Interior Fire-Rated Walls in Multi-Family, Light-Frame Wood Construction

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Thursday, January 18, 2024

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

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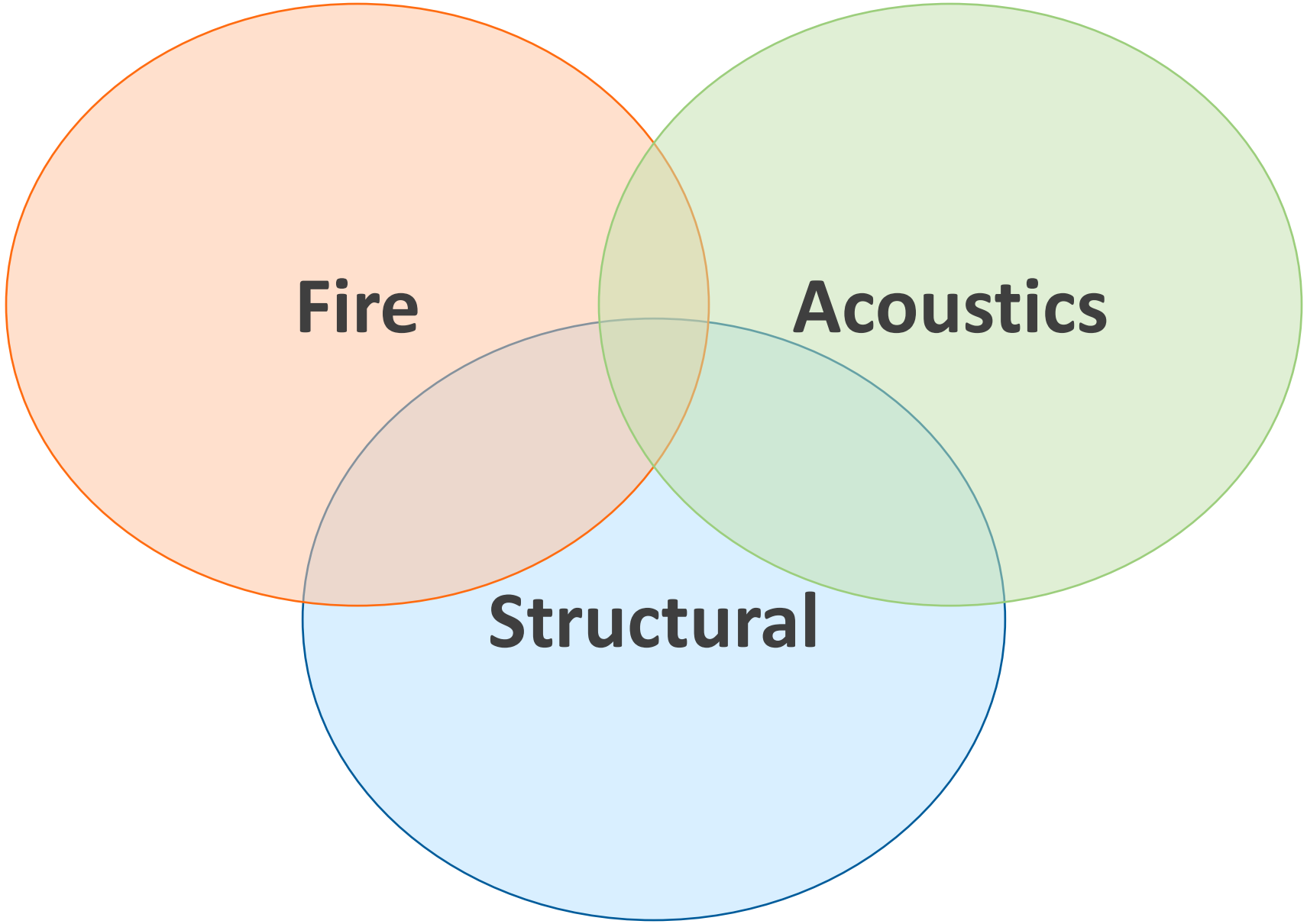
Course Description

Code-compliant and constructable detailing is an essential consideration in light-frame wood construction, and developing wall assemblies that meet structural and architectural demands requires an understanding of code requirements that are often cross-disciplinary. This presentation will focus on interior fire-rated walls such as fire walls, fire barriers, and fire partitions, and where these walls typically occur in multi-family buildings. We will also cover common detailing methods that meet structural needs, acoustical performance, and fire protection requirements.

Learning Objectives

1. Review code provisions that define fire-resistance ratings and acoustics ratings for interior wood walls such as unit demising walls and corridor walls.
2. Recognize structural design considerations for interior unit demising and corridor walls in mid-rise applications.
3. Discuss detailing aspects of fire resistance for fire walls, fire barriers, and fire partitions, including material and assembly options, continuity, structural stability, and penetrations.
4. Provide detailing options that establish fire-resistance continuity at framing intersections.


Fire
Acoustics
Structural

Fire-Rated Wall Assemblies

Interior Fire-Rated Walls: Differences

Fire Wall	Fire Barrier	Fire Partition
• Building Separation • Openings are protected and limited • Vertical continuity: from foundation to or through roof • Horizontal continuity: exterior wall to or through exterior wall • Structural stability	• Shafts; Occupancy Separation • Openings are protected and limited • Vertical continuity: from floor through concealed space at each level	• Dwelling Unit Separation; Corridors • Openings are protected • Vertical continuity: may terminate at a fire rated floor/ceiling/roof assembly

IBC Table 601 – Interior Walls

TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A	B	A	B	HT	A	B
Primary structural frame[f] (see Section 202)	3[a, b]	2[a, b]	1[b]	0	1[b]	0	HT	1[b]	0
Bearing walls Exterior[e, f]	3	2	1	0	2	2	2	1	0
Interior	3[a]	2[a]	1	0	1	0	1/HT	1	0
Nonbearing walls and partitions Exterior	See Table 602								
Nonbearing walls and partitions Interior[d]	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary members (see Section 202)	2	2	1	0	1	0	HT	1	0
Roof construction and associated secondary members (see Section 202)	$1\frac{1}{2}$[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	HT	1[b,c]	0

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

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

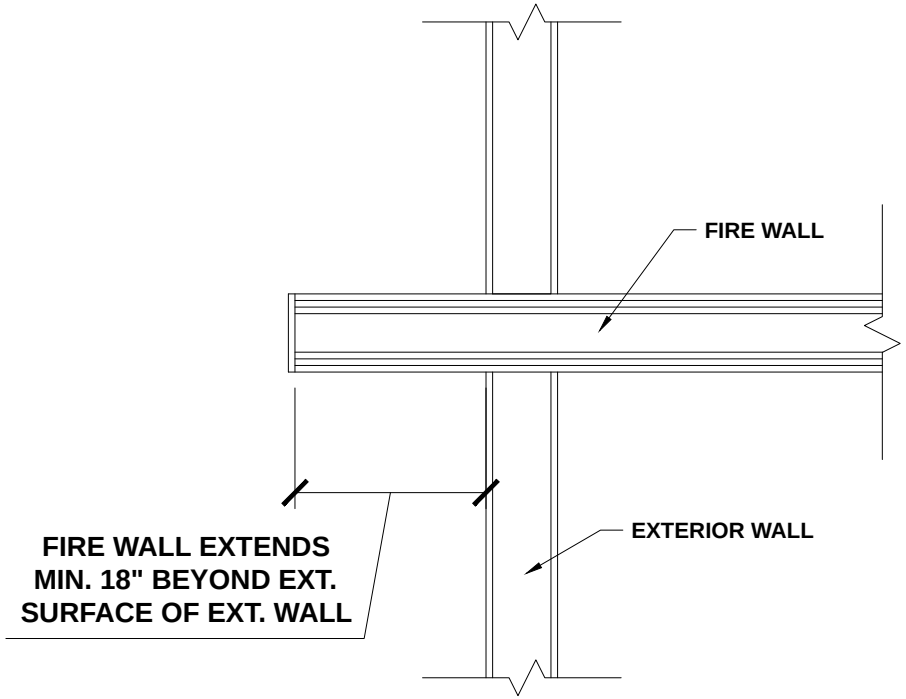
b. For Group H-1, H-2 or H-3 buildings, also see Sections 415.6 and 415.7.

IBC 706.3 – Fire walls shall be of any approved noncombustible materials.

Exception: Buildings of type V construction

Fire Walls – Horizontal Continuity

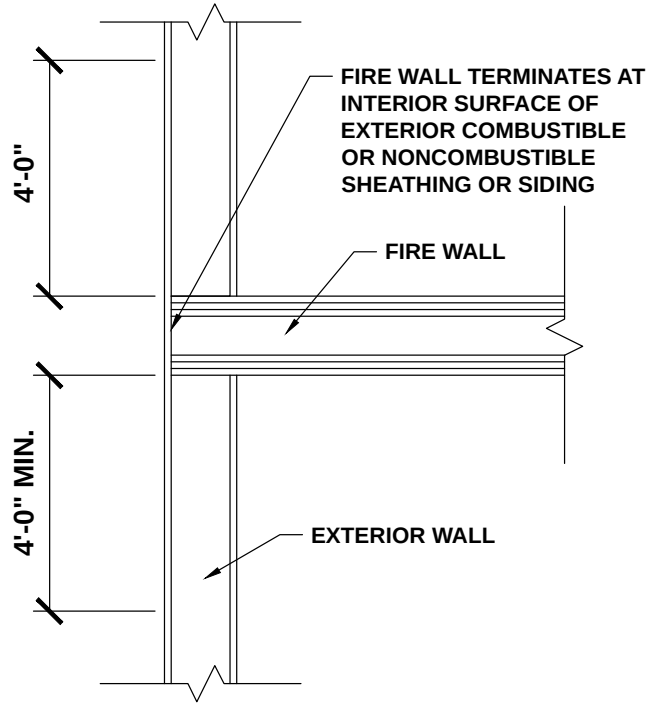
Fire walls are required to be continuous from exterior wall to exterior wall



FIRE WALL TO EXTERIOR WALL: OPTION 1

ALTERNATIVES:

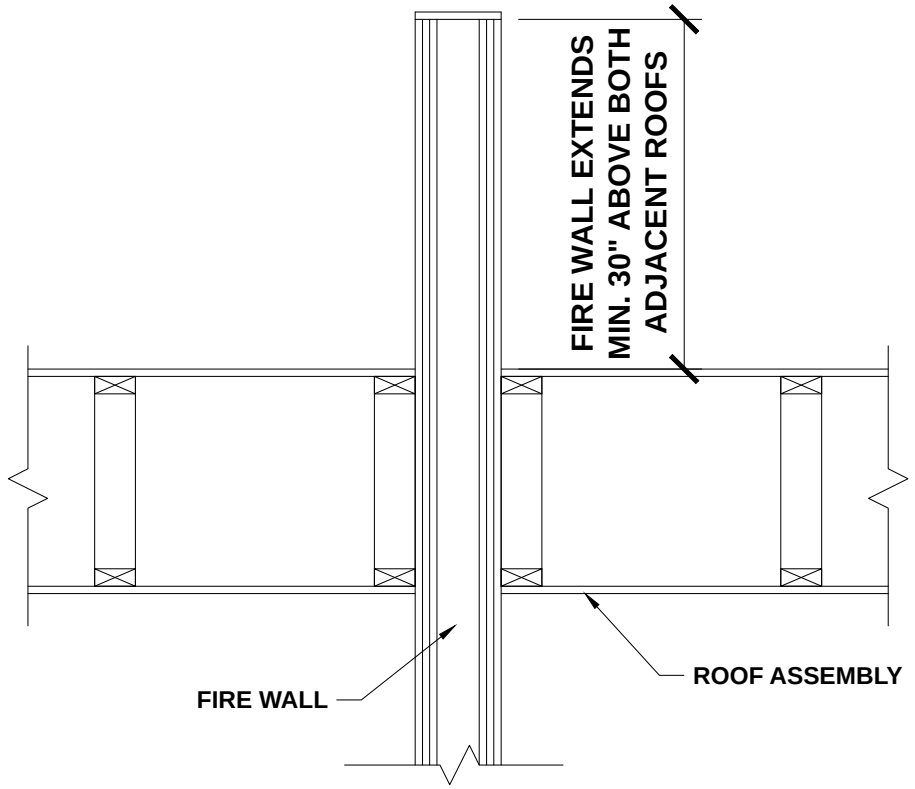
1. **EXTERIOR WALL RATED FOR 1 HR MIN. 4FT EACH SIDE (OPENING PROTECTION REQ'D)**
2. **NONCOMBUSTIBLE SHEATHING/SIDING EXTENDS MIN. 4FT EACH SIDE**
3. **BUILDING ON EACH SIDE OF THE FIRE WALL IS EQUIPPED THROUGHOUT WITH AN NFPA OR NFPA 13 SPRINKLER SYSTEM**



FIRE WALL TO EXTERIOR WALL: OPTION 2

Fire Walls – Vertical Continuity

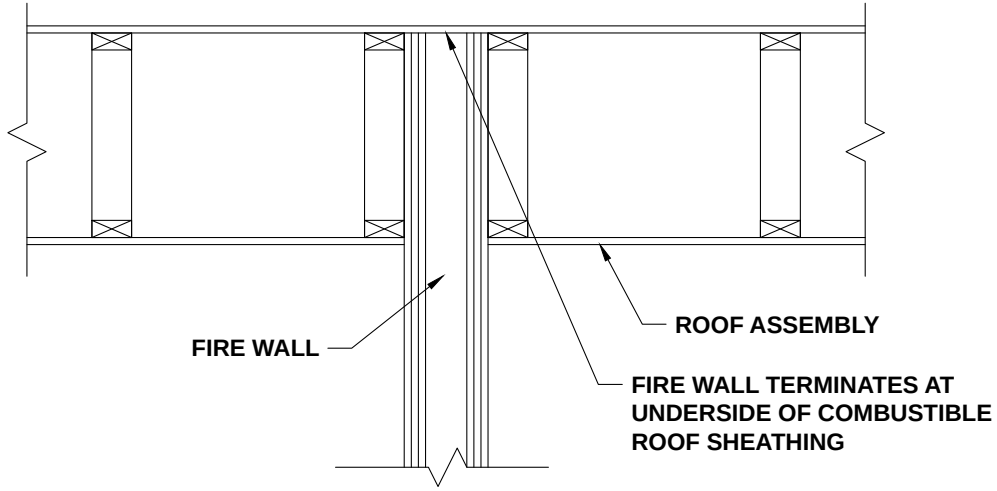
Fire walls are required to be continuous from foundation to roof



FIRE WALL TO ROOF: OPTION 1

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 $\frac{5}{8}$" TYPE X GYPSUM**

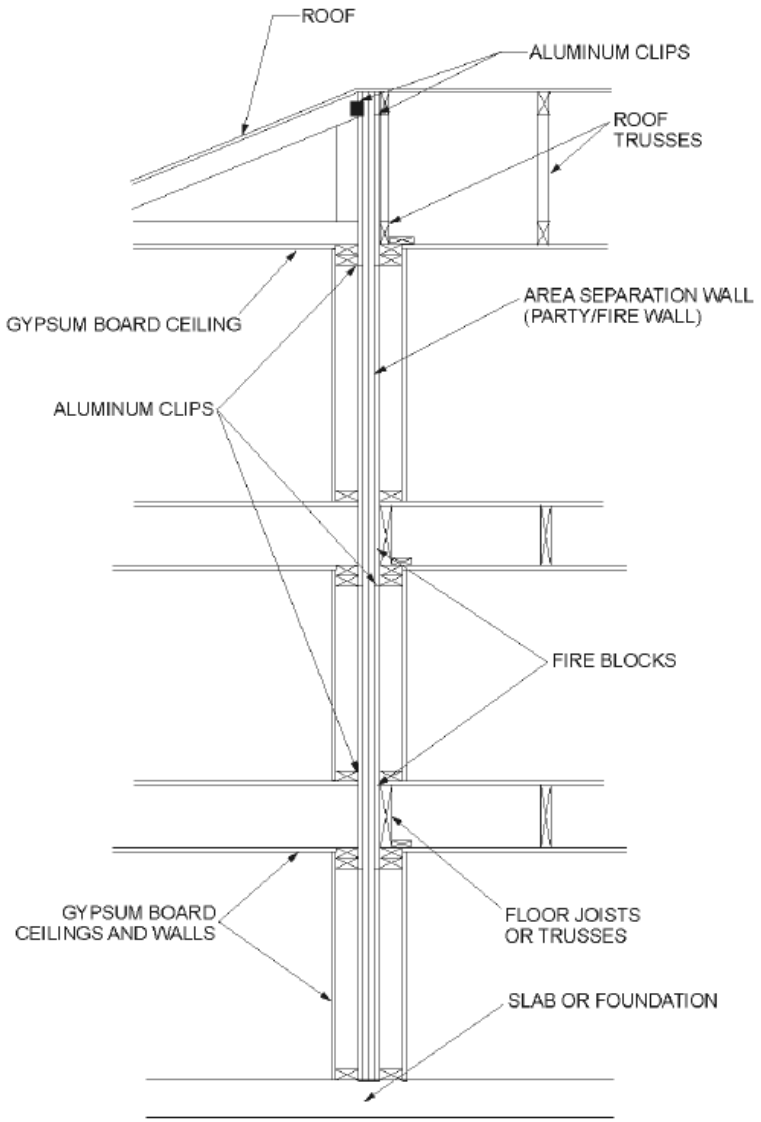


FIRE WALL TO ROOF: OPTION 2

Fire Walls – Structural Stability

706.2 Structural Stability:

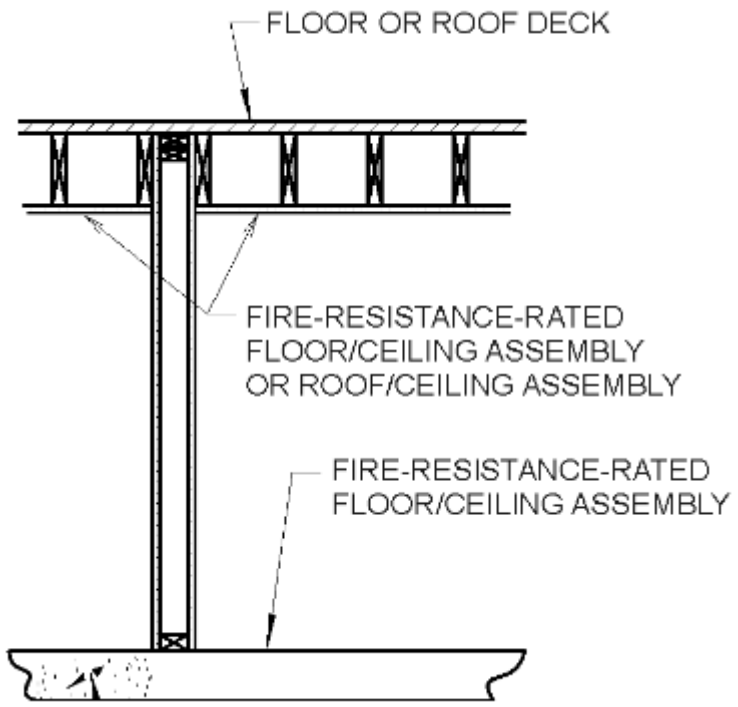
Fire walls shall have sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall for the duration of time indicated by the required fire-resistance rating or shall be constructed as double fire walls in accordance with NFPA 221.



Fire Barriers – IBC 707

Commonly used for:

- Shaft enclosures
- Interior exit stairway
- Exit stairway enclosures
- Exit passageways
- Incidental uses
- Separated occupancies
- Fire Areas



Fire Barrier Example

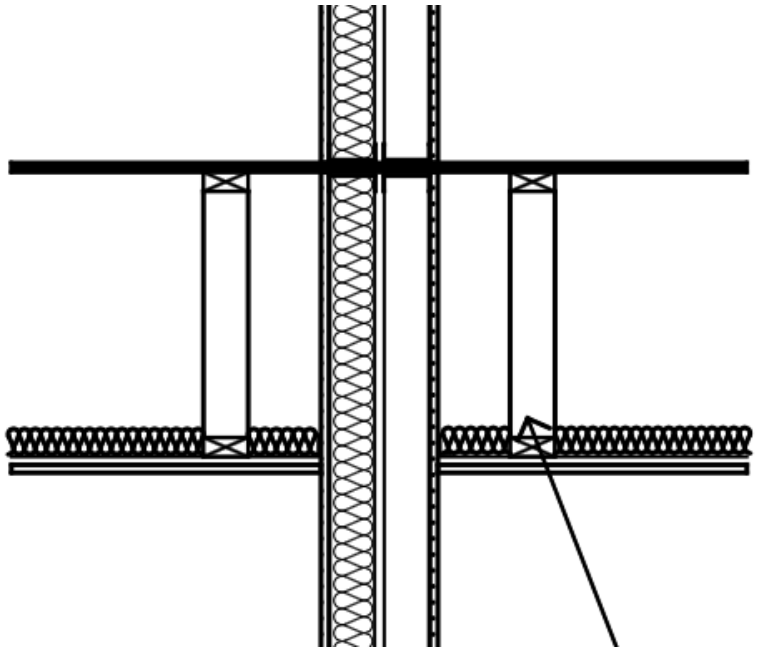
2018 IBC Code & Commentary

Fire Barriers – Ratings & Materials

Any materials permitted by the construction type

Fire Resistance Ratings:

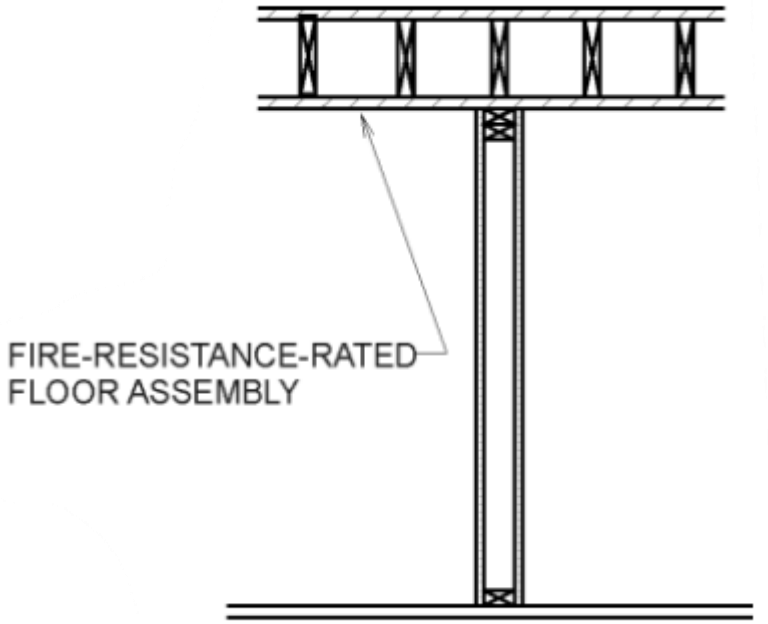
- Shaft Enclosures: IBC 713.4
  - 2-hr when connecting 4 stories or more
  - 1-hr when connecting 3 stories of less
- Separated Occupancies: IBC Table 508.4
- Fire Areas: IBC Table 707.3.10



Fire Partitions – IBC 708

Commonly used to separate:

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



Fire Partition Example

2018 IBC Code & Commentary

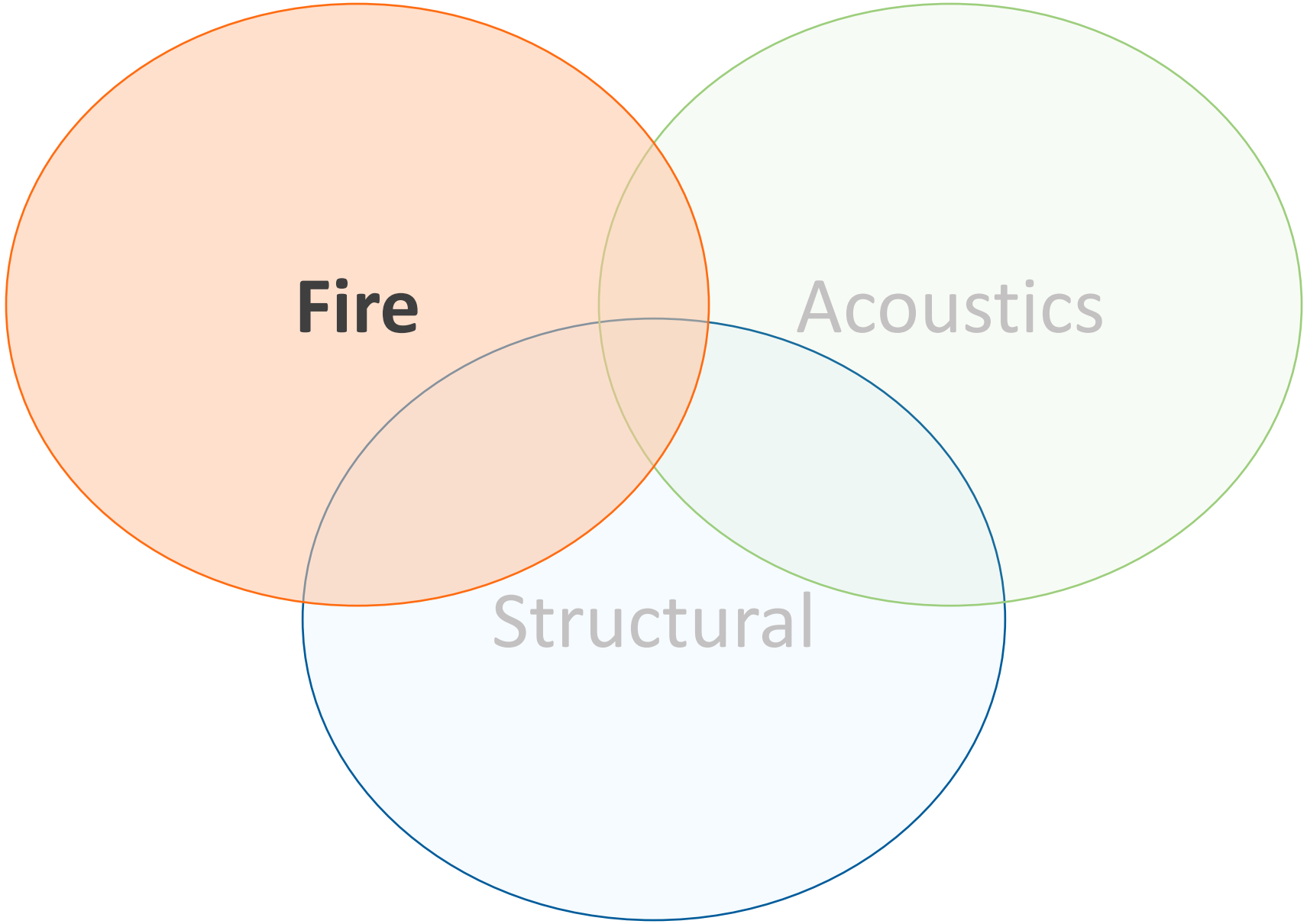
Fire Partitions – Ratings & Materials

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 ½-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 ½ hour in buildings equipped throughout with an [NFPA 13] automatic sprinkler system in accordance with Section 903.3.1.1.


Fire
Acoustics
Structural

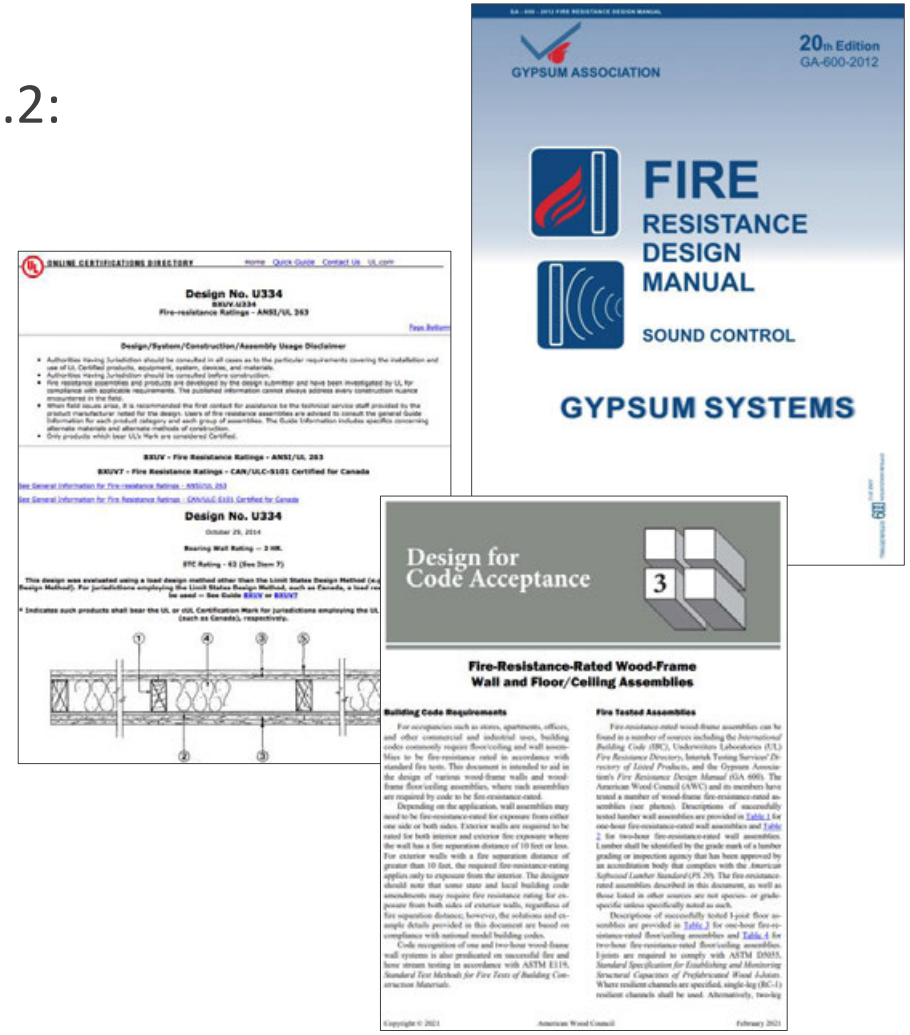
Choosing Fire Rated Assemblies

Common tested assemblies (ASTM E119) per IBC 703.2:

- UL Listings
- Gypsum Catalog
- Proprietary Manufacturer Tests
- Industry Documents: such as AWC's DCA3

Alternate Methods per IBC 703.3

- Prescriptive designs per IBC 721.1
- Calculated Fire Resistance per IBC 722
- Fire-resistance designs documented in sources
- Engineering analysis based on a comparison
- Fire-resistance designs certified by an approved agency



Exposed Framing Fire Resistance

IBC 703.3 Alternate Methods for determining fire resistance

Prescriptive designs per IBC 721.1

- **Calculations in accordance with IBC 722**
- Fire-resistance designs documented in sources
- Engineering analysis based on a comparison
- Alternate protection methods as allowed by 104.11

IBC 722 Calculated Fire Resistance

"…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**.)*"

NDS Chapter 16 Fire Design of Wood Members

Limited to calculating fire resistance up to 2 hours.
Char rate varies based on endurance required, product type and lamination thickness. Equations and tables provided.
TR10 and NDS commentary are helpful in implementing permitted calculations.

Exposed Framing Fire Resistance

Table 16.2.1A Char Depth and Effective Char Depth (for β_n = 1.5 in./hr.)

Required Fire Resistance (hr.)	Char Depth, a_{char} (in.)	Effective Char Depth, a_{eff} (in.)
1-Hour	1.5	1.8
1½-Hour	2.1	2.5
2-Hour	2.6	3.2

Source: 2018 NDS Chapter 16

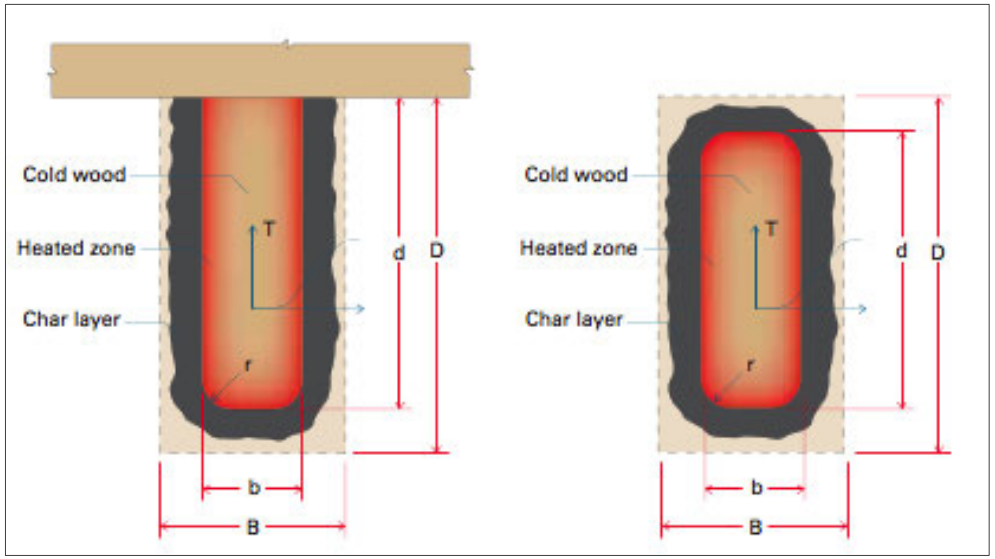
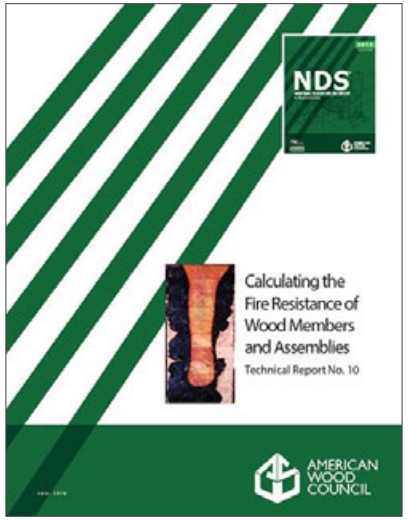
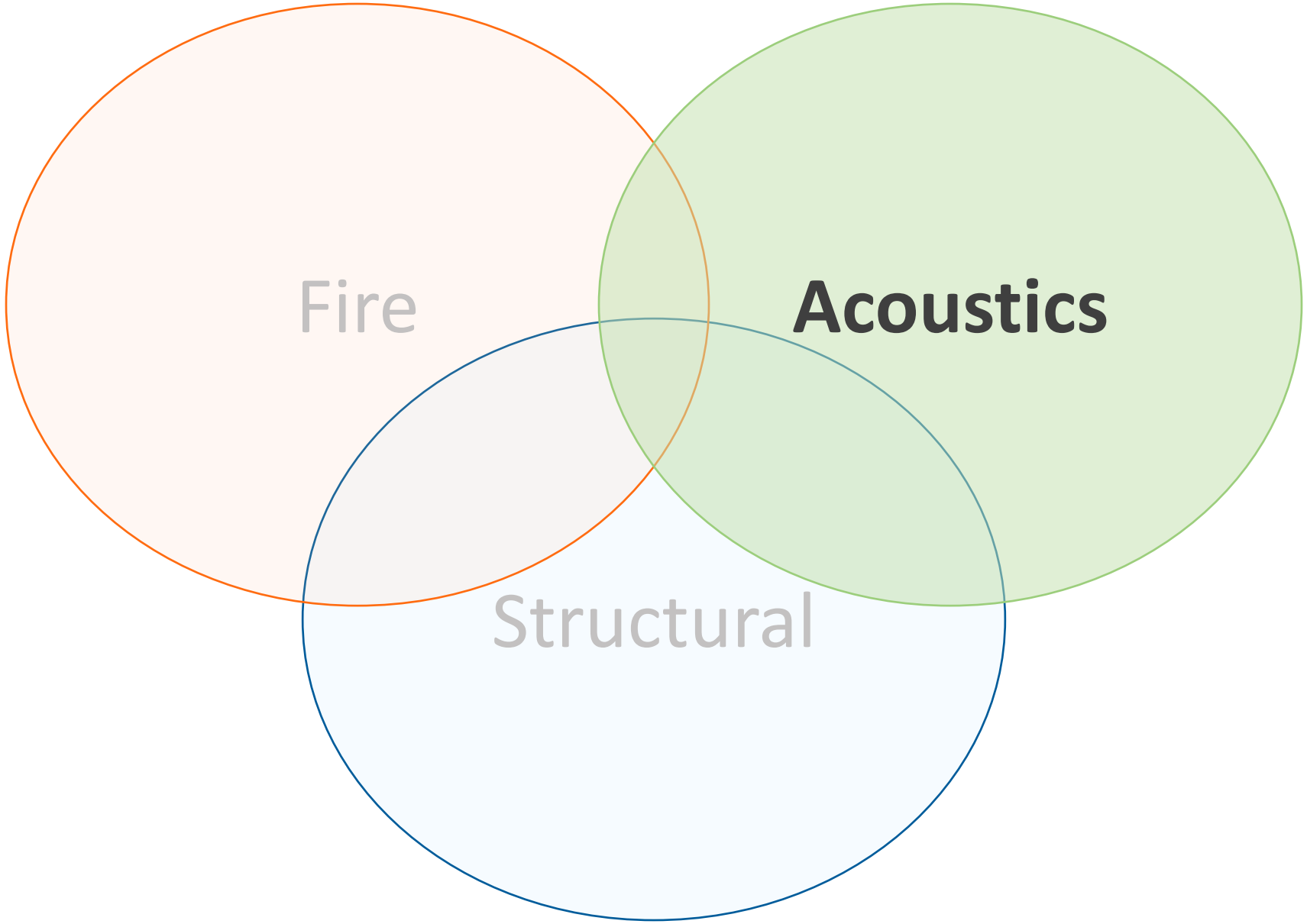


Image: AWC TR 10



https://awc.org/codes-standards/publications/tr10


Fire
Acoustics
Structural

Acoustical Criteria – IBC 1206

Code requirements only address residential occupancies:

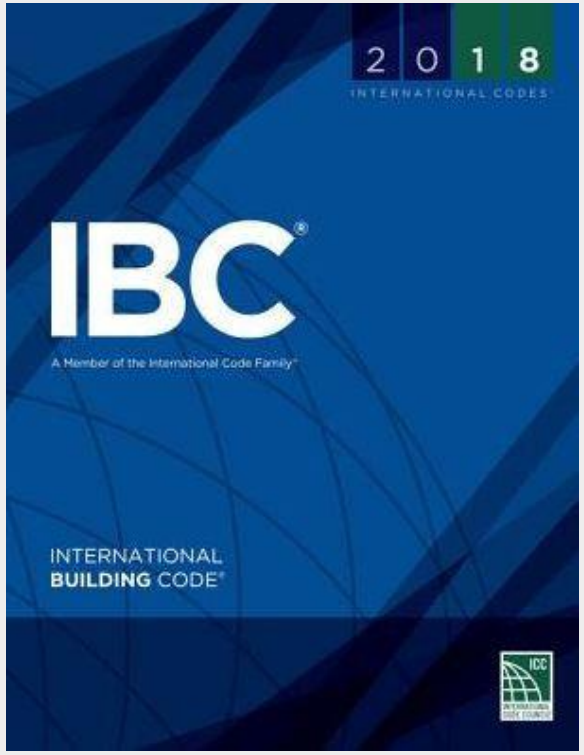
For unit to unit or unit to public or service areas:

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

- Walls, Partitions, and Floor/Ceiling Assemblies

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

- Floor/Ceiling Assemblies



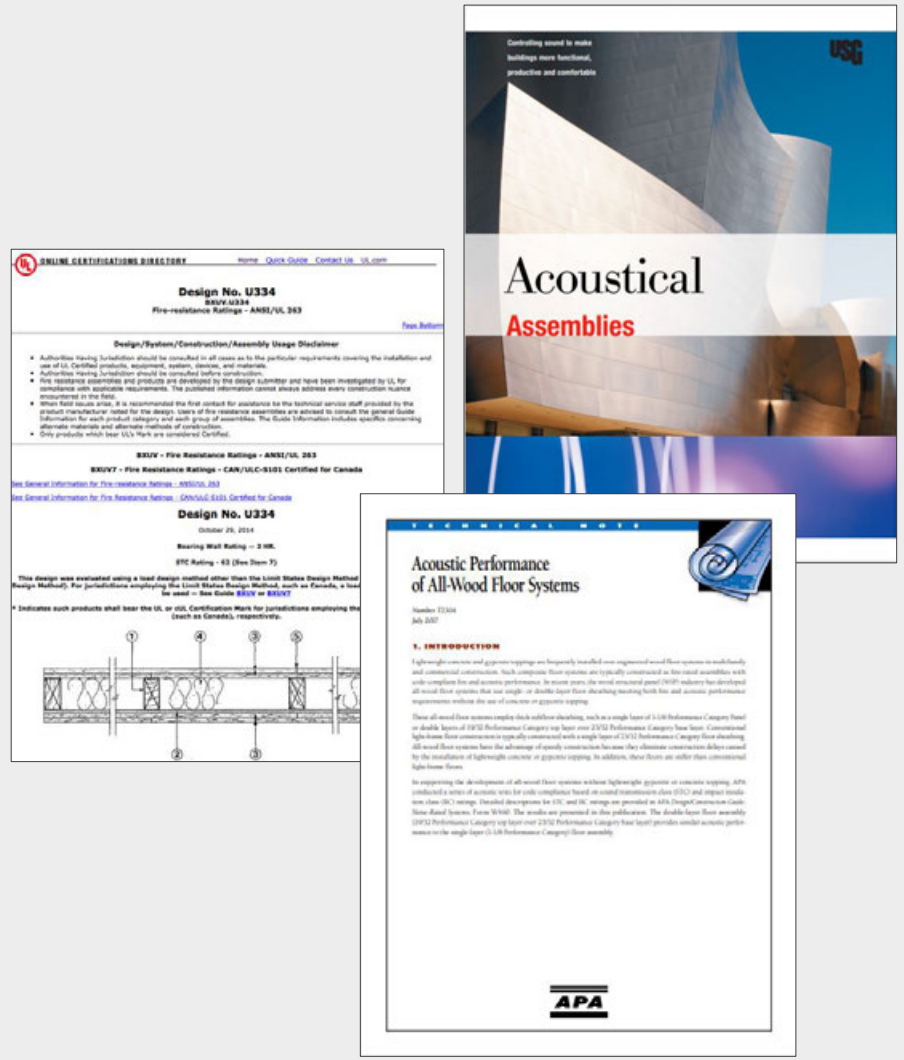
Choosing Acoustically Rated Assemblies

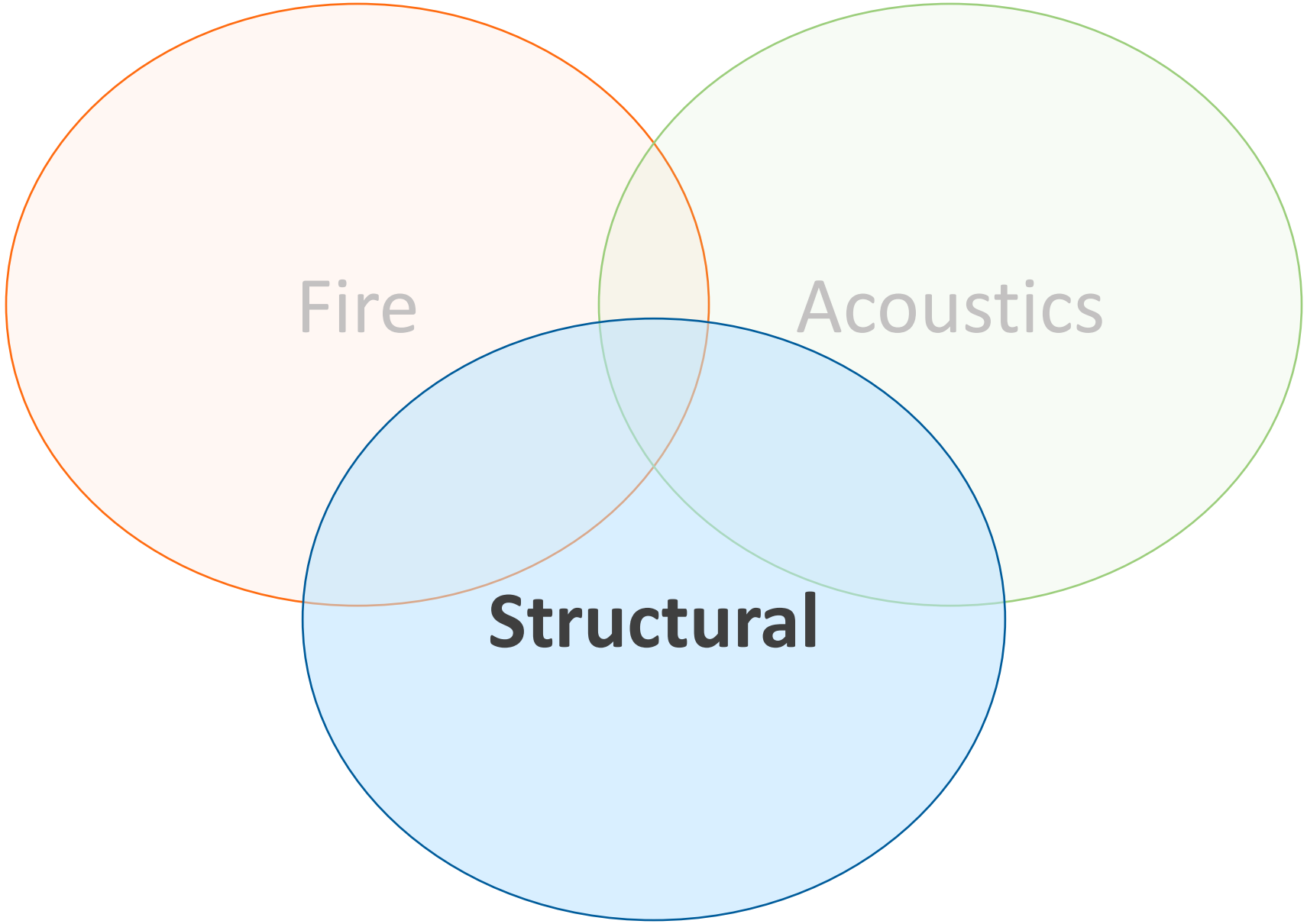
Common tested assemblies:
STC: ASTM E90, per IBC 1206.2
IIC: ASTM E492, per IBC 1206.3

- Manufacturers of gypsum, insulation, acoustical products (proprietary tests)
- UL Listings
- Gypsum Catalog
- Industry associations: AWC, APA, others
- Reach out to **WoodWorks**!

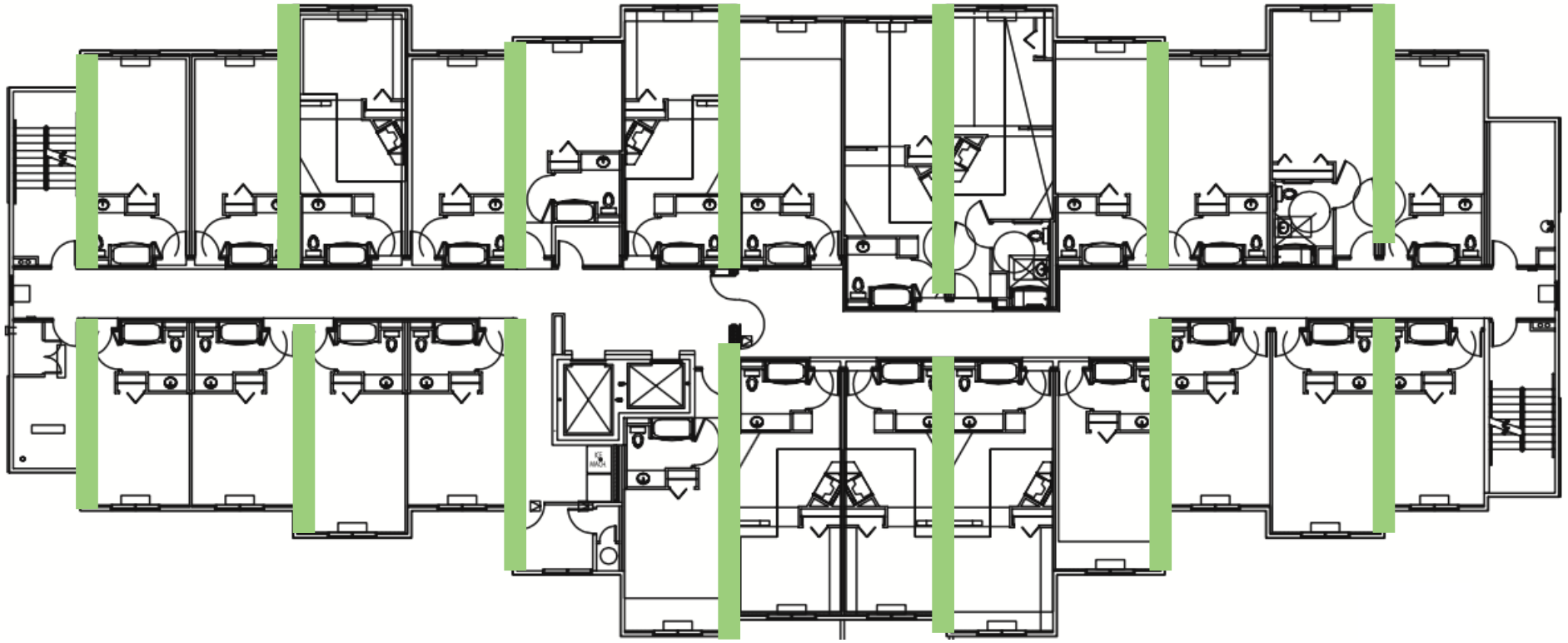
Alternate Method: IBC 1206.2 & 1206.3

- Both STC and IIC may be “established by engineering analysis based on a comparison of floor-ceiling assemblies having [STC/IIC] ratings as determined by the test procedures.”




Fire
Acoustics
Structural

Shear Wall Design



Shear Wall Layout

https://www.woodworks.org/resources/five-story-wood-frame-structure-over-podium-slab/

Fire Partitions:
Unit Demising & Corridor Walls

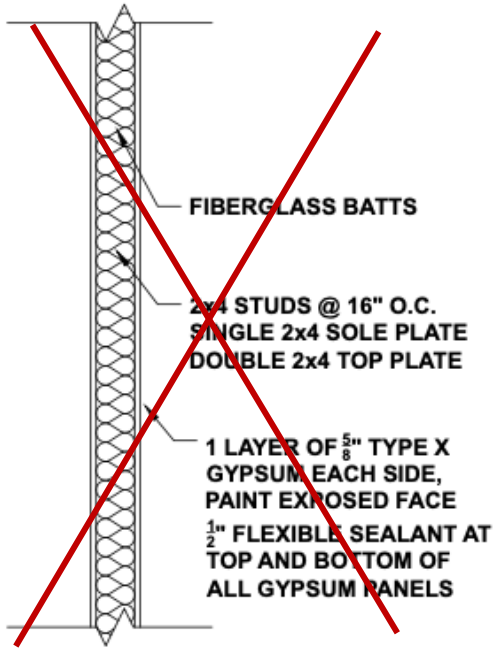
Interior Wall Types

Can generally group interior wall types into these 3 categories

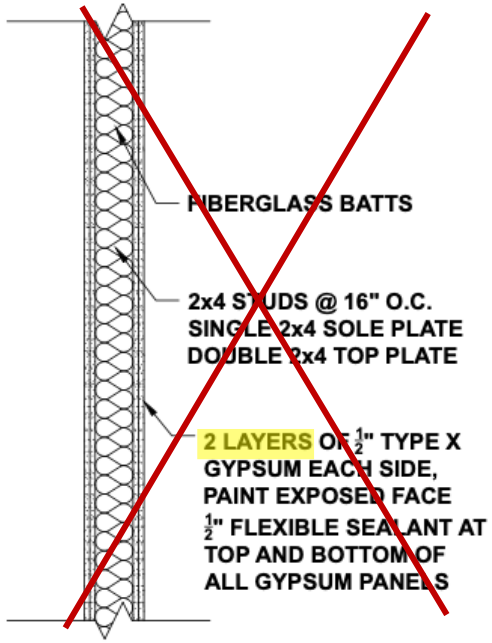
- Single stud wall
- Staggered stud wall
- Double stud wall

Interior Wall Types

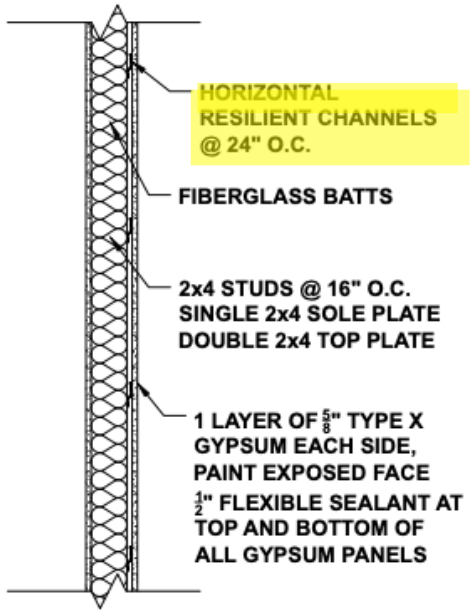
Single stud walls, (4) 1 hr options



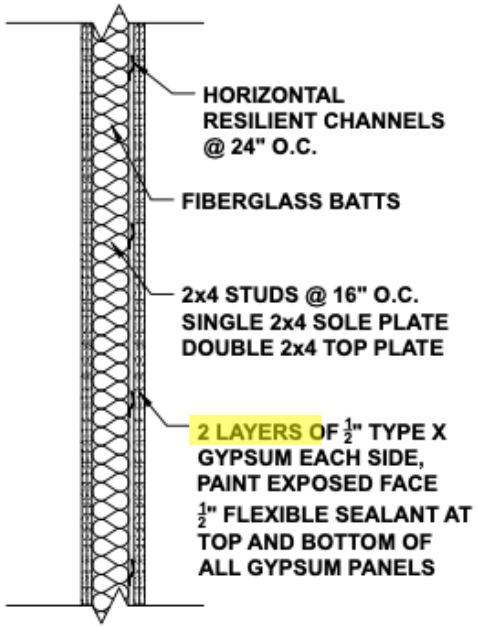
1 layer gyp
STC = 38



2 layers gyp
STC = 45



1 layer gyp + RC
STC = 50



2 layers gyp + RC
STC = 56

Interior Wall Types

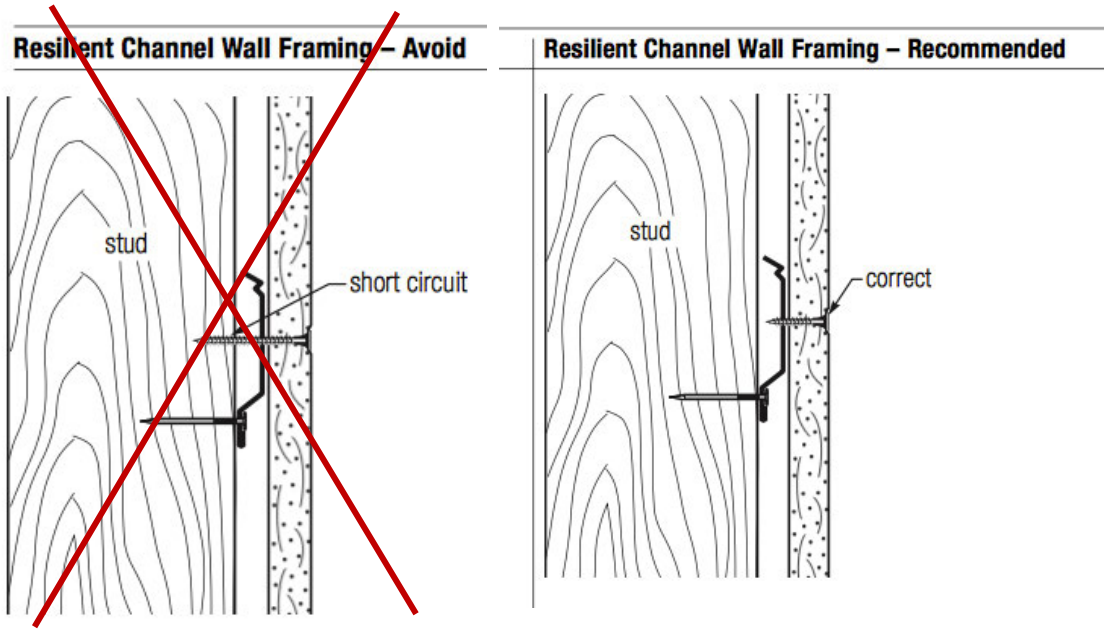
Unique attributes of unit demising walls and corridor walls:

- 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

Interior Wall Types

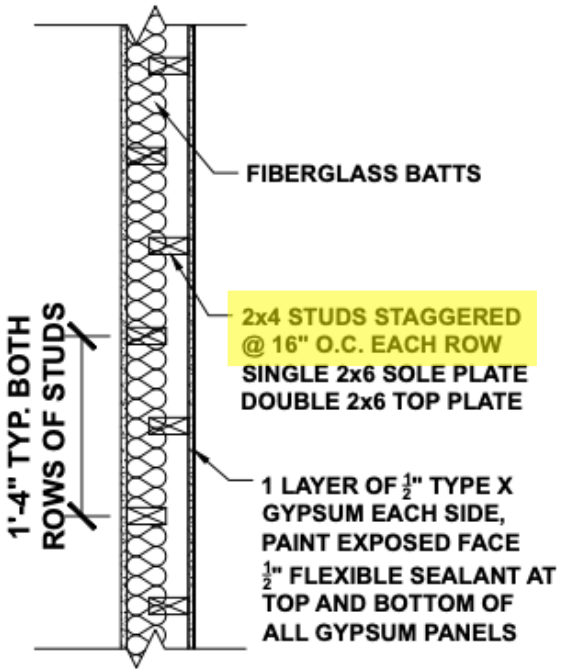
Resilient channels not commonly used for unit demising walls:

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

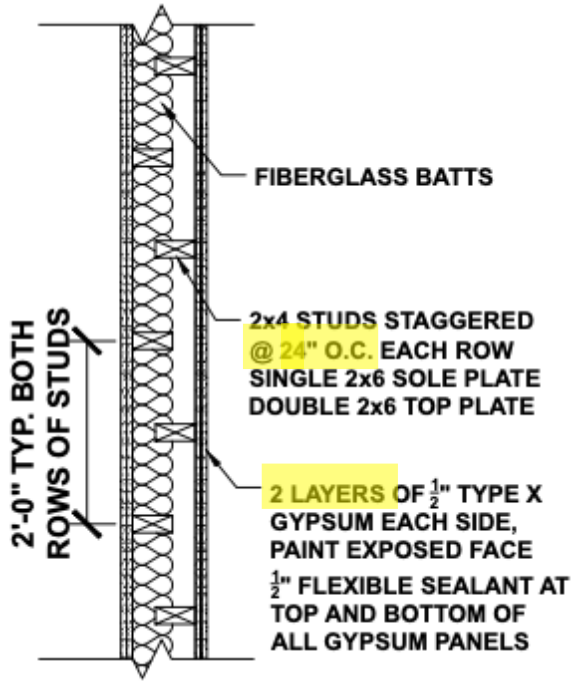


Interior Wall Types

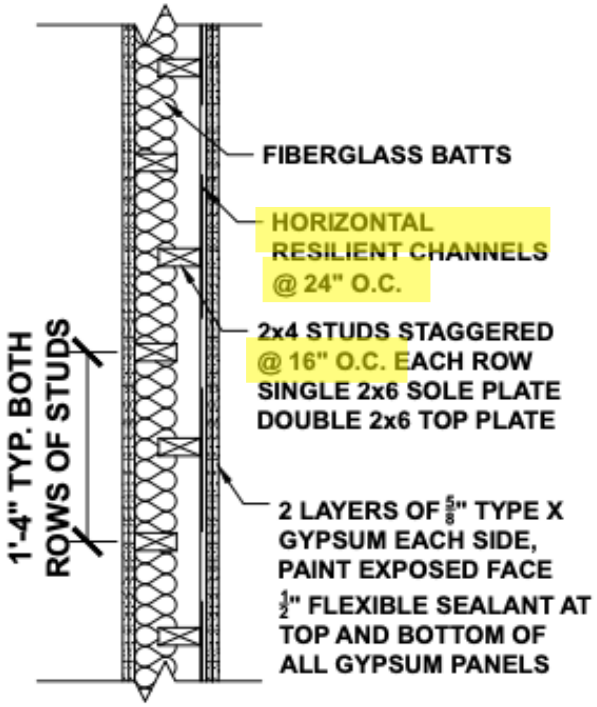
Staggered stud walls, 1 hr options



STC = 50



STC = 55



STC = 63

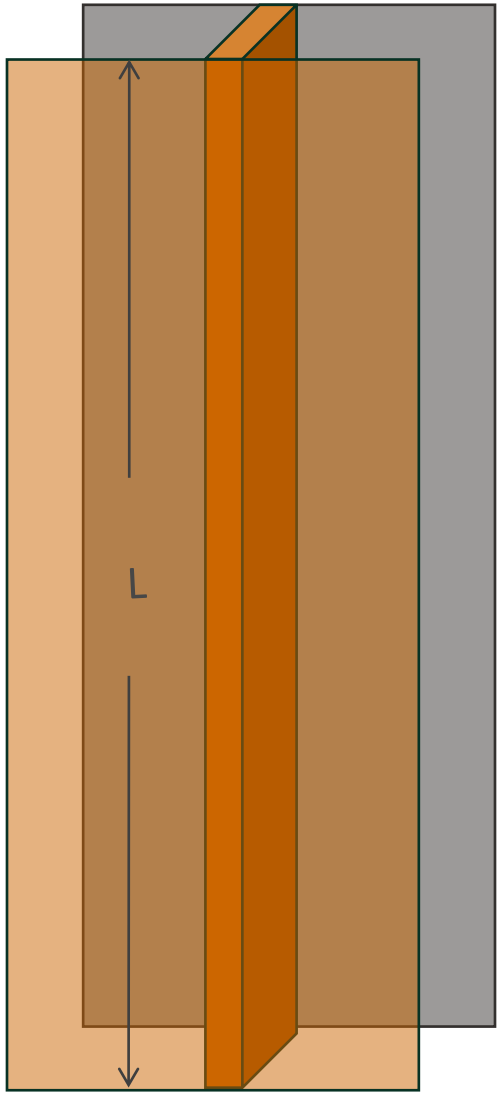
Interior Wall Types

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

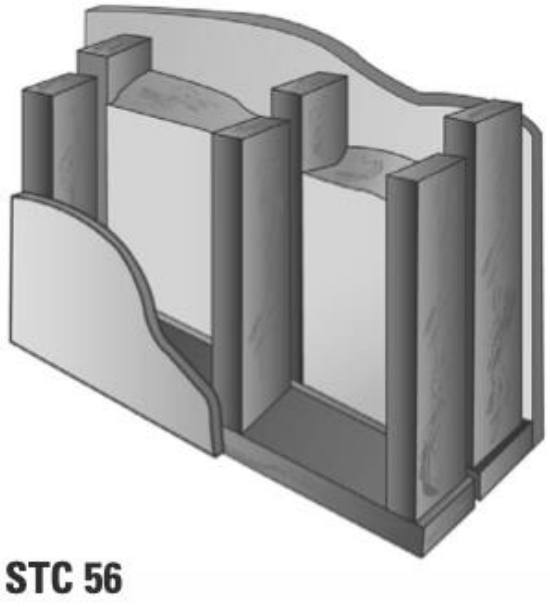


NDS Commentary:

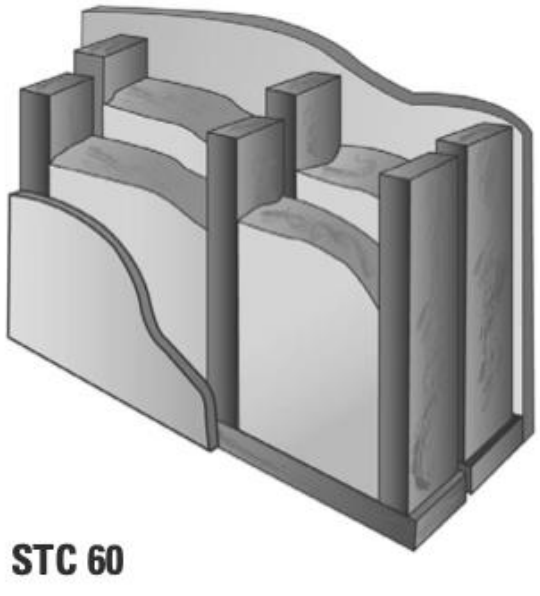
“Experience has shown that any code allowed thickness of gypsum board, hardwood plywood, or other interior finish adequately fastened directly to studs will provide adequate lateral support of the stud across its thickness irrespective of the type or thickness of exterior sheathing and/or finish used.”

Interior Wall Types

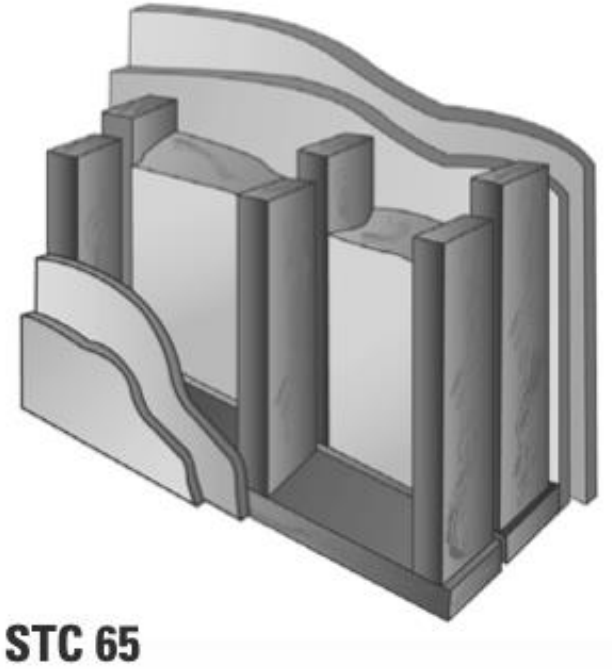
Double stud walls, all 1 hr fire rated options, no resilient channel



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



Studs @ 24” o.c.
Single gyp. each face



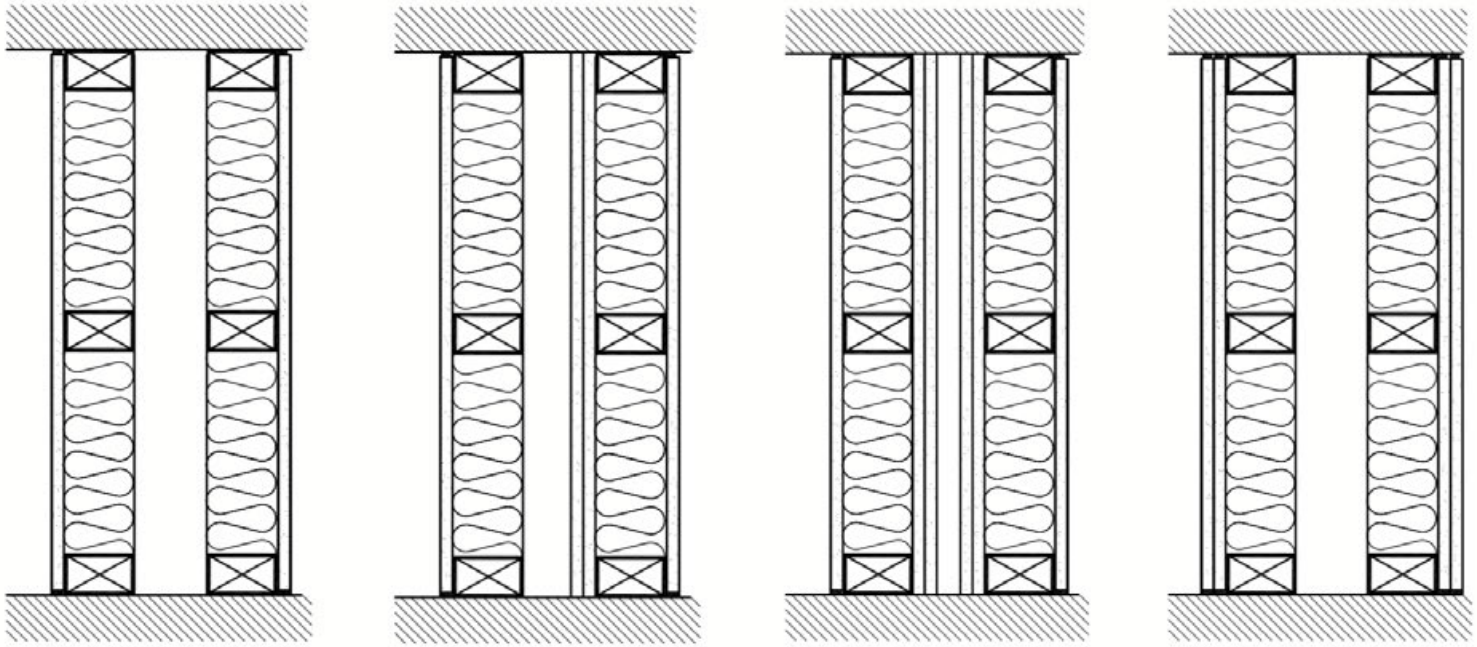
Studs @ 16” o.c.
Double gyp. each face

Source: Johns Manville

Interior Wall Types

WSP placement in double stud walls – big impact on STC

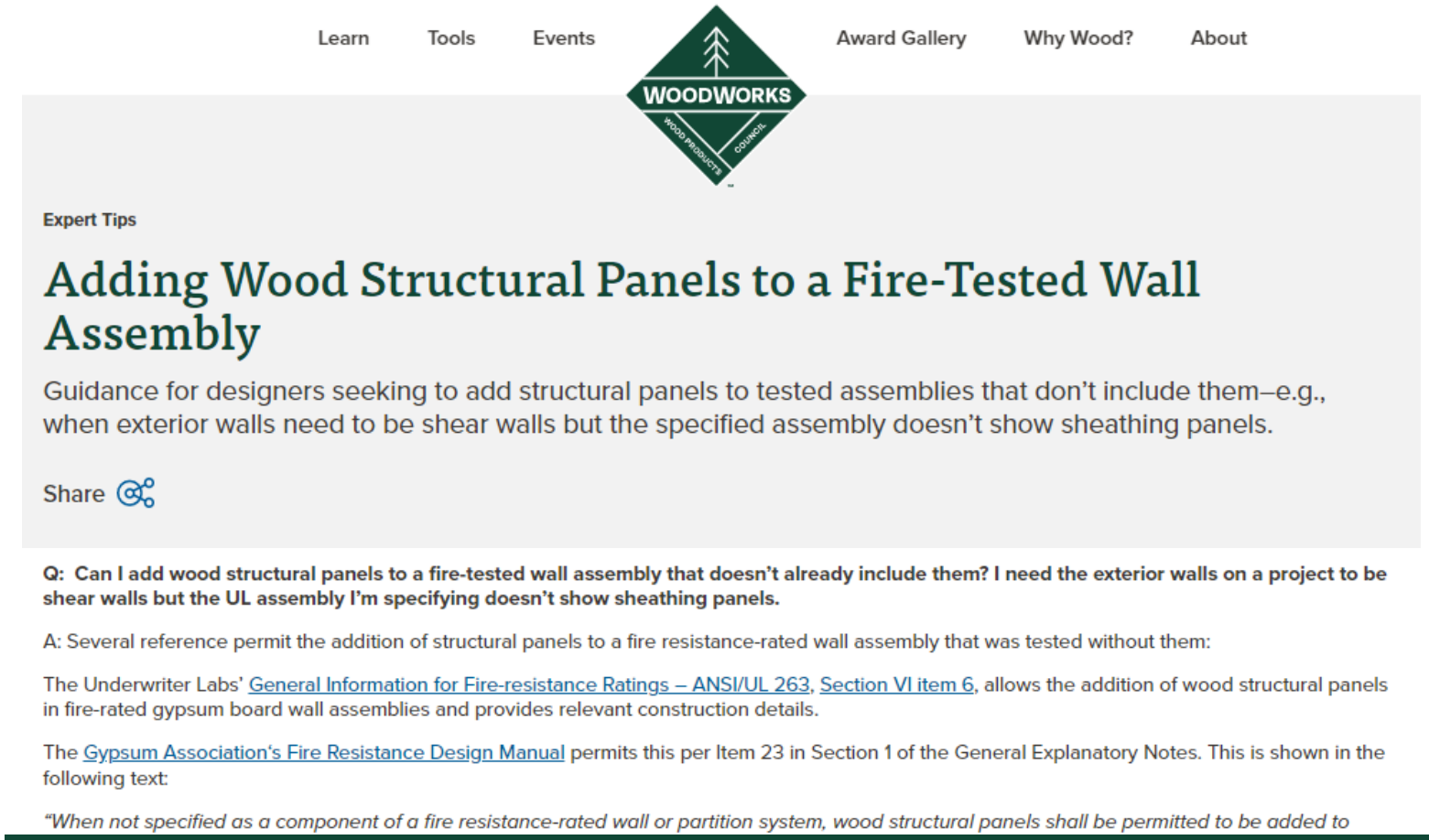
FIGURE 6
Effect of Sheathing Placement on Acoustical Performance (Plan View)



What if I need to add a layer of wood sheathing?

What if I add a layer of wood sheathing?

Adding sheathing will not negatively affect the **fire rating** of a wall.



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Expert Tips

Adding Wood Structural Panels to a Fire-Tested Wall Assembly

Guidance for designers seeking to add structural panels to tested assemblies that don't include them–e.g., when exterior walls need to be shear walls but the specified assembly doesn't show sheathing panels.

Share

Q: Can I add wood structural panels to a fire-tested wall assembly that doesn't already include them? I need the exterior walls on a project to be shear walls but the UL assembly I'm specifying doesn't show sheathing panels.

A: Several reference permit the addition of structural panels to a fire resistance-rated wall assembly that was tested without them:

The Underwriter Labs' General Information for Fire-resistance Ratings – ANSI/UL 263, Section VI item 6, allows the addition of wood structural panels in fire-rated gypsum board wall assemblies and provides relevant construction details.

The Gypsum Association's Fire Resistance Design Manual permits this per Item 23 in Section 1 of the General Explanatory Notes. This is shown in the following text:

"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

https://www.woodworks.org/resources/adding-wood-structural-panels-to-a-fire-tested-wall-assembly/

Fire Design

Can include WSP in assemblies which were tested without them:

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

GA Fire Resistance Design Manual item 23 in Section 1 of the General Explanatory 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 achieve a minimum fire resistance rating, a wide range of options for design exists.

Building Code Requirements

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 assemblies. The calculated fire resistance provisions within Section 722.6 of the *International Building Code® (IBC)* were developed using CAM.

What if I add a layer of wood sheathing?

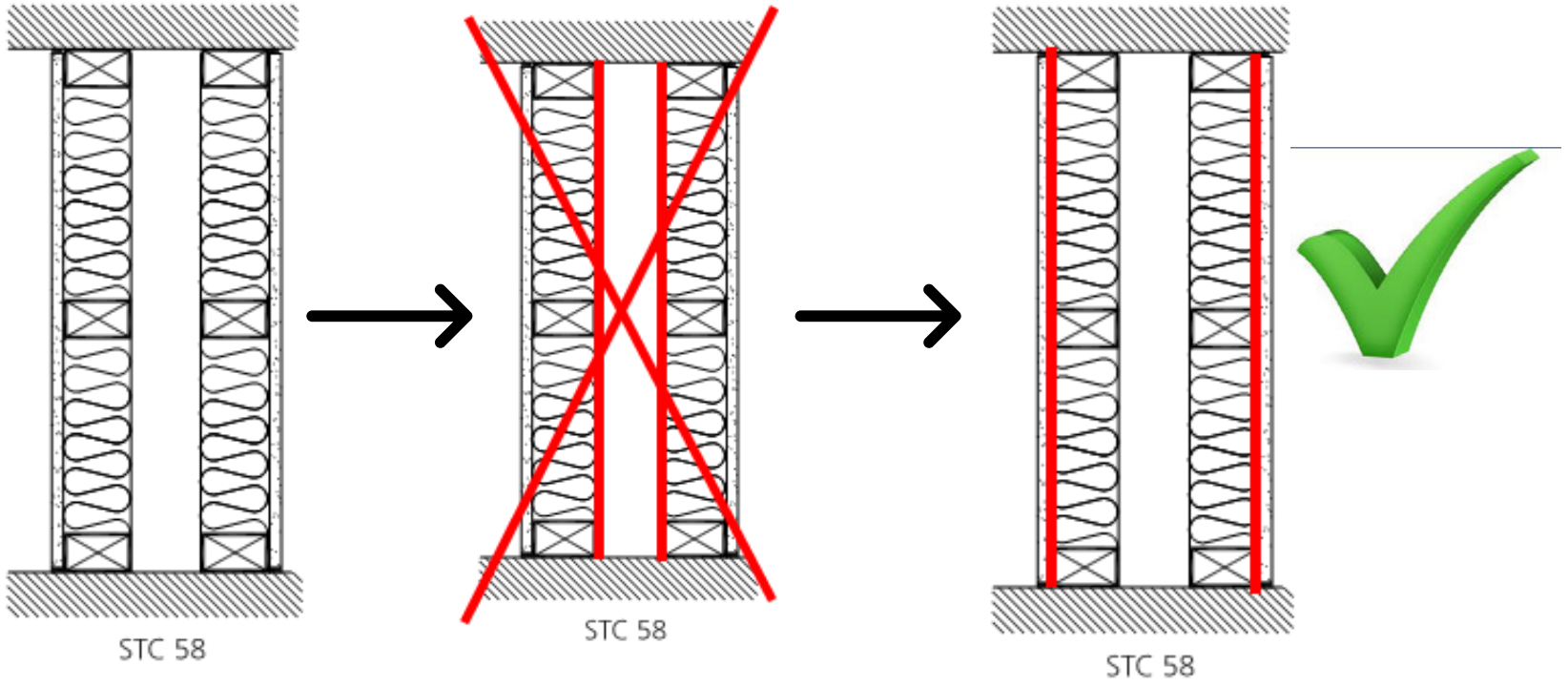
Adding sheathing *can* negatively affect the **acoustical rating** of a wall, depending on placement

https://www.woodworks.org/resources/adding-wood-structural-panels-to-acoustically-tested-assemblies/

Acoustical Design

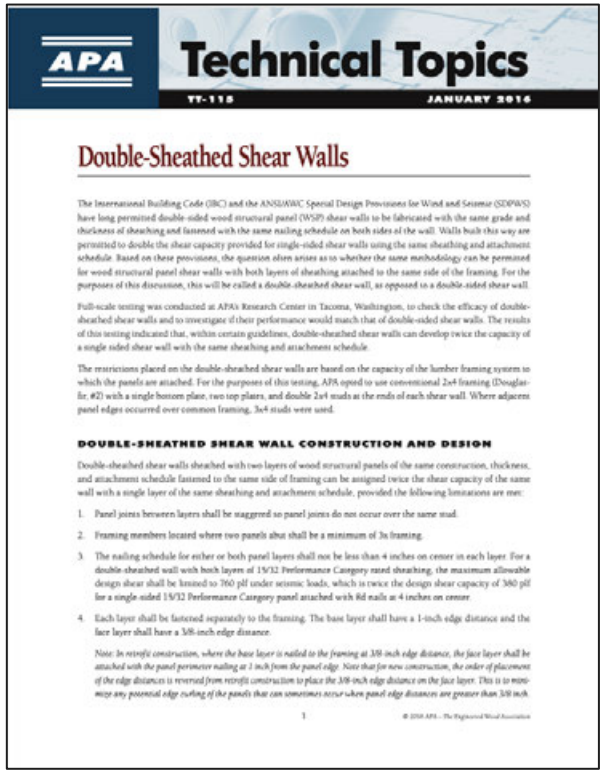
Adding sheathing will not negatively affect the STC of a wall provided:

1. It does not impede the performance of a resilient channel
2. It does not change the depth of an air space.



Acoustical Design

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



APA Technical Topics

TT-118 JANUARY 2016

Double-Sheathed Shear Walls

The International Building Code (IBC) and the ANSI/AWC Special Design Provisions for Wind and Seismic (SDPWS) have long permitted double-sided wood structural panel (WSP) shear walls to be fabricated with the same grade and thickness of sheathing and fastened with the same nailing schedule on both sides of the wall. Walls built this way are permitted to double the shear capacity provided for single-sided shear walls using the same sheathing and attachment schedule. Based on these provisions, the question often arises as to whether the same methodology can be permitted for wood structural panel shear walls with both layers of sheathing attached to the same side of the framing. For the purposes of this discussion, this will be called a *double-sheathed shear wall*, as opposed to a *double-sided shear wall*.

Full-scale testing was conducted at APA's Research Center in Tacoma, Washington, to check the efficacy of double-sheathed shear walls and to investigate if their performance would match that of double-sided shear walls. The results of this testing indicated that, within certain guidelines, double-sheathed shear walls can develop twice the capacity of a single sided shear wall with the same sheathing and attachment schedule.

The restrictions placed on the double-sheathed shear walls are based on the capacity of the lumber framing system to which the panels are attached. For the purposes of this testing, APA opted to use conventional 2x4 framing (Douglas-fir, #2) with a single bottom plate, two top plates, and double 2x4 studs at the ends of each shear wall. Where adjacent panel edges occurred over common framing, 3x4 studs were used.

DOUBLE-SHEATHED SHEAR WALL CONSTRUCTION AND DESIGN

Double-sheathed shear walls sheathed with two layers of wood structural panels of the same construction, thickness, and attachment schedule fastened to the same side of framing can be assigned twice the shear capacity of the same wall with a single layer of the same sheathing and attachment schedule, provided the following limitations are met:

1. Panel joints between layers shall be staggered so panel joints do not occur over the same stud.
2. Framing members located where two panels abut shall be a minimum of 3x framing.
3. The nailing schedule for either or both panel layers shall not be less than 4 inches on center in each layer. For a double-sheathed wall with both layers of 15/32 Performance Category rated sheathing, the maximum allowable design shear shall be limited to 760 plf under seismic loads, which is twice the design shear capacity of 380 plf for a single-sided 15/32 Performance Category panel attached with 8d nails at 4 inches on center.
4. Each layer shall be fastened separately to the framing. The base layer shall have a 1-inch edge distance and the face layer shall have a 3/8-inch edge distance.

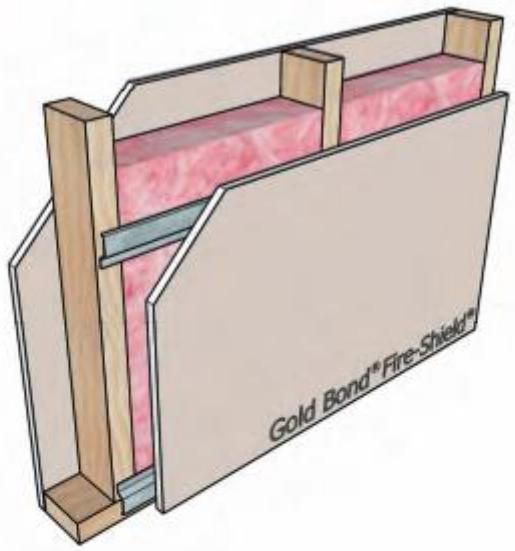
Note: In retrofit construction, where the base layer is nailed to the framing at 3/8-inch edge distance, the face layer shall be attached with the panel perimeter nailing at 1 inch from the panel edge. Note that for new construction, the order of placement of the edge distances is reversed from retrofit construction to place the 3/8-inch edge distance on the face layer. This is to minimize any potential edge curling of the panels that can sometimes occur when panel edge distances are greater than 3/8 inch.

1 © 2016 APA – The Engineered Wood Association

What if my stud spacing/size varies?

What if my stud spacing/size varies?

Let’s say we need a 1-hour corridor wall with STC >=50 and choose this assembly:



STC-51	NGC 2011071
Framing:	2x4 wood studs, 16" o.c.
Insulation:	3-1/2" glass fiber
Side 1:	5/8" Fire-Shield Gypsum Board
Side 2:	5/8" Fire-Shield Gypsum Board on RC-1
UL Design:	U305 - 1 hour

Then the engineer needs to increase the stud size or decrease the spacing.
Or perhaps add a layer of wood sheathing for shear resistance.

What if my stud spacing/size varies?

Typically having **more** or **larger** studs won't affect the fire-rating chosen.

There are a couple of references that confirm this:

» Notes 15 & 16 of the Gypsum Association Fire Resistance Design Manual state that studs can be larger than noted in the assembly and that stud spacings noted are max:

15. Greater stud sizes (depths) shall be permitted to be used in metal- or wood-stud systems. Metal studs of heavier gage than those tested shall be permitted. The assigned rating of any load-bearing system shall also apply to the same system when used as a nonload-bearing system. Indicated stud spacings are maximums.
16. Specified floor-ceiling and roof-ceiling framing sizes or truss dimensions are minimums. Greater joist or truss sizes (depths) shall be permitted to be used in metal- or wood-framed systems. Indicated joist and truss spacings are maximums.

» Section VI of the UL Fire Design Information essentially notes the same.

What if my stud spacing/size varies?

If your stud/joist size is **smaller** or spacing is **larger** (i.e. fewer studs) than the tested assembly, you'll need to show conformance to fire resistance with another method.

Acoustically, **more** studs or **larger** studs can reduce the STC.
Fewer studs increases the STC.

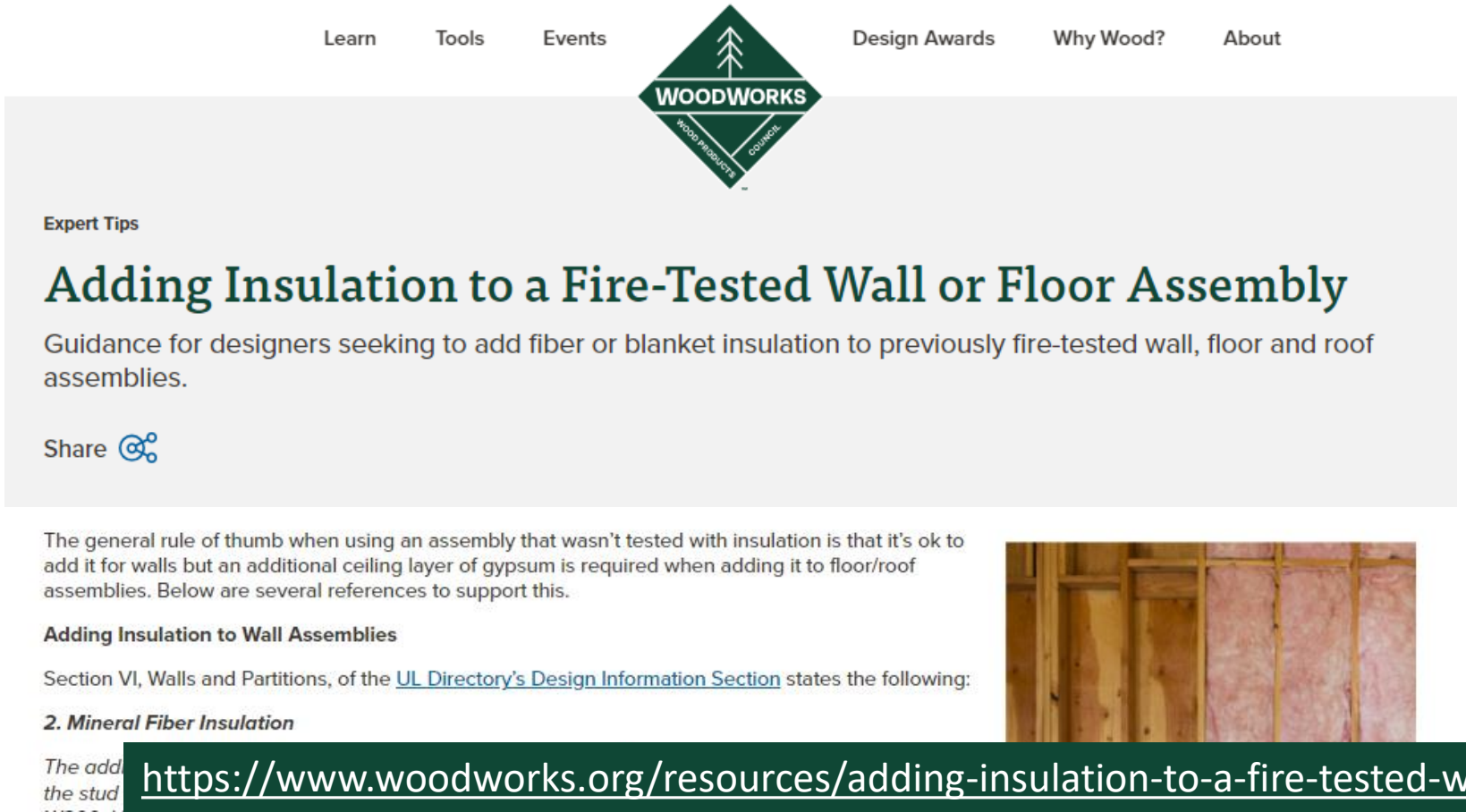
https://www.woodworks.org/resources/impact-of-wall-stud-size-and-spacing-on-fire-and-acoustic-performance/

What if I need to add insulation?

What if I add insulation?

Adding insulation will not negatively affect the **fire rating** of a wall.

(But *could* negatively affect the fire rating of a floor/ceiling assembly.)



Fire Barriers:
Shaft Walls

Shaft Wall Materials

Mass Timber

Photo: Quality Contractors

Steel Studs, Wood Studs

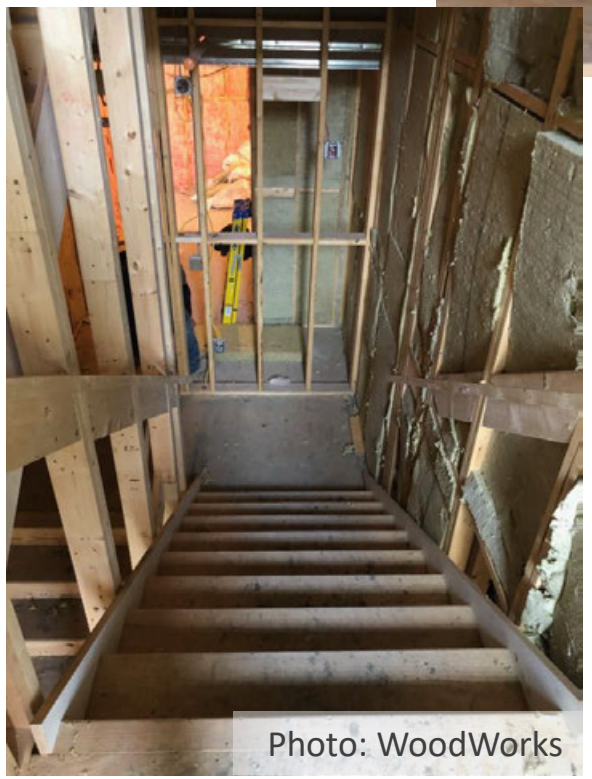


Photo: WoodWorks

Shaftliner Panels

Photo: Georgia Pacific

Masonry

Photo: WoodWorks

Defining Shaft Wall Requirements

Code requirements for shaft enclosures contained in IBC Section 713:

SECTION 713
SHAFT ENCLOSURES

713.1 General. The provisions of this section shall apply to shafts required to protect openings and penetrations through floor/ceiling and roof/ceiling assemblies. *Interior exit stairways* and *ramps* shall be enclosed in accordance with Section 1023.

- IBC 713.2: Shaft Walls shall be constructed as **Fire Barriers**
- Many shaft wall provisions contained in *IBC Section 707: Fire Barriers*

Shaft Wall Assemblies

Assembly selection considerations

- Fire resistance rating requirement (1 hr or 2 hr)
- Size and height of shaft
- Structural needs (gravity & lateral loads)
- Acoustics
- Space available for wall (allowed thickness)

Shaft Wall Assemblies

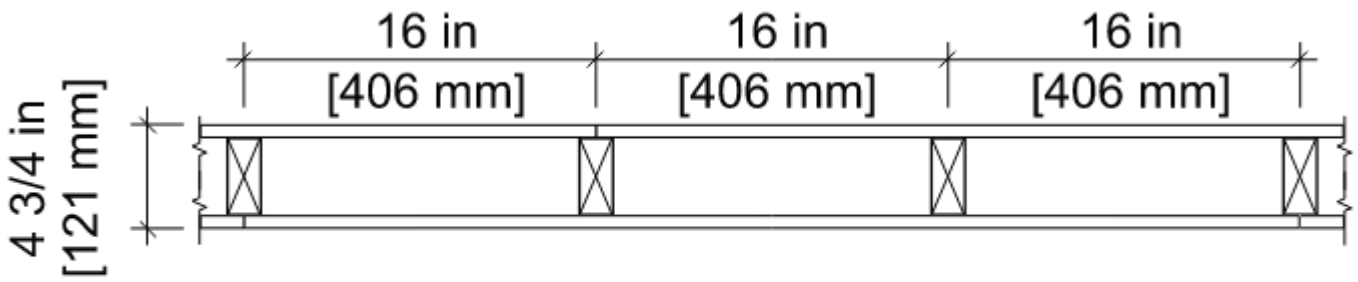


FIGURE 4: UL U305

1-Hour Single Wall

- UL U305
- GA WP 3510
- UL U311
- IBC 2012 Table 721.1(2), Item 14-1.3
- UL U332

1-Hour Double Wall

- UL U341

1-Hour Wall with Shaftliner

- UL V455
- UL V433

Shaft Wall Assemblies

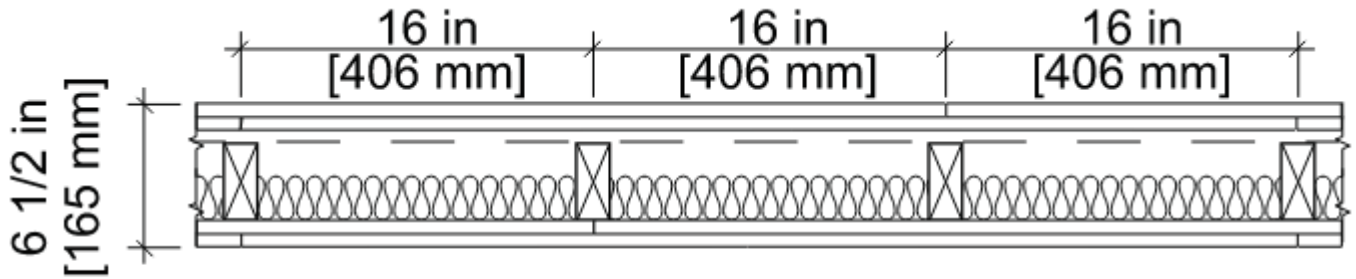


FIGURE 5: UL U334

2-Hour Single wall

- UL U301
- UL U334
- IBC 2012 Table 721.1(2) Item Number 14-1.5
- IBC 2012 Table 721.1(2) Item Number 15-1.16

2-Hour Double Wall

- UL U342
- UL U370
- GA WP 3820

2-Hour Wall with Shaftliner

- UL U336
- UL U373
- UL U375
- UL V455
- UL V433
- GA ASW 1000

Continuity Provisions

Section 713: Shaft Enclosures

713.5 Continuity.

Shaft enclosures shall have continuity in accordance with 707.5 for fire barriers.

Section 707: Fire Barriers

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 though concealed space such as the space above a suspended ceiling. Joints and voids at intersections shall comply with Sections 707.8 and 707.9.

Continuity Provisions

What do these continuity provisions look like?

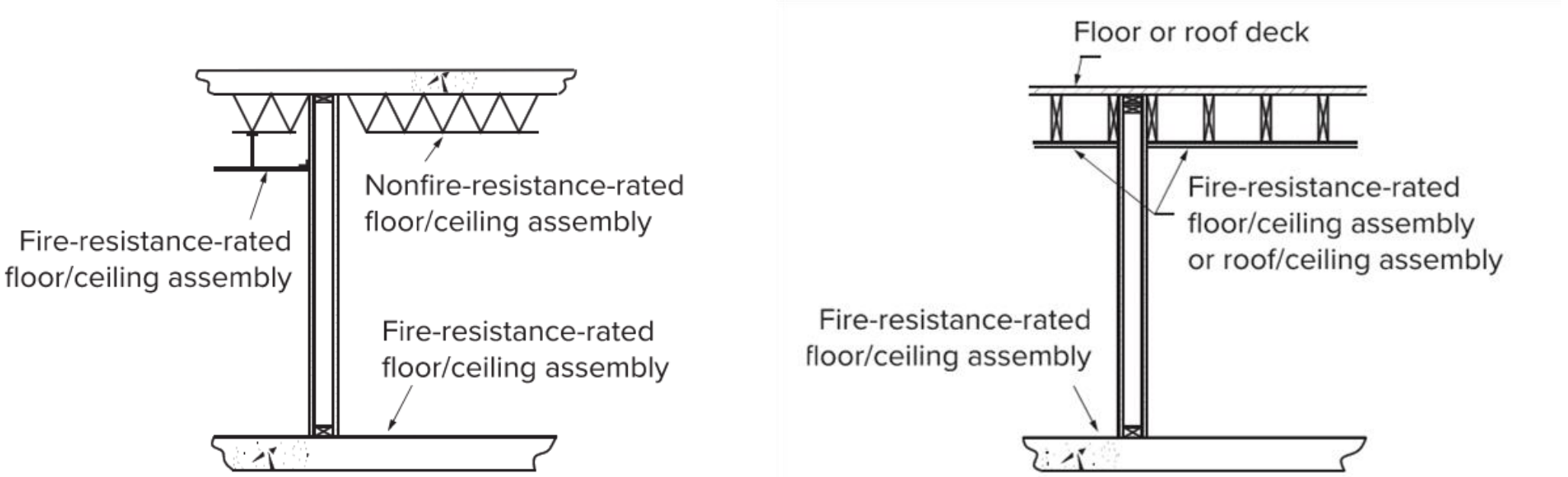
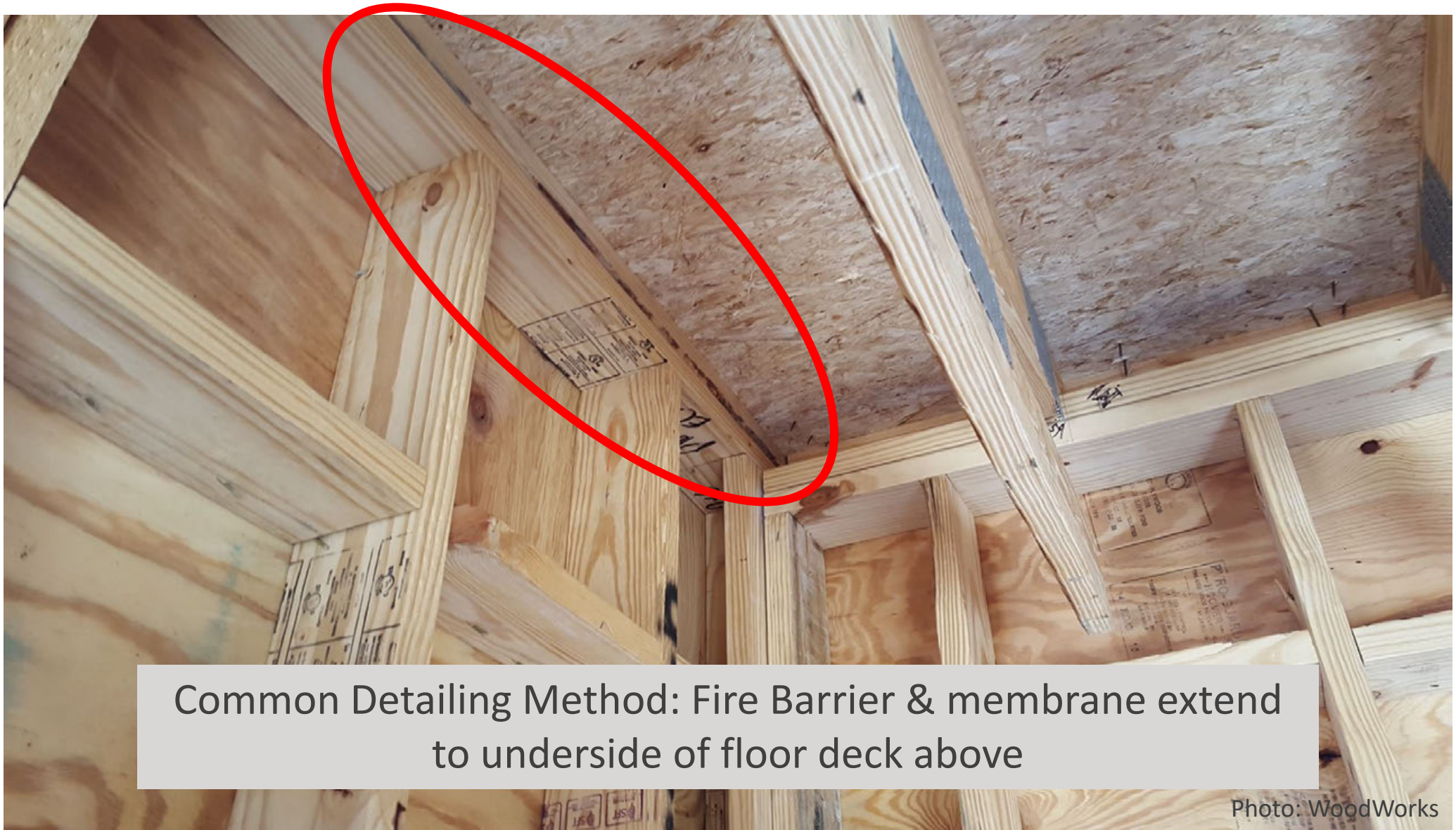


FIGURE 1: IBC Commentary Figure 707.5 – Continuity of fire barriers

Continuity Provisions



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

Photo: WoodWorks

Continuity Provisions

The continuity of the fire barrier's fire protection can be maintained even if the wall framing does not extend to the underside of the decking above

Photo: WoodWorks

Why would I use a shaftliner panel system as a shaft wall?

Shaftliner Systems - Benefits & Limitations

Benefits

» Allows installation from one side only – useful in small MEP shafts where finishing from inside isn't possible

Limitations

» Some have height limitations, both per story and overall system

» Not structural, requires back-up wood wall

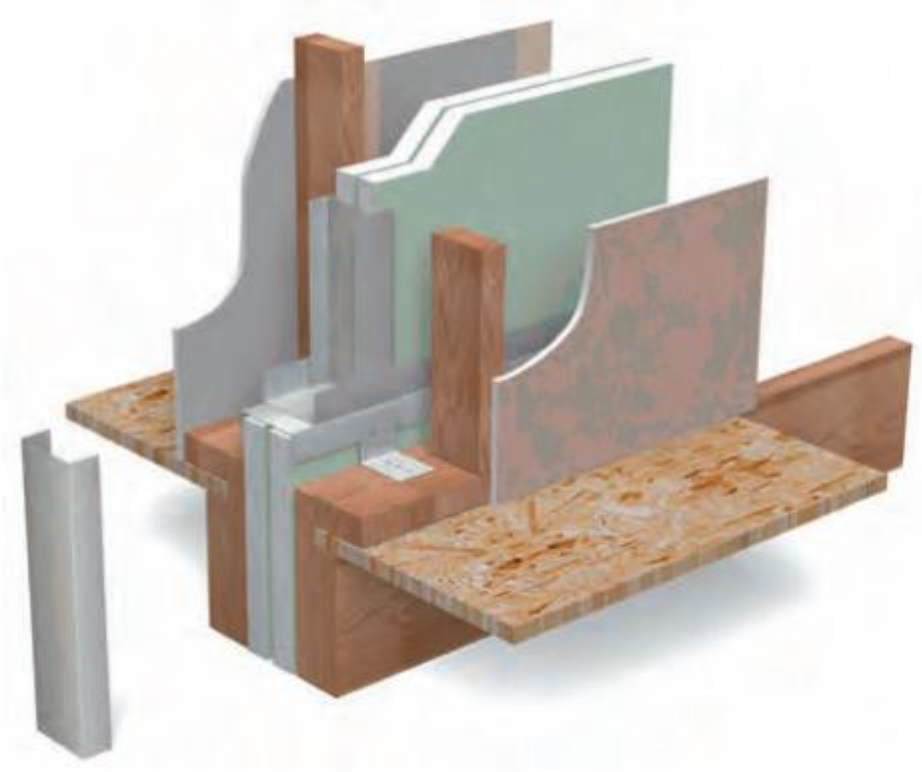


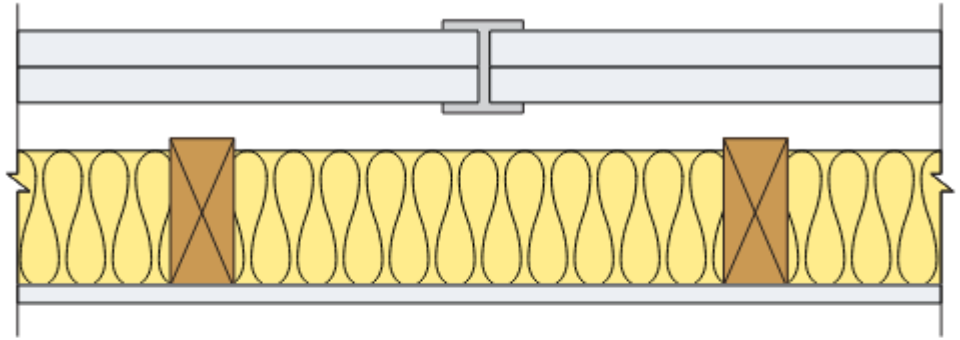
FIGURE 6: Shaftliner wall assembly with wood wall on each side

Credit: ClarkDietrich

Shaftliner Systems – Configuration Options

H-Stud Option

Source: Clark Dietrich

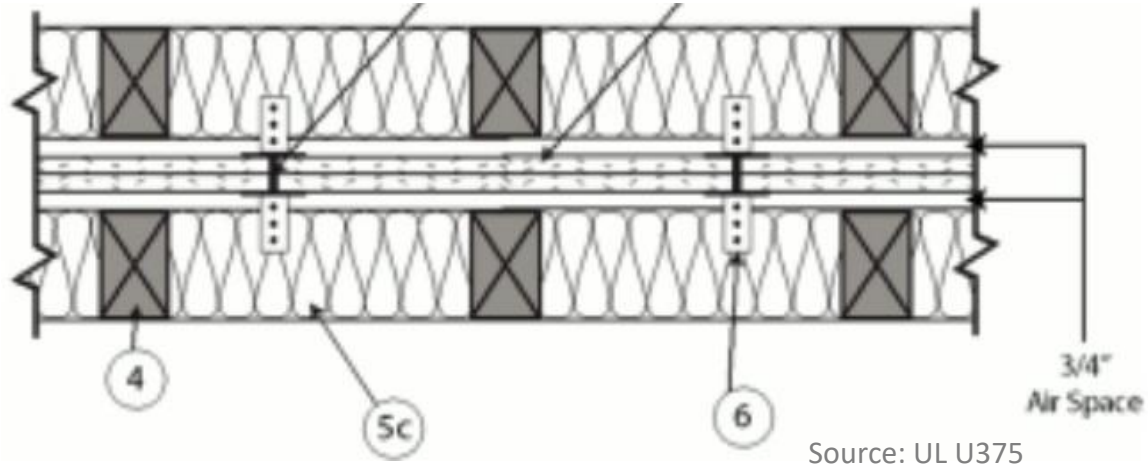


59 STC Sound Transmission

Test Reference: RAL TL 10-290

Two layers 1" (25.4 mm) shaftliner inserted in H-studs 24" (610 mm) o.c., min. 3/4" (19 mm) air spacing between liner panels and adjacent or wood metal framing

Sound tested with 2"x4" stud wall with 1/2" (12.7 mm) wallboard or interior panels and 3-1/2" (89 mm) fiberglass insulation in stud space



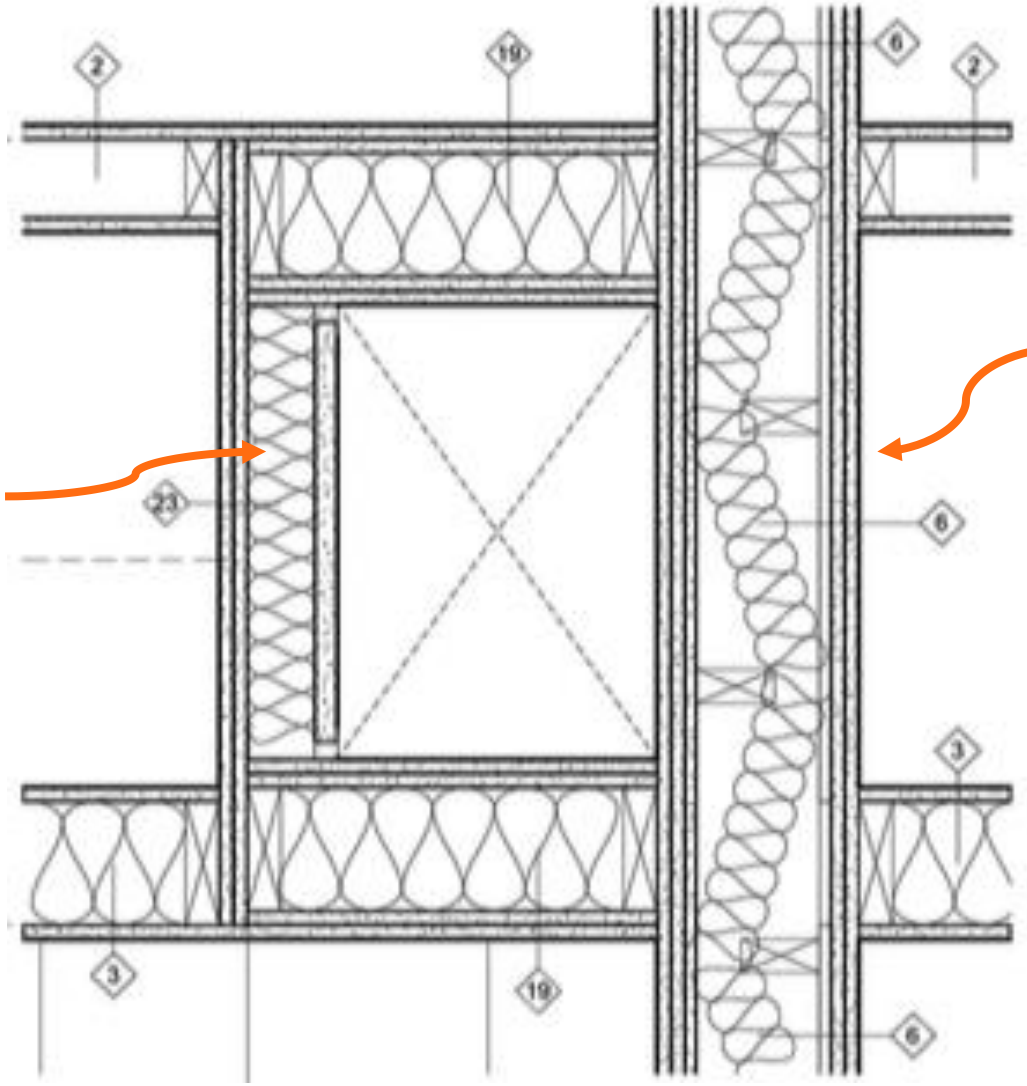
Source: UL U375

FIGURE 8: UL U373

Credit: Georgia Pacific

Shaftliner Systems – Configuration Options

CH-stud shaftliner



3 sides of wood shaft walls installed first. If shaft is small enough, might suggest shaftliner system on more than one side

Why do shaftliner panel height limits exist and how can I meet them in a 5+ story building?

Shaftliner Systems – Height Limits

Why do you need to support shaftliner panels?

- H-studs are non-structural
- Can only resist nominal horizontal pressures and self weight (but limited on self weight capacity)

PERFORMANCE SELECTOR

WALL SYSTEMS—LIMITING HEIGHTS TABLE

			One-Hour Shaft Wall / Stairwell (U415 System A)[b]				Two-Hour Shaft Wall (U415 System C)[b]			
Stud Type and Size	**Designation**	**Allowable Deflection**	**5**	**7.5**	**10**	**15**	**5**	**7.5**	**10**	**15**
2-1/2″ C-H Studs	212CH-18	L/120	11′ 5″	10′ 0″	9′ 1″ [d]	7′ 11″ [d]	—	—	—	—
		L/240	10′ 7″	9′ 3″	8′ 4″ [d]	7′ 4″ [d]	—	—	—	—
		L/360	9′ 4″	8′ 2″	7′ 5″	6′ 6″	—	—	—	—
	212CH-34	L/120	13′ 5″	11′ 8″	10′ 8″	9′ 3″	—	—	—	—
		L/240	12′ 3″	10′ 9″	9′ 9″	8′ 6″	—	—	—	—
		L/360	10′ 10″	9′ 6″	8′ 7″	7′ 6″	—	—	—	—
4″ C-H Studs	400CH-18	L/120	15′ 2″	12′ 5″	10′ 9″ [d]	8′ 9″ [d]	15′ 2″	12′ 5″	10′ 9″ [d]	8′ 9″ [d]
		L/240	14′ 5″	12′ 5″	10′ 9″ [d]	8′ 9″ [d]	14′ 5″	12′ 5″	10′ 9″ [d]	8′ 9″ [d]
		L/360	12′ 9″	11′ 2″	10′ 1″ [d]	8′ 9″ [d]	12′ 9″	11′ 2″	10′ 1″ [d]	8′ 9″ [d]
	400CH-34	L/120	20′ 5″	17′ 10″	16′ 2″ [d]	13′ 4″ [d]	20′ 5″	17′ 10″	16′ 2″ [d]	13′ 4″ [d]
		L/240	17′ 6″	15′ 3″	13′ 10″	12′ 1″ [d]	17′ 6″	15′ 3″	13′ 10″	12′ 1″ [d]
		L/360	15′ 3″	13′ 4″	12′ 1″	10′ 7″ [d]	15′ 3″	13′ 4″	12′ 1″	10′ 7″ [d]

Shaftliner Systems – Height Limits

Example Shaftliner Clip Attachment Schedule per UL U375		
System No.	System Height Limitation	Attachment Clip Schedule
1	23 ft	10 ft o.c.
2	44 ft	Base to 20 ft: 5 ft o.c. 20 ft to 44 ft: 10 ft o.c.
3	66 ft	Base to 22 ft: 3’-4” o.c. 22 ft to 42 ft: 5 ft o.c. 42 ft to 66 ft: 10 ft o.c.

H-Stud

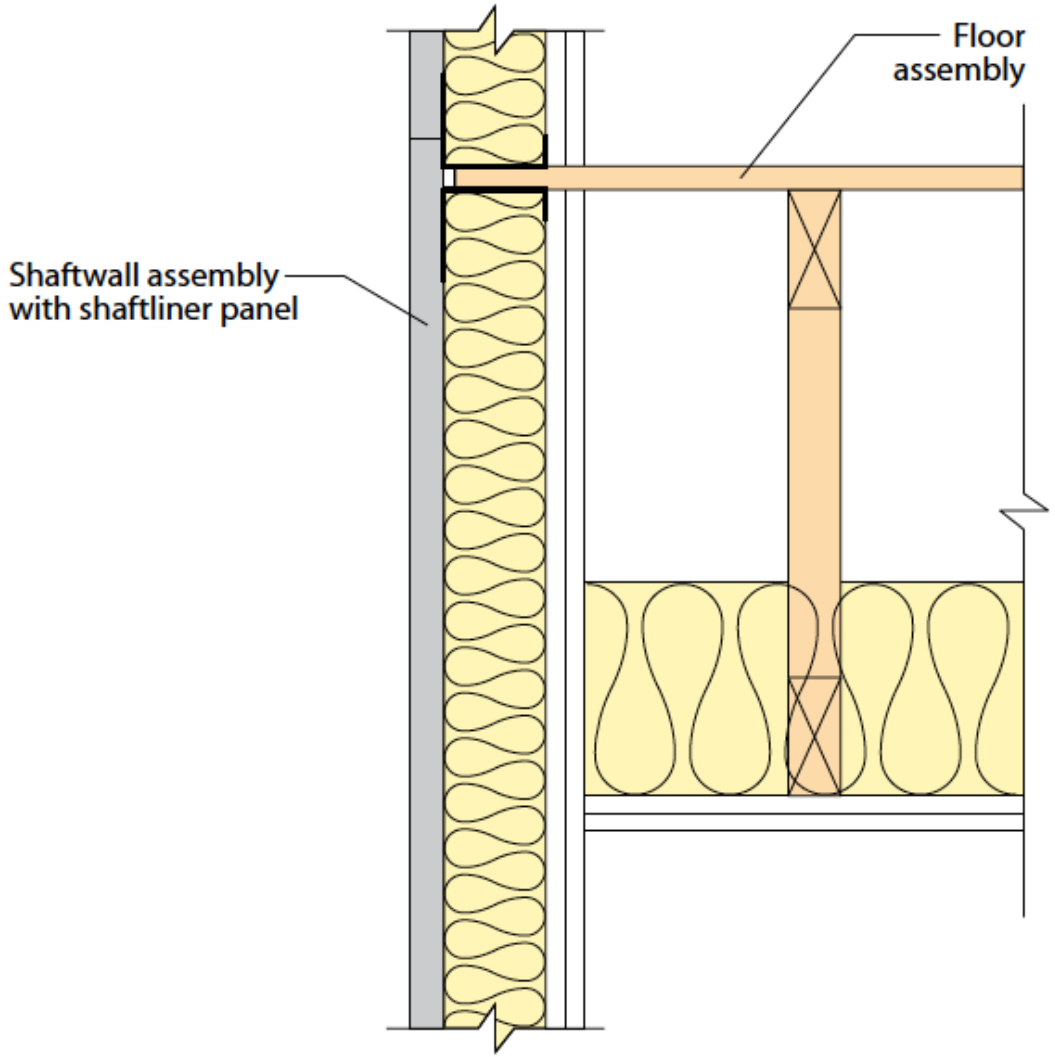
Source: Clark Dietrich

Attachment Clips: Aluminum or steel angles, usually 14 – 16 gauge, 2” wide with 2” to 2-1/2” long legs. Attaches to wall framing and H-studs

How do I support a shaftliner panel system on a wood floor assembly?

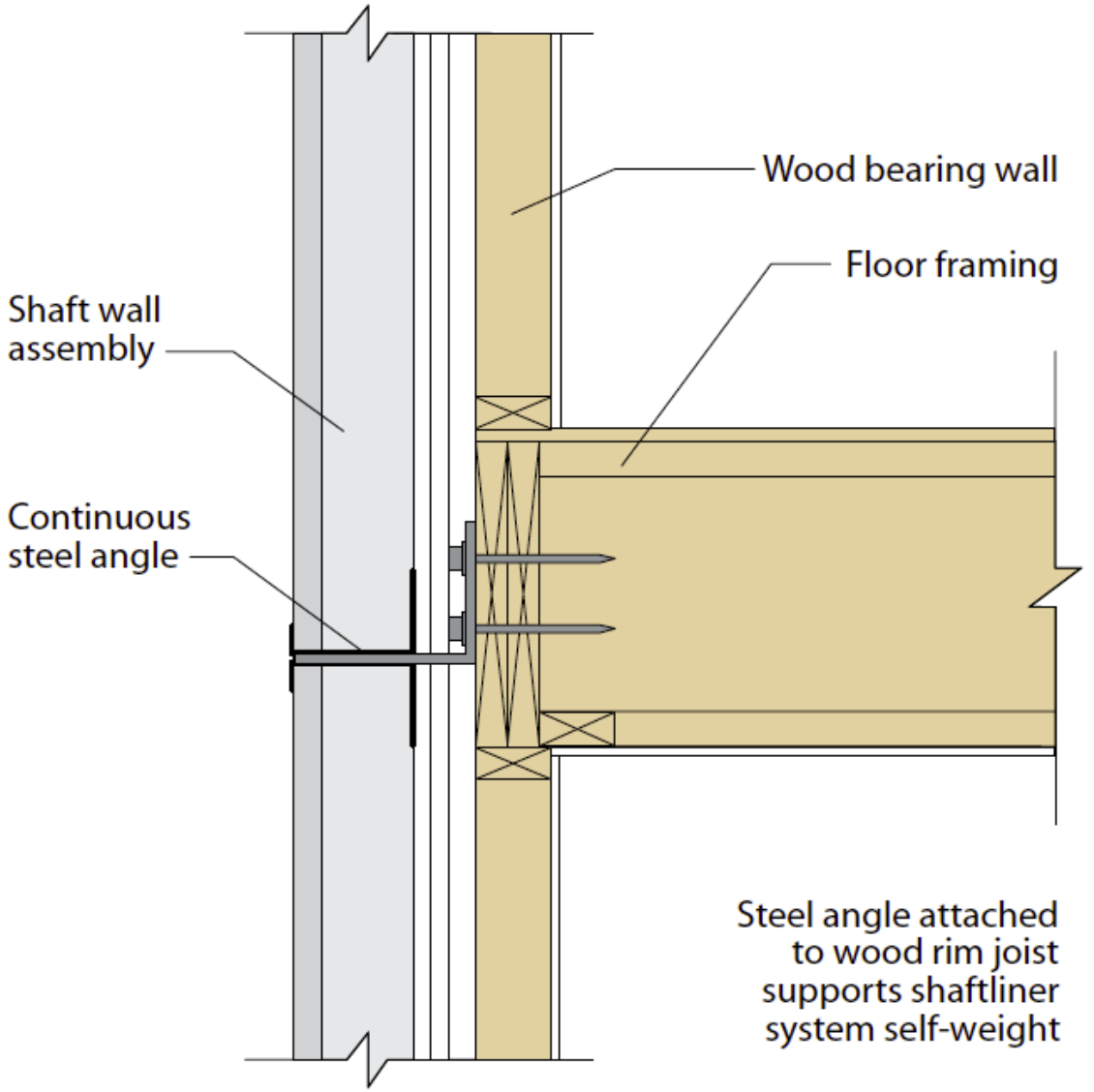
Shaftliner Systems – Support Details

Floor sheathing cantilevers out to support shaftliner system self-weight



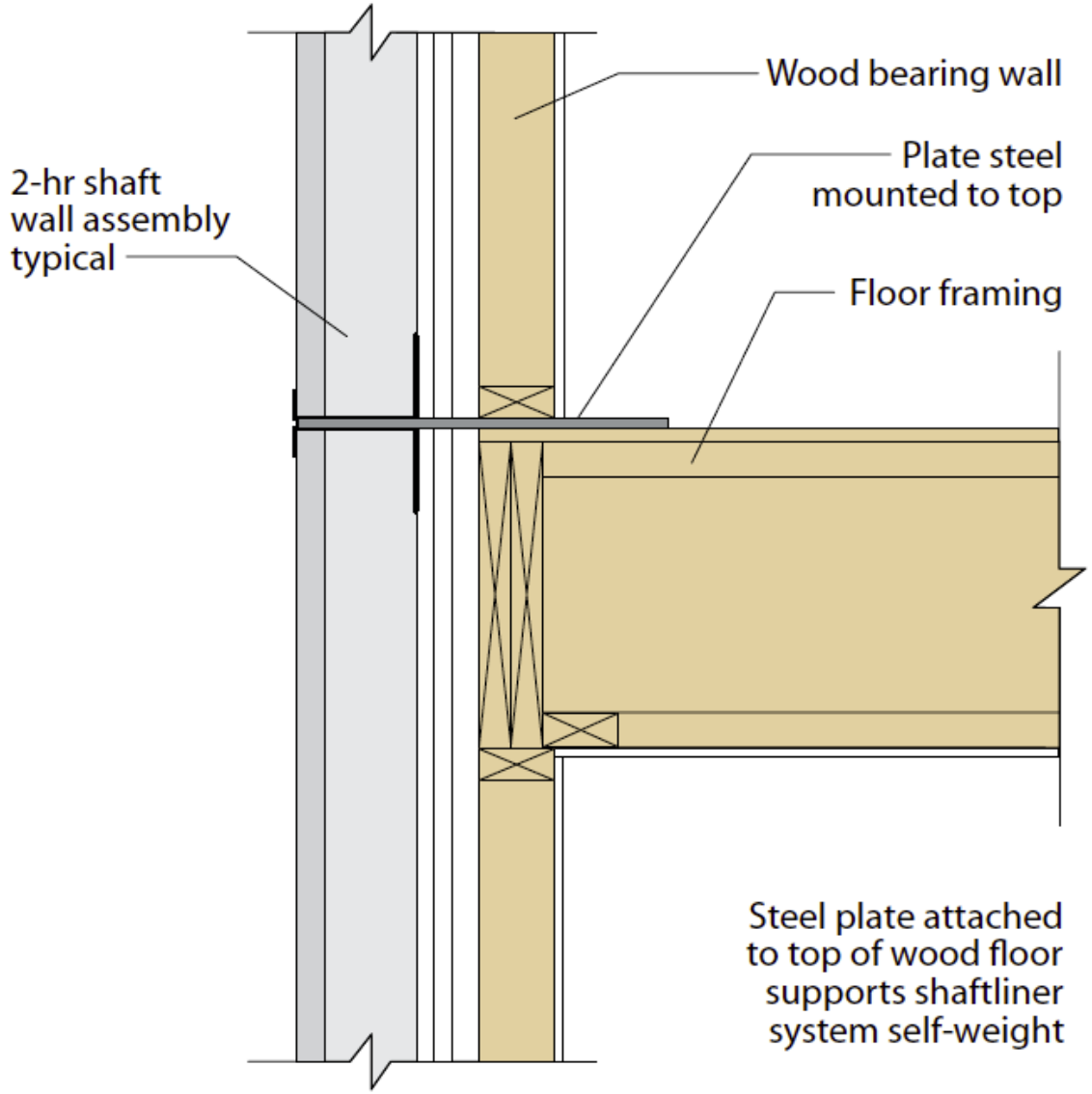
Shaftliner Systems – Support Details

Steel angle attached to wood rim joist supports shaftliner system self-weight



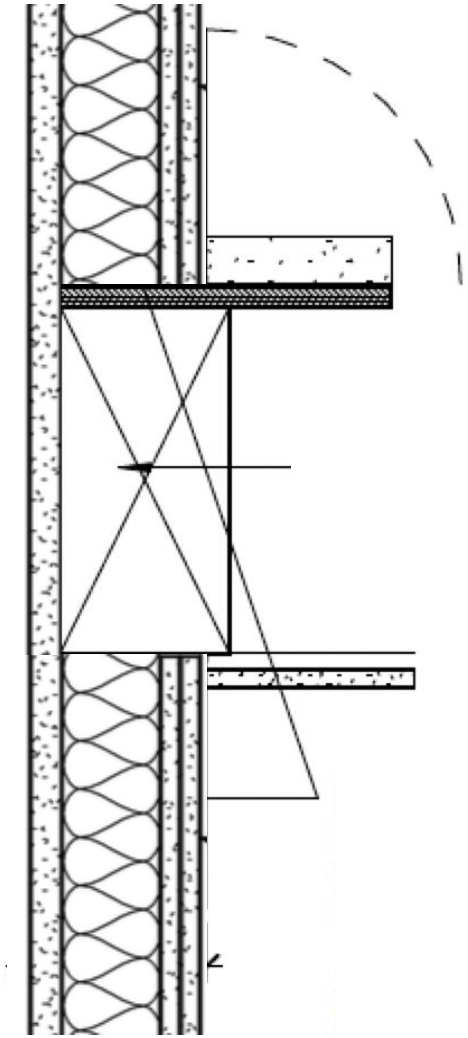
Shaftliner Systems – Support Details

Steel plate attached to top of wood floor supports shaftliner system self-weight



Shaftliner Systems – Support Details

Shaftliner system self-weight supported on wood floor in platform framed condition



Shaft Wall Resource

Code provisions, detailing options, project examples and more for light-frame wood and mass timber shaft walls

Free resource at woodworks.org

Richard McLain, PE, SE
Senior Technical Director – Tall Wood
WoodWorks – Wood Products Council

Shaft Wall Solutions for Light-Frame and Mass Timber Buildings

An overview of design considerations, detailing options and code requirements

It is fairly common for mid-rise wood buildings to include shaft walls made from other materials. However, wood shaft walls are a code-compliant option for both light-frame and mass timber projects—and they typically have the added benefits of lower cost and faster installation.

A shaft is defined in Section 202 of the 2018 International Building Code[1] (IBC) as *"an enclosed space extending through one or more stories of a building, connecting vertical openings in successive floors, or floors and roof."* Therefore, shaft enclosure requirements apply to stairs, elevators, and mechanical-engineering-plumbing (MEP) chases in multi-story buildings. While these applications might be similar in their fire design requirements, they often have different construction constraints and scenarios where assemblies and detailing may also differ.

This paper provides an overview of design considerations, requirements, and options for light wood-frame and mass timber shaft walls under the 2018 and 2021 IBC, and considerations related to non-wood shaft walls in wood buildings.

CONTENTS

Fire Resistance

Fire Barrier Construction

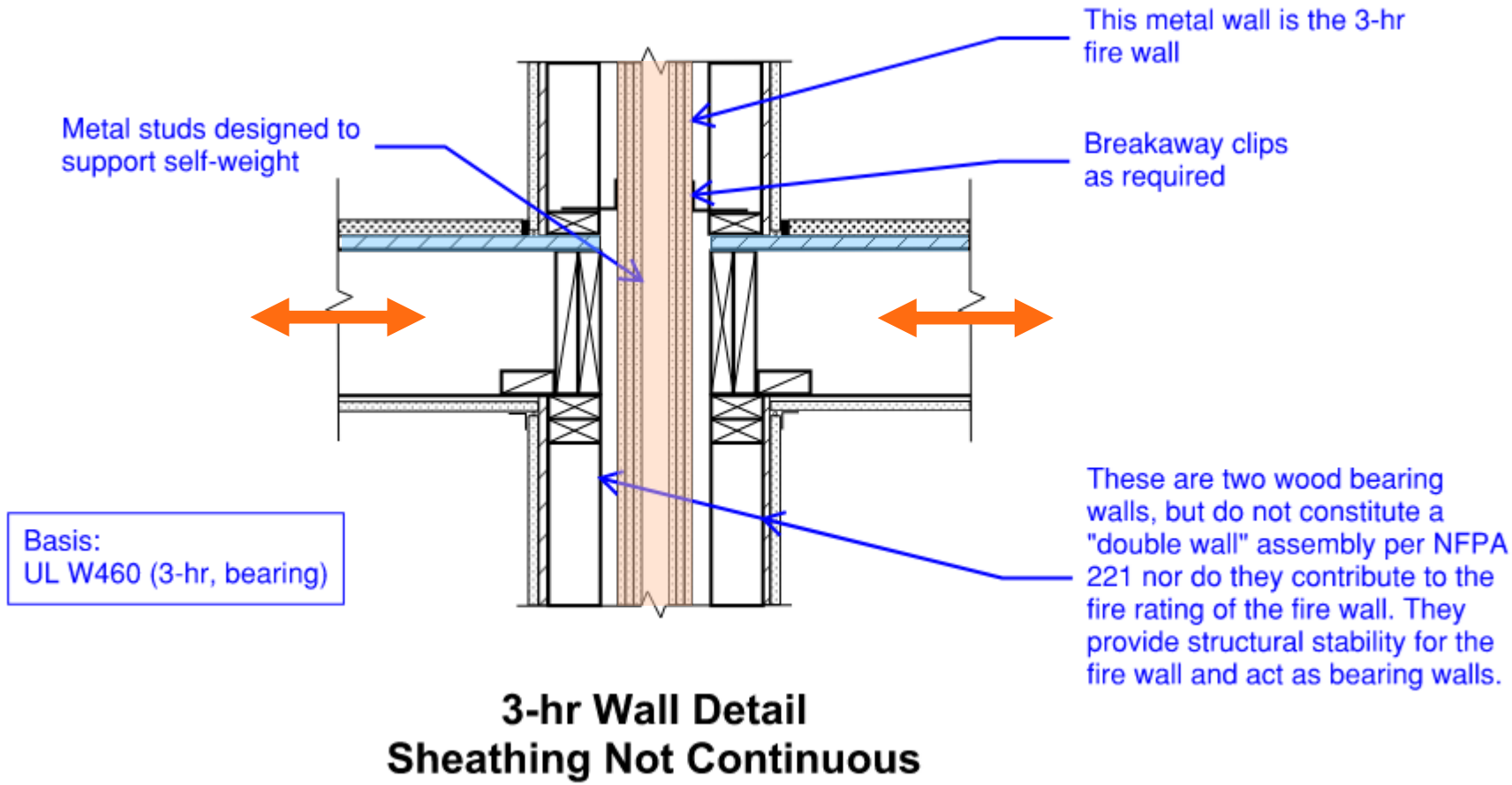
Shaft enclosures are specifically addressed in IBC Section 713. However, because shaft enclosure walls need to be constructed as fire barriers per Section 713.2, many shaft wall requirements directly reference provisions of fire barriers found in Section 707.

Provisions addressing materials permitted in shaft wall construction are given in both the shaft enclosures section (713.3) and fire barriers section (707.2). These

https://www.woodworks.org/resources/shaft-wall-solutions-for-wood-frame-buildings/

Fire Walls:
Meeting Continuity Requirements

Fire Walls – Seismic Diaphragm Continuity



3-hr Wall Detail
Sheathing Not Continuous

Fire Walls – Seismic Diaphragm Continuity

SEAOSC

SEAoSC LIGHT-FRAMING CONSTRUCTION COMMITTEE
STRUCTURAL ENGINEERS ASSOCIATION OF SOUTHERN CALIFORNIA
SEISMOLOGY OPINION

DATE: **March 21, 2008**

Continuity of Plywood Diaphragm Sheathing in 2 hr and 3hr Fire Walls:

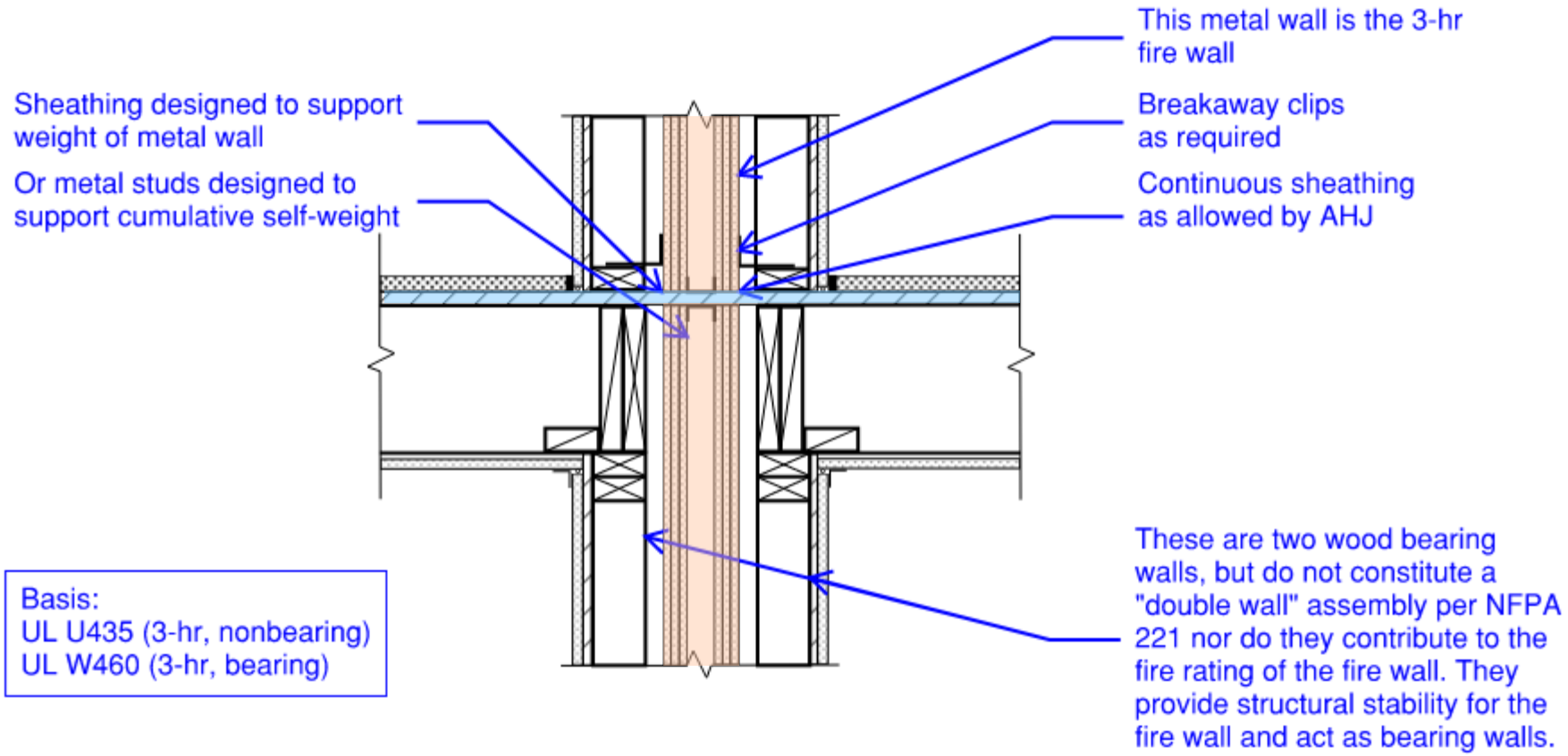
Opinion: The continuity of plywood diaphragm sheathing should be maintained across the air gap commonly encountered in double stud Firewalls of 2 or 3 hour construction. The intent is to ensure that structural continuity is not significantly reduced in the roof and floor diaphragms.

Commentary:

This opinion is prepared to address the issue of diaphragm continuity as it relates to recent changes in 2007 CBC and 2006 IBC model code. Specifically the outgoing UBC provisions for Area-Separation walls have more or less been replaced by the Fire wall provisions of the IBC. Such walls are encountered in light-frame multifamily or mixed-use construction and are often constructed as a double studwall when occurring at partywall locations. The double stud walls are typically separated by an airspace of a one to four inches.

The IBC has introduced language [IBC 705.4] that states fire walls must have "sufficient structural stability" under fire conditions to allow collapse of either side. Previous commentary to the UBC topic of Area Separation

Fire Walls – Seismic Diaphragm Continuity



3-hr Wall Detail
Sheathing Continuous

https://www.woodworks.org/cad-revit/light-frame/

Fire Walls – Seismic Diaphragm Continuity

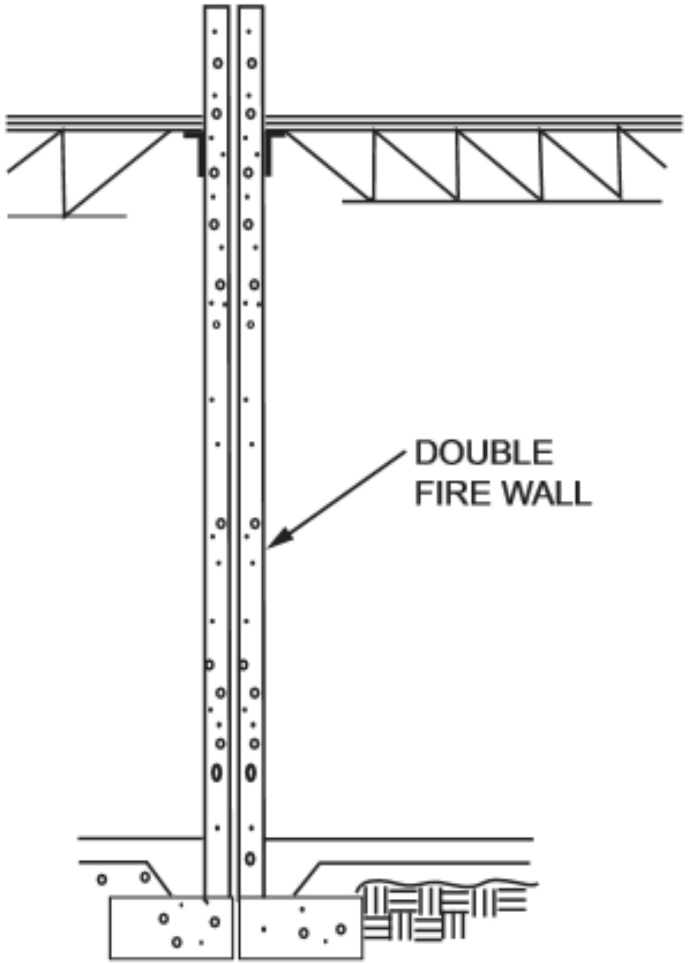
2018 IBC Provisions Allow Floor Sheathing Through Firewall under Certain Conditions

706.2 Structural stability.

Fire walls shall be designed and constructed to allow collapse of the structure on either side without collapse of the wall under fire conditions. *Fire walls* designed and constructed in accordance with NFPA 221 shall be deemed to comply with this section.

Exception: In Seismic Design Categories D through F, where double *fire walls* are used in accordance with NFPA 221, floor and roof sheathing not exceeding $^{3}/_{4}$ inch (19.05 mm) thickness shall be permitted to be continuous through the wall assemblies of light frame construction.

NFPA 221 – Double Walls



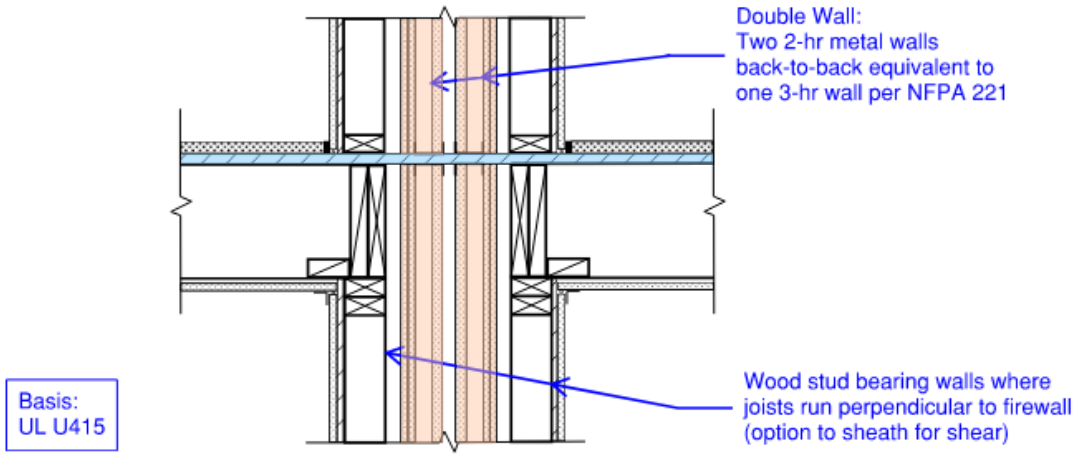
4.5* Double Wall Assemblies. Where either wall of a double wall is laterally supported by a building frame with a fire resistance rating less than that required for the wall, double wall assemblies shall be considered to have a combined assembly fire resistance rating as specified in Table 4.5.

Table 4.5 Fire Resistance Ratings for Double Wall Assemblies

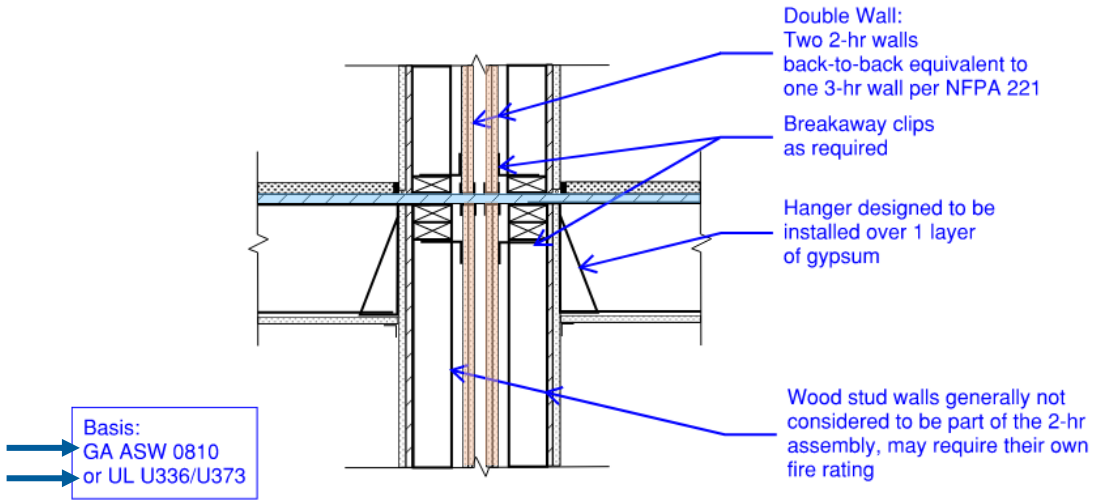
Fire Resistance Rating of Each Wall (hr)	Equivalent to Single Wall (hr)
3	4
2	3
1	2

Double Walls in Type III

Noncombustible Construction Required



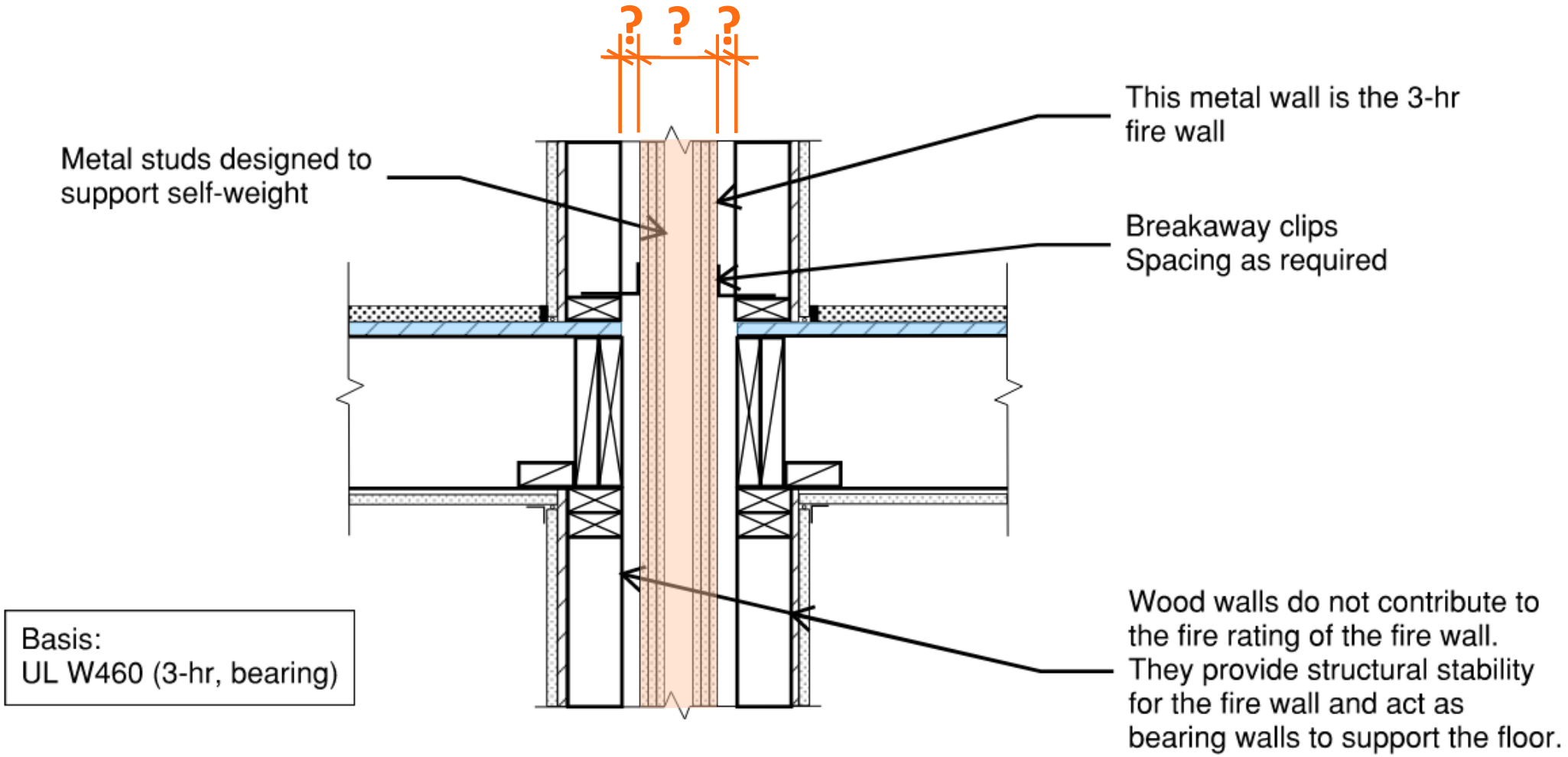
NFPA 221 Double Wall
3-hr Wall Detail for use in Type III
(noncombustible)



NFPA 221 Double Wall
3-hr Wall Detail for use in Type III
(noncombustible)

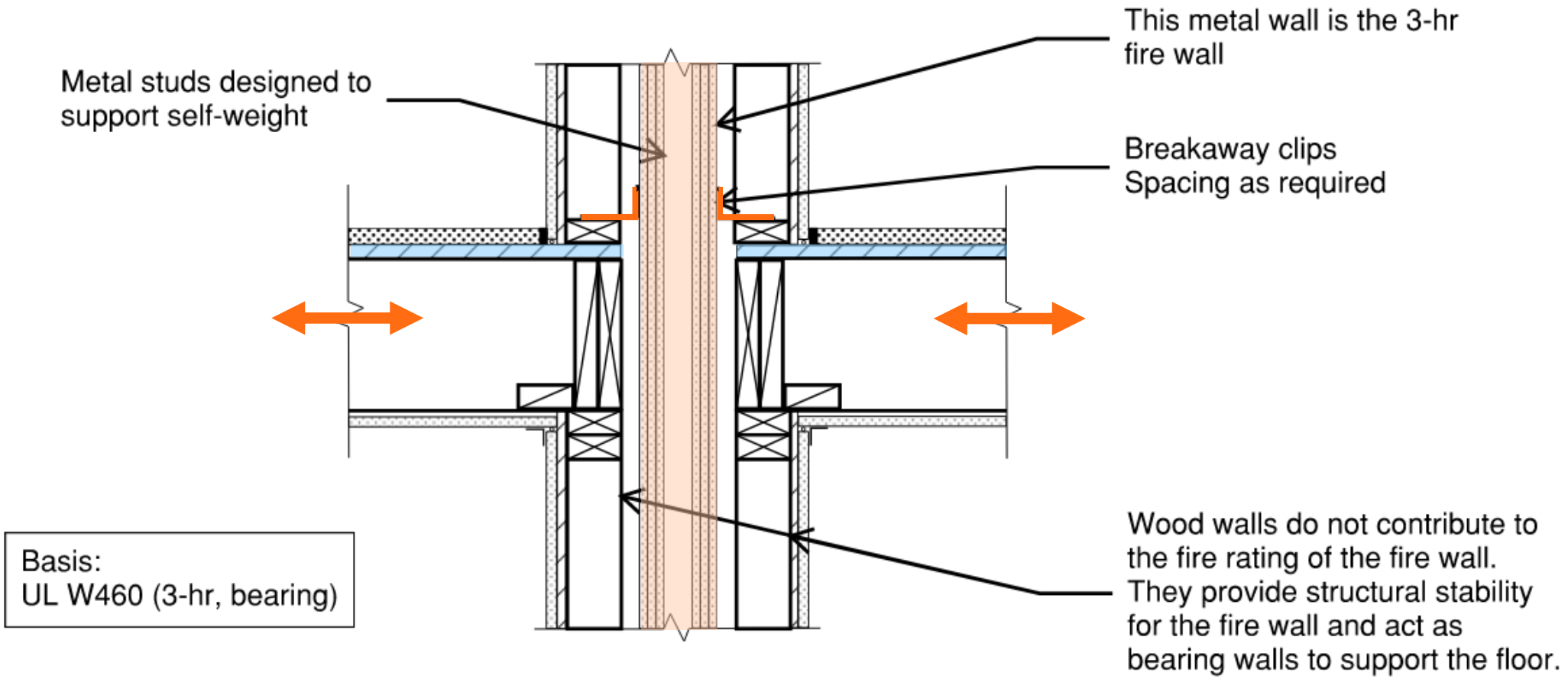
What if we use a seismic separation instead?

Fire Walls – Seismic Joint



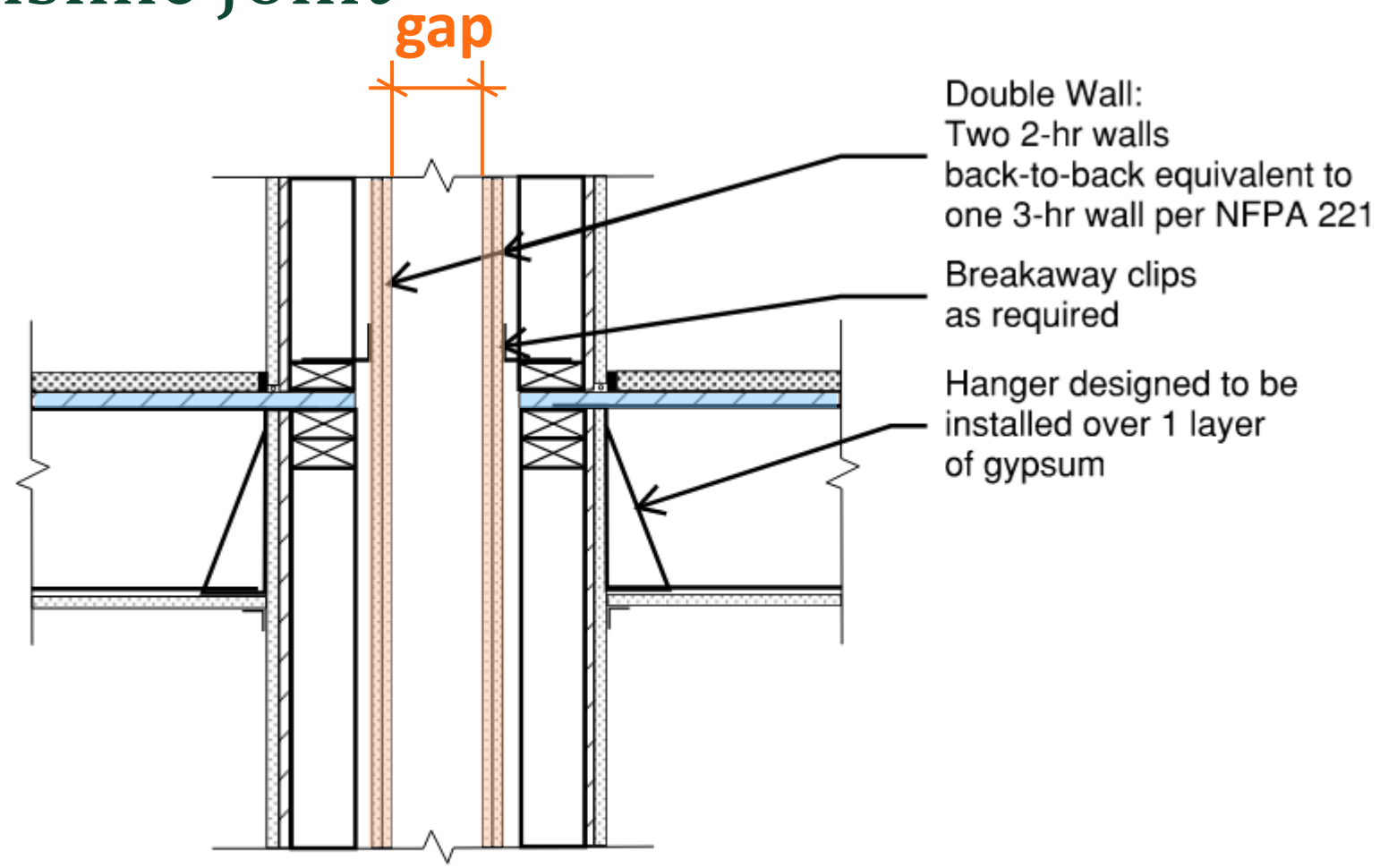
3-hr Wall Detail
Sheathing Not Continuous

Fire Walls – Seismic Joint



3-hr Wall Detail
Sheathing Not Continuous

Fire Walls – Seismic Joint



Basis:
UL U336
UL U373

NFPA 221 Double Wall: (2) 2-hr walls
Sheathing Not Continuous

What if we want diaphragm continuity but we're in a lower SDC?

Fire Walls – Seismic Diaphragm Continuity

2018 IBC Provisions allow
floor sheathing through firewall
under certain conditions

706.2 Structural stability.

Fire walls shall be designed and constructed to allow collapse of the structure on either side without collapse of the wall under fire conditions. *Fire walls* designed and constructed in accordance with NFPA 221 shall be deemed to comply with this section.

Exception: In Seismic Design Categories D through F, where double *fire walls* are used in accordance with NFPA 221, floor and roof sheathing not exceeding $^{3}/_{4}$ inch (19.05 mm) thickness shall be permitted to be continuous through the wall assemblies of light frame construction.

QUESTIONS?

This concludes The American Institute of Architects Continuing Education Systems Course

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Funding provided in part by the Softwood Lumber Board