STATE OF WASHINGTON

STATE BUILDING CODE COUNCIL

1. State Building Code to be Amended:

- ☒ International Building Code
- ☐ ICC ANSI A117.1 Accessibility Code
- ☐ International Existing Building Code
- ☐ International Residential Code
- ☒ International Fire Code
- ☐ Uniform Plumbing Code
- ☐ State Energy Code
- ☐ International Mechanical Code
- ☐ International Fuel Gas Code
- ☐ NFPA 54 National Fuel Gas Code
- ☐ NFPA 58 Liquefied Petroleum Gas Code
- ☐ Wildland Urban Interface Code

Section(s):

2015 IBC Code Sections

Section: 202
Section: R403.3.2
Section 504.3
Section 504.4
Section 506.2
Section 508.4.4.1
New Section 509.4.1.1
Section 602.4
New Section 703.8
New Section 703.9
Section 718.2.1
New Section 722.7
Section 3102
Appendix D102.2.5

2015 IFC Code Section

Section 701.~~6~~3
New Section 3308.~~9~~8

Title:

Definitions
Water supply to required fire pumps
Allowable building height
Allowable number of stories
Allowable area
Construction of fire barriers
Type IV construction types
Fire-resistance rating requirements for building elements
Fire-resistance rating requirements for exterior walls
Determination of noncombustible protection time contribution

Sealing of adjacent mass timber elements
Fire blocking
Fire resistance rating of mass timber
Type of construction
Structural fire rating
Owner's responsibility
Fire safety requirements for buildings of Types IV-A, IV-B and IV-C construction

2. **Proponent Name (Specific local government, organization or individual):**

Proponent: AIA Washington Council
Title:
Date: May 1, 2018

3. **Designated Contact Person:**

Name: Jeffrey Hamlett, AIA
Title: Executive Director
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4. **Proposed Code Amendment**. ~~Reproduce the section to be amended by underlining all added language, striking through all deleted language. Insert new sections in the appropriate place in the code in order to continue the established numbering system of the code. If more than one section is proposed for amendment or more than one page is needed for reproducing the affected section of the code additional pages may be attached. (Examples on the SBCC website)~~

Code(s) 2015 ~~I~~IBC & 2015 ~~U~~IFC **Section(s)** Please see Sections noted in Section 1 of this document.

~~Enforceable code language must be used; see an example by clicking here.~~

Amend section to read as follows: Please see Attachment A for our proposed changes to the code.

5. **Briefly explain your proposed amendment, including the purpose, benefits and problems addressed.** ~~Specifically note any impacts or benefits to business, and specify construction types, industries and services that would be affected. Finally, please note any potential impact on enforcement such as special reporting requirements or additional inspections required.~~

This amendment is proposed to permit the use of mass timber in the construction of taller buildings. The development and use of mass timber in the construction of taller buildings has been proceeding apace in other areas of the world, and technical performance research and testing in the United States has demonstrated that buildings constructed of cross-laminated timber (CLT) and other mass timber components can be built safely and meet the intent of the code at taller heights.

This code amendment proposal is the result of over 2 years of comprehensive research and testing, including full-scale fire tests, completed by the ICC Ad Hoc Committee on Tall Wood Buildings

(TWB). The TWB Committee is a diverse group of Building Code Officials, Engineers, Architects and Industry representatives, including the steel, concrete and wood industries. The result of the TWB Committee's work is a collection of 14 code change proposals written to allow the safe construction of taller mass timber buildings. These 14 code change proposals were overwhelmingly approved by the ICC, at the Committee Action Hearing (CAH) in Columbus, Ohio in April of 2018. Committee members approved the amendments from a 12-2 to 14-0 margin, making adoption in to the 2021 International Building code very likely. In accordance with ICC Committee members, we feel there is sufficient technical justification to support changes to the Washington State building and fire codes to permit the safe use of mass timber in taller buildings, and be a leader in tall wood building design by adopting the 14 code changes in advance of the International Building Code.

There are definite economic benefits to enacting these proposed amendments, which is why the Legislature weighed in and passed ESB 5450 directing the SBCC to adopt rules for the use of mass timber products for residential and commercial building construction. A recent study on advancing CLT production in the Pacific Northwest found that this industry could generate up to 17,300 jobs and generate significant income for the workers and the State (see Attachment D). While this report focuses on Oregon, the findings are also applicable to Washington.

The Legislature passed ESB 5450 to assist in the development of a mass timber manufacturing, construction and design industries within the state. The timber communities will additionally benefit by increased logging activities of the smaller diameter trees on which mass timber manufacturing is based and help prevent catastrophic wildfires on state lands that are too densely planted and have not been managed for extended periods of time. Rather than exporting raw logs abroad, a manufacturing base of mass timber will preserve working forest landscapes in the state, sequester atmospheric carbon, create a value-added engineered timber building component and create new jobs and opportunities in the state's rural economies while providing a sustainable building material. Construction of a new CLT manufacturing facility is about to begin and a second is currently under construction in northeastern Washington. These facilities will provide new jobs to rural Washington and provide domestic supply for the industry. Currently, there are only two domestic suppliers of cross-laminated timber in the United States. The projects currently being built in the region are purchasing material from Canada, Germany, and Austria, with some being purchased from the new JR Johnson plant in Oregon.

Mass timber construction will comprise a relatively small percentage of overall construction in Washington State and therefore pose minimal negative impacts on the concrete and steel manufacturing and construction industries as buildings. Also, the typical mass timber building utilizes concrete in the floor system and foundation, and steel connections are the mechanism for providing the necessary ductility in the structural system to resist earthquakes. Moreover, buildings taller than 18 stories, are not permitted to be constructed of mass timber in the proposed code amendment, so these tall buildings will have no impact. By providing a new construction option for owners and developers, mass timber will stimulate competition, cost competiveness and innovation in the construction market. Depending on the exact circumstances, the ability to use mass timber may lead to development of taller buildings where previously owners and developers would have built a shorter building because the cost of building a taller building using concrete or steel was cost prohibitive in the market. As the construction industry gains experience with mass timber construction, the construction speed will increase (through the use of accelerated construction methods) and costs associated with labor, equipment, and financing will reduce. The current economic models show that mass timber buildings fit the 10-18 story size of building well. This could serve to meet density goals in our cities and provide additional housing capacity, a critical issue in Washington State. Recent examples of mass timber buildings have shown that the construction timeline is shortened by 3-8 months, which reduced the time of disruption of normal city operations around the construction site.

We see no potential impact with respect to enforcement. While mass timber will have different special reporting aspects than concrete or steel construction, all such construction has special reporting requirements.

6. **Specify what criteria this proposal meets.** You may select more than one.
   - ☐ The amendment is needed to address a critical life/safety need.
   - ☒ The amendment is needed to address a specific state policy or statute.
   - ☐ The amendment is needed for consistency with state or federal regulations.
   - ☐ The amendment is needed to address a unique character of the state.
   - ☐ The amendment corrects errors and omissions.

7. **Is there an economic impact:** ☐ Yes ☒ No

   Explain:

   Adoption of this proposed code amendment will have no direct economic impact because it does not mandate owners to choose mass timber as a construction methodology. Instead, this proposed amendment would provide an additional option for owner and designers to choose from when selecting a building's structural system. While the overall cost impact of a structural system will depend on project specifics, research suggests that mass timber can be a cost competitive and even cost saving approach when compared to more traditional steel and concrete building methods. A report exploring the feasibility of CLT in the Pacific Northwest found that mass timber could offer a 4% savings when compared to other building methods (see Attachment E). Mass timber offers a new cost effective approach to buildings between 10 and 18 stories tall, which are not currently being built in steel and concrete because these construction methodologies are too expense to build at these heights.

~~If there is an economic impact, use the Table below to estimate the costs and savings of the proposal on construction practices, users and/or the public, the enforcement community, and operation and maintenance. If preferred, you may submit an alternate cost benefit analysis.~~

~~Building Type~~	~~Construction[1]~~		~~Enforcement[2]~~		~~Operations & Maintenance[3]~~	
	~~Costs~~	~~Benefits[4]~~	~~Costs~~	~~Benefits[4]~~	~~Costs~~	~~Benefits[4]~~
~~Residential~~						
~~Single family~~						
~~Multi-family~~						
~~Commercial/Retai~~						
~~Industrial~~						
~~Institutional~~						

~~Please send your completed proposal to: sbcc@ga.wa.gov~~

~~All questions must be answered to be considered complete. Incomplete proposals will not be accepted.~~

~~[1] $ / square foot of floor area or other cost. Attach data. **Construction** costs are costs prior to occupancy, and include both design and direct construction costs that impact the total cost of the construction to the owner/consumer.~~

~~[2] Cost per project plan. Attach data. **Enforcement** costs include governmental review of plans, field inspection, and other action required for enforcement.~~

~~[3] Cost to building owner/tenants over the life of the project.~~

~~[4] Measurable benefit.~~

ATTACHMENT A (2015 IBC IEBC)

Preamble: ~~We are introducing t~~These amendments to the 2015~~8~~ International Building Code and 2015~~8~~ International Fire Code ~~to~~ better ~~utilize~~ use developing technologies in the production of mass timber products and ~~to~~ address the desire of our state legislature, as expressed in ESB 5450, signed into law on March 9, 2018, directing the building code council to adopt rules for the use of mass timber products. The rules to be adopted must consider applicable national and international standards.

The amendments proposed herein, rely upon the work of the International Code Council's (ICC) Ad Hoc Committee on Tall Wood Buildings ("Committee") that published its report in January 2018 and was amended and approved by the ICC's Code Action Hearing (CAH) in April 2018. That January report and April modifications are attached as Attachment B to these proposed amendments.

The crux of these amendments is to revise the building code to allow for the use of mass timber in taller buildings. This is accomplished primarily by adding three new building types under the Type IV category. We have identified those types as Type IV-A, Type IV-B, and Type IV-C. Type IV-HT remains the same other than its designation.

PROPOSED REVISIONS TO THE WASHINGTON STATE BUILDING CODE

Revise 2015 IBC Section 202 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 timber wall that supports more than 200 pounds per linear foot (2919 N/m) of vertical load in addition to its own weight.

Add new definition 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.

Revise 2015 IBC Section 403.3.2 as follows:

403.3.2 Water supply to required fire pumps. In all buildings that are more than 420 feet (128 m) in *building height*, and buildings of Type IV-A and IV-B that are more than 120 feet in building height, required fire pumps shall be supplied by connections to not 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 that the main is valved such that an interruption can be isolated so that the water supply will continue without interruption through not fewer than one of the connections.

Rationale:

Fire protection is a concern with increased height. This revision requires the new Type IV-A and Type IV-B buildings in excess of 120' to meet the same requirements for fire pump water supply as buildings more than 420 feet in building height that was added after the events of September 11, 2001. Because of the added fuel load in mass timber construction there is a greater need for active fire protection systems. The Committee, in considering this need noted the current code permits Type IV buildings up to heights of 85 feet without the requirement to meet this section of the code. It was felt, however, that for the taller buildings allowed under Types IV-A and IV-B, given the added fuel load that requiring the Type IV-A and Type IV-B buildings in excess of 120', it was prudent to require such buildings to comply with Section 403.3.2.

Please refer to the copy of the TWB Ad Hoc Committee's report, attached as a reference, for a more detailed description of the reasons for this proposed change.

Revise 2015 IBC Table 504.3 as follows:

T ABLE 504.3
ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE a

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION											TYPE OF CONSTRUCTION	TYPE OF CONSTRUCTION
	SEE FOOT NOTES	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
		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	120	90	65	65	50	40
	S												
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-1 Condition1, 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-1 Condition 2, I-2	NS d, e, f	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85									
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~~[BR(1]
	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

For SI: 1 foot = 304.8 mm.

UL = Unlimited; NS = Buildings not equipped throughout with an automatic sprinkler system; S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2; ~~S13D = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.3.~~[BR(2]

a. See Chapters 4 and 5 for specific exceptions to the allowable height in this chapter.

b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.

c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.

d. The NS value is only for use in evaluation of existing building height in accordance with the International Existing Building Code.

e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies Condition 1, see Exception 1 of Section 903.2.6.

f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and Section 1103.5 of the ***International Fire Code***.

g. For new Group I-4 occupancies, see Exceptions 2 and 3 of Section 903.2.6.

h. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8.

Rationale:

The TWB Ad Hoc Committee identified a number of performance objectives to be met in any proposed code amendments to permit tall wood buildings. Their objectives were as follows:

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.

Fire Protection: In order to validate their concepts the Committee commissioned a fire test consisting of 2 one-bedroom apartments stacked one above the other, with each apartment having a corridor leading to a stair. The results of those tests supported the changes proposed in this amendment. We have attached a copy of the paper documenting the fire test. To view

videos of the fire test, go to: http://bit.ly/ATF-firetestvideos. (This link was still active on 2/24/18.)

Allowable Height: Based on the Committee's review of fire safety and structural integrity performance they equated Type IV-B to Type I-B for allowable building height in feet. This is based on a comparison between 2-hour mass timber construction that is partially exposed, versus 1-hour Type I-B construction. They noted in their analysis, based on these proposed changes, the portion of unprotected mass timber also needs to meet the 2-hour FRR, which means the protected area will exceed the FRR required and provide a higher level of safety compared to Type I-B construction.

The Committee believed Type IV-A logically should be taller than a Type IV-B building because the no exposed mass timber is permitted in Type IV-A. They did not feel, however, it should be of unlimited height. The Committee settled on a height based on applying a 1.5 multiplier to the heights proposed for Type IV-B construction to arrive at reasonable allowable heights for Type IV-A construction.

The Committee viewed Type IV-C as being similar to the exiting Type IV-HT construction with respect to height in feet. With respect to the number of stories, however, the Committee felt, that due to the greater FRR of the Type IV-C construction additional stories could be permitted.

Taller building heights than Type IV-HT require a full sprinkler system.

Please refer to the copy of the TWB Ad Hoc Committee's report, attached as a reference, for a more detailed description of the reasons for this proposed change.

Revise 2015 IBC Table 504.4 as follows:

TABLE 504.4
ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE [a, b]

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION										TYPE OF CONSTRUCTION	TYPE OF CONSTRUCTION	TYPE OF CONSTRUCTION
	SEE FOOTNOTES	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE IV	TYPE IV	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		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	NS c, d	1	1	1	1	1	1	NP	NP	NP	1	1	NP
	S							1	1	1			
H-2	NS c, d	UL	3	2	1	2	1	1	1	1	2	1	1
	S							2	2	2			
H-3	NS c, d	UL	6	4	2	4	2	3	3	3	4	2	1
	S							4	4	4			
H-4	NS c, 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	NS c, d	4	4	3	3	3	3	2	2	2	3	3	2
	S							3	3	3			
I-1 Condition 1	NS d, 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 Condition 2	NS d, e	UL	9	4	3	4	3	3	3	3	4	3	2
	S	UL	10	5				10	6	4			
I-2	NS d, f	UL	4	2	1	1	NP	NP	NP	NP	1	1	NP
	S	UL	5	3				7	5	1			
I-3	NS d, 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	NS d, 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	UL	12	5	3	5	3	12	8	6	5	4	2
R-1 h	NS d	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4									4	3
	S	UL	12	5	5	5	5	18	12	8	5	4	3
R-2h	NS d	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4	4								4	3

	S	UL	12	5	5	5	5	18	12	8	5	4	3
R-3h	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-4h	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	4	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

UL = Unlimited; NP = Not Permitted; NS = Buildings not equipped throughout with an automatic sprinkler system; S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2~~; S13D = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.3[BR(3]~~.

a. See Chapters 4 and 5 for specific exceptions to the allowable height in this chapter.

b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.

c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.

d. The NS value is only for use in evaluation of existing building height in accordance with the International Existing Building Code.

e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies, Condition 1, see Exception 1 of Section 903.2.6.

f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and 1103.5 of the International Fire Code.

g. For new Group I-4 occupancies, see Exceptions 2 and 3 of Section 903.2.6.

h. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8.

Rationale:

Allowable Stories: In establishing the allowable stories for each new Type IV construction type, the Committee started by setting Type IV-B allowances equivalent to Type I-B as the tabular fire resistance ratings of the building elements for those two types of construction were identical. The Committee then proceeded to analyze each occupancy, sprinklered or non

sprinklered, using Type I-B as the baseline.

It was felt Type IV-A should be somewhat larger than Type IV-B because of Type IV-A's entirely protected construction. While the Committee believes the rating of the proposed Type IV-A construction is equivalent to Type I-A construction, they did not find it acceptable to permit the same scale of heights. They instead have proposed a multiplier of 1.5 to the heights proposed for Type IV-B construction (rounded up or down based on judgment) to establish the story heights allowable for Type IV-A. As Type IV-C is sufficiently similar to the existing HT construction, the height in feet for Type IV-C is proposed to be equal to HT construction. The Committee, however, felt in certain instances additional stories were warranted. The Committee felt this was warranted as the proposed Type IV-C construction has a required 2-hour rating for structural elements, while traditional Type IV-HT uses dimensional wood, which is understood to yield an approximate fire rating of 1-hour.

While the base code allows significant height for non-sprinklered buildings, the Committee did not propose an increase in height for what is currently permitted for Type IV non sprinklered uses.

The proposed revisions to Table 506.1 reflect the Committee's professional judgment from both a fire safety and structural perspective.

Please refer to the copy of the TWB Ad Hoc Committee's report, attached as a reference, for a more detailed description of the reasons for this proposed change.

Revise 2015 IBC Table 506.2 as follows:

TABLE 506.2

ALLOWABLE AREA FACTOR (At = NS, S1, S13R, S13D or SM, as applicable) IN SQUARE FEET [a, b] [BR(4]

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION									TYPE OF CONSTRUCTION	TYPE OF CONSTRUCTION	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	UL	15,500	8,500	14,000	8,500	45,000	30,000	18,750	15,000	11,500	5,500
	S1	UL	UL	62,000	34,000	56,000	34,000	180,000	120,000	75,000	60,000	46,000	22,000
	SM	UL	UL	46,500	25,500	42,000	25,500	135,000	90,000	56,250	45,000	34,500	16,500
A-2	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-3	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-4	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-5	NS	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S1												
	SM												
B	NS	UL	UL	37,500	23,000	28,500	19,000	108,000	72,000	45,000	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	114,000	76,000	432,000	288,000	180,000	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	85,500	57,000	324,000	216,000	135,000	108,000	54,000	27,000
E	NS	UL	UL	26,500	14,500	23,500	14,500	76,500	51,000	31,875	25,500	18,500	9,500
	S1	UL	UL	106,000	58,000	94,000	58,000	306,000	204,000	127,500	102,000	74,000	38,000
	SM	UL	UL	79,500	43,500	70,500	43,500	229,500	153,000	95,625	76,500	55,500	28,500
F-1	NS	UL	UL	25,000	15,500	19,000	12,000	100,500	67,000	41,875	33,500	14,000	8,500
	S1	UL	UL	100,000	62,000	76,000	48,000	402,000	268,000	167,500	134,000	56,000	34,000
	SM	UL	UL	75,000	46,500	57,000	36,000	301,500	201,000	125,625	100,500	42,000	25,500
F-2	NS	UL	UL	37,500	23,000	28,500	18,000	151,500	101,000	63,125	50,500	21,000	13,000
	S1	UL	UL	150,000	92,000	114,000	72,000	606,000	404,000	252,500	202,000	84,000	52,000
	SM	UL	UL	112,500	69,000	85,500	54,000	454,500	303,000	189,375	151,500	63,000	39,000
H-1	NS[c]	21,000	16,500	11,000	7,000	9,500	7,000	10,500	10,500	10,500	10,500	7,500	NP
	S1												
H-2	NS[c]	21,000	16,500	11,000	7,000	9,500	7,000	10,500	10,500	10,500	10,500	7,500	3,000
	S1												
	SM												
H-3	NS[c]	UL	60,000	26,500	14,000	17,500	13,000	25,500	25,500	25,500	25,500	10,000	5,000
	S1												
	SM												
H-4	NS[c, d]	UL	UL	37,500	17,500	28,500	17,500	72,000	54,000	40,500	36,000	18,000	6,500
	S1	UL	UL	150,000	70,000	114,000	70,000	288,000	216,000	162,000	144,000	72,000	26,000
	SM	UL	UL	112,500	52,500	85,500	52,500	216,000	162,000	121,500	108,000	54,000	19,500
H-5	NS[c, d]	UL	UL	37,500	23,000	28,500	19,000	72,000	54,000	40,500	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	114,000	76,000	288,000	216,000	162,000	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	85,500	57,000	216,000	162,000	121,500	108000	54,000	27,000
I-1	NS[d, e]	UL	55,000	19,000	10,000	16,500	10,000	54,000	36,000	18,000	18,000	10,500	4,500
	S1	UL	220,000	76,000	40,000	66,000	40,000	216,000	144,000	72,000	72,000	42,000	18,000
	SM	UL	165,000	57,000	30,000	49,500	30,000	162,000	108,000	54,000	54,000	31,500	13,500
I-2	NS[d, f]	UL	UL	15,000	11,000	12,000	NP	36,000	24,000	12,000	12,000	9,500	NP
	S1	UL	UL	60,000	44,000	48,000	NP	144,000	96,000	48,000	48,000	38,000	NP
	SM	UL	UL	45,000	33,000	36,000	NP	108,000	72,000	36,000	36,000	28,500	NP
I-3	NS[d, e]	UL	UL	15,000	10,000	10,500	7,500	36,000	24,000	12,000	12,000	7,500	5,000
	S1	UL	UL	45,000	40,000	42,000	30,000	144,000	96,000	48,000	48,000	30,000	20,000
	SM	UL	UL	45,000	30,000	31,500	22,500	108,000	72,000	36,000	36,000	22,500	15,000
I-4	NS[d, g]	UL	60,500	26,500	13,000	23,500	13,000	76,500	51,000	25,500	25,500	18,500	9,000
	S1	UL	121,000	106,000	52,000	94,000	52,000	306,000	204,000	102,000	102,000	74,000	36,000
	SM	UL	181,500	79,500	39,000	70,500	39,000	229,500	153,000	76,500	76,500	55,500	27,000
M	NS	UL	UL	21,500	12,500	18,500	12,500	61,500	41,000	25,625	20,500	14,000	9,000
	S1	UL	UL	86,000	50,000	74,000	50,000	246,000	164,000	102,500	82,000	56,000	36,000
	SM	UL	UL	64,500	37,500	55,500	37,500	184,500	123,000	76,875	61,500	42,000	27,000
R-1[h]	NS[d]	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000
	S13R												
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000
R-2[h]	NS[d]	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000
	S13R												
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000
R-3[h]	NS[d]	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S13D												
	S13R												
	S1												
	SM												
R-4[h]	NS[d]	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000
	S13D												
	S13R												
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000
S-1	NS	UL	48,000	26,000	17,500	26,000	17,500	76,500	51,000	31,875	25,500	14,000	9,000
	S1	UL	192,000	104,000	70,000	104,000	70,000	306,000	204,000	127,500	102,000	56,000	36,000
	SM	UL	144,000	78,000	52,500	78,000	52,500	229,500	153,000	95,625	76,500	42,000	27,000
S-2	NS	UL	79,000	39,000	26,000	39,000	26,000	115,500	77,000	48,125	38,500	21,000	13,500
	S1	UL	316,000	156,000	104,000	156,000	104,000	462,000	308,000	192,500	154,000	84,000	54,000
	SM	UL	237,000	117,000	78,000	117,000	78,000	346,500	231,000	144,375	115,500	63,000	40,500
U	NS[i]	UL	35,500	19,000	8,500	14,000	8,500	54,000	36,000	22,500	18,000	9,000	5,500
	S1	UL	142,000	76,000	34,000	56,000	34,000	216,000	144,000	90,000	72,000	36,000	22,000
	SM	UL	106,500	57,000	25,500	42,000	25,500	162,000	108,000	67,500	54,000	27,000	16,500

For SI: 1 square foot = 0.0929 m2.

UL = Unlimited; NP = Not Permitted; NS = Buildings not equipped throughout with an automatic sprinkler system; S1 = Buildings a maximum of one story above grade plane equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; SM = Buildings two or more stories above grade plane equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2; S13D = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.3.[BR(5]

a. See Chapters 4 and 5 for specific exceptions to the allowable height in this chapter.

b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.

c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.

d. The NS value is only for use in evaluation of existing building area in accordance with the International Existing Building Code.

e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies, Condition 1, see Exception 1 of Section 903.2.6.

f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and Section 1103.5 of the International Fire Code.

g. New Group I-4 occupancies see Exceptions 2 and 3 of Section 903.2.6.

h. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8.

i. The maximum allowable area for a single-story non-sprinklered Group U greenhouse is permitted to be 9,000 square feet, or the allowable area shall be permitted to comply with Table C102.1 of Appendix C.

Rationale:

Allowable Area: The Committee felt it was necessary to develop height and area criteria for each new type of construction being proposed. Each new proposed type of construction was examined for its fire safety characteristics and compared the existing Heavy Timber construction type. Based on this examination the Committee has proposed the allowable area for the new Type IV-C construction to be 1.25 times the allowable area for HT construction, the allowable area for Type IV-B to be 2.0 times the allowable area for HT construction, and the allowable area for Type IV-A to be 3.0 times the allowable area for HT construction.

The Committee also felt fire testing was necessary to validate its concepts. See the discussion about the fire test in the Rationale discussion related to the proposed changes to Table 504.3. We have attached a copy of the paper documenting the fire test. To view videos of the fire test, go to: http://bit.ly/ATF-firetestvideos. (This link was still active on 2/24/18.)

Please refer to the copy of the TWB Ad Hoc Committee's report, attached as a reference, for a more detailed description of the reasons for this proposed change.

Revise 2015 IBC Section 508.4.4.1 and add New Section 509.4.1.1 as follows:

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 a minimum of 1/2inch (12.7 mm) gypsum board 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.

509.4.1.1 **Type IV-B and IV-C construction.** Where Table 509 specifies a fire- resistance-rated separation, mass timber elements serving as fire barriers or a horizontal assembly 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 a minimum of ½ inch (12.7 mm) gypsum board 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.

Rationale:

Based on its examination of the proposed construction types, the Committee determined that additional measures were necessary to address cases where mass timber served as a fire barrier or horizontal assembly. The concern was that without any modification to these provisions, in Types IV-B and IV-C construction, a fire barrier or horizontal assembly could be designed using mass timber that, while complying with the fire resistance rating, would permit exposed mass timber that could contribute to the fire load.

The intent of the proposed changes 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. With respect to Section 509.4 (incidental use separations) the proposed new Section 509.4.1.1 is intended to provide the thermal barrier only on the side where the hazard exists.

Please refer to the copy of the TWB Ad Hoc Committee's report, attached as a reference, for a more detailed description of the reasons for this proposed change.

Delete 2015 IBC Section 602.4 in its entirety (except keep Sections 602.4.1, 602.4.1, and 602.4.3 and renumber as 602.4.4.1, 602.4.4.2, and 602.4.4.3, respectively) and substitute with new Section 602.4 as follows:[BR(6]

602.4 Type IV. 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 or 703.3. 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 703.8 and comply with 722.7.

Cross-laminated timber shall be labeled as conforming to PRG 320 - 18 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, B, and C, construction with an occupied floor located more than 75 feet above the lowest level of fire department access, up to and including 12 stories or 180 feet 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 above grade plane, interior exit and elevator hoistway enclosures shall be constructed of non-combustible 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 or Section 703.3.

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 determined in Section 722.7.1. All 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/m2 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 E 84 or UL 723. The ASTM E 1354 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.

602.4.1.2 **Interior protection.** Interior faces of all mass timber elements, including the inside faces of exterior mass timber walls and mas timber roofs, shall be protected with materials complying with Section 703.5

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 listed 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 one inch 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 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 Sections 602.4.1.2.

602.4.1.6 **Shafts.** Shafts shall be permitted in accordance with Sections 713 and Section 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 or Section 703.3.

602.4.2.1 **Exterior protection.** The outside face of exterior walls of mass timber construction shall be protected with non-combustible protection with a minimum assigned time of 40 minutes as determined in Section 722.7.1. All 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/m2 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 E 84 or UL 723. The ASTM E 1354 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 703.5.

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 listed 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.** All interior faces of all mass timber elements shall be protected in accordance with Section 602.4.2.2.1, including the inside face of exterior mass timber walls and mass timber roofs.

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, including attached beams, shall be permitted and shall be limited to an area equal to 20% of the floor area in any dwelling unit or fire area; or
2. Unprotected portions of mass timber walls, including attached columns, shall be permitted and shall be limited to an area equal to 40% of the floor area in any dwelling unit or fire area; or
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.
4. Mass timber columns and beams which 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.

(Utc/Uac) + (Utw/Uaw) ≤ 1 (Equation 6-1) where:

Utc= Total unprotected mass timber ceiling areas

Ua c = Allowable unprotected mass timber ceiling area conforming to Section 602.4.2.2.2, Exception 1

Utw= Total unprotected mass timber wall areas

Uaw = Allowable unprotected mass timber wall area conforming to Section 602.4.2.2.2, Exception 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 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 one inch 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 602.4.2.2 except, in non-occupiable 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 Section 713 and Section 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 or Section 703.3.

602.4.3.1 **Exterior protection.** The exterior side of walls of combustible construction shall be protected with non-combustible protection with a minimum assigned time of 40 minutes as determined in Section 722.7.1. All 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/m2 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 E 84 or UL 723. The ASTM E 1354 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 **Roofs.** 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 determined in Section 722.7.1.

602.4.3.6 **Shafts.** Shafts shall be permitted in accordance with Section 713 and Section 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 determined in Section 722.7.1, on both the inside of the shaft and the outside of the shaft.

602.4.4 Type IV-HT. Type IV-HT construction (Heavy Timber, HT) 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. The minimum dimensions for permitted materials including solid timber, glued-laminated timber, structural composite lumber (SCL) and cross-laminated timber (CLT) 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 one hour fire resistance rating 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* 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 exterior surface of the cross-laminated timber is protected by one the following:

Fire-retardant-treated wood sheathing complying with Section 2303.2 and not less than 15/32 inch (12 mm) thick;

Gypsum board not less than 1/2 inch (12.7 mm) thick; or

A noncombustible material.

~~602.4.3~~ **602.4.4.3 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.

Revise 2015 IBC Table 601 as follows:

T ABLE 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	A	B	C	HT	A	B
Primary structural frame[f] (see Section 202)	3[a, b]	2[a, b]	1[b]	0	1[b]	0	3[a]	2[a]	2[a]	HT	1[b]	0
Bearing walls Exterior[e, f] Interior	3 3[a]	2 2[a]	1 1	0 0	2 1	2 0	3 3	2 2	2 2	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	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	2	2	2	HT	1	0
Roof construction and associated secondary members (see Section	11/2[b]	1[b,c]	1[b,c]	0c	1[b,c]	0	1 1/2	1	1	HT	1[b,c]	0

202)												

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 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.

c. 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. 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.

Revise 2015 IBC Table 602 as follows:

T ABLE 602
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE a, d, g

FIRE SEPARAT ION DIST ANCE =X (feet)	T YPE OF CONST RUCT ION	OCCUPANCY GROUP H[e]	OCCUPANCYGROUP F-1, M, S-1[f]	OCCUPANCYGROUP A, B, E, F-2, I, R[i], S-2, U[h]
X < 5[b]	All	3	2	1

5 ≤ X < 10	IA, IVA Others	3 2	2 1	11
10 ≤ X < 30	IA, IB, IVA, IVB IIB, VB Others	2 1 1	1 0 1	1[c] 0 1[c]
X ≥ 30	All	0	0	0

For SI: 1 foot = 304.8 mm.

a. Load-bearing exterior walls shall also comply with the fire-resistance rating requirements of Table 601.

b. See Section 706.1.1 for party walls.

c. Open parking garages complying with Section 406 shall not be required to have a fire-resistance rating.

d. The fire-resistance rating of an exterior wall is determined based upon the fire separation distance of the exterior wall and the story in which the wall is located.

e. For special requirements for Group H occupancies, see Section 415.6.

f. For special requirements for Group S aircraft hangars, see Section 412.3.1.

g. Where Table 705.8 permits nonbearing exterior walls with unlimited area of unprotected openings, the required fire-resistance rating for the exterior walls is 0 hours.

h. For a building containing only a Group U occupancy private garage or carport, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet (1523 mm) or greater.

i. ~~For a Group R-3 building of Type II-B or Type V-B construction, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet (1523 mm) or greater.~~ [BR(7]

Rationale:

To fully address mass timber as a proposed new type of construction, new or revised definitions are necessary. Thus new/revised definitions for: Wall, Load Bearing; Mass Timber; and Noncombustible protection (for mass timber) were added in Section 602.4.

The term "load bearing wall" has been updated to include "mass timber" as a category equivalent to masonry or concrete. The term "mass timber" in the proposed changes represents both the legacy heavy timber construction and the three new Type IV constructions types proposed. The purpose was to establish a single term that represented the various sawn and engineered timber products that are referenced in IBC Chapter 23 (Wood) and in PRG-320 "Standard for Performance-rated Cross-laminated Timber". The definition of "Noncombustible Protection (for Mass Timber)" was 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).

Types of Construction:

The Committee recognized that tall, mass timber buildings around the world generally fell into three categories: buildings in which the mass timber was fully protected by fire resistant materials, buildings in which the mass timber was in part fully protected and in part exposed, and buildings in which the mass timber was unprotected.

Type IV-A is the proposed new type for which the mass timber must be fully protected by fire resistant materials. Type IV-B is the proposed new type for which the mass timber must be fully protected in part and permitted to be unprotected in part. Type IV-C is the proposed new type for which the mass timber may be unprotected.

The TWB also determined that fire testing was necessary to validate these concepts. To review a summary of the fire tests, please visit:
http://bit.ly/ATF-firetestreport

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.) 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.

Please refer to the copy of the TWB Ad Hoc Committee's report, attached as a reference, for a more detailed description of the reasons for this proposed change.

Add new 2015 IBC Sections 703.8, 703.8.1, 703.8.2, and 703.9 as follows:

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 E 119 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.

1. Test Assembly 1 shall be without protection.
2. Test Assembly 2 shall include the representative noncombustible protection. The protection shall be fully de**fire**ed 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:

The Committee determined the fire resistance rating of mass timber structural elements should consist of the inherent fire resistance rating of the mass timber and the additional fire resistance rating of the Noncombustible Protection (see proposed definitions). The Committee determined at least 2/3 of the required fire resistance rating should come from the Noncombustible Protections. Section 703.8 provides a performance path for calculating the required protection. A prescriptive path is provided in proposed new Section 722.7, below.

Please refer to the copy of the TWB Ad Hoc Committee's report, attached as a reference, for a more detailed description of the reasons for this proposed change.

Add New 2015 IBC Section 703.9 as follows

703.9 **Sealing of adjacent mass timber elements.** In buildings of Type IVA, IVB, and IVC 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 a fire resistance-rated assembly does not include them as a required component.

Or

Exception: Sealants or adhesives at abutting edges and intersections are not required where sealants or adhesives are not a component of a tested fire resistance=rated assembly, [BR(8]

Rationale:

When mass timber panels are connected together, fire test 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 fire-tested structures supporting this submittal were constructed with this sealing. Refer to the fire tests noted in the Rationale discussion for Table 504.3.

Please refer to the copy of the TWB Ad Hoc Committee's report, attached as a reference, for a more detailed description of the reasons for this proposed change.

Revise 2015 IBC Section 718.2.1 as follows:

718.2.1 Fireblocking materials. *Fireblocking* shall consist of the following materials:

1. Two-inch (51 mm) nominal lumber.
2. Two thicknesses of 1-inch (25 mm) nominal lumber with broken lap joints.
3. One thickness of 0.719-inch (18.3 mm) wood structural panels with joints backed by 0.719-inch (18.3 mm) wood structural panels.
4. One thickness of 0.75-inch (19.1 mm) particleboard with joints backed by 0.75- inch (19 mm) particleboard.
5. One-half-inch (12.7 mm) gypsum board.
6. One-fourth-inch (6.4 mm) cement-based millboard.
7. Batts or blankets of mineral wool, mineral fiber or other ***approved*** materials installed in such a manner as to be securely retained in place.
8. Cellulose insulation installed as tested for the specific application.
9. Mass timber complying with Section 2304.11.

Rationale:

The purpose of this proposed code change is to recognize that mass timber is a suitable fire-blocking material. The current list of acceptable materials lists "nominal lumber", therefore since mass timber (e.g. Sawn, glued-laminated, and cross laminated timbers) are of greater mass the correlation from single nominal lumber to mass timber was determined to be of equal or greater blocking resistance to reduce the ability of fire, smoke and gasses from moving to different parts of the building through combustible concealed spaces.

Please refer to the copy of the TWB Ad Hoc Committee's report, attached as a reference, for a more detailed description of the reasons for this proposed change.

Add New 2015 IBC Sections 722.7, 722.7.1, TABLE 722.7.1(a), TABLE 722.7.1(b), 722.7.2, 722.7.2.1, and 722.7.2.2 as follows:

722.7 **Fire resistance rating of mass timber.** The required fire resistance of mass timber elements in section 602.4 shall be determined in accordance with Section 703.2 or Section 703.3. The fire resistance rating of building elements shall be as required in Tables 601 and 602 and as specified elsewhere in this code. The fire resistance rating of the mass timber elements shall consist of the fire resistance of the unprotected element added to the protection time of the noncombustible protection.

722.7.1 **Minimum required protection.** When 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 703.8. The protection contributions indicated in Table 722.7.1(2) shall be deemed to comply with this requirement when 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 Tables 601 and 602 (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.

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 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 #6 Type S drywall screws to furring channels in accordance with ASTM C-645.

2. Screws for attaching the base layer shall be 12 inches on center in both directions.
3. Screws for each layer after the base layer shall be 12 inches on center in both directions and offset from the screws of the previous layers by 4 inches in both directions.
4. All panel edges of any layer shall be offset 8 inches from those of the previous layer.
5. All panel edges shall be attached with screws sized and offset as in items 1 through 4 above and placed at least 1 inch but not more than 2 inches from the panel edge.
6. All panels installed at wall-to-ceiling intersections shall be installed such that the ceiling panel(s) is installed first and the wall panel(s) is 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 panel(s) covering an exterior wall or a wall with a greater fire resistance rating shall be installed first and the panel(s) 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 1- 1/4 inch 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 heavy timber walls determined in accordance with Table 722.7.1(a) shall be fastened 12 inches on center each way and 6 inches on center at all joints or ends. All panel edges shall be attached with fasteners located at least 1 inch but not more than 2 inches from the panel edge. Fasteners shall comply with one of the following:

1. Galvanized nails of minimum 12 gage with a 7/16 inch head of sufficient length to penetrate the mass timber a minimum of 1 inch.
2. Screws that comply with ASTM C1002 (Type S, Type W, or Type G) of sufficient length to penetrate the mass timber a minimum of 1 inch.

Rationale:

Recognizing that mass timber elements will be large due to structural requirements, resulting in excess fire resistance capacity, this new Section 722.7 provides a prescriptive path 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.

Please refer to the copy of the TWB Ad Hoc Committee's report, attached as a reference, for a more detailed description of the reasons for this proposed change.

2015 IBC Section 1705.~~3~~ 5 [BR(9)] Wood Construction

Add new text as follows:

1705.5.3 Mass Timber Construction. *Special inspections* of *Mass Timber* construction in buildings, structures, or portions thereof greater than 85 feet above grade plane shall be in accordance with Table 1705.5.3.

TABLE 1705.5.3

REQUIRED SPECIAL INSPECTIONS OF MASS TIMBER CONSTRUCTION

Type	Continuous	Periodic

	Special Inspection	Special Inspection
1. Inspection of anchorage and connections of mass timber construction to timber deep foundation systems.		X
2. Inspect erection and sequence of Mass Timber construction		X
3. Inspection of connections where installation methods are required to meet design loads		
a. Threaded fasteners		
1. Verify use of proper installation equipment.		X
2. Verify use of pre-drilled holes where required.		X
3. Inspect screws, including diameter, length, head type, spacing, installation angle, and depth.		X
b. Adhesive anchors installed in horizontal or upwardly inclined orientation to resist sustained tension loads	X	
c. Bolted connections		X
d. Other proprietary concealed connection		X

2015 IBC Section 1705.11.1 Structural Wood

Revise as follows:

1705.11.1 Structural wood. *Continuous special inspection* is required during field gluing operations of elements of the main windforce-resisting system. *Periodic special inspection* is required for nailing, bolting, anchoring and other fastening of elements of the main windforce-resisting system, including wood shear walls, wood diaphragms, drag struts, braces and hold-downs.

Exception: *Special inspections* are not required for wood shear walls, shear panels and diaphragms, including nailing, bolting, anchoring and other fastening to other elements of the main windforce-resisting system, where the lateral resistance is provided by

sheathing of wood structural panels, and the fastener spacing of the sheathing is more than 4 inches (102 mm) on center.

2015 IBC Section 1705.12.2 Structural Wood

Revise as follows:

1705.12.2 Structural wood. For the seismic force-resisting systems of structures assigned to *Seismic Design Category* C, D, E or F:

1. *Continuous special inspection* shall be required during field gluing operations of elements of the seismic force-resisting system.

2. *Periodic special inspection* shall be required for nailing, bolting, anchoring and other fastening of elements of the seismic force-resisting system, including wood shear walls, wood diaphragms, drag struts, braces, shear panels and hold-downs.

Exception: *Special inspections* are not required for wood shear walls, shear panels and diaphragms, including nailing, bolting, anchoring and other fastening to other elements of the seismic force-resisting system, where the lateral resistance is provided by sheathing of wood structural panels, and the fastener spacing of the sheathing is more than 4 inches (102 mm) on center.

Rationale:

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 height trigger of 85 feet is intended to address buildings of Type IV-HT, where mass timber products may be used in the construction of Type IV-HT but would not require special inspection as the current codes apply for Type IV-HT construction. The height trigger would establish that mass timber buildings constructed of Type IV-A, IV-B, IV-C and a very select buildings using Mass Timber Products in Type IV-HT.
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 proprietary 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. Proprietary connectors must be installed correctly. 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.

This code change also includes slight modifications to the exceptions in sections 1705.11.1 and

1705.12.2 to clarify that the exceptions to special inspections for wind and seismic resistance apply to only shear walls, panels, and diaphragms sheathed with wood structural panels. The exceptions should apply to traditional 2x framed elements or nail-laminated or dowel laminated diaphragms with structural sheathing; but not lateral force resisting systems relying solely on mass timber products for lateral resistance.

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 6 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/

Add New 2015 IBC Section 1705.19 as follows

1705.19 Sealing of Mass Timber. Periodic special inspections of sealants or adhesives shall be conducted where sealant or adhesive required by Section 703.9 is applied to mass timber building elements as designated in the approved construction documents.

Rationale:

Section 703.9 in this proposal requires abutting edges and intersections of fire-resistance rated mass timber elements be sealed to prevent air flow and thus, spread of fire and smoke through the intersection. One of the fire tests conducted at the ATF facility raised concerns as to how the quality of construction would be maintained in the field. The requirement for periodic special inspection of the sealants in this new section 1705.19 is to verify the required

intersections are properly sealed.

Revise 2015 IBC Sections 3102.3 and 3102.6.1.1 as follows:

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 gerhouses, 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.

Rationale:

These are both housekeeping changes to clarify, with the proposed addition of three new Type IV construction types, the Type IV construction type referred to in these sections is HT.

Please refer to the copy of the TWB Ad Hoc Committee's report, attached as a reference, for a more detailed description of the reasons for this proposed change.

2015 IBC Chapter 35 add reference standard as follows:

Standard reference number	Title	Referenced in code section number
ANSI/APA PRG-320-18	Standard for Performance-Rated Cross-Laminated Timber (revised 2018)	.....602.4

Rationale:

This is a housekeeping change to add PRG-320-18 as a reference standard as it is referenced in revised proposed code section 602.4.

Revise 2015 IBC Appendix D102.2.5 as follows[BR(10)]:

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.

Rationale:

This is another housekeeping change to clarify, with the proposed addition of three new Type IV construction types, the Type IV construction type referred to in this section is HT.

Please refer to the copy of the TWB Ad Hoc Committee's report, attached as a reference, for a more detailed description of the reasons for this proposed change.

PROPOSED REVISIONS TO THE WASHINGTON STATE FIRE CODE

~~Revise~~ Add 2015 IFC Section 701.~~6~~ 3 as follows:

701.6 Owner's responsibility. The owner shall maintain an inventory of all required ***fire-resistance-rated*** construction, construction installed to resist the passage of smoke and

the construction included in Sections 703 through 707 and Sections 602.4.1 and 602.4.2 of the International Building Code. Such construction shall be visually inspected by the ***owner*** annually and properly repaired, restored or replaced where damaged, altered, breached or penetrated. Records of inspections and repairs shall be maintained. Where concealed, such elements shall not be required to be visually inspected by the ***owner*** unless the concealed space is accessible by the removal or movement of a panel, access door, ceiling tile or similar movable entry to the space.

Rationale:

This is another housekeeping change to address the addition of Sections 602.4.1 and 602.4.2.

Please refer to the copy of the TWB Ad Hoc Committee's report, attached as a reference, for a more detailed description of the reasons for this proposed change.

Add new 2015 IFC Section 3308.9 as follows:

3308.~~9~~ 8 Fire safety requirements for buildings of Types IV-A, IV-B, and IV-C construction. Buildings of Types IV-A, IV-B, and IV-C construction designed to be greater than six stories above grade plane shall meet the following requirements during construction unless otherwise approved by the fire code official.

1. Standpipes shall be provided in accordance with Section 3313.
2. A water supply for fire department operations, as approved by the fire code official and [BR(11)] the fire chief.
3. Where building construction exceeds six stories above grade plane, at least one layer of noncombustible protection where required by Section 602.4 of the International Building Code shall be installed on all building elements more than 4 floor levels, including mezzanines, below active mass timber construction before erecting additional floor levels. **Exception**: Shafts and vertical exit enclosures shall not be considered a part of the active mass timber construction.
4. Where building construction exceeds six stories above grade plane required exterior wall coverings shall be installed on all floor levels more than 4 floor levels, including mezzanines,

below active mass timber construction before erecting additional floor level.

Exception: Shafts and vertical exit enclosures shall not be considered a part of the active mass timber construction.

Rationale:

The goal of this proposed new Section is to provide guidance and requirements during the period of construction, when the combustible building is most vulnerable. This section would insure the lower portions of the combustible structure had redundant, active and passive, protection as greater heights are added.

Please refer to the copy of the TWB Ad Hoc Committee's report, attached as a reference, for a more detailed description of the reasons for this proposed change. This Section, by the way, is incorrectly referenced in the TWB Ad Hoc Committee's report.

TABLE 506.2[a, b]
ALLOWABLE AREA FACTOR (A_t = 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				TYPE V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A-1	NS	UL	UL	15,500	8,500	14,000	8,500	45,000	30,000	18,000	15,000	11,500	5,500
	S1	UL	UL	62,000	34,000	56,000	34,000	180,000	120,000	75,000	60,000	46,000	22,000
	SM	UL	UL	46,500	25,500	42,000	25,500	135,000	90,000	56,250	45,000	34,500	16,500
A-2	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-3	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,000	45,000	34,500	18,000
A-4	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-5	NS	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S1												
	SM												
B	NS	UL	UL	37,500	23,000	28,500	19,000	108,000	75,000	45,000	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	114,000	76,000	432,000	288,000	180,000	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	85,500	57,000	324,000	216,000	135,000	108,000	54,000	27,000
E	NS	UL	UL	26,500	14,500	23,500	14,500	76,500	51,000	31,875	25,500	18,500	9,500
	S1	UL	UL	106,000	58,000	94,000	58,000	306,000	204,000	127,500	102,000	74,000	38,000
	SM	UL	UL	79,500	43,500	70,500	43,500	229,500	153,000	95,625	76,500	55,500	28,500
F-1	NS	UL	UL	25,000	15,500	19,000	12,000	100,500	67,000	41,875	33,500	14,000	8,500
	S1	UL	UL	100,000	62,000	76,000	48,000	402,000	268,000	167,500	134,000	56,000	34,000
	SM	UL	UL	75,000	46,500	57,000	36,000	301,500	201,000	125,625	100,500	42,000	25,500
F-2	NS	UL	UL	37,500	23,000	28,500	18,000	151,500	101,000	63,125	50,500	21,000	13,000
	S1	UL	UL	150,000	92,000	114,000	72,000	606,000	404,000	252,500	202,000	84,000	52,000
	SM	UL	UL	112,500	69,000	85,500	54,000	454,500	303,000	189,375	151,500	63,000	39,000
H-1	NS[c]	21,000	16,500	11,000	7,000	9.500	7,000	10,500	10,500	10,000	10,500	7,500	NP
	S1												
H-2	NS[c]	21,000	16,500	11,000	7,000	9.500	7,000	10,500	10,500	10,000	10,500	7,500	3,000
	S1												
	SM												
H-3	NS[c]	UL	60,000	26,500	14,000	17,500	13,000	25,000	25,000	25,000	25,500	10,000	5,000
	S1												
	SM												
H-4	NS[c,d]	UL	UL	37,500	17,500	28,500	17,500	75,000	54,000	40,500	36,000	18,000	6,500
	S1	UL	UL	150,000	70,000	114,000	70,000	288,000	216,000	162,000	144,000	72,000	26,000
	SM	UL	UL	112,500	52,500	85,500	52,500	216,000	162,000	121,500	108,000	54,000	19,500
H-5	NS[c,d]	UL	UL	37,500	23,000	28,500	19,000	72,000	54,000	40,500	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	114,000	76,000	288,000	216,000	162,000	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	85,500	57,000	216,000	162,000	121,500	108,000	54,000	27,000

(continued)

TABLE 506.2[a, b]—continued
ALLOWABLE AREA FACTOR (A_t = 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				TYPE V	
		A	B	A	B	A	B	A	B	C	HT	A	B
I-1	NS[d, e]	UL	55,000	19,000	10,000	16,500	10,000	54,000	36,000	18,000	18,000	10,500	4,500
	S1	UL	220,000	76,000	40,000	66,000	40,000	216,000	144,000	72,000	72,000	42,000	18,000
	SM	UL	165,000	57,000	30,000	49,500	30,000	162,000	108,000	54,000	54,000	31,500	13,500
I-2	NS[d, f]	UL	UL	15,000	11,000	12,000	NP	36,000	24,000	12,000	12,000	9,500	NP
	S1	UL	UL	60,000	44,000	48,000	NP	144,000	96,000	48,000	48,000	38,000	NP
	SM	UL	UL	45,000	33,000	36,000	NP	108,000	72,000	36,000	36,000	28,500	NP
I-3	NS[d, e]	UL	UL	15,000	10,000	10,500	7,500	36,000	24,000	12,000	12,000	7,500	5,000
	S1	UL	UL	45,000	40,000	42,000	30,000	144,000	96,000	48,000	48,000	30,000	20,000
	SM	UL	UL	45,000	30,000	31,500	22,500	108,000	72,000	36,000	36,000	22,500	15,000
I-4	NS[d, g]	UL	60.500	26,500	13,000	23,500	13,000	76,500	51,000	25,500	25,500	18,500	9,000
	S1	UL	121,000	106,000	52,000	94,000	52,000	306,000	204,000	102,000	102,000	74,000	36,000
	SM	UL	181,500	79,500	39,000	70,500	39,000	229,500	153,000	76,500	76,500	55,500	27,000
M	NS	UL	UL	21,500	12,500	18,500	12,500	61,500	41,000	25,625	20,500	14,000	9,000
	S1	UL	UL	86,000	50,000	74,000	50,000	246,000	164,000	102,500	82,000	56,000	36,000
	SM	UL	UL	64,500	37,500	55,500	37,500	184,500	123,000	76,875	61,500	42,000	27,000
R-1	NS[d, h]	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000
	S13R												
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000
R-2	NS[d, h]	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25.625	20,500	12,000	7,000
	S13R												
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000
R-3	NS[d, h]	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S13R												
	S1												
	SM												
R-4	NS[d, h]	UL	UL	24,000	16,000	24,000	16,000	61,000	41,000	25,625	20,500	12,000	7,000
	S13R												
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000
S-1	NS	UL	48,000	26,000	17,500	26,000	17,500	76,500	51,000	31,875	25,500	14,000	9,000
	S1	UL	192,000	104,000	70,000	104,000	70,000	306,000	204,000	127,500	102,000	56,000	36,000
	SM	UL	144,000	78,000	52,500	78,000	52,500	229,500	153,000	95,625	76,500	42,000	27,000
S-2	NS	UL	79,000	39,000	26,000	39,000	26,000	115,500	77,000	48,125	38,500	21,000	13,500

	S1	UL	316,000	156,000	104,000	156,000	104,000	462,000	308,000	192,500	154,000	84,000	54,000
	SM	UL	237,000	117,000	78,000	117,000	78,000	346,500	231,000	144,375	115,500	63,000	40,500
U	NS	UL	35,500	19,000	8,500	14,000	8,500	54,000	36,000	22,500	18,000	9,000	5,500
	S1	UL	142,000	76,000	34,000	56,000	34,000	216,000	144,000	90,000	72,000	36,000	22,000
	SM	UL	106,500	57,000	25,500	42,000	25,500	162,000	108,000	67,500	54,000	27,000	16,500

ATTACHMENT B (bookmarked)

Pages 1 is a review guide to the code change proposals issued from the ICC TWB

2021 IBC, 2018 Group A, Tall Mass Timber Proposals Review Guide:

Recommended review process and order of review for interested Code Officials:

The ICC 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 to develop and submit code change proposals in the ICC process. Currently there are 14 proposals submitted into cdpACCESS for the Group A Committee Action Hearings. With repetitive reason background material removed these TWB proposals make up a package that is 45 pages long and is placed in the most efficient reading order after this cover sheet.

This document is intended to assist individual code official groups to navigate the proposals in order to become familiar and understand the proposed changes with the least amount of time and effort.

These proposals will create three new types of construction: IVA, IVB and IVC. Heavy timber (Type IV HT) remains technically unchanged by these proposals as in the current 2018 IBC. It is important to note none of the new types of construction permit the utilization of combustible light frame construction in any manner. As a start Mass Timber, used in the new types of construction, must meet the minimum dimensions assigned the 2018 IBC for heavy timber construction.

For organizations with several code committees it is recommended that the 14 code proposals are not sent out separately to different committees but reviewed by a group comprised of representatives from a cross section of each of the code committee areas. In order to understand the concept those reviewing this material will need to become familiar with the entire package.

In order to do this, it is recommended the code change proposals are reviewed in the following order starting with the basic requirements for the new types of construction: **G108-18**: Section 602.4 - Type of Construction; **FS5-18**: Section 703.8 - Performance Method; **FS81-18**: Section 722.7 – Ratings Installation; **FS6-18**: Section 703.9 – Sealants at Edges; **FS73-18:** Chapter 7 – Section 718.2.1 – Fire and Smoke Protection; **G28-18:** Section 403.3.2 – High Rise Sprinkler Water Supply; **F88-18:** Section 701.6 – Owners Responsibility; **F266-18:** Section 3308.4 of the IFC - Fire Safety During Construction.

It is recommended the three code change proposals dealing with height, number of stories and allowable area (**G75-18:** Table 504.3; **G 80-18:** Table 504.4; and **G84-18:** Table 506.2) are reviewed only after one becomes familiar with the types of construction. Height and area has been a subject of debate in the IBC since Legacy Codes were first combined to form the IBC. Considerable judgment was applied by the committee after fully understanding the proposed type of construction features, fire resistance, noncombustible protection, active fire sprinkler systems, and then only after full scale fire testing with and without sprinklers.

Finally there are three more code changes that are more housekeeping with little relevance to the overall performance of the new types of construction. It is recommended these proposals are reviewed last: **G146-18:** Chapter 31 – Section 3102 – Special Construction; **G152-18:** IBC Appendix D – Fire Districts; and **G89-18:** Sections 508.4 and 509.4 (Fire Barriers).

Pages 2-72 are the original draft code change language submitted by ICC TWB Committee in January, 2018

403.3.2 High rise sprinkler water supply

IBC: 403.3.2

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

See pages 73-147 for modifications to draft code change language approved at the ICC CAH meeting in April, 2018

2018 International Building Code

Revise as follows:

[F] 403.3.2 Water supply to required fire pumps. In all buildings that are more than 420 feet (128 m) in *building height*, and buildings of Type IVA and IVB that are more than 120' in building heiight, required fire pumps shall be supplied by connections to not 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 that the main is valved such that an interruption can be isolated so that the water supply will continue without interruption through not fewer than one of the connections.

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 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 has proposed greater permitted heights and areas of mass timber construction than those contained in the 2018 IBC. The Ad Hoc believes this code change proposal is an important component to these proposed increased heights and areas. If the permitted heights and areas of mass timber construction are raised it is imperative we adopt related code change proposals to insure the reliable performance of active and passive protection features to insure the safety of occupants and responding fire fighters.

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 12/27/17). 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.

IBC Code Section	Description
403.3.2	Water supply requirements for fire pumps in high rise buildings of Type IVA and IVB construction.
504.3	Allowable building height (feet) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT construction.
504.4	Allowable building height (stories) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
506.2	Allowable building area for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
602.4	Type of Construction requirements for new proposed types of construction: Types IVA, IVB and IVC. No changes to Type IV HT construction. Includes definitions for new terms: Mass timber and Noncombustible protection (mass timber). **THIS IS THE KEY CODE CHANGE PROPOSAL WHICH OUTLINES THE CONSTRUCTION REQUIREMENTS FOR THE PROPOSED NEW TYPE OF MASS TIMBER BUILDINGS. THE PROPOSAL ALSO ADDRESSES CONCEALED SPACES, ADHESIVE PERFORMANCE AND EXTERIOR WALL PROTECTION.**
703.8 (new)	The performance method to determine the increase to the fire resistance rating provided by noncombustible protection applied to the mass timber building element.
703.9 (new)	Requirements for sealants and adhesives to be placed at abutting edges and intersections of mass timber building elements. The reason statement references a Group B proposal to Chapter 17 for special inspection requirements of sealants and adhesives.
718.2.1	Requirements on the use of mass timber building elements used for Fireblocking.
722.7 (new)	Requirements for the fire resistance rating of mass timber elements, including minimum required protection and gypsum board attachment requirements.
3102	Requirements for membrane structures using Type IV HT construction.
3314.7 (new)	New special precautions during construction of buildings of Types IVA, IVB and IVC construction: Standpipes; Water supply for fire department connections; Noncombustible protection required for mass timber elements as construction height increases.
Appendix	Requirements for walls, floors and roofs of Type IV HT construction in buildings located in Fire Districts.
IFC Code Section	**Description**
701.6	Requirements which stipulate the owner's responsibility to maintain inventory of all required fire resistance rated construction in buildings of Types IVA and IVB construction. This includes an annual inspection and proper repair where necessary.
Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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

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

http://bit.ly/ATF-firetestvideos

Both of these links were confirmed active on 12/27/17.

Cost Impact
The code change proposal will not increase or decrease the cost of construction.

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

Table 504.3
IBC: TABLE 504.3

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

2018 International Building Code

Revise as follows:

TABLE 504.3
ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANEa

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION											TYPE OF CONSTRUCTION	TYPE OF CONSTRUCTION
	SEE FOOTNOTES	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A, B, E, F, M, S, U	NSb	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	NSc, d	UL	160	65	55	65	55	120	90	65	65	50	40
	S												
H-4	NSc, 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-1 Condition 1, I-3	NSd, 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-1 Condition 2, I-2	NSd, e, f	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85									
I-4	NSd, g	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
Rh	NSd	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

For SI: 1 foot = 304.8 mm.

UL = Unlimited; NS = Buildings not equipped throughout with an automatic sprinkler system; S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2; S13D = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.3.

a. See Chapters 4 and 5 for specific exceptions to the allowable height in this chapter.

b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.

c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.

d. The NS value is only for use in evaluation of existing building height in accordance with the International Existing Building Code.

e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies Condition 1, see Exception 1 of Section 903.2.6.

f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and Section 1103.5 of the *International Fire Code*.

g. For new Group I-4 occupancies, see Exceptions 2 and 3 of Section 903.2.6.

h. New Group R occupancies are required to be protected by an automatic sprinkler system in

accordance with Section 903.2.8.

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:

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. 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

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 12/27/17

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:

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;

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;

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, I-4, M, R, S, U, the methodology described above accurately reflects how the height proposals were developed.

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, I-4, 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, I-4, 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-I(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/ (link active and up to date as of 12/27/17). 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.

IBC Code Section	Description
403.3.2	Water supply requirements for fire pumps in high rise buildings of Type IVA and IVB construction.
504.3	Allowable building height (feet) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT construction.
504.4	Allowable building height (stories) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
506.2	Allowable building area for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
602.4	Type of Construction requirements for new proposed types of construction: Types IVA, IVB and IVC. No changes to Type IV HT construction. Includes definitions for new terms: Mass timber and Noncombustible protection (mass timber). **THIS IS THE KEY CODE CHANGE PROPOSAL WHICH OUTLINES THE CONSTRUCTION REQUIREMENTS FOR THE PROPOSED NEW TYPE OF MASS TIMBER BUILDINGS. THE PROPOSAL ALSO ADDRESSES CONCEALED SPACES, ADHESIVE PERFORMANCE AND EXTERIOR WALL PROTECTION.**
703.8 (new)	The performance method to determine the increase to the fire resistance rating provided by noncombustible protection applied to the mass timber building element.
703.9 (new)	Requirements for sealants and adhesives to be placed at abutting edges and intersections of mass timber building elements. The reason statement references a Group B proposal to Chapter 17 for special inspection requirements of sealants and adhesives.
718.2.1	Requirements on the use of mass timber building elements used for Fireblocking.
722.7 (new)	Requirements for the fire resistance rating of mass timber elements, including minimum required protection and gypsum board attachment requirements.
3102	Requirements for membrane structures using Type IV HT construction.
3314.7 (new)	New special precautions during construction of buildings of Types IVA, IVB and IVC construction: Standpipes; Water supply for fire department connections; Noncombustible protection required for mass timber elements as construction height increases.
Appendix	Requirements for walls, floors and roofs of Type IV HT construction in buildings located in Fire Districts.
IFC Code Section	**Description**
701.6	Requirements which stipulate the owner's responsibility to maintain inventory of all required fire resistance rated construction in buildings of Types IVA and IVB construction. This includes an annual inspection and proper repair where necessary.
Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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

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

http://bit.ly/ATF-firetestvideos

Both of these links were confirmed active on 12/27/17.

Cost Impact

The code change proposal will not increase or decrease the cost of construction.

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

Table 504.4
IBC: TABLE 504.4

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

2018 International Building Code

Revise as follows:

TABLE 504.4
ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANEa, b

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION										TYPE OF CONSTRUCTION	TYPE OF CONSTRUCTION	TYPE OF CONSTRUCTION
	SEE FOOTNOTES	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE IV	TYPE IV	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		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	1	1	1	1	1	1	NP	NP	NP	1	1	NP
	S							1	1	1			
H-2	NSc, d	UL	3	2	1	2	1	1	1	1	2	1	1
	S							2	2	2			
H-3	NSc, d	UL	6	4	2	4	2	3	3	3	4	2	1
	S							4	4	4			
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	4	4	3	3	3	3	2	2	2	3	3	2
	S							3	3	3			
I-1 Condition 1	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 Condition 2	NSd, e	UL	9	4	3	4	3	3	3	3	4	3	2
	S	UL	10	5				10	6	4			
I-2	NSd, f	UL	4	2	1	1	NP	NP	NP	NP	1	1	NP
	S	UL	5	3				7	5	1			
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	UL	12	5	3	5	3	12	8	6	5	4	2
R-1 h	NSd	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4									4	3
	S	UL	12	5	5	5	5	18	12	8	5	4	3
R-2h	NSd	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4	4								4	3

	S	UL	12	5	5	5	5	18	12	8	5	4	3
R-3h	NSd	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-4h	NSd	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	4	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

~~UL~~ TUL = Unlimited; NP = Not Permitted; NS = Buildings not equipped throughout with an automatic sprinkler system; S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2; S13D = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.3.

a. See Chapters 4 and 5 for specific exceptions to the allowable height in this chapter.

b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.

c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.

d. The NS value is only for use in evaluation of existing building height in accordance with the International Existing Building Code.

e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies, Condition 1, see Exception 1 of Section 903.2.6.

f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and 1103.5 of the International Fire Code.

g. For new Group I-4 occupancies, see Exceptions 2 and 3 of Section 903.2.6.

h. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8.

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:

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.

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

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 12/27/17.

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 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.

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-on-tall-wood-buildings/ (link active and up to date as of 12/27/17). 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

IBC Code Section	**Description**
403.3.2	Water supply requirements for fire pumps in high rise buildings of Type IVA and IVB construction.
504.3	Allowable building height (feet) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT construction.
504.4	Allowable building height (stories) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
506.2	Allowable building area for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
602.4	Type of Construction requirements for new proposed types of construction: Types IVA, IVB and IVC. No changes to Type IV HT construction. Includes definitions for new terms: Mass timber and Noncombustible protection (mass timber). **THIS IS THE KEY CODE CHANGE PROPOSAL WHICH OUTLINES THE CONSTRUCTION REQUIREMENTS FOR THE PROPOSED NEW TYPE OF MASS TIMBER BUILDINGS. THE PROPOSAL ALSO ADDRESSES CONCEALED SPACES, ADHESIVE PERFORMANCE AND EXTERIOR WALL PROTECTION.**
703.8 (new)	The performance method to determine the increase to the fire resistance rating provided by noncombustible protection applied to the mass timber building element.
703.9 (new)	Requirements for sealants and adhesives to be placed at abutting edges and intersections of mass timber building elements. The reason statement references a Group B proposal to Chapter 17 for special inspection requirements of sealants and adhesives.
718.2.1	Requirements on the use of mass timber building elements used for Fireblocking.
722.7 (new)	Requirements for the fire resistance rating of mass timber elements, including minimum required protection and gypsum board attachment requirements.
3102	Requirements for membrane structures using Type IV HT construction.
3314.7 (new)	New special precautions during construction of buildings of Types IVA, IVB and IVC construction: Standpipes; Water supply for fire department connections; Noncombustible protection required for mass timber elements as construction height increases.
Appendix	Requirements for walls, floors and roofs of Type IV HT construction in buildings located in Fire Districts.
IFC Code Section	**Description**
701.6	Requirements which stipulate the owner's responsibility to maintain inventory of all required fire resistance rated construction in buildings of Types IVA and IVB construction. This includes an annual inspection and proper repair where necessary.
Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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.

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Both of these links were confirmed active on 12/27/17.

Cost Impact

The code change proposal will not increase or decrease the cost of construction .

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

TABLE 506.2
IBC: TABLE 506.2

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

2018 International Building Code

Revise as follows:

TABLE 506.2
ALLOWABLE AREA FACTOR (At = NS, S1, S13R, S13D or SM, as applicable) IN SQUARE FEETa, b

OCCUPANCYCLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION									CO
		TYPE I		TYPE II		TYPE III		TYPE IV			
		A	B	A	B	A	B	A	B	C	
A-1	NS	UL	UL	15,500	8,500	14,000	8,500	45,000	30,000	18,750	
	S1	UL	UL	62,000	34,000	56,000	34,000	180,000	120,000	75,000	
	SM	UL	UL	46,500	25,500	42,000	25,500	135,000	90,000	56,250	
A-2	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	
A-3	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	
A-4	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	
A-5	NS	UL	UL	UL	UL	UL	UL	UL	UL	UL	
	S1										
	SM										
B	NS	UL	UL	37,500	23,000	28,500	19,000	108,000	72,000	45,000	
	S1	UL	UL	150,000	92,000	114,000	76,000	432,000	288,000	180,000	
	SM	UL	UL	112,500	69,000	85,500	57,000	324,000	216,000	135,000	
E	NS	UL	UL	26,500	14,500	23,500	14,500	76,500	51,000	31,875	
	S1	UL	UL	106,000	58,000	94,000	58,000	306,000	204,000	127,500	
	SM	UL	UL	79,500	43,500	70,500	43,500	229,500	153,000	95,625	
F-1	NS	UL	UL	25,000	15,500	19,000	12,000	100,500	67,000	41,875	
	S1	UL	UL	100,000	62,000	76,000	48,000	402,000	268,000	167,500	
	SM	UL	UL	75,000	46,500	57,000	36,000	301,500	201,000	125,625	
F-2	NS	UL	UL	37,500	23,000	28,500	18,000	151,500	101,000	63,125	
	S1	UL	UL	150,000	92,000	114,000	72,000	606,000	404,000	252,500	
	SM	UL	UL	112,500	69,000	85,500	54,000	454,500	303,000	189,375	
H-1	NSc	21,000	16,500	11,000	7,000	9,500	7,000	10,500	10,500	10,500	
	S1										
H-2	NSc	21,000	16,500	11,000	7,000	9,500	7,000	10,500	10,500	10,500	
	S1										
	SM										
H-3	NSc	UL	60,000	26,500	14,000	17,500	13,000	25,500	25,500	25,500	
	S1										
	SM										
H-4	NSc, d	UL	UL	37,500	17,500	28,500	17,500	72,000	54,000	40,500	
	S1	UL	UL	150,000	70,000	114,000	70,000	288,000	216,000	162,000	
	SM	UL	UL	112,500	52,500	85,500	52,500	216,000	162,000	121,500	
H-5	NSc, d	UL	UL	37,500	23,000	28,500	19,000	72,000	54,000	40,500	
	S1	UL	UL	150,000	92,000	114,000	76,000	288,000	216,000	162,000	
	SM	UL	UL	112,500	69,000	85,500	57,000	216,000	162,000	121,500	
I-1	NSd, e	UL	55,000	19,000	10,000	16,500	10,000	54,000	36,000	18,000	
	S1	UL	220,000	76,000	40,000	66,000	40,000	216,000	144,000	72,000	
	SM	UL	165,000	57,000	30,000	49,500	30,000	162,000	108,000	54,000	
I-2	NSd, f	UL	UL	15,000	11,000	12,000	NP	36,000	24,000	12,000	
	S1	UL	UL	60,000	44,000	48,000	NP	144,000	96,000	48,000	

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

For SI: 1 square foot = 0.0929 m2.

UL = Unlimited; NP = Not Permitted; NS = Buildings not equipped throughout with an automatic sprinkler system; S1 = Buildings a maximum of one story above grade plane equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; SM = Buildings two or more stories above grade plane equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2; S13D = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.3.

a. See Chapters 4 and 5 for specific exceptions to the allowable height in this chapter.

b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.

c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.

d. The NS value is only for use in evaluation of existing building area in accordance with the International Existing Building Code.

e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies, Condition 1, see Exception 1 of Section 903.2.6.

f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and Section 1103.5 of the International Fire Code.

g. New Group I-4 occupancies see Exceptions 2 and 3 of Section 903.2.6.

h. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8.

i. The maximum allowable area for a single-story nonsprinklered Group U greenhouse is permitted to be 9,000 square feet, or the allowable area shall be permitted to comply with Table C102.1 of Appendix C.

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:

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.

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 IV-C), 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 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 the Committee 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 adopted 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 12/27/17.

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-on-tall-wood-buildings/ (link active and up to date as of 12/27/17). 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.

IBC Code Section	Description
403.3.2	Water supply requirements for fire pumps in high rise buildings of Type IVA and IVB construction.
504.3	Allowable building height (feet) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT construction.
504.4	Allowable building height (stories) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
506.2	Allowable building area for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
602.4	Type of Construction requirements for new proposed types of construction: Types IVA, IVB and IVC. No changes to Type IV HT construction. Includes definitions for new terms: Mass timber and Noncombustible protection (mass timber). **THIS IS THE KEY CODE CHANGE PROPOSAL WHICH OUTLINES THE CONSTRUCTION REQUIREMENTS FOR THE PROPOSED NEW TYPE OF MASS TIMBER BUILDINGS. THE PROPOSAL ALSO ADDRESSES CONCEALED SPACES, ADHESIVE PERFORMANCE AND EXTERIOR WALL PROTECTION.**
703.8 (new)	The performance method to determine the increase to the fire resistance rating provided by noncombustible protection applied to the mass timber building element.
703.9 (new)	Requirements for sealants and adhesives to be placed at abutting edges and intersections of mass timber building elements. The reason statement references a Group B proposal to Chapter 17 for special inspection requirements of sealants and adhesives.
718.2.1	Requirements on the use of mass timber building elements used for Fireblocking.
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3102	Requirements for membrane structures using Type IV HT construction.
3314.7 (new)	New special precautions during construction of buildings of Types IVA, IVB and IVC construction: Standpipes; Water supply for fire department connections; Noncombustible protection required for mass timber elements as construction height increases.
Appendix	Requirements for walls, floors and roofs of Type IV HT construction in buildings located in Fire Districts.
IFC Code Section	**Description**
701.6	Requirements which stipulate the owner's responsibility to maintain inventory of all required fire resistance rated construction in buildings of Types IVA and IVB construction. This includes an annual inspection and proper repair where necessary.
Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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.

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Cost Impact

The code change proposal will not increase or decrease the cost of construction.

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

Sections 508.4 and 509.4 (Fire Barriers)

IBC: 508.4.4, 508.4.4.1, 509.4.1.1 (New)

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

2018 International Building Code

508.4.4 Separation. Individual occupancies shall be separated from adjacent occupancies in accordance with Table 508.4.

Revise as follows:

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 a minimum of 1/2inch (12.7 mm) gypsum board or a noncombustible equivalent.

509.4.1.1 Type IV-B and IV-C construction. Where Table 509 specifies a fire-resistance-rated separation, mass timber elements serving as fire barriers or a horizontal assembly 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 a minimum of ½ inch (12.7 mm) gypsum board or a noncombustible equivalent.

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.

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. 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.

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 12/27/17). 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.

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506.2	Allowable building area for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
602.4	Type of Construction requirements for new proposed types of construction: Types IVA, IVB and IVC. No changes to Type IV HT construction. Includes definitions for new terms: Mass timber and Noncombustible protection (mass timber). **THIS IS THE KEY CODE CHANGE PROPOSAL WHICH OUTLINES THE CONSTRUCTION REQUIREMENTS FOR THE PROPOSED NEW TYPE OF MASS TIMBER BUILDINGS. THE PROPOSAL ALSO ADDRESSES CONCEALED SPACES, ADHESIVE PERFORMANCE AND EXTERIOR WALL PROTECTION.**
703.8 (new)	The performance method to determine the increase to the fire resistance rating provided by noncombustible protection applied to the mass timber building element.
703.9 (new)	Requirements for sealants and adhesives to be placed at abutting edges and intersections of mass timber building elements. The reason statement references a Group B proposal to Chapter 17 for special inspection requirements of sealants and adhesives.
718.2.1	Requirements on the use of mass timber building elements used for Fireblocking.
722.7 (new)	Requirements for the fire resistance rating of mass timber elements, including minimum required protection and gypsum board attachment requirements.
3102	Requirements for membrane structures using Type IV HT construction.
3314.7 (new)	New special precautions during construction of buildings of Types IVA, IVB and IVC construction: Standpipes; Water supply for fire department connections; Noncombustible protection required for mass timber elements as construction height increases.
Appendix	Requirements for walls, floors and roofs of Type IV HT construction in buildings located in Fire Districts.
IFC Code Section	**Description**
701.6	Requirements which stipulate the owner's responsibility to maintain inventory of all required fire resistance rated construction in buildings of Types IVA and IVB construction. This includes an annual inspection and proper repair where necessary.
Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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

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

http://bit.ly/ATF-firetestvideos

Both of these links were confirmed active on 12/27/17.

Cost Impact
The code change proposal will not increase or decrease the cost of construction.

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

Section 602.4 Type of Construction

IBC: 202, (New), 202 (New), 602.4, 602.4.1 (New), 602.4.1.1 (New), 602.4.1.2 (New), 602.4.1.2.1 (New), 602.4.1.3 (New), 602.4.1.4 (New), 602.4.1.5 (New), 602.4.1.6 (New), 602.4.2 (New), 602.4.2.1 (New), 602.4.2.2 (New), 602.4.2.2.1 (New), 602.4.2.2.2 (New), 602.4.2.2.3 (New), 602.4.2.2.4 (New), 602.4.2.3 (New), 602.4.2.4 (New), 602.4.2.5 (New), 602.4.2.6 (New), 602.4.3 (New), 602.4.3.1 (New), 602.4.3.2 (New), 602.4.3.3 (New), 602.4.3.4 (New), 602.4.3.5 (New), 602.4.3.6 (New), 602.4.4 (New), 602.4.4.1, 602.4.4.2, 602.4.4.3, TABLE 601, TABLE 602

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

2018 International Building Code

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 timber wall that supports more than 200 pounds per linear foot (2919 N/m) of vertical load in addition to its own weight.

Add new definition 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.

Delete and substitute 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 602.4.1 or 602.4.2 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.~~

602.4 Type IV. 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 or 703.3. 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 703.8 and comply with 722.7.

All cross-laminated timber shall be labeled as conforming to the heat performance requirements of Section 6.1.3.4 of DOC PS1 and have no delamination in any specimen, except when occurring at a localized characteristic when permitted in the product standard.

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

Exception: 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: 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, B, and C, construction with an occupied floor located more than 75 feet above the lowest level of fire department access, up to and including 12 stories or 180 feet 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 above grade plane, interior exit and elevator hoistway enclosures shall be constructed of non-combustible materials.

Add new text as follows:

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 or Section 703.3.

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 determined in Section 722.7.1(a). All 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/m2and 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 E 84 or UL 723. The ASTM E 1354 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.

602.4.1.2 Interior protection. Interior faces of all mass timber elements, including the inside faces of exterior mass timber walls and mas timber roofs, shall be protected with materials complying with Section 703.5

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(a), but not less than 80 minutes. The use of materials and their respective protection contributions listed in Table 722.7.1(b) 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 one inch 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 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 Sections 602.4.1.2.

602.4.1.6 Shafts. Shafts shall be permitted in accordance with Sections 713 and Section 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 or Section 703.3.

602.4.2.1 Exterior protection. The outside face of exterior walls of mass timber construction shall be protected with non-combustible protection with a minimum assigned time of 40 minutes as determined in Section 722.7.1(a). All 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/m2and 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 E 84 or UL 723. The ASTM E 1354 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 703.5.

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(a), but not less than 80 minutes. The use of materials and their respective protection contributions listed in Table 722.7.1(b) shall be permitted to be used for compliance with Section 722.7.1.

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

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, including attached beams, shall

be permitted and shall be limited to an area equal to 20% of the floor area in any dwelling unit or fire area; or

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

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.

4. Mass timber columns and beams which 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.

(Utc/Uac) + (Utw/Uaw) ≤ 1 (Equation 6-1) where:

Utc= Total unprotected mass timber ceiling areas

Uac = Allowable unprotected mass timber ceiling area conforming to Section 602.4.2.2.2, Exception 1

Utw= Total unprotected mass timber wall areas Uaw= Allowable unprotected mass timber wall area conforming to Section 602.4.2.2.2, Exception 2

602.4.2.2.4 Separation distance between unprotected mass timber elements. In each dwelling unit or fire area, unprotectedportions of mass timber walls and ceilings shall be not less than 15 feet 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 one inch 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 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 Section 713 and Section 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 or Section 703.3.

602.4.3.1 Exterior protection. The exterior side of walls of combustible construction shall be protected with non-combustible protection with a minimum assigned time of 40 minutes as determined in Section 722.7.1(a). All 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/m2and 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 E 84 or UL 723. The ASTM E 1354 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 Roofs. 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 determined in Section 722.7.1(a).

602.4.3.6 Shafts. Shafts shall be permitted in accordance with Section 713 and Section 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 determined in Section 722.7.1(a), on both the inside of the shaft and the outside of the shaft.

602.4.4 Type IV-HT. Type IV construction (Heavy Timber, HT) 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. The minimum dimensions for permitted materials including solid timber, glued-laminated timber, structural composite lumber (SCL) and cross laminated timber (CLT) 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 one hour fire resistance rating or heavy timber conforming with Section 2304.11.2.2 shall be permitted.

Revise as follows:

~~**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* 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 exterior surface of the cross-laminated timber is 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; or
3. A noncombustible material.

~~602.4.3~~ 602.4.4.3 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.

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	A	B	C	HT	A	B
Primary structural framef (see Section 202)	3a, b	2a, b	1b	0	1b	0	3a	2a	2a	HT	1b	0
Bearing walls Exteriore, f Interior	3 3a	2 2a	1 1	0 0	2 1	2 0	3 3	2 2	2 2	2 1/HT	1 1	0 0
Nonbearing walls and partitions Exterior	See Table 602											
Nonbearing walls and partitions Interiord	0	0	0	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	2	2	2	HT	1	0
Roof construction and associated secondary members (see Section 202)	11/2b	1b,c	1b,c	0c	1b,c	0	1 1/2	1	1	HT	1b,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 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.

c. 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. 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.

TABLE 602
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCEa, d, g

FIRE SEPARATION DISTANCE =X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP He	OCCUPANCYGROUP F-1, M, S-1f	OCCUPANCYGROUP A, B, E, F-2, I, Ri, S-2, Uh
X < 5b	All	3	2	1
5 ≤ X < 10	IA, IVA Others	32	2 1	11
10 ≤ X < 30	IA, IB, IVA, IVB IIB, VB Others	21 1	1 0 1	1c 0 1c
X ≥ 30	All	0	0	0

For SI: 1 foot = 304.8 mm.

a. Load-bearing exterior walls shall also comply with the fire-resistance rating requirements of Table 601.

b. See Section 706.1.1 for party walls.

c. Open parking garages complying with Section 406 shall not be required to have a fire-resistance rating.

d. The fire-resistance rating of an exterior wall is determined based upon the fire separation distance of the exterior wall and the story in which the wall is located.

e. For special requirements for Group H occupancies, see Section 415.6.

f. For special requirements for Group S aircraft hangars, see Section 412.3.1.

g. Where Table 705.8 permits nonbearing exterior walls with unlimited area of unprotected openings, the required fire-resistance rating for the exterior walls is 0 hours.

h. For a building containing only a Group U occupancy private garage or carport, the exterior wall shall not be required to have a fire-resistance rating where the

fire separation distance is 5 feet (1523 mm) or greater.

i. For a Group R-3 building of Type II-B or Type V-B construction, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet (1523 mm) or greater.

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:

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 yimber” 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 Cross-laminated 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 12/27/17.

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 12/27/17). 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.

IBC Code Section	Description
403.3.2	Water supply requirements for fire pumps in high rise buildings of Type IVA and IVB construction.
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506.2	Allowable building area for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
602.4	Type of Construction requirements for new proposed types of construction: Types IVA, IVB and IVC. No changes to Type IV HT construction. Includes definitions for new terms: Mass timber and Noncombustible protection (mass timber). **THIS IS THE KEY CODE CHANGE PROPOSAL WHICH OUTLINES THE CONSTRUCTION REQUIREMENTS FOR THE PROPOSED NEW TYPE OF MASS TIMBER BUILDINGS. THE PROPOSAL ALSO ADDRESSES CONCEALED SPACES, ADHESIVE PERFORMANCE AND EXTERIOR WALL PROTECTION.**
703.8 (new)	The performance method to determine the increase to the fire resistance rating provided by noncombustible protection applied to the mass timber building element.
703.9 (new)	Requirements for sealants and adhesives to be placed at abutting edges and intersections of mass timber building elements. The reason statement references a Group B proposal to Chapter 17 for special inspection requirements of sealants and adhesives.
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722.7 (new)	Requirements for the fire resistance rating of mass timber elements, including minimum required protection and gypsum board attachment requirements.
3102	Requirements for membrane structures using Type IV HT construction.
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Appendix	Requirements for walls, floors and roofs of Type IV HT construction in buildings located in Fire Districts.
IFC Code Section	**Description**
701.6	Requirements which stipulate the owner's responsibility to maintain inventory of all required fire resistance rated construction in buildings of Types IVA and IVB construction. This includes an annual inspection and proper repair where necessary.
Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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.

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Both of these links were confirmed active on 12/27/17.

Cost Impact

The code change proposal will not increase or decrease the cost of construction .

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

Section 703.8 - Performance Method

IBC: 703.8 (New), 703.8.1 (New), 703.8.2 (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:

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 E 119 or UL 263.

703.8.1 Test Assemblies. Test Assembly 1 shall be without protection, and Test Assembly 2 shall contain the representative noncombustible protection. 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. 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.

703.8.2 Details. The protection shall be fully defined in terms of configuration details, attachment details, joint sealing details, accessories and all other relevant details.

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 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 12/27/17.

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.

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 12/27/17). 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.

IBC Code Section	Description
403.3.2	Water supply requirements for fire pumps in high rise buildings of Type IVA and IVB construction.
504.3	Allowable building height (feet) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT construction.
504.4	Allowable building height (stories) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
506.2	Allowable building area for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
602.4	Type of Construction requirements for new proposed types of construction: Types IVA, IVB and IVC. No changes to Type IV HT construction. Includes definitions for new terms: Mass timber and Noncombustible protection (mass timber). **THIS IS THE KEY CODE CHANGE PROPOSAL WHICH OUTLINES THE CONSTRUCTION REQUIREMENTS FOR THE PROPOSED NEW TYPE OF MASS TIMBER BUILDINGS. THE PROPOSAL ALSO ADDRESSES CONCEALED SPACES, ADHESIVE PERFORMANCE AND EXTERIOR WALL PROTECTION.**
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703.9 (new)	Requirements for sealants and adhesives to be placed at abutting edges and intersections of mass timber building elements. The reason statement references a Group B proposal to Chapter 17 for special inspection requirements of sealants and adhesives.
718.2.1	Requirements on the use of mass timber building elements used for Fireblocking.
722.7 (new)	Requirements for the fire resistance rating of mass timber elements, including minimum required protection and gypsum board attachment requirements.
3102	Requirements for membrane structures using Type IV HT construction.
3314.7 (new)	New special precautions during construction of buildings of Types IVA, IVB and IVC construction: Standpipes; Water supply for fire department connections; Noncombustible protection required for mass timber elements as construction height increases.
Appendix	Requirements for walls, floors and roofs of Type IV HT construction in buildings located in Fire Districts.
IFC Code Section	**Description**
701.6	Requirements which stipulate the owner's responsibility to maintain inventory of all required fire resistance rated construction in buildings of Types IVA and IVB construction. This includes an annual inspection and proper repair where necessary.
Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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:

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Cost Impact
The code change proposal will not increase or decrease the cost of construction.

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

Section 703.9 - Sealants at edges

IBC: 703.9 (New), 35

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:

703.9 Sealing of adjacent mass timber elements. In buildings of Type IVA, IVB, and IVC 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: Where sealant or adhesive is not a required component of a fire resistance-rated assembly.

ASTM

ASTM International
100 Barr Harbor Drive,
P.O. Box C700
West Conshohocken PA
19428-2959

A416/A416M—15

Specification for Steel Strand, Uncoated Seven-wire for Prestressed Concrete

D3498—03(2011)

Standard Specification for Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems

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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.

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.

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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 special inspections during construction are required to make sure it is clear that the appropriate sealant or adhesive is used and to establish inspections to verify for ongoing quality control. However, Chapter 17 is a Group B topic. It will be taken up then. It is shown below for clarity and to emphasize the importance the TWB places on proper application of sealants and adhesives in mass timber construction.

1705.19 Sealing of Mass Timber. Periodic special inspections of sealants or adhesives shall be conducted where sealant or adhesive required by Section 703.9 is applied to mass timber building elements as designated in the approved construction documents.

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.

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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.

IBC Code Section	Description
403.3.2	Water supply requirements for fire pumps in high rise buildings of Type IVA and IVB construction.
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506.2	Allowable building area for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
602.4	Type of Construction requirements for new proposed types of construction: Types IVA, IVB and IVC. No changes to Type IV HT construction. Includes definitions for new terms: Mass timber and Noncombustible protection (mass timber). **THIS IS THE KEY CODE CHANGE PROPOSAL WHICH OUTLINES THE CONSTRUCTION REQUIREMENTS FOR THE PROPOSED NEW TYPE OF MASS TIMBER BUILDINGS. THE PROPOSAL ALSO ADDRESSES CONCEALED SPACES, ADHESIVE PERFORMANCE AND EXTERIOR WALL PROTECTION.**
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703.9 (new)	Requirements for sealants and adhesives to be placed at abutting edges and intersections of mass timber building elements. The reason statement references a Group B proposal to Chapter 17 for special inspection requirements of sealants and adhesives.
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722.7 (new)	Requirements for the fire resistance rating of mass timber elements, including minimum required protection and gypsum board attachment requirements.
3102	Requirements for membrane structures using Type IV HT construction.
3314.7 (new)	New special precautions during construction of buildings of Types IVA, IVB and IVC construction: Standpipes; Water supply for fire department connections; Noncombustible protection required for mass timber elements as construction height increases.
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Proposed changes to be submitted in 2019 Group B	
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IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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.

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Chapter 7 – Section 718.2.1 – Fire and Smoke Protection

IBC: 718.2.1

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

2018 International Building Code

Revise as follows:

718.2.1 Fireblocking materials. *Fireblocking* shall consist of the following materials:

1. Two-inch (51 mm) nominal lumber.
2. Two thicknesses of 1-inch (25 mm) nominal lumber with broken lap joints.
3. One thickness of 0.719-inch (18.3 mm) wood structural panels with joints backed by 0.719-inch (18.3 mm) wood structural panels.
4. One thickness of 0.75-inch (19.1 mm) particleboard with joints backed by 0.75-inch (19 mm) particleboard.
5. One-half-inch (12.7 mm) gypsum board.
6. One-fourth-inch (6.4 mm) cement-based millboard.
7. Batts or blankets of mineral wool, mineral fiber or other *approved* materials installed in such a manner as to be securely retained in place.
8. Cellulose insulation installed as tested for the specific application.
9. Mass timber complying with Section 2304.11.

Reason:
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The purpose of this code change proposal is to recognize that mass timber as a suitable fireblocking material. The current list of acceptable materials lists “nominal lumber”, therefore since mass timber (e.g. Sawn, glued-laminated, and cross laminated timbers) are of greater mass the correlation from single nominal lumber to mass timber was determined to be of equal or greater blocking resistance to reduce the ability of fire, smoke and gasses from moving to different part of the building through combustible concealed spaces.

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

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IFC Code Section	**Description**
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3308.4 (new)	New special precautions during construction of buildings of Types IVA, IVB and IVC construction: Standpipes; Water supply for fire department connections; Noncombustible protection required for mass timber elements as construction height increases.
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In addition, fire tests designed to simulate the three new construction types (Types IVA,

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This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

722.7 Ratings Installation

IBC: 722.7 (New), 722.7.1 (New), TABLE 722.7.1(a) (New), TABLE 722.7.1(b) (New), 722.7.2 (New), 722.7.2.1 (New), 722.7.2.2 (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:

722.7 Fire resistance rating of mass timber. The required fire resistance of mass timber elements in section 602.4 shall be determined in accordance with Section 703.2 or Section 703.3. The fire resistance rating of building elements shall be as required in Tables 601 and 602 and as specified elsewhere in this code. The fire resistance rating of the mass timber elements shall consist of the fire resistance of the unprotected element added to the protection time of the noncombustible protection.

722.7.1 Minimum required protection. When 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(a). The rating, in minutes, contributed by the noncombustible protection of mass timber building elements, components, or assemblies, shall be established in accordance with Section 703.8. The protection contributions indicated in Table 722.7.1(b) shall be deemed to comply with this requirement when installed and fastened in accordance with Section 722.7.2.

TABLE 722.7.1(a)
PROTECTION REQUIRED FROM NONCOMBUSTIBLE COVERING MATERIAL

Required Fire Resistance Rating of Building Element per Tables 601 and 602 (hours)	Minimum Protection Required from Noncombustible Protection (minutes)
1	40
2	80
3 or more	120

TABLE 722.7.1(b)
PROTECTION PROVIDED BY NONCOMBUSTIBLE COVERING MATERIAL

Noncombustible Protection	Protection Contribution (minutes)
1/2 inch Type X Gypsum Board	30
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(b) 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(a) 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 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 with1 inch #6 Type S drywall screws to furring channels in accordance with ASTM C-645.

2. Screws for attaching the base layer shall be 12 inches on center in both directions.
3. Screws for each layer after the base layer shall be 12 inches on center in both directions and offset from the screws of the previous layers by 4 inches in both directions.
4. All panel edges of any layer shall be offset 18 inches from those of the previous layer.
5. All panel edges shall be attached with screws sized and offset as in items 1 through 4 above and placed at least 1 inch but not more than 2 inches from the panel edge.
6. All panels installed at wall-to-ceiling intersections shall be installed such that the ceiling panel(s) is installed first and the wall panel(s) is 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 panel(s) covering an exterior wall or a wall with a greater fire resistance rating shall be installed first and the panel(s) 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 1-1/4 inch 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 heavy timber walls determined in accordance with Table 722.7.1(a) shall be fastened 12 inches on center each way and 6 inches on center at all joints or ends. All panel edges shall be attached with fasteners located at least 1inch but not more than 2 inches from the panel edge. Fasteners shall comply with one of the following:

1. Galvanized nails of minimum 12 Gage with a 7/16 inch head of sufficient length to penetrate the mass timber a minimum of 1 inch.
2. Screws which comply with ASTM C1002 (Type S, Type W, or Type G) of sufficient length to penetrate the mass timber a minimum of 1 inch.

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.

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 12/27/17.

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.

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 12/27/17). 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.

IBC Code Section	Description
403.3.2	Water supply requirements for fire pumps in high rise buildings of Type IVA and IVB construction.
504.3	Allowable building height (feet) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT construction.
504.4	Allowable building height (stories) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
506.2	Allowable building area for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
602.4	Type of Construction requirements for new proposed types of construction: Types IVA, IVB and IVC. No changes to Type IV HT construction. Includes definitions for new terms: Mass timber and Noncombustible protection (mass timber). **THIS IS THE KEY CODE CHANGE PROPOSAL WHICH OUTLINES THE CONSTRUCTION REQUIREMENTS FOR THE PROPOSED NEW TYPE OF MASS TIMBER BUILDINGS. THE PROPOSAL ALSO ADDRESSES CONCEALED SPACES, ADHESIVE PERFORMANCE AND EXTERIOR WALL PROTECTION.**
703.8 (new)	The performance method to determine the increase to the fire resistance rating provided by noncombustible protection applied to the mass timber building element.
703.9 (new)	Requirements for sealants and adhesives to be placed at abutting edges and intersections of mass timber building elements. The reason statement references a Group B proposal to Chapter 17 for special inspection requirements of sealants and adhesives.
718.2.1	Requirements on the use of mass timber building elements used for Fireblocking.
722.7 (new)	Requirements for the fire resistance rating of mass timber elements, including minimum required protection and gypsum board attachment requirements.
3102	Requirements for membrane structures using Type IV HT construction.
3314.7 (new)	New special precautions during construction of buildings of Types IVA, IVB and IVC construction: Standpipes; Water supply for fire department connections; Noncombustible protection required for mass timber elements as construction height increases.
Appendix	Requirements for walls, floors and roofs of Type IV HT construction in buildings located in Fire Districts.
IFC Code Section	**Description**
701.6	Requirements which stipulate the owner's responsibility to maintain inventory of all required fire resistance rated construction in buildings of Types IVA and IVB construction. This includes an annual inspection and proper repair where necessary.
Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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

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

http://bit.ly/ATF-firetestvideos

Both of these links were confirmed active on 12/27/17.

Cost Impact
The code change proposal will not increase or decrease the cost of construction.

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

Chapter 31 – Section 3102 – Special Construction

IBC: 3102.3, 3102.6.1.1

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

2018 International Building Code

Revise as follows:

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:

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.

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 12/27/17). 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.

IBC Code Section	Description
403.3.2	Water supply requirements for fire pumps in high rise buildings of Type IVA and IVB construction.
504.3	Allowable building height (feet) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT construction.
504.4	Allowable building height (stories) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
506.2	Allowable building area for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
602.4	Type of Construction requirements for new proposed types of construction: Types IVA, IVB and IVC. No changes to Type IV HT construction. Includes definitions for new terms: Mass timber and Noncombustible protection (mass timber). **THIS IS THE KEY CODE CHANGE PROPOSAL WHICH OUTLINES THE CONSTRUCTION REQUIREMENTS FOR THE PROPOSED NEW TYPE OF MASS TIMBER BUILDINGS. THE PROPOSAL ALSO ADDRESSES CONCEALED SPACES, ADHESIVE PERFORMANCE AND EXTERIOR WALL PROTECTION.**
703.8 (new)	The performance method to determine the increase to the fire resistance rating provided by noncombustible protection applied to the mass timber building element.
703.9 (new)	Requirements for sealants and adhesives to be placed at abutting edges and intersections of mass timber building elements. The reason statement references a Group B proposal to Chapter 17 for special inspection requirements of sealants and adhesives.
718.2.1	Requirements on the use of mass timber building elements used for Fireblocking.
722.7 (new)	Requirements for the fire resistance rating of mass timber elements, including minimum required protection and gypsum board attachment requirements.
3102	Requirements for membrane structures using Type IV HT construction.
Appendix	Requirements for walls, floors and roofs of Type IV HT construction in buildings located in Fire Districts.
IFC Code Section	**Description**
701.6	Requirements which stipulate the owner's responsibility to maintain inventory of all required fire resistance rated construction in buildings of Types IVA and IVB construction. This includes an annual inspection and proper repair where necessary.
3308.4 (new)	New special precautions during construction of buildings of Types IVA, IVB and IVC construction: Standpipes; Water supply for fire department connections; Noncombustible protection required for mass timber elements as construction height increases.
Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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

To watch summary videos of the fire tests, please visit http://bit.ly/ATF-firetestvideos

Both of these links were confirmed active on 12/27/17.

Cost Impact

The code change proposal will not increase or decrease the cost of construction.

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

IBC Appendix D – Fire Districts

IBC: D102.2.5

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

2018 International Building Code

Revise as follows:

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.

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.

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.

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 12/27/17). 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.

IBC Code Section	Description
403.3.2	Water supply requirements for fire pumps in high rise buildings of Type IVA and IVB construction.
504.3	Allowable building height (feet) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT construction.
504.4	Allowable building height (stories) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
506.2	Allowable building area for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
602.4	Type of Construction requirements for new proposed types of construction: Types IVA, IVB and IVC. No changes to Type IV HT construction. Includes definitions for new terms: Mass timber and Noncombustible protection (mass timber). **THIS IS THE KEY CODE CHANGE PROPOSAL WHICH OUTLINES THE CONSTRUCTION REQUIREMENTS FOR THE PROPOSED NEW TYPE OF MASS TIMBER BUILDINGS. THE PROPOSAL ALSO ADDRESSES CONCEALED SPACES, ADHESIVE PERFORMANCE AND EXTERIOR WALL PROTECTION.**
703.8 (new)	The performance method to determine the increase to the fire resistance rating provided by noncombustible protection applied to the mass timber building element.
703.9 (new)	Requirements for sealants and adhesives to be placed at abutting edges and intersections of mass timber building elements. The reason statement references a Group B proposal to Chapter 17 for special inspection requirements of sealants and adhesives.
718.2.1	Requirements on the use of mass timber building elements used for Fireblocking.
722.7 (new)	Requirements for the fire resistance rating of mass timber elements, including minimum required protection and gypsum board attachment requirements.
3102	Requirements for membrane structures using Type IV HT construction.
Appendix	Requirements for walls, floors and roofs of Type IV HT construction in buildings located in Fire Districts.
IFC Code Section	**Description**
701.6	Requirements which stipulate the owner's responsibility to maintain inventory of all required fire resistance rated construction in buildings of Types IVA and IVB construction. This includes an annual inspection and proper repair where necessary.
3308.4 (new)	New special precautions during construction of buildings of Types IVA, IVB and IVC construction: Standpipes; Water supply for fire department connections; Noncombustible protection required for mass timber elements as construction height increases.
Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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

To watch summary videos of the fire tests, please visit http://bit.ly/ATF-firetestvideos

Both of these links were confirmed active on 12/27/17.

Cost Impact

The code change proposal will not increase or decrease the cost of construction.

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

701.6 Owner’s responsibility

IFC: 701.6

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

2018 International Fire Code

Revise as follows:

701.6 Owner's responsibility. The owner shall maintain an inventory of all required *fire-resistance-rated* construction, construction installed to resist the passage of smoke and the construction included in Sections 703 through 707 and Sections 602.4.1 and 602.4.2 of the International Building Code. Such construction shall be visually inspected by the *owner* annually and properly repaired, restored or replaced where damaged, altered, breached or penetrated. Records of inspections and repairs shall be maintained. Where concealed, such elements shall not be required to be visually inspected by the *owner* unless the concealed space is accessible by the removal or movement of a panel, access door, ceiling tile or similar movable entry to the space.

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 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. One of the basic requirements incorporated into these proposed increased heights and areas is the added active and passive protection features to these structures.

Specific to this code change proposal, in the related code change proposals for Type IV-A and Type IV-B, mass timber walls and ceilings, except where permitted, will be required to meet a fire-resistance performance with a specified amount provided with gypsum board or its equivalent.

The greater permitted heights and areas are being proposed based on the requirement of this added level of passive protection. It would seem obvious that we should incorporate a methodology to insure this passive protection remains in place.

This is not an undue burden to the building owner or management. Section 701.6 of the International Fire Code permits these inspections to be done by current building staff. Local jurisdictions may or may not require the annual inspection to be reported. The managing authority simply must keep a record of such inspections and take steps to correct any deficiencies identified.

Some have suggested that we do not require other types of construction to inspect the gypsum board annually to insure it has not been compromised. Other forms of construction do not contribute to the fuel load in the manner mass timber construction potentially will do. If we are going to permit mass timber construction to greater heights than previously permitted it means we are relying on the performance of active and

passive protection to protect the occupants of the building in the event of a fire. We currently require the active protection to be inspected for performance it is time we require the same for the passive.

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 12/27/17). 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.

IBC Code Section	Description
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703.8 (new)	The performance method to determine the increase to the fire resistance rating provided by noncombustible protection applied to the mass timber building element.
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701.6	Requirements which stipulate the owner's responsibility to maintain inventory of all required fire resistance rated construction in buildings of Types IVA and IVB construction. This includes an annual inspection and proper repair where necessary.
Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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

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

http://bit.ly/ATF-firetestvideos

Both of these links were confirmed active on 12/27/17.

Cost Impact
The code change proposal will not increase or decrease the cost of construction .

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

3308.4

IFC: 3308.4 (New)

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

2018 International Fire Code

3308.4 Fire safety requirements for buildings of Types IV-A, IV-B, and IV-C construction. Buildings of Types IV-A, IV-B, and IV-C construction designed to be greater than six stories above grade plane shall meet the following requirements during construction unless otherwise approved by the fire code official.

1. Standpipes shall be provided in accordance with Section 3313.
2. A water supply for fire department operations, as approved by the fire chief.
3. Where building construction exceeds six stories above grade plane, at least one layer of noncombustible protection where required by Section 602.4 of the International Building Code shall be installed on all building elements more than 4 floor levels, including mezzanines, below active mass timber construction before erecting additional floor levels.
4. Where building construction exceeds six stories above grade plane required exterior wall coverings shall be installed on all floor levels more than 4 floor levels, including mezzanines, below active mass timber construction before erecting additional floor level.

Exception: Shafts and vertical exit enclosures.

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 has developed a number of proposals to potentially increase the permitted height and area for Type IV structures, specifically mass timber buildings adding additional Types IV-A, IV-B & IV-C. 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 goal of this proposal is to provide guidance and requirements for when this combustible building is most vulnerable, while under construction prior to fire protection systems have been installed.

Over the recent years we have experienced a number of fires while combustible buildings have been under construction. It is understood the vast majority of these fires did occur in structures of light-frame structural wood members which present a significant fire hazard when exposed. Even with this fact we cannot simply ignore the potential risk of fire in combustible construction simply due to the size of the timber element and the potentially longer period of time for ignition as the potentially fuel load of a mass timber building

can be substantial.

The TWB had a great deal of discussion regarding the proposed requirements regarding water supply to the buildings of combustible construction sites. On one hand, there was a desire to establish a minimum water flow of 250 gpm with a minimum pressure. But the counter discussion identified that these combustible building construction sites may have various degrees of hazards on the site and was not restrictive to just the structure. Mass timber construction typically proceeds with little stored combustible material on the site, mass timber is generally installed as it arrives. Thus, there may be more or fewer site hazards than on a typical construction site utilizing combustible materials. Moreover, protection of the installed material must occur before the project moves above certain specified numbers of levels. This is very different from conventional construction processes.

With this understanding, the TWB is proposing project developers meet and confer with the local fire service to establish the fire department's response needs, in terms of water flow and pressure, for the specific building, while under construction, and job site.

While sub-sections 1 and 2 apply to the delivery of water to the job site, and/or structure, sub-sections 3 and 4 are specific to the passive protection related to the structure. Due to the proposed increased heights and areas, the TWB felt it was important to require interior and exterior passive protection as the construction progressed. This would insure the lower portions of the combustible structure had redundant, active and passive, protection as greater heights were added.

Two figures are shown below to illustrate the requirements of sub-sections 3 and 4 of this proposal. Since both buildings will exceed six-stories, protection must be provided during construction. The solid thick lines indicate building elements that are required to be protected. Solid thin lines indicate elements that are in-place, but are not required to be protected and dashed lines indicate elements that have not yet been placed. Figure 1 is shown to illustrate when protection is first required on a building under construction. When level 6 is the active level of mass timber construction, protection of the building elements and the exterior wall coverings are required before level 7 panels can be placed. In Figure 2, the progress of protection on each successive level is indicated as construction continues. In this example, level 14 is the active level of mass timber construction, so prior to placement of floor panels at level 15, protection is required on level 9.

New paragraph for the reason statement: Two figures are shown below to illustrate the requirements of sub-sections 3 and 4 of this proposal. Since both buildings will exceed six-stories, protection must be provided during construction. The solid thick lines indicate building elements that are required to be protected. Solid lines indicate elements that are in-place, but are not required to be protected and dashed lines indicate elements that have not yet been place. Figure 1 is shown to indicate when protection is first required to be provided on a building under construction. When level 6 is the active level, protection of the building elements and the exterior wall coverings are required before level 7 panels can be placed. In Figure 2, the progress of protection on each successive level is indicated as construction continues. In this example, level 14 is the active level, so prior to placement of floor panels at level 15, protection is required on level 9.

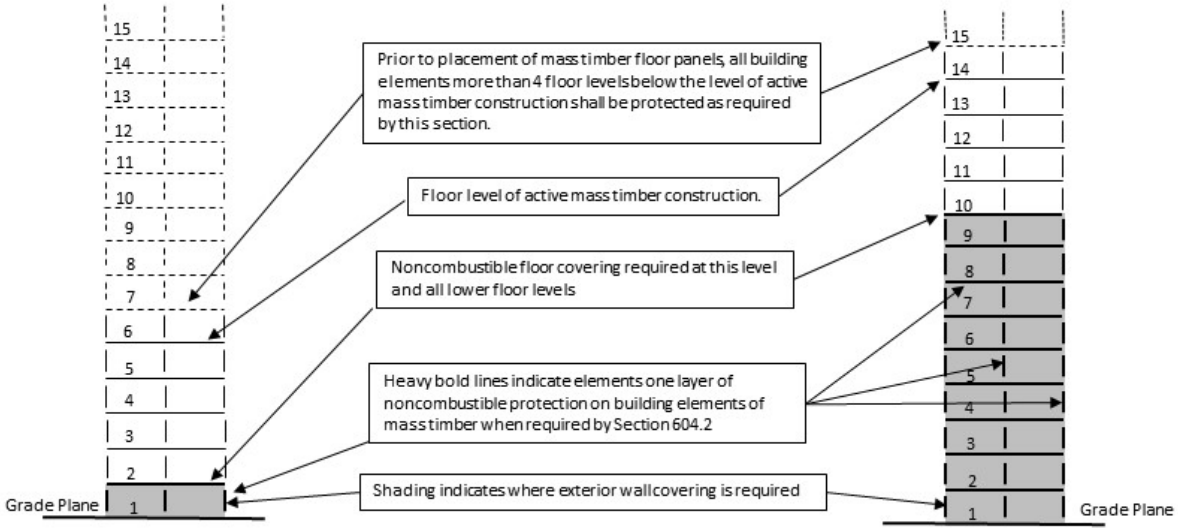

Figure 1 Figure 2

Examples of Protection During Construction For Mass Timber Buildings Greater Than 6 Stories Above Grade Plane

The TWB strongly feels these code change proposals should be adopted as a whole package. By adopting a few of the code change proposals without the complete package potentially ignores the details required to insure these proposed projects are designed, built and maintained properly now and in the future. **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 12/27/17). 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.

IBC Code Section	Description
403.3.2	Water supply requirements for fire pumps in high rise buildings of Type IVA and IVB construction.
504.3	Allowable building height (feet) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT construction.
504.4	Allowable building height (stories) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
506.2	Allowable building area for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
602.4	Type of Construction requirements for new proposed types of construction: Types IVA, IVB and IVC. No changes to Type IV HT construction. Includes definitions for new terms: Mass timber and Noncombustible protection (mass timber). **THIS IS THE KEY CODE CHANGE PROPOSAL WHICH OUTLINES THE CONSTRUCTION REQUIREMENTS FOR THE PROPOSED NEW TYPE OF MASS TIMBER BUILDINGS. THE PROPOSAL ALSO ADDRESSES CONCEALED SPACES, ADHESIVE PERFORMANCE AND EXTERIOR WALL PROTECTION.**
703.8 (new)	The performance method to determine the increase to the fire resistance rating provided by noncombustible protection applied to the mass timber building element.
703.9 (new)	Requirements for sealants and adhesives to be placed at abutting edges and intersections of mass timber building elements. The reason statement references a Group B proposal to Chapter 17 for special inspection requirements of sealants and adhesives.
718.2.1	Requirements on the use of mass timber building elements used for Fireblocking.
722.7 (new)	Requirements for the fire resistance rating of mass timber elements, including minimum required protection and gypsum board attachment requirements.
3102	Requirements for membrane structures using Type IV HT construction.
3314.7 (new)	New special precautions during construction of buildings of Types IVA, IVB and IVC construction: Standpipes; Water supply for fire department connections; Noncombustible protection required for mass timber elements as construction height increases.
Appendix	Requirements for walls, floors and roofs of Type IV HT construction in buildings located in Fire Districts.
IFC Code Section	**Description**
701.6	Requirements which stipulate the owner's responsibility to maintain inventory of all required fire resistance rated construction in buildings of Types IVA and IVB construction. This includes an annual inspection and proper repair where necessary.
Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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.

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Cost Impact
The code change proposal will not increase or decrease the cost of construction.

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Pages 73-147 are modifications to draft code change language approved at the ICC CAH meeting in April, 2018

2021 IBC, 2018 Group A, Tall Mass Timber Proposals

Code Action Hearing (CAH) Unofficial Results:

The ICC Ad Hoc Committee on Tall Wood Buildings (TWB) was created by the ICC Board of Directors to explore the science of tall wood buildings and take action to develop and submit code change proposals in the ICC process. 14 proposals were submitted into cdpACCESS for the Group A Committee Action Hearing (CAH). All proposals were approved as submitted (AS) or approved as modified (AM) at the Committee Action Hearing in Columbus Ohio. The next step in the ICC process will be a web posting on May 30 of a report of the committee action hearing. Until that time, this list of committee action hearing proposals and actions including modifications is based on information on the ICC live hearing website: www.cdpaccess.com/live The 2018/2019 ICC Code Development Schedule is attached for reference.

This document is intended to assist individual code official groups to navigate the proposals in order to become familiar and understand the proposed changes with the least amount of time and effort and also provide a clean copy from the hearings for those governmental agencies who want to consider early adoption of the proposals and modifications that were approved at the CAH.

The CAH approved proposals, when finalized, will create three new types of construction: IVA, IVB and IVC. Heavy timber (Type IV HT) remains technically unchanged by these proposals as in the current 2018 IBC. It is important to note none of the new types of construction permit the utilization of combustible light frame construction in any manner. As a start Mass Timber, used in the new types of construction, must meet the minimum dimensions assigned the 2018 IBC for heavy timber construction. For those becoming familiar with the package, it is recommended the code change proposals are reviewed in the following order starting with the basic requirements for the new types of construction:

- **G108-18**: Section 602.4 - Type of Construction; Approved As Modified (AM) by DiGiovanni 1 & 2
- **FS5-18**: Section 703.8 - Performance Method; Approved As Submitted (AS)
- **FS81-18**: Section 722.7 – Ratings Installation; Approved AM by DiGiovanni 1
- **FS6-18**: Section 703.9 – Sealants at Edges; Approved AS (note: DiGiovanni 1 ruled out of order due to format but recommended for future approval by the ad hoc committee).
- **FS73-18:** Chapter 7 – Section 718.2.1 – Fireblocking Material; Approved AS
- **G28-18:** Section 403.3.2 – High Rise Sprinkler Water Supply; Approved AS
- **F88-18:** Section 701.6 – Owners Responsibility; Approved AS
- **F266-18:** Section 3308.4 of the IFC - Fire Safety During Const; Approved AM DiGiovanni 2
- **G75-18:** Table 504.3; Approved AM by DiGiovanni 1
- **G 80-18:** Table 504.4; Approved AS
- **G84-18:** Table 506; Approved AS
- **G146-18:** Chapter 31 – Section 3102 – Special Construction; Approved AS
- **G152-18:** IBC Appendix D – Fire Districts; Approved AS
- **G89-18:** Sections 508.4 and 509.4 Fire Barriers; Approved AM DiGiovanni 1

2018/2019 ICC CODE DEVELOPMENT SCHEDULE

(February 10, 2017)

STEP IN CODE DEVELOPMENT CYCLE	DATE	
	2018 – Group A Codes **IBC- E, IBC - FS, IBC -G, IFC, IFGC, IMC, IPC, IPMC, IPSDC, IRC – M, IRC- P, ISPSC, IWUIC, IZC**	**2019 – Group B Codes** **Admin, IBC-S, IEBC, IECC-C, IECC-R/IRC-E, IgCC (Ch. 1), IRC – B**
2018 EDITION OF I-CODES PUBLISHED	Fall/2017 (except 2018 IgCC, see Group B Codes on page 2)	
DEADLINE FOR RECEIPT OF APPLICATIONS FOR ALL CODE COMMITTEES	June 1, 2017 for the 2018/2019 Cycle. Call for committee posted in February /2017.	
DEADLINE FOR cdpACCESS ONLINE RECEIPT OF CODE CHANGE PROPOSALS	January 8, 2018	January 7, 2019
WEB POSTING OF "PROPOSED CHANGES TO THE I-CODES"	February 28, 2018*	March 4, 2019*
COMMITTEE ACTION HEARING (CAH)	April 15 – 25, 2018 Greater Columbus Convention Center Columbus, OH	April 28 – May 8, 2019 Albuquerque Convention Center Albuquerque, NM
ONLINE CAH ASSEMBLY FLOOR MOTION VOTE	Starts approx. two weeks after last day of the CAH. Open for 2 weeks.	Starts approx. two weeks after last day of the CAH. Open for 2 weeks.
WEB POSTING OF "REPORT OF THE COMMITTEE ACTION HEARING"	May 30, 2018	June 11, 2019
DEADLINE FOR cdpACCESS ONLINE RECEIPT OF PUBLIC COMMENTS	July 16, 2018	July 24, 2019
WEB POSTING OF "PUBLIC COMMENT AGENDA"	August 31, 2018*	September 4, 2019*
PUBLIC COMMENT HEARING (PCH) ANNUAL CONFERENCE DATES NOTED BY AC	October 24 – 31, 2018 Greater Richmond Convention Center Richmond, VA AC: October 21 – 23	October 23 – 30, 2019 Clark County, NV AC: October 20 - 22
ONLINE GOVERNMENTAL CONSENUS VOTE (OGCV)	Starts approx. two weeks after last day of the PCH. Open for 2 weeks.	Starts approx. two weeks after last day of the PCH. Open for 2 weeks.
WEB POSTING OF FINAL ACTION	Following Validation Committee certification of OGCV and ICC Board confirmation.	Following Validation Committee certification of OGCV and ICC Board confirmation.

* Web posting of the "Proposed Changes to the I-Codes" and "Public Comment Agenda" will be posted no later than scheduled. ICC will make every effort to post these documents earlier, subject to code change/public comment volume and processing time.

2018 Group A Codes/Code committees:

- IBC-E: IBC Egress provisions. Chapters 10 and 11.
- IBC-FS: IBC Fire Safety provisions. Chapters 7, 8, 9 (partial), 14 and 26. Majority of IBC Chapter 9 is maintained by the IFC. See notes.
- IBC-G: IBC General provisions. Chapters 3 – 6, 12, 13, 27 – 33.
- IFC: The majority of IFC Chapter 10 is maintained by IBC-E. See notes.
- IFGC
- IMC
- IPC
- IPMC (code changes heard by the IPM/ZC (IPMC & IZC) code committee)
- IPSDC (code changes heard by the IPC code committee)
- IRC-M: IRC Mechanical provisions. Chapters 12 – 23 (code changes heard by the IRC - MP code committee)
- IRC-P: IRC Plumbing provisions. Chapters 25 – 33 (code changes heard by the IRC - MP code committee)
- ISPSC
- IWUIC (code changes heard by the IFC code committee)
- IZC (code changes heard by the IPM/ZC (IPMC & IZC) code committee)

2019 Group B Codes/Code committees:

- Admin: Chapter 1 of all the I-Codes except the IECC, IgCC and IRC. Also includes the update of currently referenced standards in all of the 2018 Codes, except the IgCC.
- IBC-S: IBC Structural provisions. IBC Chapters 15 – 25 and IEBC structural provisions. See notes.
- IEBC: IEBC Non-structural provisions. See notes.
- IECC-C: IECC Commercial energy provisions.
- IECC-R/IRC-E: IECC Residential energy provisions and IRC Energy provisions in Chapter 11.
- IgCC: Chapter 1 of the IgCC. Remainder of the code is based on the provisions of ASHRAE Standard 189.1 *Standard for the Design of High-Performance Green Buildings, Except Low-Rise Residential Buildings*. The 2018 IgCC is scheduled to be published in the Summer/2018.
- IRC-B: IRC Building provisions. Chapters 1 – 10.

A 2020 Group C cycle is not scheduled.

Notes:

- Be sure to review the document entitled “2018/2019 Code Committee Responsibilities” which will be posted. This identifies responsibilities which are different than Group A and B codes and committees which may impact the applicable code change cycle and resulting code change deadline. As an example, throughout Chapter 9 of the IBC (IBC- Fire Safety), there are numerous sections which include the designation “[F]” which indicates that the provisions of the section are maintained by the IFC code committee. Similarly, there are numerous sections in the IEBC which include the designation “[BS]”. These are structural provisions which will be heard by the IBC – Structural committee. The designations in the code are identified in the Code Committee Responsibilities document.
- I-Code Chapter 1: Proposed changes to the provisions in Chapter 1 of the majority of the I-Codes are heard in Group B (see Admin above for exceptions). Be sure to review the brackets ([ ]) of the applicable code.
- Definitions. Be sure to review the brackets ([ ]) in Chapter 2 of the applicable code and the Code Committee Responsibilities document to determine which code committee will consider proposed changes to the definitions.
- Proposed changes to the ICC Performance Code will be heard by the code committee noted in brackets ([ ]) in the section of the code and in the Code Committee Responsibilities document

G108-18

IBC: 202, 602.4, 602.4.1, 602.4.1.1 (New), 604.2.4.1.2(New), 602.4.1.2.1 (New), 602.4.1.3 (New), 602.4.1.4 (New), 602.4.1.5 (New), 602.4.1.6 (New), 602.4.2, 602.4.2.1 (New), 602.4.2.2 (New), 602.4.2.2.1 (New), 602.4.2.2.2 (New), 602.4.2.2.3 (New), 602.4.2.2.4 (New), 602.4.2.3 (New), 602.4.2.4 (New), 602.4.2.5 (New), 602.4.2.6 (New), 602.4.3, 602.4.3.1 (New), 602.4.3.2 (New), 602.4.3.3 (New), 602.4.3.4 (New), 602.4.3.5 (New), 602.4.3.6 (New), 602.4.4(New), , TABLE 601, TABLE 602

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

2018 International Building Code

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 timber wall that supports more than 200 pounds per linear foot (2919 N/m) of vertical load in addition to its own weight.

Add new definition 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.

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 602.4.1 or 602.4.2 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 or 703.3. 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 703.8 and comply with 722.7.

Cross-laminated timber shall be labeled as conforming to the heat performance requirements of Section 6.1.3.4 of DOC PS1 and have no delamination in any specimen, except where occurring at a localized characteristic when permitted in the product standard.

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, B, and C, construction with an occupied floor located more than 75 feet above the lowest level of fire department access, up to and including 12 stories or 180 feet 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 above grade plane, interior exit and elevator hoistway enclosures shall be constructed of non-combustible materials.

Add new text as follows:

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 or Section 703.3.

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 determined in Section 722.7.1(a). All 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/m^2, 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 E 84 or UL 723. The ASTM E 1354 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.

602.4.1.2 Interior protection. Interior faces of all mass timber elements, including the inside faces of exterior mass timber walls and mas timber roofs, shall be protected with materials complying with Section 703.5

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(a), but not less than 80 minutes. The use of materials and their respective protection contributions listed in Table 722.7.1(b) 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 one inch 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 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 Sections 602.4.1.2.

602.4.1.6 Shafts. Shafts shall be permitted in accordance with Sections 713 and Section 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 or Section 703.3.

602.4.2.1 Exterior protection. The outside face of exterior walls of mass timber construction shall be protected with non-combustible protection with a minimum assigned time of 40 minutes as determined in Section 722.7.1(a). All 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/m^2, 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 E 84 or UL 723. The ASTM E 1354 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.

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 703.5.

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(a), but not less than 80 minutes. The use of materials and their respective protection contributions listed in Table 722.7.1(b) shall be permitted to be used for compliance with Section 722.7.1.

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

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, including attached beams, shall be permitted and shall be limited to an area equal to 20% of the floor area in any dwelling unit or fire area; or
2. Unprotected portions of mass timber walls, including attached columns, shall be permitted and shall be limited to an area equal to 40% of the floor area in any dwelling unit or fire area; or
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.
4. Mass timber columns and beams which 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.

$(U_{tc}/U_{ac}) + (U_{tw}/U_{aw}) \leq 1$ (Equation 6-1) where:

U_{tc} = Total unprotected mass timber ceiling areas

U_{ac} = Allowable unprotected mass timber ceiling area conforming to Section 602.4.2.2.2, Exception 1

U_{tw} = Total unprotected mass timber wall areas

U_{aw} = Allowable unprotected mass timber wall area conforming to Section 602.4.2.2.2, Exception 2

602.4.2.2.4 Separation distance between unprotected mass timber elements. In each dwelling unit or fire area, unprotectedportions of mass timber walls and ceilings shall be not less than 15 feet 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 one inch 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 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 Section 713 and Section 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 or Section 703.3.

602.4.3.1 Exterior protection. The exterior side of walls of combustible construction shall be protected with non-

combustible protection with a minimum assigned time of 40 minutes as determined in Section 722.7.1(a). All 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/m^2, 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 E 84 or UL 723. The ASTM E 1354 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.

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 Roofs. 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 determined in Section 722.7.1(a).

602.4.3.6 Shafts. Shafts shall be permitted in accordance with Section 713 and Section 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 determined in Section 722.7.1(a), on both the inside of the shaft and the outside of the shaft.

602.4.4 Type IV-HT. Type IV construction (Heavy Timber, HT) 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. The minimum dimensions for permitted materials including solid timber, glued-laminated timber, structural composite lumber (SCL) and cross laminated timber (CLT) 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 one hour fire resistance rating or heavy timber conforming with Section 2304.11.2.2 shall be permitted.

Revise as follows:

~~**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* 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 exterior surface of the cross-laminated timber is 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; or
3. A noncombustible material.

~~**602.4.3**~~**602.4.4.3 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.

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	A	B	C	HT	A	B
Primary structural frame[f] (see Section 202)	3[a, b]	2[a, b]	1[b]	0	1[b]	0	3[a]	2[a]	2[a]	HT	1[b]	0
Bearing walls Exterior[e, f] Interior	3 3[a]	2 2[a]	1 1	0 0	2 1	2 0	3 3	2 2	2 2	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	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	2	2	2	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	1 $1^1/_2$	1	1	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 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.

c. 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. 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.

TABLE 602
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE[a, d, g]

FIRE SEPARATION DISTANCE =X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP H[e]	OCCUPANCYGROUP F-1, M, S-1[f]	OCCUPANCYGROUP A, B, E, F-2, I, R[i], S-2, U[h]
X < 5[b]	All	3	2	1
5 ≤ X < 10	IA, IVA Others	3 2	2 1	11
10 ≤ X < 30	IA, IB, IVA, IVB IIB, VB Others	2 1 1	1 0 1	1[c] 0 1[c]
X ≥ 30	All	0	0	0

For SI: 1 foot = 304.8 mm.

a. Load-bearing exterior walls shall also comply with the fire-resistance rating requirements of Table 601.

b. See Section 706.1.1 for party walls.

c. Open parking garages complying with Section 406 shall not be required to have a fire-resistance rating.

d. The fire-resistance rating of an exterior wall is determined based upon the fire separation distance of the exterior wall and the story in which the wall is located.

e. For special requirements for Group H occupancies, see Section 415.6.

f. For special requirements for Group S aircraft hangars, see Section 412.3.1.

g. Where Table 705.8 permits nonbearing exterior walls with unlimited area of unprotected openings, the required fire-resistance rating for the exterior walls is 0 hours.

h. For a building containing only a Group U occupancy private garage or carport, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet (1523 mm) or greater.

i. For a Group R-3 building of Type II-B or Type V-B construction, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet (1523 mm) or greater.

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:

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 yimber” 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 Cross-laminated 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 12/27/17.

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 12/27/17). 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.

IBC Code Section	Description
403.3.2	Water supply requirements for fire pumps in high rise buildings of Type IVA and IVB construction.
504.3	Allowable building height (feet) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT construction.
504.4	Allowable building height (stories) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
506.2	Allowable building area for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
602.4	Type of Construction requirements for new proposed types of construction: Types IVA, IVB and IVC. No changes to Type IV HT construction. Includes definitions for new terms: Mass timber and Noncombustible protection (mass timber). **THIS IS THE KEY CODE CHANGE PROPOSAL WHICH OUTLINES THE CONSTRUCTION REQUIREMENTS FOR THE PROPOSED NEW TYPE OF MASS TIMBER BUILDINGS. THE PROPOSAL ALSO ADDRESSES CONCEALED SPACES, ADHESIVE PERFORMANCE AND EXTERIOR WALL PROTECTION.**
703.8 (new)	The performance method to determine the increase to the fire resistance rating provided by noncombustible protection applied to the mass timber building element.
703.9 (new)	Requirements for sealants and adhesives to be placed at abutting edges and intersections of mass timber building elements. The reason statement references a Group B proposal to Chapter 17 for special inspection requirements of sealants and adhesives.
718.2.1	Requirements on the use of mass timber building elements used for Fireblocking.
722.7 (new)	Requirements for the fire resistance rating of mass timber elements, including minimum required protection and gypsum board attachment requirements.
3102	Requirements for membrane structures using Type IV HT construction.
3314.7 (new)	New special precautions during construction of buildings of Types IVA, IVB and IVC construction: Standpipes; Water supply for fire department connections; Noncombustible protection required for mass timber elements as construction height increases.
Appendix	Requirements for walls, floors and roofs of Type IV HT construction in buildings located in Fire Districts.
IFC Code Section	**Description**
701.6	Requirements which stipulate the owner's responsibility to maintain inventory of all required fire resistance rated construction in buildings of Types IVA and IVB construction. This includes an annual inspection and proper repair where necessary.
Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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

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

http://bit.ly/ATF-firetestvideos

Both of these links were confirmed active on 12/27/17.

Cost Impact
The code change proposal will not increase or decrease the cost of construction .

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

Analysis: The standards referenced in the changes in this proposal, DOC PS1, ASTM E1354, ASTM E84 and UL 723, are already referenced in the International Codes.

Internal ID: 852

FLOOR MODIFICATION

G108-18-DIGIOVANNI-1

Proponent of Floor Modification: Stephen DiGiovanni, representing ICC Ad Hoc Committee on Tall Wood Buildings (TWB)

2018 International Building Code

Modify proposal as follows:

602.4 Type IV. Ttimber (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 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 or 703.3. 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 703.8 and comply with 722.7.

Cross-laminated timber shall be labeled as conforming to PRG 320 - 18 as referenced in Section 2303.1.4. ~~the heat performance requirements of Section 6.1.3.4 of DOC PS1 and have no delamination in any specimen, except where occurring at a localized characteristic when permitted in the product standard.~~

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, B, and C, construction with an occupied floor located more than 75 feet above the lowest level of fire department access, up to and including 12 stories or 180 feet 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 above grade plane, interior exit and elevator hoistway enclosures shall be constructed of non-combustible materials.

Internal ID: 46

FLOOR MODIFICATION

G108-18-DIGIOVANNI-2

Proponent of Floor Modification: Stephen DiGiovanni, representing Ad Hoc Committee for Tall Wood Buildings

2018 International Building Code

Modify proposal as follows:

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 determined in Section 722.7.1~~(a)~~. All 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/m^2, 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 E 84 or UL 723. The ASTM E 1354 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.

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~~a~~), but not less than 80 minutes. The use of materials and their respective protection contributions listed in Table 722.7.1(2~~b~~) shall be permitted to be used for compliance with Section 722.7.1.

602.4.2.1 Exterior protection. The outside face of exterior walls of mass timber construction shall be protected with non-combustible protection with a minimum assigned time of 40 minutes as determined in Section 722.7.1~~(a)~~. All 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/m^2, 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 E 84 or UL 723. The ASTM E 1354 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.

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~~a~~), but not less than 80 minutes. The use of materials and their respective protection contributions listed in Table 722.7.1(2~~b~~) shall be permitted to be used for compliance with Section 722.7.1.

602.4.3.1 Exterior protection. The exterior side of walls of combustible construction shall be protected with non-combustible protection with a minimum assigned time of 40 minutes as determined in Section 722.7.1~~(a)~~. All 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/m^2, 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 E 84 or UL 723. The ASTM E 1354 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.

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 determined in Section 722.7.1~~(a)~~.

602.4.3.6 Shafts. Shafts shall be permitted in accordance with Section 713 and Section 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 determined in Section 722.7.1~~(a)~~, on both the inside of the shaft and the outside of the shaft.

Internal ID: 210

FS5-18
IBC: 703.8 (New)

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

THIS CODE CHANGE WILL BE HEARD BY THE IBC GENERAL COMMITTEE. SEE THE TENTATIVE HEARING ORDER FOR THIS COMMITTEE.

2018 International Building Code

Add new text as follows:

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 E 119 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.

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.

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 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 12/27/17.

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.

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 12/27/17). 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.

IBC Code Section	Description
403.3.2	Water supply requirements for fire pumps in high rise buildings of Type IVA and IVB construction.
504.3	Allowable building height (feet) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT construction.
504.4	Allowable building height (stories) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
506.2	Allowable building area for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
602.4	Type of Construction requirements for new proposed types of construction: Types IVA, IVB and IVC. No changes to Type IV HT construction. Includes definitions for new terms: Mass timber and Noncombustible protection (mass timber). **THIS IS THE KEY CODE CHANGE PROPOSAL WHICH OUTLINES THE CONSTRUCTION REQUIREMENTS FOR THE PROPOSED NEW TYPE OF MASS TIMBER BUILDINGS. THE PROPOSAL ALSO ADDRESSES CONCEALED SPACES, ADHESIVE PERFORMANCE AND EXTERIOR WALL PROTECTION.**
703.8 (new)	The performance method to determine the increase to the fire resistance rating provided by noncombustible protection applied to the mass timber building element.
703.9 (new)	Requirements for sealants and adhesives to be placed at abutting edges and intersections of mass timber building elements. The reason statement references a Group B proposal to Chapter 17 for special inspection requirements of sealants and adhesives.
718.2.1	Requirements on the use of mass timber building elements used for Fireblocking.
722.7 (new)	Requirements for the fire resistance rating of mass timber elements, including minimum required protection and gypsum board attachment requirements.
3102	Requirements for membrane structures using Type IV HT construction.
3314.7 (new)	New special precautions during construction of buildings of Types IVA, IVB and IVC construction: Standpipes; Water supply for fire department connections; Noncombustible protection required for mass timber elements as construction height increases.
Appendix	Requirements for walls, floors and roofs of Type IV HT construction in buildings located in Fire Districts.
IFC Code Section	**Description**
701.6	Requirements which stipulate the owner's responsibility to maintain inventory of all required fire resistance rated construction in buildings of Types IVA and IVB construction. This includes an annual inspection and proper repair where necessary.
Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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

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

http://bit.ly/ATF-firetestvideos

Both of these links were confirmed active on 12/27/17.

Cost Impact
The code change proposal will not increase or decrease the cost of construction .

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

Internal ID: 942

FS81-18

IBC: 722.7 (New), 722.7.1 (New), TABLE 722.7.1(1) (New), TABLE 722.7.1(2) (New), 722.7.2 (New), 722.7.2.1 (New), 722.7.2.2 (New)

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

THIS CODE CHANGE WILL BE HEARD BY THE IBC GENERAL COMMITTEE. SEE THE TENTATIVE HEARING ORDER FOR THIS COMMITTEE.

2018 International Building Code

Add new text as follows:

722.7 Fire resistance rating of mass timber. The required fire resistance of mass timber elements in Section 602.4 shall be determined in accordance with Section 703.2 or Section 703.3. The fire resistance rating of building elements shall be as required in Tables 601 and 602 and as specified elsewhere in this code. The fire resistance rating of the mass timber elements shall consist of the fire resistance of the unprotected element added to the protection time of the noncombustible protection.

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 703.8. The protection contributions indicated in Table 722.7.1(2) shall be deemed to comply with this requirement when 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 Tables 601 and 602 (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	30
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 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 with1 inch #6 Type S drywall screws to furring channels in accordance with ASTM C645.

2. Screws for attaching the base layer shall be 12 inches on center in both directions.

3. Screws for each layer after the base layer shall be 12 inches on center in both directions and offset from the screws of the previous layers by 4 inches in both directions.

4. All panel edges of any layer shall be offset 18 inches from those of the previous layer.

5. All panel edges shall be attached with screws sized and offset as in items 1 through 4 above and placed at least 1 inch but not more than 2 inches 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 1-1/4 inch 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 heavy timber walls determined in accordance with Table 722.7.1(1) shall be fastened 12 inches on center each way and 6 inches on center at all joints or ends. All panel edges shall be attached with fasteners located at least 1inch but not more than 2 inches from the panel edge. Fasteners shall comply with one of the following:

1. Galvanized nails of minimum 12 Gage with a 7/16 inch head of sufficient length to penetrate the mass timber a minimum of 1 inch.

2. Screws which comply with ASTM C1002 (Type S, Type W, or Type G) of sufficient length to penetrate the mass timber a minimum of 1 inch.

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.

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 12/27/17.

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.

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 12/27/17). 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.

IBC Code Section	Description
403.3.2	Water supply requirements for fire pumps in high rise buildings of Type IVA and IVB construction.
504.3	Allowable building height (feet) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT construction.
504.4	Allowable building height (stories) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
506.2	Allowable building area for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
602.4	Type of Construction requirements for new proposed types of construction: Types IVA, IVB and IVC. No changes to Type IV HT construction. Includes definitions for new terms: Mass timber and Noncombustible protection (mass timber). **THIS IS THE KEY CODE CHANGE PROPOSAL WHICH OUTLINES THE CONSTRUCTION REQUIREMENTS FOR THE PROPOSED NEW TYPE OF MASS TIMBER BUILDINGS. THE PROPOSAL ALSO ADDRESSES CONCEALED SPACES, ADHESIVE PERFORMANCE AND EXTERIOR WALL PROTECTION.**
703.8 (new)	The performance method to determine the increase to the fire resistance rating provided by noncombustible protection applied to the mass timber building element.
703.9 (new)	Requirements for sealants and adhesives to be placed at abutting edges and intersections of mass timber building elements. The reason statement references a Group B proposal to Chapter 17 for special inspection requirements of sealants and adhesives.
718.2.1	Requirements on the use of mass timber building elements used for Fireblocking.
722.7 (new)	Requirements for the fire resistance rating of mass timber elements, including minimum required protection and gypsum board attachment requirements.
3102	Requirements for membrane structures using Type IV HT construction.
3314.7 (new)	New special precautions during construction of buildings of Types IVA, IVB and IVC construction: Standpipes; Water supply for fire department connections; Noncombustible protection required for mass timber elements as construction height increases.
Appendix	Requirements for walls, floors and roofs of Type IV HT construction in buildings located in Fire Districts.
IFC Code Section	**Description**
701.6	Requirements which stipulate the owner's responsibility to maintain inventory of all required fire resistance rated construction in buildings of Types IVA and IVB construction. This includes an annual inspection and proper repair where necessary.
Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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

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

http://bit.ly/ATF-firetestvideos

Both of these links were confirmed active on 12/27/17.

Cost Impact
The code change proposal will not increase or decrease the cost of construction .

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

Analysis: The referenced standards, ASTM C645 and ASTM C1002, are currently referenced in 2018 I-codes.

Internal ID: 945

FLOOR MODIFICATION

FS81-18-DIGIOVANNI-1

Proponent of Floor Modification: Stephen DiGiovanni, representing ICC Ad Hoc Committee on Tall Wood Buildings (TWB)

2018 International Building Code

Modify proposal as follows:

TABLE 722.7.1(2)
PROTECTION PROVIDED BY NONCOMBUSTIBLE COVERING MATERIAL

Noncombustible Protection	Protection Contribution (minutes)
$^{1}/_{2}$ inch Type X Gypsum Board	~~30~~ 25
$^{5}/_{8}$ inch Type X Gypsum Board	40

Internal ID: 48

FS6-18
IBC: 703.9 (New), Chapter 35

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

THIS CODE CHANGE WILL BE HEARD BY THE IBC GENERAL COMMITTEE. SEE THE TENTATIVE HEARING ORDER FOR THIS COMMITTEE.

2018 International Building Code

Add new text as follows:

703.9 Sealing of adjacent mass timber elements. In buildings of Type IVA, IVB, and IVC 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: Where sealant or adhesive is not a required component of a fire resistance-rated assembly.

Add new standard(s) follows:

ASTM

ASTM International
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken PA 19428-2959
US

D3498-03(2011):

Standard Specification for Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems

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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.

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 12/27/17.

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 special inspections during construction are required to make sure it is clear that the appropriate sealant or adhesive is used and to establish inspections to verify for ongoing quality control. However, Chapter 17 is a Group B

topic. It will be taken up then. It is shown below for clarity and to emphasize the importance the TWB places on proper application of sealants and adhesives in mass timber construction.

1705.19 Sealing of Mass Timber. Periodic special inspections of sealants or adhesives shall be conducted where sealant or adhesive required by Section 703.9 is applied to mass timber building elements as designated in the approved construction documents.

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.

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 12/27/17). 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.

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506.2	Allowable building area for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
602.4	Type of Construction requirements for new proposed types of construction: Types IVA, IVB and IVC. No changes to Type IV HT construction. Includes definitions for new terms: Mass timber and Noncombustible protection (mass timber). **THIS IS THE KEY CODE CHANGE PROPOSAL WHICH OUTLINES THE CONSTRUCTION REQUIREMENTS FOR THE PROPOSED NEW TYPE OF MASS TIMBER BUILDINGS. THE PROPOSAL ALSO ADDRESSES CONCEALED SPACES, ADHESIVE PERFORMANCE AND EXTERIOR WALL PROTECTION.**
703.8 (new)	The performance method to determine the increase to the fire resistance rating provided by noncombustible protection applied to the mass timber building element.
703.9 (new)	Requirements for sealants and adhesives to be placed at abutting edges and intersections of mass timber building elements. The reason statement references a Group B proposal to Chapter 17 for special inspection requirements of sealants and adhesives.
718.2.1	Requirements on the use of mass timber building elements used for Fireblocking.
722.7 (new)	Requirements for the fire resistance rating of mass timber elements, including minimum required protection and gypsum board attachment requirements.
3102	Requirements for membrane structures using Type IV HT construction.
3314.7 (new)	New special precautions during construction of buildings of Types IVA, IVB and IVC construction: Standpipes; Water supply for fire department connections; Noncombustible protection required for mass timber elements as construction height increases.
Appendix	Requirements for walls, floors and roofs of Type IV HT construction in buildings located in Fire Districts.
IFC Code Section	**Description**
701.6	Requirements which stipulate the owner's responsibility to maintain inventory of all required fire resistance rated construction in buildings of Types IVA and IVB construction. This includes an annual inspection and proper repair where necessary.
Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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.

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Both of these links were confirmed active on 12/27/17.

Cost Impact
The code change proposal will not increase or decrease the cost of construction .

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

Analysis: A review of the standard proposed for inclusion in the code, ASTM D3498-03(2011), with regard to the ICC criteria for referenced standards (Section 3.6 of CP#28) will be posted on the ICC website on or before April 2, 2018.

Internal ID: 943

FLOOR MODIFICATION

FS6-18-DIGIOVANNI-1

Proponent of Floor Modification: Stephen DiGiovanni, representing ICC Ad Hoc Committee on Tall Wood Buildings (TWB)

2018 International Building Code

Modify proposal as follows:

703.9 Sealing of adjacent mass timber elements. In buildings of Type IVA, IVB, and IVC 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: Where sealant or adhesive is not a required component of a fire resistance-rated assembly.

1705.19 Sealing of Mass Timber. Periodic special inspections of sealants or adhesives shall be conducted where sealant or adhesive required by Section 703.9 is applied to mass timber building elements as designated in the approved construction documents.

Internal ID: 49

FS73-18
IBC: 718.2.1

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

THIS CODE CHANGE WILL BE HEARD BY THE IBC GENERAL COMMITTEE. SEE THE TENTATIVE HEARING ORDER FOR THIS COMMITTEE.

2018 International Building Code

Revise as follows:

718.2.1 Fireblocking materials. *Fireblocking* shall consist of the following materials:

1. Two-inch (51 mm) nominal lumber.
2. Two thicknesses of 1-inch (25 mm) nominal lumber with broken lap joints.
3. One thickness of 0.719-inch (18.3 mm) wood structural panels with joints backed by 0.719-inch (18.3 mm) wood structural panels.
4. One thickness of 0.75-inch (19.1 mm) particleboard with joints backed by 0.75-inch (19 mm) particleboard.
5. One-half-inch (12.7 mm) gypsum board.
6. One-fourth-inch (6.4 mm) cement-based millboard.
7. Batts or blankets of mineral wool, mineral fiber or other *approved* materials installed in such a manner as to be securely retained in place.
8. Cellulose insulation installed as tested for the specific application.
9. Mass timber complying with Section 2304.11.

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 purpose of this code change proposal is to recognize that mass timber as a suitable fireblocking material. The current list of acceptable materials lists “nominal lumber”, therefore since mass timber (e.g. Sawn, glued-laminated, and cross laminated timbers) are of greater mass the correlation from single nominal lumber to mass timber was determined to be of equal or greater blocking resistance to reduce the ability of fire, smoke and gasses from moving to different part of the building through combustible concealed spaces.

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 12/27/17). 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.

IBC Code Section	Description
403.3.2	Water supply requirements for fire pumps in high rise buildings of Type IVA and IVB construction.
504.3	Allowable building height (feet) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT construction.
504.4	Allowable building height (stories) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
506.2	Allowable building area for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
602.4	Type of Construction requirements for new proposed types of construction: Types IVA, IVB and IVC. No changes to Type IV HT construction. Includes definitions for new terms: Mass timber and Noncombustible protection (mass timber). **THIS IS THE KEY CODE CHANGE PROPOSAL WHICH OUTLINES THE CONSTRUCTION REQUIREMENTS FOR THE PROPOSED NEW TYPE OF MASS TIMBER BUILDINGS. THE PROPOSAL ALSO ADDRESSES CONCEALED SPACES, ADHESIVE PERFORMANCE AND EXTERIOR WALL PROTECTION.**
703.8 (new)	The performance method to determine the increase to the fire resistance rating provided by noncombustible protection applied to the mass timber building element.
703.9 (new)	Requirements for sealants and adhesives to be placed at abutting edges and intersections of mass timber building elements. The reason statement references a Group B proposal to Chapter 17 for special inspection requirements of sealants and adhesives.
718.2.1	Requirements on the use of mass timber building elements used for Fireblocking.
722.7 (new)	Requirements for the fire resistance rating of mass timber elements, including minimum required protection and gypsum board attachment requirements.
3102	Requirements for membrane structures using Type IV HT construction.
Appendix	Requirements for walls, floors and roofs of Type IV HT construction in buildings located in Fire Districts.
IFC Code Section	**Description**
701.6	Requirements which stipulate the owner's responsibility to maintain inventory of all required fire resistance rated construction in buildings of Types IVA and IVB construction. This includes an annual inspection and proper repair where necessary.
3308.4 (new)	New special precautions during construction of buildings of Types IVA, IVB and IVC construction: Standpipes; Water supply for fire department connections; Noncombustible protection required for mass timber elements as construction height increases.
Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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

To watch summary videos of the fire tests, please visit http://bit.ly/ATF-firetestvideos

Both of these links were confirmed active on 12/27/17.

Cost Impact

The code change proposal will not increase or decrease the cost of construction .

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

Internal ID: 944

G28-18

IBC: [F] 403.3.2; IFC: 914.3.1.2

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

THIS CODE CHANGE PROPOSAL WILL BE HEARD BY THE IFC COMMITTEE. PLEASE CONSULT THE AGENDA FOR THE IFC COMMITTEE.

2018 International Building Code

Revise as follows:

[F] 403.3.2 Water supply to required fire pumps. In all buildings that are more than 420 feet (128 m) in *building height*, and buildings of Type IVA and IVB construction that are more than 120 feet in building height, required fire pumps shall be supplied by connections to not 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 that the main is valved such that an interruption can be isolated so that the water supply will continue without interruption through not fewer than one of the connections.

2018 International Fire Code

914.3.1.2 Water supply to required fire pumps. In all buildings that are more than 420 feet (128 m) in building height, and buildings of Type IVA and IVB construction that are more than 120 feet in building height, required fire pumps shall be supplied by connections to not 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 that the main is valved such that an interruption can be isolated so that the water supply will continue without interruption through not fewer than one of the connections.

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 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 has proposed greater permitted heights and areas of mass timber construction than those contained in the 2018 IBC. The Ad Hoc believes this code change proposal is an important component to these proposed increased heights and areas. If the permitted heights and areas of mass timber construction are raised it is imperative we adopt related code change proposals to insure the reliable performance of active and passive protection features to insure the safety of occupants and responding fire fighters.

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 12/27/17). 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.

IBC Code Section	Description
403.3.2	Water supply requirements for fire pumps in high rise buildings of Type IVA and IVB construction.
504.3	Allowable building height (feet) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT construction.
504.4	Allowable building height (stories) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
506.2	Allowable building area for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
602.4	Type of Construction requirements for new proposed types of construction: Types IVA, IVB and IVC. No changes to Type IV HT construction. Includes definitions for new terms: Mass timber and Noncombustible protection (mass timber). **THIS IS THE KEY CODE CHANGE PROPOSAL WHICH OUTLINES THE CONSTRUCTION REQUIREMENTS FOR THE PROPOSED NEW TYPE OF MASS TIMBER BUILDINGS. THE PROPOSAL ALSO ADDRESSES CONCEALED SPACES, ADHESIVE PERFORMANCE AND EXTERIOR WALL PROTECTION.**
703.8 (new)	The performance method to determine the increase to the fire resistance rating provided by noncombustible protection applied to the mass timber building element.
703.9 (new)	Requirements for sealants and adhesives to be placed at abutting edges and intersections of mass timber building elements. The reason statement references a Group B proposal to Chapter 17 for special inspection requirements of sealants and adhesives.
718.2.1	Requirements on the use of mass timber building elements used for Fireblocking.
722.7 (new)	Requirements for the fire resistance rating of mass timber elements, including minimum required protection and gypsum board attachment requirements.
3102	Requirements for membrane structures using Type IV HT construction.
3314.7 (new)	New special precautions during construction of buildings of Types IVA, IVB and IVC construction: Standpipes; Water supply for fire department connections; Noncombustible protection required for mass timber elements as construction height increases.
Appendix	Requirements for walls, floors and roofs of Type IV HT construction in buildings located in Fire Districts.
IFC Code Section	**Description**
701.6	Requirements which stipulate the owner's responsibility to maintain inventory of all required fire resistance rated construction in buildings of Types IVA and IVB construction. This includes an annual inspection and proper repair where necessary.
Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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:

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Both of these links were confirmed active on 12/27/17.

Cost Impact
The code change proposal will not increase or decrease the cost of construction .

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

Internal ID: 959

F88-18
IFC: 701.6

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

2018 International Fire Code

Revise as follows:

701.6 Owner's responsibility. The owner shall maintain an inventory of all required *fire-resistance-rated* construction, construction installed to resist the passage of smoke and the construction included in Sections 703 through 707 and Sections 602.4.1 and 602.4.2 of the International Building Code. Such construction shall be visually inspected by the *owner* annually and properly repaired, restored or replaced where damaged, altered, breached or penetrated. Records of inspections and repairs shall be maintained. Where concealed, such elements shall not be required to be visually inspected by the *owner* unless the concealed space is accessible by the removal or movement of a panel, access door, ceiling tile or similar movable entry to the space.

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 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. One of the basic requirements incorporated into these proposed increased heights and areas is the added active and passive protection features to these structures.

Specific to this code change proposal, in the related code change proposals for Type IV-A and Type IV-B, mass timber walls and ceilings, except where permitted, will be required to meet a fire-resistance performance with a specified amount provided with gypsum board or its equivalent.

The greater permitted heights and areas are being proposed based on the requirement of this added level of passive protection. It would seem obvious that we should incorporate a methodology to insure this passive protection remains in place.

This is not an undue burden to the building owner or management. Section 701.6 of the International Fire Code permits these inspections to be done by current building staff. Local jurisdictions may or may not require the annual inspection to be reported. The managing authority simply must keep a record of such inspections and take steps to correct any deficiencies identified.

Some have suggested that we do not require other types of construction to inspect the gypsum board annually to insure it has not been compromised. Other forms of construction do not contribute to the fuel load in the manner mass timber construction potentially will do. If we are going to permit mass timber construction to greater heights than previously permitted it means we are relying on the performance of active and passive protection to protect the occupants of the building in the event of a fire. We currently require the active protection to be inspected for performance it is time we require the same for the passive.

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 12/27/17). 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.

IBC Code Section	Description
403.3.2	Water supply requirements for fire pumps in high rise buildings of Type IVA and IVB construction.
504.3	Allowable building height (feet) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT construction.
504.4	Allowable building height (stories) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
506.2	Allowable building area for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
602.4	Type of Construction requirements for new proposed types of construction: Types IVA, IVB and IVC. No changes to Type IV HT construction. Includes definitions for new terms: Mass timber and Noncombustible protection (mass timber). **THIS IS THE KEY CODE CHANGE PROPOSAL WHICH OUTLINES THE CONSTRUCTION REQUIREMENTS FOR THE PROPOSED NEW TYPE OF MASS TIMBER BUILDINGS. THE PROPOSAL ALSO ADDRESSES CONCEALED SPACES, ADHESIVE PERFORMANCE AND EXTERIOR WALL PROTECTION.**
703.8 (new)	The performance method to determine the increase to the fire resistance rating provided by noncombustible protection applied to the mass timber building element.
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3102	Requirements for membrane structures using Type IV HT construction.
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IFC Code Section	**Description**
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Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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.

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Cost Impact
The code change proposal will not increase or decrease the cost of construction .

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

Internal ID: 962

F266-18

IFC: 3308.4 (New)

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

2018 International Fire Code

3308.4 Fire safety requirements for buildings of Types IV-A, IV-B, and IV-C construction. Buildings of Types IV-A, IV-B, and IV-C construction designed to be greater than six stories above grade plane shall comply with the following requirements during construction unless otherwise approved by the fire code official.

1. Standpipes shall be provided in accordance with Section 3313.
2. A water supply for fire department operations, as approved by the fire chief.
3. Where building construction exceeds six stories above grade plane, at least one layer of noncombustible protection where required by Section 602.4 of the International Building Code shall be installed on all building elements more than 4 floor levels, including mezzanines, below active mass timber construction before erecting additional floor levels.
4. Where building construction exceeds six stories above grade plane required exterior wall coverings shall be installed on all floor levels more than 4 floor levels, including mezzanines, below active mass timber construction before erecting additional floor level.

   Exception: Shafts and vertical exit enclosures.

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 has developed a number of proposals to potentially increase the permitted height and area for Type IV structures, specifically mass timber buildings adding additional Types IV-A, IV-B & IV-C. 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 goal of this proposal is to provide guidance and requirements for when this combustible building is most vulnerable, while under construction prior to fire protection systems have been installed.

Over the recent years we have experienced a number of fires while combustible buildings have been under construction. It is understood the vast majority of these fires did occur in structures of light-frame structural wood members which present a significant fire hazard when exposed. Even with this fact we cannot simply ignore the potential risk of fire in combustible construction simply due to the size of the timber element and the potentially longer period of time for ignition as the potentially fuel load of a mass timber building can be substantial.

The TWB had a great deal of discussion regarding the proposed requirements regarding water supply to the buildings of combustible construction sites. On one hand, there was a desire to establish a minimum water flow of 250 gpm with a minimum pressure. But the counter discussion identified that these combustible building construction sites may have various degrees of hazards on the site and was not restrictive to just the structure. Mass timber construction typically proceeds with little stored combustible material on the site, mass timber is generally installed as it arrives. Thus, there may be more or fewer site hazards than on a typical construction site utilizing combustible materials. Moreover, protection of the installed material must occur before the project moves above certain specified numbers of levels. This is very different from conventional construction processes.

With this understanding, the TWB is proposing project developers meet and confer with the local fire service to establish the fire department’s response needs, in terms of water flow and pressure, for the specific building, while under construction, and job site.

While sub-sections 1 and 2 apply to the delivery of water to the job site, and/or structure, sub-sections 3 and 4 are specific to the passive protection related to the structure. Due to the proposed increased heights and areas, the TWB felt it was important to require interior and exterior passive protection as the construction progressed. This would insure the lower portions of the combustible structure had redundant, active and passive, protection as greater heights were added.

Two figures are shown below to illustrate the requirements of sub-sections 3 and 4 of this proposal. Since both buildings will exceed six-stories, protection must be provided during construction. The solid thick lines indicate building

elements that are required to be protected. Solid thin lines indicate elements that are in-place, but are not required to be protected and dashed lines indicate elements that have not yet been placed. Figure 1 is shown to illustrate when protection is first required on a building under construction. When level 6 is the active level of mass timber construction, protection of the building elements and the exterior wall coverings are required before level 7 panels can be placed. In Figure 2, the progress of protection on each successive level is indicated as construction continues. In this example, level 14 is the active level of mass timber construction, so prior to placement of floor panels at level 15, protection is required on level 9.

New paragraph for the reason statement: Two figures are shown below to illustrate the requirements of sub-sections 3 and 4 of this proposal. Since both buildings will exceed six-stories, protection must be provided during construction. The solid thick lines indicate building elements that are required to be protected. Solid lines indicate elements that are in-place, but are not required to be protected and dashed lines indicate elements that have not yet been place. Figure 1 is shown to indicate when protection is first required to be provided on a building under construction. When level 6 is the active level, protection of the building elements and the exterior wall coverings are required before level 7 panels can be placed. In Figure 2, the progress of protection on each successive level is indicated as construction continues. In this example, level 14 is the active level, so prior to placement of floor panels at level 15, protection is required on level 9.

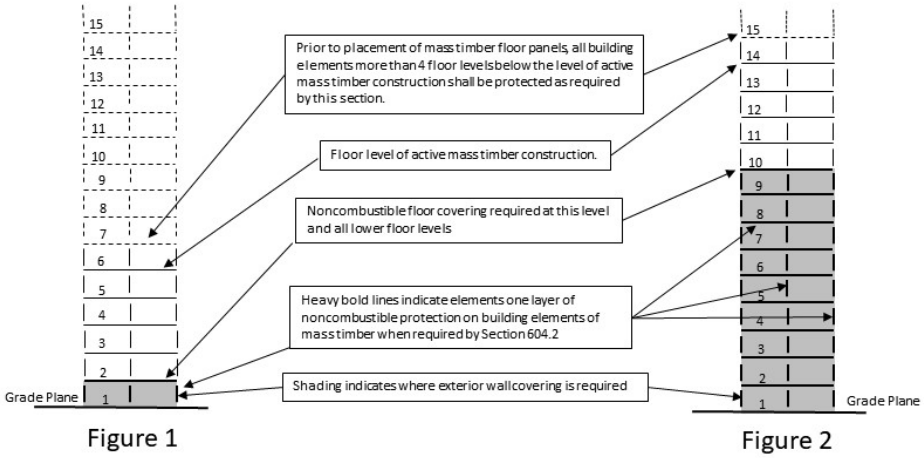

Figure 1 Figure 2

Examples of Protection During Construction For Mass Timber Buildings Greater Than 6 Stories Above Grade Plane

The TWB strongly feels these code change proposals should be adopted as a whole package. By adopting a few of the code change proposals without the complete package potentially ignores the details required to insure these proposed projects are designed, built and maintained properly now and in the future. **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 12/27/17). 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.

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508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
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IFC Code Section	**Description**
701.6	Requirements which stipulate the owner's responsibility to maintain inventory of all required fire resistance rated construction in buildings of Types IVA and IVB construction. This includes an annual inspection and proper repair where necessary.
Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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

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

http://bit.ly/ATF-firetestvideos

Both of these links were confirmed active on 12/27/17.

Cost Impact
The code change proposal will not increase or decrease the cost of construction .

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

Internal ID: 963

FLOOR MODIFICATION

F266-18-DIGIOVANNI-2

Proponent of Floor Modification: Stephen DiGiovanni, representing Ad Hoc Committee for Tall Wood Buildings

2018 International Fire Code

Modify proposal as follows:

3308.4 Fire safety requirements for buildings of Types IV-A, IV-B, and IV-C construction. Buildings of Types IV-A, IV-B, and IV-C construction designed to be greater than six stories above grade plane shall comply with the following requirements during construction unless otherwise approved by the fire code official.

1. Standpipes shall be provided in accordance with Section 3313.
2. A water supply for fire department operations, as approved by the fire chief.
3. Where building construction exceeds six stories above grade plane, at least one layer of noncombustible protection where required by Section 602.4 of the International Building Code shall be installed on all building elements more than 4 floor levels, including mezzanines, below active mass timber construction before erecting additional floor levels.
   Exception: Shafts and vertical exit enclosures shall not be considered a part of the active mass timber construction.
4. Where building construction exceeds six stories above grade plane required exterior wall coverings shall be installed on all floor levels more than 4 floor levels, including mezzanines, below active mass timber construction before erecting additional floor level.
   Exception: Shafts and vertical exit enclosures shall not be considered a part of the active mass timber construction.

Internal ID: 551

G75-18
IBC: TABLE 504.3

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

2018 International Building Code

Revise as follows:

TABLE 504.3
ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANEa

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION											TYPE OF CONSTRUCTION	TYPE OF CONSTRUCTION
	SEE FOOTNOTES	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
		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	120	90	65	65	50	40
	S												
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-1 Condition 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-1 Condition 2, I-2	NS[d, e, f]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85									
I-4	NS[d, g]	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
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

For SI: 1 foot = 304.8 mm.

UL = Unlimited; NS = Buildings not equipped throughout with an automatic sprinkler system; S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2; S13D = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.3.

a. See Chapters 4 and 5 for specific exceptions to the allowable height in this chapter.

b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.

c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.

d. The NS value is only for use in evaluation of existing building height in accordance with the International Existing Building Code.

e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies Condition 1, see Exception 1 of Section 903.2.6.

f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and Section 1103.5 of the *International Fire Code*.

g. For new Group I-4 occupancies, see Exceptions 2 and 3 of Section 903.2.6.

h. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8.

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:

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. 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

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 12/27/17

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:

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;

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;

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, I-4, M, R, S, U, the methodology described above accurately reflects how the height proposals were developed.

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, I-4, 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, I-4, 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-I(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/ (link active and up to date as of 12/27/17). 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.

IBC Code Section	Description
403.3.2	Water supply requirements for fire pumps in high rise buildings of Type IVA and IVB construction.
504.3	Allowable building height (feet) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT construction.
504.4	Allowable building height (stories) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
506.2	Allowable building area for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
602.4	Type of Construction requirements for new proposed types of construction: Types IVA, IVB and IVC. No changes to Type IV HT construction. Includes definitions for new terms: Mass timber and Noncombustible protection (mass timber). **THIS IS THE KEY CODE CHANGE PROPOSAL WHICH OUTLINES THE CONSTRUCTION REQUIREMENTS FOR THE PROPOSED NEW TYPE OF MASS TIMBER BUILDINGS. THE PROPOSAL ALSO ADDRESSES CONCEALED SPACES, ADHESIVE PERFORMANCE AND EXTERIOR WALL PROTECTION.**
703.8 (new)	The performance method to determine the increase to the fire resistance rating provided by noncombustible protection applied to the mass timber building element.
703.9 (new)	Requirements for sealants and adhesives to be placed at abutting edges and intersections of mass timber building elements. The reason statement references a Group B proposal to Chapter 17 for special inspection requirements of sealants and adhesives.
718.2.1	Requirements on the use of mass timber building elements used for Fireblocking.
722.7 (new)	Requirements for the fire resistance rating of mass timber elements, including minimum required protection and gypsum board attachment requirements.
3102	Requirements for membrane structures using Type IV HT construction.
3314.7 (new)	New special precautions during construction of buildings of Types IVA, IVB and IVC construction: Standpipes; Water supply for fire department connections; Noncombustible protection required for mass timber elements as construction height increases.
Appendix	Requirements for walls, floors and roofs of Type IV HT construction in buildings located in Fire Districts.
IFC Code Section	**Description**
701.6	Requirements which stipulate the owner's responsibility to maintain inventory of all required fire resistance rated construction in buildings of Types IVA and IVB construction. This includes an annual inspection and proper repair where necessary.
Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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

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

http://bit.ly/ATF-firetestvideos

Both of these links were confirmed active on 12/27/17.

Cost Impact
The code change proposal will not increase or decrease the cost of construction .

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

Internal ID: 844

FLOOR MODIFICATION

G75-18-DIGIOVANNI-1

Proponent of Floor Modification: Stephen DiGiovanni, representing ICC Ad Hoc Committee on Tall Wood Buildings (TWB)

2018 International Building Code

Modify proposal as follows:

TABLE 504.3
ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANEa

Portions of table not shown remain unchanged.

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION											TYPE OF CONSTRUCTION	TYPE OF CONSTRUCTION
	SEE FOOTNOTES	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
		A	B	A	B	A	B	A	B	C	HT	A	B
I-4	NS[d, g]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	~~270~~ 180	~~180~~ 120	85	85	70	60

For SI: 1 foot = 304.8 mm.

UL = Unlimited; NS = Buildings not equipped throughout with an automatic sprinkler system; S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2; S13D = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.3.

a. See Chapters 4 and 5 for specific exceptions to the allowable height in this chapter.
b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.
c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.
d. The NS value is only for use in evaluation of existing building height in accordance with the International Existing Building Code.
e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies Condition 1, see Exception 1 of Section 903.2.6.
f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and Section 1103.5 of the *International Fire Code*.
g. For new Group I-4 occupancies, see Exceptions 2 and 3 of Section 903.2.6.
h. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8.

Internal ID: 50

G80-18

IBC: TABLE 504.4

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

2018 International Building Code

Revise as follows:

TABLE 504.4
ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANEa, b

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION										TYPE OF CONSTRUCTION	TYPE OF CONSTRUCTION	TYPE OF CONSTRUCTIO
	SEE FOOTNOTES	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE IV	TYPE IV	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		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	NS[c, d]	1	1	1	1	1	1	NP	NP	NP	1	1	NP
	S							1	1	1			
H-2	NS[c, d]	UL	3	2	1	2	1	1	1	1	2	1	1
	S							2	2	2			
H-3	NS[c, d]	UL	6	4	2	4	2	3	3	3	4	2	1
	S							4	4	4			
H-4	NS[c, 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	NS[c, d]	4	4	3	3	3	3	2	2	2	3	3	2
	S							3	3	3			
I-1 Condition 1	NS[d, 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 Condition 2	NS[d, e]	UL	9	4	3	4	3	3	3	3	4	3	2
	S	UL	10	5				10	6	4			
I-2	NS[d, f]	UL	4	2	1	1	NP	NP	NP	NP	1	1	NP
	S	UL	5	3				7	5	1			
I-3	NS[d, 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	NS[d, 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	UL	12	5	3	5	3	12	8	6	5	4	2
R-1 [h]	NS[d]	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4									4	3
	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	5	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	4	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

~~UL~~ TUL = Unlimited; NP = Not Permitted; NS = Buildings not equipped throughout with an automatic sprinkler system; S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2; S13D = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.3.

a. See Chapters 4 and 5 for specific exceptions to the allowable height in this chapter.

b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.

c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.

d. The NS value is only for use in evaluation of existing building height in accordance with the International Existing Building Code.

e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies, Condition 1, see Exception 1 of Section 903.2.6.

f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and 1103.5 of the International Fire Code.

g. For new Group I-4 occupancies, see Exceptions 2 and 3 of Section 903.2.6.

h. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8.

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:

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.

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

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 12/27/17.

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 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.

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-on-tall-wood-buildings/ (link active and up to date as of 12/27/17). 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

IBC Code Section	**Description**
403.3.2	Water supply requirements for fire pumps in high rise buildings of Type IVA and IVB construction.
504.3	Allowable building height (feet) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT construction.
504.4	Allowable building height (stories) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
506.2	Allowable building area for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
602.4	Type of Construction requirements for new proposed types of construction: Types IVA, IVB and IVC. No changes to Type IV HT construction. Includes definitions for new terms: Mass timber and Noncombustible protection (mass timber). **THIS IS THE KEY CODE CHANGE PROPOSAL WHICH OUTLINES THE CONSTRUCTION REQUIREMENTS FOR THE PROPOSED NEW TYPE OF MASS TIMBER BUILDINGS. THE PROPOSAL ALSO ADDRESSES CONCEALED SPACES, ADHESIVE PERFORMANCE AND EXTERIOR WALL PROTECTION.**
703.8 (new)	The performance method to determine the increase to the fire resistance rating provided by noncombustible protection applied to the mass timber building element.
703.9 (new)	Requirements for sealants and adhesives to be placed at abutting edges and intersections of mass timber building elements. The reason statement references a Group B proposal to Chapter 17 for special inspection requirements of sealants and adhesives.
718.2.1	Requirements on the use of mass timber building elements used for Fireblocking.
722.7 (new)	Requirements for the fire resistance rating of mass timber elements, including minimum required protection and gypsum board attachment requirements.
3102	Requirements for membrane structures using Type IV HT construction.
3314.7 (new)	New special precautions during construction of buildings of Types IVA, IVB and IVC construction: Standpipes; Water supply for fire department connections; Noncombustible protection required for mass timber elements as construction height increases.
Appendix	Requirements for walls, floors and roofs of Type IV HT construction in buildings located in Fire Districts.
IFC Code Section	**Description**
701.6	Requirements which stipulate the owner's responsibility to maintain inventory of all required fire resistance rated construction in buildings of Types IVA and IVB construction. This includes an annual inspection and proper repair where necessary.
Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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

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

http://bit.ly/ATF-firetestvideos

Both of these links were confirmed active on 12/27/17.

Cost Impact
The code change proposal will not increase or decrease the cost of construction .

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

Internal ID: 846

G84-18

IBC: TABLE 506.2

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

2018 International Building Code

Revise as follows:

TABLE 506.2
ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, S13D or SM, as applicable) IN SQUARE FEET [a, b]

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION									TYPE OF CONSTRUCTION	TYPE OF CONSTRUCTION	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	UL	15,500	8,500	14,000	8,500	45,000	30,000	18,750	15,000	11,500	5,500
	S1	UL	UL	62,000	34,000	56,000	34,000	180,000	120,000	75,000	60,000	46,000	22,000
	SM	UL	UL	46,500	25,500	42,000	25,500	135,000	90,000	56,250	45,000	34,500	16,500
A-2	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-3	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-4	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-5	NS	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S1												
	SM												
B	NS	UL	UL	37,500	23,000	28,500	19,000	108,000	72,000	45,000	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	114,000	76,000	432,000	288,000	180,000	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	85,500	57,000	324,000	216,000	135,000	108,000	54,000	27,000
E	NS	UL	UL	26,500	14,500	23,500	14,500	76,500	51,000	31,875	25,500	18,500	9,500
	S1	UL	UL	106,000	58,000	94,000	58,000	306,000	204,000	127,500	102,000	74,000	38,000
	SM	UL	UL	79,500	43,500	70,500	43,500	229,500	153,000	95,625	76,500	55,500	28,500
F-1	NS	UL	UL	25,000	15,500	19,000	12,000	100,500	67,000	41,875	33,500	14,000	8,500
	S1	UL	UL	100,000	62,000	76,000	48,000	402,000	268,000	167,500	134,000	56,000	34,000
	SM	UL	UL	75,000	46,500	57,000	36,000	301,500	201,000	125,625	100,500	42,000	25,500
F-2	NS	UL	UL	37,500	23,000	28,500	18,000	151,500	101,000	63,125	50,500	21,000	13,000
	S1	UL	UL	150,000	92,000	114,000	72,000	606,000	404,000	252,500	202,000	84,000	52,000
	SM	UL	UL	112,500	69,000	85,500	54,000	454,500	303,000	189,375	151,500	63,000	39,000
H-1	NS[c]	21,000	16,500	11,000	7,000	9,500	7,000	10,500	10,500	10,500	10,500	7,500	NP
	S1												
H-2	NS[c]	21,000	16,500	11,000	7,000	9,500	7,000	10,500	10,500	10,500	10,500	7,500	3,000
	S1												
	SM												
H-3	NS[c]	UL	60,000	26,500	14,000	17,500	13,000	25,500	25,500	25,500	25,500	10,000	5,000
	S1												
	SM												
H-4	NS[c, d]	UL	UL	37,500	17,500	28,500	17,500	72,000	54,000	40,500	36,000	18,000	6,500
	S1	UL	UL	150,000	70,000	114,000	70,000	288,000	216,000	162,000	144,000	72,000	26,000
	SM	UL	UL	112,500	52,500	85,500	52,500	216,000	162,000	121,500	108,000	54,000	19,500
H-5	NS[c, d]	UL	UL	37,500	23,000	28,500	19,000	72,000	54,000	40,500	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	114,000	76,000	288,000	216,000	162,000	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	85,500	57,000	216,000	162,000	121,500	108000	54,000	27,000
I-1	NS[d, e]	UL	55,000	19,000	10,000	16,500	10,000	54,000	36,000	18,000	18,000	10,500	4,500
	S1	UL	220,000	76,000	40,000	66,000	40,000	216,000	144,000	72,000	72,000	42,000	18,000
	SM	UL	165,000	57,000	30,000	49,500	30,000	162,000	108,000	54,000	54,000	31,500	13,500
I-2	NS[d, f]	UL	UL	15,000	11,000	12,000	NP	36,000	24,000	12,000	12,000	9,500	NP
	S1	UL	UL	60,000	44,000	48,000	NP	144,000	96,000	48,000	48,000	38,000	NP
	SM	UL	UL	45,000	33,000	36,000	NP	108,000	72,000	36,000	36,000	28,500	NP
I-3	NS[d, e]	UL	UL	15,000	10,000	10,500	7,500	36,000	24,000	12,000	12,000	7,500	5,000
	S1	UL	UL	45,000	40,000	42,000	30,000	144,000	96,000	48,000	48,000	30,000	20,000
	SM	UL	UL	45,000	30,000	31,500	22,500	108,000	72,000	36,000	36,000	22,500	15,000
I-4	NS[d, g]	UL	60,500	26,500	13,000	23,500	13,000	76,500	51,000	25,500	25,500	18,500	9,000
	S1	UL	121,000	106,000	52,000	94,000	52,000	306,000	204,000	102,000	102,000	74,000	36,000
	SM	UL	181,500	79,500	39,000	70,500	39,000	229,500	153,000	76,500	76,500	55,500	27,000
M	NS	UL	UL	21,500	12,500	18,500	12,500	61,500	41,000	25,625	20,500	14,000	9,000
	S1	UL	UL	86,000	50,000	74,000	50,000	246,000	164,000	102,500	82,000	56,000	36,000
	SM	UL	UL	64,500	37,500	55,500	37,500	184,500	123,000	76,875	61,500	42,000	27,000
R-1[h]	NS[d]	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000
	S13R												
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000
R-2[h]	NS[d]	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000
	S13R												
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000
R-3[h]	NS[d]	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S13D												
	S13R												
	S1												
	SM												
R-4[h]	NS[d]	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000
	S13D												
	S13R												
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000
S-1	NS	UL	48,000	26,000	17,500	26,000	17,500	76,500	51,000	31,875	25,500	14,000	9,000
	S1	UL	192,000	104,000	70,000	104,000	70,000	306,000	204,000	127,500	102,000	56,000	36,000
	SM	UL	144,000	78,000	52,500	78,000	52,500	229,500	153,000	95,625	76,500	42,000	27,000
S-2	NS	UL	79,000	39,000	26,000	39,000	26,000	115,500	77,000	48,125	38,500	21,000	13,500
	S1	UL	316,000	156,000	104,000	156,000	104,000	462,000	308,000	192,500	154,000	84,000	54,000
	SM	UL	237,000	117,000	78,000	117,000	78,000	346,500	231,000	144,375	115,500	63,000	40,500
U	NS[i]	UL	35,500	19,000	8,500	14,000	8,500	54,000	36,000	22,500	18,000	9,000	5,500
	S1	UL	142,000	76,000	34,000	56,000	34,000	216,000	144,000	90,000	72,000	36,000	22,000
	SM	UL	106,500	57,000	25,500	42,000	25,500	162,000	108,000	67,500	54,000	27,000	16,500

For SI: 1 square foot = 0.0929 m^2.

UL = Unlimited; NP = Not Permitted; NS = Buildings not equipped throughout with an automatic sprinkler system; S1 = Buildings a maximum of one story above grade plane equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; SM = Buildings two or more stories above grade plane equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2; S13D = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.3.

a. See Chapters 4 and 5 for specific exceptions to the allowable height in this chapter.

b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.

c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.

d. The NS value is only for use in evaluation of existing building area in accordance with the International Existing Building Code.

e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies, Condition 1, see Exception 1 of Section 903.2.6.

f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and Section 1103.5 of the International Fire Code.

g. New Group I-4 occupancies see Exceptions 2 and 3 of Section 903.2.6.

h. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8.

i. The maximum allowable area for a single-story nonsprinklered Group U greenhouse is permitted to be 9,000 square feet, or the allowable area shall be permitted to comply with Table C102.1 of Appendix C.

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:

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.

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 IV-C), 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 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 the Committee 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 adopted 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 12/27/17.

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-on-tall-wood-buildings/ (link active and up to date as of 12/27/17). 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.

IBC Code Section	Description
403.3.2	Water supply requirements for fire pumps in high rise buildings of Type IVA and IVB construction.
504.3	Allowable building height (feet) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT construction.
504.4	Allowable building height (stories) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
506.2	Allowable building area for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
602.4	Type of Construction requirements for new proposed types of construction: Types IVA, IVB and IVC. No changes to Type IV HT construction. Includes definitions for new terms: Mass timber and Noncombustible protection (mass timber). **THIS IS THE KEY CODE CHANGE PROPOSAL WHICH OUTLINES THE CONSTRUCTION REQUIREMENTS FOR THE PROPOSED NEW TYPE OF MASS TIMBER BUILDINGS. THE PROPOSAL ALSO ADDRESSES CONCEALED SPACES, ADHESIVE PERFORMANCE AND EXTERIOR WALL PROTECTION.**
703.8 (new)	The performance method to determine the increase to the fire resistance rating provided by noncombustible protection applied to the mass timber building element.
703.9 (new)	Requirements for sealants and adhesives to be placed at abutting edges and intersections of mass timber building elements. The reason statement references a Group B proposal to Chapter 17 for special inspection requirements of sealants and adhesives.
718.2.1	Requirements on the use of mass timber building elements used for Fireblocking.
722.7 (new)	Requirements for the fire resistance rating of mass timber elements, including minimum required protection and gypsum board attachment requirements.
3102	Requirements for membrane structures using Type IV HT construction.
3314.7 (new)	New special precautions during construction of buildings of Types IVA, IVB and IVC construction: Standpipes; Water supply for fire department connections; Noncombustible protection required for mass timber elements as construction height increases.
Appendix	Requirements for walls, floors and roofs of Type IV HT construction in buildings located in Fire Districts.
IFC Code Section	**Description**
701.6	Requirements which stipulate the owner's responsibility to maintain inventory of all required fire resistance rated construction in buildings of Types IVA and IVB construction. This includes an annual inspection and proper repair where necessary.
Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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.

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Both of these links were confirmed active on 12/27/17.

Cost Impact
The code change proposal will not increase or decrease the cost of construction .

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

Internal ID: 849

G146-18

IBC: 3102.3, 3102.6.1.1

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

2018 International Building Code

Revise as follows:

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:

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.

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 12/27/17). 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.

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506.2	Allowable building area for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
602.4	Type of Construction requirements for new proposed types of construction: Types IVA, IVB and IVC. No changes to Type IV HT construction. Includes definitions for new terms: Mass timber and Noncombustible protection (mass timber). **THIS IS THE KEY CODE CHANGE PROPOSAL WHICH OUTLINES THE CONSTRUCTION REQUIREMENTS FOR THE PROPOSED NEW TYPE OF MASS TIMBER BUILDINGS. THE PROPOSAL ALSO ADDRESSES CONCEALED SPACES, ADHESIVE PERFORMANCE AND EXTERIOR WALL PROTECTION.**
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3102	Requirements for membrane structures using Type IV HT construction.
Appendix	Requirements for walls, floors and roofs of Type IV HT construction in buildings located in Fire Districts.
IFC Code Section	**Description**
701.6	Requirements which stipulate the owner's responsibility to maintain inventory of all required fire resistance rated construction in buildings of Types IVA and IVB construction. This includes an annual inspection and proper repair where necessary.
3308.4 (new)	New special precautions during construction of buildings of Types IVA, IVB and IVC construction: Standpipes; Water supply for fire department connections; Noncombustible protection required for mass timber elements as construction height increases.
Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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.

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Both of these links were confirmed active on 12/27/17.

Cost Impact

The code change proposal will not increase or decrease the cost of construction .

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

Internal ID: 949

G152-18
IBC: D102.2.5

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

2018 International Building Code

Revise as follows:

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.

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.

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.

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 12/27/17). 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.

IBC Code Section	Description
403.3.2	Water supply requirements for fire pumps in high rise buildings of Type IVA and IVB construction.
504.3	Allowable building height (feet) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT construction.
504.4	Allowable building height (stories) for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
506.2	Allowable building area for buildings of Type IVA, IVB and IVC construction. No changes to Type IV HT.
508.4.4.1 509.4.1.1 (new)	Requirements for mass timber building elements serving as fire barriers or horizontal assemblies in buildings of Type IVB of IVC construction.
602.4	Type of Construction requirements for new proposed types of construction: Types IVA, IVB and IVC. No changes to Type IV HT construction. Includes definitions for new terms: Mass timber and Noncombustible protection (mass timber). **THIS IS THE KEY CODE CHANGE PROPOSAL WHICH OUTLINES THE CONSTRUCTION REQUIREMENTS FOR THE PROPOSED NEW TYPE OF MASS TIMBER BUILDINGS. THE PROPOSAL ALSO ADDRESSES CONCEALED SPACES, ADHESIVE PERFORMANCE AND EXTERIOR WALL PROTECTION.**
703.8 (new)	The performance method to determine the increase to the fire resistance rating provided by noncombustible protection applied to the mass timber building element.
703.9 (new)	Requirements for sealants and adhesives to be placed at abutting edges and intersections of mass timber building elements. The reason statement references a Group B proposal to Chapter 17 for special inspection requirements of sealants and adhesives.
718.2.1	Requirements on the use of mass timber building elements used for Fireblocking.
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3102	Requirements for membrane structures using Type IV HT construction.
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IFC Code Section	**Description**
701.6	Requirements which stipulate the owner's responsibility to maintain inventory of all required fire resistance rated construction in buildings of Types IVA and IVB construction. This includes an annual inspection and proper repair where necessary.
3308.4 (new)	New special precautions during construction of buildings of Types IVA, IVB and IVC construction: Standpipes; Water supply for fire department connections; Noncombustible protection required for mass timber elements as construction height increases.
Proposed changes to be submitted in 2019 Group B	
IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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.

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Cost Impact

The code change proposal will not increase or decrease the cost of construction .

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

Internal ID: 951

G89-18

IBC: 508.4.4.1, 509.4.1.1 (New)

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

2018 International Building Code

508.4.4 Separation. Individual occupancies shall be separated from adjacent occupancies in accordance with Table 508.4.

Revise as follows:

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 a minimum of 1/2 inch (12.7 mm) gypsum board or a noncombustible equivalent.

Add new text as follows:

509.4.1.1 Type IV-B and IV-C construction. Where Table 509 specifies a fire-resistance-rated separation, mass timber elements serving as fire barriers or a horizontal assembly 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 a minimum of ½ inch (12.7 mm) gypsum board or a noncombustible equivalent.

Reason:

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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. 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.

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 12/27/17). 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.

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IBC Chapter 17	Required special inspections of mass timber construction • Structural • Sealants and adhesives (see IBC 703.8)
IBC Chapter 23	An update to referenced standard APA PRG 320 Standard for Performance –rated Cross-laminated Timber which is currently undergoing revision to ensure the adequacy of the adhesives under fire conditions.

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

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

http://bit.ly/ATF-firetestvideos

Both of these links were confirmed active on 12/27/17.

Cost Impact
The code change proposal will not increase or decrease the cost of construction .

This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.

Internal ID: 960

FLOOR MODIFICATION

G89-18-DIGIOVANNI-1

Proponent of Floor Modification: Stephen DiGiovanni, representing ICC Ad Hoc Committee on Tall Wood Buildings (TWB)

2018 International Building Code

Modify proposal as follows:

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 a minimum of $^1/_2$ inch (12.7 mm) gypsum board or a ~~noncombustible equivalent~~ 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.

509.4.1.1 Type IV-B and IV-C construction. Where Table 509 specifies a fire-resistance-rated separation, mass timber elements serving as fire barriers or a horizontal assembly 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 a minimum of Â½ inch (12.7 mm) gypsum board or a ~~noncombustible equivalent~~ 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.

Internal ID: 47

WCTE 2018
2018 World Conference on Timber Engineering
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FULL-SCALE FIRE TESTS OF A TWO-STORY CROSS-LAMINATED TIMBER STRUCTURE

Laura E. Hasburgh[1], Samuel L. Zelinka[1], Keith J. Bourne[1], David R. Tucholski[2], Jason P. Ouellette[2]

ABSTRACT: There is a current trend towards mid- and high-rise mass timber buildings. With this trend, there is a research need to develop a comparison between mass timber compartment fires and non-combustible compartment fires. In an effort to address the knowledge gaps in the fire performance of cross-laminated timber compartments, a full-scale fire test series was developed. The fire test series included five tests with varying levels of exposed cross-laminated timber on a two story cross-laminated timber structure. Here we present a detailed summary of the fire test series, instrumentation plan, and an overview of the results.

KEYWORDS: Cross-laminated timber, full-scale fire test, timber construction, fire performance, compartment fire

1 INTRODUCTION

Mid- and high-rise mass timber buildings can provide an array of economic, environmental, and design benefits. However, further research and testing on the fire performance of timber buildings has been deemed necessary to develop relevant building code provisions in the United States.

The test series presented here was performed to better understand the contribution of cross-laminated timber (CLT) to the compartment fire, life safety of occupants, firefighter safety, and property protection. The specific performance parameters that were measured and evaluated included the development of smoke and hot gases within compartments and egress routes, the temperature rise on material surfaces, in the CLT and at connections, heat release rates, and the heat flux at various locations.

Here we present an overview of the test series and preliminary results from the full-scale fire tests on a two-story CLT structure.

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2 TEST STRUCTURE AND MATRIX

2.1 CLT TEST STRUCTURE

The CLT test structure was two stories with one apartment per level. Each apartment was approximately 9 m x 9 m x 2.7 m high and included a kitchen open to a living room, a hallway to a bathroom, utility closet, and a bedroom. A 1.5 m-wide corridor wrapped around the apartments on each floor and connected to a stairwell. A schematic of the structure and a floor plan are provided in Figure 1. The floor/ceiling assemblies and walls A, B, C, D, E and F consisted of five-ply CLT (175 mm thick) manufactured with Douglas-fir – Larch and a polyurethane adhesive. The construction type was balloon frame with the CLT walls continuous from the bottom of the first floor to the top of the second floor and the CLT floors/ceilings supported by concealed ledgers and a glulam beam that was supported by glulam columns. Interior partition walls within each apartment were constructed with steel studs and one layer of 13 mm non-fire rated gypsum wallboard on each side. Wall A had openings consisting of 60% of the area.

Entry into each compartment from the corridor was via a 20-minute solid core door that remained closed for Tests 1 through 4 and was open for Test 5. The doors to the bedroom and bathroom were hollow-core wood doors and were left open during the tests.

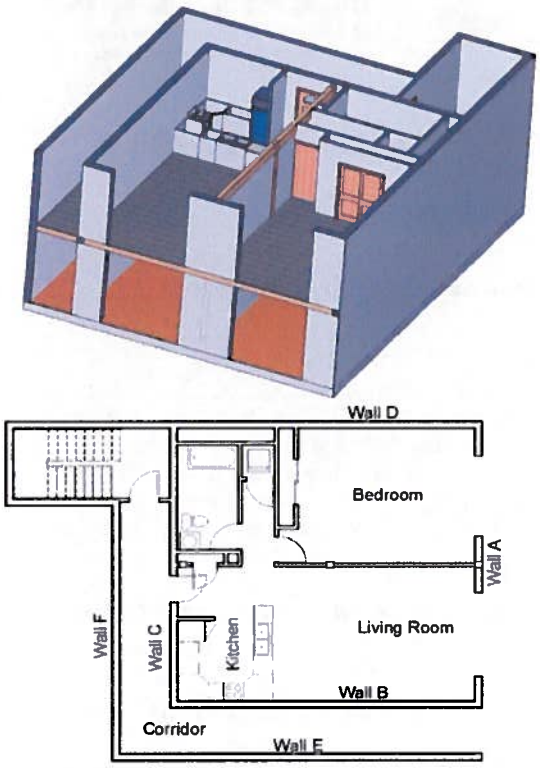

***Figure 1:** Schematic of CLT structure and floor plan*

Penetrations to simulate plumbing fixtures were included in the floor/ceiling assembly between the first and second floors. The penetrations were located in the kitchen and bathroom. Each penetration was protected with a tested and listed fire stop system. To simulate mechanical/utility space, the kitchen and the hallway outside of the bedroom included a dropped ceiling with a ceiling height of 2.4 m.

2.2 TEST MATRIX

Each test was conducted with the fire confined to the floor in which the fire was started. One of the main variables tested was the amount of exposed CLT. When used, the passive fire protection for each test consisted of two layers of 16 mm Type X gypsum board on the CLT walls and ceiling surfaces and two layers of cement board on the floors. In Test 1, there were no exposed CLT surfaces. Test 2 included 30% exposed CLT ceiling in the living room and bedroom. For Test 3, the living room portion of Wall B and Wall D in the bedroom were fully exposed. For Tests 4 and 5, the living room and bedroom had all CLT wall and ceiling surfaces exposed as well as glulam beams and columns.

In addition to the amount of exposed CLT the other variables included glazing on the openings of Wall A and an active fire protection system. Tests 1, 2 and 3 had no glazing over the openings in Wall A and no active fire protection system installed. Tests 4 and 5 included glazing over the openings in Wall A and an automatic sprinkler system was installed with a density of 2 mm/min, which is less than the density for light hazard per NFPA 13 [1]. For Test 4, the sprinkler system was allowed to activate automatically. In Test 5, the sprinkler system was activated manually approximately 20 minutes after the activation time from Test 4.

2.3 IGNITION SOURCE AND FUEL LOAD

In each test, the fire was started in a lower kitchen cabinet along Wall C, as shown in Figure 2. The ignition source was medical gauze and paper towel, soaked in approximately 200 ml of gasoline, and then placed inside of a one litre plastic bag.

***Figure 2:** Ignition packet inside kitchen cabinet with wood cribs (left) and screen shot of ignition from Test 1 (right)*

The fuel load density was set at 570 MJ/m^2 for each test and consisted of furniture, books, cabinets and wood cribs. Table 1 provides the energy values of the furniture and books in each room as well as the doors, cribs and gypsum paper throughout the compartment. The total of these values was then divided by the area of 80.2 m^2 to calculate the fuel load density.

***Table 1:** Fuel (MJ) per room*

Room	MJ
Living Room	6970
Kitchen	15271
Dining Room	1273
Bedroom	9940
Other (doors, cribs, gypsum paper)	12345
Total:	45800

3 INSTRUMENTATION

3.1 THERMOCOUPLES

Over 200 channels of data were recorded in each test with a majority used for the thermocouples installed throughout the structure. This included thermocouple trees, embedded and surface thermocouples, and thermocouples at wall/ceiling joints.

A total of 20 thermocouple trees (24 gauge, Type K glass insulated, SLE) were installed inside of the structure with thermocouples at 0, 0.6, 1.2, 1.8, 2.4 and 2.7 m above the finished floor. The thermocouple trees located in the kitchen and inside the interior wall did not have a measurement at 2.7 m. Each floor of the structure had 10 thermocouple trees: one in the kitchen, two in the

living room, two in the bedroom, three in the corridor (one by the door to the stairwell, one outside of the door to the kitchen and one near the opening on Wall A), and two inside of the interior wall. In addition, thermocouple trees were located at the midpoint near the opening of Wall A.

Figure 3 is a schematic of the embedded thermocouples and the CLT surface thermocouples as well as the thermocouples installed when gypsum board was present. The thermocouples (30 gauge, Type K glass insulated) were installed within the CLT walls and ceiling by drilling holes from the non-fire exposed surface. They were then inserted into the holes at 12, 23, 35, 47, 58, 70 and 105 mm from the fire-exposed surface. The embedded and surface thermocouple configuration was installed on each level at three locations along Wall B, one location in Wall D and in the ceiling above the living room for a total of 10 locations throughout the structure. Additional thermocouples were located on the surfaces of the ceiling in the bedroom and living room.

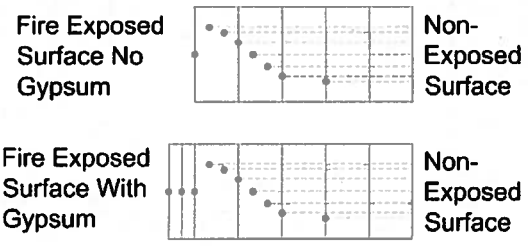

***Figure 3:** Schematic of embedded and surface thermocouples*

To obtain the temperature along the wall/ceiling joints, thermocouples were installed along the angle iron (Wall B), ledger board (Wall D) and at the tops of Walls B and D before the roof was in place. Thermocouples were installed at seven locations evenly spaced along the joints for Wall B. For Wall D, four locations were evenly spaced along the joints in the bedroom. The location of the thermocouples at the joints are detailed in Figure 4 below.

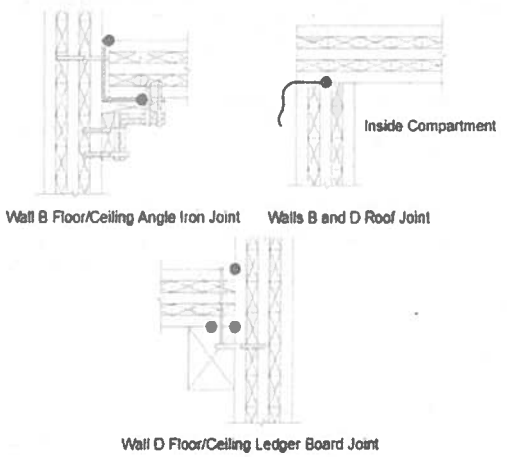

***Figure 4:** Wall/Ceiling joint details with thermocouple locations*

3.2 HEAT RELEASE RATE AND HEAT FLUX

The entire test structure was constructed under a 19.8 m by 19.8 m exhaust hood that was equipped with gas analysers, temperature probes, and velocity probes to calculate the heat release rate using the oxygen consumption method.

For each test, one Schmidt-Boelter water-cooled heat flux sensor was installed in the structure and four were installed outside the openings on Wall A. The heat flux sensor inside the structure was directly across from the entry/kitchen door of the fire compartment, mounted on Wall F at 0.9 m above the finished floor. This sensor was particularly important to obtain information about the heat flux to a fire fighter's polycarbonate face shield. The four sensors outside of the fire compartment were located mid-point of the bedroom and living room openings at 1.5 m above the compartment floor. Two were at a distance of 2.4 m from the openings and the other two were at 4.8 m from the openings.

3.3 OTHER INSTRUMENTATION

It was important to capture the exposure levels of smoke and combustion products that occupants and safety personnel may encounter in the corridor. To obtain this information, both optical density measurements (Light Source: GE PAR36 - Pin Spot – Model 4515 6V/30W, Photo Cell: Huygen Model 856 RRV) and gas analysis, including O_2 (Siemens Oxymat 61), CO and CO_2 (Siemens Ultramat 23), were taken near the door from the kitchen to the corridor at 1.5 m above finished floor.

Both photoelectric and ionization smoke detectors were located next to each other in the stairwell, corridor, bedroom, hallway and living room The activation times of all smoke detectors were recorded.

For visual observations, a combination of low- and high-definition video cameras and a forward looking infrared (FLIR) camera were used. Seven cameras were located within the test compartment. Three high-definition cameras and the FLIR were located outside of the openings in Wall A. Images were also captured during the tests, using digital still photography (Figure 5).

Figure 5: Photo during Test 3 after flashover in the bedroom

4 RESULTS

The data collection length of each test ranged from 30 minutes with sprinkler activation to four hours without sprinkler activation, and data was collected once per second during the entire test. The results presented below are preliminary with the full report and final details to be published in 2018 [2].

Table 2 provides an overview of the major events during each test. Despite the differences in exposed CLT surfaces, flashover occurred at approximately the same times for Tests 1, 2 and 3. Based on heat release rate data, the fully developed fire phase for these three tests were similar and each approximately 15-18 minutes long before the decay phase began. Tests 4 and 5 did not reach flashover because the sprinkler systems activated at 2:37 and 23:00 (mm:ss), respectfully. Additionally, for Test 5, flashover did not occur because the glazing over the openings in Wall A limited the oxygen which, in turn, limited the fire growth.

Table 2: Major events during the test series

Event[1]	Time to Event after Ignition (mm:ss)				
	1	2	3	4	5
Flashover LR	13:27	11:42	12:37	-	-
Flashover BR	17:20	17:20	17:00	-	-
Flames in Corridor	26.51	30:38	13:06[2]	-	17:00[3]
Sprinkler Activation	-	-	-	2:37	23:00

[1] Flashover is the average time for thermocouples at 1.8 m above the floor reached 600°C or greater in either the bedroom (BR) or the living room (LR).

[2] The flames to the corridor occurred faster in Test 3 due to an installation error in the 20-minute solid core door.

[3] The 20-minute solid core door remained open for the duration of Test 5.

4.1 THERMOCOUPLES

Tests 1, 2 and 3 spiked to a temperature of 1200°C at flashover with the remaining room temperatures during the fully developed phase being less than 1050°C. For all three tests, the bedroom stayed hotter longer than the living room due to the delay in flashover. Figure 6 includes the temperatures from the thermocouple trees closest to the openings in Wall A in both the living room and bedroom for Test 2.

For Test 4, the maximum temperature reached approximately 100°C and then quickly decreased after sprinkler activation. For Test 5, the peak temperature in the living room and bedroom was between approximately 700°C and 800°C and then quickly decreased below 100°C in approximately 30 seconds after sprinkler activation. In the kitchen, where the fire initiated, the peak temperature reached approximately 1000°C and then decreased below 100°C in approximately 2-3 minutes after sprinkler activation.

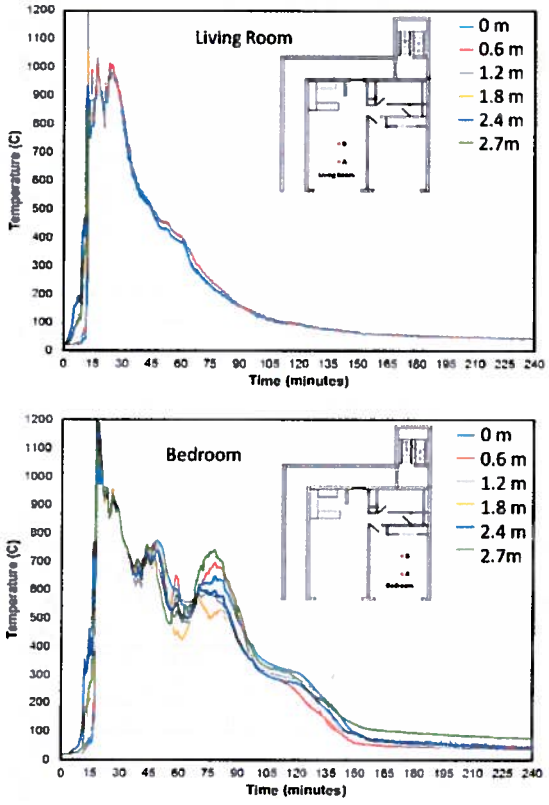

Figure 6: Thermocouple tree temperatures in the living room (top) and bedroom (bottom) during Test 2 for the trees located nearest the openings in Wall A

Ultimately, the data collected from the embedded thermocouples will be used to calculate the char rates during the various fire stages (growth, fully developed, and decay). However, here we present the initial findings for Tests 1-3. For Test 1, all of the thermocouples embedded in the CLT remained below 100°C with the highest reading in the ceiling location at the surface thermocouple and the 12 mm depth peaking at 90°C. Test 2 had the partially exposed CLT ceiling, which caused the char front in the ceiling to be between 23 mm, which reached 480°C, and 35mm, which did not

exceed 250°C, as shown in Figure 7. Charring for wood is typically assumed to occur at 300°C [3]. The remaining embedded thermocouples in the walls for Test 2 were protected with gypsum board and performed similar to Test 1 with the wood temperatures not exceeding 90°C.

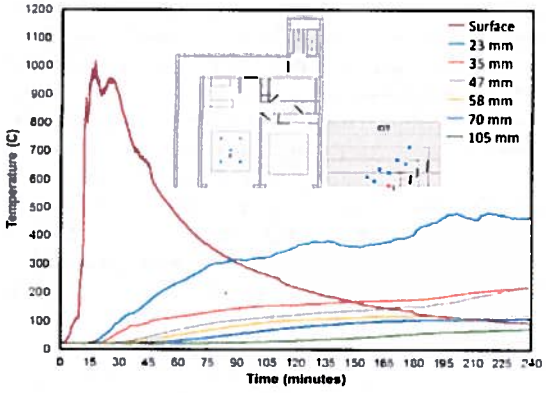

***Figure 7:** Temperature profile from the embedded thermocouples in the living room ceiling for Test 2*

The embedded thermocouples in the ceiling in Test 3 did not go above 100°C while the embedded thermocouples in the exposed walls varied based on the location. The Wall B and D locations closest to the openings in Wall A did not char past 23 mm while the location in Wall B near the dining room table had charring up to a depth of 47 mm. This particular location saw some localized delamination around 90 minutes after ignition, causing ignition of the second ply and resulting in a deeper char depth (Figure 8).

***Figure 8:** Image at approximately 90 minutes after ignition when delamination of the first ply occurs and ignition of the second ply takes place on Wall B during Test 3*

Figure 9 shows that the thermocouples located at the wall/ceiling joints all remained at or well below the char temperature for Tests 1 and 2 with the maximum temperatures (325°C and 135°C) occurring along the floor during Test 2. Due to several factors, Test 3 resulted in much higher, localized temperatures in the joints. In two locations along the roof/wall joint for Wall D, the temperatures reached 1000°C. Additionally, at two locations along the floor in the bedroom, the maximum temperatures were near 750°C. These high temperatures were localized (Figure 10) and were most likely artifacts of inadequate fire caulk application and the short cure time for the fire caulk permitted between Tests 2 and 3. Furthermore, the CLT surface of Wall D in the bedroom had been exposed during Test 2, which most likely impacted the tightness of the joints and allowed hot gasses to pass through during Test 3. This indicates that the construction details, particularly at the joints for both new construction and rehabilitated construction, must be carefully reviewed to improve integrity during fire exposure.

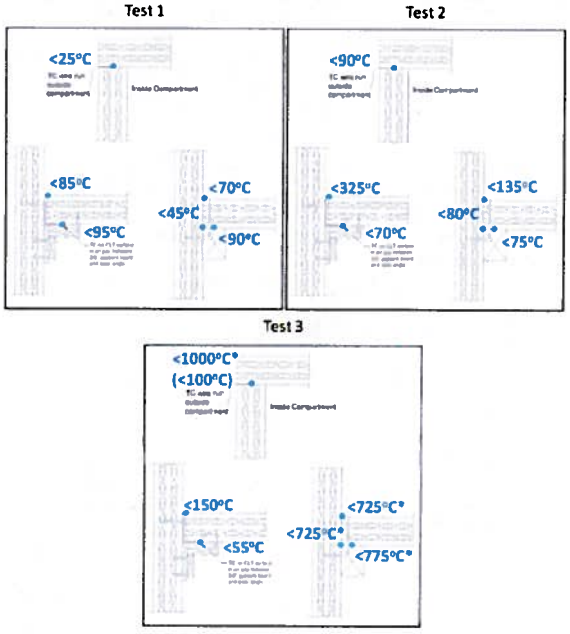

***Figure 9:** Maximum thermocouple temperatures at the joints during Tests 1, 2 and 3. *Denotes installation issues with the fire caulk resulting in exaggerated temperatures at localized points in during Test 3.*

***Figure 10:** Localized tunnelling at wall/ceiling joint during Test 3*

4.2 HEAT RELEASE RATE AND HEAT FLUX

The heat release rate was measured using a nominally rated 14 MW Fire Products Collector (FPC) that has a

19.8 m by 19.8 m square hood. Although the FPC has only been verified (C-factor) up to 5 MW, the measured values would be reasonably accurate with a small percentage for error (approximately 10-15%), as long as the products of combustion were being collected. The resulting peak heat release rates are provided in Table 3. Based on observations and issues with the gas sampling equipment that occurred during Tests 1 and 3, the peak heat release rate might be slightly higher than the recorded measured value (See notes under Table 3 for more details).

***Table 3:** Peak Heat Release Rates (MW)*

Test	Peak HRR (MW)
1	18.5[1]
2	23.3
3	20.9[2]
4	0
5	5.7

[1] Peak was most likely higher than measured value due to spillage of smoke from hood (increased hood flow for subsequent tests) and an issue in the gas sampling equipment during the peak time.

[2] Peak was most likely higher than measured value. An issue with the gas sampling system at the start of the test was not resolved until 20.3 minutes after ignition.

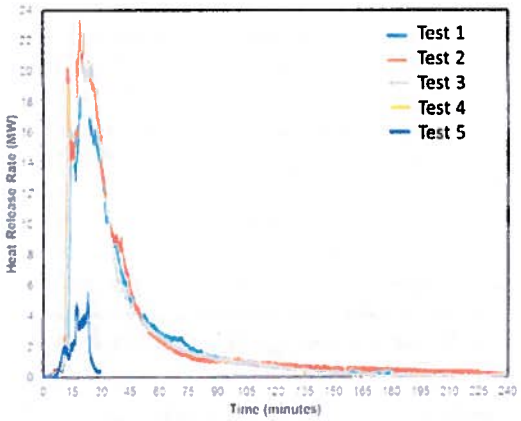

***Figure 11:** Heat release rate in MW for Tests 1 through 5*

As previously stated, based on the heat release rates, the fully developed fire phase for Tests 1 through 3 was approximately 15-18 minutes between the time to flashover and when the decay phase began. Because of relatively small fire due to the quick sprinkler activation at 2:37 (mm:ss) in Test 4, there is no heat release rate data available. For Test 5, the heat release rate remains at or below 2 MW for the first 19 minutes. At approximately 16.5 minutes, a panel of glazing closest to Wall D in the bedroom was manually broken to simulate fire-service intervention. This resulted in more oxygen to feed the fire as well as more products of combustion escaping from the structure, causing a sharp increase in the heat release rate. At 23 minutes after ignition, the sprinkler system water was turned on and a decay period occurred while the sprinkler water controlled the fire (see Figure 11). When the water was turned on, failure of other glazing panels occurred due to the rapid temperature change.

The heat flux sensor inside the structure was directly across from the kitchen door of the fire compartment, mounted on Wall F at 0.9 m above the finished floor. This sensor was particularly important to obtain information about the heat flux to a crawling fight fighter's polycarbonate face shield, which start to show signs of deterioration at 15 kW/m^2 for a duration of one minute [4]. The results for Tests 1 and 2 showed that the heat flux at this location remained below 4 kW/m^2 with a brief flare up outside the door that cause a spike up to 12 kW/m^2 in Test 2 (Figure 12). The results for Test 3 are much higher with the maximum reaching 65 kW/m^2. This is due to the fact that the 20-minute door was not installed properly and failed sooner than in Tests 1 and 2.

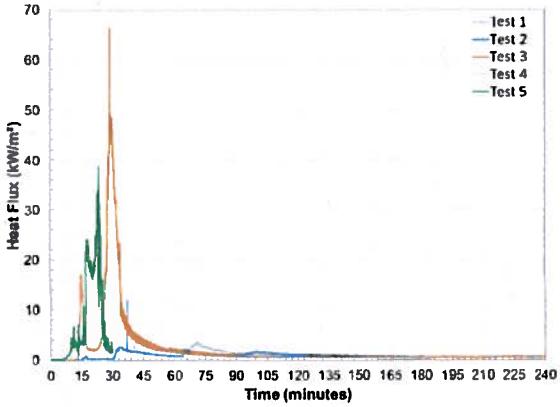

***Figure 12:** Heat flux measurements from heat flux sensor mounted on Wall F across the corridor from the entry/kitchen door*

The four heat flux sensors outside of the fire compartment were located at the mid-point of the bedroom and living room openings in Wall A at a height of 1.5 m above the compartment floor. The two sensors that were at a distance of 2.4 m from the openings peaked around 70 kW/m^2 for Test 1 and 60 kW/m^2 for Tests 2 and 3. The two sensors located 4.8 m from the opening in Wall A peaked at 30 kW/m^2 for Test 1 and around 20 kW/m^2 for Tests 2 and 3. Test 1 is believed to be higher because it was conducted on the first floor and radiation from the test room floor to the heat flux sensor increased the measurement slightly. The heat flux sensors for Tests 2 and 3 were mounted higher and were not affected by radiation from the floor, but could have also been slightly lower than Test 1 due to convective cooling.

4.3 OTHER INSTRUMENTATION

The gas measurements were highly dependent on when the door between the apartment and corridor failed or if it was blocked open, like in Test 5. Of particular interest is the amount of CO present in the path of egress. Tests

2 and 4 had non-detectable limits of CO. Test 1 and 3 resulted in some CO present after the door failures and peaked at 500 and 3,500 ppm, respectively. Since the door was blocked open in Test 5, the CO limits were very high in the corridor and peaked at 39,000 ppm (Figure 13).

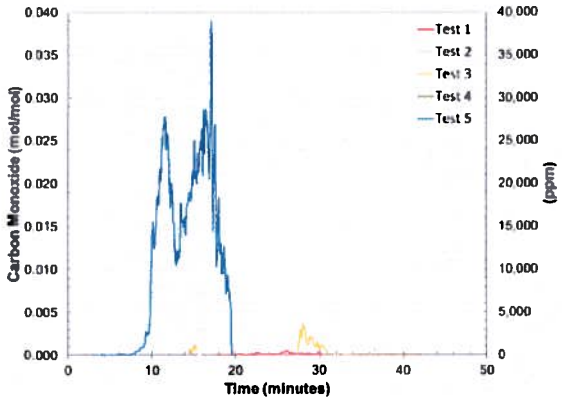

***Figure 13:** Carbon Monoxide (CO) levels in the corridor during each test*

The smoke detector alarm times are given in Table 4. Both the location and the test variables significantly impacted when the alarms activated. In general, the smoke detectors at the each location in the apartment activated at similar times for Tests 1 through 5. However, for Tests 1 through 4, the smoke detectors in the corridor and stairwell activated much slower (or not at all) than those during Test 5 when the door from the apartment to the corridor was blocked open.

***Table 4:** Alarm times for smoke detectors*

Location	Time to alarm (seconds)				
	1	2	3	4	5
Living Room, Ion	36	46	49	33	43
Living Room, Photo	41	51	62	44	443
Bedroom, Ion	189	202	184	X	577
Bedroom, Photo	191	223	218	140	158
Hallway, Ion	42	600	57	36	49
Hallway, Photo	787	106	80	39	395
Corridor by door, Ion	873	220	300	332	118
Corridor by door, Photo	865	1026	273	339	116
Corridor by Wall A, Ion	1310	406	540	X	200
Corridor by Wall A, Photo	1081	732	788	X	195
Stairwell, Ion	3573	3875	7045	X	597
Stairwell, Photo	X	X	1604	X	618

X - Indicates the unit did not alarm

5 CONCLUSIONS

The results of these tests will be used to explore the fire science of tall wood buildings evaluate occupant and firefighter safety in realistic fire scenarios, thus further informing the development of building code provisions applicable to such structures.

ACKNOWLEDGEMENT

The authors acknowledge funding from the American Wood Council and thank LendLease for constructing the test structure.

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[3] R. White, Analyitical Methods for Determining Fire Resistance of Timber Members, in *SFPE Handbook of Fire Protection Engineering, Fouth Edition*, 2008, pp. (4)346-366.

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CLT FEASIBILITY STUDY

A STUDY OF ALTERNATIVE CONSTRUCTION METHODS IN THE PACIFIC NORTHWEST

14 MAY 2014

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Image front page: Structurlam

BELOW | CLT PANEL BEING LIFTED INTO PLACE

CLT FEASIBILITY REPORT

A STUDY OF ALTERNATIVE CONSTRUCTION METHODS IN THE PACIFIC NORTHWEST

CLT roof panel lifted into place. Image: Structurlam

INTRODUCTION

CROSS LAMINATED TIMBER

This study explores the use of Cross Laminated Timber (CLT) in a 10-story residential building as an alternative building method to concrete and steel construction. The study is not meant to be exhaustive, rather a preliminary investigation to test the economic viability of utilizing this new material to increase density, walkability and sustainable responsiveness in our built environment.

Based on international precedent, CLT is an applicable material for low-rise, as well as mid-rise to high-rise construction and has a lighter environmental footprint than traditional concrete and steel construction systems. Cross-laminated timber is a large format solid wood panel building system originating from central Europe. As a construction system it is similar to precast concrete in which large prefabricated panels are lifted by crane and installed using either a balloon frame or platform frame system. The advantages to using CLT are many, but the main benefits include: shorter construction times, fewer skilled laborers, better tolerances and quality, safer work environment, utilization of regional, sustainable materials, and reduction of carbon footprint of buildings. As a new, unproven material in the Pacific Northwest, this study investigates the cost competitiveness of CLT versus traditional materials for "low high-rise" buildings.

THE STUDY

A NEW OPPORTUNITY?

Common assumptions for the Seattle market dictate that concrete is too expensive for building only slightly above midrise (heights above 75 ft and lower than around 125 ft). For purposes of this study we will refer to these buildings as "low high-rise." Consequently, lots in certain zones may not get built-out to their maximum zoning height potential. Instead, economical 5-over-2 construction is used and lots leave valuable development potential unrealized. Seattle has a unique amended building code that allows 5 stories of light wood frame construction to be built on top of 2 stories of concrete construction for a 7-story building, commonly referred to as "5-over-2". While this construction type is economical and has proliferated across the city, it does not offer the potential for vertical expansion to meet the needs of a rapidly growing and evolving city.

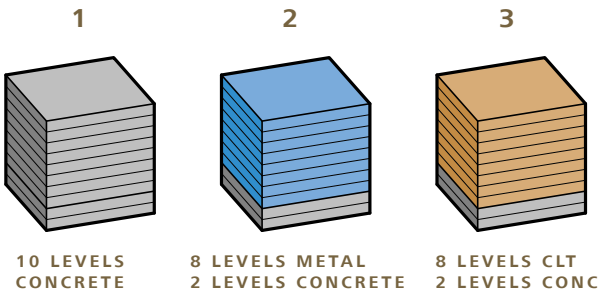
The study takes an existing 7-story student housing project as a base for investigation of several other construction material options. Importantly, each study adds three stories to the existing 7-story base building. The study then compares three alternative 10-story structural options:

:: Concrete
:: Metal (light gauge frame)
:: CLT

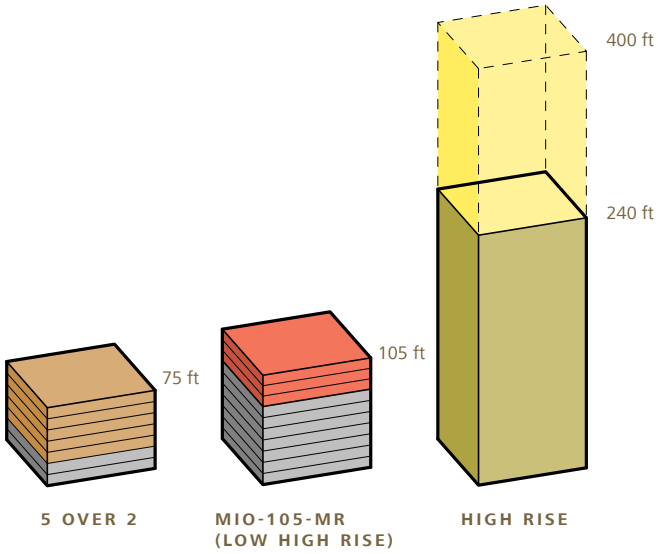
Due to the nature of the existing 5-over-2 building, the first two stories are maintained as concrete in all three schemes and only the upper 8 stories are changed (see Figure 1). All three structural schemes are priced to compare which option is most favorable to the Seattle market.

10-story buildings in Seattle, while not common, would typically be erected as a cast-in-place concrete frame structure with post-tensioned concrete floor decks. As such, a 10-story concrete building was used as the base-line cost model for this study from which the two other structural systems (steel and CLT) were compared.

BELOW | FIGURE 1: THREE MATERIAL OPTIONS STUDIED FOR THE FEASIBILITY STUDY



BELOW | A FEW COMMON SEATTLE BUILDING HEIGHTS CONSIDERED FOR THE STUDY



The site for the existing 7-story student housing project is zoned as MIO-105-MR, meaning that the maximum building height is 105 ft from grade. The 5-over-2 construction type used for the existing building could only reach a maximum height of 75 ft by code, which is the threshold between midrise and high-rise construction. The consequence of building 5-over-2 was 30 feet of buildable height was unrealized.

The team for this study hypothesized that CLT could be an economically favorable option for buildings taller than 75 ft, but shorter than 125 ft. The benefits of finding an economic development solution to this zoning height range (75 ft – 125 ft) are twofold: it provides more potential revenue for developers and will help fill-out the city's desired density targets to promote smart and sustainable growth.

There are many other areas of Seattle zoned (with varying uses) between 85 ft to 125 ft, which is seen as an ideal height for CLT in the Pacific Northwest by the study team. Areas of Seattle that have zoning between 85 ft to 125 ft include: Ballard, Belltown, Capitol Hill, Duwamish, First Hill, International District, Lower Queen Anne, NE 65th, Pioneer Square, SODO, South Lake Union, the University District and others. While not all pockets of these zoning heights are large, as Seattle continues to gain population, as it has over the last decade, we can expect zoning heights over time to increase. Taller structures provide more density and support sustainability and livability goals like those promoted by the City of Seattle's Comprehensive Plan.

CHALLENGES

BUILDING CODE

A 10-story building whose structure is built from wood presents several jurisdictional challenges. The City of Seattle Department of Planning and Development (DPD) has started a CLT Advisory Committee to explore the use of CLT and other solid wood/mass wood building systems in taller applications than currently allowed by code (see End Note 1). The Advisory Committee has helped lead to an early introduction of CLT into the City's building code, but issues involving seismic design and combustibility require additional discussion.

According to the International Building Code, of which Seattle uses an appended version, combustible materials are not allowed as load bearing structure in high-rise buildings (taller that 75 ft). While using a wood based building system for low high-rise construction may at first seem questionable, CLT is capable of offering ample fire and life-safety. Like Heavy Timber (HT) construction, CLT panels char in the event of a fire. This protective char layer allows CLT wall and floor panels to be exposed for extended periods of time during a fire without sacrificing structural integrity. Unlike structural steel, CLT needn't be encapsulated with layers of non-combustible material to maintain its strength during a fire. CLT assemblies have been demonstrated to last 2 and 3 hours fully loaded in standard fire-resistance tests, depending on their thickness (American Wood Council, 2012). Encapsulating CLT with layers of gypsum board or other cladding can be used to further improve fire-resistance.

Cross-laminated timber was added to the 2012 Seattle Building Code (SBC) and will be included in the model 2015 International Building Code (IBC). In Seattle, CLT is currently allowed in Type IV and Type V construction (however, Type IV construction is also allowed to varying degrees in Types I, II, and III construction as well). In Type IV construction, CLT can be used as external bearing walls and floors with some

BELOW | COMPARISON OF EXTERIOR WALL GRAVITY SUPPORT SYSTEM FOR AN 8-STORY BUILDING

Demand-Capacity Ratios

BELOW | FIGURE 2: COMPARISON OF CLT FLOOR SPANS CONSIDERING STRENGTH, DEFLECTION AND VIBRATION

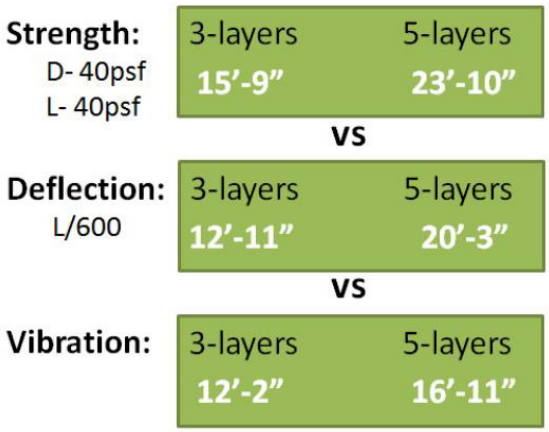


Image: Coughlin Porter Lundeen

limitations (see SBC Sections 602.4.2 and 602.4.6.2), allowing a maximum 6-story / 85 ft height for certain occupancies when sprinkled. The IBC allows a maximum of 4-stories and 70 ft of type VA construction if fully sprinkled (5-stories in SBC if fully sprinkled).

CLT, however, does not fit well into these existing construction classifications – Type IV is a vestige from late 19th century industrial timber construction technology and Type V is for light wood frame buildings. CLT, as a high mass panelized modern method of construction, is neither. Because of the inherent fire-resistiveness and structural capacity of CLT, this construction type is seen by the study team as roughly equivalent to Type 1B construction when properly detailed. Type 1B construction allows buildings to reach 12 stories. While this codification may not be perfect for CLT development, a 10-story CLT structure is imminently achievable with today's technology without sacrificing fire and life-safety standards.

SEISMIC

Cross-laminated timber as a load bearing structural material is used in high rise building construction in multiple countries. There is little doubt regarding CLT's ability to support gravity loads. But what about CLT structures constructed in high seismic zones? The goals for this study include a review of CLT's gravity load-bearing capabilities, but more importantly the investigation of the product's feasibility for use in high-rise lateral force resisting systems.

Cross-laminated timber products, because of the volume of wood, are more expensive than traditional 2x wood framing. Therefore, value engineering of the product to the minimal amount required structurally is an important design constraint, as it is with most structural materials. In many instances, 3-layer panels (which are the thinnest panels available) have adequate capacity to support gravity loads with reasonable resistance to deflection and vibration. However, additional layers are required when charring is relied upon for fire resistance (see page 4 for further discussion of fire strategy). Therefore, in the design for this study 5-layer panels were used at the floors and all load bearing walls. More economical 3-layer CLT is used only in the roof construction.

Figure 2 illustrates span capabilities for common residential loads and shows that vibration is a controlling design criterion for CLT floors. The load bearing CLT wall panels have low demand-capacity ratios in the order of 20% under 8 stories of load.

Unfortunately, a lateral force resisting system with solid panel wood shear walls like CLT is not defined in American Society of Civil Engineers (ASCE) 7 or the IBC. Establishing the required seismic coefficients, such as a Response Modification Coefficient (R) for CLT shear walls, is a laborious and expensive venture that is beyond the scope of this investigation. However, that effort is necessary for practicing structural engineers to eventually design buildings like the one in this study – see Figure 3. In order to proceed with conventional engineering methods, we rationalized that an R of 5 will produce a desirable earthquake response, is a reasonable target coefficient, and seems feasible to achieve with proper detailing of ductile panel connections and hold downs. Admittedly, this is a notable leap of faith and must ultimately be verified through proper testing and research, such as the protocol established in Federal Emergency Management Agency (FEMA) P695. Such efforts are now underway with funding from the federal government.

BELOW | FIGURE 3: DIGITAL STUDY ANALYSIS MODEL

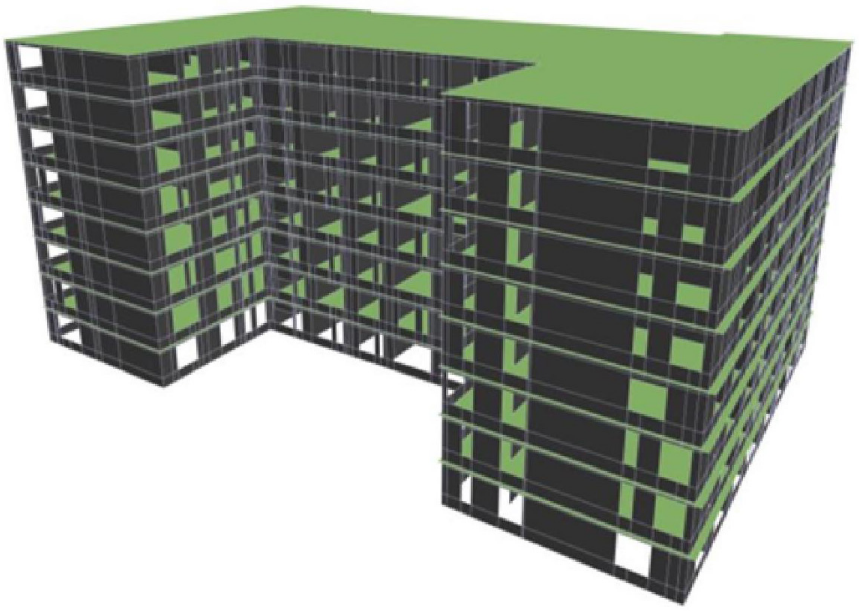


Image: Coughlin Porter Lundeen

The trial R value and other assumptions were used to analyze the CLT shear walls, which consisted of the 5-layer load bearing walls and 3-layer panels at wall locations with no fire resistant requirements. We reviewed three primary failure modes: horizontal shear stresses, compressive or tensile stresses from overturning, and torsional stresses developed by load transfer between laminations. The results illustrated how capable a structural product CLT can be, even after value engineering much of the CLT walls out of the building. For example, the controlling failure mode in the highest stressed 3-layer panel had a demand-capacity ratio (DCR) of 60%. The DCR for the highest stressed 5-layer panel is roughly 30%, and DCR's for horizontal diaphragm shears are similar. Despite our aggressive assumptions for deriving seismic base shear, we can conclude that lateral force resisting systems in 8 to 10 story high rise buildings can be constructed using CLT products. Future development in the U.S. should include investigations in ductile connections leading to codification of CLT shear wall systems.

While engineering CLT buildings for seismic zones is still developing, shake table tests have been conducted on full-scale solid wood cross-laminated timber buildings at 3-story and 7-story heights with favorable results. Of considerable interest is the 7-story CLT structure tested by the Italian SOPHIE project at the world's largest shake table in Kobe, Japan. The CLT structure survived without needing significant repairs and the structure was not permanently deformed. In fact, the CLT panels were shipped back to Italy and reused in another structure (Quenneville et al. 2007).

FIRE

Type IB construction requires all interior and exterior load bearing walls to achieve a 2-hour fire rating. For the proposed CLT study option, all load bearing walls are constructed from 5-layer CLT. By cladding each side of the CLT wall with one layer of gypsum board, the assembly is assumed to meet a 2-hour fire rating based on assumptions from full-scale fire tests. The floors are also constructed from 5-layer CLT panels with a gypsum topping and dropped gypsum wall board ceiling below and assumed to meet a 2-hour fire rating based on full-scale fire tests (Osborne et al. 2012). Required walls and floors are also furred-out and filled with acoustic insulation to meet sound transmission requirements. Although CLT panels meet Class B flame spread index for an interior finish material (depending on the wood species used at exterior layers), encapsulation with gypsum wallboard provides an additional level of safety.

For Type IB buildings, non-bearing walls are not required to be fire rated. Because the majority of exterior wall area in the test building was not required to take vertical loads, most of the exterior envelope is constructed from light gauge, non-load bearing, non-combustible steel framing with traditional sheathing and gypsum board interior finish rather than with CLT. The study also assumes a fully sprinkled building and a short fire response time based on the building's location only 4 minutes away (by car) from the nearest fire station. It is believed that with the combination of fire resistance of CLT, the protective gypsum board cladding and sprinkler system, the proposed design meets the technical requirements of a IB structure.

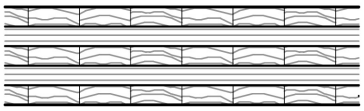
BELOW | FULL SCALE CLT WALL ASSEMBLY FIRE TEST

Fire testing CLT wall assembly. Image: FPInnovations

BELOW | FIRE RATED ASSEMBLY ASSUMPTIONS BASED ON FULL-SCALE FIRE TESTS*

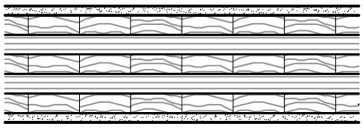
WALL ASSEMBLY

FIRE-TESTED WALL ASSEMBLY*



5ply CLT unprotected = 113 min

PROPOSED MODIFICATION TO FIRE-TESTED WALL ASSEMBLY

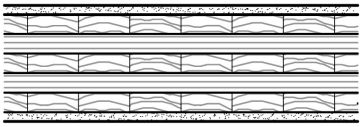


5ply CLT + 1 layer 5/8" gyp = 143 min estimated

* See End Note 4

FLOOR ASSEMBLY

FIRE-TESTED FLOOR ASSEMBLY*



5ply CLT + 1 layer 5/8" gyp = 124 min

CONSTRUCTION COST ANALYSIS

BASIC ESTIMATING ASSUMPTIONS

As noted earlier, the assumptions for estimating the three models is based upon a recently completed existing facility which includes a substantial two level concrete podium on which five wood framed floors were constructed. The specific use of the building and any design cost premiums that would follow remain consistently applied to each cost model estimate. Therefore the true cost differences for each structural component model would include only those items specific to each model's material use requirements. Additionally, the added costs for life safety "high rise" elements due to exceeding the height threshold of 75 ft have been applied equally to all options studied.

It should also be noted that the team assumed only minor variations in the design of the 2-story concrete podium structure would be required for the three different structural model applications, so the cost for this area of the building is consistent in each estimate compared. The study keeps primary details of the exterior enclosure the same for each option as to compare "apples to apples." All 3 options include the same exterior enclosure components, such as sheathing, weather resistant barrier, insulation, external cladding and backup system. All interior partitions are assumed to be metal stud with gypsum wall board except where load bearing CLT walls occur. HVAC equipment is the same in all cost models.

CONCRETE BUILDING ASSUMPTIONS

The Concrete Frame option assumes a fairly typical concrete column spacing and shear wall layout with a 7 inch post tension concrete floor assembly and 5 inch post tension roof assembly. This option offers a more flexible partition wall layout due to its independence from unit stacking requirements.

STRUCTURAL METAL STUD FRAMING

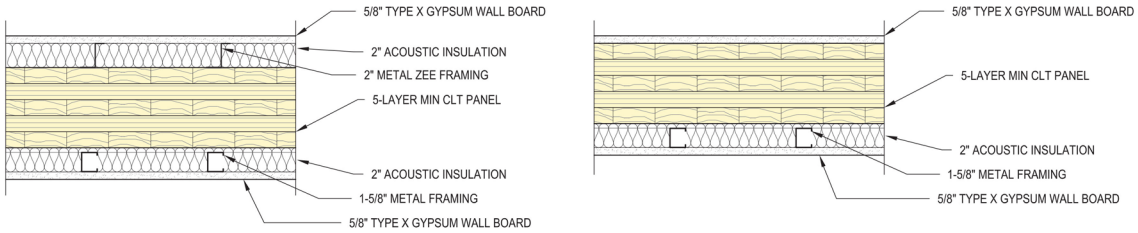
The metal stud option includes cost assumptions that were derived from a current project cost estimate in a building with similar use. This was done not only to identify component type and size but also to maintain current market price information in the study. This design includes metal stud bearing walls integrated with concrete shear walls with floor and roof construction consisting of two inch Versalock Deck material allowing for a three inch concrete fill. This approach also concedes that the design maintain a consistent stacking of unit bearing walls in order to minimize any transfer loads which would require more complicated and costly framing. 2-hour fire rated exterior walls require 3 layers of Type X gypsum board cladding and 2-hour rated floor and roof assemblies require 2 layers of Type X gypsum wall board suspended on the underside of structure.

CLT COST ANALYSIS

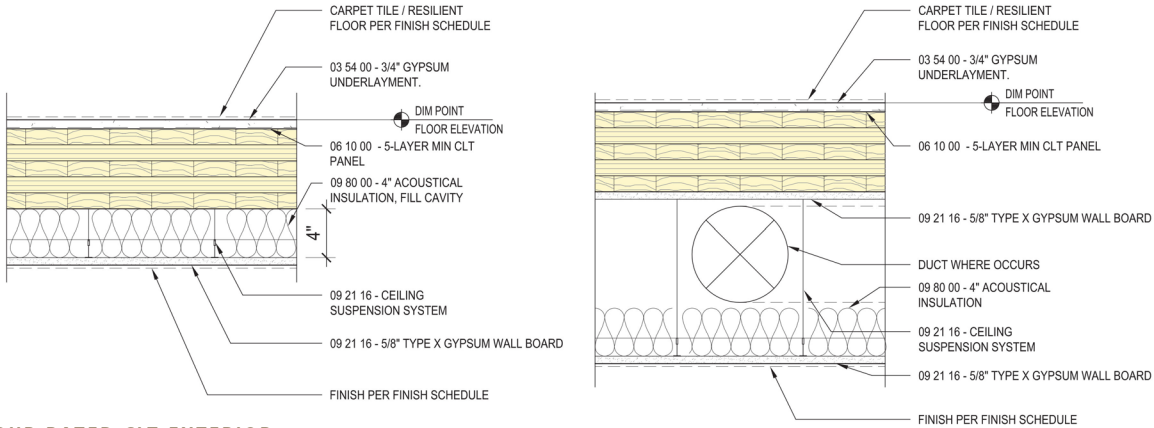
The approach taken by the team initially was to use CLT panels of various sizes and thickness for all walls noted in the original building design. Bearing walls would receive 5-layer panels while non-load bearing walls would utilize a lighter and more economical 3-layer panel. This approach was quickly dismissed for three reasons. First, where the benefit of CLT panels for their intrinsic load bearing capacity is not required, why pay a premium for this heavier construction element over a conventionally framed infill wall? Second, the conventional infill framing allows easier installations of mechanical, plumbing and electrical rough-in components. Finally, fewer CLT panels to erect during the structural framing phase of construction saves critical path construction time. See Figure 4 for proposed CLT wall and floor assemblies used in the study.

BELOW | FIGURE 4: PROPOSED CLT WALL, ROOF AND FLOOR ASSEMBLIES

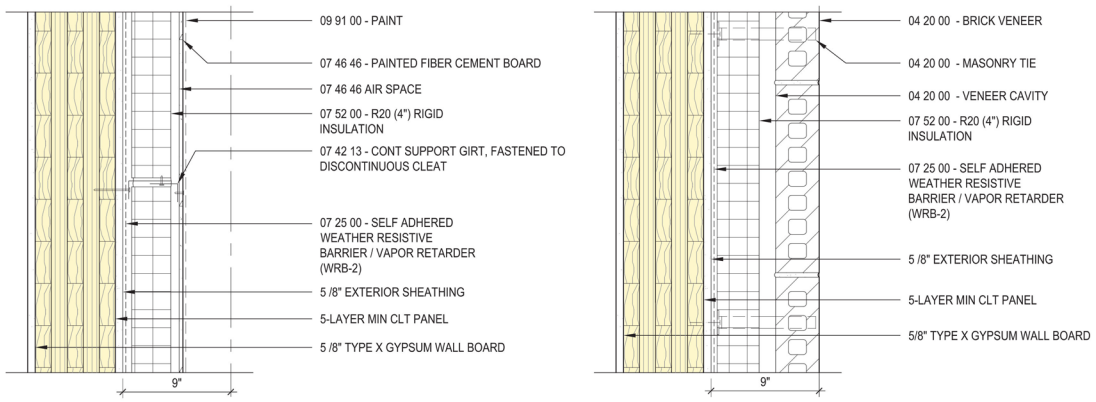
PROPOSED 2-HOUR RATED CLT INTERIOR WALL ASSEMBLIES*



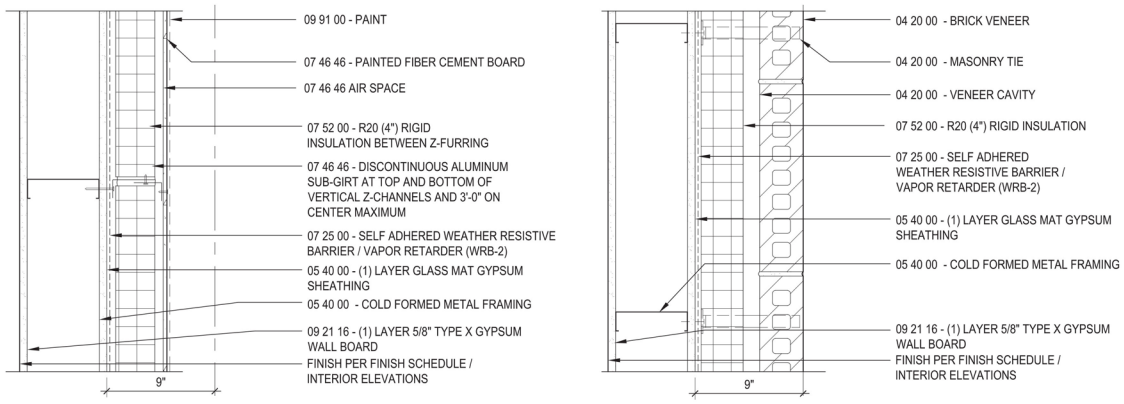
PROPOSED 2-HOUR RATED CLT FLOOR ASSEMBLIES*



PROPOSED 2-HOUR RATED CLT EXTERIOR WALL ASSEMBLIES*

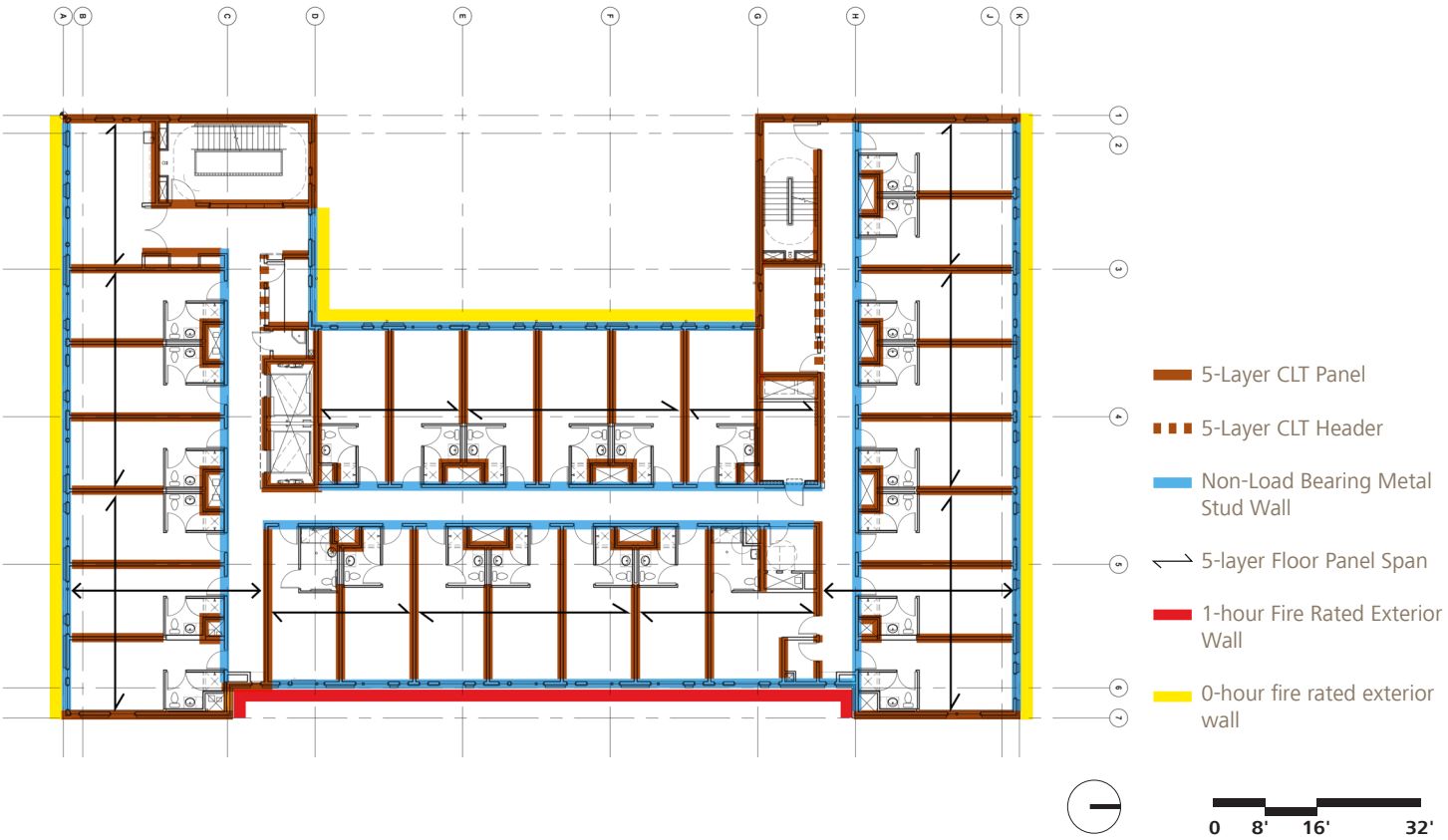


PROPOSED 1-HOUR RATED METAL STUD WALL ASSEMBLIES



* Assemblies here are proposed based on fire testing results in accordance with ASTM E119 standard and additional layers of protective gypsum board cladding.

BELOW | TYPICAL RESIDENTIAL LEVEL FRAMING PLAN



Once the team focused on utilizing the CLT approach only for the required bearing and shear components the complexity and cost lowered to a more favorable level. The overall construction schedule also improved by several months, due to the speed of erecting the prefabricated panels vs. the slower process of cast in place concrete or the metal stud option which still relies on significant concrete shear walls. The cost benefit of reduced general conditions expenses has been realized within the construction estimate for this approach.

Consultation with CLT suppliers provided us with productivity rates that have been used in other regions. Factoring in connection details for moment frame steel connectors and likely inclement weather conditions, a conservative installation production rate was used to assure ourselves that a composite crew of operators, riggers and carpenters would achieve production much like the crews that install precast concrete panels. We believe with further development of the process and required details; a significant savings in this area is possible.

Because of the extensive prefabrication of the material, CLT could likely use a less skilled workforce, a potential cost saving factor. Temporary weather protection of CLT elements, in addition to sequencing deliveries and storage (if necessary) of the material must also be considered. Projects where the design utilizes exposed CLT components in the finish expression of the building are likely to encounter higher costs for temporary protection.

As previously noted, the requirements for fire rated assemblies demand furred out walls and ceiling assemblies. With these layers of gypsum wall board and the addition of treatments such as acoustical insulation and gypcrete, the required fire and STC ratings can be achieved. These furred areas also provide a chase for running fire protection branch piping, plumbing, electrical and air vent ducting.

The cost drivers for CLT construction are material cost, erection timeframe and site location. Increased familiarity with CLT construction/erection methods and further development of the product supply chain could significantly reduce the costs of CLT construction compared to other construction types.

OTHER ASSUMPTIONS

:: Gross Building Area: 134,950 gsf

:: Total project Housing Area: 120,300 gsf

:: Total number of housing units: 223 (435 beds)

:: Total Rentable SF as Percent of GSF: 53.6%

CONCLUSION

COST SAVINGS

The results of the study are promising. As compared to the base 10-story concrete building, the CLT option offered an estimated 4% cost saving. The metal stud option offered a 2% cost saving compared to the concrete base building. While the estimated 4% saving is not large, it does indicate that CLT is cost competitive and could be even more competitive in the future.

Although there seems to be growing excitement surrounding the use of CLT, it has yet to reach the manufacturing sector. To date, only one viable manufacturer is available to supply panels required for the building model and in close enough proximity for practical shipping to a site in the Pacific Northwest. There would appear to be enough sustainable resources to feed the potential market, but other manufacturers of engineered wood products have not seen enough demand to warrant the capital expense of retooling. With the increased industry interest, we would expect this to change. With the addition of competition and higher production rates the savings could be higher.

Furthermore, because there is little local experience with this construction system, CLT construction is estimated at a cost premium until competency and familiarity is established. Construction time will also likely be reduced once the system is better known. This study has accounted for these "unknown" factors of using a new building system. The 4% cost savings is a conservative estimate because of these unknowns.

CLT represents a different paradigm in project delivery in that the material cost far outweighs labor costs. It should also be noted that the building design in this study was not optimized for CLT panel sizes or designed to take advantage of the benefits of large format panel construction. The design was simply translated from existing light wood frame to CLT construction. As such, the percent savings could be even greater if the building design were to follow the rigor of efficient CLT modular construction.

Finally, the study only investigated more or less "pure" material choices. Optimizing the building design through use of hybrid structural materials could lead to further cost savings and better opportunities for code approval.

To date, many CLT buildings around the world exceed current Seattle Building Code heights, including 7, 8, 9 and 10 story CLT buildings. In Prince George, a city in British Columbia, Canada, a 7-story, nearly 100 ft tall CLT building that meets similar fire and seismic requirements as in Seattle has been constructed. Buildings like these illustrate the potential of using CLT and providing a real alternative to steel and concrete that will help promote carbon neutral growth. CLT and other large format engineered timber products represent the only green alternative to carbon intensive steel and concrete construction. We hope this study helps lead to further research and development. Issues related to building code, seismic response, supply and experience all must be expanded. With recent developments, wood offers the first new structural systems for tall buildings in over 100 years; an exciting time for architects, engineers, contractors, developers and city officials to re-envision how we build for a sustainable future.

End Notes

1. Seattle CLT Advisory Committee web site: <http://seattle.gov/dpd/codesrules/changestocode/crosslaminatedtimber/getinvolved/default.htm>

2. Cross Laminated Timber (CLT) Gains Code Approval, 2012. Available from: <http://www.awc.org/NewsReleases/2012/newsreleases2012.php>. [23 December 2013]

3. Quenneville, Dr. Pierre; Morris, Hugh Morris, 2007. "Japan Kobe Earthquake Shake Table Simulation - The Earthquake Performance of Multi-storey", NZ Timber Design Journal: Volume 15, Issue 4.

4. Osborne, Lindsay; Dagenais, Christian; Benichou, Noureddine, 2012. "Preliminary CLT Fire Testing Report", FPInnovations, Project No. 301006155.

Image: Structurlam

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