

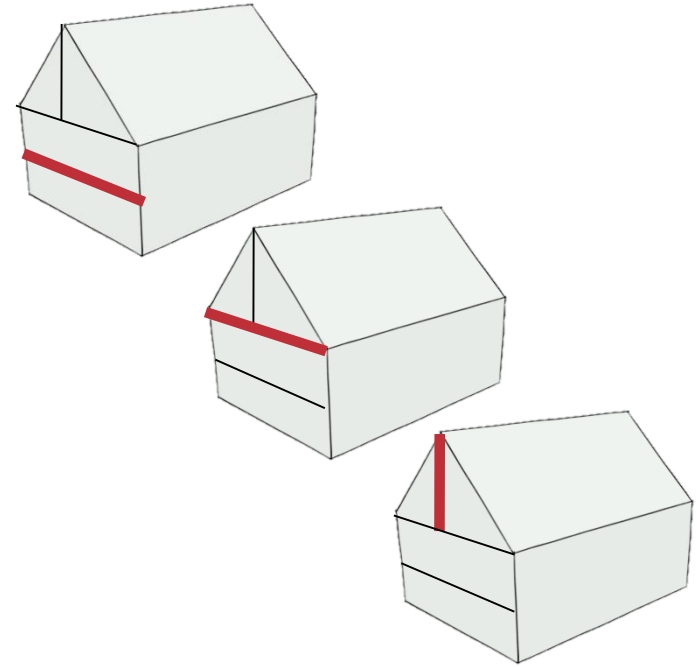
Fire Resistance Rated Truss Assemblies

Educational Overview

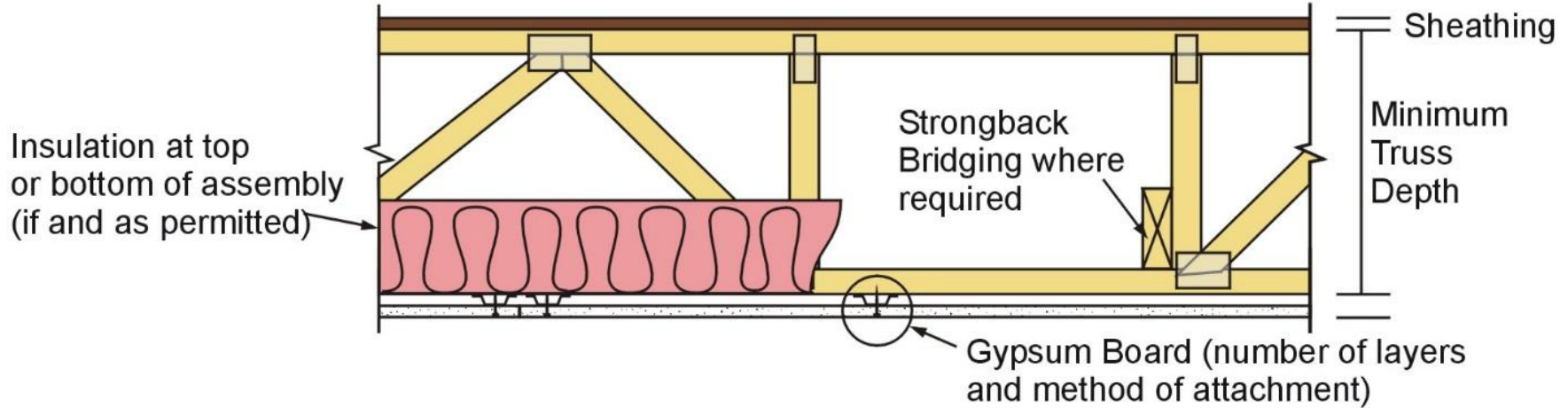


Introduction

- Building codes may require a fire endurance rating for several applications where trusses are used:
 - Floor/ceiling
 - Roof/ceiling
 - Attic separation



Generic fire rated wood truss assembly



Introduction

- Truss protection in fire resistance rated assemblies is covered in the IBC
- States that requirements shall be based on *“the results of full-scale tests or combinations of tests”* or *“approved calculations based on such tests”* that demonstrate fire resistance
- 704.5 Truss protection.

Key Definitions

- **Approved Source**: An independent person, firm or corporation, approved by the building official, who is competent and experienced in the application of engineering principles to materials, methods or systems analyses.
- **Fire Resistance**: That property of materials or their assemblies that prevents or retards the passage of excessive heat, hot gases or flames under conditions of use.
- **Fire-Resistance Rating**: The period of time a building element, component or assembly maintains the ability to confine a fire, continues to perform a given structural function, or both, as determined by the tests, or the methods based on tests, prescribed in [Section 703](#).

Introduction

- The IBC allows five methods for determining fire resistance ([Section 703.3](#)):
 1. Fire-resistance designs documented in sources.
 2. Prescriptive designs of fire-resistance-rated building elements, components or assemblies as prescribed in [Section 721](#).
 3. Calculations in accordance with [Section 722](#).
 4. Engineering analysis based on a comparison of building element, component or assemblies designs having fire-resistance ratings as determined by the test procedures set forth in ASTM E119 or UL 263.
 5. Alternative protection methods as allowed by [Section 104.11](#).

Method 1: Documented fire-resistance designs

- To qualify as a documented design, testing is performed in accordance with one of the following tests:
 - [ASTM E119](#) Standard Methods for Fire Tests of Building Construction and Materials
 - [ANSI/UL 263](#) Fire Resistance Ratings



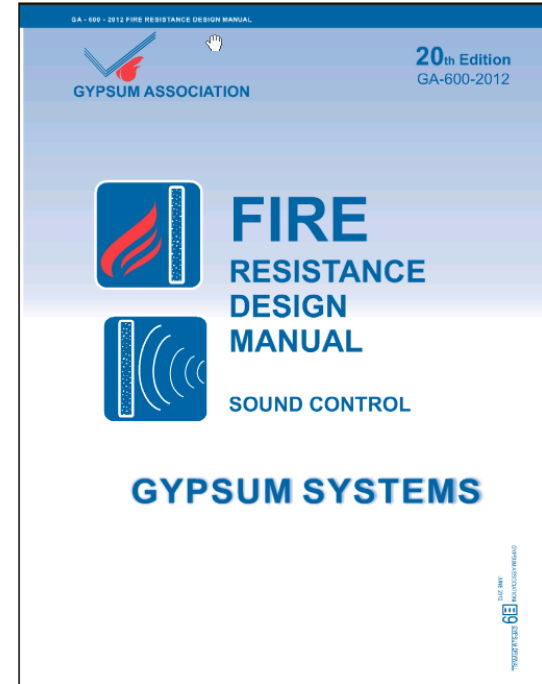
Method 1: Documented fire-resistance designs

- Tested assemblies may be specified where a rated assembly is required
- Assemblies can generally be applied to both floor and roof applications



Method 1: Documented fire-resistance designs

- Some sources of documented fire-resistance designs include:
- Gypsum Association
 - *Fire Resistance Design Manual (GA-600)*
 - [Online Manual \(read only\)](#)



Method 1: Documented fire-resistance designs

- Underwriters Laboratories:
 - *Fire Resistance Directory*
 - [Searchable Database](#)
- Many UL tested designs can also be found in the product literature of companies whose products are certified to be listed in the assemblies



Method 1: Documented fire-resistance designs

- Other sources of documented fire-resistance designs include:
 - Warnock Hersey ([Intertek Directory](#))
 - [Factory Mutual](#)
 - [PFS Corporation](#)



Method 1: Documented fire-resistance designs

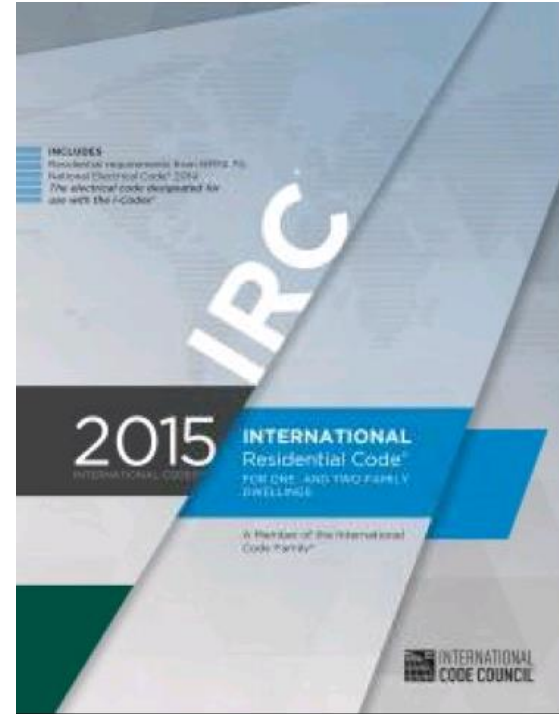
- **General:**

- The fire resistance rating of listed assemblies applies to the entire assembly
- Components are NOT intended to be interchanged between assemblies.



Method 1: Documented fire-resistance designs

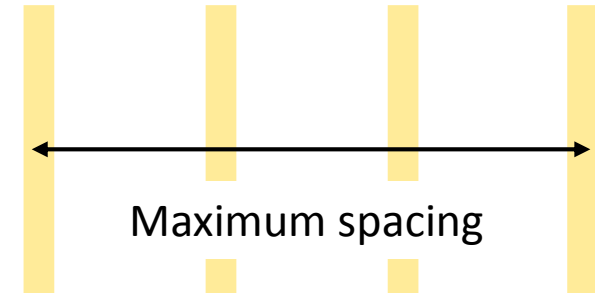
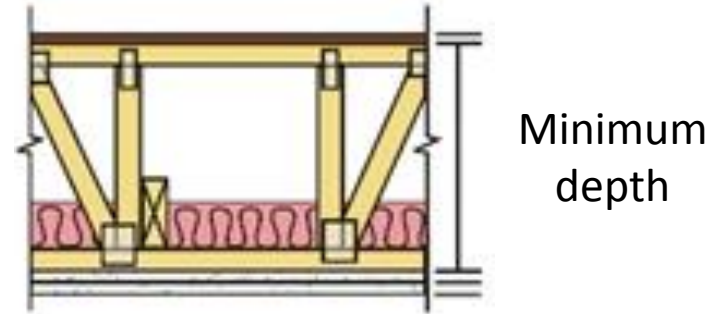
- However, evaluation by comparison of tested assemblies is permitted by *IBC* Section 703.3 Method 4.



Method 1: Documented fire-resistance designs

- **Depth/Spacing:**

- Depths given are minimums
 - Greater depths are allowed
- Spacings given are maximums
 - Smaller spacings are allowed



Method 1: Documented fire-resistance designs

- **Insulation:**

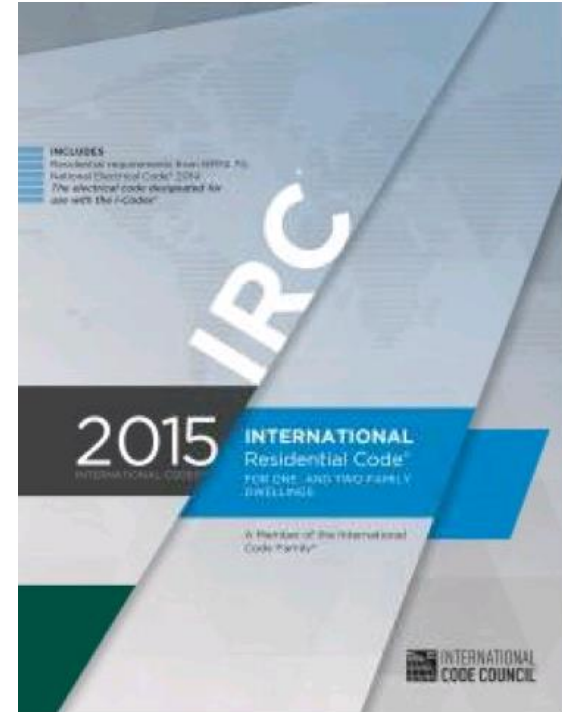
- Some assemblies allow addition of insulation if an additional layer of gypsum is installed at the ceiling.



Modifications?

Method 1: Documented fire-resistance designs

- However, IBC Section 703.3 Method 4 and Method 5 permit modifications to assemblies
- This would include modifications involving insulation
 - Rational design must be provided to the building official



Method 1: Documented fire-resistance designs

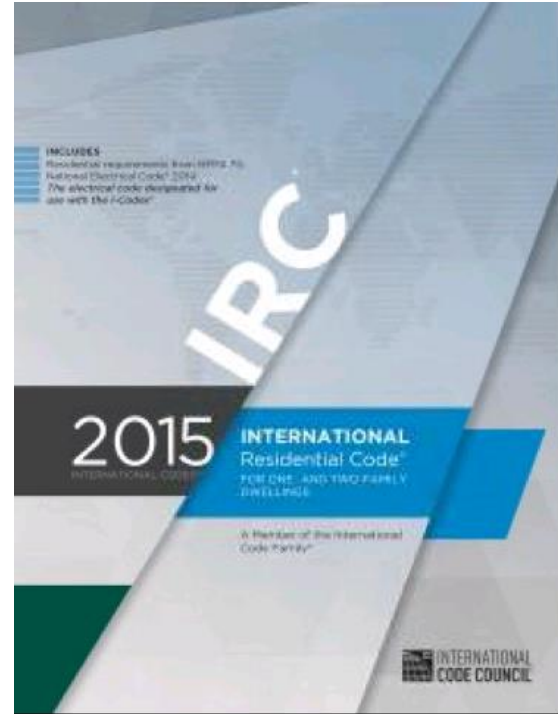
- Use of floor/ceiling designs for roof/ceiling (or reverse):
 - [UL BXUV.GuideInfo](#) Section III.19 states:
 - Class A, B or C roof coverings may be used on floors without reducing the fire-resistance rating
 - A nailer of equal thickness to the length of the mechanical fasteners must be added to the flooring

Method 1: Documented fire-resistance designs

- Use of floor/ceiling designs for roof/ceiling (or reverse):
 - The reverse case is not typical
 - Floor/ceiling designs that specify a finish floor cannot be used as roof/ceiling assemblies

Method 1: Documented fire-resistance designs

- However, *IBC* item 4 or item 5 would allow use of assemblies tested as floor/ceiling or roof/ceiling in the other application, even if not specified as such in the listing
 - Rational design must be provided to the building official.

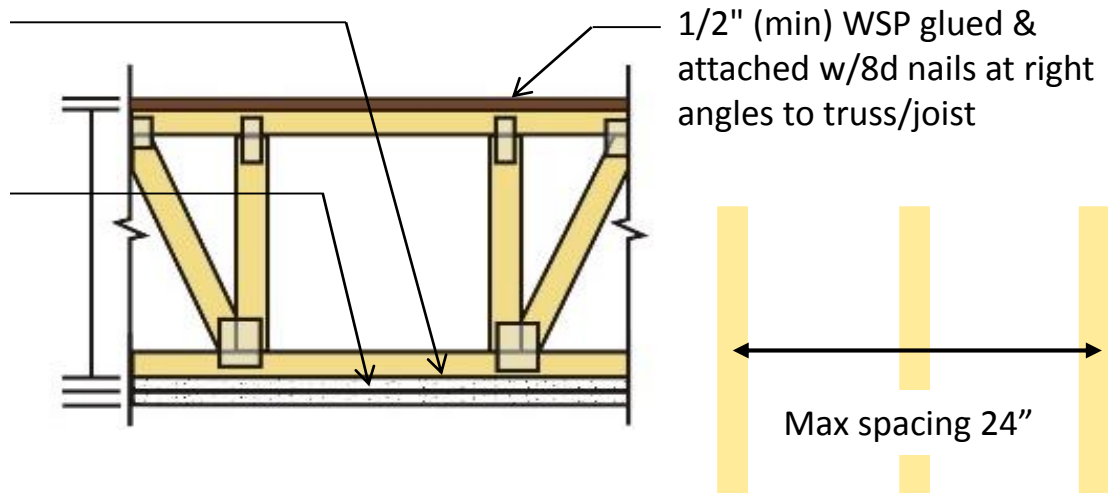


Method 2: Prescriptive designs

- *IBC Table 721.1(3)*, item 21-1.1 describes one prescriptive 1-hour rated floor or roof assembly that includes wood trusses:

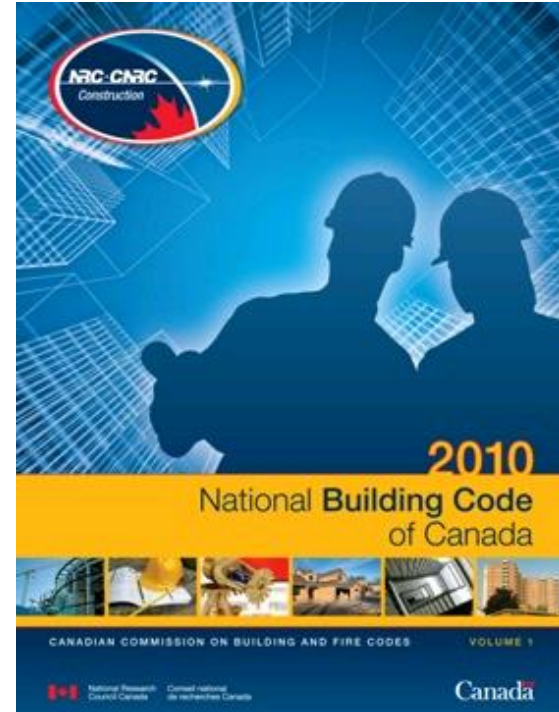
Base layer: 5/8" Type X gyp attached w/1-1/4" Type S or W drywall screws @ 24" o.c. at right angles to truss/joist

Face layer: 5/8" Type X gyp or veneer base attached thru base layer w/1-7/8" Type S or W drywall screws 12" o.c. at joints and intermediate truss/joist. Type G drywall screws placed 2" back on either side of face layer end joints @ 12" o.c.



Method 2: Prescriptive designs

- The National Building Code of Canada (NBC) 2010 provides an extensive listing of prescriptive assemblies that include metal plate connected wood trusses in Table A-9.10.3.1.B.
- These listings also include sound ratings, so can be very useful to the building designer.



Method 3: Calculated designs

- *IBC* Section 722.6 addresses fire resistance calculations for wood assemblies
 - The unexposed side membrane is NOT included in the calculation

Fire-exposed side membrane
+
Framing members
+
Other (e.g. Insulation)
=
Fire-resistance rating
(minutes)

Method 3: Calculated designs

- The maximum fire-resistance rating allowed using this method is 1-hour.
- This section includes tables with times assigned to both structural members and membranes.

TABLE 722.6.2(1) TIME ASSIGNED TO WALLBOARD MEMBRANES^{a, b, c, d}

DESCRIPTION OF FINISH	TIME ^a (minutes)
$\frac{3}{8}$ -inch wood structural panel bonded with exterior glue	5
$\frac{15}{32}$ -inch wood structural panel bonded with exterior glue	10
$\frac{19}{32}$ -inch wood structural panel bonded with exterior glue	15
$\frac{3}{8}$ -inch gypsum wallboard	10
$\frac{1}{2}$ -inch gypsum wallboard	15
$\frac{5}{8}$ -inch gypsum wallboard	30
$\frac{1}{2}$ -inch Type X gypsum wallboard	25
$\frac{5}{8}$ -inch Type X gypsum wallboard	40
Double $\frac{3}{8}$ -inch gypsum wallboard	25
$\frac{1}{2}$ -inch + $\frac{3}{8}$ -inch gypsum wallboard	35
Double $\frac{1}{2}$ -inch gypsum wallboard	40

Method 4: Comparison

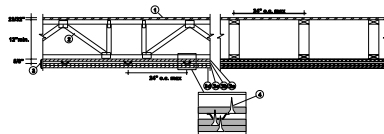
- The IBC allows the determination of fire resistance ratings based on a comparison of building element, component or assembly designs having fire-resistance ratings as determined by the test procedures set forth in *ASTM E119* or *UL 263*.

Method 4: Comparison

- Combined with the provisions of *IBC* Section 104.11 listed at item 5, this allows the building official to approve a design that *"complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety."*

Method 4: Comparison

- SBCA has calculated a two hour fire rated MPCWT assembly based on this provision
- See SBCA SRR 1509-02 for full details



Research Report

Calculation of a 2-Hour Fire Endurance Assembly for Metal-Plate-Connected Wood Truss Structural Floor and Roof Framing Systems

SRR No. 1509-02

Prepared for the Structural Building Components Association (SBCA)

Draft Date: January 11, 2016

SBCA is an APPROVED SOURCE

This research report is based on practical scientific research (literature review, testing, analysis, etc.). This research report complies with the following sections of the building code:

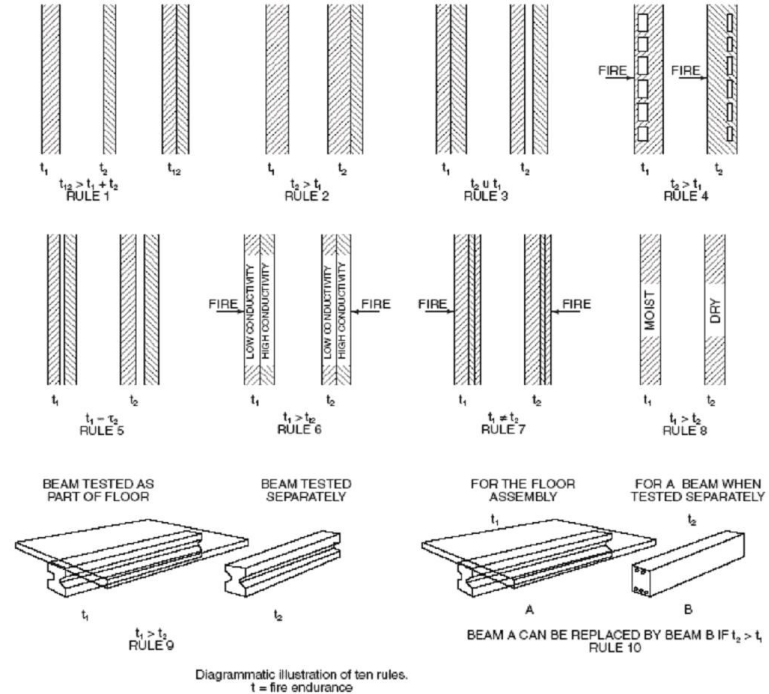
- **IBC Section 104.11.1 and Section 1703.4.2** – "Research reports. Supporting data, where necessary to assist in the approval of materials or assemblies not specifically provided for in this code, shall consist of valid research reports from approved sources."
- **IBC Section 202** – "APPROVED SOURCE. An independent person, firm or corporation, approved by the building official, who is competent and experienced in the application of engineering principles to materials, methods or systems analyses."

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Method 4: Comparison

- One basis for this type of analysis is Harmathy's "Ten Rules of Fire Endurance Rating"
- Consult [Section 4-13](#) in the SFPE Handbook of Fire Protection Engineering for further info



Method 5: Alternative materials and methods

- **104.11 Alternative materials, design and methods of construction and equipment.**
 - The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, **fire resistance**, durability and safety.

Method 5: Alternative materials and methods

- This allows for other methods of developing a design by an approved source that complies with the intent of the code and, unless it can be demonstrated not to comply with the code, should be approved by the building official.



Conclusion

- A Building Designer may submit to a code jurisdiction a fire resistance rated design incorporating metal plate connected wood trusses using any of the five methods allowed by [Section 703.3.](#)
- If it is not a listed design, the Building Designer should submit details regarding how the submitted design was determined and show how it complies with the intent of the building code.

References

- SBCA Research Report 1509-01
- National Design Specification[®] for Wood Construction (NDS[®]) 2012 or 2015, American Wood Council (AWC), Section 16, Fire Design of Wood Members.
- Analytical methods for determining fire resistance of timber members, Robert White, 2008, included in the SFPE handbook of fire protection engineering. Quincy, Mass.; National Fire Protection Association; Bethesda, Md.: Society of Fire Protection Engineers, c2008: pages 4.346-4.366.
- Guidelines on Fire Ratings of Archaic Materials and Assemblies. International Code Council (ICC).
- National Building Code of Canada, 2010.

References

- [International Building Code \(IBC\)](#), 2012 and 2015, International Code Council (ICC).
- [BXUV.GuideInfo](#), Underwriters Laboratory.
- [Gypsum Association Handbook](#), GA-600, 2012
- [Fire Resistance Provided by Gypsum Board Membrane Protection](#), GA-610, 2013
- [ESR-1338](#), Gypsum Wall and Ceiling Assemblies and Gypsum Board Interior and Exterior Applications
- [Intertek Directory of Certified Products](#)
- [PFS Corporation](#)
- [Factory Mutual](#)