Fire Resistance Detailing for Light-frame Mid-rise Structures

Including Fire Wall, Exterior Wall and Shaft Wall Conditions

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National Mid-rise Movement
What do you see?
Fire Design

Combustibility

Fire Resistance

Fire Protection Systems

Flame Spread Classification
# Fire Resistance Ratings

## Key Differences in Fire Ratings for Construction Types

<table>
<thead>
<tr>
<th></th>
<th>IIIA</th>
<th>IIIB</th>
<th>VA</th>
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<tbody>
<tr>
<td>Exterior (bearing) wall framing</td>
<td>FRT</td>
<td>FRT</td>
<td>non-FRT</td>
</tr>
<tr>
<td>Exterior wall fire rating</td>
<td>2 hr</td>
<td>2 hr</td>
<td>1 hr</td>
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<tr>
<td>Floor assembly fire rating</td>
<td>1 hr</td>
<td>0 hr</td>
<td>1 hr</td>
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<tr>
<td>Fire wall rating</td>
<td>3 hr</td>
<td>3 hr</td>
<td>2 hr</td>
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Choosing Fire Rated Assemblies

Tested assemblies (ASTM E119) per IBC703.2:
• UL Listings
• Gypsum Catalog
• Proprietary Manufacturer Tests
• Industry Documents: such as AWC’s DCA3

Alternate Methods per IBC703.3
• Prescriptive designs per IBC721
• Calculated Fire Resistance per IBC722
• Fire-resistance designs documented in sources
• Engineering analysis based on a comparison
• Fire-resistance designs certified by an approved agency
Exterior Walls

703.5 Fire resistance ratings. Exterior walls shall be fire-resistance rated in accordance with Tables 601 and 602 and this section. The required fire-resistance rating of exterior walls with a fire separation distance of greater than 10 feet (3048 mm) shall be rated for exposure to fire from the inside. The required fire-resistance rating of exterior walls with a fire separation distance of less than or equal to 10 feet (3048 mm) shall be rated for exposure to fire from both sides.
Exterior Walls

Lot Line

Exterior

X<10'

Interior
Exterior Walls - Asymmetry

2-HOUR EXTERIOR WALL

- EXTERIOR CEMENT PLASTER, MIN. THICKNESS 3/4" TO FACE OF LATH
- 1 LAYER 5/8" FIBERGLASS MAT GYPSUM SHEATHING
- FRAMING AT 16" O.C., MIN. 2 X 4
- STRUCTURAL WOOD PANEL(S) WHERE REQUIRED FOR SHEAR
- MIN. 3" THICK MINERAL WOOL BATT INSULATION
- 2 LAYERS 5/8" TYPE 'X' GYPSUM BOARD AT INTERIOR CONDITIONS
- EXTERIOR CEMENT PLASTER OVER FIBERGLASS MAT GYPSUM SHEATHING AT EXTERIOR CONDITIONS

2-HOUR RATING PER UL DESIGN NO. U371
Exterior Walls – Addition  WSP

ESR-2586

4.7 Fire-resistive Construction:

As an alternate to plywood of the same thickness, structural-use panels may be used in one-hour fire-resistive floor-ceiling or roof-ceiling assemblies permitted by the applicable code. In lieu of 11/32-inch-thick (11.9 mm) or 1/4-inch-thick (12.7 mm) plywood, two-layer assemblies are permitted to be constructed with 1/16-inch-thick (11.1 mm), nonveneer rated sheathing (span-rated 24/16).

The 11/32-inch- or 1 1/4-inch-thick (27.9 mm or 28.6 mm) Sturd-I-Floor (rated 48 oc) panels may be substituted for the double-wood floor for one-hour wood-floor construction.

Structural-use panels may be installed between the fire protection and the wood studs on either the interior or exterior side of fire-resistance-rated wood frame wall and partition assemblies described in the applicable code, provided the length of fasteners is adjusted for the added thickness of the panel.

Tongue-and-groove structural-use panels that are either 11/16 inch or 1 1/4 inch (27.9 mm or 28.6 mm) thick, with exterior glue, may be substituted for the plywood permitted in the code for heavy timber roof decks in Type IV
Exterior Walls – Primary Frame Protection

Frequently Asked Questions

What is the correct application of 2009/2012 IBC Sections 704.2 (Column Protection) and 704.3 (Protection of the primary structural frame other than columns) to wood construction?

Section 704.2 of the 2009 and 2012 International Building Code (IBC) has its source in the legacy building codes and was primarily intended to address steel construction. The current text first appeared in the 2009 IBC, but was actually part of the 1999 BOCA National Building Code and 1994 editions of the SBCCI Standard Building Code and the ICBO Uniform Building Code. In earlier editions of the IBC, omission of fireproofing on portions of steel columns or beams behind ceiling or wall membranes of fire-resistance rated assemblies was permitted. During more recent code development cycles, it was agreed that membrane protection alone was inadequate, especially for members carrying the upper floors of a building, since they would be exposed to fire which originates in a...
Exterior Walls – Intersecting Floors

Legend

- Yellow: Untreated
- Gray: FRT Wood

FRT sheathing

Floor sheathing
Exterior Walls

705.6 Structural stability. The wall shall extend to the height required by Section 705.11 and shall have sufficient structural stability such that it will remain in place for the duration of time indicated by the required fire-resistance rating. Where exterior walls have a minimum fire separation distance of not less than 30 feet (9144 mm), interior structural elements which brace the exterior wall but which are not located within the plane of the exterior wall shall have the minimum fire-resistance rating required in Table 601 for that structural element. Structural elements which brace the exterior wall but are located outside of the exterior wall or within the plane of the exterior wall shall have the minimum fire-resistance rating required in Tables 601 and 602 for the exterior wall.
Exterior Walls – Intersecting Floors

Legend

- Yellow: Untreated
- Gray: FRT Wood

- FRT sheathing
- Floor sheathing
- Rim board
- Joist hanger

Point 1 of Interpretation:
- Continuity of 2hr rating
- Solid Rim Board
722.1 General. The provisions of this section contain procedures by which the fire resistance of specific materials or combinations of materials is established by calculations. These procedures apply only to the information contained in this section and shall not be otherwise used. The calculated fire resistance of concrete, concrete masonry and clay masonry assemblies shall be permitted in accordance with ACI 216.1/TMS 0216. The calculated fire resistance of steel assemblies shall be permitted in accordance with Chapter 5 of ASCE 29. The calculated fire resistance of exposed wood members and wood decking shall be permitted in accordance with Chapter 16 of ANSI/AF&PA National Design Specification for Wood Construction (NDS).
Exterior Walls – Intersecting Floors

Point #1 of Interpretation:
- Continuity of 2hr fire rating
  - Double wall membrane
  - Blocking

Point #2 of Interpretation:
- Continuity of FRT
  - Solid FRT Rim Board/Block

Deep I-joist or Bottom Chord Truss

FRT sheathing

Rim board

Joist hanger
Exterior Walls – Intersecting Floors

FRT sheathing

FRT Floor sheathing

Joist hanger
Floor sheathing (may be FRT)

Exterior Walls – Intersecting Floors

FRT sheathing

FRT blocking

Joist hanger
Exterior Walls – Intersecting Floors

- Floor membrane provides 1hr
- 2x blocking provides 1hr
- Floor sheathing (may be FRT)
- FRT sheathing
- FRT blocking
- Top flange Joist hanger
- 2x blocking

[MAP] – highlight WA, OR, CA,
Point 1 of Interpretation:

1) Continuity of 2 hour fire rating

- 1 layer of wall membrane continues through floor cavity

2) Blocking provides 1 hour

Exterior Walls – Intersecting Floors

- Exterior Walls – Intersecting Floors
- Floor sheathing
- Top flange Joist hanger
- Floor sheathing (may be FRT)

MAP – highlight WA, OR

- FRT sheathing
- FRT blocking
- 2x blocking
Exterior Walls – Intersecting Floors

- FRT sheathing
- Floor sheathing (may be FRT)
- Top flange Joist hanger approved to span 2 layers GW

MAP - Highlight: WA, OR
Over Gypsum Hangers

Joist hanger may be installed over drywall when a gap no greater than 3/8" exists between the top of the drywall and the top of the top plate.
Exterior Walls – Intersecting Floors

- FRT Floor sheathing
- FRT ledger
- FRT blocking
- Top flange Joist hanger

MAP – highlight southeast
Type III Construction Detail Example

- **Floor membrane** provides 1 hr of protection.
- 1 layer of wall membrane continues through the floor cavity.

**2x flat blocking**

**Floor sheathing**

**FRT sheathing**

**Rim board**

**FRT blocking**
Exterior Walls
Fire Walls

706.2 Structural stability. Fire walls shall have sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall for the duration of time indicated by the required fire-resistance rating or shall be constructed as double fire walls in accordance with NFPA 221.

706.3 Materials. Fire walls shall be of any approved non-combustible materials.

Exception: Buildings of Type V construction.
Fire Walls

Options per NFPA 221:
3-HOUR FIRE WALL ASSEMBLY

- 3" HOURS PER UL DESIGN NO. U435
- 1 5/8" METAL STUDS AT 24" O.C. MAX.
- BATT INSULATION (OPTIONAL)
- 3 LAYERS 1/2" TYPE 'X' GYP. BD. ON EACH SIDE OF METAL STUDS
- INTERIOR OR EXTERIOR FINISH AS REQUIRED
- AIR GAP

WOOD STRUCTURAL PANELS WHERE REQUIRED FOR SHEAR
WOOD STUD WALLS ON EITHER SIDE OF FIRE WALL

3 LAYERS 1/2" TYPE 'X' GYPSUM BD. ON EACH SIDE OF METAL STUDS

- (2) 1” Type X Gypsum
- 2” H Studs
- 2” mineral fiber insulation
Fire wall – Diaphragm Continuity

**3-HOUR FIRE WALL AT FLOOR/CEILING**

- 3-HR. ASSEMBLY: 1 5/8" METAL STUDS WITH 3 LAYERS 1/2" TYPE 'X' GYP. BD. EACH SIDE
- CONTINUOUS STRUCTURAL WOOD PANELS - USE FIRE-TREATED PANELS THROUGH WALL CAVITY
- RIM JOIST WITH SOLID BLOCKING
- RESILIENT CHANNELS
- 3-HOUR FIRE CAULKING
- 1" AIR GAP
- 2 X 4 STUD WALL EACH SIDE. WITH STRUCTURAL WOOD PANELS AS REQUIRED FOR SHEAR AND 1 LAYER 5/8" TYPE 'X' GYP. BD.

*CONSULT LOCAL JURISDICTION HAVING AUTHORITY FOR ACCEPTANCE OF FIRE-TREATED WOOD PANELS RUNNING THROUGH 3-HOUR ASSEMBLY IN THIS APPLICATION.

I-JOIST FRAMING WITH WOOD PANEL DIAPHRAGM RUNNING THROUGH FIRE WALL
Shaft Walls

707.5 Continuity. Fire barriers shall extend from the top of the foundation or floor/ceiling assembly below to the underside of the floor or roof sheathing, slab or deck above and shall be securely attached thereto. Such fire barriers shall be continuous through concealed space, such as the space above a suspended ceiling. Joints and voids at intersections shall comply with Sections 707.8 and 707.9.

713.4 Fire-resistance rating. Shaft enclosures shall have a fire-resistance rating of not less than 2 hours where connecting four stories or more, and not less than 1 hour where connecting less than four stories. The number of stories connected by the shaft enclosure shall include any basements but not any mezzanines. Shaft enclosures shall have a fire-resistance rating not less than the floor assembly penetrated, but need not exceed 2 hours. Shaft enclosures shall meet the requirements of Section 703.2.1.
Shaft Walls

CMU wall

Concrete Masonry
Shaft Walls

Gypsum liner panels

1 hr. wall fire rated assembly
Above and below

UL U336
Shaft Walls

2 layers 5/8” thk. Type “X” GWB each side for 2 hr. rating

Rim joist

WSP sht’g as required

2x6 studs

Floor joists

Concrete topping

Dbl. row of solid blocking to continue fire rating

Wood Design Focus: Volume 22, Issue 3 by Smith
Elevator Shaft Wall

2 layers 5/8” thk. Type “X” GWB each side for 2 hr. rating

Elevator guide rails and support bracket with slotted holes

Galvanized metal spacer

Double stud wall

Nailer plate

Concrete topping

Floor joists

Rim joist

Dbl. row of solid blocking to continue fire rating

WSP sh'tg as required

Wood Design Focus: Volume 22, Issue 3 by Smith
Interior Exit Stairway Enclosures
What do you see?
Performance Based Codes