Proposed draft for Mass Timber Task Force Guide

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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 any scenario that is based on performance-based design. A fire scenario, where members rely on charring of the structure, for example, should be included in the performance-based design review.

3.1.1 Checking standards for updates regarding mass timber construction: Since the 2021 edition of the NDS added information pertaining to mass timber construction, the design team should check the most recent edition of this code-referenced standard for updates. The Special Design Provisions for Wind and Seismic (SDPWS), a companion reference to the NDS, provides both general and specific information for the design of prequalified mass timber lateral force-resisting systems.

3.1.2 Classification of structural components: Generally, structural components are categorized as part of the gravity or lateral force-resisting systems, but many components dual as members of both gravity and lateral load transfer. The design team should indicate the functions (gravity, lateral, or both) of mass timber structural components to facilitate review. To date, few mass timber lateral systems have been prequalified for seismic design, making use of alternative means and methods more likely for mass timber lateral systems. In addition, critical gravity system components, such as columns supporting multiple levels, should be identified for evaluation of structural and fire performance criteria if aspects of the design are beyond the scope of standard code provisions.

3.1.3 Determining need for performance-based structural design: In the context of mass timber buildings, there may be many reasons to implement a performance-based design. One common scenario pertains to fire safety, when the insulative char of timber is used to justify the fire endurance of the structure in lieu of the prescriptive encapsulation requirements of the standard code provisions. Other reasons may include use of mass timber components in lateral systems that have yet to be prequalified by code reference standards.

3.1.4 Identifying the model code used for design: Model codes such as the International Performance Code (IPC) are designed to complement the standard IBC when the alternative means and methods provisions apply. The model used for performance-based design should be referenced to provide the peer reviewer and AHJ with a framework to evaluate the structural design methods.

3.1.5 Performance objectives: The level of performance and model code used for performance-based design should be clearly defined at the outset of a project. The design team should clearly communicate to reviewers the intent and criteria of performance-based design scenarios.

3.1.6 Levels of performance: In all scenarios, the design should perform at least equivalent to the standard safety objectives of the code. Often, performance-based design is implemented to achieve

performance objectives that are higher than code minimums. In the fire scenario context, for example, if the standard code specifies a two-hour fire rating, then the performance-based design must meet that requirement as a minimum. Project stakeholders, however, may decide to exceed minimum requirements and opt for a three-hour fire endurance rating. Whether the performance objectives meet or exceed the standard code design objectives should be clearly communicated in the introduction to the structural design. Generally, life safety and collapse prevention are the most common fundamental concerns, but project stakeholders may agree to higher safety or serviceability objectives than what is required by code.

3.1.7 Referencing analysis models developed for standards outside the jurisdiction: Should the team consider sourcing material that has been developed for design according to other building codes, the design team should provide documentation, calculations or testing reports, demonstrating that serviceability and strength parameters meet or exceed those required or documented in the NDS.

Many mass timber and connection hardware products are used successfully around the world, where engineered forest products have been developed for construction and code standards are generally on par with The International Building Code (IBC). Load factors and statistical or analytical models used in codes outside the United States, however, differ, so it is recommended the team translate design methodologies from other standards into NDS parameters or values. Conversion factors should be clearly stated for evaluation.

The design team shall justify to the AHJ and Peer Reviewer, the use of the design recommendations, factors, and equations that are sourced from other codes. If a building code in another jurisdiction, such as the Eurocode or Canadian Standards Association, provides a design methodology that is useful, the design team is responsible for demonstrating that the methodology meets or exceeds governing code standards, such as the NDS or IBC, and fulfills project-specific performance-based design objectives.

3.1.8 Validation by testing to local standards: If analysis models or prior test data is not readily translated to NDS parameters or values, products may be tested and evaluated for compliance with IBC- or NDS-referenced standards, such as the ANSI/APA PRG 320 Standard for Performance-Rated Cross-Laminated Timber, ANSI/APA A190.1 Product Standard for Structural Glued Laminated Timber, or applicable qualification provisions for connections performance in wood materials.

3.1.9 Citing other references used for design: If references outside the scope of building codes and associated standards are used to justify the design, those references should be cited to acknowledge state-of-the-art research, analysis, and design checks used on the project.

References published by various research institutions or industry and professional organizations may be useful for mass timber design, such as the:

1. *CLT Diaphragm Design for Wind and Seismic Resistance* (Woodworks)
2. *U.S. Mass Timber Floor Vibration Design Guide* (Woodworks)
3. CLT composite decking or slab research (numerous sources)
4. *Hybrid Steel Frames with Wood Floors* (AISC)
5. *2022 Fire Design Specification (FDS) for Wood Construction*
6. *CLT handbook: U.S. Edition*

(Listing is not comprehensive nor indicative of the order of importance of these documents.)

Sources of technical information should be clearly identified to facilitate review of the technical approach.

Glossary terms

References