted provisions of other codes, and further revised during the ICC 2021 Committee Action Hearings to address stakeholder concerns and suggestions. This proposal is contrary to the long-standing requirement that each elevator lobby has access to at least one exit complying with Chapter 10. The proposal was brought forward in an effort to see if a consensus can be developed permitting electrical locking of exit access doors in elevator lobbies. Proposed new Section 1010.1.9.13 includes specific requirements for where electrically locked exit access doors providing egress from elevator lobbies could be permitted. The new exception in Section 1016.2, Item 3, is intended to address a potential internal conflict in the IBC. The revision in Section 3006.4 provides the proposed alternative to requiring one means of egress from elevator lobbies. It should be noted that providing egress from an elevator lobby through tenant space(s) would typically provide access to two exits - because most tenant spaces would be required to have access to two exits. The options presented by this proposal may be applicable to new buildings, and to build-out of floors in existing buildings, and may be most desirable where exit stairways are remote from the elevator lobby.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

This may require an increase in time involved with code enforcement. But, if enclosed elevator lobbies are currently approved via alternative means and methods, the provisions in this proposal may slightly streamline code enforcement.

Impact to building and property owners relative to cost of compliance with code

There would be an increase in cost of construction to comply with these requirements for exit access doors in elevator lobbies. On the other hand, adding this provision to the IBC may result in a decrease in the cost of construction by allowing alternative layouts of the floor.

Impact to industry relative to the cost of compliance with code

There would be an increase in cost of construction to comply with these requirements for exit access doors in elevator lobbies. On the other hand, adding this provision to the IBC may result in a decrease in the cost of construction by allowing alternative layouts of the floor.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Provides an alternative for multi-story buildings while permitted alternative for layouts of tenant spaces.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Improves the code.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not discriminate.

Does not degrade the effectiveness of the code

Does not.

Alternate Language

2nd Comment Period

F10061-A1

Proponent John Woestman **Submitted** 7/29/2022 4:50:15 PM **Attachments** Yes

Rationale:

This proposed Mod F10061, was denied during the TAC meetings June 2022 with the reason "language conflicts with Life Safety Code." We don't disagree. With this in mind, we evaluated the requirements in our original proposal in Mod F10061 compared to the provisions for Elevator Lobby Exit Access Door Locking in Section 7.2.1.6.4.1 of the Florida Fire Prevention Code / Life Safety Code. Our analysis reveals: 1. The Florida Life Safety Code does not permit locking of elevator lobby exit access doors in high-rise buildings, and in occupancies that map to ICC IBC Occupancy Groups I-3, R-3, and R-4. 2. There are a couple requirements in the proposal for the Florida building code for new construction that are not included in the Florida Life Safety Code but would also not conflict with the Florida Life Safety Code. 3. The one requirement in the Florida Life Safety Code regarding staff requirements not addressed in the proposal for the Florida Building appears to not be a conflict as staff capabilities are typically enforced after the building's COO is issued. The further modifications to our public comment to Mod F10061 address the conflicts with the original proposal ?to the Florida Life Safety Code.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

If elevator lobby exit access door locking is currently permitted via alternative means and methods, the provisions in this proposal may streamline code enforcement. The revisions proposed synchronize with the Florida Fire Prevention Code / Life Safety Code.

Impact to building and property owners relative to cost of compliance with code

May or may not be an increase in cost. Building and property owners may desire this option for elevator lobbies.

Impact to industry relative to the cost of compliance with code

May or may not be an increase in cost because of the opportunity to revise the layout of the floor.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Provides an alternative for the layout of floors in multi-story buildings that are not high-rise buildings.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Improves code.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not discriminate.

Does not degrade the effectiveness of the code

Does not.

Further revise proposed new section as follows:

1010.1.9.13 Elevator lobby exit access doors. In other than high-rise buildings and Group I-3, R-3, and ?R-4 occupancies, electrically ~~Electrically~~ locked exit access doors providing egress from elevator lobbies shall be permitted where all the following conditions are met:

1. For all occupants of the floor, the path of exit access travel to not less than two exits is not required to pass through the elevator lobby.
2. The building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1, and a fire alarm system in accordance with Section 907. Elevator lobbies shall be provided with an automatic smoke detection system in accordance with Section 907.
3. Activation of the building fire alarm system by other than a manual fire alarm box shall automatically unlock the electric locks providing exit access from the elevator lobbies, and the electric locks shall remain unlocked until the system is reset.
4. The electric locks shall unlock on loss of power to the electric lock or electrical locking system.
5. The electric locks shall have the capability of being unlocked by a switch located at the fire command center, security station, or other approved location.
6. A two-way communication system complying with Chapter 7 of the Florida Building Code, Accessibility, shall be located in the elevator lobby adjacent to the electrically locked exit access door and connected to an approved constantly attended station. This constantly attended station shall have the capability of unlocking the electric locks of the elevator lobby exit access doors.
7. Emergency lighting shall be provided in the elevator lobby on both sides of the electrically locked door.
8. The door locking system units shall be listed in accordance with UL 294.

Notes:

No further revisions to proposed exception to Item 3 of Section 1016.2 in Mod F10061; and no further revisions to proposed new sentence in Section 3006.4 in Mod F10061.

2023 Florida Building Code, Building, BHMA Proposal RE Elevator Lobbies and Exit Access Door Locks, ICC IBC proposal E56-21 AM
John Woestman, Feb. 1, 2022. Revised for 2nd Public Comment July 29, 2022

Further revise the proposed new text as follows:

1010.1.9.13 Elevator lobby exit access doors. In other than high-rise buildings and Group I-3, R-3, and R-4 occupancies, ~~Electrically~~ electrically locked exit access doors providing egress from elevator lobbies shall be permitted where all the following conditions are met:

1. For all occupants of the floor, the path of exit access travel to not less than two exits is not required to pass through the elevator lobby.
2. The building is equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1, and a fire alarm system in accordance with Section 907. Elevator lobbies shall be provided with an *automatic smoke detection system* in accordance with Section 907.
3. Activation of the building fire alarm system by other than a manual fire alarm box shall automatically unlock the electric locks providing exit access from the elevator lobbies, and the electric locks shall remain unlocked until the system is reset.
4. The electric locks shall unlock on loss of power to the electric lock or electrical locking system.
5. The electric locks shall have the capability of being unlocked by a switch located at the fire command center, security station, or other approved location.
6. A two-way communication system complying with Chapter 7 of the *Florida Building Code, Accessibility*, shall be located in the elevator lobby adjacent to the electrically locked exit access door and connected to an approved constantly attended station. This constantly attended station shall have the capability of unlocking the electric locks of the elevator lobby exit access doors.
7. Emergency lighting shall be provided in the elevator lobby on both sides of the electrically locked door.
8. The door locking system units shall be listed in accordance with UL 294.

No further revisions to proposed exception to Item 3 of Section 1016.2 in Mod F10061; and no further revisions to proposed new sentence in Section 3006.4 in Mod F10061.

Reason (edited from ICC IBC proposal E55-21 and updated for 2nd public comment):
This proposal for the Florida Building Code, Building, is the result of the actions taken on ICC IBC proposal E55-21, approved as modified, for the 2024 IBC, which permits enclosed elevator lobbies. A number of jurisdictions across the country are including modifications in their building code to permit locking of exit access doors in elevator lobbies. These jurisdictions include California, Massachusetts, Houston, and Seattle. The provisions proposed were developed through reviewing currently adopted provisions of other codes, and further revised during the ICC 2021 Committee Action Hearings to address stakeholder concerns and suggestions.

This proposed Mod F10061, was denied during the TAC meetings June 2022 with the reason "language conflicts with Life Safety Code." We don't disagree.

With this in mind, we evaluated the requirements in our original proposal in Mod F10061 compared to the provisions for Elevator Lobby Exit Access Door Locking in Section 7.2.1.6.4.1 of the Florida Fire Prevention Code / Life Safety Code. Our analysis reveals:

1. The Florida Life Safety Code does not permit locking of elevator lobby exit access doors in high-rise buildings, and in occupancies that map to ICC IBC Occupancy Groups I-3, R-3, and R-4.
2. There are a couple requirements in the proposal for the Florida building code for new construction that are not included in the Florida Life Safety Code but would also not conflict with the Florida Life Safety Code.

3. The one requirement in the Florida Life Safety Code regarding staff requirements not addressed in the proposal for the Florida Building appears to not be a conflict as staff capabilities are typically enforced after the building's COO is issued.

The further modifications in our public comment to Mod F10061 address the conflicts with the original proposal to the Florida Life Safety Code.

This proposal is contrary to the long-standing requirement that each elevator lobby has access to at least one exit complying with Chapter 10. The proposal was brought forward in an effort to see if a consensus can be developed permitting electrical locking of exit access doors in elevator lobbies.

Proposed new Section 1010.1.9.13 includes specific requirements for where electrically locked exit access doors providing egress from elevator lobbies could be permitted.

The new exception in Section 1016.2, Item 3, is intended to address a potential internal conflict in the Florida Building Code, Building.

The revision in Section 3006.4 provides the proposed alternative to requiring one means of egress from elevator lobbies. It should be noted that providing egress from an elevator lobby through tenant space(s) would typically provide access to two exits - because most tenant spaces would be required to have access to two exits.

The options presented by this proposal may be applicable to new buildings, and to build-out of floors in existing buildings, and may be most desirable where exit stairways are remote from the elevator lobby.

Cost:
This may increase the cost of construction. There would be an increase in cost of construction to comply with these requirements for exit access doors in elevator lobbies. On the other hand, adding this provision to the IBC may result in a decrease in the cost of construction by allowing alternative layouts of the floor.

Add new text as follows:

1010.1.9.13 Elevator lobby exit access doors. Electrically locked exit access doors providing egress from elevator lobbies shall be permitted where all the following conditions are met:

1. For all occupants of the floor, the path of exit access travel to not less than two exits is not required to pass through the elevator lobby.
2. The building is equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1, and a fire alarm system in accordance with Section 907. Elevator lobbies shall be provided with an *automatic smoke detection system* in accordance with Section 907.
3. Activation of the building fire alarm system by other than a manual fire alarm box shall automatically unlock the electric locks providing exit access from the elevator lobbies, and the electric locks shall remain unlocked until the system is reset.
4. The electric locks shall unlock on loss of power to the electric lock or electrical locking system.
5. The electric locks shall have the capability of being unlocked by a switch located at the fire command center, security station, or other approved location.
6. A two-way communication system complying with Chapter 7 of the *Florida Building Code, Accessibility*, shall be located in the elevator lobby adjacent to the electrically locked exit access door and connected to an approved constantly attended station. This constantly attended station shall have the capability of unlocking the electric locks of the elevator lobby exit access doors.
7. Emergency lighting shall be provided in the elevator lobby on both sides of the electrically locked door.
8. The door locking system units shall be listed in accordance with UL 294.

Revise as follows:

1016.2 Egress through intervening spaces. Egress through intervening spaces shall comply with this section.

1. Exit access through an enclosed elevator lobby is permitted. Access to not less than one of the required exits shall be provided without travel through the enclosed elevator lobbies required by Section 3006. Where the path of exit access travel passes through an enclosed elevator lobby, the level of protection required for the enclosed elevator lobby is not required to be extended to the exit unless direct access to an exit is required by other sections of this code.
2. Egress from a room or space shall not pass through adjoining or intervening rooms or areas, except where such adjoining rooms or areas and the area served are accessory to one or the other, are not a Group H occupancy and provide a discernible path of egress travel to an exit.

Exception: Means of egress are not prohibited through adjoining or intervening rooms or spaces in a Group H, S or F occupancy where the adjoining or intervening rooms or spaces are the same or a lesser hazard occupancy group.

3. An exit access shall not pass through a room that can be locked to prevent egress.

Exception: An electrically locked *exit access* door providing egress from an elevator lobby shall be permitted in accordance with Section 1010.1.9.13.

4. Means of egress from dwelling units or sleeping areas shall not lead through other sleeping areas, toilet rooms or bathrooms.
5. Egress shall not pass through kitchens, storage rooms, closets or spaces used for similar purposes.

Exceptions:

1. Means of egress are not prohibited through a kitchen area serving adjoining rooms constituting part of the same dwelling unit or sleeping unit.
2. Means of egress are not prohibited through stockrooms in Group M occupancies where all of the following are met:
   2.1. The stock is of the same hazard classification as that found in the main retail area.
   2.2. Not more than 50 percent of the exit access is through the stockroom.
   2.3. The stockroom is not subject to locking from the egress side.
   2.4. There is a demarcated, minimum 44- inch-wide (1118 mm) aisle defined by full- or partial-height fixed walls or similar construction that will maintain the required width and lead directly from the retail area to the exit without obstructions.

3006.4 Means of egress. Elevator lobbies shall be provided with not less than one means of egress complying with Chapter 10 and other provision in this code. Egress through an enclosed elevator lobby shall be permitted in accordance with Item 1 of Section 1016.2. Electrically locked exit access doors providing egress from elevator lobbies shall be permitted in accordance with Section 1010.1.9.13.

2023 Florida Building Code, Building, BHMA Proposal RE Elevator Lobbies and Exit Access Door Locks, ICC IBC proposal E56-21 AM
John Woestman, Feb. 1, 2022

Add new text as follows:

1010.1.9.13 Elevator lobby exit access doors. Electrically locked exit access doors providing egress from elevator lobbies shall be permitted where all the following conditions are met:

1. For all occupants of the floor, the path of exit access travel to not less than two exits is not required to pass through the elevator lobby.
2. The building is equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1, and a fire alarm system in accordance with Section 907. Elevator lobbies shall be provided with an *automatic smoke detection system* in accordance with Section 907.
3. Activation of the building fire alarm system by other than a manual fire alarm box shall automatically unlock the electric locks providing exit access from the elevator lobbies, and the electric locks shall remain unlocked until the system is reset.
4. The electric locks shall unlock on loss of power to the electric lock or electrical locking system.
5. The electric locks shall have the capability of being unlocked by a switch located at the fire command center, security station, or other approved location.
6. A two-way communication system complying with Chapter 7 of the *Florida Building Code, Accessibility*, shall be located in the elevator lobby adjacent to the electrically locked exit access door and connected to an approved constantly attended station. This constantly attended station shall have the capability of unlocking the electric locks of the elevator lobby exit access doors.
7. Emergency lighting shall be provided in the elevator lobby on both sides of the electrically locked door.
8. The door locking system units shall be listed in accordance with UL 294.

Revise as follows:

1016.2 Egress through intervening spaces. Egress through intervening spaces shall comply with this section.

1. *Exit access* through an enclosed elevator lobby is permitted. Access to not less than one of the required *exits* shall be provided without travel through the enclosed elevator lobbies required by Section 3006. Where the path of exit access travel passes through an enclosed elevator lobby, the level of protection required for the enclosed elevator lobby is not required to be extended to the *exit* unless direct access to an *exit* is required by other sections of this code.
2. Egress from a room or space shall not pass through adjoining or intervening rooms or areas, except where such adjoining rooms or areas and the area served are accessory to one or the other, are not a Group H occupancy and provide a discernible path of egress travel to an exit.

   Exception: *Means of egress* are not prohibited through adjoining or intervening rooms or spaces in a Group H, S or F occupancy where the adjoining or intervening rooms or spaces are the same or a lesser hazard occupancy group.
3. An exit access shall not pass through a room that can be locked to prevent egress.

   Exception: An electrically locked *exit access* door providing egress from an elevator lobby shall be permitted in accordance with Section 1010.1.9.13.
4. Means of egress from dwelling units or sleeping areas shall not lead through other sleeping areas, toilet rooms or bathrooms.
5. Egress shall not pass through kitchens, storage rooms, closets or spaces used for similar purposes.

   Exceptions:
   1. *Means of egress* are not prohibited through a kitchen area serving adjoining rooms constituting part of the same *dwelling unit* or *sleeping unit*.
   2. *Means of egress* are not prohibited through stockrooms in Group M occupancies where all of the following are met:

2.1. The stock is of the same hazard classification as that found in the main retail area.

2.2. Not more than 50 percent of the *exit access* is through the stockroom.

2.3. The stockroom is not subject to locking from the egress side.

2.4. There is a demarcated, minimum 44- inch-wide (1118 mm) *aisle* defined by full- or partial-height fixed walls or similar construction that will maintain the required width and lead directly from the retail area to the *exit* without obstructions.

3006.4 Means of egress. Elevator lobbies shall be provided with not less than one means of egress complying with Chapter 10 and other provision in this code. Egress through an enclosed elevator lobby shall be permitted in accordance with Item 1 of Section 1016.2. Electrically locked exit access doors providing egress from elevator lobbies shall be permitted in accordance with Section 1010.1.9.13.

Reason (edited from ICC IBC proposal E55-21):
This proposal for the Florida Building Code, Building, is the result of the actions taken on ICC IBC proposal E55-21, approved as modified, for the 2024 IBC, which permits enclosed elevator lobbies. A number of jurisdictions across the country are including modifications in their building code to permit locking of exit access doors in elevator lobbies. These jurisdictions include California, Massachusetts, Houston, and Seattle. The provisions proposed were developed through reviewing currently adopted provisions of other codes, and further revised during the ICC 2021 Committee Action Hearings to address stakeholder concerns and suggestions.

This proposal is contrary to the long-standing requirement that each elevator lobby has access to at least one exit complying with Chapter 10. The proposal was brought forward in an effort to see if a consensus can be developed permitting electrical locking of exit access doors in elevator lobbies.

Proposed new Section 1010.1.9.13 includes specific requirements for where electrically locked exit access doors providing egress from elevator lobbies could be permitted.

The new exception in Section 1016.2, Item 3, is intended to address a potential internal conflict in the Florida Building Code, Building.

The revision in Section 3006.4 provides the proposed alternative to requiring one means of egress from elevator lobbies. It should be noted that providing egress from an elevator lobby through tenant space(s) would typically provide access to two exits - because most tenant spaces would be required to have access to two exits.

The options presented by this proposal may be applicable to new buildings, and to build-out of floors in existing buildings, and may be most desirable where exit stairways are remote from the elevator lobby.

Cost:
This may increase the cost of construction. There would be an increase in cost of construction to comply with these requirements for exit access doors in elevator lobbies. On the other hand, adding this provision to the IBC may result in a decrease in the cost of construction by allowing alternative layouts of the floor.

Florida Public Comment F10061, Enclosed Elevator Lobby Exit Access Door Locking
Based on ICC IBC E56-21 AM for the 2024 IBC
Comparison and analysis of inconsistencies between mod F10061 proposed language and Florida Fire Prevention Code (FFPC) based on NFPA 101-2021
John Woestman, BHMA, July 29, 2022
Note: NFPA 101-2021 is used for analysis as the next edition of the Florida Fire Prevention Code / Life Safety Code is expected to reference the 2021 edition of NFPA 101.

Florida Building Code Proposed Requirements per Mod F10061 **Mod F10061 is based on ICC IBC proposal E56-21 AM for the 2024 IBC**	**Florida Fire Prevention Code Requirements / Life Safety Code Requirements** **Assumes next FFPC will be based on 2021 NFPA 101**	**Comments** **Evaluation of requirements of Mod F10061 compared to FFPC / Life Safety Code**
1010.1.9.13 Elevator lobby exit access doors. Electrically locked exit access doors providing egress from elevator lobbies shall be permitted where all the following conditions are met:	**7.2.1.6.4.1 Elevator Lobby Exit Access Door Assemblies Locking.** Where permitted in Chapters 11 through 43, door assemblies separating the elevator lobby from the exit access required by 7.4.1.6.1 shall be permitted to be electrically locked, provided that all the following criteria are met:	As proposed, FBC would permit doors complying with 1010.1.9.13 in all occupancies. Door locking per FFPC 7.2.1.6.4.1 is **permitted** by FFPC / LSC in these occupancies: • Special structures and existing high-rise bldgs. (Ch. 11) • New and existing assembly occ. (Ch. 12 & 13) • New and existing educational occ. (Ch. 14, & 15) • New and existing day-care occ. (Ch. 16, & 17) • New and existing health care occ. (Ch. 18 & 19) • New and existing ambulatory health care occ. (Ch. 20 & 21) • New and existing hotels and dormitories (Ch. 28 & 29) • New and existing apartments (Ch. 30 & 31) • New and existing mercantile occ. (Ch. 36 & 37) • New and existing business (Ch. 38 & 39) • Industrial occ. (Ch. 40) • Storage occ. (Ch. 42) FFPC / LSC does **not permit** door locking per FFPC 7.2.1.6.4.1 in the following: • Newly constructed high-rise buildings. (Ch. 11) • Detention and correctional facilities (Ch. 22 & 23) • One- and two-family dwellings (Ch. 24) • Lodging or rooming houses (Ch. 26) • Residential board and care occupancies (Ch. 32 & 33) **Observations** To align Mod F10061 with the FFPC / LSC, Mod F10061 could be modified to not permit the proposed elevator lobby exit access door locking systems in high-rise buildings and Groups I-3, R-3, and R-4 occupancies.

Florida Building Code Proposed Requirements per Mod F10061 **Mod F10061 is based on ICC IBC proposal E56-21 AM for the 2024 IBC**	**Florida Fire Prevention Code Requirements / Life Safety Code Requirements** **Assumes next FFPC will be based on 2021 NFPA 101**	**Comments** **Evaluation of requirements of Mod F10061 compared to FFPC / Life Safety Code**
1. For all occupants of the floor, the path of exit access travel to not less than two exits is not required to pass through the elevator lobby.		Not required by FFPC / LSC. Would not result in a conflict with existing buildings where new construction is configured per this requirement.
2. The building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1, and a fire alarm system in accordance with Section 907. Elevator lobbies shall be provided with an automatic smoke detection system in accordance with Section 907.	(2) The building is protected throughout by a fire alarm system in accordance with Section 9.6.	Appears to be equivalent.
	(3) The building is protected throughout by an approved, supervised automatic sprinkler system in accordance with Section 9.7.	Appears to be equivalent.
	(4) Waterflow in the sprinkler system required by 7.2.1.6.4.1 is arranged to initiate the building fire alarm system.	Appears to be equivalent.
	(5) The elevator lobby is protected by an approved, supervised smoke detection system in accordance with Section 9.6.	Appears to be equivalent – assumes automatic smoke detection systems required by the FBC are considered equivalent to the supervised smoke detection system in accordance with Section 9.6 (of the FFPC).
	(6) Detection of smoke by the detection system required by 7.2.1.6.4.1 is arranged to initiate the building fire alarm system and notify building occupants.	Appears to be equivalent. FBC 907.2 requires occupant notification.
3. Activation of the building fire alarm system by other than a manual fire alarm box shall automatically unlock the electric locks providing exit access from the elevator lobbies, and the electric locks shall remain unlocked until the system is reset.	(7) Initiation of the building fire alarm system by other than manual fire alarm boxes unlocks the electrical locks on the elevator lobby door assembly.	Appears to be equivalent.
	(9) Once unlocked, the elevator lobby door assemblies remain electrically unlocked until the building fire alarm system has been manually reset.	Appears to be equivalent.
4. The electric locks shall unlock on loss of power to the electric lock or electrical locking system.	(8) Loss of power to the elevator lobby electrical lock system unlocks the electrical locks on the elevator lobby door assemblies.	Appears to be equivalent.
5. The electric locks shall have the capability of being unlocked by a switch located at the fire command center, security station, or other approved location.		Not explicitly required by FFPC / LSC. Would not result in a conflict with existing buildings where new construction is configured per this requirement.
6. A two-way communication system complying with Chapter 7 of the Florida Building Code, Accessibility, shall be located in the elevator lobby adjacent to the electrically locked exit access door and connected to an approved constantly attended station. This constantly attended station shall have the capability of	(11) A two-way communication system is provided for communication between the elevator lobby and a central control point that is constantly staffed.	Appears to be equivalent.
	(12) The central control point staff required by 7.2.1.6.3 is capable, trained, and authorized to provide emergency assistance.	Appears to be equivalent, but with additional specificity in FFPC / LSC regarding central control point staff.

unlocking the electric locks of the elevator lobby exit access doors.		FBC proposal has no requirements addressing central control point staff.
7. Emergency lighting shall be provided in the elevator lobby on both sides of the electrically locked door.		Not required by FFPC / LSC. Would not result in a conflict with existing buildings where new construction is configured per this requirement.
8. The door locking system units shall be listed in accordance with UL 294.	(1) The electrical locking hardware is listed in accordance with ANSI/UL 294, Standard for Access Control System Units.	Appears to be equivalent.
	(10) Where the elevator lobby door assemblies remain mechanically latched after being electrically unlocked, latch-releasing hardware in accordance with 7.2.1.5.3 is affixed to the door leaves.	Appears to be equivalent. FFPC / LSC Section 7.2.1.5.3 is latch-release devices. Latch release requirements are equivalent between the FBC and FFPC / LSC. The requirements in Item (10) would apply should Item (10) not exist in FFPC Section 7.2.1.6.4.1.

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F10168

Date Submitted	02/10/2022	**Section**	1711	**Proponent**	Greg Johnson
Chapter	17	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

Mass timber Type IV package; mods # 10098, 10099, 10161, 10162, 10163, 10167 and more

Summary of Modification

Provides requirements for inspection of mass timber construction.

Rationale

see uploaded rationale

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Where this method of construction is chosen by the owner, inspections of the sealing of mass timber elements will be required. This expense is typically borne by the owner similar to special or third party inspections.

Impact to building and property owners relative to cost of compliance with code

None. This is an optional construction method. Owners can choose not to bear this cost.

Impact to industry relative to the cost of compliance with code

None. This is an optional construction method. Owners can choose not to bear this cost.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This is a fire-resistive construction and inspection provision.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Improves the code by supporting a new construction method.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No material is required or prohibited.

Does not degrade the effectiveness of the code

Improves the code by supporting a new construction method.

2nd Comment Period

F10168-G1

Proponent	Greg Johnson	Submitted	8/17/2022 3:45:54 PM	Attachments	No

Comment:

Nothing in the FL Building code prohibits mass timber construction. In fact, Sec. 602.4 provides requirements for mass timber elements, including Sec. 602.4.2 which addresses cross-laminated timber, a form of mass timber. Also, Sec. 104.11, Alternative materials, design and methods of construction and equipment permits AHJs to accept mass timber construction types as an alternate method of construction.. Modification F10168 provides requirements for the inspection mass timber elements and assemblies. These provisions should already be available in the FL Building Code for already permissible buildings and those that may be accepted under Sec. 104.11.

2nd Comment Period

F10168-G2

Proponent	Sam Francis	Submitted	8/25/2022 4:41:33 PM	Attachments	No

Comment:

I am recommending this be Accepted as originally submitted. At the first Comment Period hearing, after the TAC voted to deny the first of the Tall Mass Timber proposed modifications and one or two more, no testimony was offered by opponents or supporters to the subsequent proposed modifications. When we reached out to opponents of the mods which were hotly debated, they offered thoughts on those and on subsequent items which received no debate in the first Comment hearing. This modification as proposed was not found contentious. It is another example of important fire safety built into the package of proposals. The ICC Ad Hoc Tall Wood Building committee deemed it an important part of the fire and structural safety being placed into this new type of construction. I recommend that the TAC approve the original proposed modification.

2nd Comment Period

F10168-G3

Proponent	ashley ong	Submitted	8/26/2022 4:02:10 PM	Attachments	No

Comment:

Building Officials Association of Florida (BOAF) supports this modification.

1711 Mass timber construction.

1711.1 Inspections of mass timber elements in Types IV-A, IV-B and IV-C construction shall be in accordance with Table 1711.1.

-

-

-

TABLE 1711.1
REQUIRED INSPECTIONS OF MASS TIMBER CONSTRUCTION

-

		TYPE	CONTINUOUSINSPECTION	PERIODICINSPECTION
1		Inspectionof anchorageandconnectionsofmasstimberconstructiontotimberdeepfoundation systems.	—	X
2		Inspecterectionofmasstimberconstruction.	—	X
3		Inspectionofconnectionswhereinstallationmethodsarerequiredtomeetdesignloads.	-	-
-	- Threaded fasteners	Verifyuseofproperinstallationequipment.	—	X
		Verifyuseofpre-drilledholeswhererequired.	—	X
		Inspectscrews,includingdiameter,length,headtype,spacing,installationangleand depth.	—	X
	Adhesiveanchorsinstalledinhorizontalorupwardlyinclinedorientationtoresistsustainedtensionloads.		X	—
		Adhesiveanchorsnot definedinprecedingcell.	—	X
		Boltedconnections.	—	X
		Concealedconnections.	—	X

-

-

1711.2 Sealing of mass timber.

1711.2.1. In buildings of Types IV-A, IV-B and IV-C construction, sealant or adhesive shall be provided to resist the passage of air in the following locations:

1. At abutting edges and intersections of mass timber building elements required to be fire-resistance rated.

2. At abutting intersections of mass timber building elements and building elements of other materials where both are required to be fire-resistance rated.

Sealants shall meet the requirements of ASTM C920. Adhesives shall meet the requirements of ASTM D3498.

Exception: Sealants or adhesives need not be provided where they are not a required component of a tested fire-resistance-rated assembly.

1711.2.2. Periodic inspections of sealants or adhesives shall be conducted where sealant or adhesive required by Section 703.7 is applied to mass timber building elements as designated in the approved construction documents.

Modification # 10168 by Greg Johnson for the American Wood Council

1711 Mass timber construction.
1711.1 Inspections of mass timber elements in Types IV-A, IV-B and IV-C construction shall be in accordance with Table 1711.1.

TABLE 1711.1
REQUIRED INSPECTIONS OF MASS TIMBER CONSTRUCTION

	TYPE		CONTINUOUS SPECIAL INSPECTION	PERIODIC INSPECTION
1.	Inspection of anchorage and connections of mass timber construction to timber deep foundation systems.		—	X
2.	Inspect erection of mass timber construction.		—	X
3.	Inspection of connections where installation methods are required to meet design loads.			
	Threaded fasteners	Verify use of proper installation equipment.	—	X
		Verify use of pre-drilled holes where required.	—	X
		Inspect screws, including diameter, length, head type, spacing, installation angle and depth.	—	X
	Adhesive anchors installed in horizontal or upwardly inclined orientation to resist sustained tension loads.		X	—
	Adhesive anchors not defined in preceding cell.		—	X
	Bolted connections.		—	X
	Concealed connections.		—	X

1711.2 Sealing of mass timber.

1711.2.1. In buildings of Types IV-A, IV-B and IV-C construction, sealant or adhesive shall be provided to resist the passage of air in the following locations:

1. At abutting edges and intersections of mass timber building elements required to be fire-resistance rated.

2. At abutting intersections of mass timber building elements and building elements of other materials where both are required to be fire-resistance rated.
Sealants shall meet the requirements of ASTM C920. Adhesives shall meet the requirements of ASTM D3498.

Exception: Sealants or adhesives need not be provided where they are not a required component of a tested fire-resistance-rated assembly.

1711.2.2. Periodic inspections of sealants or adhesives shall be conducted where sealant or adhesive required by Section 703.7 is applied to mass timber building elements as designated in the approved construction documents.

Rationale: Sec. 703.9 Sealing of adjacent mass timber elements

AWC proposes this code change as part of a package which, when taken together, as a group, creates the safety and reliability requirements necessary for the regulation of large mass timber (MT) buildings by the Florida Building Code. The following statement was offered by the Ad Hoc Committee on Tall Wood Buildings (TWB) for this proposal (IBC-FS6-18, S100) in the ICC Code Development monograph 2018 Group A:

The Ad Hoc Committee on Tall Wood Buildings (TWB) was created by the ICC Board to explore the science of tall wood buildings and take action on developing code changes for tall wood buildings. The TWB has created several code change proposals with respect to the concept of tall buildings of mass timber and the background information is at the end of this Statement. Within the statement are important links to information, including documents and videos, used in the deliberations which resulted in these proposals.

Mass timber has inherent properties of fire resistance, serving both to provide structural fire resistance and to safeguard against the spread of fire and smoke within a building or the spread of fire between structures.

When mass timber panels are connected together, fire tests have demonstrated that it is important for the abutting edges and intersections in the plane of and between the different planes of panels that form a separation to be sealed. The structures tested as part of the fire tests supporting this submittal were constructed with this sealing.

To review a summary of the fire tests, please visit: http://bit.ly/ATF-firetestreport

To watch summary videos of the fire tests, which are accelerated to run in 3-1/2 minutes each, please visit: http://bit.ly/ATF-firetestvideos.

Both of these links were confirmed active on 1/14/22.

The US CLT manual recommends a bead of construction adhesive. Construction adhesive or other sealant can be used to prevent air flow. When a wall or horizontal assembly serves as the separation between two atmospheres, a fire creates differential pressure where heated gasses raise the pressure and work to drive fire and hot gasses through the structure. Voids that are not properly sealed can serve as a conduit for air movement during a fire, so abutting edges and intersections are recommended to be sealed.

Periodic inspections during construction are required to make that the appropriate sealant or adhesive is used and to establish inspections to verify for ongoing quality control.

Some panels are manufactured under proprietary processes to ensure there are no voids at these intersections.

Where this proprietary process is incorporated and tested, there is no requirement for sealant or adhesive and an exception is provided for this instance. Where the sealant is not required and is not specifically excluded it is still considered to be a good practice covered by this section.

This code change proposal does not apply to “joints” as defined in Section 202 of the IBC as joints have their own requirements for the placement and inspection of fire resistant joint systems in IBC Section 715. Joints are defined as having an opening that is designed to accommodate building tolerances or to allow independent movement. Panels and members that are connected together as covered by this code change proposal do not meet the definition of a joint since they are rigidly connected and do not have an opening.

The Ad Hoc Committee for Tall Wood Buildings (AHC-TWB) was created by the ICC Board of Directors to explore the building science of tall wood buildings with the scope to investigate the feasibility of and take action on developing code changes for these buildings. Members of the AHC-TWB were appointed by the ICC Board of Directors. Since its creation in January 2016, the AHC-TWB has held 8 open meetings and numerous Work Group conference calls. Four Work Groups were established to address over 80 issues and concerns and review over 60 code proposals for consideration by the AHC-TWB. Members of the Work Groups included AHC-TWB members and other interested parties. Related documentation and reports are posted on the AHC-TWB website at

https://www.iccsafe.org/codes-tech-support/cs/icc-ad-hoc-committee-on-tall-wood-buildings/ .

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F10111

Date Submitted	02/07/2022	**Section**	2304.11	**Proponent**	Greg Johnson
Chapter	23	**Affects HVHZ**	No	**Attachments**	No
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

Mod #10110 to Sec 602.4

Summary of Modification

Provides internal references to Sec 602.4 treatment of concealed spaces in Type IV construction for floors and roof decks.

Rationale

The option of having protected concealed spaces in Type IV buildings is important to encourage the adaptive re-use of existing heavy timber buildings as well as to provide for the installation of mechanicals in Type IV cross laminated timber (CLT) construction. In addition to the current requirements for all concealed spaces in combustible construction, this change would require additional protection of the concealed spaces with sprinkler coverage, or eliminating all air space with noncombustible insulation, or covering all combustible surfaces with gypsum. These alternatives are the same protection required for concealed spaces in NFPA 13, except they are slightly more restrictive since 5/8-inch Type X gypsum is required in the one case. In addition, because the provisions are taken from NFPA 13, in order to use these provisions, the entire building must be protected by a sprinkler system complying with NFPA 13. A similar change was recently successful in NFPA 220 and NFPA 5000. This proposal is more conservative in that it requires 5/8-inch Type X gypsum instead of ½ -inch gypsum in the alternative for sheathing combustible concealed spaces with gypsum in proposed section 602.4.4.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

No impacts, no additional duties required.

Impact to building and property owners relative to cost of compliance with code

None; optional provisions that may reduce the cost of construction.

Impact to industry relative to the cost of compliance with code

None; optional provisions that may reduce the cost of construction.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This mod provides alternative methods of protecting concealed spaces in Type IV construction, ensuring robust fire-resistant construction.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This mod provides alternative methods of protecting concealed spaces in Type IV construction, ensuring robust fire-resistant construction.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No material isprohibited or required by this mod.

Does not degrade the effectiveness of the code

This mod provides alternative methods of protecting concealed spaces in Type IV construction, ensuring robust fire-resistant construction.

2nd Comment Period

F10111-G1

Proponent	Greg Johnson	Submitted	8/22/2022 4:41:35 PM	Attachments	No

Comment:

This modification is companion to modification #10110. It is applicable to current Type IV Heavy Timber buildings, already designated as Type IV buildings in the FL Building Code. It is not a 'mass timber' (part of the tall wood package of new Type IV construction) proposed modification. This modification, with modification #10110, provides extremely stringent requirements for the protection of concealed spaces in Type IV heavy timber buildings. This creates flexibility in the re-use of older heavy timber buildings.

2nd Comment Period

F10111-G2

Proponent	Sam Francis	Submitted	8/26/2022 10:34:28 AM	Attachments	No

Comment:

I urge the TAC to accept this modification as originally proposed. This is a necessary correlation with Mod 10110 and 10174.

2nd Comment Period

F10111-G3

Proponent	Sam Francis	Submitted	8/26/2022 11:24:51 AM	Attachments	No

Comment:

this correlates to the changes in Mod 10174 and will enhance the code.

2nd Comment Period

Proponent	ashley ong	Submitted	8/26/2022 4:06:57 PM	Attachments	No

Comment:

Building Officials Association of Florida (BOAF) supports this modification.

2304.11.3 Floors.
Floors shall be without concealed spaces or with concealed spaces complying with Section 602.4.4. Wood floors shall be constructed in accordance with Section 2304.11.3.1 or 2304.11.3.2.

2304.11.3.1 Cross-laminated timber floors.
Cross-laminated timber shall be not less than 4 inches (102 mm) in actual thickness. Cross-laminated timber shall be continuous from support to support and mechanically fastened to one another. Cross-laminated timber shall be permitted to be connected to walls without a shrinkage gap providing swelling or shrinking is considered in the design. Corbelling of masonry walls under the floor shall be permitted to be used.

2304.11.3.2 Sawn or glued-laminated plank floors.
Sawn or glued-laminated plank floors shall be one of the following:

1.Sawn or glued-laminated planks, splined or tongue-and-groove, of not less than 3 inches (76 mm) nominal in thickness covered with 1-inch (25 mm) nominal dimension tongue-and-groove flooring, laid crosswise or diagonally, 15/32-inch (12 mm) wood structural panel or 1/2-inch (12.7 mm) particleboard.

2.Planks not less than 4 inches (102 mm) nominal in width set on edge close together and well spiked and covered with 1-inch (25 mm) nominal dimension flooring or 15/32-inch (12 mm) wood structural panel or 1/2-inch (12.7 mm) particleboard.

The lumber shall be laid so that no continuous line of joints will occur except at points of support. Floors shall not extend closer than 1/2 inch (12.7 mm) to walls. Such 1/2-inch (12.7 mm) space shall be covered by a molding fastened to the wall and so arranged that it will not obstruct the swelling or shrinkage movements of the floor. Corbelling of masonry walls under the floor shall be permitted to be used in place of molding.

2304.11.4 Roof decks.
Roofs shall be without concealed spaces ~~and roof~~ or with concealed spaces complying with Section 602.4.3. Roof decks shall be constructed in accordance with Section 2304.11.4.1 or 2304.11.4.2. Other types of decking shall be permitted to be used where equivalent fire resistance and structural properties are being provided. Where supported by a wall, roof decks shall be anchored to walls to resist forces determined in accordance with Chapter 16. Such anchors shall consist of steel bolts, lags, screws or approved hardware of sufficient strength to resist prescribed forces.

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F10248

Date Submitted	02/11/2022	**Section**	2304.10	**Proponent**	Greg Johnson
Chapter	23	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

Type IV mass timber modifications including mods# 10098, 10099, 10161, 10162, 10163, 10167, 10169, 10174, and more

Summary of Modification

This modification provides two options for demonstrating compliance with thee requirement for the protection of connections in Types IV-A, IV-B and IV-C construction.

Rationale

see uploaded rationale

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None; these are typical design and plan review requirements.

Impact to building and property owners relative to cost of compliance with code

None; this is an optional building method. The owner can choose another method of construction to avoid costs.

Impact to industry relative to the cost of compliance with code

None; this is an optional building method. The owner can choose another method of construction to avoid costs

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This is a fire resistant construction provision.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This improves the code by supporting a new optional construction method.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No materials are required or prohibited by this change.

Does not degrade the effectiveness of the code

This improves the code by supporting a new optional construction method.

2nd Comment Period

F10248-G1

Proponent	Greg Johnson	Submitted	8/22/2022 4:28:00 PM	Attachments	No

Comment:

Nothing in the current FL Building Code prohibits construction using mass timber material. Nothing in the FL Building Code currently prevents a building official from approving a mass timber building without fire-resistance requirements determined by the nation's leading experts in these matters in the IBC development process. 10248 should be passed so that local building officials have the tools to appropriately regulate mass timber construction.

2nd Comment Period

F10248-G2

Proponent	Sam Francis	Submitted	8/26/2022 11:42:58 AM	Attachments	No

Comment:

AWC discussed the issues with interested parties and found that this change is appropriate as written and adds to the context of the regulation of mass timber buildings.

2nd Comment Period

F10248-G3

Proponent	ashley ong	Submitted	8/26/2022 4:04:39 PM	Attachments	No

Comment:

Building Officials Association of Florida (BOAF) supports this modification.

2304.10.8 Connection fire resistance rating. Fire resistance ratings for connections in Type IV-A, IV-B, or IV-C construction shall be determined by one of the following:

1. Testing in accordance with Section 703.2 where the connection is part of the fire resistance test.
2. Engineering analysis that demonstrates that the temperature rise at any portion of the connection is limited to an average temperature rise of 250°F (139°C), and a maximum temperature rise of 325°F (181°C), for a time corresponding to the required fire resistance rating of the structural element being connected. For the purposes of this analysis, the connection includes connectors, fasteners, and portions of wood members included in the structural design of the connection.

Section 2304.10.8 connection fire resistance rating rationale

AWC proposes this code change as part of a package which, when taken together, as a group, creates the safety and reliability requirements necessary for the regulation of large mass timber (MT) buildings by the Florida Building Code. The following statement was offered by the Ad Hoc Committee on Tall Wood Buildings (TWB) for this proposal (IBC-S170-19) in the ICC Code Development monograph 2018 Group A:

The Ad Hoc Committee on Tall Wood Buildings (TWB) was created by the ICC Board to explore the science of tall wood buildings and take action on developing code changes for tall wood buildings. The TWB has created several code change proposals with respect to the concept of tall buildings of mass timber and the background information is at the end of this Statement. Within the statement are important links to information, including documents and videos, used in the deliberations which resulted in these proposals.

BC Sections 704.2 and 704.3 require connections of columns and other primary structural members to be protected with materials that have the required fire-resistance rating. This proposed change provides two options for demonstrating compliance with this requirement for connections in Types IV-A, IV-B and IV-C construction: a testing option and a calculation option. Types IV-A, IV-B and IV-C construction utilize mass timber elements that have inherent fire resistance. The new provisions which added these construction types have explicit fire-resistance ratings and protection requirements. Option 1 allows connections that are part of a successful ASTM E119 fire resistance test to be considered acceptable evidence of meeting the requirements of Sections 704.2 and 704.3.

Some connections used in Types IV-A, IV-B and IV-C construction are not part of the mass timber element or assembly testing. For those connections, an engineering analysis is required. Analysis procedures have been developed that allow the protection of these connections to be designed based on test results of E119 fire tests from protection configurations using the wood member outside of the connection, additional wood cover, and/or gypsum board. The analysis procedures must demonstrate that the protection will limit the temperature rise at any portion of the

connection, including the metal connector, the connection fasteners, and portions of the wood member that are necessary for the structural design of the connection. The average temperature rise limit of 250°F (139°C) and maximum temperature rise limit of 325°F (181°C) represent the fire separation and thermal protection requirements for wall and floor assemblies tested per ASTM E119 and ensure that the connection retains most of its initial strength throughout the fire-resistance rating time. Please note the Celsius values in parentheses are for temperature rise calculated as the difference between the final temperature and the initial temperature, not a direct conversion of a Fahrenheit temperature.

IBC 722 permits structural fire-resistance ratings of wood members to be determined using Chapter 16 of the National Design Specification® (NDS®) for Wood Construction. Where a wood connection is required to be fire-resistance rated, NDS Section 16.3 requires all components of the wood connection, including the steel connector, the connection fasteners, and the wood needed in the structural design of the connection, to be protected for the required fire-resistance rating time. NDS permits the connection to be protected by wood, gypsum board or other approved materials. AWC publication *Technical Report 10: Calculating the Fire Resistance of Wood Members and Assemblies* (https://www.awc.org/codesstandards/publications/tr10) , which is referenced in the NDS Commentary to Chapter 16, has been specifically updated to provide guidance on and examples of connection designs meeting the requirements of IBC 704 and NDS 16.3.

The Ad Hoc Committee for Tall Wood Buildings (AHC-TWB) was created by the ICC Board of Directors to explore the building science of tall wood buildings with the scope to investigate the feasibility of and take action on developing code changes for these buildings. Members of the AHC-TWB were appointed by the ICC Board of Directors. Since its creation in January 2016, the AHC-TWB has held 8 open meetings and numerous Work Group conference calls. Four Work Groups were established to address over 80 issues and concerns and review over 60 code proposals for consideration by the AHC-TWB. Members of the Work Groups included AHC-TWB members and other interested parties. Related documentation and reports are posted on the AHC-TWB website at

https://www.iccsafe.org/codes-tech-support/cs/icc-ad-hoc-committee-on-tall-wood-buildings/.

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F10098

Date Submitted	02/05/2022	**Section**	3102	**Proponent**	Greg Johnson
Chapter	31	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

Modifications to Definitions, Chapter 4, Chapter 5, Chapter 6, Chapter 7, Chapter 17, Chapter 23, and Appendix D that add provisions for Type IV A,B, & C mass timber construction.

Summary of Modification

Clarifies that the reference to Type IV construction means heavy timber construction and not mass timber

Rationale

AWC proposes this code change as part of a package which, when taken together, as a group, creates the safety and reliability requirements necessary for the regulation of large mass timber (MT) buildings by the Florida Building Code. An uploaded support file has detailed reasons.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None; this is a clarification of application of the code

Impact to building and property owners relative to cost of compliance with code

None; this is a clarification of application of the code

Impact to industry relative to the cost of compliance with code

None; this is a clarification of application of the code

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

It clarifies application of the code so that mass timber buildings are not confused with heavy timber buildings.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

It clarifies application of the code so that mass timber buildings are not confused with heavy timber buildings.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No material is required or prohibited by this change.

Does not degrade the effectiveness of the code

It clarifies application of the code so that mass timber buildings are not confused with heavy timber buildings, making the code more effective.

2nd Comment Period

F10098-G1

Proponent	Greg Johnson	Submitted	8/11/2022 4:38:04 PM	Attachments	No

Comment:

This change is needed to differentiate Type IV heavy timber from other Type IV construction types.

2nd Comment Period

F10098-G2

Proponent	ashley ong	Submitted	8/26/2022 4:03:00 PM	Attachments	No

Comment:

Building Officials Association of Florida (BOAF) supports this modification.

3102.3 Type of construction.
Noncombustible membrane structures shall be classified as Type IIB construction. Noncombustible frame or cable-supported structures covered by an approved membrane in accordance with Section 3102.3.1 shall be classified as Type IIB construction. Heavy timber frame-supported structures covered by an approved membrane in accordance with Section 3102.3.1 shall be classified as Type IV-HT construction. Other membrane structures shall be classified as Type V construction.

Exception: Plastic less than 30 feet (9144 mm) above any floor used in greenhouses, where occupancy by the general public is not authorized, and for aquaculture pond covers is not required to meet the fire propagation performance criteria of Test Method 1 or Test Method 2, as appropriate, of NFPA 701.

3102.3.1 Membrane and interior liner material.
Membranes and interior liners shall be either noncombustible as set forth in Section 703.5 or meet the fire propagation performance criteria of Test Method 1 or Test Method 2, as appropriate, of NFPA 701 and the manufacturer's test protocol.

Exception: Plastic less than 20 mil (0.5 mm) in thickness used in greenhouses, where occupancy by the general public is not authorized, and for aquaculture pond covers is not required to meet the fire propagation performance criteria of Test Method 1 or Test Method 2, as appropriate, of NFPA 701.

3102.4 Allowable floor areas.
The area of a membrane structure shall not exceed the limitations specified in Section 506.

3102.5 Maximum height.
Membrane structures shall not exceed one story nor shall such structures exceed the height limitations in feet specified in Section 504.3.

Exception: Noncombustible membrane structures serving as roofs only.

3102.6 Mixed construction.
Membrane structures shall be permitted to be utilized as specified in this section as a portion of buildings of other types of construction. Height and area limits shall be as specified for the type of construction and occupancy of the building.

3102.6.1 Noncombustible membrane.
A noncombustible membrane shall be permitted for use as the roof or as a skylight of any building or atrium of a building of any type of construction provided the membrane is not less than 20 feet (6096 mm) above any floor, balcony or gallery.

3102.6.1.1 Membrane.
A membrane meeting the fire propagation performance criteria of Test Method 1 or Test Method 2, as appropriate, of NFPA 701 shall be permitted to be used as the roof or as a skylight on buildings of Type IIB, III, IV-HT and V construction, provided the membrane is not less than 20 feet (6096 mm) above any floor, balcony or gallery.

G146-18 as proposed:

3102.3 Type of construction.
Noncombustible membrane structures shall be classified as Type IIB construction. Noncombustible frame or cable-supported structures covered by an *approved* membrane in accordance with Section 3102.3.1 shall be classified as Type IIB construction. Heavy timber frame-supported structures covered by an approved membrane in accordance with Section 3102.3.1 shall be classified as Type IV-HT construction. Other membrane structures shall be classified as Type V construction.

> **Exception:** Plastic less than 30 feet (9144 mm) above any floor used in *greenhouses* , where occupancy by the general public is not authorized, and for aquaculture pond covers is not required to meet the fire propagation performance criteria of Test Method 1 or Test Method 2, as appropriate, of NFPA 701.

3102.6.1.1 Membrane. A membrane meeting the fire propagation performance criteria of Test Method 1 or Test Method 2, as appropriate, of NFPA 701 shall be permitted to be used as the roof or as a skylight on buildings of Type IIB, III, IV-HT and V construction, provided that the membrane is not less than 20 feet (6096 mm) above any floor, balcony or gallery.

Reason:
AWC proposes this code change as part of a package which, when taken together, as a group, creates the safety and reliability requirements necessary for the regulation of large mass timber (MT) buildings by the Florida Building Code. The following statement was offered by the Ad Hoc Committee on Tall Wood Buildings (TWB) for this proposal (IBC-G146-18) in the ICC Code Development monograph 2018 Group A:

The Ad Hoc Committee on Tall Wood Buildings (TWB) was created by the ICC Board to explore the science of tall wood buildings and take action on developing code changes for tall wood buildings. The TWB has created several code change proposals with respect to the concept of tall buildings of mass timber and the background information is at the end of this Statement. Within the statement are important links to information, including documents and videos, used in the deliberations which resulted in these proposals.

This code change will result in consistency with the purpose and scope which was to leave intact the current Type IV heavy timber provisions. The HT category was created to differentiate the three (3) new categories of "mass timber", where HT represents the long-established heavy timber category that has been in the ICC family of codes, and the predecessor legacy codes, for decades.

The Ad Hoc Committee for Tall Wood Buildings (AHC-TWB) was created by the ICC Board of Directors to explore the building science of tall wood buildings with the scope to investigate the feasibility of and act on developing code changes for these buildings. Members of the AHC-TWB were appointed by the ICC Board of Directors. Since its creation in January 2016, the AHC-TWB has held 8 open meetings and numerous Work Group conference calls. Four Work Groups were established to address over 80 issues and concerns and review over 60 code proposals for consideration by the AHC-TWB. Members of the Work Groups included AHC-TWB members and other interested parties. Related documentation and reports are posted on the AHC-TWB website at:

https://www.iccsafe.org/codes-tech-support/cs/icc-ad-hoc-committee-on-tall-wood-buildings/ .

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

F10353

Date Submitted	02/13/2022	**Section**	35	**Proponent**	Greg Johnson
Chapter	35	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

Type IV Mass timber proposed mods: 10099; 10162; 10163; 10167; 10168; 10174

Summary of Modification

Identifies referenced standards related to new Type IV construction classifications

Rationale

This modification provides section and edition details for standards referenced as part of the Type IV mass timber construction modifications. These standards were all updated or added as part of Mod#9124 (ADM47-16) so staff and TAC members should already have copies. APA 320-19 is provided as it is not referenced in the current FBC.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None; reference standards update.

Impact to building and property owners relative to cost of compliance with code

None; reference standards update.

Impact to industry relative to the cost of compliance with code

None; reference standards update.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Reference standards update.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Improves the code by updating to current referenced standards.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No materials are required of prohibited by this modification.

Does not degrade the effectiveness of the code

Improves the code by updating to current referenced standards.

2nd Comment Period

F10353-G1

Proponent	Greg Johnson	Submitted	8/11/2022 5:57:11 PM	Attachments	No

Comment:

All of the proposed referenced standards are already accepted for reference in the FL Building Code (S10106 provided some updates approved by the structural TAC). This modification identifies the applicability of the referenced standard to specific sections related to mass timber.

2nd Comment Period

F10353-G2

Proponent	ashley ong	Submitted	8/26/2022 4:05:08 PM	Attachments	No

Comment:

Building Officials Association of Florida (BOAF) supports this modification.

AISI S220—~~15~~20 North American Standard for Cold-formed Steel Framing-Nonstructural Members, ~~2015~~
722.7.2.1, 2203.1, 2203.2, 2211.1, 2211.2, 2214.3, Table 2506.2, Table 2507.2

ANSI/APA PRG 320-19 Standard for Performance-Rated Cross-Laminated Timber
602.4

ASTM C920—~~14~~18 A Standard for Specification for Elastomeric Joint Sealants
1711.2.1, 2415.4, Table 2506.2, B303.6, E303.3.1

ASTM C1002-18 Specification for Steel Self-piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
722.7.2.2

ASTM D3498—03 (2011) Standard Specifications for Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems
1711.2.1, 2314.4.4, 2322.1.5

ASTM E84—2016 Test Methods for Surface Burning Characteristics of Building Materials
202, 402.6.4.4, 406.7.2, 452.2.16.3, 602.4.1.1, 602.4.2.1, 602.4.3.1, 1703.5.2, 720.1, 720.4, 803.1.1, 803.1.4, 803.10, 803.11, 806.7, 1403.5, 1404.12.1, 1407.9, 1407.10.1, 1409.9, 1409.10.1, 1510.6.2, 1510.6.3, 2303.2, 2314.4.4, 2603.3, 2603.4.1.13, 2603.5.5, 2604.2.4, 2606.4, 2612.3, 2614.3, 3105.6

NFPA 275—17 Standard Method of Fire Tests for the Evaluation of Thermal Barriers
508.4.4.1, 509.4.1, 1407.10.2, 1409.10.2, 2603.4

UL 723—~~2008~~2018 Standard for Test for Surface Burning Characteristics of Building Materials—with Revisions through August 2013
202, 402.6.4.4, 406.7.2, 602.4.1.1, 602.4.2.1, 602.4.3.1, 703.5.2, 720.1, 720.4, 803.1.1, 803.1.4, 803.10, 803.11, 806.7, 1403.5, 1404.12.1, 1407.9, 1407.10.1,1409.9, 1409.10.1, 1510.6.2, 1510.6.3, 2303.2, 2603.3, 2603.4.1.13, 2603.5.4, 2603.5.5, 2604.2.4, 2606.4, 2612.3, 2614.3, 3105.3.4.1, D102.2.8, D106

ANSI/APA PRG 320-2019

AMERICAN NATIONAL STANDARD

Standard for Performance-Rated Cross-Laminated Timber

AMERICAN NATIONAL STANDARD

Approval of an American National Standard requires review by ANSI that the requirements for due process, consensus, and other criteria for approval have been met by the standards developer. Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made towards their resolution. The use of American National Standards is completely voluntary; their existence does not in any respect preclude anyone from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standards.

The American National Standards Institute does not develop standards and will in no circumstances give an interpretation of any American National Standard. Moreover, no person shall have the right or authority to issue an interpretation of an American National Standard in the name of the American National Standards Institute. Requests for interpretations should be addressed to the secretariat or sponsor whose name appears on the title page of this standard.

Caution Notice: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken periodically to reaffirm, revise, or withdraw this standard. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute.

American National Standards Institute
25 West 43rd Street, 4th Floor
New York, NY 10036
www.ansi.org

Published by
APA – The Engineered Wood Association
7011 South 19th Street
Tacoma, WA 98466

Cover photo courtesy of Nordic Structures.

ANSI/APA PRG 320-2019

AMERICAN NATIONAL STANDARD

Standard for Performance-Rated Cross-Laminated Timber

APA – The Engineered Wood Association

Approved January 6, 2020
American National Standards Institute

FOREWORD (This Foreword is not a part of American National Standard ANSI/APA PRG 320-2019)

This standard provides requirements and test methods for qualification and quality assurance for performance-rated cross-laminated timber (CLT), which is manufactured from solid-sawn lumber or structural composite lumber (SCL) intended for use in construction applications. Product performance classes are also specified.

The development of this consensus American National Standard was achieved by following the *Operating Procedures for Development of Consensus Standards* of *APA – The Engineered Wood Association*, approved by the American National Standards Institute (ANSI).

Inquiries or suggestions for improvement of this Standard should be directed to *APA – The Engineered Wood Association* at 7011 South 19th Street, Tacoma, WA 98466, www.apawood.org.

CONTENTS

Continued next page

CONTENTS (continued)

1 SCOPE

Cross-laminated timber (CLT) panels referenced in this standard are defined in 3.2 and shall be qualified and marked in accordance with this standard. This standard provides requirements for dimensions and tolerances, performance, test methods, quality assurance, and marking for CLT panels.

CLT panels shall be used in dry service conditions, such as in most covered structures, where the average equilibrium moisture content of solid wood is less than 16 percent in the U.S. and is 15 percent or less over a year without exceeding 19 percent in Canada. CLT panels qualified in accordance with the provisions of this standard are intended to resist the effects of moisture on structural performance as may occur due to construction delays or other conditions of similar severity. Products marked in accordance with this standard shall be used in accordance with the installation requirements prescribed in the recommendations provided by the CLT manufacturer, an *approved agency*, and/or its trade association. Finger joining, edge gluing, and face gluing between CLT panels, and camber of CLT panels are beyond the scope of this standard.

The annex contained in this standard is mandatory, while notes and appendices are non-mandatory. This standard incorporates the U.S. customary units as well as the International System of Units (SI). The values given in the U.S. customary units are the standard in the U.S. and the SI values given in parentheses are the standard in Canada.

2 REFERENCED DOCUMENTS

This standard incorporates dated references. Subsequent amendments or revisions to these references apply to this standard only when incorporated into this standard by amendments or revisions.

2.1 ASTM Standards

ASTM D9-12 Standard Terminology Relating to Wood and Wood-Based Products

ASTM D198-15 Standard Test Methods of Static Tests of Lumber in Structural Sizes

ASTM D905-08 (2013) Standard Test Method for Strength Properties of Adhesive Bonds in Shear by Compression Loading

ASTM D907-15 Standard Terminology of Adhesives

ASTM D1037-12 Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials

ASTM D2395-17 Standard Test Methods for Specific Gravity of Wood and Wood-Base Materials

ASTM D2559-12a (2018) Standard Specification for Adhesives for Bonded Structural Wood Products for Use Under Exterior Exposure Conditions

ASTM D2915-17 Standard Practice for Sampling and Data-Analysis for Structural Wood and Wood-Based Products

ASTM D3737-18e1 Standard Practice for Establishing Stresses for Structural Glued Laminated Timber (Glulam)

ASTM D4761-19 Standard Test Methods for Mechanical Properties of Lumber and Wood-Based Structural Material

ASTM D5055-19 Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists

ASTM D5456-19 Standard Specification for Evaluation of Structural Composite Lumber Products

ASTM D6815-09 (2015) Standard Specification for Evaluation of Duration of Load and Creep Effects of Wood and Wood-Based Products

ASTM D7247-17 Standard Test Method for Evaluating the Shear Strength of Adhesive Bonds in Laminated Wood Products at Elevated Temperatures

ASTM D7374-08 (2015) Standard Practice for Evaluating Elevated Temperature Performance of Adhesives Used in End-Jointed Lumber

2.2 CSA Standards

CAN/CSA O86-14 (Reprint 2016) Engineering Design in Wood

CAN/ULC S101-14 Standard Methods of Fire Endurance Tests of Building Construction and Materials

CSA O112.10-08 (R2013) Evaluation of Adhesives for Structural Wood Products (Limited Moisture Exposure)

CSA O122-16 Structural Glued-Laminated Timber

CSA O141-05 (R2014) Softwood Lumber

CSA O177-06 (R2015) Qualification Code for the Manufacturers of Structural Glued-Laminated Timber

2.3 Other Standards

AITC Test T107-2007 Shear Test

ANSI 405-2018 Standard for Adhesives for Use in Structural Glued Laminated Timber

ANSI A190.1-2017 Structural Glued Laminated Timber

ANSI/AWC NDS-2018 National Design Specification for Wood Construction

ISO/IEC 17011-2017 Conformity Assessment—General Requirements for Accreditation Bodies Accrediting Conformity Assessment Bodies

ISO/IEC 17020-2012 Conformity Assessment—Requirements for Operation of Various Types of Bodies Performing Inspection

ISO/IEC 17025-2017 General Requirements for the Competence of Testing and Calibration Laboratories

ISO/IEC 17065-2012 Conformity Assessment—Requirements for Bodies Certifying Products, Processes, and Services

NLGA Standard Grading Rules for Canadian Lumber (2017)

NLGA SPS 1-2017 Special Products Standard for Fingerjoined Structural Lumber

NLGA SPS 2-2019 Special Products Standard for Machine Graded Lumber

NLGA SPS 4-2014 Special Products Standard for Fingerjoined Machine Graded Lumber

NLGA SPS 6-2015 Special Products Standard for Structural Face-Glued Lumber

U.S. Product Standard PS 1-09 Structural Plywood

U.S. Product Standard PS 20-15 American Softwood Lumber Standard

3 TERMINOLOGY

3.1 Definitions

See the referenced documents for definitions of terms used in this standard.

3.2 Terms Specific to This Standard

ASD Reference Design Value—design value used in the U.S. based on normal duration of load, dry service conditions, and reference temperatures up to 100°F (38°C) for Allowable Stress Design (ASD)

Adhesive—a chemical substance capable of bonding materials together (aka Glue)

Adherend—a material held to another material by an adhesive

Approved Agency (Canada)—an established and recognized agency regularly engaged in conducting certification services, when such agency has been approved by regulatory bodies (see *Qualified Certification Agency*)

Approved Agency (U.S.)—an established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved by regulatory bodies (see *Qualified Inspection Agency* and *Qualified Testing Agency*)

Billet— an unfinished CLT panel formed by a single pressing operation

Note 1: *One or several finished CLT panels may be produced from a billet*

Bond—the attachment at an interface between adhesive and adherends or the act of attaching adherends together by adhesive

Bondline—the layer of adhesive that attaches two adherends

- **Face bondline**—the bondline joining the wide faces of laminations in adjacent layers
- **Bondline**—the optional bondline joining the narrow faces of adjacent laminations within one layer

Characteristic Values—the structural property estimate, typically a population mean for stiffness properties or a tolerance limit (5th percentile with 75% confidence) for strength properties, as estimated from the test data that is representative of the population being sampled

Certificate of Conformance—a certificate issued by an approved agency certifying the product as in conformance to a standard or standards

Cross-Laminated Timber (CLT)—a prefabricated engineered wood product made of at least three orthogonal layers of graded sawn lumber or structural composite lumber (SCL) that are laminated by gluing with structural adhesives

CLT Grade—a class of CLT determined by the combination of grades of laminations in the longitudinal and transverse layers

Note 2: *Basic CLT grades and layups in this standard are listed in Annex A. Custom CLT grades and layups may be established in accordance with 7.1.2 (see Layup).*

CLT Length—dimension of the CLT panel measured parallel to the major strength direction

Note 3: *The length and width of CLT defined in this standard are based on the CLT panel face layer orientation and may not be related to the end-use applications, such as wall, roof, and floor.*

CLT Panel—a single piece of CLT

CLT Thickness—dimension of the CLT panel measured perpendicular to the plane of the panel

CLT Width—dimension of the CLT panel measured perpendicular to the major strength direction

Cure—the process of converting an adhesive into a fixed or hardened state by chemical and/or physical action

Delamination—the separation of layers in a laminate due to failure of the adhesive either in the adhesive itself or at the interface between the adhesive and the adherend

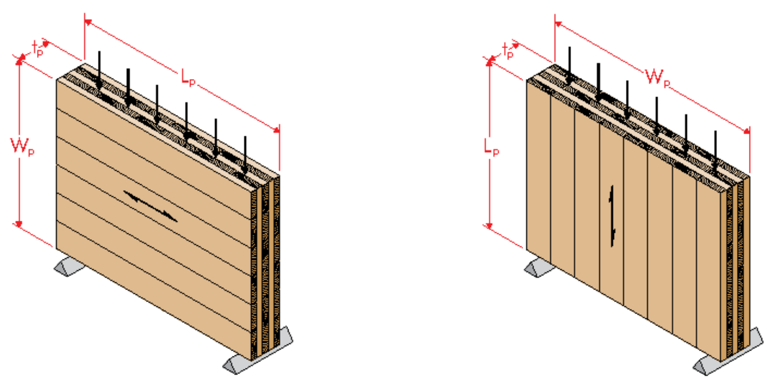
Note 4: *For a specimen, the average delamination is calculated as the ratio of the total length of delamination on all exposed bond lines divided by the total length of all exposed bond lines, in percentage.*

Edge (Panel Edge)—the narrow face of a panel that exposes the ends or narrow faces of the laminations

Edgewise Bending—bending of CLT under loads applied to the panel edge (see Figure 1) creating in-plane bending and edgewise shear, also known as in-plane shear or shear through-the-thickness

FIGURE 1

EDGEWISE BENDING IN THE MAJOR (LEFT) AND MINOR (RIGHT) CLT STRENGTH DIRECTIONS



Edge Joint—a joint of the narrow faces of adjacent laminations within a CLT layer with or without gluing

Effective Bonding Area—proportion of the lamination wide face averaged over its length that is able to form a close contact bond upon application of pressure

End Joint—a joint made by gluing the ends of two pieces of laminations within a CLT layer

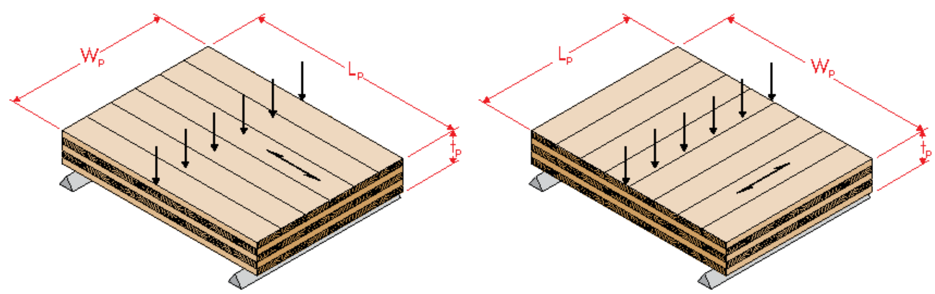
Face—one of the four longitudinal surfaces of a piece or panel

- **Lamination narrow face**—the face with the least dimension perpendicular to the lamination length
- **Lamination wide face**—the face with the largest dimension perpendicular to the lamination length
- **Panel face**—the face of the CLT length-width plane

Flatwise Bending—bending of CLT under transverse loads applied to the panel face (see Figure 2) creating out-of-plane bending and flatwise shear, also known as planar or rolling shear

FIGURE 2

FLATWISE BENDING IN THE MAJOR (LEFT) AND MINOR (RIGHT) CLT STRENGTH DIRECTIONS



Lamination—a piece of sawn lumber or structural composite lumber, including stress rated boards, remanufactured lumber, or end-joined lumber, which has been prepared and qualified for laminating

Layer—an arrangement of laminations laid out parallel to each other in one plane

- **Longitudinal layer**—a layer with the laminations oriented parallel to the major strength direction
- **Transverse layer**—a layer with the laminations oriented perpendicular to the major strength direction, also referred to as cross layer

Layup—an arrangement of layers in a CLT panel determined by the grade(s), number, orientations, and thickness(es) of layers

LSD Design Value—design value used in Canada based on standard-term duration of load, dry service conditions, and temperatures up to 122°F (50°C) except for occasional exposures to 150°F (65°C) for Limit States Design (LSD)

Major Strength Direction—direction parallel to strength direction of the laminations in the outer layers of the CLT panel

Manufacturing Standard—a document that establishes the minimum requirements for manufacturing practices, staff, facilities, equipment, and specific quality assurance processes, including inspection (in the U.S.) and/or certification (in Canada), by which the product is manufactured

Mill Specification—a manufacturing specification based on product evaluation to be used for quality assurance purposes by the manufacturer and the *approved agency*

Minor Strength Direction—direction of the grain of the inner layers perpendicular to the major strength direction of the CLT panel

Qualified Certification Agency (Canada)—an agency meeting the following requirements:

a. has trained personnel to perform product certification in compliance with all applicable requirements specified in this standard,

b. has procedures to be followed by its personnel in performance of the certification,

c. has no financial interest in, or is not financially dependent upon, any single company manufacturing the product being certified,

d. is not owned, operated, or controlled by any such company, and

e. is accredited by a recognized accreditation body under ISO/IEC 17065

Qualified Inspection Agency (U.S.)—an agency meeting the following requirements:

a. has trained personnel to verify that the grading, measuring, species, construction, bonding, workmanship, and other characteristics of the products as determined by inspection in compliance with all applicable requirements specified in this standard,

b. has procedures to be followed by its personnel in performance of the inspection,

c. has no financial interest in, or is not financially dependent upon, any single company manufacturing the product being inspected,

d. is not owned, operated, or controlled by any such company, and

e. is accredited by a recognized accreditation body under ISO/IEC 17020

Qualified Testing Agency—an agency meeting the following requirements:

a. has access to the facilities and trained technical personnel to conduct testing on the characteristics of the products by sampling and testing in compliance with all applicable requirements specified in this standard,

b. has procedures to be followed by its personnel in performance of the testing,

c. has no financial interest in, or is not financially dependent upon, any single company manufacturing the product being tested,

d. is not owned, operated, or controlled by any such company, and

e. is accredited by a recognized accreditation body under ISO/IEC 17025

Recognized Accreditation Body—an organization complying with ISO/IEC 17011 and recognized by the regulatory body having jurisdiction as qualified to evaluate and accredit certification agencies, inspection agencies and/or testing agencies

Remanufactured Lumber—lumber that meets the requirements of Section 5.4 of ANSI A190.1 in the U.S., or NLGA SPS 1, 2, 4, or 6 in Canada

Sample—one or more items taken as representative of a population or portion of material taken without bias from a bulk of material for assessment

Specimen—an individual piece of material or product selected for testing

Structural Composite Lumber (SCL)—an engineered wood product that is intended for structural use and bonded with adhesives, and meeting the definition and requirements of ASTM D5456

Wood Failure—the rupturing of wood fibers from the specified block shear test on bonded specimens, measured as the area of wood fiber remaining at the bondline and expressed as a percentage of total area involved in such failure

4 SYMBOLS

4.1 CLT Section and Mechanical Properties

Symbol	Definition	Reference(s)
$E_{e,0}$	Effective edgewise bending modulus of elasticity of CLT, in psi (MPa), in the major strength direction, used with $I_{e,0}$ when calculating edgewise bending stiffness	8.5.5.2
$E_{e,90}$	Effective edgewise bending modulus of elasticity of CLT, in psi (MPa), in the minor strength direction, used with $I_{e,90}$ when calculating edgewise bending stiffness	8.5.5.2
$(EI)_{eff,f,0}$	Effective flatwise bending stiffness of CLT, in lbf-in²/ft (N-mm²/m) of width, in the major strength direction	8.5.3.2 and Tables A2 and A4
$(EI)_{eff,f,90}$	Effective flatwise bending stiffness of CLT, in lbf-in²/ft (N-mm²/m) of width, in the minor strength direction	8.5.3.2 and Tables A2 and A4
$f_{b,e,0}$	Effective LSD specified edgewise bending strength of CLT, in MPa, in the major strength direction, used with $S_{e,0}$ when calculating LSD edgewise bending moment resistance.	8.5.5.2
$F_{b,e,0}$	Effective ASD reference edgewise bending stress of CLT, in psi, in the major strength direction, used with $S_{e,0}$ when calculating ASD reference edgewise bending moment.	8.5.5.2
$f_{b,e,90}$	Effective LSD specified edgewise bending strength of CLT, in MPa, in the minor strength direction, used with $S_{e,90}$ when calculating LSD edgewise bending moment resistance.	8.5.5.2
$F_{b,e,90}$	Effective ASD reference edgewise bending stress of CLT, in psi, in the minor strength direction, used with $S_{e,90}$ when calculating ASD reference edgewise bending moment.	8.5.5.2
$(f_bS)_{eff,f,0}$	Effective LSD flatwise bending moment resistance of CLT, in N-mm/m of width, in the major strength direction	8.5.3.2 and Table A4
$(F_bS)_{eff,f,0}$	Effective ASD reference flatwise bending moment of CLT, in lbf-ft/ft of width, in the major strength direction	8.5.3.2 and Table A2
$(f_bS)_{eff,f,90}$	Effective LSD flatwise bending moment resistance of CLT, in N-mm/m of width, in the minor strength direction	8.5.3.2 and Table A4
$(F_bS)_{eff,f,90}$	Effective ASD reference flatwise bending moment of CLT, in lbf-ft/ft of width, in the minor strength direction	8.5.3.2 and Table A2
$f_{v,e,0}$	LSD specified edgewise shear strength of CLT, in MPa, in the major strength direction, used with t_p when calculating LSD edgewise shear resistance.	8.5.6.2
$F_{v,e,0}$	ASD reference edgewise shear stress of CLT, in psi, in the major strength direction, used with t_p when calculating ASD reference edgewise shear capacity.	8.5.6.2
$f_{v,e,90}$	LSD specified edgewise shear strength of CLT, in MPa, in the minor strength direction, used with t_p when calculating LSD edgewise shear resistance.	8.5.6.2
$F_{v,e,90}$	ASD reference edgewise shear stress of CLT, in psi, in the minor strength direction, used with t_p when calculating ASD reference edgewise shear capacity	8.5.6.2
$G_{e,0}$	Effective modulus of rigidity (shear modulus) in edgewise bending of CLT, in psi (MPa), in the major strength direction, used with t_p when calculating edgewise shear stiffness	8.5.6.2
$G_{e,90}$	Effective modulus of rigidity (shear modulus) in edgewise bending of CLT, in psi (MPa), in the minor strength direction, used with t_p when calculating edgewise shear stiffness	8.5.6.2
$(GA)_{eff,f,0}$	Effective shear stiffness in flatwise bending of CLT in lbf/ft (N/m) of width in the major strength direction	8.5.4.2, and Tables A2 and A4
$(GA)_{eff,f,90}$	Effective shear stiffness in flatwise bending of CLT in lbf/ft (N/m) of width in the minor strength direction	8.5.4.2, and Tables A2 and A4
$I_{e,0}$	Gross moment of inertia of CLT in edgewise bending in the major strength direction, in in.⁴ (mm⁴), for a specific panel width (beam depth), calculated as $\frac{W_p^3 t_p}{12}$	8.5.5.2

Symbol	Definition	Reference(s)
$I_{e,90}$	Gross moment of inertia of CLT in edgewise bending in the minor strength direction, in in.[4] (mm[4]), for a specific panel length (beam depth), calculated as $\frac{L_p^3 t_p}{12}$	8.5.5.2
L_p	Length of CLT panel in ft (m), measured in the major strength direction	Figures 1 and 2
$S_{e,0}$	Gross section modulus of CLT in edgewise bending in the major strength direction, in in.[3] (mm[3]) for a specific CLT width (beam depth), calculated as $\frac{W_p^2 t_p}{6}$	8.5.5.2
$S_{e,90}$	Gross section modulus of CLT in edgewise bending in the minor strength direction, in in.[3] (mm[3]) for a specific CLT length (beam depth), calculated as $\frac{L_p^2 t_p}{6}$	8.5.5.2
t_p	Gross thickness of CLT panel, in in. (mm)	Figures 1 and 2, Tables A2 and A4, and 8.5.6.2
$v_{s,0}$	LSD flatwise shear resistance, in N/m of width, in the major strength direction	8.5.4.2 and Table A4
$V_{s,0}$	ASD reference flatwise shear capacity, in lbf/ft of width, in the major strength direction	8.5.4.2 and Table A2
$v_{s,90}$	LSD flatwise shear strength, in N/m of width, in the minor strength direction	8.5.4.2 and Table A4
$V_{s,90}$	ASD reference flatwise shear capacity, in lbf/ft of width, in the minor strength direction	8.5.4.2 and Table A2
W_p	Width of CLT panel in ft (m), measured in the minor strength direction	Figures 1 and 2

4.2 Lamination Mechanical Properties

Symbol	Definition	Reference(s)
E	Modulus of elasticity of a lamination, in psi (MPa)	Tables A1 and A3
f_b	Characteristic bending strength or LSD specified bending strength of a lamination, in psi (MPa)	Table A3
F_b	ASD reference bending stress of a lamination, in psi	Table A1
f_c	Characteristic axial compressive strength or LSD specified axial compressive strength of a lamination, in psi (MPa)	Table A3
F_c	ASD reference axial compressive stress of a lamination, in psi	Table A1
f_s	Characteristic planar (rolling) shear strength or LSD specified planar (rolling) shear strength of a lamination, in psi (MPa)	Table A3
F_s	ASD reference planar (rolling) shear stress of a lamination, in psi	Table A1
f_t	Characteristic axial tensile strength or LSD specified axial tensile strength of a lamination, in psi (MPa)	Table A3
F_t	ASD reference axial tensile stress of a lamination, in psi	Table A1
f_v	Characteristic shear strength or LSD specified shear strength of a lamination, in psi (MPa)	Table A3
F_v	ASD reference shear stress of a lamination, in psi	Table A1
G	Modulus of rigidity (shear modulus) of a lamination, in psi (MPa)	Tables A1 and A3

5 PANEL DIMENSIONS AND DIMENSIONAL TOLERANCES

5.1 CLT Thickness

The CLT thickness shall not exceed 20 inches (508 mm).

5.2 CLT Dimensional Tolerances

Dimension tolerances permitted at the time of manufacturing shall be as follows:

- CLT Thickness: ± 1/16 inch (1.6 mm) or 2% of the CLT thickness, whichever is greater
- CLT Width: ± 1/8 inch (3.2 mm)
- CLT Length: ± 1/4 inch (6.4 mm)

Textured or other face or edge finishes are permitted to alter the tolerances specified in this section. The designer shall compensate for any loss in cross-section and/or specified strength of such alterations.

Note 5: *The manufacturer may be contacted for recommendations.*

5.3 Squareness

Unless specified otherwise, the length of the two panel face diagonals measured between panel corners shall not differ by more than 1/8 inch (3.2 mm).

5.4 Straightness

Unless specified otherwise, deviation of edges from a straight line between adjacent panel corners shall not exceed 1/16 inch (1.6 mm).

6 COMPONENT REQUIREMENTS

6.1 Laminations

6.1.1 General

Lumber meeting the requirements of 6.1.2 and structural composite lumber meeting the requirements of 6.1.3 shall be permitted for use as laminations in CLT manufacturing and shall meet the requirements specified in 6.1.4 through 6.1.8. Laminations within the same layer shall be of the same thickness, type, grade, and species or species combination.

Note 6: *Laminations in different layers may be of different thicknesses, types, grades, and species or species combinations.*

6.1.2 Sawn lumber laminations

a. Lumber species – Lumber of any softwood species or species combinations recognized by American Lumber Standards Committee (ALSC) under PS 20 or Canadian Lumber Standards Accreditation Board (CLSAB) under CSA O141 with a minimum published specific gravity of 0.35, as published in the National Design Specification for Wood Construction (NDS) in the U.S. and CSA O86 in Canada, shall be permitted.

b. Lumber grades – The minimum grade of lumber in the longitudinal layers of CLT shall be 1200f-1.2E MSR or visual grade No. 2. The minimum grade of lumber in the transverse layers of CLT shall be visual grade No. 3. Remanufactured lumber shall be considered as equivalent to solid-sawn lumber when qualified in accordance with Section 5.4 of ANSI A190.1 in the U.S. or SPS 1, 2, 4, or 6 in Canada. Proprietary lumber grades meeting or exceeding the mechanical properties of the lumber grades specified above shall be permitted for use provided that they are qualified in accordance with the requirements of an *approved agency.*

Note 7: *ASTM D5055 provides guidance for proprietary lumber grades used specifically in I-joist applications.*

6.1.3 Structural composite lumber (SCL) laminations

Laminated Strand Lumber (LSL), Laminated Veneer Lumber (LVL), Oriented Strand Lumber (OSL), and Parallel Strand Lumber (PSL) meeting the requirements of ASTM D5456 and with a minimum published equivalent specific gravity of 0.35 shall be permitted.

6.1.4 Lamination sizes

a. Width – For longitudinal layers (major strength direction), the net lamination width shall not be less than 1.75 times the net lamination thickness. For transverse layers (minor strength direction), the net width of a lamination, or the combined width of an edge-bonded lamination or remanufactured lumber shall not be less than 3.5 times the net lamination thickness unless the interlaminar shear strength and creep are evaluated by testing in accordance with Section 8.5.5 and the principles of ASTM D6815, respectively. Laminations made of SCL shall be permitted to be full CLT width.

b. Thickness – The net lamination thickness in any layer at the time of gluing shall not be less than 5/8 inch (16 mm) or more than 2 inches (51 mm). The lamination thickness shall not vary within the same CLT layer subject to the tolerances specified in 6.1.7.

Note 8: *The CLT manufacturer should contact the SCL manufacturer to ensure that protective coatings have not been applied to the surface of the SCL that may hamper the face bonding of the SCL laminations.*

6.1.5 Moisture content

The moisture content of the laminations at the time of CLT manufacturing shall be typically 12 ± 3% and 8 ± 3%, for lumber and SCL laminations, respectively. Lower lamination moisture contents shall be permitted if the adhesive bond performance is qualified at the lower moisture content in accordance with 6.3.3, 8.2.5, and 8.2.6, and meets the recommendations provided by the adhesive manufacturer. When a lower moisture content is used, the as-manufactured moisture content of the laminations shall be within ± 3% of the average moisture content from the qualification.

6.1.6 Face–bonding surface

a. General – Laminations shall be prepared to provide bonding surfaces for adhesive bond performance required by this standard and to meet the recommendations provided by the adhesive manufacturer.

Note 9: *Satisfactory face-bonding surfaces are typically free from dust, foreign matter, and exudation that are detrimental to adhesive bond performance.*

b. Lumber – All face-bonding surfaces shall be planed or sanded prior to face bonding. The process used to prepare bonding surfaces shall be approved by the *approved agency.*

Note 10: *Satisfactory face-bonding surfaces are typically free of raised grain, torn grain, skip, burns, glazing or other deviations from the plane of the surface that might interfere with the contact of sound wood fibers in the bonding surfaces, except for minor local variations. It may be necessary to plane or sand the lumber lamination surfaces within 48 hours of face bonding for some wood species.*

c. SCL – Planing or sanding of face-bonding surfaces prior to face bonding shall not be required unless indicated otherwise by the adhesive bond qualification or required to meet lamination thickness tolerances.

6.1.7 Face–bonding dimensional tolerances

At the time of face bonding, the thickness variation across the width of a lumber lamination shall not exceed ±0.008 inch (0.20 mm) and the thickness variation across the width of a SCL lamination shall not exceed ±0.008 inch (0.20 mm) in every 12-inch (30.5-mm) width. The thickness variation along the length of a lumber or SCL lamination shall not exceed ±0.012 inch (0.30 mm).

Note 11: *Cup and twist, if present, should be small enough to be flattened out by pressure in bonding.*

6.1.8 Gaps between adjacent lamination edges

At the time of CLT manufacturing, laminations in the CLT layers shall be tightly fit. Gaps between adjacent lamination edges (edge joint gaps) are permitted as follows: Edge joint gaps in face layers shall not exceed 1/4 inch (6.4 mm) and edge joint gaps between adjacent lamination edges in other layers shall not exceed 3/8 inch (9.5 mm).

Note 12: *Edge joint gaps are typically caused by imperfections such as crook or twist in individual laminations, which prevent contact along the full length of edges. Consequently, small gaps may occur in a layer at the time of manufacturing. These gaps are not typically present between all laminations in the layer or along the full length of individual edges. Small natural growth characteristics of lumber, such as knots and wane, are not considered as part of an edge joint gap and should not be included in the measurements. The intent of this standard is for the laminations to be tightly fit with no individual gap exceeding the prescribed limits.*

Note 13: *This provision applies at the time when the CLT billet exits the press and the quality assurance measures are implemented at the plant. Gaps in face layers may increase slightly as CLT billets or panels season.*

Note 14: *When edge joints of laminations are not bonded with an adhesive or not filled with a filler, small air gaps are common for CLT (see Note 12). These gaps will affect the air tightness through the CLT thickness, and the effect will depend on the number of CLT layers and actual gap size as manufactured. If air tightness is an important requirement, such as in fire containment, thermal resistance, or sound attenuation, additional measures should be incorporated in the assembly design, such as the use of an air-tight membrane (e.g. concrete floor topping or finished gypsum wallboard ceiling for floor-ceiling assemblies or finished gypsum wallboard or plaster for wall assemblies).*

6.2 Adhesives

Adhesives used for CLT manufacturing shall meet the requirements specified in this section.

6.2.1 Requirements in the U.S.

Adhesives used in CLT shall meet the requirements of ANSI 405 with the following exceptions:

a. Section 2.1.6 of ANSI 405 is not required, and

b. The CSA O177 small-scale flame test (Sections 2.1.7 and 3.7 of ANSI 405) shall be conducted using CLT specimens of the same size and geometry as the structural glued laminated timber specimens.

6.2.2 Requirements in Canada

Adhesives used in CLT shall meet the requirements of CSA O112.10, and Sections 2.1.3, 2.1.7, 3.3, and 3.7 of ANSI 405 with the following exception:

a. The CSA O177 small-scale flame test (Sections 2.1.7 and 3.7 of ANSI 405) shall be conducted using CLT specimens of the same size and geometry as the structural glued laminated timber specimens.

Note 15: *The CSA O177 small-scale flame test specimens should be made with orthogonal 0.78-inch (20-mm) laminations to replicate a CLT configuration, resulting in 8 laminations (6.3 inches or 160 mm) in height, and approximately 6 inches (150 mm) in width and 1.6 inches (40 mm) in thickness. There should be no edge joints within the inner 6 laminations. Whenever possible, the pith should be centered along the lamination.*

6.2.3 Elevated temperature performance requirements in the U.S. and Canada

Adhesives shall be evaluated and comply with the requirements for elevated temperature performance in accordance with Annex B.

Note 16: *The intent of the elevated temperature performance evaluation is to identify and exclude use of adhesives that permit CLT char layer fall-off resulting in fire regrowth during the cooling phase of a fully developed fire.*

6.3 Lamination Joints

6.3.1 General

The lamination joints of CLT shall meet the requirements specified in this section.

6.3.2 End joints in laminations

End joints in each lamination shall be either finger-jointed or scarf-jointed. Butt joints shall not be permitted. The manufacturing of end joints shall follow ANSI A190.1 in the U.S. or CSA O122 in Canada. The strength, wood failure, and bond durability of lamination end joints shall be qualified in accordance with the requirements specified herein.

a. Full-size end-joint specimens shall be prepared from lumber or SCL selected at random from stock meeting the requirements of 6.1.1 to 6.1.5. Additional requirements specified in the CLT plant manual procedures and quality manuals shall be followed.

b. A minimum of 30 full-size end-joint specimens shall be tested in tension. The specimens shall be centered between the grips of the testing machine, which are spaced at minimum 24 inches (610 mm) apart and tested to failure in approximately 3 to 5 minutes at a constant rate of loading. The accuracy of the load measurements shall be within ±1%. Average wood failure of all end-joint specimens tested shall be equal to or greater than 80%. The characteristic tensile strength of the end joints (5th percentile with 75% confidence) shall be equal to or greater than 2.1 times the ASD tension design value in the U.S. or 1.1 times the LSD specified tensile strength in Canada of the laminating lumber or SCL.

c. A minimum of 5 individual end-joint specimens shall be selected and tested for bond durability. Each specimen shall have a length of approximately 6 inches (152 mm) with the end joint located approximately in the center of the specimen. The specimen shall be crosscut through the center of the joint with a saw kerf of 1/8 inch (3.2 mm) or less to create two specimens with a length of approximately 3 inches (76 mm) and each having at least 1/4 inch (6.4 mm) of the end joint remaining after crosscutting. The specimens shall be tested for bond durability in accordance with the method in 8.2.6(b) and shall meet the delamination requirements specified in 6.3.3(b).

6.3.3 Edge and face joints between laminations

a. The wood failure of the edge (when required for structural performance) and face joints in the block shear specimens (see Figure 4) prepared in accordance to 8.2.4 and tested in accordance to 8.2.5 shall meet the following requirements:

1. The average wood failure of all specimens combined shall equal to or greater than 80%,
2. At least 95% of all specimens shall have a wood failure of minimum 60%, and
3. For specimens with wood failure below 50%, a second block shear specimen shall be permitted to be prepared from the same bond line and tested in accordance with 8.2.5. Wood failure of the second specimen shall be 80% minimum.

b. The delamination for the edge (when required for structural performance) and face joints in the delamination specimens (see Figure 5) prepared in accordance with 8.2.4 and tested in accordance with 8.2.6 shall meet the following requirements:

1. The average delamination of all bond lines in each specimen shall not exceed 5%, and
2. If the average delamination of all bond lines in a specimen exceeds 5% but is not more than 10%, a second delamination specimen shall be permitted to be prepared from the same CLT panel and tested in accordance with 8.2.6. The average delamination of all bond lines in the second specimen shall be no more than 5%.

For CLT products using SCL laminations, the SCL-to-lumber and SCL-to-SCL face bonds shall be permitted to be evaluated in accordance with the short-span flatwise bending tests specified in Section A4.2 of ASTM D5456 except that a single vacuum-pressure-soak cycle shall be permitted, and the average strength retention shall be at least 75%.

7 CLT PERFORMANCE CRITERIA

CLT shall meet the performance requirements established in this section.

7.1 CLT Grade and Layup Requirements

CLT grades and layups shall be specified in the manufacturing standard of each CLT plant when qualified in accordance with the requirements specified in this section and by an *approved agency*. Each custom CLT grade shall have unique designation assigned by the *approved agency*.

7.1.1 Basic CLT Grades and Layups

Basic CLT grades and layups are those provided in Annex A.

Note 17: *As illustrated in Tables A2 and A4, the basic CLT grades and layups are balanced and symmetrical about the neutral axis, with alternating layers of the same lamination thickness.*

7.1.2 Custom CLT Grades and Layups

CLT grades and layups that are not listed in Annex A shall be considered as custom grades and layups. Custom CLT grades and layups shall be permitted when approved by an *approved agency* in accordance with the qualification and mechanical test requirements specified in 8.4 and 8.5.

Note 18: *Custom CLT grades and layups may be asymmetric, contain different lamination thicknesses, and have adjacent layers oriented in the same direction.*

7.2 Structural Performance Requirements

Design values for each CLT grade and layup shall be developed using an engineering model recognized by an *approved agency* and shall be evaluated and confirmed by test results in accordance with 8.4 and 8.5.

Note 19: *Design values for basic CLT grades and layups are provided in Table A2 for use in the U.S. and Table A4 for use in Canada based on the engineering model shown in Appendix X3.*

7.3 Appearance Classifications

CLT panel appearance shall be as agreed upon between the end-user and the CLT manufacturer.

Note 20: *Appendix X1 contains examples of CLT appearance classifications for reference.*

8 QUALIFICATION AND PRODUCT MARKING

8.1 Qualification Requirements

Required qualification tests for CLT components, such as lumber, SCL, adhesives, and end, face, and edge joints are provided in Section 6 and summarized in Table 1. This section provides requirements for plant qualification and CLT qualification tests to meet the structural performance levels specified in Tables A2 and A4.

TABLE 1

SUMMARY OF QUALIFICATION REQUIREMENTS

Qualification for	Standard(s)	Referenced Section(s) in This Standard
Lumber	Grading Rules/Manufacturing Standard	6.1.1, 6.1.2, 6.1.4 through 6.1.7
SCL	ASTM D5456	6.13
Adhesives	This standard	6.2
End Joints	This standard	6.3.2 and 8.2.6(b)
Face Joints	This standard	6.1.6, 6.1.7, 6.3.3, 8.2, and 8.3
Edge Joints (if applicable)	This standard	6.1.8, 6.3.3, and 8.2
CLT Panel Dimensions	This standard	5
CLT Panel Structural Performance	ASTM D198 or ASTM D4761	7.2 and 8.5

8.2 Plant Pre-Qualification

8.2.1 General

The CLT plant shall be pre-qualified for the manufacturing factors considered (see 8.2.2) using full-thickness qualification panels of 24 inches (610 mm) or more in the major strength direction and 18 inches (457 mm) or more in the minor strength direction (hereafter referred to as "pre-qualification panels"). A minimum of two replicate CLT pre-qualification panels shall be manufactured for pre-qualification for each combination of factors considered in 8.2.2. The two replicate CLT pre-qualification panels shall not be extracted from a single billet.

Note 21: *A pre-qualification panel of 24 inches (610 mm) or more in the minor strength direction is recommended, particularly for thicker CLT products.*

Pre-qualification panels shall be prepared at the facility or at an alternative facility acceptable to the *approved agency*. All pre-qualification panels shall be:

a. Of the same approximate length and width at the time of pressing;

b. Pressed individually; and

c. Taken from approximately the geometric center of the larger panel, if applicable.

8.2.2 Fabrication of pre–qualification panels

Application of pressure to manufacture pre-qualification panels shall reflect the key characteristics of the manufacturing equipment, including the platen and glue spreader (as applicable) that is or will be used in the facility to be qualified. The applicability of the results shall be documented by the *approved agency*.

Note 22: For example, pre-qualification panels for facilities using a vacuum press or an air bag should be clamped using a vacuum press or an air bag inserted between the specimen and the rigid platen. In addition, the specimen preparation facility should distinguish between, for example, roller versus curtain coating and single spread versus double spread, which varies in the uniformity of the adhesive spread.

Factors considered for pre-qualification evaluation shall include assembly time, lamination moisture content, adhesive spread rate, clamping pressure, and wood surface temperature, as specified in the manufacturing standard of the plant and accepted by the *approved agency*.

8.2.3 Conditioning of pre–qualification panels

Pre-qualification panels shall be stored in an indoor environment for a minimum of 24 hours or until the adhesive has cured sufficiently to permit evaluation, whichever is longer.

Note 23: For panels larger than the specified pre-qualification panel size, the panels may be trimmed to the specified size to facilitate conditioning.

8.2.4 Specimens

A minimum of six square/rectangular specimens (three for block shear tests, i.e., "B" specimens and three for delamination tests, i.e., "D" specimens) shall be extracted from each pre-qualification panel at the locations shown in Figure 3 and labeled to indicate the panel number and the specimen position within the panel. The block shear "B" specimens and delamination "D" specimens shall be prepared in such a way that all laminations in the major strength direction are continuous (i.e. do not include an edge joint between laminations). In the minor strength direction, a maximum of one edge joint between laminations shall be allowed in each specimen. To meet this specimen requirement, additional "B" and "D" specimens shall be considered in the specimen preparation.

The "B" and "D" specimens shall be prepared in accordance with the test specimen configuration shown in Figures 4 and 5, respectively. If the pre-qualification panel is larger than the specified pre-qualification panel size, the pre-qualification sampling area shall be 24 inches (610 mm) to 36 inches (910 mm) square located at the geometric center of the panel.

FIGURE 3

BLOCK SHEAR ("B") AND DELAMINATION ("D") SPECIMEN LOCATIONS
a = 4 ± 1 inches, L_1 = 24 to 36 inches, and L_2 = 24 to 36 inches (1 inch = 25.4 mm)

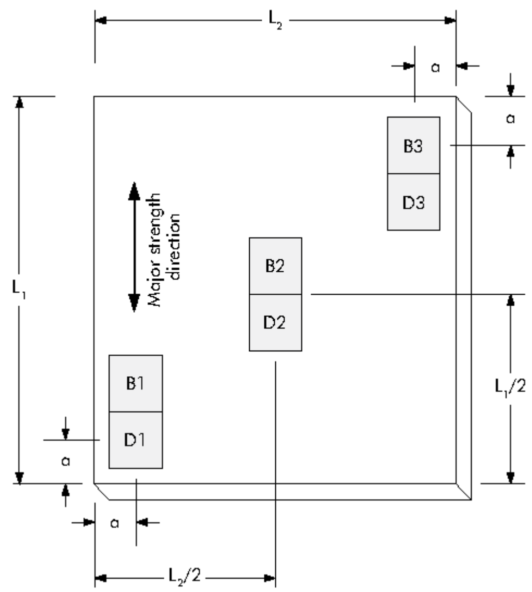
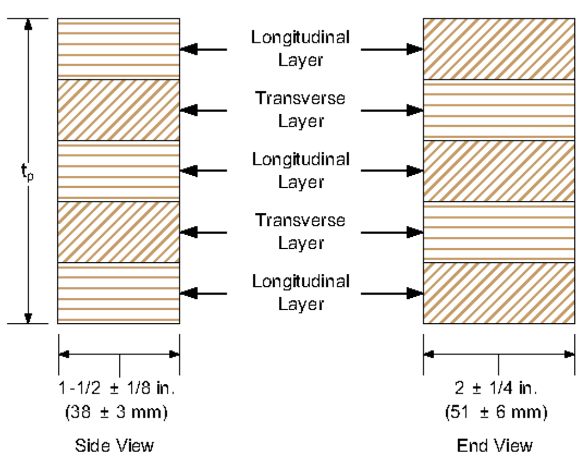


FIGURE 4

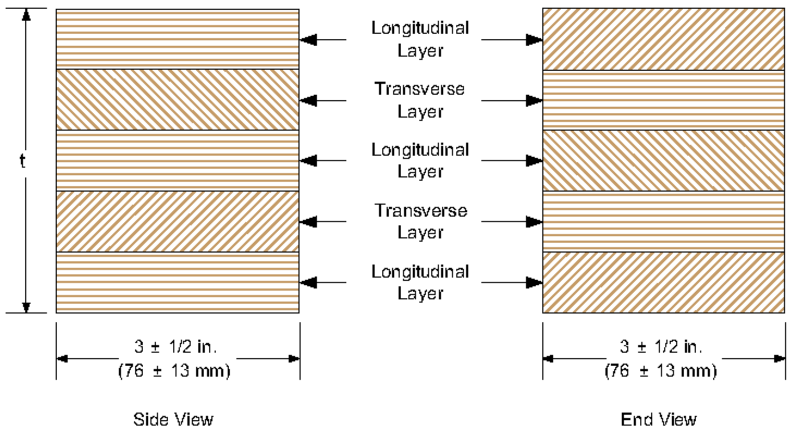
STRAIGHT-BLOCK SHEAR SPECIMEN CONFIGURATION (5-PLY CLT SHOWN)



Shear specimen configurations conforming to Figure A, B, or D of AITC Test T107 or Figure 1 of CSA 0177 are deemed to comply

FIGURE 5

DELAMINATION SPECIMEN CONFIGURATION (5-PLY CLT SHOWN)



See 8.2.4 for permissible edge joints in the minor strength direction

8.2.5 Shear tests

a. The block shear specimens obtained in accordance with 8.2.4 shall be subjected to the shear test specified herein and meet the wood failure requirements specified in 6.3.3.

b. The block shear specimens shall be placed in a standard shearing tool and tested in shear by compression loading at a uniform rate of loading of 0.50 ± 0.05 inch/min (12.7 ± 1 mm/min). The specimen shall be positioned in the shearing tool with the bond line in the shearing plane.

Note 24: *A shearing tool for testing block shear specimens in shear by compression loading is described in ASTM D905. The ASTM D905 shear block test is intended for the assessment of adhesive bonds in wood products with bonded layers parallel to each other and with the grain oriented in the same direction, such as glulam. In the case of CLT, one half of the specimen is compressed parallel to the grain, which may produce longitudinal shear along the bond line, while the other half is compressed perpendicular to the grain, which may produce rolling shear along the shear plane. It is likely that the half of the specimen loaded perpendicular to the grain undergoes substantial deformation during the test, which may lead to crushing or tensile rupture perpendicular to the grain (peeling). These complications make interpretation of the shear block test on CLT specimens challenging and are likely to increase uncertainties related to the determination of wood failure fraction values. Therefore, it is important to include the description of the failure mode(s) in the test report.*

8.2.6 Cyclic Delamination Test

a. The delamination specimens obtained in accordance with 8.2.4 shall be subjected to the cyclic delamination test specified herein and meet the delamination requirements specified in 6.3.3(b).

b. The initial weight of the delamination specimens shall be measured to the nearest gram and recorded prior to placing the specimens in an autoclave or similar pressure vessel that can safely withstand a minimum of 75 psi (517 kPa) of pressure. The specimens shall be weighted down and covered with water at a temperature of 65 to 85 °F (18 to 29 °C). A vacuum of 10 to 12 psi (69 to 85 kPa, which is equivalent to 20 to 25 inches or 510 to 640 mm Hg) shall be drawn and held for 30 minutes. The vacuum shall then be released and a pressure of 75 ± 5 psi (517 ± 34 kPa) shall be applied for 2 hours. The specimens shall be removed from the autoclave and dried in a drying oven with forced air circulation at a temperature of approximately 160°F (71°C) until their weight is approximately between 110% and 115% of their original weight. During drying, the specimens shall be spaced at approximately 2 inches (50 mm) apart and with their end-grain surfaces parallel to the direction of the air flow. After drying to 110% to 115% of their initial weight, the specimens shall be removed from the oven, and delamination measured immediately and recorded.

8.3 Qualification of Effective Bond Area

8.3.1 General

The manufacturer shall establish visual grading rules for the bonded faces and limit the average glue skip to maintain an average effective bond area of 80% or more. The manufacturer's visual grading rules established to achieve the effective bond area shall include major visual characteristics, such as wane, knots, decay, pitch pockets, torn grain, and raised grain, based on characteristic measurements consistent with standard lumber grading rules.

8.3.2 Sample selection and inspection

Samples shall be drawn from representative production of laminations meeting the manufacturer's visual grading rules and positioned in accordance with the in-plant manufacturing standard. The layer formed by the laminations shall be verified by the *approved agency* to provide an effective bond area of 80% or more over any randomly selected area not less than 48 inches (1,220 mm) by 48 inches (1,220 mm).

Note 25: *A template with a square opening, i.e., 48 inches (1,220 mm) by 48 inches (1,220 mm), may be used to facilitate inspection.*

8.4 Qualification for Structural Performance

Following plant pre-qualification, a representative sample of CLT panels shall be manufactured for qualification tests in accordance with 8.4.1 and 8.4.2. Depending on the number of CLT grades and layups intended for qualification, a qualification plan shall be developed and accepted by an *approved agency* in accordance with the requirements prescribed in this section.

8.4.1 Required mechanical property qualification

The flatwise bending and flatwise shear properties of CLT grades at extreme depths in both major and minor strength directions shall be tested in accordance with 8.5.3 and 8.5.4 to confirm the design values shown in Table A2 for use in the U.S. or Table A4 for use in Canada, or the design values approved by an *approved agency*.

8.4.2 Optional mechanical property qualification

When edgewise bending and edgewise shear properties are to be approved by an *approved agency*, qualification tests shall be conducted in accordance with 8.5.5 and 8.5.6, respectively.

8.5 Mechanical Property Qualification

The design values from required mechanical property qualification (8.4.1) and optional mechanical property qualification (8.4.2) shall be approved by an *approved agency* in accordance with this section.

8.5.1 Sampling

Test specimens, including the width of laminations, shall be representative of typical production and shall be sampled at the manufacturing facility by an *approved agency* using the layup intended for qualification. The sample size required for stiffness capacities shall be sufficient for estimating the population mean within 5% precision with 75% confidence, or 10 specimens, whichever is greater. In general, a sample size larger than 10 is needed when the coefficient of variation is greater than 13%. The sample size required for strength capacities shall be sufficient for estimating the characteristic value with 75% confidence in accordance with ASTM D2915.

Note 26: *Both flatwise and edgewise bending moment, and shear capacities in the U.S. and both flatwise and edgewise bending moment, and shear resistances in Canada may be affected by the lamination width used in the CLT manufacturing. A significant change in the lamination width from original qualification will require subsequent requalification in accordance with 8.6 and Table 2.*

8.5.2 Moisture conditioning

CLT specimens shall be stored in an indoor environment for a minimum of 24 hours or until the adhesive has cured sufficiently to permit evaluation, whichever is longer. The CLT specimens at the time of mechanical tests shall have an average moisture content of not less than 8%.

8.5.3 Flatwise bending properties

Flatwise bending stiffness and bending moment capacity (resistance) shall be evaluated in accordance with 8.5.3.1 and 8.5.3.2.

8.5.3.1 Flatwise bending test methods

Flatwise bending tests shall be conducted in both major and minor strength directions in accordance with the third-point load method of Sections 4 through 12 of ASTM D198 or Section 8 of ASTM D4761 using the specimen width of not less than 12 inches (305 mm) and the on-center span equal to approximately 30 times the specimen depth for the tests in the major strength direction and approximately 18 times the specimen depth for the tests in the minor strength direction. The weight of the CLT panel is permitted to be included in the determination of the flatwise bending moment capacity (resistance).

8.5.3.2 Flatwise bending qualification requirements

In the U.S. and Canada, the average flatwise bending stiffness determined from qualification tests shall equal or exceed the published flatwise bending stiffness [$(EI)_{eff,f,0}$ or $(EI)_{eff,f,90}$]. In the U.S., the characteristic flatwise bending moment capacity determined from qualification tests shall equal or exceed the published ASD reference flatwise bending moment capacity [$(F_bS)_{eff,f,0}$ or $(F_bS)_{eff,f,90}$] times 2.1. In Canada, the characteristic flatwise bending moment resistance determined from qualification tests shall equal or exceed the published LSD flatwise bending resistance [$(f_bS)_{eff,f,0}$ or $(f_bS)_{eff,f,90}$] divided by 0.96.

8.5.4 Flatwise shear properties

Flatwise shear stiffness and capacity (resistance) shall be evaluated in accordance with 8.5.4.1 and 8.5.4.2.

8.5.4.1 Flatwise shear test methods

Flatwise shear stiffness tests shall be conducted in both major and minor strength directions in accordance with Sections 45 through 52 of ASTM D198. Flatwise shear tests shall be conducted in both major and minor strength directions in accordance with the center-point load method of Sections 4 through 12 of ASTM D198 or Section 7 of ASTM D4761 using the specimen width of not less than 12 inches (305 mm) and the on-center span equal to 5 to 6 times the specimen depth. The bearing length shall be sufficient to avoid bearing failure, but not greater than the specimen depth. All specimens are to be cut to length with no overhangs allowed.

8.5.4.2 Flatwise shear qualification requirements

In the U.S. and Canada, the average flatwise shear stiffness determined from qualification tests shall equal or exceed the published shear stiffness in flatwise bending [$(GA)_{eff,f,0}$ or $(GA)_{eff,f,90}$]. In the U.S., the characteristic flatwise shear capacity determined from qualification tests shall equal or exceed the published ASD reference flatwise shear capacity ($V_{s,0}$ or $V_{s,90}$) times 2.1. In Canada, the characteristic flatwise shear resistance determined from qualification tests shall equal or exceed the published LSD flatwise shear resistance ($v_{s,0}$ or $v_{s,90}$) divided by 0.96.

8.5.5 Edgewise bending properties

If the manufacturer intends to publish edgewise bending properties, edgewise bending stiffness and bending moment capacity (resistance) shall be evaluated in accordance with 8.5.5.1 and 8.5.5.2. If the specimens are not pre-conditioned to a standard moisture content level prior to testing, which may not be feasible depending on the size of the test specimens, the calculated bending strength and stiffness shall be adjusted to the standard moisture content using the procedures given in ASTM D2915 for CLT made of lumber laminations or ASTM D5456 made of SCL laminations. The volume, creep and load duration effects of edgewise bending capacity (resistance) shall be evaluated in accordance with the principles of Sections 7.4.1 and 7.4.2 of ASTM D5456.

8.5.5.1 Edgewise bending test methods

Bending tests shall be conducted edgewise in both major and minor strength directions in accordance with the third-point load method of Sections 4 through 12 of ASTM D198 or Section 6 of ASTM D4761 using the specimen depth of not less than 12 inches (305 mm) and the on-center span equal to approximately 18 times the specimen depth. The weight of the CLT panel is permitted to be included in the determination of the edgewise bending moment capacity (resistance).

8.5.5.2 Edgewise bending qualification requirements

Separate qualification shall be conducted for each layup. In the U.S. and Canada, the average edgewise bending stiffness determined from qualification tests divided by the calculated gross moment of inertia ($I_{e,0}$ or $I_{e,90}$) shall equal or exceed the published edgewise bending modulus of elasticity ($E_{e,0}$ or $E_{e,90}$). In the U.S., the characteristic edgewise bending moment capacity determined from qualification tests shall equal or exceed the published ASD reference edgewise bending stress ($F_{b,e,0}$ or $F_{b,e,90}$) multiplied by the calculated gross edgewise section modulus ($S_{e,0}$ or $S_{e,90}$) and an adjustment factor of 2.1. In Canada, the characteristic edgewise bending moment resistance determined from qualification tests shall equal or exceed the published LSD specified edgewise bending strength ($f_{b,e,0}$ or $f_{b,e,90}$) multiplied by the calculated gross edgewise section modulus ($S_{e,0}$ or $S_{e,90}$) and divided by an adjustment factor of 0.96.

8.5.6 Edgewise shear properties

If the manufacturer intends to publish edgewise shear properties, edgewise shear stiffness and capacity (resistance) shall be evaluated in accordance with 8.5.6.1 and 8.5.6.2.

8.5.6.1 Edgewise shear test methods

Edgewise shear stiffness tests shall be conducted in both major and minor strength directions in accordance with Sections 45 through 52 of ASTM D198. Edgewise shear capacity (resistance) tests shall be conducted in both major and minor strength directions in accordance with the full-scale test method specified in Annex A3 of ASTM D5456. The web thickness of the I-shaped cross section shall be the CLT thickness. The specimen shall contain at least one edge joint, as applicable, in the middle 1/3 of the specimen depth.

Note 27: Tests have demonstrated that reinforcing the specimens with flanges (creating I-shaped beams) is necessary for development of the shear failure mode. Conducting preliminary tests to confirm the failure mode is recommended prior to producing the entire batch of I-shaped test specimens. Tests have also demonstrated that it may not be possible to fail the 7-ply or thicker CLT beams in shear in both minor and major strength directions. High-capacity testing apparatus is needed in all cases.

8.5.6.2 Edgewise shear qualification requirements

Separate qualification shall be conducted for each layup. For use in the U.S. or Canada, the average edgewise shear stiffness determined from qualification tests divided by the CLT thickness (t_p) shall equal or exceed the published modulus of rigidity (shear modulus) in edgewise bending ($G_{e,0}$ or $G_{e,90}$). In the U.S., the characteristic edgewise shear capacity determined from qualification tests shall equal or exceed the published ASD reference edgewise shear capacity ($F_{v,e,0}$ t_p or $F_{v,e,90}$ t_p) multiplied by an adjustment factor of 2.1. In Canada, the characteristic edgewise shear resistance determined from qualification tests shall equal or exceed the published LSD edgewise shear resistance ($f_{v,e,0}$ t_p or $f_{v,e,90}$ t_p) divided by an adjustment factor of 0.96.

8.6 Process Changes Qualification

Significant changes to the manufacturing process or facilities shall be subjected to subsequent qualification testing. The requirements of 8.2 through 8.5 shall be reapplied for significant changes listed or equivalent to that listed in Table 2.

TABLE 2

SUBSEQUENT QUALIFICATION IN RESPONSE TO SIGNIFICANT CHANGES

Category	Applicable Sections	Material Change (examples)	Notes
A	8.2 through 8.5	▪ Press equipment ▪ Adhesive formulation class ▪ Addition or substitution of species from a different species group ▪ Changes to the visual grading rules that reduce the effective bond area or the effectiveness of the applied pressure (e.g., warp permitted)	
B	8.2, 8.3	▪ Other changes to the manufacturing process or component quality not listed above ▪ Adhesive composition (e.g., fillers and extenders)	Additional evaluation in accordance with 8.4 and 8.5 is at the discretion of the approved agency[a]
C	8.4, 8.5	▪ Increase in billet width or length of more than 20%	
D	8.5.3 and 8.5.5 as applicable	▪ Increase in the net lamination width of more than 2 inches (51 mm) from the lamination width used in the product qualification in either major or minor CLT strength direction[b]	
E	8.5.4 and 8.5.6 as applicable	▪ Decrease in the net lamination width of more than 2 inches (51 mm) from the lamination width used in the product qualification in either major or minor CLT strength direction[b]	

a. Changes involving two or more manufacturing parameters shall be considered for reevaluation in accordance with 8.4 and 8.5.
b. Lamination width shall comply with 6.1.4.

8.7 Mill Specification

Upon conformance with the requirements specified in this standard, a manufacturing specification or documentation unique to the product and mill shall be written based on product evaluation. This specification shall be used for quality assurance purposes by the manufacturer and the *approved agency*. Control values for quality assurance shall be established during product evaluation to ensure conformance to performance requirements in this standard.

8.8 Certification and Marking

8.8.1 Certification

CLT products represented as conforming to this standard shall bear the stamp or certificate of conformance of an *approved agency* which (1) either inspects the manufacturer or (2) has tested a random sampling of the finished products in the shipment being certified for conformance with this standard.

8.8.2 Product marking

CLT products represented as conforming to this standard shall be identified with marks containing the following information:

a. CLT grade qualified in accordance with this standard;

b. The CLT thickness or identification;

c. The mill name or identification number;

d. The *approved agency* name or logo;

e. The symbol of "ANSI PRG 320" signifying conformance to this standard;

f. Any manufacturer's designations which shall be separated from the grade-marks or trademarks of the *approved agency* by not less than 6 inches (152 mm);

g. "Top" stamp on the top face of custom CLT panels used for roof or floor if manufactured with an unbalanced layup; and

h. A production lot number or job identification number as a means to trace the CLT product back to the production and quality control records at the manufacturing facility.

8.8.3 Frequency of marking

Non-custom and other required marks in this section shall be placed on standard products at intervals of 8 feet (2.4 m) or less along the longest dimension of the CLT panel in order that each piece cut from a longer piece will have at least one of each of the required marks.

8.8.4 Custom products

For products manufactured to meet specific job specifications (custom products), the marking shall be permitted to contain information less than that specified in 8.8.2. However, custom products shall bear at least one mark containing the information specified in 8.8.2(c), (d), (e), and (h). In addition, custom products shall be accompanied by a certificate of conformance to this standard including all of the information listed in 8.8.2. When CLT products shipped to a job are to be cut later into several members for use in the structure, the frequency of marking required in 8.8.3 shall be followed.

8.8.5 Voiding marks

CLT products originally marked as conforming to this standard but subsequently rejected as not conforming thereto shall have any reference to the standard obliterated or voided by the manufacturer.

Note 28: *This can be performed by blocking out the stamp with permanent black ink or light sanding.*

9 QUALITY ASSURANCE

9.1 Objectives

This section is intended for use with CLT products that have been qualified under this standard. The purpose of this section is to assure product quality by detecting changes in properties that may adversely affect the CLT performance. In all cases, the criteria to which the CLT products are tested shall be provided in the Mill Specification or equivalent document.

9.2 Process Control

On-going evaluation of the process properties listed in this section shall be performed to confirm that the CLT quality remains in satisfactory compliance to the product specification requirements. Sampling methods and quality assurance testing shall be documented in an in-plant manufacturing standard and approved by the *approved agency*. All processes and test records relevant to the production shall be retained based on the manufacturer's record retention policy and are subject to audit by the *approved agency*. Production shall be held pending results of the quality assurance testing on representative samples.

9.3 End, Face, and Edge Joints in Laminations

The lamination end joints, face joints, and edge joints (when applicable) shall be sampled and tested for ongoing quality assurance in accordance with Table 3 and meet the strength (required for end joints only), wood failure, and durability requirements specified herein. The sampling shall be well-spaced in each production shift to avoid sampling concentration in the production time. Special considerations for face bonding of the CLT panel as a whole are provided in 9.3.1 through 9.3.4.

TABLE 3

SUMMARY OF OFFLINE TESTS – FOR DAILY REQUIREMENTS

Test	Minimum Number of Specimens	Requirements	Referenced Section(s) in This Standard
Face and Edge Joints[a,b,c]	1 specimen per billet up to 4 specimens per production shift	Wood Failure	6.3.3(a) and 8.2.5
	1 specimen per billet up to 2 specimens per production shift	Delamination	6.3.3(b) and 8.2.6
End Joints[a,c,d]	1 specimen per 5,000 joints produced up to 8 specimens per production shift	Tensile Strength	6.3.2(b)
	1 specimen per production shift	Delamination	6.3.2(c)

a. For each adhesive, lamination type, and species combination used.

b. Edge joint daily tests are required only when the edge joint is a structural requirement.

c. For each production line.

d. All grades and widths shall be tested over time. In each shift, at least one specimen shall represent the highest grade and widest width produced during the shift.

9.3.1 Effective bonding area

Laminations shall be laid up to maintain an effective bonding area of not less than 80% on surfaces to be bonded for each bondline.

Note 29: *To maintain an effective bond area, lumber laminations in adjacent layers may need to be oriented such that the bark and pith faces of adjacent pieces are generally alternated.*

9.3.2 Lumber lamination grade limits

Grade limits intended to limit the amount of lumber lamination warp that will not be corrected upon application of pressure shall be qualified in accordance with 8.3.

9.3.3 Glue skip in the face bondline

The average glue skip in a face bondline shall not exceed the level established to maintain the effective bonding area specified in 9.3.1.

9.3.4 Additional consideration for face joints

Sampling of face joints for quality assurance shall consider the large bonding area for a typical CLT panel and avoid a constant location at all times. Core shear specimens based on AITC Test T107 shall be permitted to be used in place of the block shear specimens specified in 8.2.4 and 8.2.5 for the quality assurance of face joints provided that a correlation factor between core shear and block shear specimens are evaluated in accordance with AITC Test T107 except that a minimum of 40 block shear specimens and an equal number of core shear specimens shall be tested. The correlation shall be documented and included in the in-plant manufacturing standard after the approval by the *approved agency*. The correlation factor shall be reevaluated at least annually.

9.3.5 Additional consideration for end joints

For each production line, sampling of end joints shall include all grades and widths of laminations over time for each adhesive, lamination type, and species combination used. Each combination of grade, width, adhesive, lamination type, and species combination shall be tracked separately for quality assurance. For each production line, at least one end joint tested for each shift shall represent the highest grade and widest width for each adhesive, lamination type, and species combination produced during the shift.

9.4 Finished Production Inspection

All production shall be inspected visually, and/or by measurements or testing for conformance to this standard with the following attributes:

a. Dimensions (width, depth and length);

b. Shape, including straightness and squareness;

c. Type, quality and location of structural bond lines;

d. Appearance classification;

e. Layup, including lumber species and grades, placement, and orientation;

f. Moisture content; and

g. Application of the appropriate marks.

9.5 Minor Variations

A product is considered conforming to this standard when minor variations of a limited extent in non-critical locations exist, or when structural damage or defects have been repaired and, in the judgment of a qualified person, the product is structurally adequate for the use intended. The identity of the product and the nature of the minor variation shall be documented and provided to the engineer of record upon request. A qualified person is one who is familiar with the job specifications and applicable design requirements and has first-hand knowledge of the manufacturing process.

ANNEX A. Design Properties for PRG-320 CLT (Mandatory)

This Annex provides the design properties for basic CLT grades and layups listed in Table A2 using the lamination design values provided in Table A1. The CLT grades and layups represent the CLT production intended for use by the CLT manufacturers in North America and are based on the following:

- E1: 1950f-1.7E Spruce-pine-fir MSR lumber in all longitudinal layers and No. 3 Spruce-pine-fir lumber in all transverse layers
- E2: 1650f-1.5E Douglas fir-Larch MSR lumber in all longitudinal layers and No. 3 Douglas fir-Larch lumber in all transverse layers
- E3: 1200f-1.2E Eastern Softwoods, Northern Species, or Western Woods MSR lumber in all longitudinal layers and No. 3 Eastern Softwoods, Northern Species, or Western Woods lumber in all transverse layers
- E4: 1950f-1.7E Southern pine MSR lumber in all longitudinal layers and No. 3 Southern pine lumber in all transverse layers
- E5: 1650f-1.5E Hem-fir MSR umber in all longitudinal layers and No. 3 Hem-fir lumber in all transverse layers
- V1: No. 2 Douglas fir-Larch lumber in all longitudinal layers and No. 3 Douglas fir-Larch lumber in all transverse layers
- V1(N): No. 2 Douglas fir-Larch (North) lumber in all longitudinal layers and No. 3 Douglas fir-Larch (North) lumber in all transverse layers
- V2: No. 1/No. 2 Spruce-pine-fir lumber in all longitudinal layers and No. 3 Spruce-pine-fir lumber in all transverse layers
- V3: No. 2 Southern pine lumber in all longitudinal layers and No. 3 Southern pine lumber in all transverse layers
- V4: No. 2 Spruce-pine-fir South lumber in all longitudinal layers and No. 3 Spruce-pine-fir South lumber in all transverse layers
- V5: No. 2 Hem-fir lumber in all longitudinal layers and No. 3 Hem-fir lumber in all transverse layers
- S1: 2250f-1.5E Laminated Veneer Lumber (LVL) in all longitudinal and transverse layers
- S2: 1900f-1.3E Laminated Strand Lumber (LSL) in all longitudinal and transverse layers
- S3: 1750f-1.3E Oriented Strand Lumber (OSL) in all longitudinal and transverse layers

TABLE A1

ASD REFERENCE DESIGN VALUES[a] FOR LAMINATIONS USED IN BASIC CLT GRADES (FOR USE IN THE U.S.)

	Laminations Used in Major Strength Direction						Laminations Used in Minor Strength Direction					
CLT Grade	F_b (psi)	E [b] (10^6 psi)	F_t (psi)	F_c (psi)	F_v (psi)	F_s (psi)	F_b (psi)	E [b] (10^6 psi)	F_t (psi)	F_c (psi)	F_v (psi)	F_s (psi)
E1	1,950	1.7	1,375	1,800	135	45	500	1.2	250	650	135	45
E2	1,650	1.5	1,020	1,700	180	60	525	1.4	325	775	180	60
E3	1,200	1.2	600	1,400	110	35	350	0.9	150	475	110	35
E4	1,950	1.7	1,375	1,800	175	55	450	1.3	250	725	175	55
E5	1,650	1.5	1,020	1,700	150	50	500	1.2	300	725	150	50
V1	900	1.6	575	1,350	180	60	525	1.4	325	775	180	60
V1(N)	850	1.6	500	1,400	180	60	475	1.4	300	825	180	60
V2	875	1.4	450	1,150	135	45	500	1.2	250	650	135	45
V3	750	1.4	450	1,250	175	55	450	1.3	250	725	175	55
V4	775	1.1	350	1,000	135	45	450	1.0	200	575	135	45
V5	850	1.3	525	1,300	150	50	500	1.2	300	725	150	50
S1	2,250	1.5	1,500	1,950	130	40	2,250	1.5	1,500	1,950	130	40
S2	1,900	1.3	1,300	1,650	150	50	1,900	1.3	1,300	1,650	150	50
S3	1,750	1.3	1,200	1,500	115	35	1,750	1.3	1,200	1,500	115	35

For SI: 1 psi = 0.006895 MPa

a. The ASD reference design values for laminations in the basic CLT grades made of visually graded lumber are based on 2x12 lumber. Because the basic CLT grades do not limit the lamination sizes used, the ASD reference design values for laminations in basic CLT grades are not increased for the lamination size, repetitive member, and flat use adjustment factors when calculating the ASD reference design properties for basic CLT grades provided in Table A2.

b. The tabulated E values are published E for lumber and flatwise (plank) apparent E for SCL.

The ASD reference design capacities for the basic CLT grades with 3, 5, and 7 layers are provided in Table A2. These capacities were derived analytically using the Shear Analogy Model[1] (the calculated moment capacities in the major strength direction were further multiplied by a factor of 0.85 for conservatism) and validated by testing. The lamination thicknesses are as tabulated. The ASD reference tensile and compressive capacities will be developed and added to future editions of this standard.

1. Gagnon, S. and M. Popovski. 2011. *Structural Design of Cross-Laminated Timber Elements*. In: Chapter 3, *CLT Handbook*. FPInnovations, Canada

TABLE A2

ASD REFERENCE DESIGN VALUES[a] FOR BASIC CLT GRADES AND LAYUPS (FOR USE IN THE U.S.)

		Lamination Thickness (in.) in CLT Layup							Major Strength Direction				Minor Strength Direction			
CLT Grade	t_p (in.)	=	⊥	=	⊥	=	⊥	=	$(F_bS)_{eff,f,0}$ (lbf-ft/ft of width)	$(EI)_{eff,f,0}$ (10^6 lbf-in.^{2}/ft of width)	$(GA)_{eff,f,0}$ (10^6 lbf/ft of width)	$V_{s,0}$ (lbf/ft of width)	$(F_bS)_{eff,f,90}$ (lbf-ft/ft of width)	$(EI)_{eff,f,90}$ (10^6 lbf-in.^{2}/ft of width)	$(GA)_{eff,f,90}$ (10^6 lbf/ft of width)	$V_{s,90}$ (lbf/ft of width)
E1	4 1/8	1 3/8	1 3/8	1 3/8					4,525	115	0.46	1,490	160	3.1	0.61	495
	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			10,400	440	0.92	2,480	1,370	81	1.2	1,490
	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	18,375	1,089	1.4	3,475	3,150	313	1.8	2,480
E2	4 1/8	1 3/8	1 3/8	1 3/8					3,825	102	0.53	1,980	165	3.6	0.56	660
	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			8,825	389	1.1	3,300	1,440	95	1.1	1,980
	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	15,600	963	1.6	4,625	3,300	364	1.7	3,300
E3	4 1/8	1 3/8	1 3/8	1 3/8					2,800	81	0.35	1,160	110	2.3	0.44	385
	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			6,400	311	0.69	1,930	955	61	0.87	1,160
	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	11,325	769	1.0	2,700	2,210	234	1.3	1,930
E4	4 1/8	1 3/8	1 3/8	1 3/8					4,525	115	0.50	1,820	140	3.4	0.62	605
	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			10,400	440	1.0	3,025	1,230	88	1.2	1,820
	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	18,400	1,089	1.5	4,225	2,850	338	1.9	3,025
E5	4 1/8	1 3/8	1 3/8	1 3/8					3,825	101	0.46	1,650	160	3.1	0.55	550
	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			8,800	389	0.92	2,750	1,370	81	1.1	1,650
	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	15,575	962	1.4	3,850	3,150	312	1.7	2,750
V1	4 1/8	1 3/8	1 3/8	1 3/8					2,090	108	0.53	1,980	165	3.6	0.59	660
	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			4,800	415	1.1	3,300	1,440	95	1.2	1,980
	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	8,500	1,027	1.6	4,625	3,300	364	1.8	3,300
V1(N)	4 1/8	1 3/8	1 3/8	1 3/8					1,980	108	0.53	1,980	150	3.6	0.59	660
	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			4,550	415	1.1	3,300	1,300	95	1.2	1,980
	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	8,025	1,027	1.6	4,625	3,000	364	1.8	3,300
V2	4 1/8	1 3/8	1 3/8	1 3/8					2,030	95	0.46	1,490	160	3.1	0.52	495
	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			4,675	363	0.91	2,480	1,370	81	1.0	1,490
	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	8,275	898	1.4	3,475	3,150	312	1.6	2,480

Table continued on next page.

TABLE A2 (continued)

ASD REFERENCE DESIGN VALUES[a] FOR BASIC CLT GRADES AND LAYUPS (FOR USE IN THE U.S.)

CLT Grade	t_p (in.)	Lamination Thickness (in.) in CLT Layup: =	⊥	=	⊥	=	⊥	=	Major Strength Direction: $(F_bS)_{eff,f,0}$ (lbf-ft/ft of width)	$(EI)_{eff,f,0}$ (10^6 lbf-in.^{2}/ft of width)	$(GA)_{eff,f,0}$ (10^6 lbf/ft of width)	$V_{s,0}$ (lbf/ft of width)	Minor Strength Direction: $(F_bS)_{eff,f,90}$ (lbf-ft/ft of width)	$(EI)_{eff,f,90}$ (10^6 lbf-in.^{2}/ft of width)	$(GA)_{eff,f,90}$ (10^6 lbf/ft of width)	$V_{s,90}$ (lbf/ft of width)
V3	4 1/8	1 3/8	1 3/8	1 3/8					1,740	95	0.49	1,820	140	3.4	0.52	605
	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			4,000	363	0.98	3,025	1,230	88	1.0	1,820
	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	7,100	899	1.5	4,225	2,825	338	1.6	3,025
V4	4 1/8	1 3/8	1 3/8	1 3/8					1,800	74	0.38	1,490	140	2.6	0.41	495
	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			4,150	285	0.76	2,480	1,230	68	0.82	1,490
	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	7,325	706	1.1	3,475	2,825	260	1.2	2,480
V5	4 1/8	1 3/8	1 3/8	1 3/8					1,980	88	0.45	1,650	160	3.1	0.48	550
	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			4,550	337	0.91	2,750	1,370	81	0.97	1,650
	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	8,025	835	1.4	3,850	3,150	312	1.5	2,750
S1	4 1/2	1 1/2	1 1/2	1 1/2					6,225	132	0.61	1,440	845	5.1	0.61	480
	7 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2			14,325	506	1.2	2,400	7,325	132	1.2	1,440
	10 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	25,325	1,252	1.8	3,350	16,850	506	1.8	2,400
S2	4 1/2	1 1/2	1 1/2	1 1/2					5,250	114	0.53	1,800	715	4.4	0.53	600
	7 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2			12,100	438	1.1	3,000	6,175	114	1.1	1,800
	10 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	21,400	1,085	1.6	4,200	14,225	438	1.6	3,000
S3	4 1/2	1 1/2	1 1/2	1 1/2					4,850	114	0.53	1,260	655	4.4	0.53	420
	7 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2			11,150	438	1.1	2,100	5,700	114	1.1	1,260
	10 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	19,700	1,085	1.6	2,950	13,000	438	1.6	2,100

For SI: 1 in. = 25.4 mm; 1 ft = 304.8 mm; 1 lbf = 4.448 N

a. This table represents the basic CLT grades and layups. Custom CLT grades and layups that are not listed in this table shall be permitted in accordance with 7.1.2.

Note A1: *The rounding rules in Table A2 are as follows:*

F_bS (lbf-ft/ft) and Vs (lbf/ft)—Nearest 25 for values greater than 2,500, nearest 10 for values between 1,000 and 2,500, or nearest 5 otherwise.

EI (lbf-in.^{2}/ft) and GA (lbf/ft)—Nearest 10^6 for values greater than 10^7, nearest 10^5 for values between 10^6 and 10^7, or nearest 10^4 otherwise.

TABLE A3

LSD SPECIFIED STRENGTH AND MODULUS OF ELASTICITY[a,b] FOR LAMINATIONS USED IN BASIC CLT GRADES (FOR USE IN CANADA)

CLT Grade	Laminations Used in Major Strength Direction						Laminations Used in Minor Strength Direction					
	f_b (MPa)	E[(d)] (MPa)	f_t (MPa)	f_c (MPa)	f_v (MPa)	f_s (MPa)	f_b (MPa)	E[(d)] (MPa)	f_t (MPa)	f_c (MPa)	f_v (MPa)	f_s (MPa)
E1	28.2	11,700	15.4	19.3	1.5	0.50	7.0	9,000	3.2	9.0	1.5	0.50
E2	23.9	10,300	11.4	18.1	1.9	0.63	4.6	10,000	2.1	7.3	1.9	0.63
E3	17.4	8,300	6.7	15.1	1.3	0.43	4.5	6,500	2.0	5.2	1.3	0.43
E5	23.9	10,300	11.4	18.1	1.6	0.53	7.0	10,000	3.2	9.2	1.6	0.53
V1(N)	10.0	11,000	5.8	14.0	1.9	0.63	4.6	10,000	2.1	7.3	1.9	0.63
V2	11.8	9,500	5.5	11.5	1.5	0.50	7.0	9,000	3.2	9.0	1.5	0.50
V5	11.0	11,000	6.2	14.8	1.6	0.53	7.0	10,000	3.2	9.2	1.6	0.53
S1	28.7	10,300	19.1	21.5	1.7	0.56	28.7	10,300	19.1	21.5	1.7	0.56
S2	24.2	8,900	16.6	18.2	1.9	0.64	24.2	9,300	16.6	18.2	1.9	0.64
S3	22.3	8,900	15.3	16.5	1.5	0.49	22.3	8,900	15.3	16.5	1.5	0.49

For SI: 1 MPa = 145 psi

a. The LSD design values for laminations in the basic CLT grades made of visually graded and MSR lumber are based on 2x12 lumber except for the specified tensile strength made of MSR lumber. Because the basic CLT grades do not limit the lamination sizes used, the LSD design values for laminations in basic CLT grades are not increased for the lamination size and system factors in accordance with CSA O86 when calculating the LSD design properties for basic CLT grades provided in Table A4. The LSD specified tensile strength values for MSR lumber are based on 2x8 lumber and not permitted to be increased for the system factor in accordance with CSA O86 when calculating the LSD design properties for basic CLT grades provided in Table A4.

b. The tabulated E values are published E for lumber and flatwise (plank) apparent E for SCL.

For use in Canada, the LSD design resistances for basic CLT grades and layups are listed in Table A4 using the LSD design values for the laminations provided in Table A3. The LSD design resistances are not compatible with the ASD reference design capacities used in the U.S. Since there are no published LSD specified strength and modulus of elasticity for Southern pine and Spruce-pine-fir South lumber in Canada, the CLT Grades E4, V1, V3, and V4 are not listed in Tables A3 and A4.

TABLE A4

LSD STIFFNESS AND UNFACTORED RESISTANCE VALUES[a] FOR BASIC CLT GRADES AND LAYUPS (FOR USE IN CANADA)

CLT Grade	t_p (mm)	Lamination Thickness (mm) in CLT Layup =	⊥	=	⊥	=	⊥	=	Major Strength Direction $(f_bS)_{eff,f,0}$ (10^6 N-mm/m of width)	$(EI)_{eff,f,0}$ (10^9 N-mm²/m of width)	$(GA)_{eff,f,0}$ (10^6 N/m of width)	$V_{s,0}$ (kN/m of width)	Minor Strength Direction $(f_bS)_{eff,f,90}$ (10^6 N-mm/m of width)	$(EI)_{eff,f,90}$ (10^9 N-mm²/m of width)	$(GA)_{eff,f,90}$ (10^6 N/m of width)	$V_{s,90}$ (kN/m of width)
	105	35	35	35					42	1,088	7.3	35	1.40	32	9.1	12
E1	175	35	35	35	35	35			98	4,166	15	58	12	837	18	~~35~~
	245	35	35	35	35	35	35	35	172	10,306	22	82	29	3,220	27	58
	105	35	35	35					36	958	8.0	44	0.94	36	8.2	15
E2	175	35	35	35	35	35			83	3,674	16	74	8.2	930	16	44
	245	35	35	35	35	35	35	35	146	9,097	24	103	19	3,569	25	74
	105	35	35	35					26	772	5.3	30	0.92	23	6.4	10
E3	175	35	35	35	35	35			60	2,956	11	50	8.0	605	13	30
	245	35	35	35	35	35	35	35	106	7,313	16	70	18	2,325	19	50
	105	35	35	35					36	958	8.0	37	1.40	36	8.2	12
E5	175	35	35	35	35	35			83	3,674	16	62	12	930	16	37
	245	35	35	35	35	35	35	35	146	9,097	24	87	29	3,569	25	62
	105	35	35	35					15	1,023	8.0	44	0.94	36	8.7	15
V1(N)	175	35	35	35	35	35			35	3,922	16	74	8.2	930	17	44
	245	35	35	35	35	35	35	35	61	9,708	24	103	19	3,571	26	74
	105	35	35	35					18	884	7.2	35	1.4	32	7.5	12
V2	175	35	35	35	35	35			41	3,388	14	58	12	837	15	~~35~~
	245	35	35	35	35	35	35	35	72	8,388	22	82	29	3,213	23	58
	105	35	35	35					17	1,023	8.0	37	1.40	36	8.7	12
V5	175	35	35	35	35	35			38	3,922	16	62	12	930	17	37
	245	35	35	35	35	35	35	35	67	9,708	24	87	29	3,571	26	62
	114	38	38	38					51	1,226	8.9	43	6.90	47	8.9	14
S1	190	38	38	38	38	38			117	4,704	18	71	60	1,226	18	43
	266	38	38	38	38	38	38	38	207	11,647	27	99	138	4,704	27	71

Table continued on next page.

TABLE A4 (continued)

LSD STIFFNESS AND UNFACTORED RESISTANCE VALUES[a] FOR BASIC CLT GRADES AND LAYUPS (FOR USE IN CANADA)

		Lamination Thickness (mm) in CLT Layup							Major Strength Direction				Minor Strength Direction			
CLT Grade	t_p (mm)	=	⊥	=	⊥	=	⊥	=	$(f_bS)_{eff,f,0}$ (10^6 N-mm/m of width)	$(EI)_{eff,f,0}$ (10^9 N-mm²/m of width)	$(GA)_{eff,f,0}$ (10^6 N/m of width)	$v_{s,0}$ (kN/m of width)	$(f_bS)_{eff,f,90}$ (10^6 N-mm/m of width)	$(EI)_{eff,f,90}$ (10^9 N-mm²/m of width)	$(GA)_{eff,f,90}$ (10^6 N/m of width)	$v_{s,90}$ (kN/m of width)
S2	114	38	38	38					43	1,059	7.7	49	5.80	41	7.7	16
	190	38	38	38	38	38			99	4,064	15	81	51	1,059	15	49
	266	38	38	38	38	38	38	38	175	10,064	23	113	116	4,064	23	81
S3	114	38	38	38					40	1,059	7.7	37	5.40	41	7.7	12
	190	38	38	38	38	38			91	4,064	15	62	47	1,059	15	37
	266	38	38	38	38	38	38	38	161	10,064	23	87	107	4,064	23	62

For SI: 1 mm = 0.03937 in.; 1 m = 3.28 ft; 1 N = 0.2248 lbf

a. This table represents the basic CLT grades and layups.Custom CLT grades and layups that are not listed in this table shall be permitted in accordance with 7.1.2.

Note A2. *The rounding rules in Table A4 are as follows:*

f_bS (N-mm/m) and GA (N/m)—Nearest 10^6 for values greater than 10^7, nearest 10^5 for values between 10^6 and 10^7, or nearest 10^4 otherwise.

v_s (kN/m)—Nearest 1 for values greater than 10, nearest 0.1 for values between 10 and 1, or nearest 0.01 otherwise.

EI (N-mm²/m)—Nearest 10^9 for values greater than 10^{10}, nearest 10^8 for values between 10^9 and 10^{10}, or nearest 10^7 otherwise.

ANNEX B. Practice for Evaluating Elevated Temperature Performance of Adhesives Used in Cross-Laminated Timber Using the Compartment Fire Test (CFT) Method (Mandatory)

B1 Scope

B1.1 This annex is to be used to evaluate the elevated temperature performance of adhesives used in cross-laminated timber (CLT).

B1.2 An unprotected CLT floor-ceiling slab is exposed to specified fire conditions representative of a real fire scenario.

B1.3 The unprotected CLT floor-ceiling slab shall sustain the applied load during the specified fire exposure for a period of 240 minutes without char layer fall-off resulting in fire regrowth during the cooling phase of a fully developed fire.

B1.4 This annex is used to evaluate the performance of adhesives used in CLT to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire hazard or fire risk assessment under actual fire conditions

B1.5 This annex does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this annex to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

B2 Referenced Documents

See Section 2 of the standard for referenced documents. Referenced standards specific to this annex are listed below.

ASTM C1396/C1396M-17 Standard Specification for Gypsum Board

ASTM E176-15ae1 Standard Terminology of Fire Standards

B3 Terminology

B3.1 Definition

Definitions used in this annex are in accordance with Section 3 of the standard, and the terminology standards ASTM D9 and ASTM E176, unless otherwise indicated.

B3.2 Superimposed Load

The additional external load needed to be applied to the slab to result in the specified calculated stresses within the slab when any dead load of the assembly itself is accounted for in the calculations.

B4 Summary of Practice

B4.1 This annex shall be used to evaluate adhesives intended for use in CLT by fire testing a floor-ceiling slab under a vertical load associated with 25% of the effective ASD reference flatwise bending moment of the CLT. The unprotected CLT floor-ceiling slab shall sustain the applied load during the specified fire exposure for a period of 240 minutes without char layer fall-off resulting in a significant temperature increase at the compartment ceiling during the cooling phase of a fully developed fire. The temperature increase is considered significant if, after 150 minutes, any room interior thermocouple at the compartment ceiling exceeds 950 °F (510 °C) at any time before termination of the test.

B5 Significance and Use

B5.1 CLT used in fire-resistance-rated assemblies shall be able to support the superimposed design load for the specified time under the specified fire exposure without char layer fall-off resulting in fire regrowth during the cooling phase of a fully developed fire.

B6 Sample Description

B6.1 Dimensions

CLT floor-ceiling sample shall be approximately 8 feet by 16 feet (2438 mm by 4877 mm), with the long dimension spanning in the major strength direction. Clear distance between the supports shall be at least 15 feet (4572 mm).

B6.2 Fabrication

CLT floor-ceiling test sample shall be at least 5-ply CLT with maximum lamination thickness of 1-3/8 inches (35 mm) and maximum lamination widths of 7-1/4 inches (184 mm). The edge joints in the laminations shall be tight, but shall not be edge-glued.

B6.3 Adhesive

CLT floor-ceiling test sample shall be fabricated using the adhesive being evaluated.

B6.4 Moisture Content

The moisture content of the CLT floor-ceiling test sample shall be not greater than the moisture content specified in Section 6.1.4 of this standard at the time of the fire test.

B7 Test Room Description

B7.1 Test Room Dimensions

A test room shall have interior dimensions of 9 feet ± 4 inches (2743 mm ± 102 mm) in width by 19 feet ± 4 inches (5791 mm ± 102 mm) in depth by 8 feet ± 2 inches (2438 mm ± 51 mm) in height. The test room shall consist of two sections separated by a protected beam across the width of the room, located at approximately 15 feet (4572 mm) from the interior of the front wall. The CLT floor-ceiling sample shall be located in the front section of the room. A propane or natural gas diffusion burner shall be used to create the exposing fire. The burner shall be located in the back section of the test room (referred to hereafter as the burner compartment).

Note B1: *A steel frame structure protected with three layers of 5/8-inch (15.9-mm) type X gypsum board conforming to ASTM C1396/C1396M and three layers of 6 pcf (96 kg/m^3) ceramic fiber blanket (four layers of each in the back section) has been found suitable (see Appendix X2 for a detailed description of the test structure that was used in the development of the method described in this annex).*

B7.2 Floor–Ceiling Support

The CLT floor-ceiling slab shall be supported across the full 8-foot (2438-mm) width of the room by the front wall at one end and by a protected beam at the other end. The beam shall be located at a sufficient distance from the front wall to result in a clear span of at least 15 feet (4572 mm). The remaining portion of the ceiling over the burner shall be protected.

B7.3 Front Wall

The 8-foot (2438-mm) tall bearing wall at the front end of the room shall be capable of supporting the CLT floor-ceiling slab for the duration of the fire test.

B7.4 Back Wall

The 8-foot (2438-mm) tall bearing wall at the back end of the room shall be capable of supporting the protected ceiling over the burner for the duration of the fire test.

B7.5 Non–Loadbearing Side Walls

The 10-foot (3048 mm) tall, 19-foot (5791-mm) long side walls of the test room shall be capable of remaining in place without deflection for the duration of the fire test. A narrow gap along each of the side walls shall permit the floor-ceiling slab to deflect freely without contacting the side walls. The gap between the side wall and the CLT floor-ceiling slab shall be covered with ceramic fiber blanket to prevent smoke and hot gases from leaking and exposing the long edges of the CLT slab.

B7.6 Wall Opening Dimensions

All four walls shall be enclosed except for a ventilation opening in the front 8-foot (2438-mm) wall, which shall have dimensions of 36 ± 2 inches (914 ± 51 mm) in width by 75 ± 2 inches (1905 ± 51 mm) in height.

B7.7 Protected Beam

The beam shall be located 15 feet ± 4 inches (4572 ± 102 mm) from the interior of the front wall, and shall be capable of supporting the CLT floor-ceiling slab and the protected ceiling over the burner for the duration of the fire test.

B7.8 Burner Compartment

The back part of the test room shall consist of a 9 feet ± 4 inches (2743 mm ± 102 mm) wide by 7 feet ± 2 inches (2134 mm ± 51 mm) high burner compartment, and shall be open to the front part of the test room where the CLT floor-ceiling slab is located. The burner compartment shall be protected to ensure that its walls and ceiling remain in place without deflection for the duration of the fire test.

B8 Instrumentation

B8.1 Hot Gas Layer (Ceiling) Thermocouples

Five 1/8-inch- (3.2-mm-) diameter exposed junction Inconel-sheathed type K thermocouples shall be located 4 inches (102 mm) below the ceiling in the following locations: at the center of the exposed ceiling and at the center of each of the four quadrants of the CLT floor-ceiling slab.

Note B2: *To obtain an indication of the temperature evolution at the glue-lines, 1/16-inch- (1.6-mm-) diameter grounded junction Inconel-sheathed type K thermocouples can be inserted from the unexposed side of the CLT. Since the thermal exposure conditions vary somewhat between the front and the back of the test room, it is recommended that embedded thermocouples be installed at three locations along the long dimension of the CLT floor-ceiling slab, i.e., at the center and the quarter points of the clear span. It is further recommended that thermocouples be located at the bottom first, second, and third gluelines, and as far as possible from joints and edges. For example, for CLT made with 1-3/8-in- (35-mm-) thick laminations, the following thermocouple locations apply: 1.38, 2.75, and 4.13 inches (35, 70, and 105 mm) from the exposed side (bottom) of the CLT floor-ceiling slab. The measurement uncertainty of the embedded thermocouples is due to the error associated with the assumed depth at which the thermocouple is located, heat conduction along the thermocouple wires, the potential presence of gaps and/or local density variations (such as knots) in the vicinity of the thermocouple, etc. Consequently, the optional embedded thermocouple measurements are indicative, and are not part of the acceptance criteria.*

B8.2 Gaseous fuel shall be supplied to the burner at a time-varying rate to obtain the heat release rate profile established from calibration testing (see Section B10).

B8.3 Temperatures and the fuel flow rate shall be recorded throughout the test.

B9 Loading

B9.1 The superimposed load on the CLT floor-ceiling slab shall result in 25% of the effective ASD reference flatwise bending moment.

B10 Calibration Test Method

B10.1 Calibration testing shall be conducted to determine the fuel flow rate for the qualification tests. The fuel flow rate shall provide an average temperature of the five ceiling thermocouple temperatures as shown in Figure B1. The time-temperature curve in Figure B1 is achieved by using a diffusion burner placed in the back of the test room, and by changing the burner fuel flow rate in steps at 0, 13, 38, 58, and 88 min. The average ceiling thermocouple temperature at those times shall be within the tolerances given in Table B1. The temperatures at other times in Table B1 are provided for guidance. In no case shall any ceiling thermocouple temperature drop more than 10% below the average of the recorded ceiling thermocouple temperatures.

Note B3: A burner consisting of a 2-by-6-by-1-foot- (610-by-1829-by-305-mm-) tall steel box with open top, filled with gravel and supplied with propane gas has been found suitable. See Appendix X2 for a detailed description of the burner that was used in the development of the method described in this annex.

B10.2 The CLT floor-ceiling slab shall be protected from the bottom with three layers of 5/8-inch (15.9-mm) Type X gypsum wallboard conforming to ASTM C1396/C1396M. The gypsum wallboard shall be attached with Type S drywall screws every 12 inches (305 mm) o.c. with a minimum penetration into the wood of at least 1 inch (25.4 mm).

B11 Qualification Test Method

B11.1 The fuel flow rate determined in Section B10.1 shall be used for the qualification tests.

B11.2 The unprotected CLT floor-ceiling slab, complying with Section B6, shall be tested for 240 minutes.

Note B4: If the CLT floor-ceiling slab clearly fails prior to 240 minutes, the test should be permitted to be terminated early.

B12 Acceptance Criteria

B12.1 The unprotected CLT floor-ceiling slab shall sustain the applied load during the specified fire exposure for a period of 240 minutes.

B12.2 After 150 minutes, none of the ceiling thermocouples shall exceed 950 °F (510 °C).

B13 Report

B13.1 The report shall contain the following minimum information:

B13.1.1 Description of the CLT floor-ceiling sample including the lamination species, lamination dimensions, slab thickness, and the manufacturer;

B13.1.2 Adhesive manufacturer, adhesive type, and adhesive formulation identification;

B13.1.3 Description of the test room construction;

B13.1.4 Description of the loading method;

B13.1.5 Results of the calibration test including the fuel flow rates and thermocouple data;

B13.1.6 Time-temperature curve for the ceiling thermocouples; and

B13.1.7 Visual observations during and after the test.

FIGURE B1

CALIBRATION TIME-TEMPERATURE CURVE

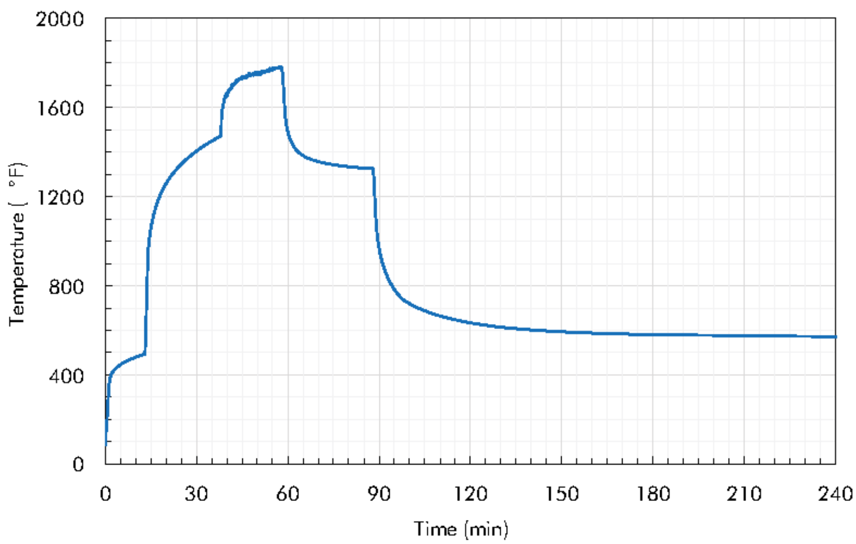


TABLE B1

CALIBRATION TEMPERATURES AND TOLERANCES AT SPECIFIC TIMES

Time (min.)	Temperature (°F)	Tolerance (°F)	Temperature (°C)	Tolerance (°C)
13	493	±36	256	±20
28	1383		751	
38	1472	±45	800	±25
48	1746		952	
58	1778	±54	970	±30
68	1366		741	
78	1338		725	
88	1326	±45	719	±25
120	634		335	
150	594		312	
180	581	±36	305	±20
240	572		300	

APPENDIX X1. Examples of CLT Appearance Classifications (Non-Mandatory)

This appendix contains examples of CLT appearance classifications for CLT panels manufactured with lumber laminations for reference only. These requirements are based on the appearance at the time of manufacturing. The actual CLT panel appearance requirements are recommended to be agreed upon between the end-user and the CLT manufacturer.

X1-1 Architectural Appearance Classification

An appearance classification normally suitable for applications where appearance is an important, but not overriding consideration. Specific characteristics of this classification are as follows:

- In exposed surfaces, all knot holes and voids measuring over 3/4 inch (19 mm) are filled with a wood-tone filler or clear wood inserts selected for similarity with the grain and color of the adjacent wood.
- The face layers exposed to view are free of loose knots and open knot holes are filled.
- Knot holes do not exceed 3/4 inch (19 mm) when measured in the direction of the lamination length with the exception that a void may be longer than 3/4 inch (19 mm) if its area is not greater than 1/2 in.^{2} (323 mm^2).
- Voids greater than 1/16 inch (1.6 mm) wide created by edge joints appearing on the face layers exposed to view are filled.
- Exposed surfaces are surfaced smooth with no misses permitted.

X1-2 Industrial Appearance Classification

An appearance classification normally suitable for use in concealed applications where appearance is not of primary concern. Specific characteristics of this classification are as follows:

- Voids appearing on the edges of laminations need not be filled.
- Loose knots and knot holes appearing on the face layers exposed to view are not filled.
- Members are surfaced on face layers only and the appearance requirements apply only to these layers.
- Occasional misses, low laminations or wane (limited to the lumber grade) are permitted on the surface layers and are not limited in length.

APPENDIX X2. Test Setup Used in the Development of Annex B (Non-Mandatory)

X2-1 Introduction

This appendix provides a detailed description of the room that was used in the development of the test method described in Annex B.

X2-2 Test Room

A test room was constructed with nominal interior dimensions 9 feet 4 inches (2845 mm) in width, 19 feet (5791 mm) in length, and 8 feet (2438 mm) in height. The ventilation opening in the front wall was nominally 36 inches (914 mm) in width by 75 inches (1905 mm) in height. The test room was built directly on the concrete floor of the laboratory, but the test room floor was protected with several layers of type X gypsum board. Drawings of the finished test room can be found in Figures X2-1 through X2-4. A detailed description follows.

Two steel I-beams of 12 inches (305 mm) in height and 41 lbf/foot (0.6 kN/m) by weight welded together were located at approximately 15 feet (4572 mm) from the front wall to subdivide the test room into two sections. The ceiling of the front section was left open and allowed for the exposure of a 16-foot- (4877-mm-) long by 8-foot- (2438-mm-) wide mass timber ceiling panel. The panel was simply supported by the front wall at one end (bearing length ≈ 6 inches or 152 mm), and by the steel I-beam at the other end (bearing length ≈ 5-1/4 inches or 133 mm). The sides of the panel were not supported, and the panel was allowed to deflect freely between the two side walls. A gas burner to create the desired fire exposure was located in the back section of the room, as shown in Figure X2-5. Construction details for the test room walls, floor and ceiling are as follows:

X2–2.1 Front Wall

The front wall of the test room consisted of 8-foot- (2438-mm-) tall and 6-inch- (152-mm-) deep, 16-gauge steel studs at 12 inches (305 mm) on center, and with 16-gauge track top and bottom. The interior surface of the frame was covered with three layers of 5/8-inch (15.9-mm) type X gypsum board (National Gypsum Fire-Shield®), 20-gauge galvanized sheet steel, and three layers of 1-inch- (25.4-mm-) thick ceramic fiber blanket (Morgan Thermal Ceramics 6 pcf or 96 kg/m^3 Cerablanket®). The exterior surface was covered with two layers of 5/8-inch (15.9-mm) type X gypsum board, 20-gauge galvanized sheet steel (top half only), and one layer of 1-inch- (25.4-mm-) thick ceramic fiber blanket (additional layers of blanket were used at the soffit and above the ventilation opening).

X2–2.2 Side Walls

The side walls of the test room consisted of three layers of 4-foot- (1219-mm-) wide by 10-foot- (3048-mm-) tall 5/8-inch (15.9-mm) type X gypsum board attached to steel racks. The interior surface of the gypsum board was covered with three layers of 1-inch- (25.4-mm-) thick ceramic fiber blanket. An additional layer of blanket was attached to the side walls in the back section of the test room. In the front section of the test room, the web of a 6-inch- (152-mm-) deep steel stud covered with 16-gauge track was attached to the side walls at 8 feet (2438 mm) above the floor. The bottom of the covered studs was protected with three layers of 5/8-inch (15.9-mm) type X gypsum board. Two layers were used to protect the vertical and top surfaces. The studs and track mounted along the side walls were covered with four layers of ceramic fiber blanket to reduce the width of the opening in the front section of the test room from 9 feet 4 inches (2845 mm) to 8 feet 5 inches (2565 mm), as shown in Figure X2-5. The gaps along the edges of the panel were filled with ceramic fiber blanket, and the top and bottom of the gaps were then covered with a strip ceramic fiber blanket attached to the panel and a side wall of the test room, as shown in Figure X2-6.

X2–2.3 Back Wall

The back wall of the test room consisted of 8-foot- (2440-mm-) tall, 3-5/8-inch- (92-mm-) deep, 18-gauge steel studs at 12 inches (305 mm) on center and with 18-gauge track top and bottom. The interior surface of the frame was covered with four layers of 5/8-inch (15.9-mm) type X gypsum board and three layers of 1-inch- (25.4-mm-) thick ceramic fiber blanket. The exterior surface was not finished. An opening at the bottom of the back wall allowed the 2-inch- (50.8-mm-) diameter propane pipe nipple from the burner to pass-through to connect to the supply hose outside the test room. The opening was sealed with ceramic fiber blanket.

X2–2.4 I–beams

The space between the exposed surfaces of the flanges and web were filled with several layers of 5/8-inch (15.9-mm) type X gypsum board, and the beams were then wrapped with four layers of 1-inch- (25.4-mm-) thick ceramic fiber blanket.

X2–2.5 Back Section Ceiling

The ceiling above the burner consisted of a spare 4.5-foot (1372-mm) by 8-foot (2438-mm) CLT panel, protected with four layers of 5/8-inch (15.9-mm) type X gypsum board and four layers of 1-inch-(25.4-mm-) thick ceramic fiber blanket. The front edge of the CLT panel was supported by one of the two I-beams. At the back edge, the CLT panel was attached to a 3-1/2-inch (89-mm) by 3-1/2-inch (89-mm) by 1/4-inch (6.4-mm) angle iron welded to the racks supporting the side walls.

Fastener details are as follows:

First layer of gypsum board: 1-7/8-inch (48-mm) #6 type S bugle head drywall screws.

Second layer of gypsum board: 2-1/2-inch (64-mm) #6 type S bugle head drywall screws.

Third and fourth layer of gypsum board: 3-inch (76-mm) #8 type S bugle head drywall screws.

First and second layer of ceramic fiber blanket: 4-1/2-inch (114-mm) coarse thread screws with 1-inch (25.4-mm) washers.

Third and fourth layer of ceramic fiber blanket: 12-gauge galvanized steel wire bent into horseshoe shape.

Screw spacing was approximately 12 inches (305 mm). Wires were used where needed. All joints were staggered with at least 1 foot (305 mm) separation.

X2-3 Gas Burner

X2–3.1 Burner Construction

A gas burner was constructed to create the exposing fire. The burner consisted of a 6-foot- (1829-mm-) long by 2-foot- (610-mm-) wide by 1-foot- (305-mm-) tall steel box with open top. Five pieces of 2-inch (51-mm) by 3-inch (76 mm) steel rectangle tube were welded to the bottom plate, elevating the burner approximately 2 inches (51 mm) above the floor (see Figure X2-5). The burner was supplied with propane through a 2-inch-(51-mm-) diameter pipe. The gas flow was evenly distributed to eight downward-facing release points as shown in Figure X2-7. The burner was filled with coarse gravel to ensure relatively uniform propane flow at the top surface (see Figure X2-5).

TABLE X2-1

BURNER HRR STEP PROFILE

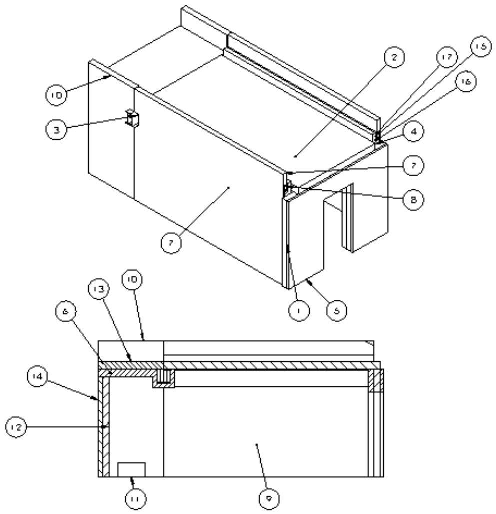
Start (min.)	End (min.)	HRR (kW)
0	13	250
13	38	1075
38	58	1377
58	88	834
88	End of Test	250

X2–3.2 Burner Heat Release Rate Profile

Propane was supplied from two tanks via a vaporizer, a regulator, and a 2-inch- (51-mm-) diameter pipe with several shut-off valves and a control valve. The propane flow rate was manually controlled, and measured with a Coriolis mass flow sensor. The burner profile is shown in Table X2-1 and Figure X2-8.

FIGURE X2-1

3-D VIEW OF TEST ROOM



Item No.	Description	Quantity
1	Front wall	1
2	CLT panel	1
3	I beam 12 x 41	2
4	Front wall interior insulation	1
5	Front wall exterior insulation	1
6	Burner section ceiling insulation	1
7	Side wall CLT section	2
8	Sidewall studs and track	4
9	Sidewall stud insulation blanket	2
10	Burner section side wall	2
11	Burner	1
12	Burner section back wall	1
13	Burner section CLT panel	1
14	Burner section outside gyp	1
15	Sidewall stud-side gyp	2
16	Sidewall stud under gyp	2
17	Sidewall stud top gyp	2

FIGURE X2-2

PLAN VIEW AND SIDE ELEVATION (SECTION) OF TEST ROOM (Units in inches)

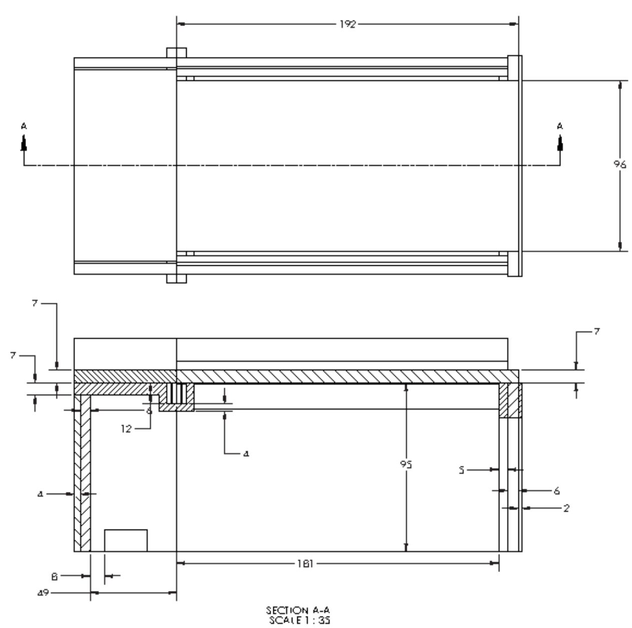


FIGURE X2-3

PLAN VIEW (SECTION) AND SIDE ELEVATION (SECTION) OF TEST ROOM (Units in inches)

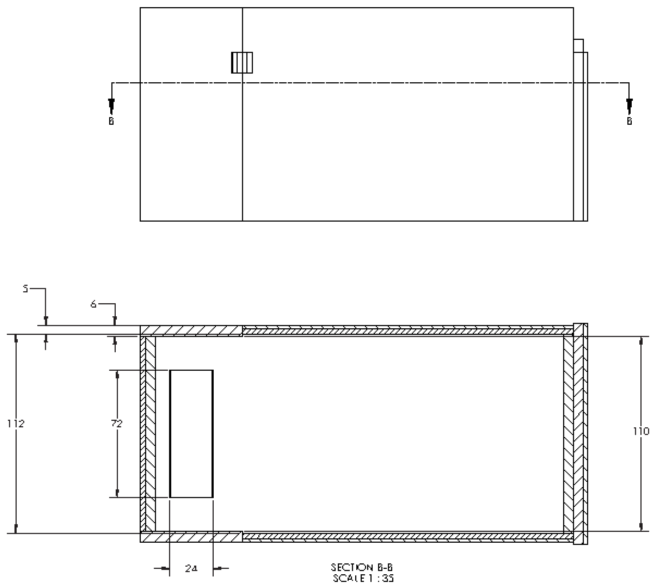


FIGURE X2-4

FRONT ELEVATION AND CONSTRUCTION DETAIL TO NARROW GAP ALONG SIDES OF CLT SAMPLE (Units in inches)

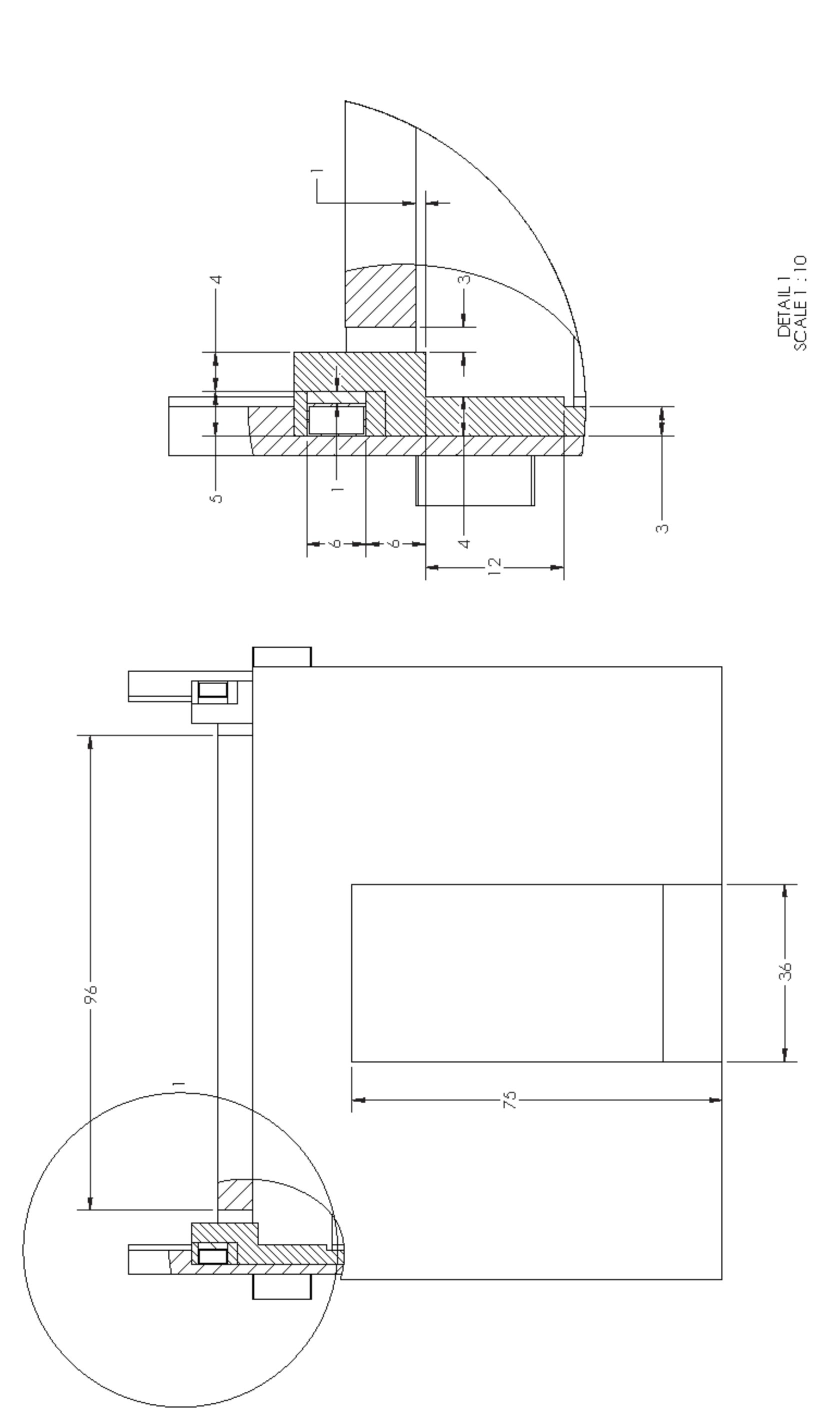


FIGURE X2-5

PROPANE DIFFUSION BURNER

FIGURE X2-6

PICTURE ILLUSTRATING CERAMIC FIBER COVER AROUND PANEL PERIMETER

FIGURE X2-7

SCHEMATIC OF BURNER ILLUSTRATING DISTRIBUTION OF PROPANE FLOW

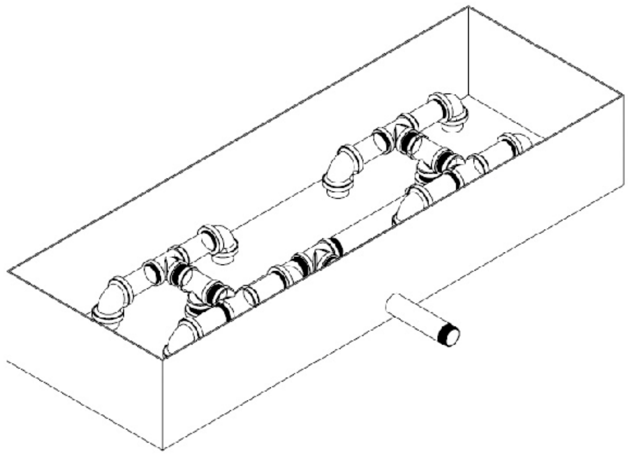
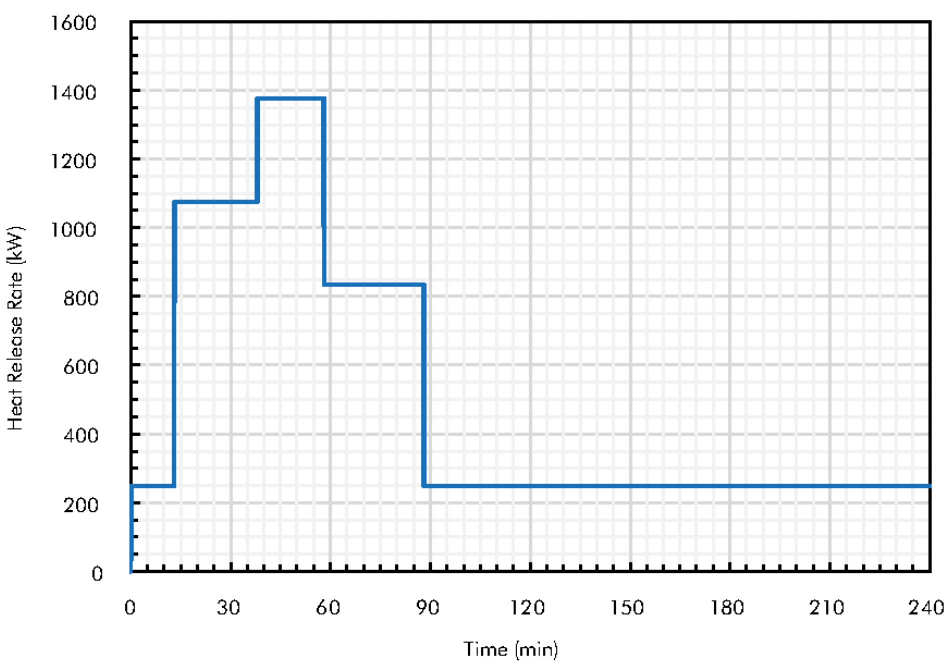


FIGURE X2-8

BURNER HEAT RELEASE RATE PROFILE



APPENDIX X3. Engineering Model Used in the Development of Design Values in Annex A (Non-Mandatory)

X3.1 General

This appendix provides engineering formulas for the determination of CLT design values published in Annex A based on the shear-analogy model and CSA O86. This methodology has been recognized by the consensus-based canvas committee that developed this standard.

These formulas are applicable to CLT grades and layups that are symmetric using laminations with design properties recognized by the *approved agency*. For other grades and layups, such as unsymmetrical layups or the layups having adjacent layers oriented in the same direction, additional consideration may be necessary when using these formulas.

For calculating the CLT design properties, such as those shown in Tables A2 and A4, the transverse E of the lamination is customarily assumed to be E/30, the longitudinal G of the lamination is assumed to be E/16, and the transverse G of the lamination is assumed to be longitudinal G/10.

X3.2 Flatwise Bending Moment

$$(F_bS)_{eff,f,0} = \left(\frac{1}{12}\right) 0.85\, F_{b,major}\, S_{eff,f,0} \qquad \text{[X3-1 ASD]}$$

$$(f_bS)_{eff,f,0} = 0.85\, f_{b,major}\, S_{eff,f,0} \qquad \text{[X3-1 LSD]}$$

$$(F_bS)_{eff,f,90} = \left(\frac{1}{12}\right) F_{b,minor}\, S_{eff,f,90} \qquad \text{[X3-2 ASD]}$$

$$(f_bS)_{eff,f,90} = f_{b,minor}\, S_{eff,f,90} \qquad \text{[X3-2 LSD]}$$

where

$(F_b,S)_{eff,f,0}$ = Effective ASD reference flatwise bending moment of CLT, in lbf-ft/ft of width, in the CLT major strength direction

$(f_b,S)_{eff,f,0}$ = Effective LSD flatwise bending moment resistance of CLT, in N-mm/m of width, in the CLT major strength direction

$(F_b,S)_{eff,f,90}$ = Effective ASD reference flatwise bending moment of CLT, in lbf-ft/ft of width, in the CLT minor strength direction

$(f_b,S)_{eff,f,90}$ = Effective LSD flatwise bending moment resistance of CLT, in N-mm/m of width, in the CLT major strength direction

$F_{b,major}$ = ASD reference bending stress of the lamination in the CLT major strength direction, in psi

$f_{b,major}$ = LSD specified bending strength of the lamination in the CLT major strength direction, in MPa

$F_{b,minor}$ = ASD reference bending stress of the lamination in the CLT minor strength direction, in psi

$f_{b,minor}$ = LSD specified bending strength of the lamination in the CLT minor strength direction, in MPa

$S_{eff,f,0}$ = $\frac{(EI)_{eff,f,0}}{E_{major}} \frac{2}{t_p}$, in in.^{3}/ft or mm^3/m of width, in the CLT major strength direction

$S_{eff,f,90}$ = $\frac{(EI)_{eff,f,90}}{E_{minor}} \frac{2}{(t_p - t_1 - t_n)}$, in in.^{3}/ft or mm^3/m of width, in the CLT minor strength direction

$(EI)_{eff,f,0}$ = effective flatwise bending stiffness of the CLT, in lbf-in.^{2}/ft (N-mm^2/m) of width, in the CLT major strength direction

$(EI)_{eff,f,90}$ = effective flatwise bending stiffness of the CLT, in lbf-in.^{2}/ft (N-mm^2/ft) of width, in the CLT minor strength direction

E_{major} = ASD or LSD modulus of elasticity of the lamination, in psi (MPa), in the CLT major strength direction

E_{minor} = ASD or LSD modulus of elasticity of the lamination, in psi (MPa), in the CLT minor strength direction

t_p = gross thickness of CLT, in in. (mm)

t_1 = thickness of the bottom layer(s) of the lamination parallel to the CLT major strength direction, in in. (mm)

t_n = thickness of the top layer(s) of the lamination parallel to the CLT major strength direction, in in. (mm)

X3.3 Flatwise Bending Stiffness

$$(EI)_{eff,f,0} = \sum_{i=1}^{n} E_i b_0 \frac{t_i^3}{12} + \sum_{i=1}^{n} E_i b_0 t_i z_i^2 \quad \text{[X3-3]}$$

$$(EI)_{eff,f,90} = \sum_{i=2}^{n-1} E_i b_{90} \frac{t_i^3}{12} + \sum_{i=2}^{n-1} E_i b_{90} t_i z_i^2 \quad \text{[X3-4]}$$

where

$(EI)_{eff,f,0}$ = Effective flatwise bending stiffness of CLT, in lbf-in.^{2}/ft (N-mm^2/m) of width, in the CLT major strength direction

$(EI)_{eff,f,90}$ = Effective flatwise bending stiffness of CLT, in lbf-in.^{2}/ft (N-mm^2/m) of width, in the CLT minor strength direction

b_0 = CLT width in the CLT major strength direction, in in./ft (mm/m) of width

b_{90} = CLT width in the CLT minor strength direction, in in./ft (mm/m) of width

E_i = modulus of elasticity of the lamination in the i-th layer, in psi (MPa)

G_i = modulus of rigidity (shear modulus) of the lamination in the i-th layer, in psi (MPa)

t_i = thickness of laminations in the i-th layer, in in. (mm)

z_i = distance between the center point of the i-th layer and the neutral axis, in in. (mm)

n = number of layers in the CLT

X3.4 Flatwise Shear Rigidity

$$(GA)_{eff,f,0} = \frac{(t_p - \frac{t_1}{2} - \frac{t_n}{2})^2}{\left[\left(\frac{t_1}{2G_1 b_0}\right) + \left(\sum_{i=2}^{n-1} \frac{t_i}{G_i b_0}\right) + \left(\frac{t_n}{2G_n b_0}\right)\right]} \qquad \text{[X3-5]}$$

$$(GA)_{eff,f,90} = \frac{(t_p - \frac{t_1}{2} - \frac{t_n}{2})^2}{\left[\left(\frac{t_1}{2G_1 b_{90}}\right) + \left(\sum_{i=2}^{n-1} \frac{t_i}{G_i b_{90}}\right) + \left(\frac{t_n}{2G_n b_{90}}\right)\right]} \qquad \text{[X3-6]}$$

where

$(GA)_{eff,f,0}$ = Effective flatwise shear rigidity of CLT, in lbf/ft (N/m) of width, in the CLT major strength direction

$(GA)_{eff,f,90}$ = Effective flatwise shear rigidity of CLT, in lbf/ft (N/m) of width, in the CLT minor strength direction

Other terms are as defined in previously sections.

X3.5 Flatwise (Rolling) Shear Capacity

$$V_{s,0} = F_{s,minor} \frac{2\,A_{gross,0}}{3} \quad \text{[X3-7 ASD]}$$

$$v_{s,0} = f_{s,minor} \frac{2\,A_{gross,0}}{3} \quad \text{[X3-7 LSD]}$$

$$V_{s,90} = F_{s,major} \frac{2\,A_{gross,90}}{3} \quad \text{[X3-8 ASD]}$$

$$v_{s,90} = f_{s,major} \frac{2\,A_{gross,90}}{3} \quad \text{[X3-8 LSD]}$$

where

$V_{s,0}$ = ASD reference flatwise shear capacity, in lbf/ft of width, in the CLT major strength direction

$v_{s,0}$ = LSD flatwise shear resistance, in N/m of width, in the CLT major strength direction

$V_{s,90}$ = ASD reference flatwise shear capacity, in lbf/ft of width, in the CLT minor strength direction

$v_{s,90}$ = LSD flatwise shear resistance, in N/m of width, in the CLT minor strength direction

$F_{s,major}$ = ASD reference planar (rolling) shear stress of a lamination in the CLT major strength direction = $\frac{F_{v,\,major}}{3}$, in psi

$F_{v,major}$ = ASD reference shear stress of a lamination in the CLT major strength direction, in psi

$f_{s,major}$ = LSD specified planar (rolling) shear strength of a lamination in the CLT major strength direction = $\frac{f_{v,\,major}}{3}$, in MPa

$f_{v,major}$ = LSD specified shear strength of a lamination in the CLT major strength direction, in MPa

$F_{s,minor}$ = ASD reference planar (rolling) shear stress of a lamination in the CLT minor strength direction = $\frac{F_{v,\,minor}}{3}$, in psi

$F_{v,minor}$ = ASD reference shear stress of a lamination in the CLT minor strength direction, in psi

$f_{s,minor}$ = LSD specified planar (rolling) shear strength of a lamination in the CLT minor strength direction = $\frac{f_{v,\ minor}}{3}$, in MPa

$f_{v,minor}$ = LSD specified shear strength of a lamination in the CLT minor strength direction, in MPa

$A_{gross,0}$ = gross cross-sectional area of CLT, in in.^{2}/ft (mm^2/m) of width

$A_{gross,90}$ = gross cross-sectional area of CLT excluding the outermost longitudinal layers, in in.^{2}/ft (mm^2/m) of width

NOTE X3-1: For a CLT panel manufactured with multiple longitudinal outermost layers, all these are excluded from $A_{gross,90}$.

APPENDIX X4. History of Standard (Non-Mandatory)

In March 2010, the APA Standards Committee on Standard for Performance-Rated Cross-Laminated Timber was formed to develop a national standard under the consensus processes accredited by the American National Standards Institute (ANSI). This national consensus standard, designated as ANSI/APA PRG 320, was developed based on broad input from around the world. It should be especially recognized that this standard incorporates draft standards that were developed by FPInnovations in Canada, as part of the joint effort between the U.S. and Canada in the development of a bi-national CLT standard.

The first version of this standard was approved by ANSI for publication on December 20, 2011. Subsequent revisions resulted in the publication of the following versions:

- ANSI/APA PRG 320-2012 on October 30, 2012,
- ANSI/APA PRG 320-2017 on October 6, 2017,
- ANSI/APA PRG 320-2018 on February 6, 2018, and
- ANSI/APA PRG 320-2019 (this standard).

Inquiries or suggestions for improvement of this standard should be directed to:

Secretariat, ANSI/APA PRG 320
APA – The Engineered Wood Association
7011 South 19th Street
Tacoma, WA 98466
Internet address: www.apawood.org
e-mail address: help@apawood.org

The names of the ANSI/APA PRG 320 Committee members when this version of the standard is published are as shown below. The current list of the committee membership is available from the committee secretariat upon request.

Name	Affiliation	Note
Deepareddy Akula	Stella-Jones (Formerly McFarland Cascade)	
Joshua Bartlett	Franklin International	
Mark Bartel	International Beams	
Kevin Below	Cross Laminated Timber Canada Inc.	
Todd Black	DR Johnson Wood Innovations	
Hans-Erik Blomgren	Katerra	
Scott Breneman	WoodWorks - Wood Products Council	ExSub Member
Darryl Byle	CLT Solutions LLC	
Kevin Cheung	Western Wood Products Association	
Mark Clark	Momentive Inc.	
Steve Craft	CHM Fire Consultants Ltd.	
Randy Daudet	Simpson Strong-Tie	
Don DeVisser	Pacific Lumber Inspection Bureau	
Bruno Di Lenardo	Canadian Construction Materials Centre	
Brad Douglas	American Wood Council	
Pat Farrell	Freres Lumber Company	
Julie Frappier	Nordic Structures	Vice-Chair
Sylvain Gagnon	FPInnovations	
Bill Gareis	Ashland Inc.	
Bill Gould	ICC Evaluation Service Inc.	
Jim Henjum	SmartLam LLC	
Ben Herzog	University of Maine	
Frank Lam	University of British Columbia	
Dean Lewis	DCI Engineers	
Jeff Linville	Weyerhaeuser Company	
Robert Malczyk	Equilibrium Consulting Inc.	
Andre Morf	Structurlam Products, LP	
Jeff Morrison	Rosboro LLC	
David Moses	Moses Structural Engineers Inc.	
Lech Muszynski	Oregon State University	
John Neels	National Lumber Grades Authority	
Scott Nyseth	Stonewood Structural Engineers Inc.	
Ciprian Pirvu	WoodTech Consulting	
Henry Quesada-Pineda	Virginia Tech University	
Douglas Rammer	USDA Forest Products Laboratory	
Alexander Salenikovich	Université Laval	ExSub Member
Sheldon Shi	University of North Texas	
Scott Skinner	Akzo Nobel Coatings Inc.	
Kurt Stochlia	KSPE Inc.	
Phil Vacca	Louisiana-Pacific Corp.	
Chris Whelan	Henkel Corporation	
Tom Williamson	T.Williamson-Timber Engineering LLC	Chair
Steve Winistorfer	PFS TECO	
B.J. Yeh	APA – The Engineered Wood Association	Secretariat
Cory Zurell	Blackwell Structural Engineers	

F10353Text Modification

ANSI/APA PRG 320-2019
Standard for Performance-Rated Cross-Laminated Timber

APA HEADQUARTERS
7011 So. 19th St. ▪ Tacoma, Washington 98466 ▪ (253) 565-6600 ▪ Fax: (253) 565-7265

PRODUCT SUPPORT HELP DESK
(253) 620-7400 ▪ help@apawood.org

www.apawood.org

Form No. PRG 320-2019/Issued January 2020

Page: 65

Mod_10353_Text_ANSI-APA PRG-320-2019.pdf

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Building

31

F10452

Date Submitted	02/15/2022	**Section**	102.2.5	**Proponent**	Greg Johnson
Chapter	2704	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

Mass timber package of changes

Summary of Modification

clarifies existing Type IV requirement refers to traditional Type IV heavy timber and not new Type IV mass timber types.

Rationale

See uploaded rationale

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None - a clarification only.

Impact to building and property owners relative to cost of compliance with code

None - a clarification only.

Impact to industry relative to the cost of compliance with code

None - a clarification only.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Clarifies existing code provision; supports adoption of mass timber construction types.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Clarifies existing code provision; supports adoption of mass timber construction types.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No material is required or prohibited by this modification.

Does not degrade the effectiveness of the code

Does not change requirements.

2nd Comment Period

10452-G2

Proponent	Greg Johnson	Submitted	8/11/2022 4:38:53 PM	Attachments	No

Comment:

This change is needed to differentiate Type IV heavy timber from other Type IV construction types.

2nd Comment Period

10452-G3

Proponent	ashley ong	Submitted	8/26/2022 4:03:32 PM	Attachments	No

Comment:

Building Officials Association of Florida (BOAF) supports this modification.

F10452-A5Text Modification

1234

Testing 1234

D102.2.5 Structural fire rating.
Walls, floors, roofs and their supporting structural members shall be a minimum of 1-hour fire-resistance-rated construction.

Exceptions:

1.Buildings of Type IV-HT construction.

2.Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.

3.Automobile parking structures.

4.Buildings surrounded on all sides by a permanently open space of not less than 30 feet (9144 mm).

5.Partitions complying with Section 603.1, Item 11.

G152

D102.2 Other specific requirements.
D102.2.1 Exterior walls. Exterior walls of buildings located in the fire district shall comply with the requirements in Table 601 except as required in Section D102.2.6.
D102.2.2 Group H prohibited. Group H occupancies shall be prohibited from location within the fire district.
D102.2.3 Construction type. Every building shall be constructed as required based on the type of construction indicated in Chapter 6.
D102.2.4 Roof covering. Roof covering in the fire district shall conform to the requirements of Class A or B roof coverings as defined in Section 1505.
D102.2.5 Structural fire rating. Walls, floors, roofs and their supporting structural members shall be not less than 1-hour fire-resistance-rated construction.

Exceptions:

1. Buildings of Type IV-HT construction.
2. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.
3. Automobile parking structures.
4. Buildings surrounded on all sides by a permanently open space of not less than 30 feet (9144 mm).
5. Partitions complying with Section 603.1, Item 11.

AWC proposes this code change as part of a package which, when taken together, as a group, creates the safety and reliability requirements necessary for the regulation of large mass timber (MT) buildings by the Florida Building Code. The following statement was offered by the Ad Hoc Committee on Tall Wood Buildings (TWB) for this proposal (IBC-G152-18) in the ICC Code Development monograph 2018 Group A:

This code change proposal will result in consistency with the purpose and scope which was to leave intact the current Type IV heavy timber provisions. The HT category was created to differentiate the three (3) new categories of "mass timber", where HT represents the long-established heavy timber category that has been in the ICC family of codes, and the predecessor legacy codes for decades.

The Ad Hoc Committee for Tall Wood Buildings (AHC-TWB) was created by the ICC Board of Directors to explore the building science of tall wood buildings with the scope to investigate the feasibility of and act on developing code changes for these buildings. Members of the AHC-TWB were appointed by the ICC Board of Directors. Since its creation in January 2016, the AHC-TWB has held 8 open meetings and numerous Work Group conference calls. Four Work Groups were established to address over 80 issues and concerns and review over 60 code proposals for consideration by the AHC-TWB. Members of the Work Groups included AHC-TWB members and other interested parties. Related documentation and reports are posted on the AHC-TWB website at:

https://www.iccsafe.org/codes-tech-support/cs/icc-ad-hoc-committee-on-tall-wood-buildings/ .

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Energy Conservation

F10331

32

Date Submitted	02/13/2022	**Section**	402.2.5	**Proponent**	Greg Johnson
Chapter	4	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

Type IV mass timber modifications proposed for the building code.

Summary of Modification

Adds mass timber to the list of mass wall of mass materials and assemblies.

Rationale

See uploaded rationale

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

No impact; just an addition to the list of qualifying materials/assemblies.

Impact to building and property owners relative to cost of compliance with code

No impact; just an addition to the list of qualifying materials/assemblies.

Impact to industry relative to the cost of compliance with code

No impact; just an addition to the list of qualifying materials/assemblies.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Provides for an energy efficient alternative method of compliance.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Improves the code by providing for an energy efficient alternative method of compliance.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No material is required or prohibited by this modification.

Does not degrade the effectiveness of the code

Improves the code by providing for an energy efficient alternative method of compliance.

Alternate Language

2nd Comment Period

F10331-A1

Proponent Greg Johnson **Submitted** 8/11/2022 5:45:03 PM **Attachments** Yes

Rationale:

This is a simple material equity issue. There is no prohibition on the use of mass timber in the FL Building or Residential Codes. Such construction can be proposed and accepted currently. The proposed modification makes it clear that if a mass timber wall assembly meets the heat capacity performance requirements of R402.2.5 it can be considered a mass wall. R402.2.5 already recognizes solid timber/log walls. It should do the same for built up timber.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

none

Impact to building and property owners relative to cost of compliance with code

Might provide a more cost effective approach to energy code compliance

Impact to industry relative to the cost of compliance with code

Might provide a more cost effective approach to energy code compliance

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Energy efficiency related.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Provides an equivalent method or system of construction

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Eliminates discrimination against mass timber materials

Does not degrade the effectiveness of the code

Improves the code by providing flexibility

[Modify 10331 as follows]

R402.2.5 Mass walls.

Mass walls for the purposes of this chapter shall be considered above-grade walls of concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick (other than brick veneer), earth (adobe, compressed earth block, rammed earth) and any solid timber/logs, mass timber, or ~~any~~ other walls having a heat capacity greater than or equal to 6 Btu/ft^2 · °F (123 kJ/m^2 · K).

R402.2.5 Mass walls.

Mass walls for the purposes of this chapter shall be considered above-grade walls of concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick (other than brick veneer), earth (adobe, compressed earth block, rammed earth) and solid timber/logs, mass timber, or any other walls having a heat capacity greater than or equal to 6 $Btu/ft^2 \cdot °F$ (123 $kJ/m^2 \cdot K$).

RE402.2.5 Mass timber added to mass walls

The technical requirements for lightweight mass assemblies are in the commercial provisions of the IECC (C402.2.2) and ASHRAE 90.1. Both state that walls can be considered mass if they "have a heat capacity exceeding 5 Btu/ft F where the material weight is not more than 120 pcf." The following calculations demonstrate that typical mass timber walls and floors meet this requirement.

The heat capacity of mass timber is dominated by the wood. The Wood Handbook states that the heat capacity is "practically independent of density or species," and gives equation 4-17, which calculates the heat capacity based upon moisture content and temperature. Using a temperature of 75 °F and a moisture content of 12%, the heat capacity is calculated as 0.393 Btu/lb °F. This calculated value for wood corresponds well with tested values for CLT (KLH rates its CLT at 0.382 Btu/lb °F). The closeness of these values show that the glue has little effect upon the heat capacity.

The temperature of 75 degrees is given in 16 CFR Part 460, which regulates R-values for home insulation (https://www.ftc.gov/policy/federalregister-notices/16-cfr-part-460-labeling-advertising-home-insulation-trade-0).

A moisture content of 12% is the average given in PRG 320: Standard for Performance-Rated Cross-Laminated Timber. Cross-Laminated Timber (CLT) is a type of mass timber.

Unit conversion is needed for comparison with the requirements in the IECC and ASHRAE 90.1, so a density and wall thickness need to be assumed. PRG 320 says that the minimum specific gravity of wood used shall be 0.35. Typical lumber species used in CLT manufacture range in specific gravity from 0.35-0.55. Denser wood will give a higher heat capacity. Per the Wood Handbook, the density of wood with a specific gravity of 0.35 and a moisture content of 12% is 24.0 lb/ft . The density of wood with a specific gravity of 0.55 at 12% moisture content is 38.4 lb/ft .

A 5-ply CLT assembly will be assumed with a thickness given in PRG 320 as 6 7/8". A thinner assembly will likely have gypsum wallboard, which is denser and has a higher heat capacity than wood.

By combining the above assumptions with the calculated heat capacity, typical mass timber CLT walls are shown to have a heat capacity of 5.4-8.6 Btu/ft °F, which meet the requirement of the IECC and ASHRAE 90.1.

For floors, ASHRAE 90.1 has the same minimum heat capacity requirement as walls, so no further calculation is necessary, but the commercial IECC also requires a minimum weight of 25 psf where the material weight is 120 pcf or less. This requirement can be easily met by adding a concrete or gypcrete topping to the mass timber floor panel, which is common practice. Using the minimum CLT density and the same thickness as above, and assuming lightweight concrete topping of 90 pcf, 1.5 inches of concrete will meet the minimum weight requirement. Heavier concrete, denser wood species, or a thicker CLT panel will reduce the thickness of concrete topping needed to meet the weight requirement.

Bibliography: Forest Products Laboratory. Wood handbook - Wood as an engineering material. General Technical Report FPL-GTR-190. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory: 4-12 p.

2010 https://www.fpl.fs.fed.us/documnts/fplgtr/fpl_gtr190.pdf (accessed 02-13-2022)

TAC: Fire

Total Mods for **Fire** in **Denied : 32**

Total Mods for report: 33

Sub Code: Existing Building

F10429

33

Date Submitted	02/14/2022	**Section**	505	**Proponent**	Jennifer Hatfield
Chapter	5	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

Proposals for Sections 702 and 1012.4.6 of the Florida Existing Building Code, and AJ102.4 of the Florida Residential Code

Summary of Modification

Provides for alignment with IEBC language that is not intended to change current requirements. Rather, the proposal is based on clean-up, consistency and clarity supported by industry and the ICC Building Code Action Committee addressing EEROs and WOCDs.

Rationale

This proposal is being submitted on behalf of the Fenestration & Glazing Industry Alliance to align the language in the Florida code to what is in 505 of the IEBC. It is based on clean-up provided by the ICC BCAC proposals, as well as industry backed proposals. 505.1 - clarifies that we are talking about replacing windows and is a more accurate reflection of what this section is addressing. 505.2 - provides: - clean-up that clarifies that ASTM F2090 includes criteria for window fall prevention devices and WOCDs - changes the term “top of the sill” to "bottom of the clear opening" as the latter is easier to determine and measure. This term is consistent with language for new windows, and - strikes language that is being moved to the new 505.3.1. 505.3 - provides for corrected references and directs the user to a new section (being proposed separately) on what one must do when the replacement window is part of a change of occupancy. This is in align with the IEBC and the separate proposal provides code users specifications on how to comply that currently do not exist in the Florida-EB but will be useful to facilitate compliance. This section also strikes language that is being moved to the new 505.3.1. - New section 505.3.1 includes criteria for opening control devices and fall prevention devices on EEROs that is currently in 505.2 and 505.3 of the Florida code. Note 505.2, #2 in purple was adopted/approved under Phase 1 from F9670/EB65.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Should be no fiscal impact, all of this is meant for clarity and consistency, and should be beneficial to code enforcement.

Impact to building and property owners relative to cost of compliance with code

Should be no fiscal impact, all of this is meant for clarity and consistency, and should be beneficial to the owners.

Impact to industry relative to the cost of compliance with code

Should be no fiscal impact, all of this is meant for clarity and consistency, and should be beneficial to industry.

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Provides alignment and clarity to benefit all code users, positively impacting the general public as less misinterpretation of code requirements.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Improves the code by providing clarity and consistency.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

It does not.

Does not degrade the effectiveness of the code

It does not.

Alternate Language

2nd Comment Period

F10429-A3

Proponent Jennifer Hatfield **Submitted** 8/25/2022 10:52:21 AM **Attachments** Yes

Rationale:

This alternative language comment, submitted on behalf of the Fenestration & Glazing Industry Alliance (FGIA, addresses the reason for TAC denial by reverting back to current 505.1 language, leaving it as replacement glass (instead of changing it to windows). This section was included to demonstrate we are leaving it as is by this alternative language comment. The rest of the proposal remains as initially submitted, which provides for language that is consistent with WOCD and EERO changes made in both appendix J of the FL Residential Code and Chapter 7 of the Florida Existing Building Code, which were approved by the TAC in June.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None

Impact to building and property owners relative to cost of compliance with code

None

Impact to industry relative to the cost of compliance with code

None

Impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Ensures consistent language is used, which assists the code user and in turn benefits the public.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Provides for consistent existing building code language on EERO and WOCD requirements across the three areas of code.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

It does not.

Does not degrade the effectiveness of the code

It does not, it improves it by providing consistent language.

505.1 Replacement glass.
The installation or replacement of glass shall be as required for new installations.

505.2 ~~Replacement w~~Window opening control devices on replacement windows.
In Group R-2 or R-3 buildings containing dwelling units and one- and two-family dwellings and townhouses regulated by the *Florida Building Code, Residential*, window opening control devices or fall prevention devicescomplying with ASTM F2090 shall be installed where an existing window is replaced and where all of the following apply to the replacement window:

1.The window is operable;

2.One of the following applies:

2.1.The window replacement includes replacement of the sash and the frame.

2.2.The window replacement includes the sash only when the existing frame remains.

3. One of the following applies:

3.1. In a Group R-2 or R-3 building containing dwelling units, the bottom~~top~~ of the clear opening ~~sill~~ of the window opening is at a height less than 36 inches (915 mm) above the finished floor; or

3.2. In one- and two-family dwellings and townhouses regulated by the *Florida Building Code, Residential*, the bottom ~~top~~ ~~sill~~ of the clear opening of the window opening is at a height less than 24 inches (610 mm) above the finished floor;

4.The window will permit openings that will allow passage of a 4-inch-diameter (102 mm) sphere when the window is in its largest opened position; and

5.The vertical distance from the bottom ~~top~~ of the clear opening ~~sill~~ of the window opening to the finished grade or other surface below, on the exterior of the building, is greater than 72 inches (1829 mm).

~~The window opening control device, after operation to release the control device allowing the window to fully open, shall not reduce the minimum net clear opening area of the window unit to less than the area required by Section 1030.2 of the *Florida Building Code, Building*.~~

Exception~~s~~:

~~1.~~Operable windows where the bottom ~~top~~ of the clear opening ~~sill~~ of the window opening is located more than 75 feet (22 860 mm) above the finished grade or other surface below, on the exterior of the room, space or building, and that are provided with window fall prevention devices that comply with ASTM F2006.

~~2.Operable windows with openings that are provided with window fall prevention devices that comply with ASTM F2090.~~

505.3 Replacement window emergency escape and rescue openings.

Where windows are required to provide *emergency escape* and *rescue openings* in Group R-2 and R-3 occupancies and one- and two-family dwellings and townhouses regulated by the *Florida Building Code, Residential*, replacement windows shall be exempt from the requirements of Sections 1030.2~~,~~ and 1030.3 ~~and 1030.5~~ of the *Florida Building Code, Building* and Sections R310.2.1~~,~~ and R310.2.2 ~~and R310.2.3~~ of the *Florida Building Code, Residential,* provided the replacement window meets the following conditions:

1.The replacement window is the manufacturer's largest standard size window that will fit within the existing frame or existing rough opening. The replacement window shall be permitted to be of the same operating style as the existing window or a style that provides for an equal or greater window opening area than the existing window.

2. Where t~~T~~he replacement of the window is ~~not~~ part of a change of occupancy, it shall comply with Section 1012.4.6.

~~Window opening control devices complying with ASTM F2090 shall be permitted for use on windows required to provide emergency escape and rescue openings.~~

505.3.1 Control Devices

Window opening control devices or fall prevention devices complying with ASTM F2090 shall be permitted for use on windows required to provide *emergency escape and rescue openings*. After operation to release the control device allowing the window to fully open, the control device shall not reduce the net clear opening area of the window unit. *Emergency escape and rescue openings* shall be operational from the inside of the room without the use of keys or tools.

505.1 Replacement ~~glass~~ windows.
The installation or replacement of ~~glass~~ windows shall be as required for new installations.

505.2 ~~Replacement w~~Window opening control devices on replacement windows.
In Group R-2 or R-3 buildings containing dwelling units and one- and two-family dwellings and townhouses regulated by the *Florida Building Code, Residential*, window opening control devices or fall prevention devicescomplying with ASTM F2090 shall be installed where an existing window is replaced and where all of the following apply to the replacement window:

1.The window is operable;

2.One of the following applies:

2.1.The window replacement includes replacement of the sash and the frame.

2.2.The window replacement includes the sash only when the existing frame remains.

3. One of the following applies:

3.1. In a Group R-2 or R-3 building containing dwelling units, the bottom~~top~~ of the clear opening ~~sill~~ of the window opening is at a height less than 36 inches (915 mm) above the finished floor; or

3.2. In one- and two-family dwellings and townhouses regulated by the *Florida Building Code, Residential*, the bottom ~~top~~ ~~sill~~ of the clear opening of the window opening is at a height less than 24 inches (610 mm) above the finished floor;

4.The window will permit openings that will allow passage of a 4-inch-diameter (102 mm) sphere when the window is in its largest opened position; and

5.The vertical distance from the bottom ~~top~~ of the clear opening ~~sill~~ of the window opening to the finished grade or other surface below, on the exterior of the building, is greater than 72 inches (1829 mm).

~~The window opening control device, after operation to release the control device allowing the window to fully open, shall not reduce the minimum net clear opening area of the window unit to less than the area required by Section 1030.2 of the *Florida Building Code, Building*.~~

Exception~~s~~:

~~1.~~Operable windows where the bottom ~~top~~ of the clear opening ~~sill~~ of the window opening is located more than 75 feet (22 860 mm) above the finished grade or other surface below, on the exterior of the room, space or building, and that are provided with window fall prevention devices that comply with ASTM F2006.

~~2.Operable windows with openings that are provided with window fall prevention devices that comply with ASTM F2090.~~

505.3 Replacement window emergency escape and rescue openings.

Where windows are required to provide *emergency escape* and *rescue openings* in Group R-2 and R-3 occupancies and one- and two-family dwellings and townhouses regulated by the *Florida Building Code, Residential*, replacement windows shall be exempt from the requirements of Sections 1030.2~~,~~ and 1030.3 ~~and 1030.5~~ of the *Florida Building Code, Building* and Sections R310.2.1~~,~~ and R310.2.2 ~~and R310.2.3~~ of the *Florida Building Code, Residential,* provided the replacement window meets the following conditions:

1.The replacement window is the manufacturer's largest standard size window that will fit within the existing frame or existing rough opening. The replacement window shall be permitted to be of the same operating style as the existing window or a style that provides for an equal or greater window opening area than the existing window.

2. Where t~~T~~he replacement of the window is ~~not~~ part of a change of occupancy, it shall comply with Section 1012.4.6.

~~Window opening control devices complying with ASTM F2090 shall be permitted for use on windows required to provide emergency escape and rescue openings.~~

505.3.1 Control Devices
Window opening control devices or fall prevention devices complying with ASTM F2090 shall be permitted for use on windows required to provide *emergency escape and rescue openings.* After operation to release the control

device allowing the window to fully open, the control device shall not reduce the net clear opening area of the window unit. *Emergency escape and rescue openings* shall be operational from the inside of the room without the use of keys or tools.?