A Detailing Deep Dive: Fire, Acoustics and Structural Detailing in Mid-Rise Multi-Family



July, 2021 WoodWorks Online Workshop

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Photo: Larry Harwell

Today's Outline

• Interior Wall Assemblies

- Fire-Resistance
- Acoustics
- Shearwalls and blocking
- Wall Types
 - Fire Walls
 - Fire Barriers
 - Fire Partitions/Corridors
- Assembly Intersections

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.



Step up your detailing game with this wood design workshop! What is the most economical unit demising wall assembly in a multifamily building? How do you detail the intersection of corridor walls and unit demising walls? How can you detail a head of corridor wall to underside of floor assembly while maintaining code requirements for fire-resistance continuity, minimizing acoustics flanking, and transferring structural loads for shear walls? If you have questions like this, you won't want to miss this highly interactive event focused on practical solutions for real world challenges. Join us online to engage in a step-by-step discussion of how to design and detail common interior wall assemblies and wall intersections in mid-rise multi-family wood structures. We'll analyze example details and assemblies, contrast different assembly options, learn how to make modifications to tested wall assemblies, and look at tools you can use to evaluate your options.

Learning Objectives

- 1. Review code provisions that define fire resistanceratings and acoustics ratings for interior wood walls such as unit demising walls and corridor walls.
- 2. Introduce shaft wall assembly types, evaluating their applicability to elevator, stair and mechanical shafts.
- 3. Provide detailing options that establish fire resistance continuity at framing intersections.
- Recognize structural design considerations for interior unit demising and corridor walls in mid-rise applications.

Outline

- Interior Wall Assemblies
 - Fire-Resistance
 - Acoustics
 - Shearwalls and blocking

Interior Fire-Rated Walls: Differences

Fire walls

- Building
 Separation
- Openings are protected and limited
- Continuous from foundation to/through roof and exterior wall to/through exterior wall
- Structural stability

Fire Barrier

- Shafts, Occupancy Separation
- Openings are protected and limited
- Continuous from floor through concealed space at each level

Fire Partition:

- Dwelling Unit Separation; Corridors
- Openings are protected
- May terminate at a fire rated floor/ceiling/roof assembly

Each portion of a building separated by one or more fire walls shall be considered to be a separate building.





Fire Walls – Ratings & Materials

TABLE 706.4 FIRE WALL FIRE-RESISTANCE RATINGS

GROUP	FIRE-RESISTANCE RATING (hours)	
A, B, E, H-4, I, R-1, R-2, U	3 ª	
F-1, H-3 ^b , H-5, M, S-1	3	
H-1, H-2	4 ^b	
F-2, S-2, R-3, R-4	2	

 In Type II or V construction, walls shall be permitted to have a 2-hour fire-resistance rating.

b. For Group H-1, H-2 or H-3 buildings, also see Sections 415.6 and 415.7.

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

Exception: Buildings of Type V construction



FIRE WALL TO EXTERIOR WALL: OPTION 1

Fire Walls - Horizontal Continuity

ALTERNATIVES:

- 1. EXTERIOR WALL RATED FOR 1 HR MIN. 4FT EACH SIDE (OPENING PROTECTION REQ'D)
- 2. NONCOMBUSTIBLE SHEATHING/SIDING EXTENDS MIN. 4FT EACH SIDE
- 3. BUILDING ON EACH SIDE OF THE FIRE WALL IS EQUIPPED THROUGHOUT WITH AN NFPA OR NFPA 13 SPRINKLER SYSTEM

FIRE WALL TO EXTERIOR WALL: OPTION 2

Fire Walls - Vertical Continuity

Fire Walls - Vertical Continuity

IN CONSTRUCTION TYPES III, IV OR V

- NO OPENINGS IN ROOF WITHIN 4FT OF FIRE WALL
- MIN. CLASS B ROOF COVERING
- ROOF SHEATHING/DECK MIN. 4FT EACH SIDE OF WALL IS FRT OR UNDERSIDE OF SHEATHING IS COVERED WITH ⁵/₈" TYPE X GYPSUM

FIRE WALL TO ROOF: OPTION 2

Fire Walls – Structural Stability

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.

NFPA 221 – Double Walls

4.5* Double Wall Assemblies. Where either wall of a double wall is laterally supported by a building frame with a fire resistance rating less than that required for the wall, double wall assemblies shall be considered to have a combined assembly fire resistance rating as specified in Table 4.5.

Table 4.5 Fire Resistance Ratings for Double Wall Assemblies

Fire Resistance Rating of	Equivalent to
Each Wall (hr)	Single Wall (hr)
3	4
2	3
1	2

Fire Barriers – IBC 707

Fire Barrier Example

Fire Barriers – IBC 707

Fire Barriers:

- May be constructed with any materials permitted by the construction type
- Fire Resistance Ratings:
 - Shaft Enclosures: IBC 713.4
 - 2 Hr when connecting 4 stories or more, 1 hr if less
 - Separated Occupancies: IBC Table 508.4
 - Fire Areas: IBC Table 707.3.10

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

707.5.1 Supporting Construction: The supporting construction for a fire barrier shall be protected to afford the required fireresistance rating of the fire barrier supported. Hollow vertical spaces within a fire barrier shall be fireblocked in accordance with Section 718.2 at every floor level.

Other requirements for openings, penetrations, joints

Fire Barriers – IBC 707

Common Detailing Method: Fire Barrier & membrane extend to underside of floor deck above

Commonly used to separate:

- Dwelling or sleeping units in same bldg.
- Tenant spaces in malls
- Corridor walls

Fire Partition Example

2012 IBC Code & Commentary

Fire Partitions – IBC 708

Fire Partitions:

- May be constructed with any materials permitted by the construction type
- 708.3 Fire Resistance Ratings:
 - Fire partitions shall have a *fire-resistance rating* of not less than 1 hour.

Exceptions:

1. Corridor walls permitted to have a 1/2 hour fire-resistance rating by Table 1020.1

2. Dwelling unit and sleeping unit separations in buildings of Type IIB, IIIB and VB construction shall have fire-resistance ratings of not less than 1/2 hour in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.

Fire Partitions – IBC 708

708.4 Continuity.

Fire partitions 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 or to the fire-resistance-rated floor/ceiling or roof/ceiling assembly above, and shall be securely attached thereto. In combustible construction where the *fire partitions* are not required to be continuous to the sheathing, deck or slab, the space between the ceiling and the sheathing, deck or slab above shall be fireblocked or draftstopped in accordance with Section 718.2 and 718.3 at the partition line.

The supporting construction shall be supported to afford the required fire-resistance rating of the wall supported, except for...walls separating dwelling units, walls separating sleeping units, and corridor walls, in buildings of Type IIB, IIIB and VB construction.

Fire Partitions – IBC 708

Common Detailing Method: Fire Partition & membrane stop at underside of rated floor/ceiling with fireblocking/draftstopping if required

Unit Demising Walls as Fire Partitions

IBC 708.1

Commentary:

"Fire partitions," as defined in Section 202, are wall assemblies that ... separate dwelling units [and] separate sleeping units.

Corridor Walls as Fire Partitions

IBC 1020.1: Corridor walls required to be fire-resistance rated shall comply with Section 708 for fire partitions.

Code requirements for residential occupancies:

For unit to unit or unit to public or service areas:

Min. STC of 50 (45 if field tested):

 Walls, Partitions, and Floor/Ceiling Assemblies

Min. IIC of 50 (45 if field tested) for:

• Floor/Ceiling Assemblies

Air-Borne Sound:

Sound Transmission Class (STC)

- Measures how effectively an assembly isolates air-borne sound and reduces the level that passes from one side to the other
- Applies to walls and floor/ceiling assemblies

Structure-borne sound:

Impact Insulation Class (IIC)

- Evaluates how effectively an assembly blocks impact sound from passing through it
- Only applies to floor/ceiling assemblies

STC Ratings: What Can Be Heard?

- STC 25 Soft speech can be understood
- STC **30** Normal speech can be understood
- STC 35 Loud speech can be
- STC **40** Loud speech is audible but not intelligible
- STC 45 The onset of "privacy"
- STC **50** Normal speech not audible
- STC 55 Loud speech not audible
- STC 55 Very loud speech not audible
- STC 65 Superior soundproofing

What is adequate sound control?

Shearwall Design

Very common for unit demising walls and corridor walls to function as shearwalls. Wood structural panels (plywood or OSB) directly attached to wood studs and blocking.

Shearwall Design

Floor Plan

Source: WoodWorks Five-Story Wood-Frame Structure over Podium Slab Design Example

Unit Demising Walls and Corridor Walls

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Can generally group interior wall types into these 3 categories

- Single stud wall
- Staggered stud wall
- Double stud wall

Single stud walls: 1 Hour (UL U305), but... STC = 38 No shearwall sheathing

But what about the shearwall sheathing?

Interior Wall Types – Addition of WSP

Can include WSP in assemblies which were tested without them:

- ESR 2586
- AWC's DCA4
- Gypsum Association Manual

GA Fire Resistance Design Manual item23 in Section 1 of the GeneralExplanatory Notes:

"When not specified as a component of a fire- resistance rated wall or partition system, wood structural panels shall be permitted to be added to one or both sides."

ESR 2586:

4.7 Fire-resistive 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.

Component Additive Method (CAM) for Calculating and Demonstrating Assembly Fire Resistance

Wood-frame walls and floors offer designers a unique opportunity to provide structures with economy as well as proven energy performance. Where these assemblies are required by the building codes to veloped from conducting a series of fire resistance tests. The Component Additive Method (CAM) provides for calculating the fire resistance of load bearing and non-load bearing floor, wall, ceiling and roof

- My interior, acoustically rated wall also needs to be a shearwall (think unit demising wall)
- Can I add wood structural panels to an acoustically tested wall?

Yes, but placement is very important!

- For walls with resilient channels, put WSP on opposite side of wall
- For highly loaded shearwalls, can use double layer of sheathing on same side of wall

Staggered stud walls, 1 hr options

STC = 50

STC = 55

STC = 63

- Staggered stud wall condition:
- Blocking bridges finish on one side of wall to studs on opposite side, defeats purpose.
- Solution: use flat blocking in wall (wide face against WSP)

Wall Blocking Requirements

NDS Commentary:

"Experience has shown that any code allowed thickness of gypsum board, hardwood plywood, or other interior finish adequately fastened directly to studs will provide adequate lateral support of the stud across its thickness irrespective of the type or thickness of exterior sheathing and/or finish used."

Double stud walls, 1 hr options

Studs @ 16" o.c. Single gyp. each face

Source: Johns Manville

Studs @ 24" o.c. Single gyp. each face Studs @ 16" o.c. Double gyp. each face

WSP placement in double stud walls – big impact on STC

FIGURE 6

Effect of Sheathing Placement on Acoustical Performance (Plan View)

The moral of the story...

Unique attributes of unit demising walls and corridor walls:

Cost and width are big factors (rentable SF)

Single stud walls are not as common for unit demising walls (since RC is necessary)

Resilient channels sometimes used for corridor walls, with RC on corridor side of wall

Resilient channels not commonly used for unit demising walls:

- Challenges with proper installation
- Shearwall sheathing placement
- Hanging elements to wall (TV, cabinets, etc.)

Corridors Walls

Corridor Walls – 708.4 Exception 2

Shallow Floor Depths

UL L502 GA FC5104

- 1" gypsum underlayment
- 19/32" WSP
- 3 ¹/₂" Fiberglass Batt
- 2x10 joists @24 " oc
- Resilient channel
 - 5/8" Type-X Gyp

Common issues with UL approved assemblies:

- Shallow Floor depth-
 - Use prescriptive assemblies - IBC
 - 721.1(3) assembly 21-

1.1

• Or use the CAM

method in IBC 722

Corridors - 1hr Floor

Interior Walls – Horizontal Continuity

- Code language exists to clarify vertical & horizontal continuity requirements of <u>fire walls</u>.
- However, for <u>unit demising and corridor walls</u>, only <u>vertical</u> continuity requirements exist.
- How are partition wall to partition wall (or partition wall to exterior wall) intersections handled?

PROJECT ASSISTANCE I UPCOMING EVENTS

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What are the fire-resistance rating requirements when an interior partition wall intersects a membrane-protected wall, floor or roof assembly? Can the membrane on the intersected assembly be interrupted by the partition framing?

For designers working on light woodframe multifamily and commercial structures, there are many publicly available fire

Design No. U305

March 10, 2020

Permitted as noted in tested wall assembly

12. **Non-Bearing Wall Partition Intersection** — (Optional) — Two nominal 2 by 4 in. studs or nominal 2 by 6 in. studs nailed together with two 3 in. long 10d nails spaced a max. 16 in. OC. vertically and fastened to one side of the minimum 2 by 4 in. stud with 3 in. long 10d nails spaced a max. 16 in. OC. vertically. Intersection between partition wood studs to be flush with the 2 by 4 in. studs. The wall partition wood studs are to be framed by with a second 2 by 4 in. wood stud fastened with 3 in. long 10d nails spaced a max. 16 in. OC. vertically. Maximum one non-bearing wall partition intersection per stud cavity. Non-bearing wall partition stud depth shall be at a minimum equal to the depth of the bearing wall.

1-HR INTERIOR WALL AT 2-HR EXTERIOR WALL

Source: City of Portland, OR Type III Construction Code Guide

2-HR INTERIOR WALL AT 2-HR EXTERIOR WALL

Source: City of Portland, OR Type III Construction Code Guide

Can a wall interrupt the ceiling gypsum of a rated horizontal assembly?

Yes

- **IBC 2012** 714.4.1.2, Except. 7: Permitted if wall is rated to match horizontal assembly
- IBC 2015 714.4.2, Except. 7: Permitted if wall is covered with type X gypsum each side

INTERIOR WALL TO FLOOR INTERSECTION

Time for Q&A What questions do you have?

No and a

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