

**Ad Hoc Committee – Tall Wood Buildings
Codes and Standards Work Group
Draft Code Change Proposal
Copyright ©2017 International Code Council, Inc.**

Developed: 8/22/16

Revised: 9/29/16; 11/2/16; 11/11/16; 11/23/16; 12/9/16; 02/17/17; 03/17/17; 04/05/17; 05/03/17; 07/13/17; 07/27/17; 08/30/17; 09/29/17; 10/12/17

File name: Section 602.4 Type of Construction

The following is a draft code change proposal that has been developed by the Codes and Standards Work Group (WG) of the Ad Hoc Committee on Tall Wood Buildings (TWB). This draft proposal has been reviewed by the TWB Committee and is posted for information and comments. Please direct comments to the Chair of the WG: Carl Baldassarra (cbaldassarra@wje.com). **This is a draft only and is subject to change prior to submittal to cdpACCESS by the January 8, 2018 deadline.**

+++++

IBC Chapter 6

Type of Construction

~~**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 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 602.4.1 or 602.4.2 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 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 shall be protected with noncombustible protection applied directly to the mass timber in accordance with sections 602.4.1 through 602.4.3, and the time assigned to the noncombustible protection shall be determined in accordance with Section 703.8 and comply with 722.7.

All mass timber building elements shall be manufactured using adhesives evaluated for, and labeled as conforming to, heat performance in accordance with Chapter 23. All cross-laminated timber shall be evaluated for heat performance in accordance with 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 IV-HT light frame walls 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 noncombustible materials.

602.4.1 Type IV-A. Building elements in Type IV-A construction shall be protected in accordance with 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 703.2 or 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 has 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 face of exterior mass timber walls and mass timber roofs, shall be protected with materials

complying with Section 703.5. 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. Roof fire resistance ratings shall comply with Table 601. The fire resistance of mass timber roofs shall be determined in accordance with 703.2 or 703.3. The interior surfaces of roof assemblies shall be protected in accordance with 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 Section 713, Section 718, and both the shaft side and room side 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 703.2 or 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 has 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 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 item 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 item 2.

602.4.2.2.4 Separation Distance Between Unprotected Mass Timber Elements. 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 602.4.1.2.

602.4.2.4 Roofs. Roof fire resistance ratings shall comply with Table 601. The fire resistance of mass timber roofs shall be determined in accordance with 703.2 or 703.3. 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 of Type IV-B construction 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, Section 718, and both the shaft side and room side of mass timber construction 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 703.2 or 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 has 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. The fire resistance ratings required by Table 601 shall be determined in accordance with 703.2 or 703.3.

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 fire resistance ratings shall comply with Table 601. The fire resistance of mass timber roofs shall be determined in accordance with 703.2 or 703.3. 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 of Type IV-C construction shall be protected with noncombustible protection with a minimum assigned time of 40 minutes as determined in Section 722.7.1(a) lining the concealed space continuously.

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 of Type IV-C construction 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, including any concealed spaces.

(2018 IBC Heavy Timber with no changes other than denoting HT)

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.

602.4.4.1 Fire-retardant-treated wood in exterior walls. *Fire-retardant-treated wood* framing complying with Section 2303.2 shall be permitted within exterior wall assemblies not less than 6 inches in thickness with a 2-hour rating or less.

602.4.4.2 Cross-laminated timber in exterior walls. *Cross-laminated timber* not less than 4 inches in thickness and complying with Section 2303.1.4 shall be permitted within exterior wall assemblies 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.

602.4.4.3 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 2304.11 shall be permitted to be used externally.

TABLE 601

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	2 ^a	1	0	1	0	<u>3</u> ^a	<u>2</u> ^a	<u>2</u> ^a	HT	1	0
Bearing walls												
Exterior ^{e, f}	3	2	1	0	2	2	<u>3</u>	<u>2</u>	<u>2</u>	2	1	0
Interior	3 ^a	2 ^a	1	0	1	0	<u>3</u>	<u>2</u>	<u>2</u>	1/HT	1	0
Nonbearing walls and partitions Exterior	See Table 602											
Nonbearing walls and partitions Interior ^d	0	0	0	0	0	0	<u>0</u>	<u>0</u>	<u>0</u>	See Section 2304.11.2	0	0
Floor construction and associated secondary members (see Section 202)	2	2	1	0	1	0	<u>2</u>	<u>2</u>	<u>2</u>	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	<u>1 1/2</u>	<u>1</u>	<u>1</u>	HT	1 ^{b, c}	0

- 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 412.4.1.
- 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.

TABLE 602

FIRE SEPARATION DISTANCE = X(feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP H	OCCUPANCY GROUP F-1, M, S-1	OCCUPANCY GROUP A, B, E, F-2, I, R, S-2, U
<u>X</u> <5 ^b	ALL	3	2	1
5< <u>X</u> <10	IA, IVA Others	3 2	2 1	1 1
10< <u>X</u> <30	IA, IB, IVA, IVB IIB, VB Others	2 1 1	1 0 1	1 ^c 0 1 ^c
<u>X</u> >30	ALL	0	0	0

REASON

The Tall Wood Building Ad Hoc Committee has prepared a number of code change proposals on the subject of mass timber buildings. Be sure to see the information at the end of this statement for information on those proposals and where to find more information substantiating the language of those proposals.

The Tall Wood Building Ad Hoc Committee (TWB) and its various **working groups (WG's)** studied issues and sought input from various expert sources around the world. The committee has posted those documents and input on the ICC website (www.iccsafe.org) for interested parties to follow its progress and to allow those parties to, in turn, provide input back to the Committee and its various WG's.

Early on during the committee's work, it was clear that additional fire testing was needed to address various committee questions. As such, a series of five full scale, **two** story fire demonstrations were conducted at the Alcohol, Tobacco Firearms and Explosives (ATF) laboratories in Beltsville, MD. The results of those demonstrations, as well as fire testing and demonstrations conducted by others, have been used for justification of these code change proposals. Descriptions and video of the tests are available at www.awc.org/tallwood. A report of the tests also is posted at www.awc.org.

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. All three of these construction variations were used in the full scale fire demonstrations.

The completely protected type of construction 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. 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 applied 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.

Type IV-B allows some unprotected surfaces of the ceiling, the walls or columns and beams. The amount of surface permitted to be installed, as well as required separation between unprotected portions, is clearly specified. 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 are that a predictable char layer develops on mass timber in the same fashion as traditional sawn lumber, provided that substantial delamination is avoided. 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 fire resistance requirements as the existing Type I-B construction, which sets forth requirements for 2-hour structural elements.

Type IV-C permits surfaces of mass timber to be unprotected. This construction type takes advantage of the size of the mass timber structural members and relies on a predictable char rate to provide for rated assemblies. With inherent fire resistance provided by the minimum dimensions of mass timber, 2-hour fire resistance ratings for the structural elements are also required of Type IV-C construction. Examples of Type IV-C construction were fire tested at ATF with functioning and delayed fire sprinklers. The delayed test allow free burning for 23 minutes before fire sprinklers were activated, simulating an interruption of automatic water supply and a reasonable delay for responding fire personnel to supply the fire sprinkler system. The results demonstrated that the Type IV-C construction has a viable purpose and thus is included as part of this proposal. Thus, the Type IV-C type of construction is described as having no noncombustible protection necessary. It is important to note that the permitted concealed spaces are not permitted to be of unprotected mass timber. All such concealed spaces must be fully protected on all interior surfaces as described within the Type of Construction. The committee determined that there should be no height increase, in feet, for Type C construction in Table 504.3 in order to mimic the heights for Type IV-HT buildings, although there are allowance made for building area and height in terms of stories.

Cost impact: None, this section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus no cost impact is derived.