July 11, 2019

Doug Orth
State Building Code Council Chair
1500 Jefferson Street SE
PO Box 21499
Olympia, WA 98504

Dear Doug,

Please find the attached public comment on a proposal to amend the future 2018 Washington State Building Code. The public comment provides the requirements for special inspections for mass timber elements and fire-resistant ratings for connections in Type IV-A, IV-B, and IV-C. This information is necessary to complete the mass timber proposal, log #BF02-2018, as indicated by previous testimony to the SBCC.

Sincerely,

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State Building Code Council

Public Comment on proposed 2018 Washington State code change

Submitted by Micah Chappell, Technical Code Development Manager,
Seattle Department of Construction and Inspections

Proposed Code Sections:

1705.5.3 Mass timber construction. Special inspections of Mass Timber elements in Types IV-A, IV-B and IV-C construction shall be in accordance with Table 1705.5.3.

TABLE 1705.5.3
REQUIRED SPECIAL INSPECTIONS OF MASS TIMBER CONSTRUCTION

Type	Continuous Special Inspection	Periodic Special 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		
3.1. Threaded fasteners		
3.1.1. Verify use of proper installation equipment.		X
3.1.2. Verify use of pre-drilled holes where required.		X
3.1.3. Inspect screws, including diameter, length, head type, spacing, installation angle, and depth.		X
3.2. Adhesive anchors installed in horizontal or upwardly inclined orientation to resist sustained tension loads	X	
3.3. Adhesive anchors not defined in 3.2.		X
3.4. Bolted connections		X
3.5. Concealed connections		X

2304.10.1 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.

Reason Statement:
The 2018 Washington State Building Code development process mostly occurred prior to the completion of the development of the requirements for special inspection and fire-resistance ratings for connections in mass timber construction. The incomplete requirements that are now addressed in the new sections of Chapter 17 and Chapter 23 in this public comment, were discussed at the Building Code TAG meetings, BFP Committee meetings, and the SBCC meetings that addressed the mass timber proposal.

Note that the development process for these proposals at the national level is still not complete. These changes were approved by the IBC Structural Committee in May of this year, by votes of 13-1 in favor of the special inspections table, and 14-0 in favor of the connection protection requirement. The Committee disapproved competing proposals by the same margins. The ICC Group B Public Comment Hearings will be held in late October. However, given the Structural Committee's votes, we do not anticipate the ICC membership will approve any changes to the proposals. For further information and background, see attached code change proposals S100-19 and S170-19.

The new Sections provided in this public comment are necessary to complete the mass timber package of code changes and maintain alignment with the presumptive 2021 IBC mass timber text.

S100-19

IBC: 1705.5.3 (New), TABLE 1705.5.3 (New)

Proponent: Stephen DiGiovanni, representing ICC Ad Hoc Committee on Tall Wood Buildings (TWB) (TWB@iccsafe.org)

2018 International Building Code

Add new text as follows:

1705.5.3 Mass timber construction. *Special inspections* of Mass Timber elements in Types IV-A, IV-B and IV-C construction shall be in accordance with Table 1705.5.3.

TABLE 1705.5.3
REQUIRED SPECIAL INSPECTIONS OF MASS TIMBER CONSTRUCTION

Type	Continuous Special Inspection	Periodic Special 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		
3.1. Threaded fasteners		
3.1.1. Verify use of proper installation equipment.		X
3.1.2. Verify use of pre-drilled holes where required.		X
3.1.3. Inspect screws, including diameter, length, head type, spacing, installation angle, and depth.		X
3.2. Adhesive anchors installed in horizontal or upwardly inclined orientation to resist sustained tension loads	X	
3.3. Adhesive anchors not defined in 3.2.		X
3.4. Bolted connections		X
3.5. Concealed connections		X

Reason: This proposal adds special inspection provisions to Section 1705 for mass timber. This new and unique type of construction requires a level of inspection consistent with other large buildings and unique applications where milestone inspections by the jurisdictional inspectors are not rigorous enough to ensure a level of quality control or quality assurance of the construction process. The proposed special inspections are similar to what is required for other prefabricated systems such as pre-cast concrete and structural steel.
Special Inspection is the monitoring of materials, installation, fabrication, erection and placement of components and connections that require special expertise that are critical to the integrity of the building structure. The special inspectors are required to ensure compliance with the approved construction documents and referenced standards. The program allows jurisdictions to have access to highly specialized and trained inspectors. Some special inspection activities require construction activities to be continuously inspected; which would be logistically difficult for a typical building inspection program. Special inspection is a vital part of the compliance path for successful and compliant building projects constructed under the International Building Code.

The specific elements requiring special inspection are:

1. Periodic inspection of the connection of mass timber elements to wood foundation elements. These connections are critical to transfer loads from the mass timber elements to the piles, particularly for lateral loading. The connections to concrete foundations are addressed in Table 1705.3, Item #3.
2. Periodic inspection of erection of mass timber elements. Similar to pre-cast concrete (Table 1705.3, Item #10), tall wood buildings utilizing pre-fabricated elements needs to have verification that the correct elements are placed in the right location in accordance with the design drawings.
3. Inspection of specialized connections.

Connections between mass timber products that utilized threaded, bolted, or concealed connections are considered periodic in a similar manner that concrete special inspections are required in Table 1705.3. The strength of many connection designs is predicated on specific screw lengths and installation angles. Bolted connections require specific diameters, and for lag bolts, specific lengths. Concealed connectors, many of which are proprietary, must be installed correctly for structural performance. Most of these cannot be verified by the jurisdictional inspector, so special inspections are required.

Adhesive anchorage installed in horizontal or upwardly inclined positions resisting tension loads shall be continuously inspected, again similar to Table 1705.3, Item 4a. This is required because of issues with creep of the adhesives under long-term tension loading discussed in previous code change cycles. However, once again similar to the requirements for precast concrete, all other adhesive anchors need only be inspected periodically (ref. Table 1705.3, Item 4b).

If there are other unusual items not covered in the proposed table, the existing text in Section 1705.1.1 gives the building official the authority to require special inspections for those unusual items. The same section also says the building official can require special inspections where manufacturers' installation instructions prescribe requirements not contained in the code. For example, field-glued mass timber beam or panel splices, while currently rare in North America, may become more prevalent in the future. This is not an item that is covered in the proposed Table 1705.5. While the AHC-TWB is not aware of any of those types of splices that are not currently proprietary, Section 1705.1.1 would allow the building official to require special inspections for either proprietary or non-proprietary field-glued splices. Note that many design engineers will also specify the need for special inspections for unusual conditions in their structural notes in the construction documents, or in the statement of special inspections (see Sections 1704.2.3 and 1704.3).

No changes are being proposed to address fabrication of mass timber structural elements. Mass timber structural assembled in a fabricator shop should be addressed by sections 1704.2.5 and 1704.2.5.1 of the current codes regarding fabrication

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/.

Cost Impact: The code change proposal will increase the cost of construction
Since all the code proposals related to Mass Timber products are to address new types of building construction, in theory this will not increase the cost of construction, but rather provides design options not currently provided for in the code. The committee took great care to not change the requirements of the pre-existing construction types, and our changes do not increase the cost of construction using those pre-existing construction types. However, based on a typically residential or office building of typical floor plates an estimate of Special Inspection costs would range from $1,000 to $2,000 per floor. Another approach to the cost of special inspection is a percentage of total construction costs; for typical pre-fabricated construction elements the cost of special inspection can range between 0.15% to 0.30%, depending on labor cost and complexities of the construction in the building. These estimates are based on responses to surveys of special inspection agencies in the Seattle and Las Vegas areas.

S170-19

IBC: 2304.10.1 (New)

Proponent: Stephen DiGiovanni, representing ICC Ad Hoc Committee on Tall Wood Buildings (TWB) (TWB@iccsafe.org)

2018 International Building Code

Add new text as follows:

2304.10.1 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.

Reason: IBC 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/codes-standards/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.

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Cost Impact: The code change proposal will not increase or decrease the cost of construction
Since all the code proposals related to Mass Timber products are to address new types of building construction, in theory this will not increase the cost of construction, but rather provides design options not currently provided for in the code. The committee took great care to not change the requirements of the pre-existing construction types, and our changes do not increase the cost of construction using those pre-existing construction types.