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Tony Evers, Governor
Dan Hereth, Secretary

VIRTUAL/TELECONFERENCE
MASS TIMBER TASK FORCE
Virtual, 4822 Madison Yards Way, Madison
Contact: Brad Wojciechowski (608) 266-2112
October 25, 2023

The following agenda describes the issues that the Task Force plans to consider at the meeting. At the time of the meeting, items may be removed from the agenda. Please consult the meeting minutes for a record of the actions of the Task Force.

AGENDA

10:00 A.M.

OPEN SESSION – CALL TO ORDER – ROLL CALL

A. Adoption of Agenda (1)

B. Approval of Minutes of June 13, 2023 (2-3)

C. Introductions, Announcements and Recognition

D. Reminders: Scheduling Concerns

E. Administrative Matters
1) Department, Staff and Task Force Updates

F. Administrative Rules Matters – Discussion and Consideration

G. Alternative Procedures for Design of Mass Timber Tall Buildings – Discussion and Consideration (4-33)
1) Developing Content for Alternative Procedures for Mass Timber Guidebook
2) Relating Mass Timber to Other Alternative Building Procedures

H. Public Comments

ADJOURNMENT

NEXT MEETING: TBD

****

MEETINGS AND HEARINGS ARE OPEN TO THE PUBLIC, AND MAY BE CANCELLED WITHOUT NOTICE.

Times listed for meeting items are approximate and depend on the length of discussion and voting. All meetings are held virtually unless otherwise indicated. In-person meetings are typically conducted at 4822 Madison Yards Way, Madison, Wisconsin, unless an alternative location is listed on the meeting notice. In order to confirm a meeting or to request a complete copy of the board's agenda, please visit the Department website at https:\\dsps.wi.gov. The board may also consider materials or items filed after the transmission of this notice. Times listed for the commencement of disciplinary hearings may be changed by the examiner for the convenience of the parties. Requests for interpreters for the hard of hearing, or other accommodations, are considered upon request by contacting the Affirmative Action Officer , or reach the Meeting Staff by calling 608-267-7213.

VIRTUAL/TELECONFERENCE
MASS TIMBER TASK FORCE
MEETING MINUTES
MARCH 23, 2023

PRESENT: Justin Gavin, Laura Hasburgh, Jason Korb, Marco Lo Ricco, Michael Mazmanian *(arrived at 1:04 p.m.)*, Richard Paur

EXCUSED: Erich Roden, John Peronto, Alexander Timmer

STAFF: Brad Wojciechowski, Executive Director; Joseph Ricker, Legal Counsel; Dialah Azam, Bureau Assistant; and other Department Staff

CALL TO ORDER

Richard Paur, Chairperson, called the meeting to order at 1:03 p.m. A quorum was confirmed with five (5) members present.

ADOPTION OF AGENDA

MOTION: Laura Hasburgh moved, seconded by Jason Korb, to adopt the Agenda as published. Motion carried unanimously.

(Michael Mazmanian arrived at 1:04 p.m.)

APPROVAL OF MINUTES OF MARCH 6, 2023

MOTION: Laura Hasburgh moved, seconded by Michael Mazmanian, to approve the Minutes of March 6, 2023 as published. Motion carried unanimously.

ALTERNATIVE PROCEDURES FOR DESIGN OF MASS TIMBER TALL BUILDINGS

Developing Content for Alternative Procedures for Mass Timber Guidebook

MOTION: Jason Korb moved, seconded by Laura Hasburgh, to designate DSPS to work on Section 1. Motion carried unanimously.

MOTION: Jordan Komp moved, seconded by Michael Mazmanian, to designate Justin Gavin and Jason Korb to work on Section 2. Motion carried unanimously.

MOTION: Justin Gavin moved, seconded by Laura Hasburgh, to designate Laura Hasburgh and Marco Lo Ricco to work on Section 3. Motion carried unanimously.

MOTION: Justin Gavin moved, seconded by Jason Korb, to designate Michael Mazmanian and Richard Paur to work on Section 4. Motion carried unanimously.

ADJOURNMENT

MOTION: Laura Hasburgh moved, seconded by Justin Gavin, to adjourn the meeting. Motion carried unanimously.

The meeting adjourned at 2:43 p.m.

An Alternate Procedure for the Design and Permitting of (Tall) Mass Timber Buildings

3-23-2023

An Alternative Procedure for the Design and Permitting of (Tall) Mass Timber Buildings

2023 Edition

A consensus document developed by the Wisconsin Mass Timber Task Force

Task Force Active Members:

Richard Paur, Chairperson

Justin Gavin

Wisconsin Department of Safety and Professional Services Representative

Laura E. Hasburgh

Jordan T. Komp

Jason P. Korb

Marco T. Lo Ricco

Michael C. Mazmanian

Erich J. Roden

Alexander R. Timmer

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4 Construction and Post Occupancy

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    4.2 Post Occupancy

5 Closing Remarks

IDEA: Intro to mass timber as a construction method (American Wood Council for help)

About the Mass Timber Task Force

The Mass Timber Task Force was created under Wis. Stat. § 227.13 to advise the Department and the Commercial Building Code Council on matters relating to development of mass timber guidelines.

The agency utilized informal conferences and consultations to obtain the viewpoint and advise of interested persons with respect to contemplated rule making. The agency appointed a committee of experts, interested persons or representatives of the public to advise it with respect to any contemplated rule making. The committee shall have advisory powers only.

Members:

Paur, Richard (Chairperson)

Hasburgh, Laura

Komp, Jordan

Korb, Jason

Lo Ricco, Marco

Mazmanian, Michael

Roden, Erich

Timmer, Alexander

Gavin, Justin

~~*[A]104.11 Alternative materials, design and methods of construction and equipment.*~~
~~*The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. 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. Where the alternative material, design or method of construction is not approved, the building official shall respond in writing, stating the reasons why the alternative was not approved.*~~

~~*[A]104.11.1 Research reports.*~~
~~*Supporting data, where necessary to assist in the approval of materials or assemblies not specifically provided for in this code, shall consist of valid research reports from approved sources.*~~

1. Intent, Scope, and Justification

1.1 Intent

The intent of the guidebook is to provide a framework for design professionals to work with permitting officials to facilitate the approval of (tall) Mass Timber structures, utilizing a performance-based design approach. The alternative design methods and materials described in this guidebook must provide, at a minimum, an equivalent level of quality, strength, fire resistance, durability, and safety, as buildings of similar height, occupancy, and area; as they relate to the Wisconsin Commercial Building Code, with references to the International Building Code.

1.2 Scope

The scope of this guidebook is to identify a methodology for the design, review, and approval of mass timber or composite mass timber buildings beyond the prescriptive provisions of IBC Type IV construction.

1.3 Justification

The Wisconsin Commercial Building Code (CBC) and the International Building Code (IBC) have existing provisions for alternative building materials, as well as the use of a performance-based design approach, both in lieu of a standard prescriptive code approach.

Alternate Building Materials

SPS 361.03 (6): *"Nothing in chs. SPS 361 to 366 is intended to prohibit or discourage the design and utilization of new building products, systems, components, or alternate practices, provided written approval from the department is obtained first."*

SPS 361.50 (2): *"Materials, equipment, and products that meet the intent of chs. SPS 361 to 366 and which are not approved under sub. (1) shall be permitted if approved in writing by the department.*

Approval of materials, equipment, and products shall be based on sufficient data, tests, and other evidence that prove the material, equipment, or product meets the intent of the standards specified in chs. SPS 361 to 366.

Tests, compilation of data, and calculations shall be conducted by a qualified independent third party."

Performance Based Design

IBC 2021 – Appendix O: *"Appendix O provides an optional design, review and approval framework for use by the building official. Typical uses would include cases of alternate methods in Chapter 1, select areas of the code that require a rational analysis such as Section 909 and elsewhere. It simply extracts the relevant administrative provisions from the ICC Performance Code into a more concise, usable appendix format for a jurisdiction confronted with such a need. Currently there are multiple, varying jurisdictional rules and procedures in many communities regarding procedure and none in even more. The building official is often left alone to reach decisions not just on the merits of a design, but must first also decide on the submittal and*

review process. As an appendix, the provisions herein are entirely optional to a jurisdiction. This appendix can be adopted, adopted with local modifications, or even used on a case-by-case basis as part of a Memorandum of Understanding or similar legal agreement between the jurisdiction and the owner/design team. It simply represents another tool for the jurisdiction to reach for in cases of need; it neither encourages nor creates any additional opportunity for performance-based design."

The utilization of alternative building materials and design methods are contingent on approvals from the Wisconsin Department of Safety and Professional Services (DSPS). This guidebook outlines practices that have been used prior to the establishment of the Task Force, focusing on their implementation with respect to (tall) Mass Timber structures.

This guide would recommend the mass timber design align with the performance objectives utilized by the Ad Hoc Committee on Tall Wood Buildings (TWB) in providing guidance on the development of future code change proposals, primarily:

1. *No collapse under reasonable scenarios of complete burnout 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 (building height) and risk of collapse.*

2. Permitting and Variance Process

For projects utilizing the alternate design methods and materials outlined in this guide, the following permitting and variance process in recommended.

2.1 Preliminary Meeting

Note: peer review should be included here

A preliminary meeting, likely occurring in the Concept/Schematic Design phase of the project, to introduce the project to the Authority Having Jurisdiction (AHJ), including the following items:

1. Project Location
2. Project Parameters (Height, Number of Stories, Material Exposure,…)
3. Project Timeline
4. Unique/critical project details
5. Design Team Proposed Variance Path (e.g. utilizing this guide)
6. Preliminary AHJ/Fire Department Questions
7. Schedule Next Steps

It is recommended the following parties are in attendance:

1. Authority Having Jurisdiction
2. Fire Department
3. Ownership
4. Architect on Record (A.O.R.)
5. Engineer on Record (E.O.R.)
6. Fire Engineer (if on-board)
7. Contractor (if on-board)

2.2 Process Approval

Based on the introductory meeting, and initial feedback from the AHJ/Fire Department, the design team should formally propose a Variance/Permitting Approval Process (e.g. the Alternate Materials provision, the use of this guide…), including what, if any, supplemental testing, reports, or documentation will be provided in the formal variance.

After reviewing the proposal, the AHJ should formally approve or reject the variance **process**, including any required modifications or supplement documentation to the design team proposal.

2.3 Petition for Variance

Based on the previously accepted variance process, the design team/ownership should formally issue a “Petition for Variance” (or potentially multiple variances depending on the project).

The petition should include the following:

1. The code section(s) being petitioned
2. The variance request
3. The intent of the code section being petitioned
4. Petitioner's comments, including what supplemental documentation (e.g. letters, reports, test results, peer reviews, fire engineering) will be provided with the future issuance of the Permit Documents

If deemed acceptable, the AHJ should provide "Conditional Approval" of the Petition for Variance, noting any specific conditions of approval (e.g. the petitioner carrying out all items noted in the original petition).

If deemed unacceptable, the AHJ should clarify why the petition was rejected, or note what modifications would be required for approval.

2.4 Issuance of Permit Documents

Outline the Standard Permitting Process (Drawings, Specifications, Calculations)

The permit documents should also be issued to the previously approved Independent Third Party Peer Reviewer, if applicable (refer to section 3.4 for additional information regarding the peer review process)

Update per Peer Review / AHJ Comments

2.5 Permit Approval

Prior to formal issuance of the permit, all AHJ and Peer Review comments should be addressed to the satisfaction of the AHJ.

Formal Issuance Process

i. Buildings approved under type IV construction

ii. Documentation:

1. Structural package

a. For members with fire protection based on a protective char layer, supplemental calculations to be provided for both standard occupancy, and extreme event (fire) scenarios.

2. Glulam fire test report (for chars beyond 2 hours)

3. CLT compliance with PRG-320 (2018 or beyond) to avoid heat delamination

4. CLT un-restrained load-bearing floor/ceiling assembly fire test (where fire performance not proved by char) in compliance with ASTM E119-

16a *Standard Test Methods for Fire Tests of Building Construction and Materials*

5. Connection load-bearing fire-test (for connections) in compliance with ASTM E119-16a, or supplemental fire engineering per IBC 2021, Section 2304.10.1.

3. Analysis, Design, and Detailing

For Type IV construction, beyond the prescriptive requirements of the adopted building code, it is noted that an alternate, performance-based, pathway is available for design and permitting.

The goal of this chapter is to provide guidance on design parameters, as well as any necessary supervision by third party professionals (where required), to meet the performance goals agreed to with the AHJ.

3.1 Structural Design

The structural design should follow, at a minimum, the requirements of the National Design Specification referenced by the current version of the Wisconsin Commercial Building Code. The structural calculations provided to the AHJ should include calculations for both the standard design scenario and for a fire scenario, where members rely on charring of the structure.

Given the recent additions to the 2021 NDS, it is recommended the design team utilize the additional requirements of this updated design standard, particularly with respect to the lateral design requirements included in the 2021 Special Design Provisions for Wind and Seismic (SDPWS).

Should the team consider sourcing material (timber/hardware) outside of the United States, the design team should provide documentation providing equivalency between Eurocode serviceability and strength parameters with those documented in the NDS. For these materials, it is recommended the team provide an additional equivalent Eurocode design for the controlling members/designs. The peer reviewer (where applicable) should review and comment on the conversion factors from codes outside the United States to NDS parameters/values.

In addition to the code requirements above, it is recommended that the design utilize, where possible, state of the art research and design documents (as applicable), including the latest versions of the following documents:

1. CLT Diaphragm Design for Wind and Seismic Resistance (Woodworks)
2. U.S. Mass Timber Floor Vibration Design Guide (Woodworks)
3. Current CLT Composite Research (where applicable)
4. Hybrid Steel Frames with Wood Floors (AISC) (where applicable)
5. 2022 Fire Design Specification (FDS) for Wood Construction

Where current state of the art research and documents associated with mass timber fall outside of the United States, it is recommended to reference the associated governing codes, including:

6. EuroCode 5
7. Canadian Code (CSA)

The design team shall justify to the AHJ and Peer Reviewer, the use of the design recommendations, factors, and equations provided by these codes, in accordance with American Standards.

3.2 Fire-Resistance Requirements

The design team should provide clear documentation of what structural elements are considered exposed, concealed and/or partially concealed. The design team should clearly identify the fire rating of each element. For elements where the fire protection is provided by a combination of a non-combustible material and charring layer, the contribution of each toward the overall fire rating should be documented; with the contribution of the non-combustible materials (where applicable) providing a minimum of 2/3 of the overall required fire rating.

~~This guidebook intents to identify methods of approval, including encapsulation, char layer, third party testing, or other approved methods, to demonstrate fire-resistance ratings.~~

3.2.1 Minimum Fire-Resistance Ratings (FRR's)

Primary Structural Frame:

Buildings up to 180'-0" or 12 stories: 2 hours[1]

Buildings taller than 180'-0" or 12 stories: 3 hours[1, 2]

[1.] Roof support rating is permitted to be reduced by one hour where supporting a roof only (not including additional occupancies/loading)

[2.] For buildings not greater than 420 feet in building height, the fire-resistance rating of floor framing elements (e.g. CLT slabs and glulam beams) shall be permitted to be reduced to 2 hours.

Bearing Walls:

Refer to primary structural frame[3, 4]

[3.] No reduction for roof framing is permitted

[4.] Minimum fire-rating for exterior walls to be based on fire separation distance

Non-Bearing Walls and Partitions: 0 hours

Floor Construction and Associated Secondary Structural Members: 2 hours

Roof Construction and Associated Secondary Structural Members:

Buildings up to 180'-0" or 12 stories: 1 hour

Buildings taller than 180'-0" or 12 stories: 1.5 hours

Structural Connections

Fire-Resistance Rating to match, at a minimum, the lower of the connecting member(s) FRR.

3.2.2 Mass Timber Fire-Resistance Rating Validation

3.2.2.1

NDS (Char Method)

Primary and Secondary Structure:

The utilization of NDS provisions and calculations for the determination of char rates is a well-established and industry recognized procedure. For the scope of this guideline, the following additional items shall be considered:

- LRFD Fire Factors: 2022 Fire Design Specification (FDS) for Wood Construction has included additional Fire Factors (not currently covered in NDS) for the use of Fire Factors with LRFD provisions (Table 3.2.5).

- Extreme Event Loading: For loading in a fire scenario, the designer is referenced to the 2022 Fire Design Specification (FDS) for Wood Construction section 3.1.3.4.

- Char Calculations Beyond 2 Hours: For members requiring fire ratings beyond the current NDS provisions, the design team shall provide specific testing, verifying the char rates utilized for design. It is recommended that the char rates not be reduced beyond those calculated based on extrapolation of the current NDS equations.

For projects utilizing Douglas Fir, American Spruce or European Spruce, the design team is advised to refer to the 3hr testing provided by the USDA Forest Product Laboratory for the Ascent project.

Connections:

- Bearing type connections should utilize noncombustible protection, or require load tested (under a fire event) to achieve the FRR noted in section 2.1.1.
    i. Connections utilizing intumescent paint for noncombustible protection should be load tested (under a fire event) to confirm compatibility between materials
    ii. At the AHJ's discretion, the use of engineering analysis could be provided to validate the fire-resistance rating of connections per section 2304.10.1 of IBC 2021
- All other mass timber connections should be load tested (under a fire event) for the specified fire rating.
- Testing should meet the requirements of Section 2.1.3

3.2.2.2

Non-Combustible Protection

Gypsum detailing requirements to follow IBC 2021 section 722.7. TT: Korb previously noted some general concerns regarding discrepancies in the IBC 2021 code (section 722.7). It is

recommended that the guideline specify specific detailing requirements in lieu of relying on a reference to IBC 2021.

Korb: Has a lot more that is codified? General requirements. Sealant. ASPM requirements. Specific materials for fire protection. Gypsum must be met. 2 years ago implemented. Special inspections required based on building officials. Who is appropriate qualifications? Daily/monthly/yearly reports. Up to the special inspector to work with owner, contractor.

"Proposal FS81-18 (new IBC 722.7) defined the level of noncombustible protection required and how to achieve this level, including a prescriptive method recognizing 1/2" Type X gypsum board providing 25 minutes of protection and 5/8" Type X gypsum board providing 40 minutes of protection. Proposal FS5-18 (new IBC 703.6) defined methods to determine the level of noncombustible protection provided by other applied materials through using the E119 test procedure. FS73-18 (IBC 718.2.1) added mass timber as a fire blocking material."

Minimum 2/3 rating from non-combustible materials (if utilized?)

Sealants: Sealing of adjacent mass timber elements per 703.7. Sealants shall meet the requirements of ASTM C920. Adhesives shall meet the requirements of ASTM D3498.

Fire Blocking: Materials to meeting the requirements of 718.2.1

A new code section, IBC 703.7, was included in proposal FS6-18. It required that certain adhesives be applied at abutting edges and intersections of fire resistance-rated mass timber elements unless the assembly has been shown to provide the required FRR without utilizing sealants.

3.2.2.3

Fire Testing/Certification Requirements:

Testing to be completed, and results certified, by an independent, accredited 3rd party testing agency. Testing procedure and results to be reviewed for approval by Project AOR, EOR, Fire Engineer, and AHJ.

3.2.3 Exposure

Primary and Secondary Structure:

The floor assembly should contain a non-combustible material no less than 1" in thickness above the mass timber floor. No additional limits are directly required of the primary and secondary structural exposure, contingent on meeting the fire-resistance ratings specified in Section 2.1.1.

Committee to consider if we want to discuss exposure of mass timber walls (not columns) and slabs (e.g. separation of 15 feet if exposing walls/ceilings in a dwelling unit)

Concealed Spaces:

Strong and clear stance
"No exposed mass timber in concealed spaces; concealed space permitted only with noncombustible protection as required for the interior mass timber."

i. Korb

1. Prohibition of concealed spaces 4HT has been removed. – **(KA comment – concealed spaces language in the IBC and its commentary are not in agreement. For discussion.)** gypsum detailing

a. Lean on prescriptive method. **(KA comment – gypsum detailing requirements have been defined by Fire Design Specification for Wood Construction – Wood Products Council.)**

Exterior Walls (Façade):

- " Exterior side of exterior walls protected by a non-combustible material—e.g., 5/8" Type X gypsum sheathing"
- " No combustible exterior wall coverings except for certain water-resistant barriers"
- " No exposed mass timber on the inside and outside surfaces of exit enclosures and elevator hoistways in high-rise buildings (occupied floor > 75 feet from lowest fire department access)"
- " Noncombustible construction only for exit enclosures and elevator hoistways greater than 12 stories or 180 feet"

3.2.4 Additional Recommendations:

Water Supply:

iii. Dual water supply for buildings 120 feet and above (IBC 403.3.2)

iv. Water supply in accordance with 2021 IFC 3313 and 2021 IBC 3313

Notes regarding 3.2.4 iii.)

[F]403.3.2Water supply to required fire pumps.

In buildings that are more than 420 feet (128 000 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.

Sprinklers:

i. Building fully sprinklered with an NFPA 13-compliant sprinkler system

Smoke Evacuation: Fire Department thoughts?

Type 1A Construction?

3.3 Fire Engineering Consultant:

TT Thoughts:

For buildings higher than 12 stories or 180' (only)
Qualifications and Selection
- Previous Mass Timber Experience
- Selected by Ownership/Design to be approved by AHJ

-Scope

1. Review mass timber framing and connections protection in concealed areas
2. Review mass timber connections in exposed connections
3. Review gypsum detailing per requirements of Section 3.2.2.2.
4. Smoke evacuation
5. Review testing provided by manufacturers for compliance with relevant standards

Previous committee thoughts: Fire Consultant

2.2.1Fire rating documentation and justification

i. Until such time as it is formally adopted by the IBC the documentation provided - just as important as the plan. Project by project basis.

ii. Envision you have your structural package. Specific char calculations. Heat effected zone. Mass Timber additional fire test. Documentation for any additional testing codified limits. CLT or floor system. Prg 320 correct glue. Review from fire consultant. Unique connectors for testing and data in the package.

3.4 Peer Review

TT Thoughts:

Qualifications and selection

For each project higher than 12 stories or 180', a Mass Timber Peer Review Panel (MTPRP) shall be convened

The MTPRP shall be a panel or a structural engineering firm with at least three (3) members with previous experience in relevant mass timber buildings

The MTPRP shall be selected by the Building Official based on their qualifications applicable to the Mass Timber Peer Review of the project. The Building Official may request the opinion of the Project Sponsor and EOR on proposed SPRP members, with the Building Official making the final decision on the MTPROP membership.

The MTPRP shall bear no conflict of interest with respect to the project and shall not be part of the design team for the project.

The MTPRP provides their professional opinion to and acts under the instruction of the building official

Review scope

To provide an independent, objective, technical review of those aspects of the building design that relate to the structural performance of the building according to the requirements and guidelines described on this building, and to advise Building Officials whether the design generally conforms to the intent of this documentation and other requirements set forth by the Building Official

Review structural calculations, under normal conditions and under a fire scenario; including the use of foreign codes, where applicable.

The MTPROP shall be convened as early in the structural design phase as practicable.

2.4.1 Previous task force committee thoughts: Qualifications and selections

- *Performance based approach. To verify prescriptive limitations. Requirements are peer review acting on behalf of the building owner. Due diligence for beyond code. Acting on part of city or building officials reviewing on their behalf. Foreign to DSPS practices. Contract that out? Would have to go through a petition. Special inspections – On the ownership team to run. The reviewer would not be from the state – independent reviewer. (For discussion – the EOR for Ascent performed the Sis. Pros and cons?) It could be a different structural firm outside the state. State could create the committee. Expertise – Not an additional ask for the plan review. Special inspections, the building owner/reviewer. The building official reviews and approves - selected*
- *Joe Ricker*
    0. *We do have to remember work within the rules we do have. Existing systems or legislative action.*

i. *Korb*

    0. *Peer review seems excessive. Everyone will have opinions. The data must speak for themselves.*
    1. *Lo ricco*

- *Prescriptive measures are approved. We do not need peer review. Peer review intended for performance-based route. More general approach.*
    0. *Roles*

0. *Peer review*

Technical. Review responsibilities

Building Officials - Enough data, qualified, threshold for substantial evidence. Standard of care. Justifying analysis

1 example: Exposed area. 18 story timber structure. Fully encapsulated. How much exposure would trigger a peer review. May be based on occupancy.

1. *For areas outside the code. Needs to have some technical judgment in concert with the building review with the engineers. Backstop for building official for technical knowledge on the job.*
2. *Mazmanian*

3.4.1.1.1 Common practice? Always the option to use this approach for comfort. Always thresholds in the code. If you can use the codified approach, then it is not needed. If you exceed requirements, you must use a performance based approach should have a peer review is required.

3.4.1.1.2 *Where to draw that line.*

4. Construction and Post-Occupancy

Mass Timber construction to follow the general requirements of Type IV Construction, unless otherwise noted in this guide.

4.1 During Construction

TT Thoughts:

Construction requirements per 2021 IFC 3303.5

- Standpipes
- Dual water supply
  - Non-combustible protection installed on levels 4 stories below the active mass timber construction
  - Required wall coverings shall be installed on levels 4 stories below the active mass timber construction

4.1.1 Special Inspections

TT Thoughts:

Mass timber special inspections

- Follow the requirements of IBC 2021 (1705.5.3)…recommend including these requirements specifically in the guideline
- Mass timber inspector qualification and selection
  - Previous experience in relevant mass timber buildings
  - Submit credentials to the city
- Provide access to the plans prior the start of construction
- Submit monthly reports to the city

4.2 Post Occupancy

The owner shall ensure that required passive protection remains in place over the life of the building, section 701.6 of the IFC.

5.0 Closing Remarks

Outline of Section

3.1 Structural design

3.1.1 Performance objectives

1. Load combinations
2. Fire endurance rating
3. Serviceability criteria
4. Redundancy and progressive collapse mitigation

3.1.2 Scope of performance-based design

1. Load path classifications
2. Lateral force-resisting system
3. Hybrid system
4. Composite action
5. Integrity

3.1.3 Submittal Requirements

1. Calculations
2. Drawings
3. Substantiating documents
    1. U.S. standards
    2. Voluntary design guides and technical resources
    3. Foreign standards
4. Test Data

3.1.4 Proprietary components

3.1 Structural design

Common reasons that prompt performance-based structural design may be that:

a. Standard building code requirements do not sufficiently meet the objectives of project stakeholders. For example, building codes are focused on life-safety measures to evacuate buildings safely during extreme events. The expectation that buildings are reparable after such events is not a common objective, so project stakeholders may want to define performance objectives more explicitly to enhance performance and mitigate risks of total property loss, or
b. Standard building codes lack information on innovative and recently developed structural systems, so performance-based design objectives are defined to demonstrate equivalent or enhanced performance relative to the standards.
c. Innovative materials or products not yet covered by manufacturing standards may be placed into service.

3.1.1 Performance objectives

The performance-based structural design of mass timber systems should meet or exceed the minimum requirements of the National Design Specification (NDS) referenced by the current version of the Wisconsin Commercial Building Code.

Often, performance-based design objectives may be set higher than typically required by code to minimize damage to structures, architectural and mechanical systems, and building contents. Higher performance objectives may result in buildings that exceed safety standards and need less repair when hazardous events occur.

Project stakeholders should determine at the outset whether the performance objectives are intended to be on par or better than objectives underlying minimum code requirements.

1. Load combinations

   Performance-based design should address the standard load combinations specified by ASCE/SEI 7 and list whether load cases follow minimum or enhanced requirements. For instance, seismic or wind requirements may be enhanced to mitigate higher magnitude earthquakes or wind events than those typically considered standard for design.

2. Fire endurance

   Performance-based fire designs may choose to enhance the duration of fire endurance from the minimum required for occupancy and structure type. For example, a structure that requires a two-hour fire rating may set objectives for three-hour ratings.

3. Serviceability

   While strength is essential for structural design, serviceability considerations such as deformations, floor deflections and lateral drift often control design.

4. Redundancy and progressive collapse mitigation

   Structural redundancy and measures to prevent disproportionate collapse of building structures, because of a single component failure, is typically addressed via prescriptive detailing measures in standard building codes. Performance-based design objectives specific to progressive collapse mitigation may be defined in the absence of prescriptive guidance for mass timber structures.

5. Structural integrity

   The ability of gravity framing to displace and rotate in compatibility with the lateral force-resisting system shall be generally checked in accordance with reference standards, such as ASCE/SEI 7. In addition, the displacement and rotation compatibility of non-structural mechanical and architectural components shall be checked for the expected structural movements.

a. Utility penetrations through beams or panels may affect both structural strength and fire safety, particularly in exposed mass timber components that are not encapsulated with ignition barriers.
b. Connection ductility may be necessary for the performance of mass timber components in seismic lateral force-resisting systems or in other extreme loading conditions. The rotational capacity and strengths of connections relying on ductility should be substantiated by tests and analysis.

A concise way to compare code minimum requirements and enhanced objectives of performance-based design may be accomplished in tabular form in the calculations and drawing submittal.

3.1.2 Scope of performance-based design

1. Load path classifications

   The International Building Code generally defines BEARING WALL STRUCTURE or FRAME STRUCTURE based on whether walls or columns are the primary supports for vertical loads. In addition, structural systems are defined by the load path for lateral resistance of forces. The performance-based design package should state whether mass timber structural components are elements of the gravity or lateral force-resisting system or serve dual functions in both vertical and lateral load paths.

2. Lateral Force-Resisting System

   Currently, design standards referenced by the building codes contain few prequalified mass timber lateral systems and mostly prescriptive requirements for encapsulation of mass timber components for fire safety. For innovative systems that do not match the details of prequalified mass timber systems, the structural submittal to the AHJ should include peer-reviewed calculations. Such calculations may address both standard design load combinations and fire

endurance to demonstrate that the structure will meet or exceed the minimum time of fire rating required by code occupancy.

3. Hybrid system

   Mass timber structural components may be configured in hybrid structural systems to work in unison with steel or concrete construction. The role of mass timber components should be clearly defined in the submittal, both in project narrative and on the plans general notes.

4. Composite action

   Concrete or cementitious toppings are commonly used in mass timber decking systems. Whether these toppings are intended for composite action between the concrete and mass timber products should be clearly expressed in the structural submittal and drawings. Composite behavior of concrete topping and mass timber panel substrate may have a significant impact on the structural performance of both the decking of the gravity system and the lateral stiffness of the diaphragm.

3.1.3 Submittal requirements

1. Calculations

   Calculations provided to the AHJ should address the:

   a. Fundamental structural design scenario through analysis of standard load combinations, and
   b. Fire safety scenario, where members rely on encapsulation or charring of the structure to meet an endurance rating and prevent collapse.

2. Design and construction documents

   Drawings should include a narrative explaining the use of mass timber structural components and delineate framing members and panels used as slabs or decking. Schedules for beams, columns, braces, and connections, should be provided, as customary for communicating the design of any structural material.

A loading plan should also communicate the loads to which mass timber components are designed. Layups and assumed design stress limits, modulus of elasticity in each orthogonal direction, and shear modulus in each orthogonal direction should be listed in the general notes section of the plan set.

3. References

The sources of substantiating information from tests, design standards, engineering reports and research articles should be clearly cited in the peer review calculations.

1. U.S. standards

a. Because the recent 2021 edition of the NDS specifically address cross-laminated timber (CLT), it is recommended the design team utilize the latest version of this design standard.

b. For main lateral-force resisting systems (MLFRS) including CLT diaphragms and shear walls, in particular, designers should reference 2021 Special Design Provisions for Wind and Seismic (SDPWS) as a general framework. It is likely that future editions of these documents will include more detailed and specific information on mass timber systems, to supplement the current general framework.

c. AWC technical report No. 10, Calculating the Fire Resistance of Wood Members and Assemblies provides guidance for calculating the fire endurance of timber structures with architecturally exposed surfaces.

d. ANSI/APA PRG 320: Standard for Performance-Rated Cross-Laminated Timber is referenced by building codes. Mass timber panels beyond the scope of this document should demonstrate performance with testing and calculations to demonstrate equivalent or enhanced performance.

e. ANSI A190.1-2022 Product Standard for Structural Glued Laminated Timber is referenced by building codes. Mass timber framing beyond the scope of this document

should demonstrate performance with testing and calculations to demonstrate equivalent or enhanced performance.

2. Voluntary design guides and technical resources

In addition to the code requirements above, it is recommended that the design cite state of the art research and design documents. Examples of documents to cite, wherever applicable, include:

[1] CLT Diaphragm Design for Wind and Seismic Resistance (Woodworks)

[2] U.S. Mass Timber Floor Vibration Design Guide (Woodworks)

[3] CLT Composite engineering testing reports or research articles

[4] Design Guide XX, Hybrid Steel Frames with Wood Floors (AISC)

[5] 2022 Fire Design Specification (FDS) for Wood Construction

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This bibliography is not a comprehensive list and may grow in scope and detail, as the mass timber construction industry advances.

3. Foreign Standards

Where current state of the art research and documents associated with mass timber fall outside of the United States, references des to foreign codes should check underlying assumptions of design equations and compare models with the design philosophies developed in the United States.

The design team should justify to the AHJ and Peer Reviewer, the use of the design recommendations, factors, and equations provided by these codes, in accordance with U.S. Standards.

If the team specifies material (timber/hardware) sourced outside of the United States, the design team should provide documentation providing equivalency between Eurocode serviceability and strength parameters with those documented in the NDS and applicable ANSI standards. For these materials, it is recommended the team provide an additional equivalent Eurocode design for the

controlling members/designs. The peer reviewer (where applicable) should review and comment on the conversion factors from codes outside the United States to NDS parameters/values.

4. Test Data

When test data is used to substantiate mass timber products, hardware, or composite structural assemblies, the following information should be provided:

a. Method of testing, whether standard or nonstandard. Methods of testing shall cite standards, where applicable, or provide a detailed description of the testing procedures and apparatus, including limitations of the testing and analysis.
b. Number of samples and statistical methods of analysis and modeling used in the testing. The degree of engineering confidence or fit of the statistical model with experimental data should be conveyed to peer reviewers and the AHJ.
c. Objectives of the tests, including whether the tests are project-specific prototypes or intended broadly as quality assurance or control for a commercial product.
d. Performance metric, which could be structural strength, stiffness, or fire resistance.
e. Whether testing regime is linear elastic, inelastic and nonlinear, static or dynamic, and cyclic or monotonic.

3.1.4 Proprietary components

A variety of materials and layups for mass timber beams, columns, braces, and panels is available to the designer. In addition, there is a multitude of fastener and connector options for mass timber products. Mass timber products and especially connection hardware may, therefore, include proprietary products. For mass timber products that are beyond the scope of current manufacturing standards, the design team should provide evidence of performance via testing or analysis that the products match or exceed the performance required of standard products. Proprietary components are often qualified for use by certified industry laboratories. If testing is beyond the U.S. and performed to foreign standards, the conversions necessary to translate performance into factors and models recognized by U.S. codes may apply.