

Fire Protection

Chapters 7, 8 and 9

- Chapter 7 Fire and Smoke Protection Features
- Chapter 8 Interior Finishes
- Chapter 9 Fire Protection and Life Safety Systems

New provisions were added, and modification of existing provisions occurred in Chapter 7 of the 2021 IBC for fire and smoke prevention features. A test approach for determining the added fire-resistance time provided by noncombustible protection was also incorporated along with provisions for sealing adjacent mass timber elements and defining mass timber as a fireblocking material. New provisions provide a prescriptive approach to achieve the required fire-resistance ratings for mass timber members and assemblies. The 2021 IBC includes new provisions requiring the building owner to maintain an inventory of all required fire-resistance-rated construction for Type IV-A and IV-B buildings. IBC Section 803.3 provides an interior finish exemption for heavy timber that is commonly exposed in a building without an overlaid interior finish. This provision has evolved in the 2015, 2018 and 2021 IBC to only require interior stairways, ramps and exit passageways to meet interior finish requirements in Type IV-HT. While there were no changes to IBC Chapter 9 specific to the new mass timber provisions, height and area provisions for Types IV-A, IV-B and IV-C construction that go beyond height and area limits for traditional Type IV construction (now called Type IV-HT) require an NFPA 13-compliant sprinkler system. ■



2021 IBC

703.6, 703.7, 704.4 AND 718.2.1

Fire and Smoke Protection Features

722.7

Fire-resistance Rating of Mass Timber

803.3 (INCLUDING 2015 AND 2018 IBC)

Interior Finishes – Heavy Timber Exemption

CHAPTER 9

Fire Protection and Life Safety Systems

703.6, 703.7, 704.4 and 718.2.1

Fire and Smoke Protection Features

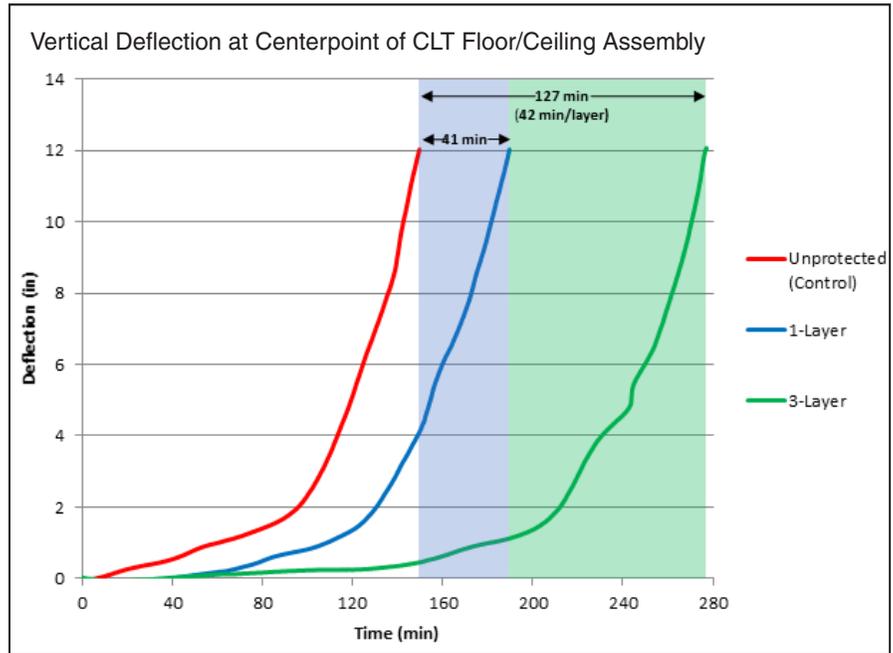
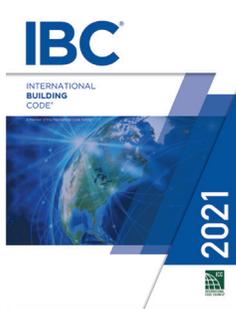


Figure 7-1. The performance method given in IBC Section 703.6 describes the methodology by which the contribution of noncombustible protection to the overall FRR of a mass timber assembly is determined. Noncombustible protection times listed in Table 722.7.1(1), which were confirmed by testing (example shown), are deemed to comply with this provision. (Excerpted from AWC Technical Report No. 10)

CHANGE TYPE: Addition and modification

CHANGE SUMMARY: New provisions were added, and modification of existing provisions occurred in the 2021 IBC for fire and smoke prevention features. A test approach for determining the added fire resistance time provided by noncombustible protection was incorporated along with provisions for sealing adjacent mass timber elements and defining mass timber as a fireblocking material.

2021 IBC: 703.6 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 E119 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.

703.7 Sealing of adjacent mass timber elements. In buildings of Type IV-A, IV-B, and IV-C 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 they are not a required component of a tested fire-resistance-rated assembly.

704.4 Protection of secondary structural members. Secondary structural members that are required to have protection to achieve a fire-resistance rating shall be protected by individual encasement protection.

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

1. Two-inch nominal lumber.
2. Two thicknesses of 1-inch nominal lumber with broken lap joints.
3. One thickness of 0.719-inch wood structural panels with joints backed by 0.719-inch wood structural panels.
4. One thickness of 0.75-inch particleboard with joints backed by 0.75-inch particleboard.
5. One-half-inch gypsum board.
6. One-fourth-inch 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~~ tested in the form and manner intended for use to demonstrate its ability to remain in place and to retard the spread of fire and hot gases.
9. Mass timber complying with Section 2304.11.

CHANGE SIGNIFICANCE:

703.6 Performance method

Section 703.6 provides a performance path to determine the contribution of noncombustible protection to the overall fire-resistance rating of a member or assembly. The fire-resistance rating (FRR) of mass timber structural members consists of the inherent FRR of the mass timber and the additional fire-resistance provided by any added noncombustible protection as described in new definitions.

The performance method given in 703.6 describes the methodology by which the contribution of noncombustible protection to the overall FRR of a mass timber assembly is determined. The methodology involves comparative testing of the assembly, both with and without the noncombustible protection, using procedures set forth in ASTM E119 or UL 263 to determine the time, in minutes, that is assigned to noncombustible protection. Noncombustible protection times listed in Table 722.7.1(1) are



703.6, 703.7, 704.4 and 718.2.1
continued



deemed to comply with this provision. This type of approach is neither new nor ambiguous. IBC Section 722.6 includes provisions by which the fire-resistance ratings of wood assemblies can be established by calculation and also contains protection times for various membranes. Testing by the American Wood Council confirmed values derived from historic testing¹ and results of those and other tests are summarized in Technical Report 10.²

The performance method requires that two tests be conducted. Both tests must be continued until structural failure occurs and must utilize identical structural failure criteria. In the first test, a mass timber assembly without noncombustible protection is tested to structural failure. In the second test, an otherwise identical assembly is tested to structural failure with noncombustible protection added to the assembly. Each test is conducted with identical mass timber elements, identical loading, construction and conditions, but one of the tests includes the noncombustible protection (as defined in IBC Section 703.5). The difference in the time to structural failure between the two samples is the contribution of the noncombustible protection. Applicable noncombustible protection configuration details, attachment details, joint sealing if utilized, and any other accessories and other relevant details must be recorded. This procedure does not eliminate the ASTM E119 thermal separation requirements for wall and floor/ceiling assemblies, which are based on the temperature rise on the unexposed side of the wall or floor/ceiling assembly. Tests of additional assemblies using other materials based on IBC Section 703.6 may be used to justify additions to IBC Table 722.6.2(1) for time assigned to wallboard membranes.

703.7 Sealants and adhesives

Mass timber has inherent properties of fire-resistance, serving to provide structural fire-resistance to comply with type of construction requirements as well as fire-resistance that can be used to safeguard against the spread of fire and smoke within a building or the spread of fire between structures (e.g., elements used as fire walls, fire barriers, etc.). Where mass timber panels, beams or columns are connected together, fire tests have demonstrated that it is important for abutting edges and intersections in the plane and between different planes to be sealed with sealants or adhesives. The structures fire tested in support of these new provisions were constructed with this sealing approach (see Figure 7-2).



Figure 7-2. In buildings of Type IV-A, IV-B and IV-C construction, IBC Section 703.7 requires that sealant or adhesive be provided to prevent air flow at intersections of panels, beams and columns. The sealant or adhesive would not normally be seen protruding from intersections as shown here.

1. The test report titled *Fire Resistance Testing of CLT Floor/Ceiling Assemblies to Establish Contribution of Gypsum Protection* can be obtained from: awc.org/tallmasstimber.
2. Technical Report 10 is available at www.awc.org.

The reference standard for elastomeric joint sealants used with gypsum board, ASTM C920, was already referenced in IBC Chapter 25. ASTM D3498, *Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing*, is a new referenced standard in the IBC to address the adhesives option for sealing abutting edges and intersections.

704.4 Protection of secondary structural members

See Chapter 2 Change Significance for background commentary on secondary structural members.

718.2.1 Fireblocking

This new addition to the list of fireblocking materials in Section 718.2.1 recognizes mass timber as an inherently suitable fireblocking material. The current list of acceptable materials includes “nominal lumber.” Since mass timber (including nail-laminated, glued-laminated and cross-laminated timber) has a greater cross-section than nominal lumber, mass timber provides equal or greater resistance to fire, smoke and gas movement to different parts of the building through combustible concealed spaces than nominal-sized solid sawn lumber.

722.7

Fire-resistance Rating of Mass Timber

IV-A

IV-B

IV-C



Figure 7-3. The TWB-AHC determined fire testing was necessary to validate established performance objectives. Consequently five full-scale, multiple-story fire tests were conducted to simulate the three new construction types (Types IV-A, IV-B and IV-C).

CHANGE TYPE: Addition

CHANGE SUMMARY: New provisions provide a prescriptive approach to achieve the required fire-resistance ratings for mass timber members and assemblies.

2021 IBC: 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. The fire-resistance rating of building elements shall be as required in Tables 601 and 705.5 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 Section 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 703.6. 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 705.5 (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.

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 with 1 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.



722.7 continued



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 1¹/₄-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 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 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.

CHANGE SIGNIFICANCE:

722.7 Fire-resistance rating of mass timber

The provisions of Section 722.7 provide a prescriptive approach to achieving fire resistance for mass timber structures. A designer can calculate the fire-resistance rating (FRR) of a protected wood element by adding the FRR of the unprotected heavy timber member to protection provided by a noncombustible material applied to exposed wood. As a prescriptive solution, the conditions of use, such as attachment, finishing and edge treatment at bordering exposed mass timber areas, are also detailed. Data from the broad testing of beams, columns, wall and ceiling panels was used to establish the values in Table 722.7.1(2).

The FRR of mass timber is permitted to be determined by the methods described in IBC Section 703.3 which are based on ASTM E119 and UL 263 test protocols. Users should also be aware of related requirements for penetrations and joint systems in Sections 714 and 715.

722.7.1 Minimum required protection

The IBC contains requirements for a minimum FRR for each mass timber element, whether exposed wood (where permitted) or protected with noncombustible materials. Noncombustible protection for mass timber in Types IV-A and IV-B construction serves to provide a portion of the fire-resistance of individual elements. Thus, Section 703.6 requires the FRR to be established by determining the minimum contribution of noncombustible protection (for mass timber) and adding that contribution to the mass timber FRR. Although the use of differing materials to achieve a fire-resistance rating is common for the other construction types, the requirement for the outermost protecting portions to be a noncombustible material of minimum fire resistance is unique to these new mass timber types of construction. The degree to which noncombustible protection limits the fuel contribution of mass timber to a fire is an important concept.