Monthly Webinar Series

Kendeda Building for Innovataive Sustainable Design, The Miller Hull Partnership with Lord Aeck Sargent, photo Jonathan Hillyer

1430 Q, The HR Group Architects, Buehler Engineering, Greg Folkins Photography

T3 Minneapolis, MGA, DLR Group, Magnusson Klemencic Associates, StructureCraft, photo Ema Peter

RESOURCES & UPCOMING EVENTS

New WOOD SOLUTION PAPER

Taking the Guesswork out of Mixed-Use Building Requirements

January 12 | ONLINE – 1 Hour

The World's Tallest Mass Timber Tower: A Behind the Scenes Look at Ascent

New for GCs and installers:

U.S. Mass Timber Construction Manual

PHOTO: MARCUS KAUFFMAN

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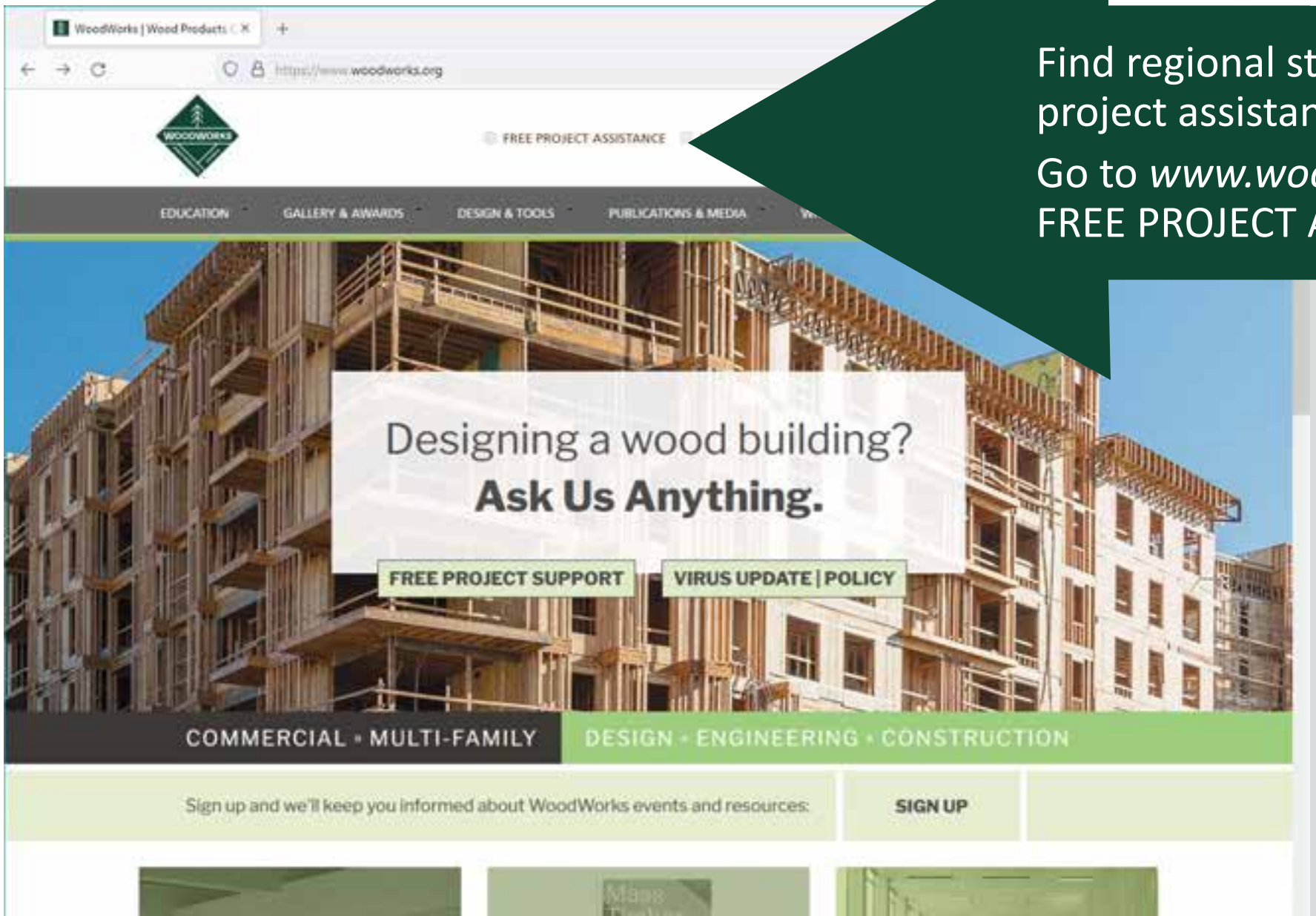

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Scott Breneman, PhD, PE, SE

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Melissa Kroskey, AIA, SE

Terry Malone, PE, SE

Ricky McLain, PE, SE

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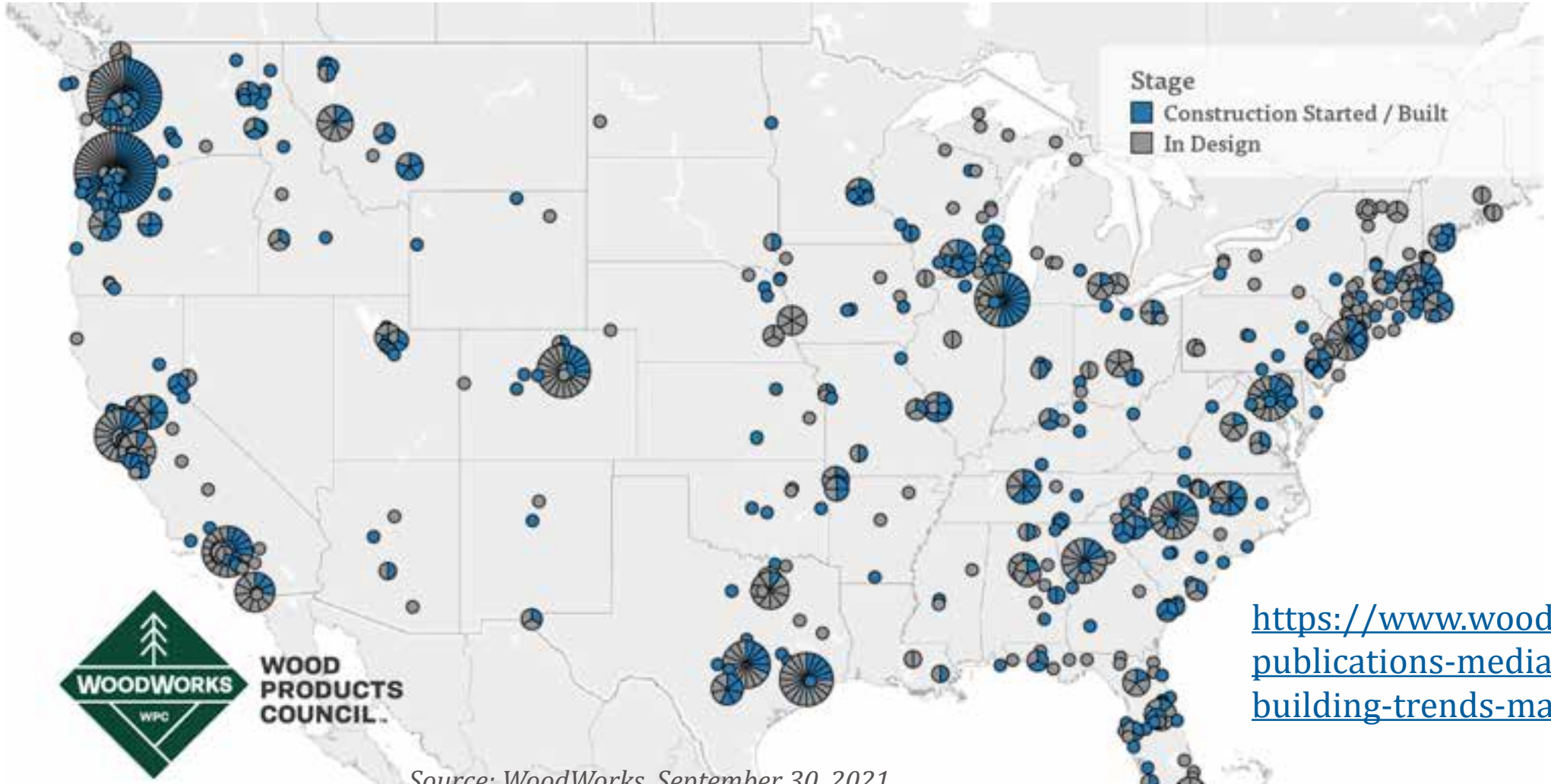
Current State of Mass Timber Projects

As of September 2021, in the US, **1,241** multi-family, commercial, or institutional projects have been constructed with, or are in design with, mass timber.



WOODWORKS WPC WOOD PRODUCTS COUNCIL

https://www.woodworks.org/publications-media/building-trends-mass-timber/

Source: WoodWorks, September 30, 2021

** This total includes modern mass timber and post-and-beam structures built since 2013*

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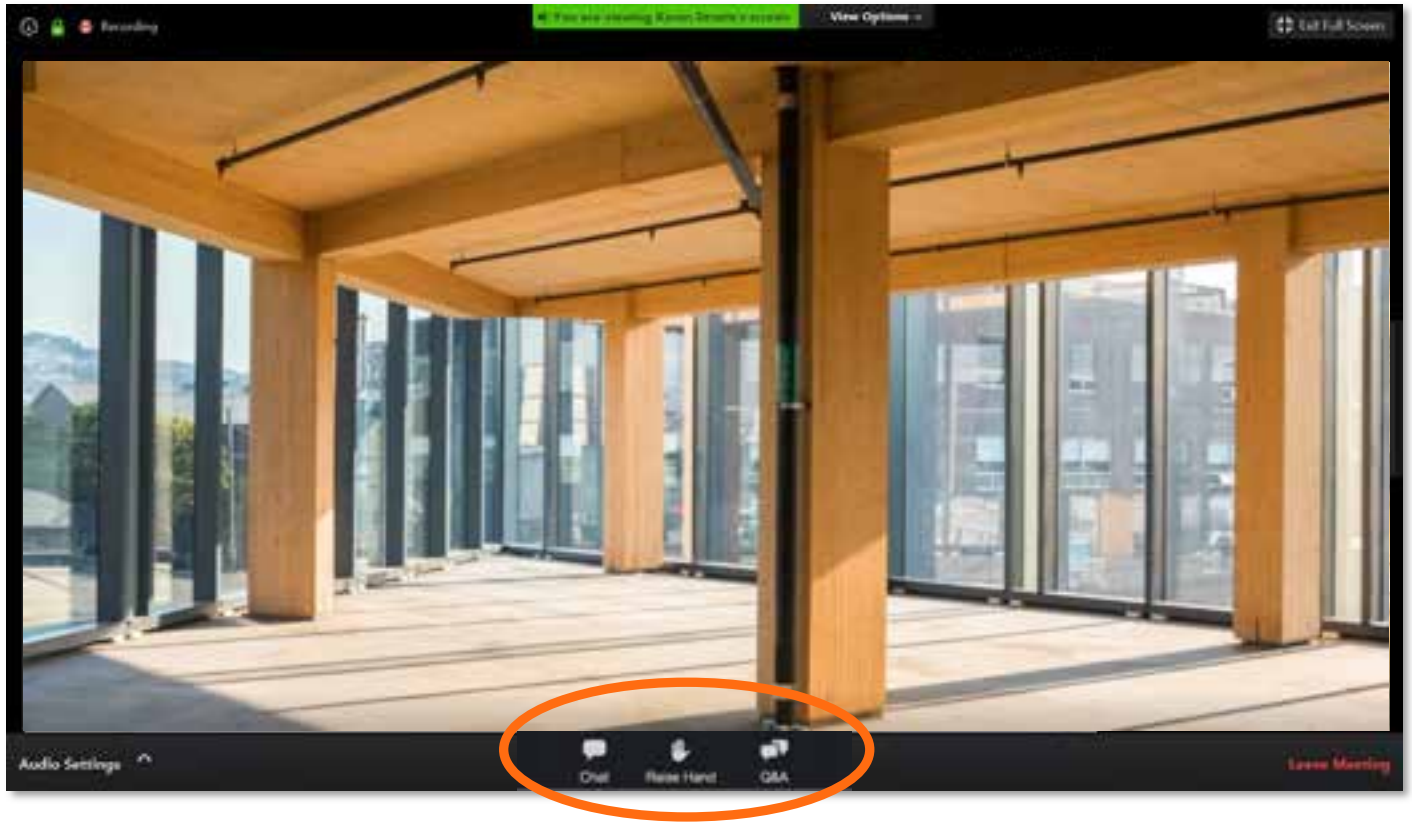
- Submit questions in the **Q&A** box at the bottom of your screen as they come up in the presentations. We will **get to as many questions as possible.**



Interior Wall and Floor Assemblies in Mid-Rise Multi-Family: Designing for Fire, Acoustics & Structure

Presented by Karen Gesa, Ricky McLain & Ashley Cagle

"The Wood Products Council" is a Registered Provider with The American Institute of Architects Continuing Education Systems (AIA/CES), Provider #G516.

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

Course Description

What are the pros and cons of using a single stud wall vs. a staggered stud wall for dwelling unit separation? Do you need sprinklers or fireblocking in the floor cavity of your wood joist floor assembly? How can you meet code requirements for fire-resistance continuity of corridor walls while also having numerous mechanical elements puncturing those walls? If you have questions like this, you won't want to miss this webinar focused on practical solutions for commonly asked multi-family design questions. Join us for this third session in our 2021 series of deep dives into this topic as we take a step-by-step approach to the design and selection of interior walls (unit demising, corridor, shafts and firewalls) and floor/ceiling assemblies and discuss how the fire-resistance, acoustical performance and structural load resolution of these assemblies can be simultaneously achieved. We'll analyze example details and assemblies, contrast different assembly options, learn how to make modifications to tested wall assemblies, answer questions that arose during the first two sessions in this series, and look at tools you can use to evaluate your options.

3-Part Series on Light-Frame Interior Detailing

July 2021 Workshop
Fire, Acoustics, and Structural Detailing of Light-Frame Interior Walls
https://www.woodinstitute.org/enrol/index.php?id=207

November 2021 Symposium
Fire, Acoustics, and Structural Detailing of Light-Frame Horizontal Assemblies
https://www.woodinstitute.org/enrol/index.php?id=212

December 8 Webinar
Wrap up on interior floor and wall assemblies
Answering follow-up questions, commonly asked questions
https://www.woodinstitute.org/enrol/index.php?id=218

February 2022 Symposium
Exterior walls: Assemblies, Fire Resistance Ratings, Claddings and Details
https://www.woodinstitute.org/course/view.php?id=228

Today’s Agenda: Light-Frame Interior Detailing

Fire-resistance and acoustics of interior walls | Impacts of:

- Stud size and spacing
- Addition of sheathing layers
- Addition of insulation

Shaftliner Panel Systems

- Assembly options
- Detailing at floor supports
- Mass timber floor to shaft wall interface

Firewalls

- Floor sheathing continuity
- Seismic joints
- Material allowances

How do I determine fire rating and STC?

What if I need to alter the tested wall assembly?

IBC allows multiple methods to determine fire resistance in 703.3:

703.3 Methods for determining fire resistance. The application of any of the methods listed in this section shall be based on the fire exposure and acceptance criteria specified in ASTM E119 or UL 263. The required *fire resistance* of a building element, component or assembly shall be permitted to be established by any of the following methods or procedures:

1. *Fire-resistance* designs documented in approved 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.
6. *Fire-resistance* designs certified by an approved agency.

Common methods for determining fire rating

1. Tested assemblies published by:
    a. Underwriters Laboratories (UL)
    b. Gypsum Association (GA)
    c. US Gypsum Corporation (USG)
    d. National Gypsum
    e. American Wood Council (AWC) DCA-3
    f. Proprietary sheathing/insulation manuf
2. IBC prescriptive assemblies per section 721
3. IBC calculated method per section 722
    a. Component Additive Method (CAM)

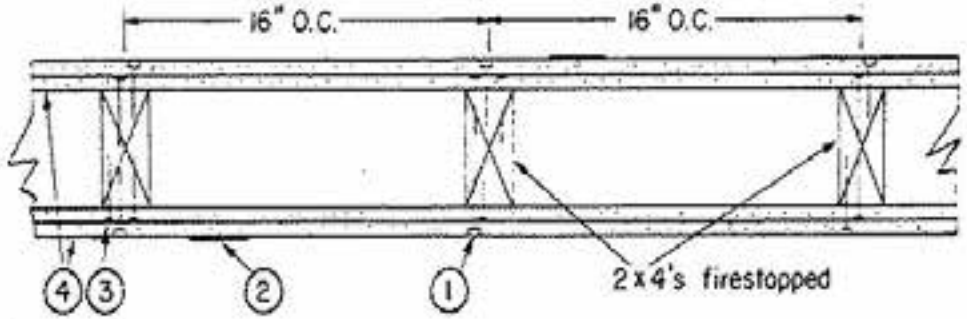
UL-rated wall assemblies

Design No. U301

May 28, 2021

Bearing Wall Rating — 2 Hr.
Finish Rating — 66 Min.
This design was evaluated using a load design method other than the Limit States Design Method (e.g., Working Stress Design Method). For jurisdictions employing the Limit States Design Method, such as Canada, a load restriction factor shall be used — See Guide BXUV or BXUV7

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**



https://iq.ulprospector.com/en/_?tt=1002

Challenge:

- Not typically an STC listed
- Fixed stud size/spacing

GA-600 wall assemblies

FIRE RESISTANCE DESIGN MANUAL
SOUND CONTROL
GYPSUM SYSTEMS

GYPSUM ASSOCIATION

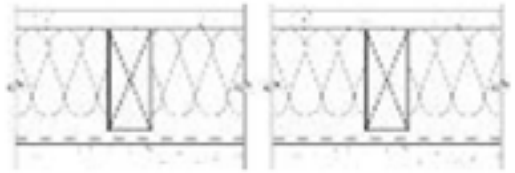
GA FILE NO. WP 3242	GENERIC	1 HOUR FIRE	50 to 54 STC SOUND

GYPSUM WALLBOARD, RESILIENT CHANNELS, MINERAL OR GLASS FIBER INSULATION, WOOD STUDS

Resilient channels 16" o.c. attached at right angles to ONE SIDE of 2 x 4 wood studs 24" o.c. with 1¼" Type S drywall screws. One layer ⅝" type X gypsum wallboard or gypsum veneer base applied at right angles to channels with 1" Type S drywall screws 8" o.c. with vertical joints located midway between studs. 3" mineral or glass fiber insulation in stud space.

OPPOSITE SIDE: One layer ⅝" type X gypsum wallboard or gypsum veneer base applied parallel or at right angles to studs with 6d cement coated nails, 1⅞" long, 0.0915" shank, ¹⁵⁄₆₄" heads, 7" o.c.

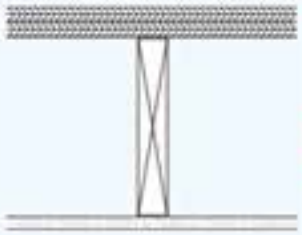
Vertical joints staggered 24" on opposite sides. **(LOAD-BEARING)**



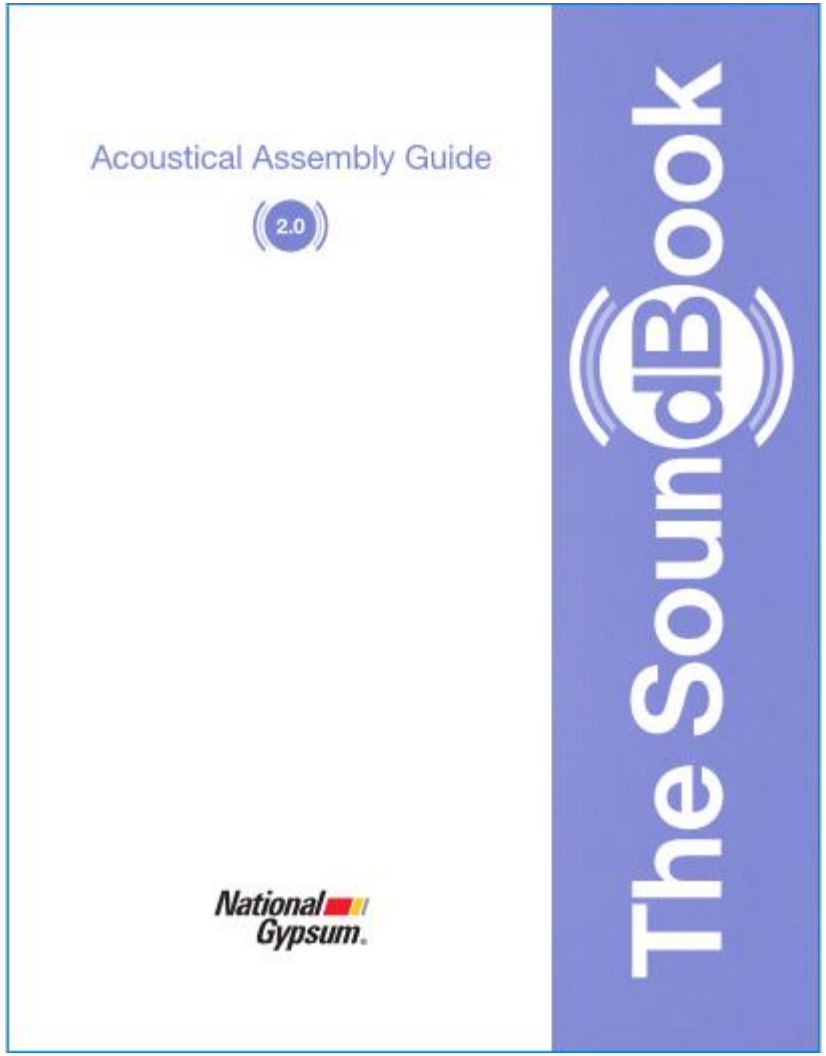
Thickness:	5⅜"
Approx. Weight:	7 psf
Fire Test:	Based on UL R14196, 05NK05371, 2-15-05, UL Design U309
Sound Test:	NRCC TL-93-098, IRC-IR-761, 3/98

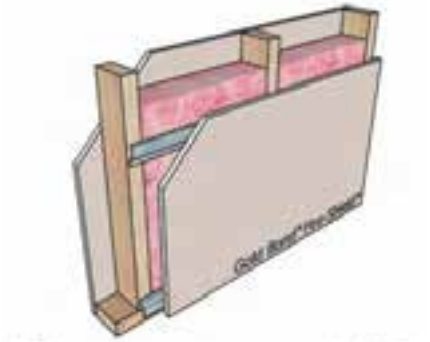
Has several wall assemblies with stud spacing at 24”

USG wall assemblies

1 Hour Fire-Rated Construction	Dimensional Lumber		Acoustical Performance			Reference
Construction Detail	Description	Test Number	STC	IIC	Test Number	Index
clg. wt. 3 	• 5/8" SHEETROCK FIRECODE Core gypsum panels, ceiling – 1" nominal wood sub and finished floor – 2 x 10 wood joist 16" o.c. – joints finished • optional LEVELROCK floor underlayment • optional SRM-25 or SRB sound mat • optional veneer plaster	UL Des L501	38	32	CK-6412-7 Based on 1-1/4" nominal wood floor	B-52
			39	56	CK-6412-8 Based on 1-1/4" nominal wood floor, 44 oz carpet and 40 oz pad atop flooring	

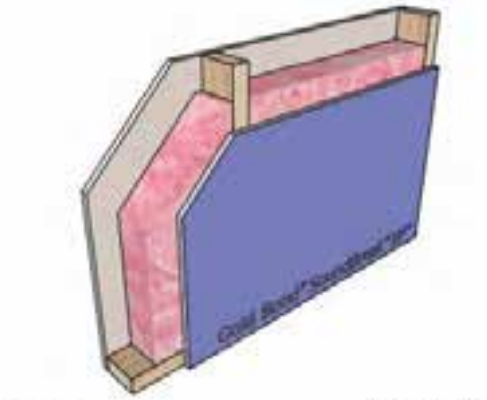
National Gypsum Wall assemblies





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

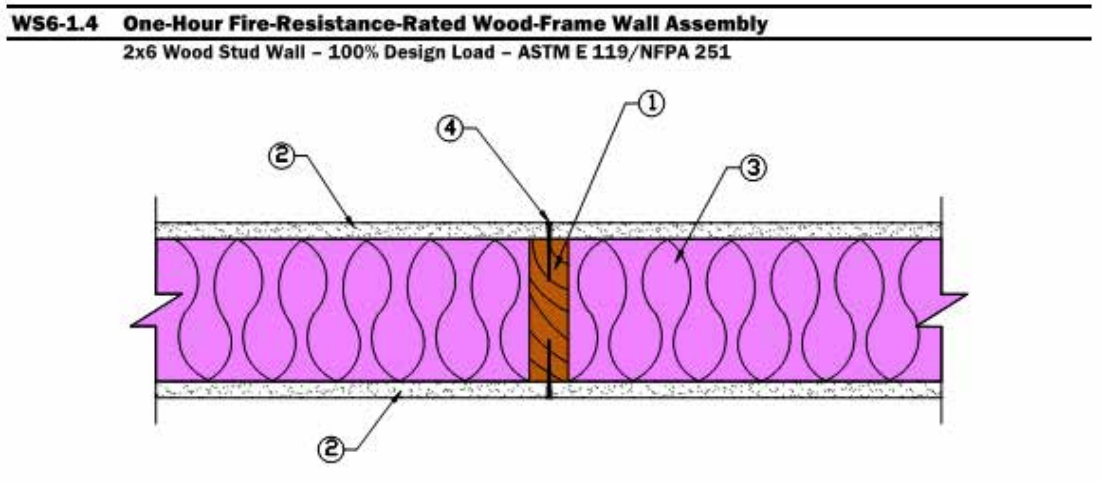


STC-50	NGC 2009015
Framing:	2x4 wood studs, 24" o.c.
Insulation:	3-1/2" glass fiber
Side 1:	5/8" Fire-Shield Gypsum Board
Side 2:	5/8" SoundBreak XP Wall Board

UL Design: U309 - 1 hour

AWC wall assemblies

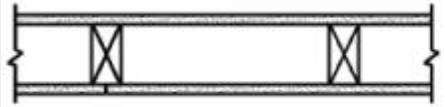
American Wood Council publication DCA-3 that has 1- and 2-hour rated assemblies, many with STC and IIC information:



Proprietary wall sheathing or insulation

REFERENCE	FIRE RATING	TEST NO.	STC	OC ASSEMBLY NO.	CONSTRUCTION DESCRIPTION
NBC-W5c (16" o.c.) NBC-W5c (16" o.c.) NBC-W5d (24" o.c.) NBC-W5d (24" o.c.)	45 min, L.B. 1 h, N.L.B. 45 min, L.B. 1 h, N.L.B.	NBC-W5c (16" o.c.) NBC-W5d (24" o.c.) *W0669 (16" o.c.)	49 53 52	UWSR037 	Single 38 mm x 89 mm (1-1/2" x 3-1/2") wood studs spaced 400 mm (16") or 600 mm (24") o.c.; resilient channels spaced 400 mm (16") or 600 mm (24") o.c.; single layer 12.7 mm (1/2") type "x" gypsum board one side; double layer other side, one thickness, 89 mm (3-1/2") thick EcoTouch® QuietZone® PINK® FIBERGLAS® Acoustic Batt Insulation.

1 Hour FIRE	Design # UL U305	GA File # WP 3605	STC - 35
		Sound Test #	NGC - 2403



Link to .PDF file
Link to .DWG file
Link to .DWG/Text file

5/8" (15.9 mm) Fire-Shield Gypsum Board or 5/8" XP Fire-Shield Gypsum Board applied horizontally or vertically to each side of 2x4 wood studs 16" o.c. with 6d coated nails, 1-7/8" long, 0.0915" shank, 1/4" heads, 7" o.c. at edges. Joints of square edge, bevel edge or predecorated gypsum board may be left exposed. Joints staggered 16" on opposite sides.

Prescriptive through IBC

IBC Section 721 has pages of prescriptive assemblies based on testing using ASTM E 119 or UL 263:

TABLE 721.1(2)—continued
RATED FIRE-RESISTANCE PERIODS FOR VARIOUS WALLS AND PARTITIONS [a, o, p]

MATERIAL	ITEM NUMBER	CONSTRUCTION	MINIMUM FINISHED THICKNESS FACE-TO-FACE[b] (inches)			
			4 hours	3 hours	2 hours	1 hour
14. Wood studs-interior partition with gypsum wallboard each side	14-1.1[h, m]	2" × 4" wood studs 16" on center with two layers of $^3/_8$" regular gypsum wallboard[e] each side, 4d cooler[n] or wallboard[n] nails at 8" on center first layer, 5d cooler[n] or wallboard[n] nails at 8" on center second layer with laminating compound between layers, joints staggered. First layer applied full length vertically, second layer applied horizontally or vertically.	—	—	—	5
	14-1.2[l, m]	2" × 4" wood studs 16" on center with two layers $^1/_2$" regular gypsum wallboard[e] applied vertically or horizontally each side[k], joints staggered. Nail base layer with 5d cooler[n] or wallboard[n] nails at 8" on center face layer with 8d cooler[n] or wallboard[n] nails at 8" on center.	—	—	—	$5^1/_2$
	14-1.3[l, m]	2" × 4" wood studs 24" on center with $^5/_8$" Type X gypsum wallboard[e] applied vertically or horizontally nailed with 6d cooler[n] or wallboard[n] nails at 7" on center with end joints on nailing members. Stagger joints each side.	—	—	—	$4^3/_4$
	14-1.4[l]	2" × 4" fire-retardant-treated wood studs spaced 24" on center with one layer of $^5/_8$" Type X gypsum wallboard[e] applied with face paper grain (long dimension) parallel to studs. Wallboard attached with 6d cooler[n] or wallboard[n] nails at 7" on center.	—	—	—	$4^3/_4$[d]
		2" × 4" wood studs 16" on center with two layers $^5/_8$" Type X gypsum wallboard[e]				

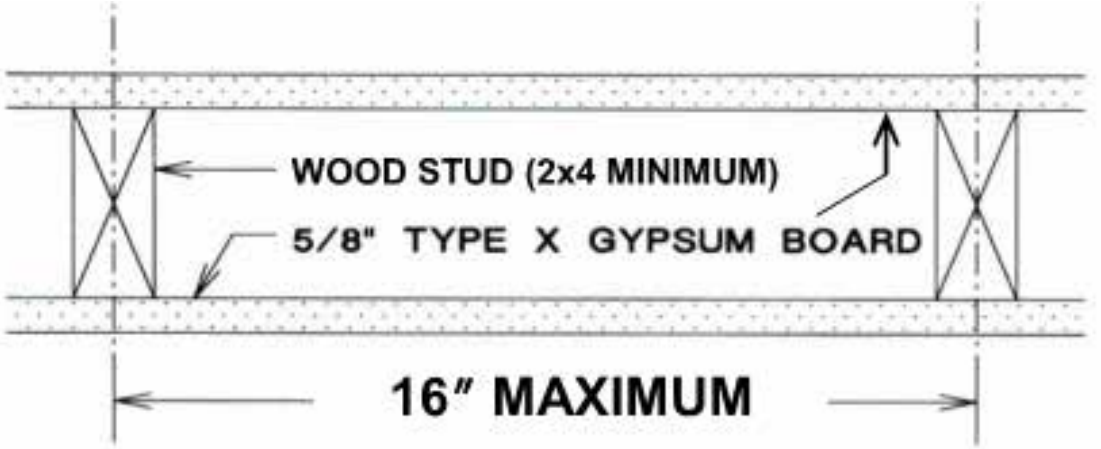
Calculated method through IBC 722/DCA 4

TABLE 722.6.2(1)
TIME ASSIGNED TO WALLBOARD MEMBRANES[a, b, c, d]

DESCRIPTION OF FINISH	TIME[e](minutes)
$^{3}/_{8}$-inch wood structural panel bonded with exterior glue	5
$^{15}/_{32}$-inch wood structural panel bonded with exterior glue	10
$^{19}/_{32}$-inch wood structural panel bonded with exterior glue	15
$^{3}/_{8}$-inch gypsum wallboard	10
$^{1}/$ -inch gypsum wallboard	15

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

Calculated method through IBC 722/DCA 4



5/8 inch Type X gypsum wallboard	=	40 minutes
Wood studs	=	20 minutes
Combined Assembly Fire Resistance Rating	=	60 minutes

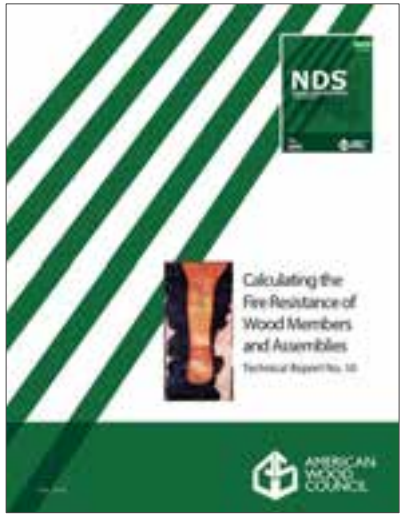
Figure 1 Interior Wall

Calculated method through IBC 722/NDS Ch 16

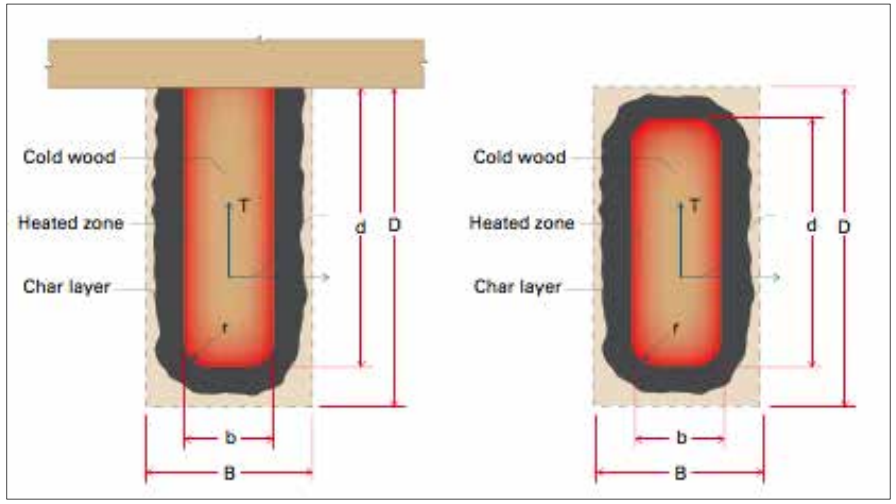
Exposed Framing Fire Resistance

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



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

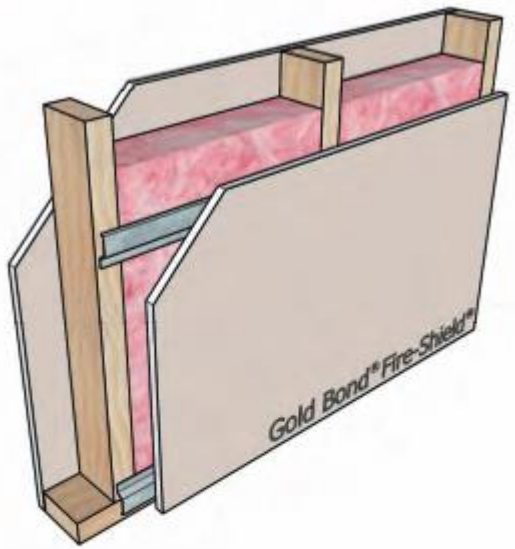


What if your stud spacing/size varies?

What if your stud spacing/size varies?

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

Figure 207



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 he/she needs a layer of wood sheathing for shear resistance.

What if your stud spacing/size varies?

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

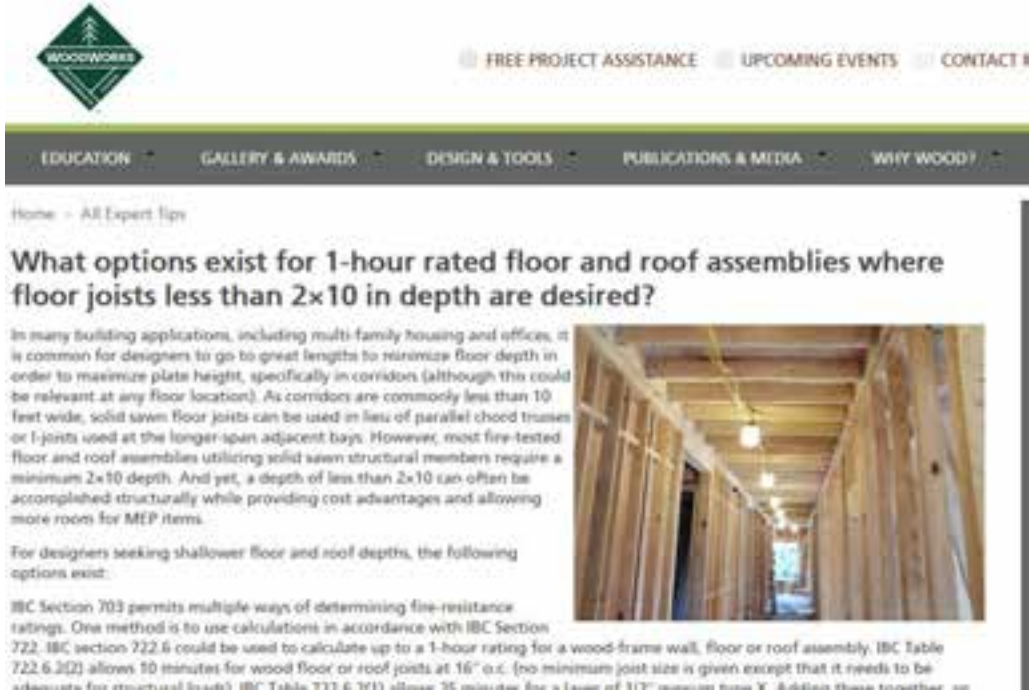
There are a couple of references that confirm this:
Notes 15 & 16 of the Gypsum Association Fire Resistance Design Manual state that studs can be larger than noted in the assembly and that stud spacings noted are max:

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 your stud spacing/size varies?

If your stud/joist size is smaller or spacing is larger than the tested assembly, you'll generally need to show conformance to fire resistance with another method.



https://www.woodworks.org/experttip/what-options-exist-for-1-hour-rated-floor-and-roof-assemblies-where-floor-joists-less-than-2x10-in-depth-are-desired/

What if your stud spacing/size varies?

Acoustically, more studs or larger studs can reduce the STC.

Fewer studs increases the STC.

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What is the impact of wood stud size and spacing on the fire-resistance and acoustical performance of a wall assembly? Can stud sizes and spacing be altered from those in tested wall systems?

Interior wall partitions in a wood-frame building—such as unit demising and corridor walls in a multi-family project—must meet several design objectives simultaneously. Two primary functions are fire resistance and acoustical separation. Having to cite two tested wall assemblies, one for fire-resistance endurance results and another for acoustic results, is common. However, matching components between the two tested systems can be challenging, and the architect may want to slightly alter the wall stud size and/or spacing of one of the systems to meet specific project needs.

For example, a corridor wall that requires a 1-hour fire-resistance rating and STC 50 acoustical rating will be constructed of 2×6 studs at 16" o.c. with resilient channels on one side, and one layer of 5/8" gypsum wallboard on each side. Is it permissible to demonstrate the fire-resistance rating (FRR) of this wall assembly with a tested assembly that included 2×4 studs instead of 2×6 studs? If the acoustical test being cited also included 2×4 studs, what is the acoustical impact of constructing the wall with 2×6 studs?

Similarly, a unit demising wall will be constructed of a staggered stud wall system, each row having 2×4 studs at 24" o.c. alternating on each side of 2×6 top and bottom plates. However, to meet structural demands, each row must have 2×4 studs at 16" o.c.. What impact does this reduction in stud spacing have on the fire resistance and acoustical performance of the wall?

It is generally accepted that stud sizes can be increased beyond those in a wall fire test, and stud spacings can be decreased relative to those in a wall fire test, without reducing the fire-resistance endurance of the wall assembly.

Item 16 of the Gypsum Association Fire Resistance Design Manual notes:

Greater stud sizes (depths) shall be permitted to be used in metal- or wood-stud systems. Metal studs of heavier gauge 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.

Similarly, Section VI of the UL Fire Design Information notes:

What if your stud spacing/size varies?

So here is the challenge:

More studs or larger studs – fire rating ok, acoustics may not be

Fewer studs or smaller studs – acoustics ok, fire rating may not be

Possible solutions:

1. Choose assembly for acoustics first, then calculate the fire-rating if needed
2. Alternate Method of determining STC/IIC:
   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.”

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

What if you add a layer of wood sheathing?

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

Home > All Expert Tips

Adding Wood Structural Panels to a Fire-Tested Wall Assembly

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: Yes, wood structural panels can be added to a fire resistance-rated wall assembly that was tested without them. Several references permit this, as outlined below:

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 one or both sides. Such panels shall be permitted to be applied either as a base layer directly to the framing (under the gypsum board), as a face layer (over the face layer of gypsum board), or between layers of gypsum board in multi-layer systems. When such panels are applied under the gypsum board or between layers of gypsum board the length of the fasteners specified for the attachment of the gypsum board applied over the wood structural panels shall be increased by not less than the thickness of the wood structural panels. Fastener spacing for the gypsum board and the number of layers of gypsum board shall be as specified in the system description."

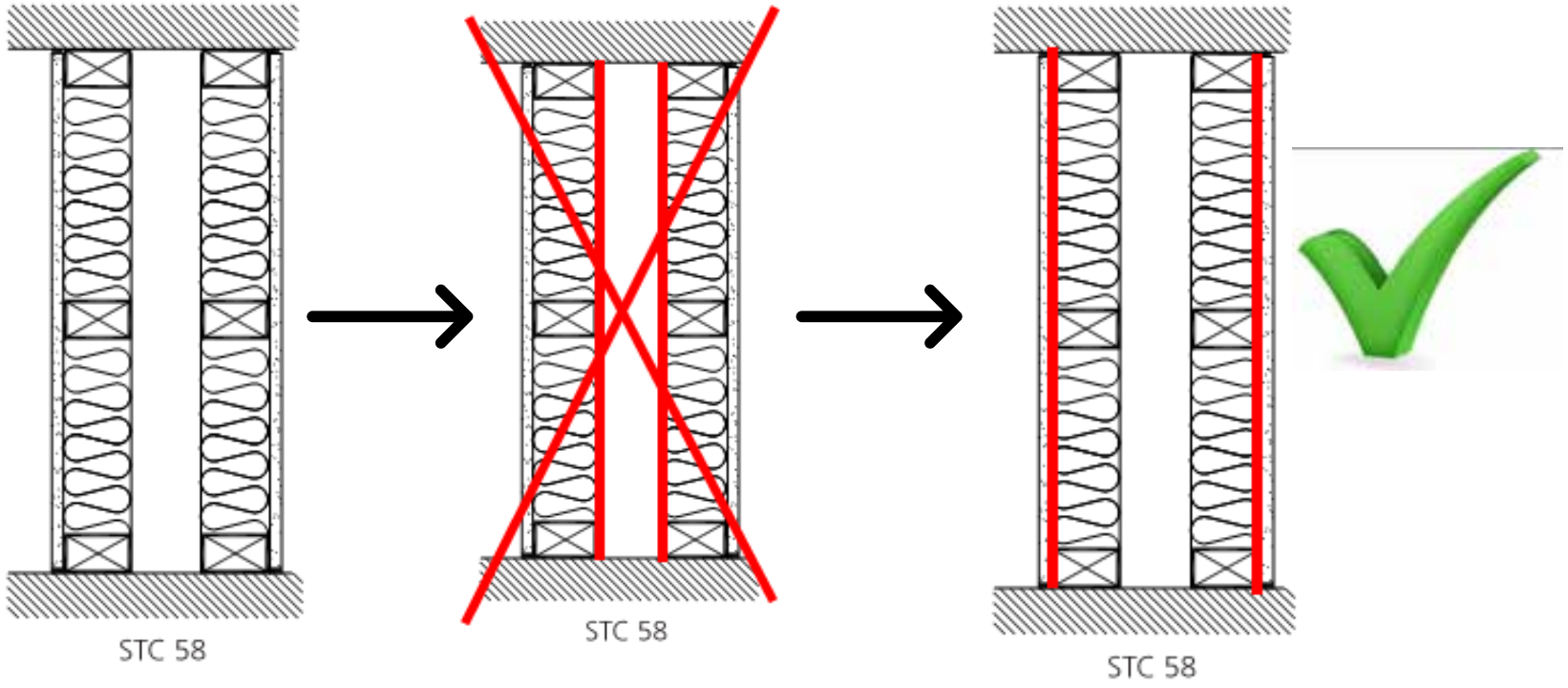
Additionally, ESR 2586, Performance Standards and Qualification Policy for Structural-Use Panels, and Performance Standard for

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

What if you add a layer of wood sheathing?

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.



What if you add a layer of wood sheathing?

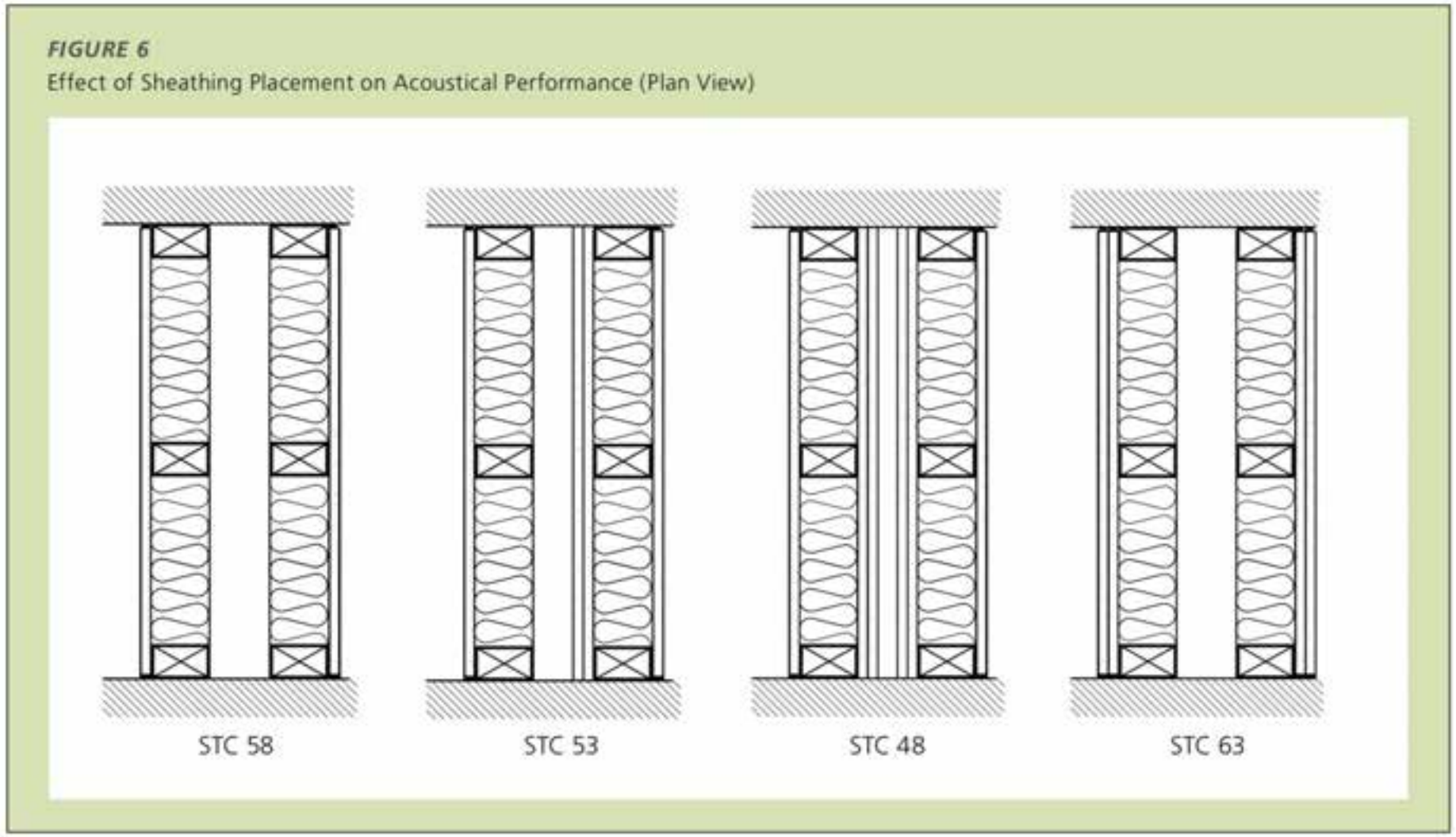
- For walls with resilient channels, put WSP on opposite side of wall
- For highly loaded shear walls, can use double layer of sheathing on same side of wall


APA Technical Topics

Double-Sheathed Shear Walls

What if you add a layer of wood sheathing?

WSP placement in double stud walls – big impact on STC



What if you add a layer of wood sheathing?

Can wood structural panels be added to an acoustically-tested wall assembly?

In many multi-family structures, interior demising walls that separate dwelling units from other units or from public spaces are required to have a minimum level of acoustical performance (IBC Section 1207). In some cases, these interior walls are also used as shear walls, utilizing plywood or OSB on one or both sides of the wall. Appropriate STC performance for walls are typically justified through the use of a tested assembly; however, most tested assemblies do not include wood structural panels (WSPs). This post contains information to help justify its inclusion in these cases.

In the WoodWorks technical paper, *Acoustical Considerations for Mixed-Use Wood-Frame Buildings*, author Steve Thorburn discusses the impact that WSPs can have on acoustical performance of walls. Adding shear wall sheathing to a wall assembly can actually increase its acoustical performance in certain circumstances because it adds mass to the assembly. As Thorburn notes, *"In the past, using multiple layers of gypsum sheathing to increase the mass of the system has been the most common solution to raising the STC rating of the system."* He goes on, *"In the case of shear wall sheathing, mass can be traded out for mass."* However, designers should be careful where they place WSPs within the wall assembly.

With respect to placement, two conditions that could negatively affect the STC performance of a wall are 1) if the WSPs impede the performance of resilient channels, and 2) if the WSPs alter the depth of the air cavity.

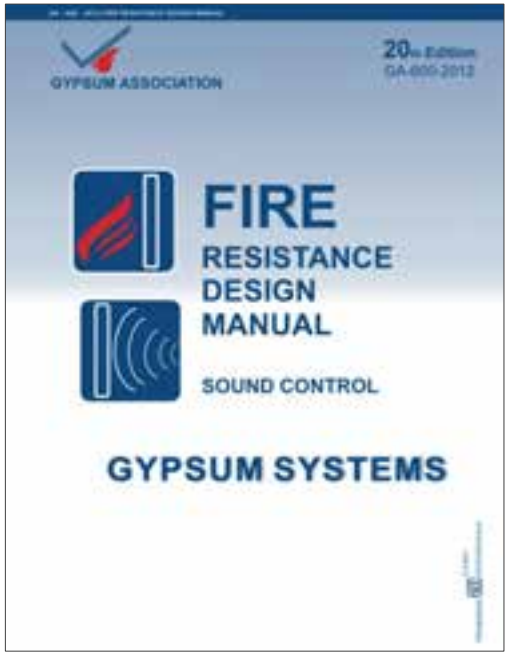
Resilient channels are a common component of many high-performing, acoustically-tested wall assemblies. If the assembly includes resilient channels on one side, the best practice is to put WSPs on the other (non-resilient channel) side of the wall, between the

https://www.woodworks.org/experttip/can-wood-structural-panels-added-acoustically-tested-wall-assembly/

What if you need to add insulation?

Fire Resistance – Insulation Effects

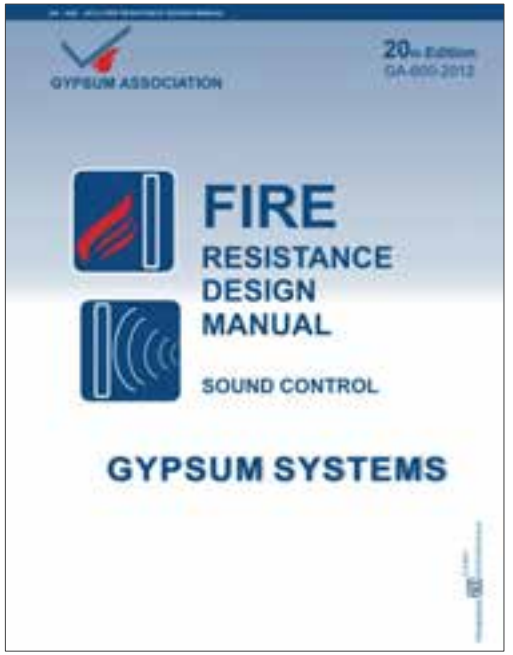
"When not specified as a component of a fire tested wall or partition system, mineral fiber, glass fiber, or cellulose fiber insulation of a thickness not exceeding that of the stud depth shall be permitted to be added within the stud cavity."



Fire Resistance – Insulation Effects

"The addition of up to 16-3/4 inches of 0.5 pcf glass fiber insulation (R-40), either batt or loose-fill, to any 1- or 2-hour fire resistance rated floor-ceiling or roof-ceiling system having a cavity deep enough to accept the insulation is permitted provided that one additional layer of either 1/2 inch or 5/8 inch type X gypsum board is applied to the ceiling. The additional layer of gypsum board shall be applied as described for the face layer of the tested system except that the fastener length shall be increased by not less than the thickness of the additional layer of gypsum board."

Section 1.12 Gypsum Association's
Fire Resistance Design Manual



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

Shaft Walls – Material Options and Detailing Impacts

Shaftliner Panels

Steel Studs, Wood Studs

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

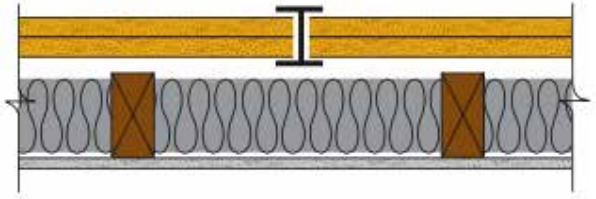
Shaftliner Systems – Configuration Options

Source: Clark Dietrich

H-Stud Option

2-Hour Fire Rating

Design Reference: UL U373, ULC W312, WHI GP/WA 120-03, cUL U373



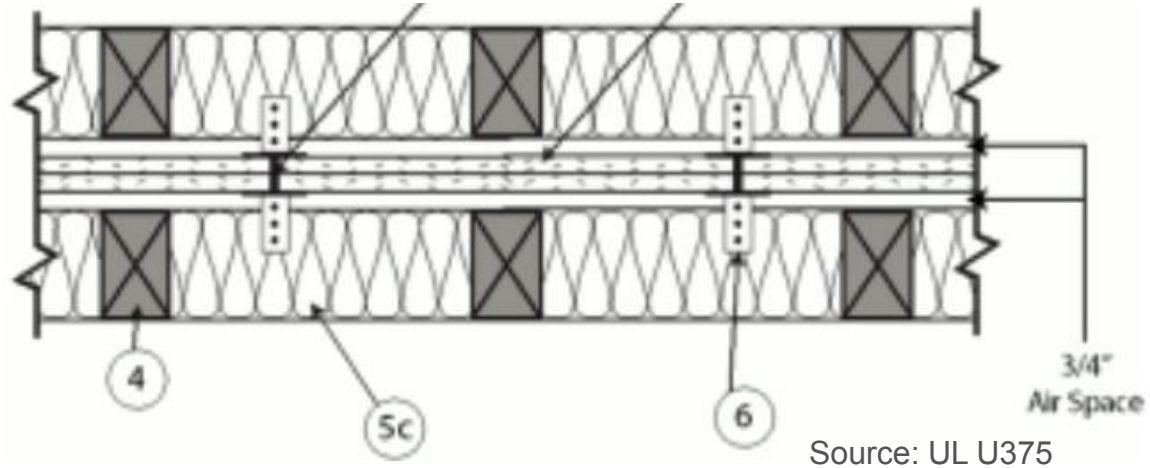
59 STC Sound Trans.

Test Reference: RAL TL 10-290

Two layers 1" (25.4 mm) DensGlass Shaftliner inserted in H-Studs 24" (610 mm) o.c. Min. 3/4" (19 mm) air space between liner panels and adjacent wood or metal framing.

Sound Tested with 2"x 4" stud wall with 1/2" (12.7 mm) ToughRock® wallboard or DensArmor Plus® interior panels and 3-1/2" (89 mm) fiberglass insulation in stud space.

Source: Georgia Pacific

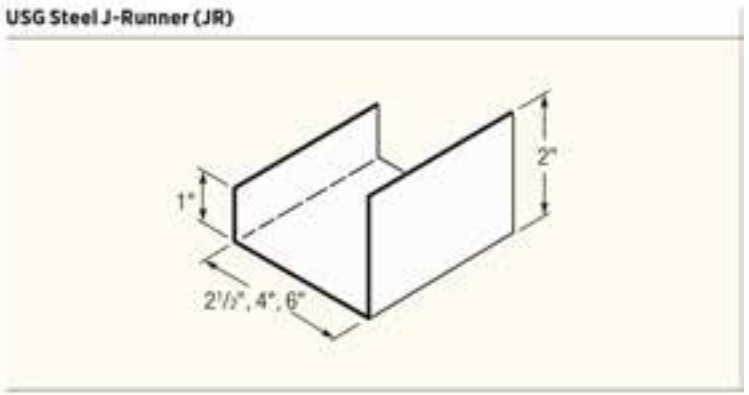


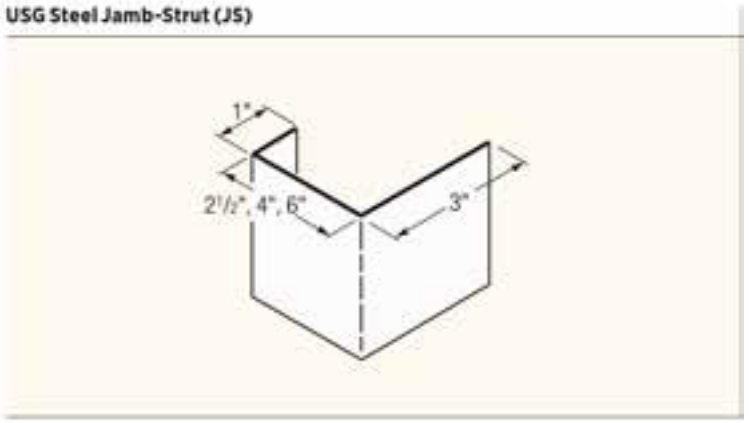
Source: UL U375

Shaftliner Systems – Configuration Options

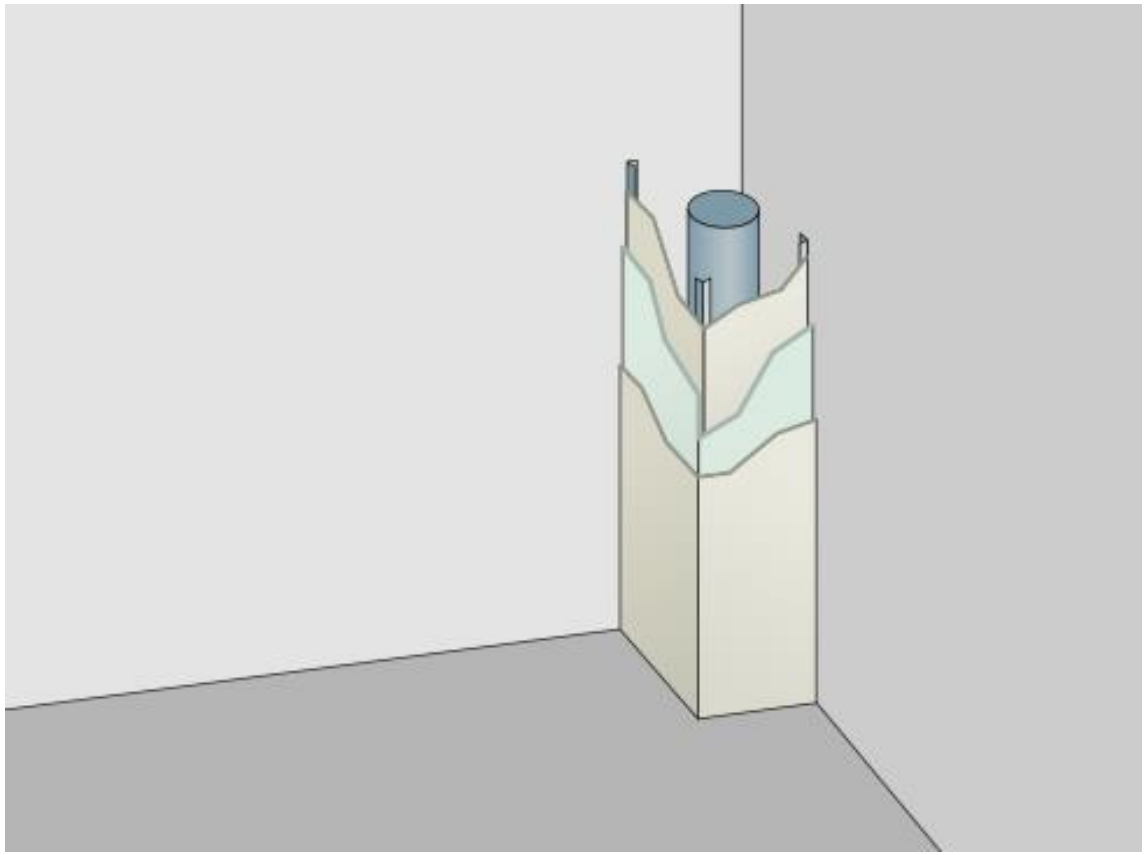
Source: Clark Dietrich

H-Stud Option



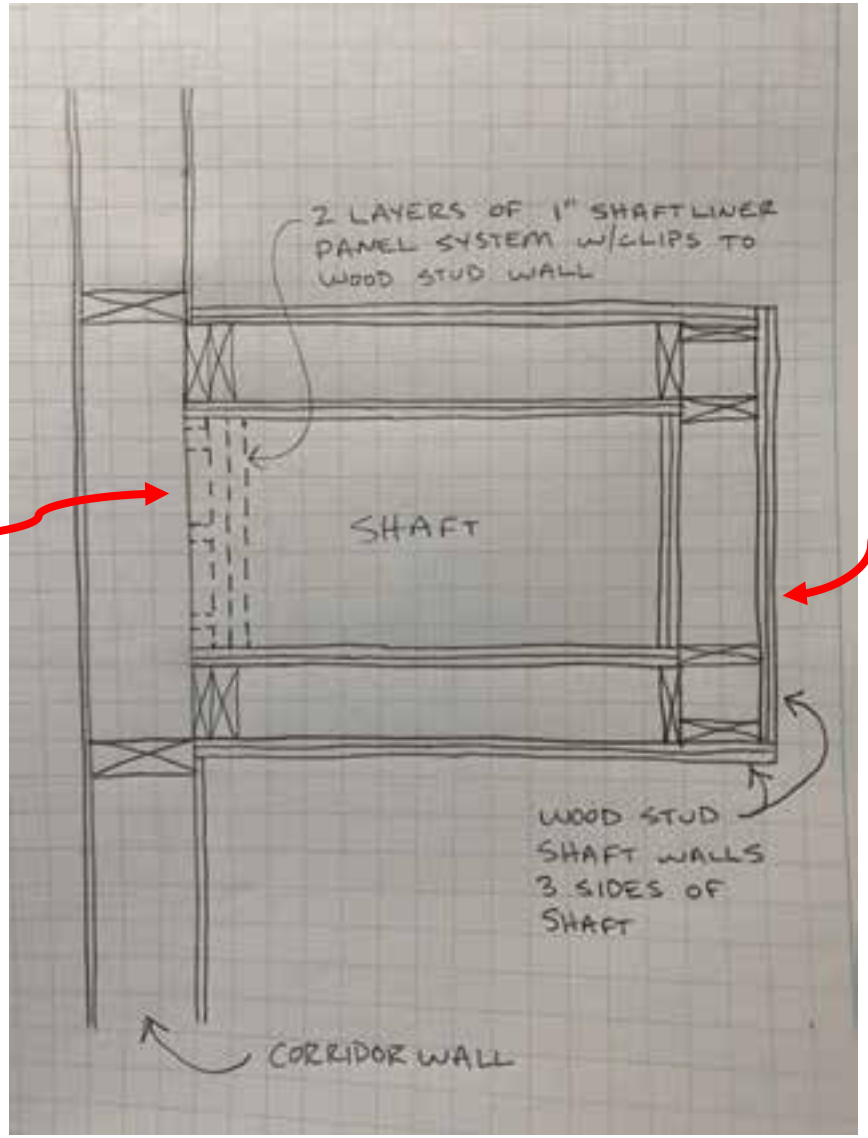


Source: USG



Shaftliner Systems – Configuration Options

H-stud shaftliner with wood stud wall backup

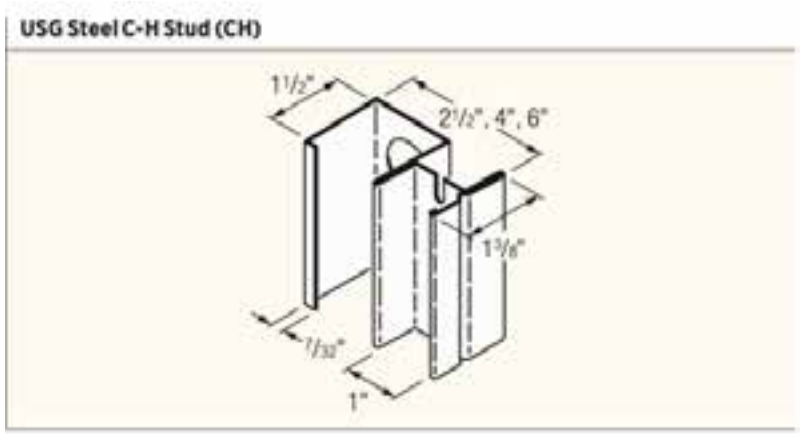


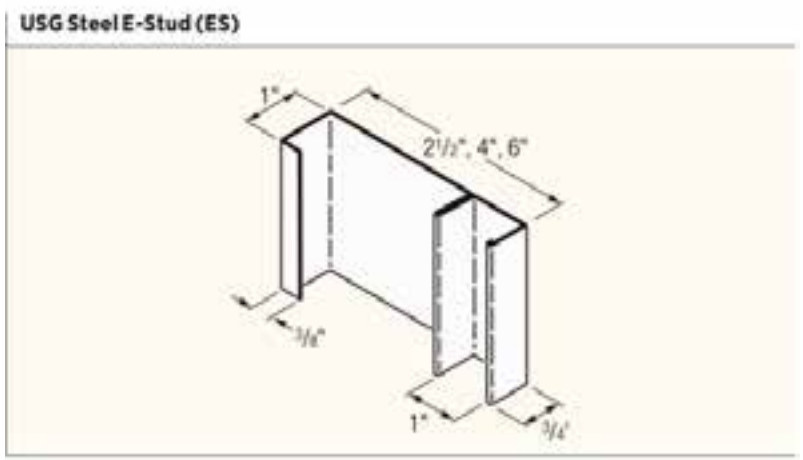
3 sides of wood shaft walls installed first. If shaft is small enough, might suggest shaftliner system on more than one side

Shaftliner Systems – Configuration Options

Source: Clark Dietrich

CH-Stud Option





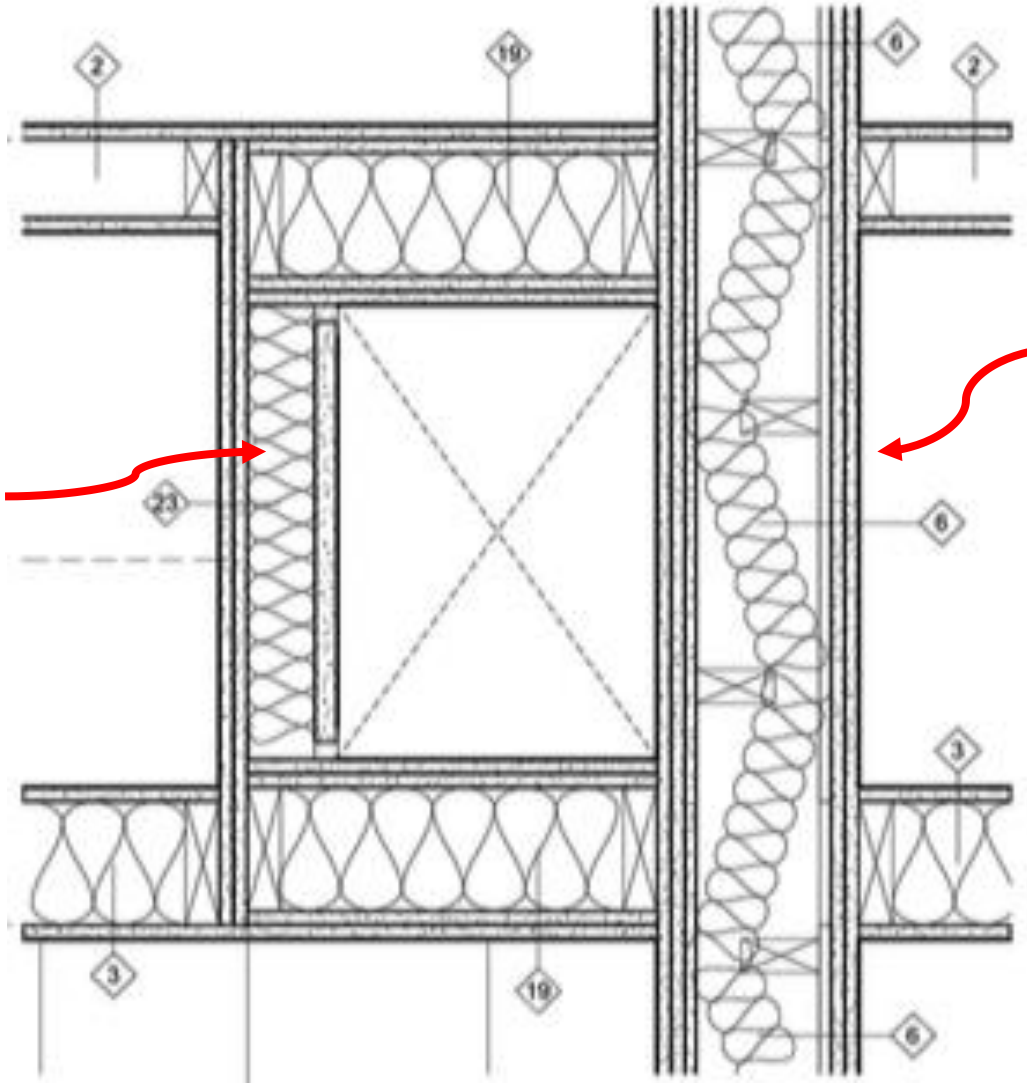
Source: USG

No wood backup wall

Source: Clark Dietrich

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

Can also perform a structural analysis of the walls, especially when stacking multiple stories, to verify adequacy

Allowable Moment, Shear and Effective Section Properties										
Section	Web A in	Flange B in	Stiffener C in	Design T in	Radius R in	Fy = 33 ksi, Fu = 45 ksi				
						May kip-in	Vax kips	Iye in^4	Sye in^3	Ae in^2
Web Depth 2.50" Lip 1.00"										
250 J100-18	2.622	2.25	1.00	0.0188	0.0843	0.8999	0.247	0.0679	0.0455	0.0366
250 J100-27	2.636	2.25	1.00	0.0283	0.0796	1.5439	0.685	0.1123	0.0781	0.0754
250 J100-30	2.641	2.25	1.00	0.0312	0.0782	1.7646	0.832	0.1270	0.0893	0.0896
250 J100-33	2.646	2.25	1.00	0.0346	0.0764	2.0359	1.023	0.1448	0.1030	0.1073
Web Depth 2.50" Lip 2.00"										
250 J200-18	2.622	2.25	2.00	0.0188	0.0843	0.8674	0.247	0.0792	0.0439	0.0369
250 J200-27	2.636	2.25	2.00	0.0283	0.0796	1.7070	0.685	0.1442	0.0864	0.0765
250 J200-30	2.641	2.25	2.00	0.0312	0.0782	1.9498	0.832	0.1634	0.0987	0.0910
250 J200-33	2.646	2.25	2.00	0.0346	0.0764	2.2482	1.023	0.1866	0.1138	0.1092
Web Depth 4.00" Lip 1.00"										
400 J100-18	4.122	2.25	1.00	0.0188	0.0843	1.4271	0.152	0.1807	0.0722	0.0373
400 J100-27	4.136	2.25	1.00	0.0283	0.0796	3.0404	0.518	0.3395	0.1539	0.0780
400 J100-30	4.141	2.25	1.00	0.0312	0.0782	3.4461	0.695	0.3818	0.1744	0.0930
400 J100-33	4.146	2.25	1.00	0.0346	0.0764	3.9409	0.948	0.4326	0.1994	0.1121

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: Clarkdietrich

Doesn’t the shaftliner system need to bypass the floor?

Shaft Wall Code 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 Code Requirements

SECTION 713
SHAFT ENCLOSURES

713.5 Continuity.

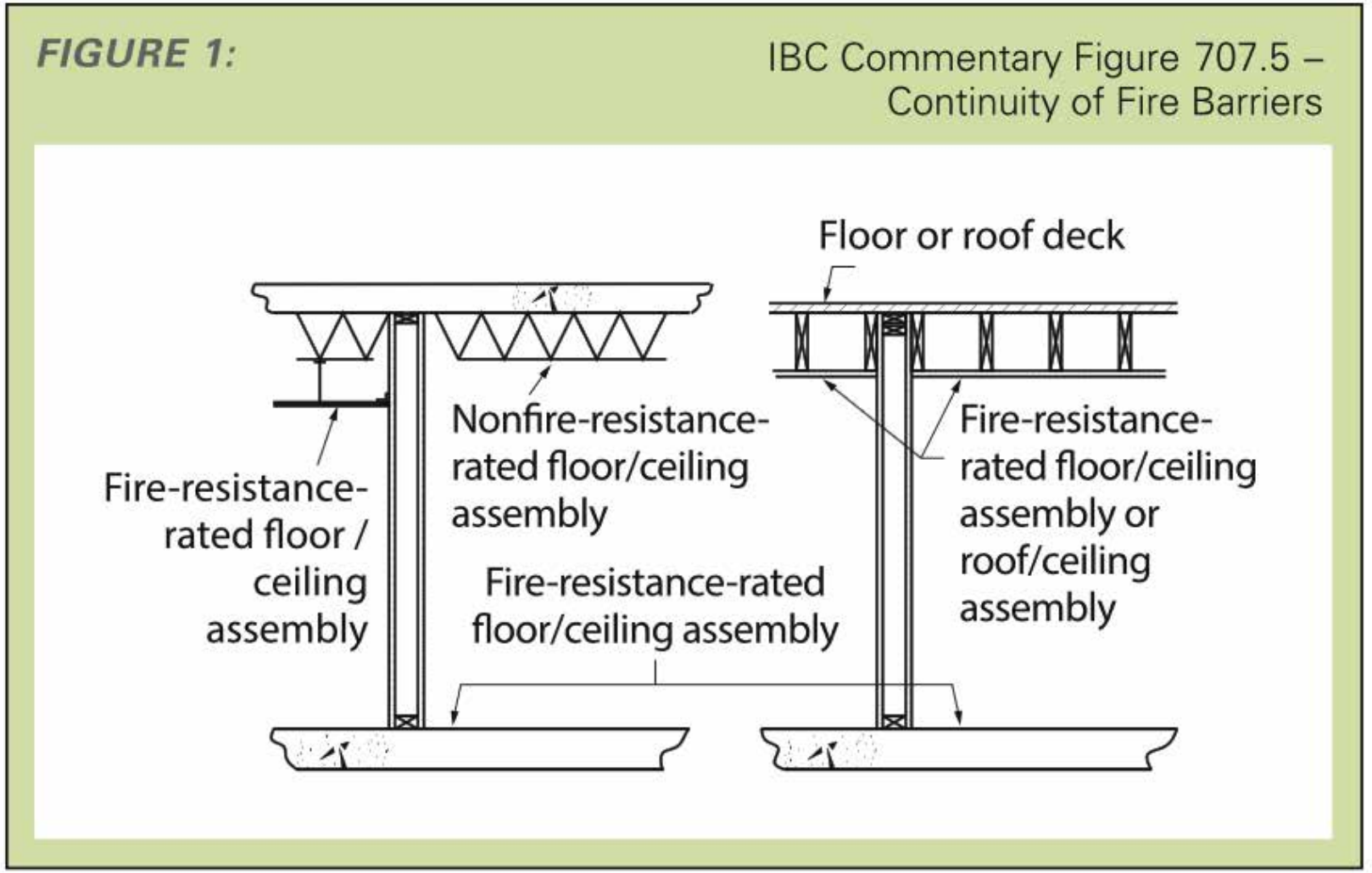
Shaft enclosures shall have continuity in accordance with 707.5 for fire barriers.

SECION 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.

Shaft Wall Code Requirements

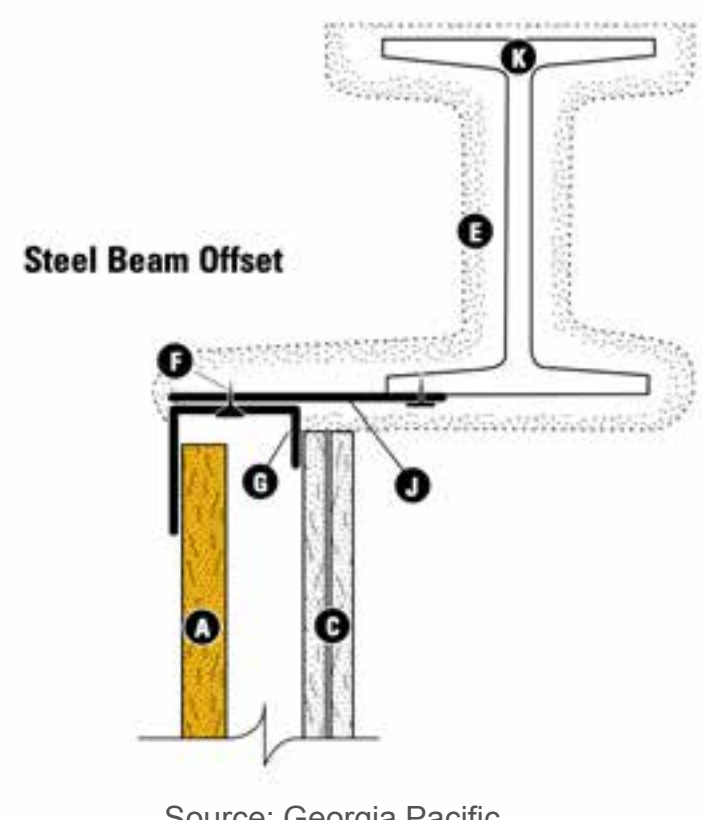


Shaft Wall Code Requirements

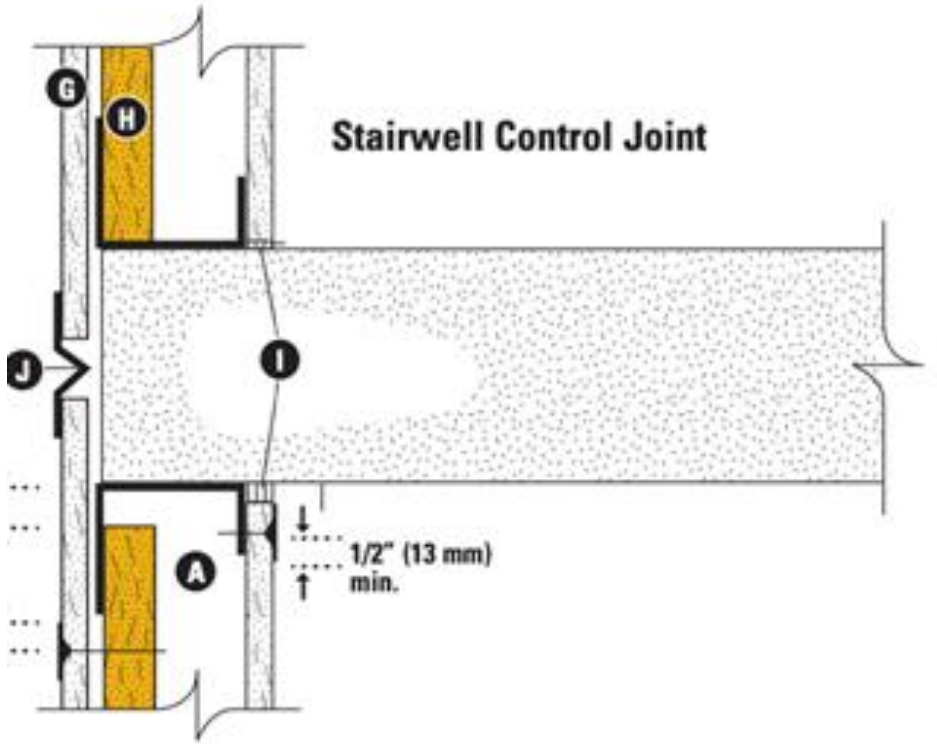
Shaft Wall Code Requirements

Shaft Wall Code Requirements

Non-bypassing details with noncombustible construction



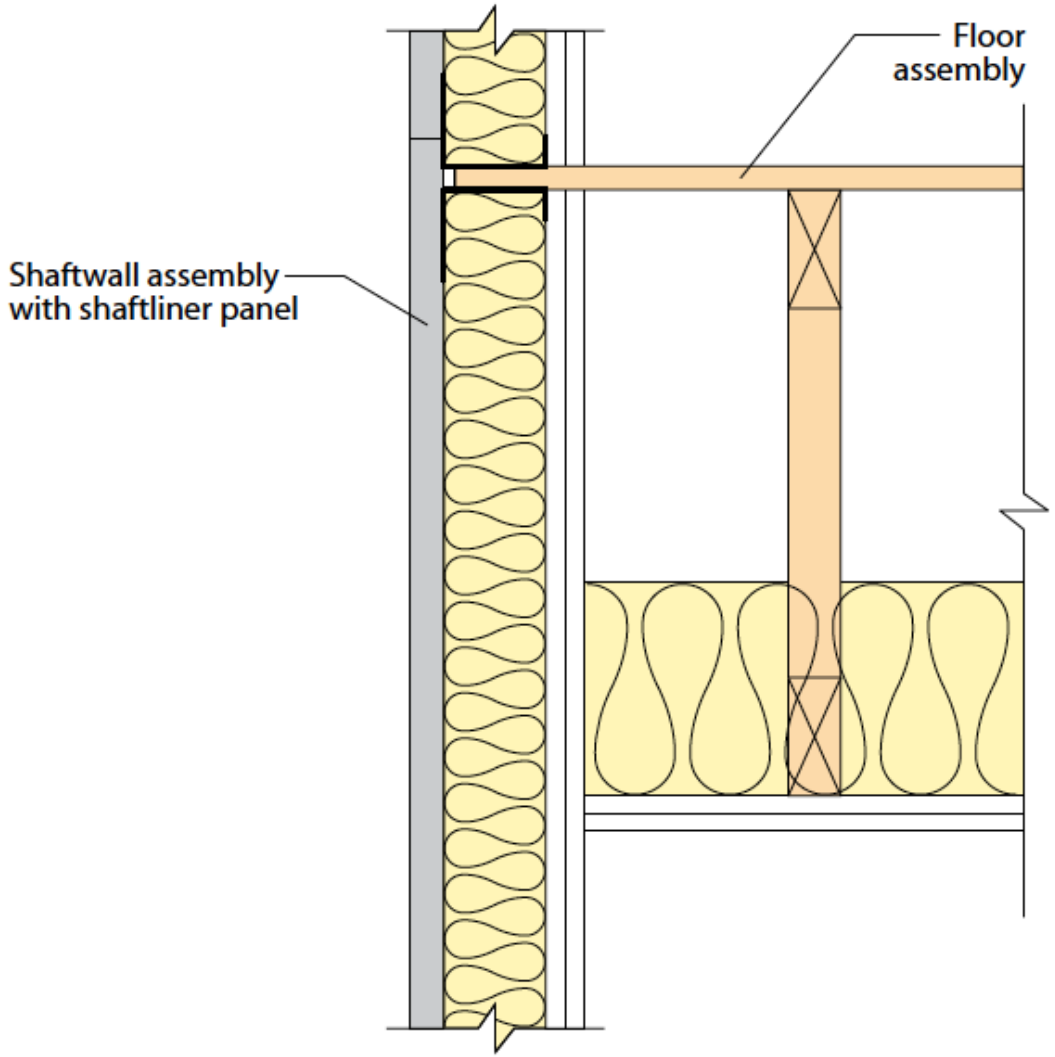
Source: Georgia Pacific



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

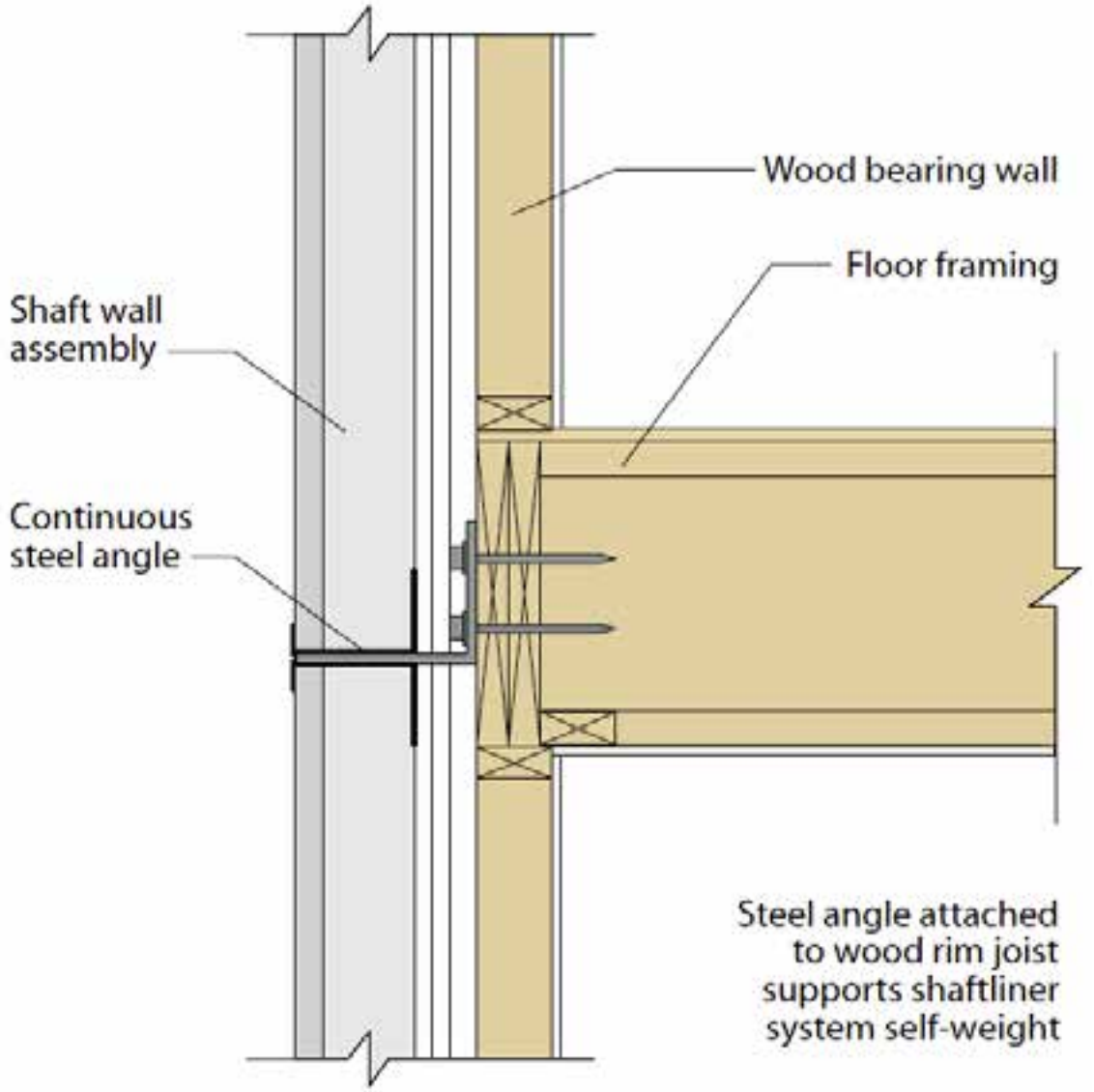
Shaftliner Systems – Support Details

Floor sheathing cantilevers out to support shaftliner system self-weight



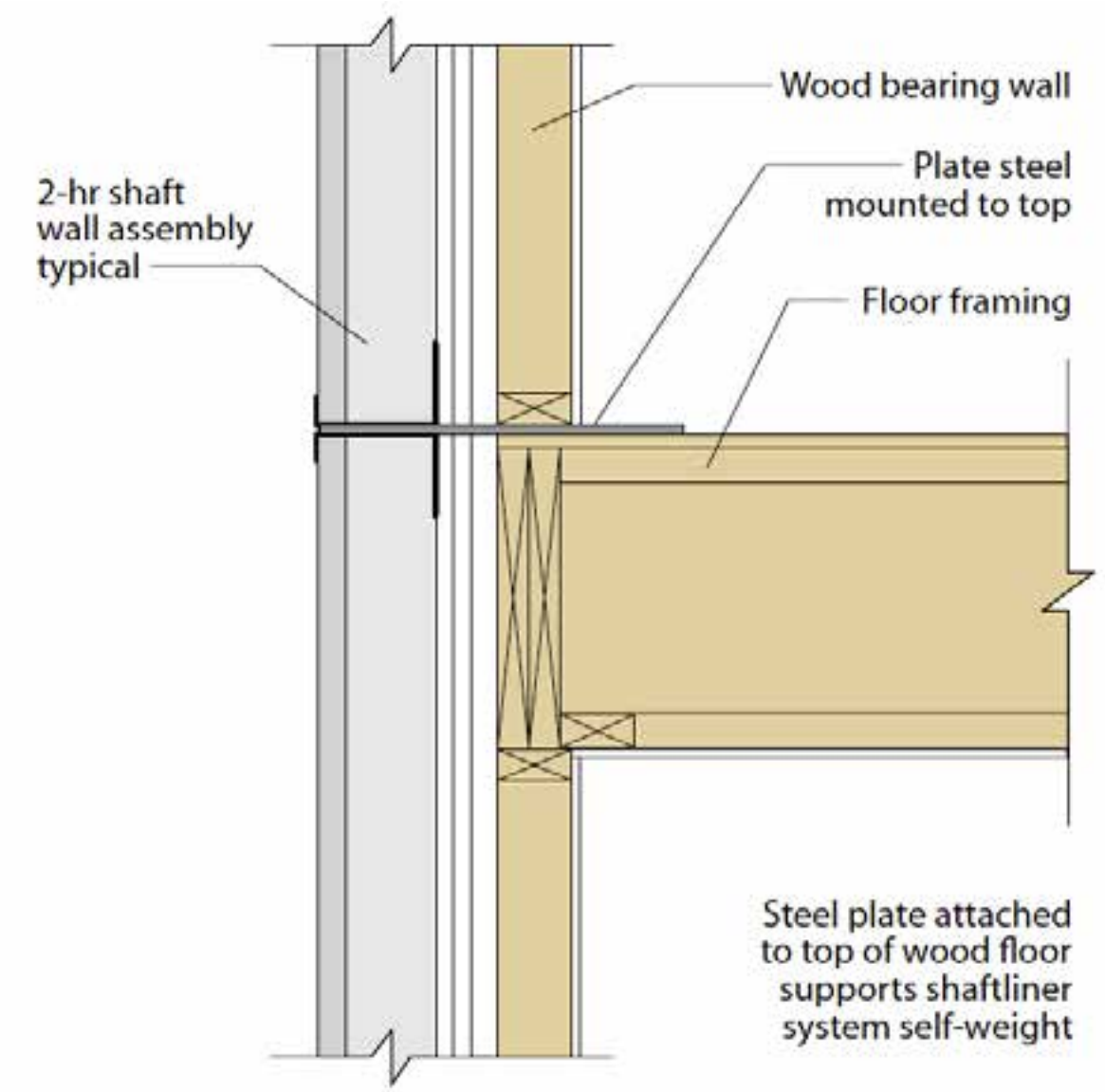
Shaftliner Systems – Support Details

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



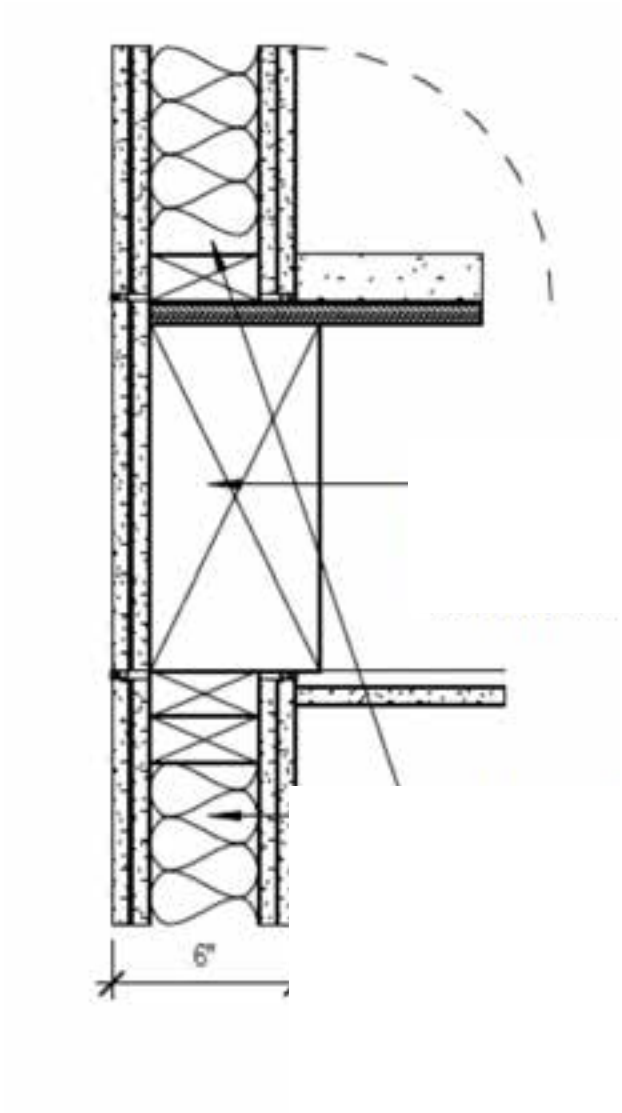
Shaftliner Systems – Support Details

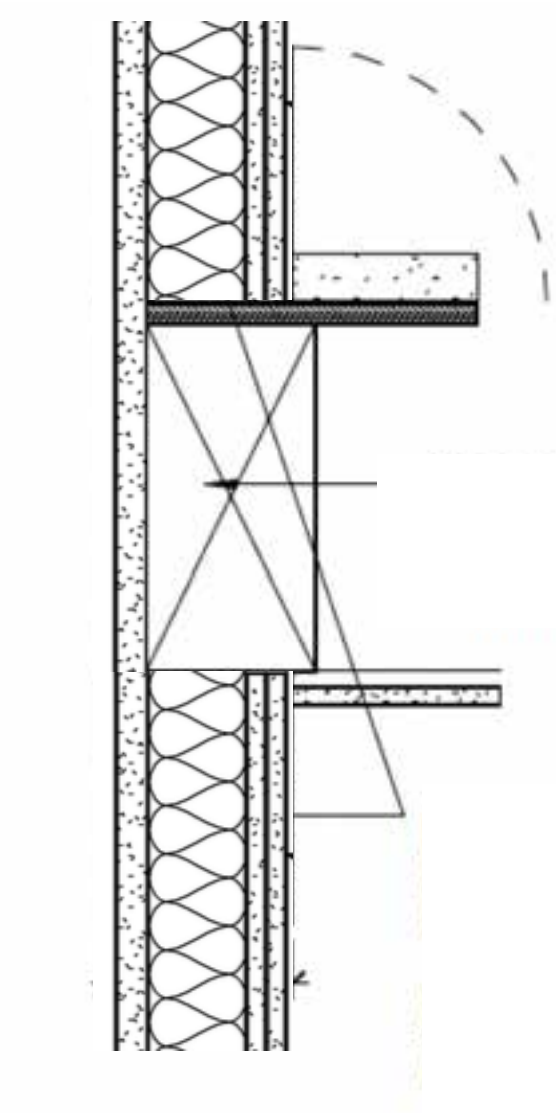
Steel plate attached to top of wood floor supports shaftliner system self-weight



Shaftliner Systems – Support Details

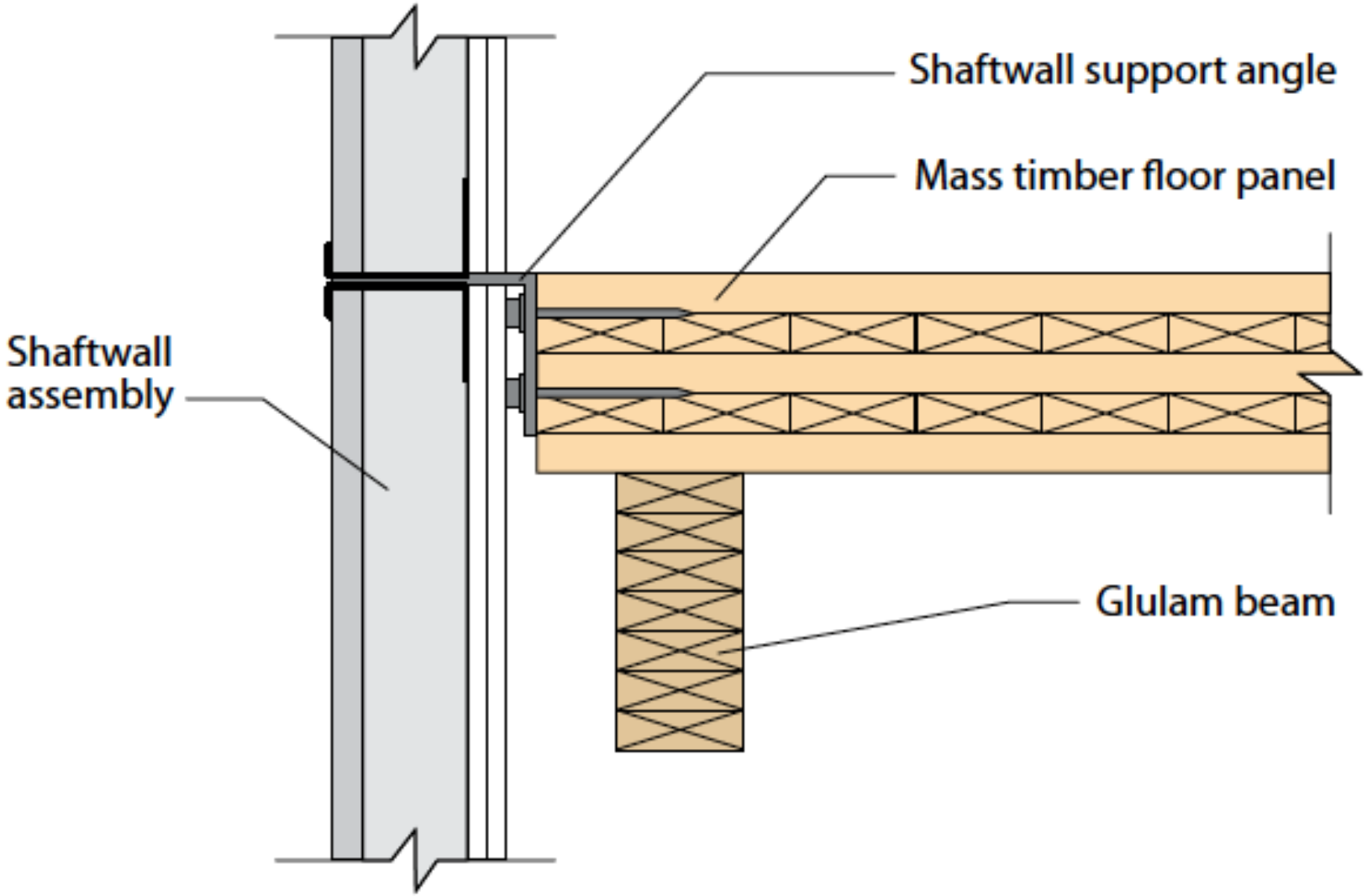
Shaftliner system self-weight supported on wood floor in platform framed condition



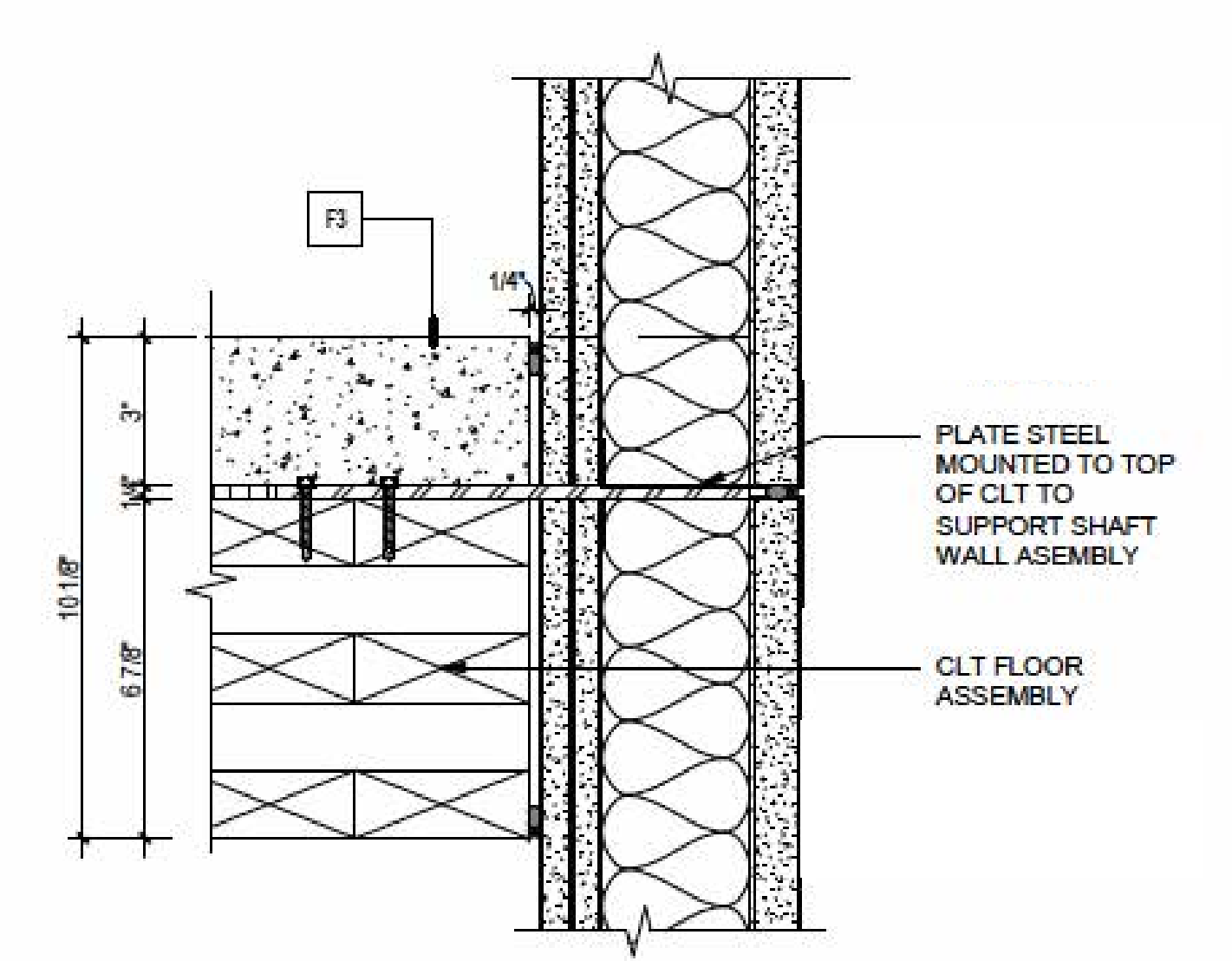


What about shaftliner systems combined with mass timber floors?

Shaftliner Systems – Support Details



Shaftliner Systems – Support Details

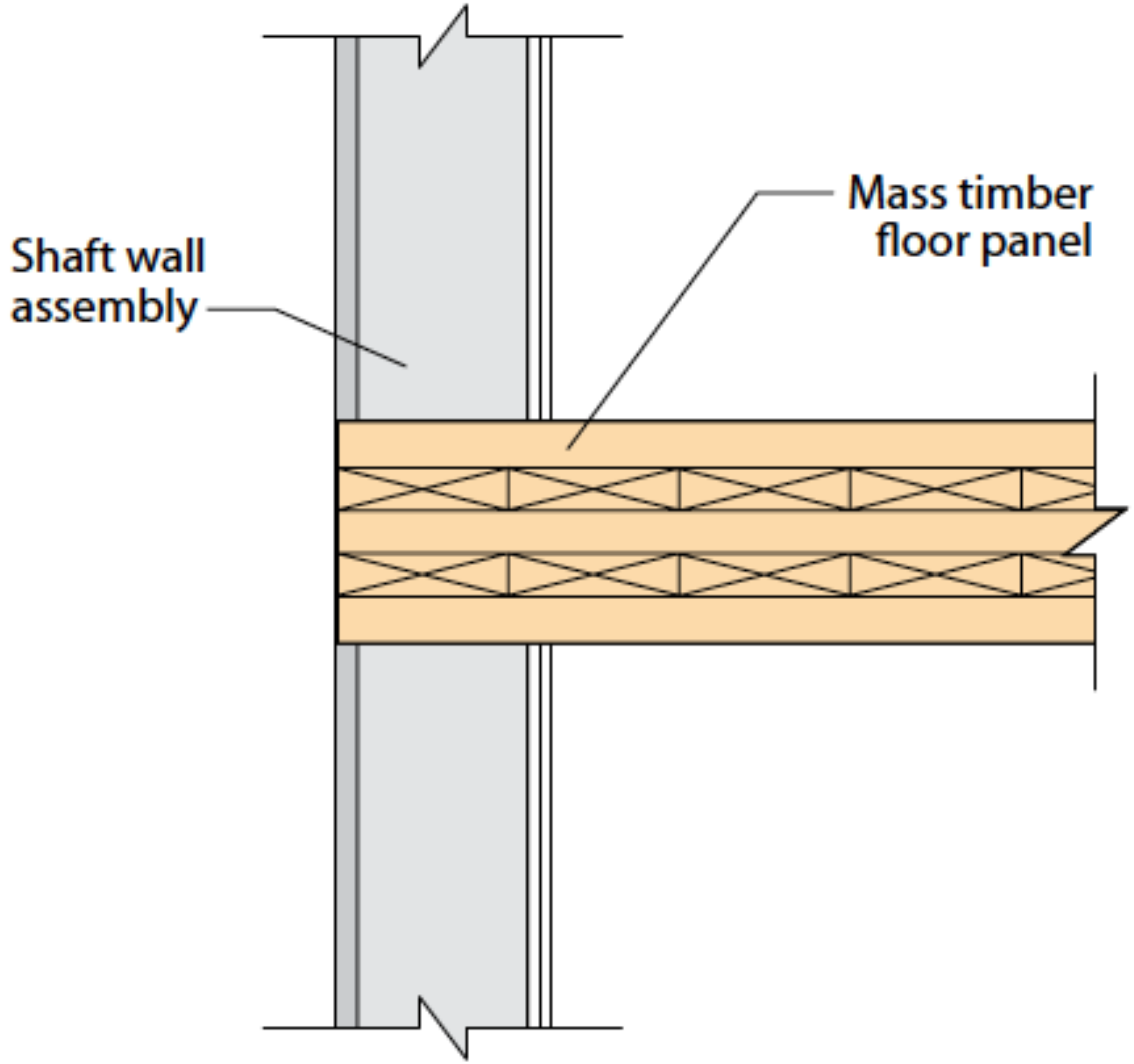


Shaftliner Systems – Support Details

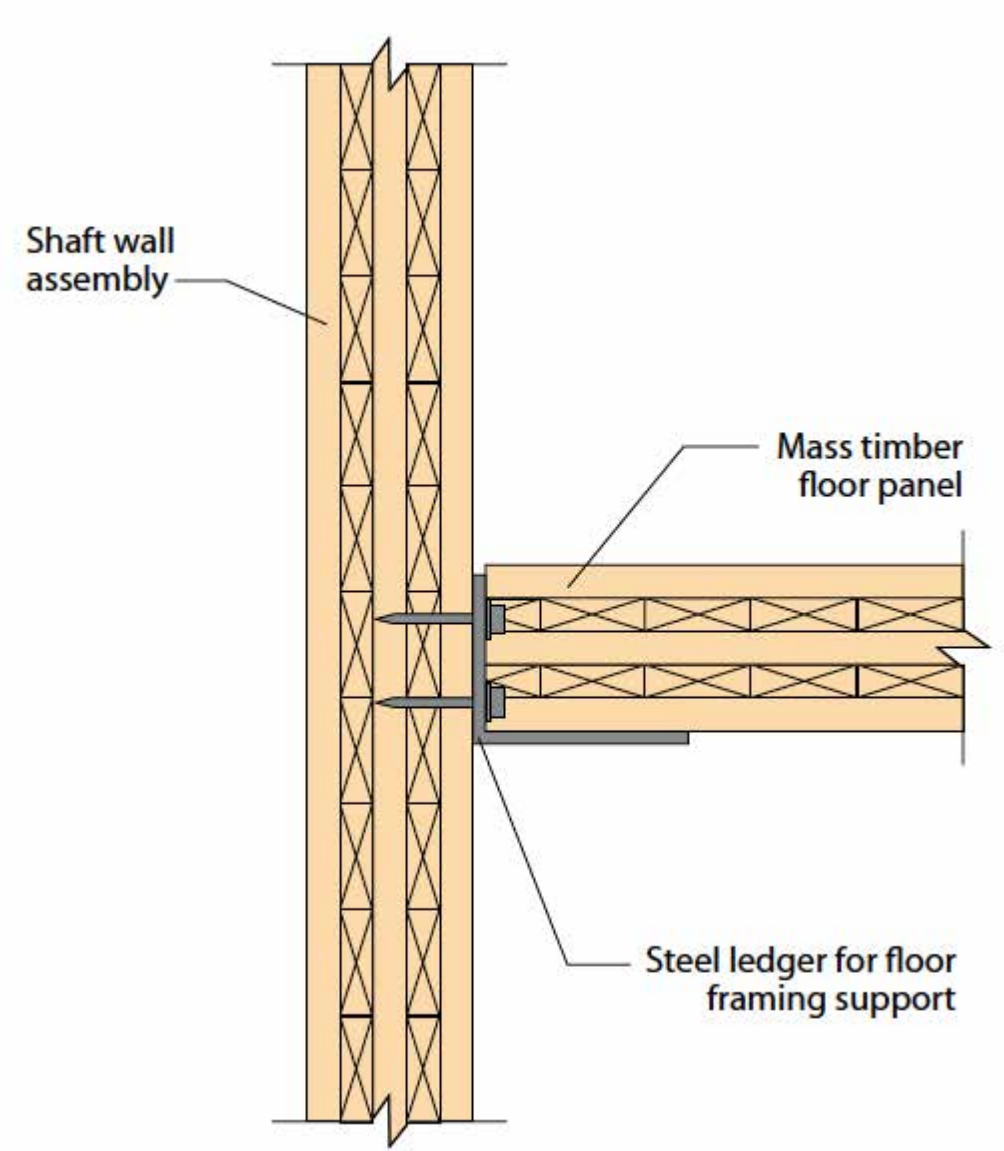
Recall fire barrier continuity definition:

shall extend … to the underside of the floor or roof sheathing, slab or deck above and shall be securely attached thereto

CLT is the “slab” and it is not disrupting the continuity of the shaft wall

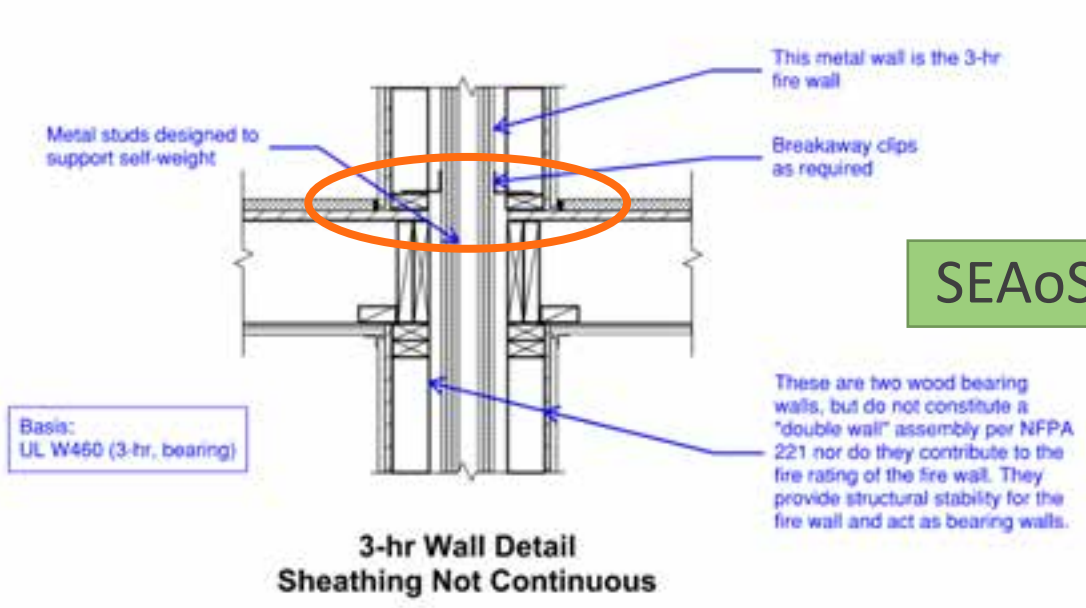


Shaftliner Systems – Support Details

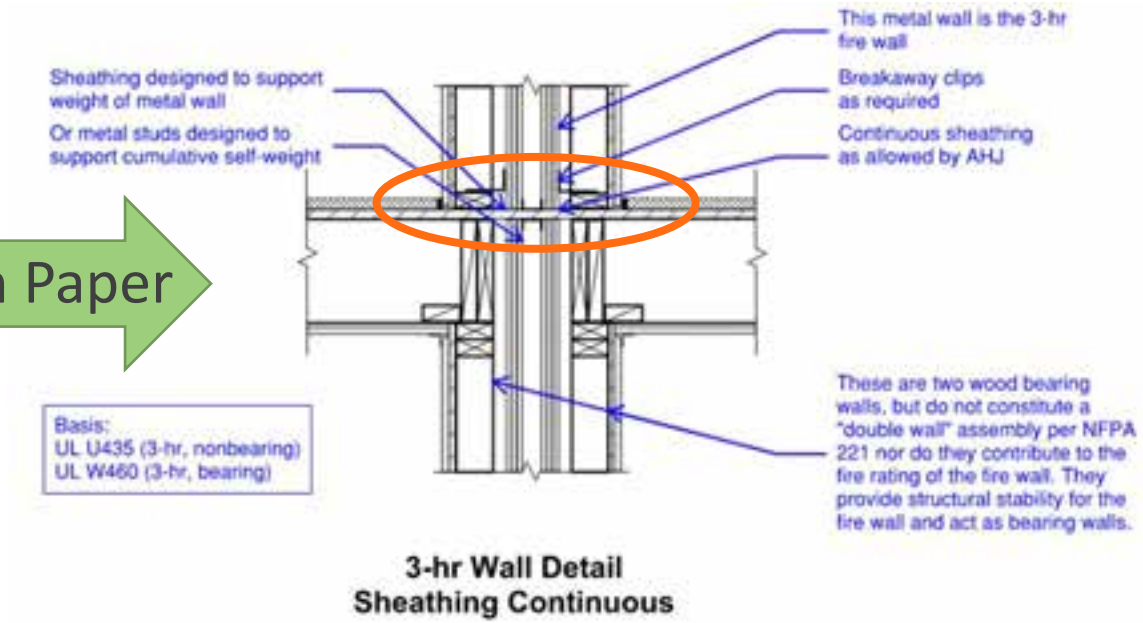


Seismic Considerations for Fire Walls

Fire Walls – Seismic Diaphragm Continuity



SEAoSC Opinion Paper



Fire Walls – Seismic Diaphragm Continuity

2018 IBC:

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.

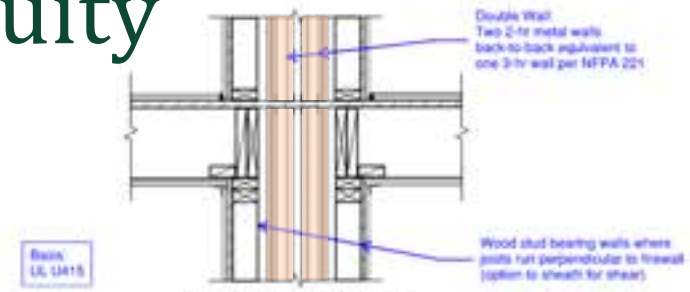
Exception: In Seismic Design Categories D through F, where double *fire walls* are used in accordance with NFPA 221, floor and roof sheathing not exceeding $^{3}/_{4}$ inch (19.05 mm) thickness shall be permitted to be continuous through the wall assemblies of light frame construction.

NFPA 221:

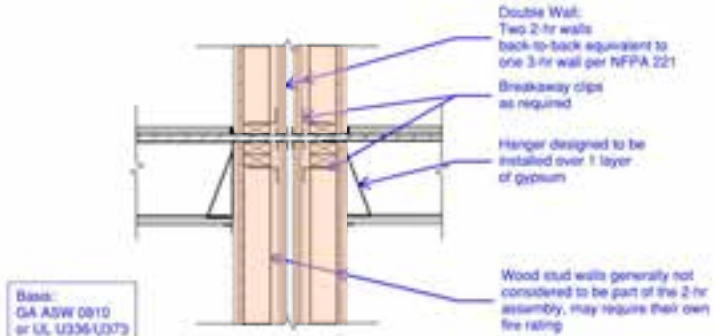
4.5* Double Wall Assemblies. Where either wall of a double wall is laterally supported by a building frame with a fire resistance rating less than that required for the wall, double wall assemblies shall be considered to have a combined assembly fire resistance rating as specified in Table 4.5.

Table 4.5 Fire Resistance Ratings for Double Wall Assemblies

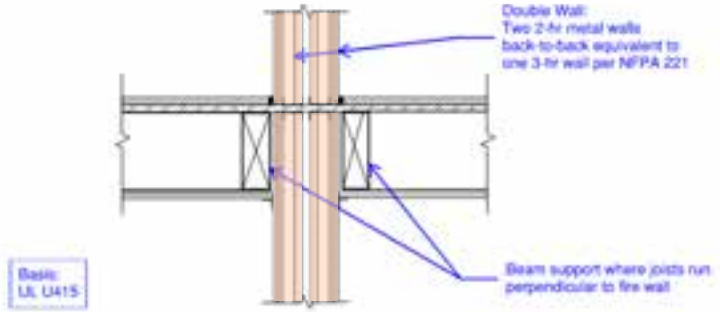
Fire Resistance Rating of Each Wall (hr)	Equivalent to Single Wall (hr)
3	4
2	3
1	2



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



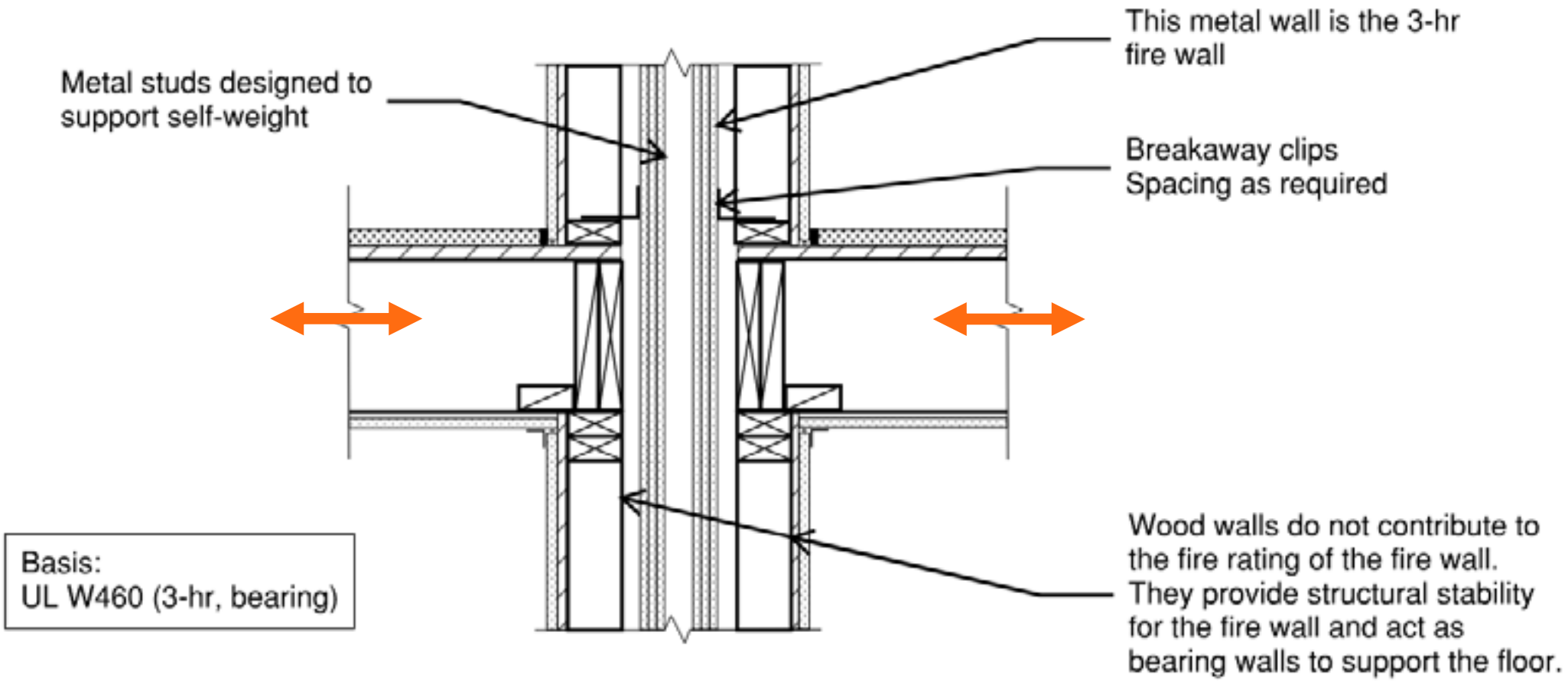
NFPA 221 Double Wall
3-hr Wall Detail for use in Type III
(noncombustible)



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

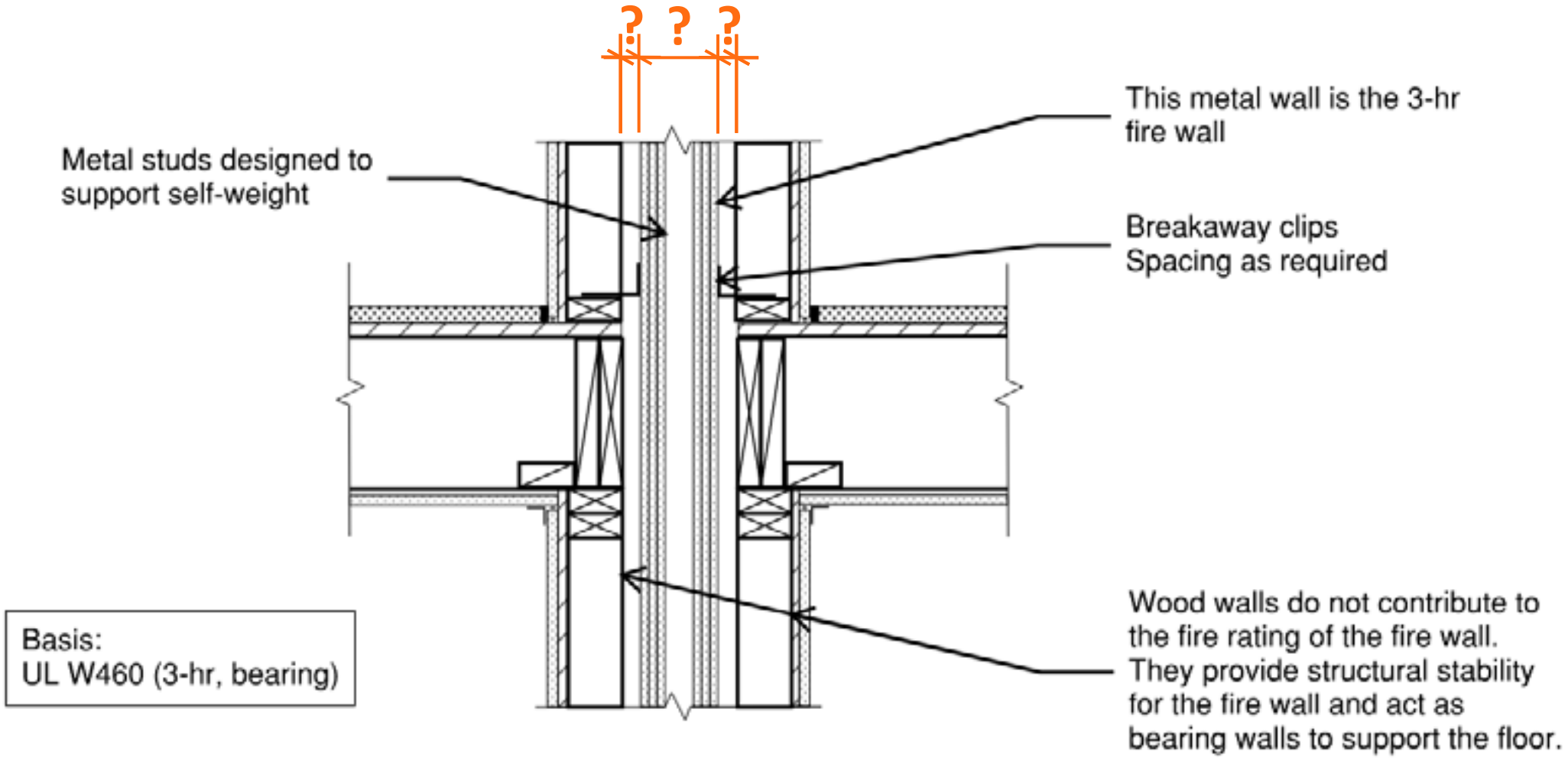
But what if we *want* a seismic separation?

Fire Walls – Seismic Joint



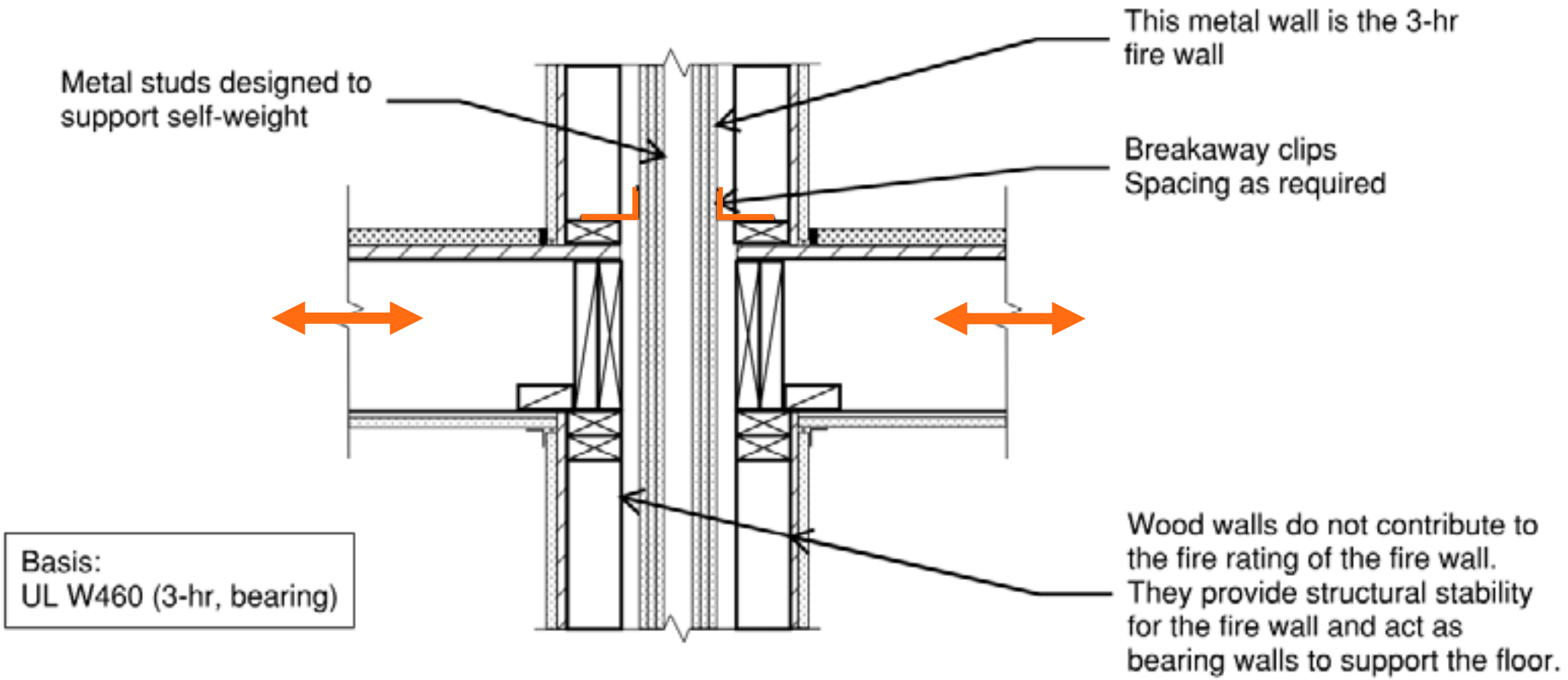
3-hr Wall Detail
Sheathing Not Continuous

Fire Walls – Seismic Joint



3-hr Wall Detail
Sheathing Not Continuous

Fire Walls – Seismic Joint



3-hr Wall Detail
Sheathing Not Continuous

Fire Walls – Seismic Joint

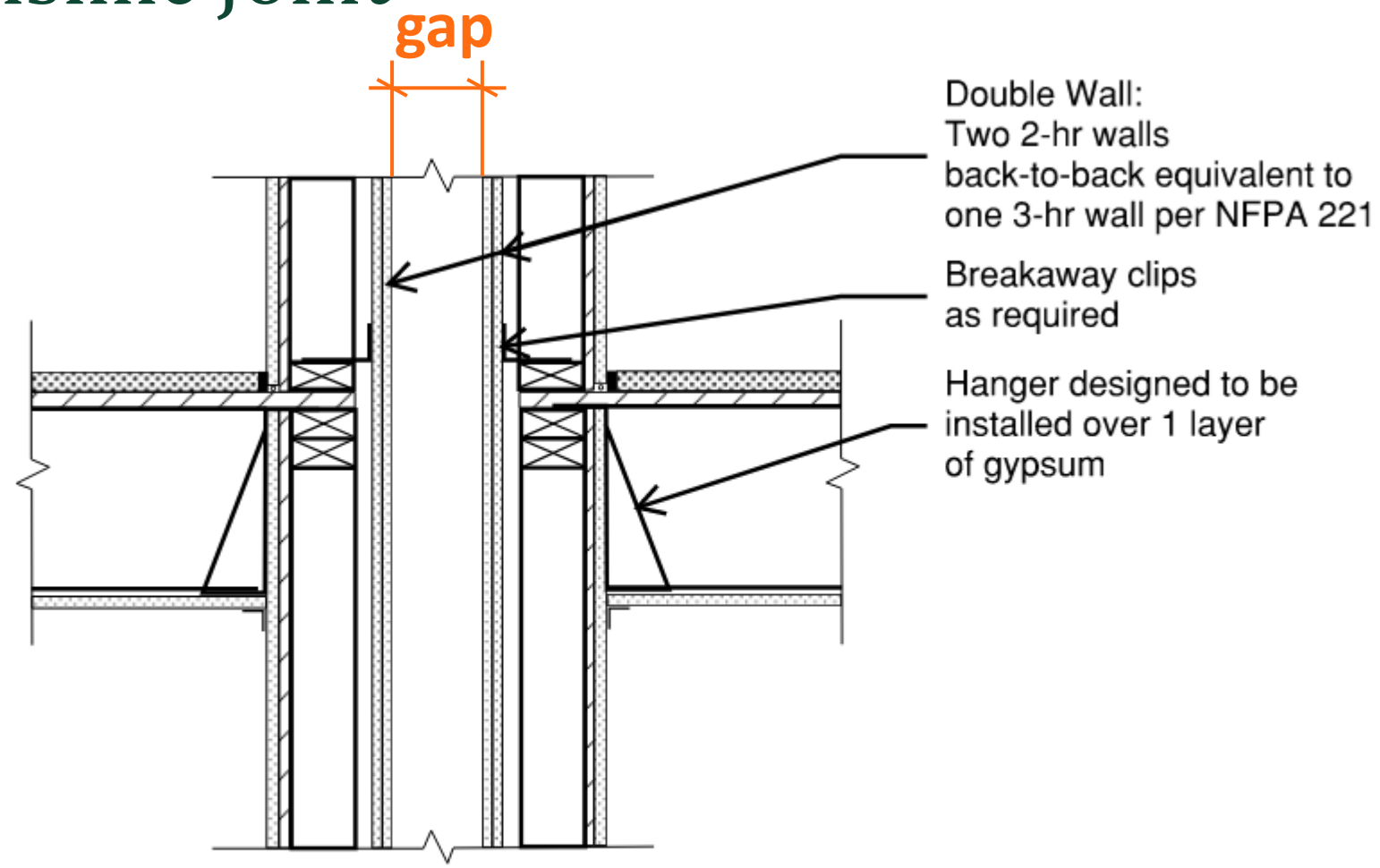
2018 IBC Provisions for Structural Stability

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.

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.

Fire Walls – Seismic Diaphragm Continuity

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

SEAOSC

DATE: **March 21, 2008**

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

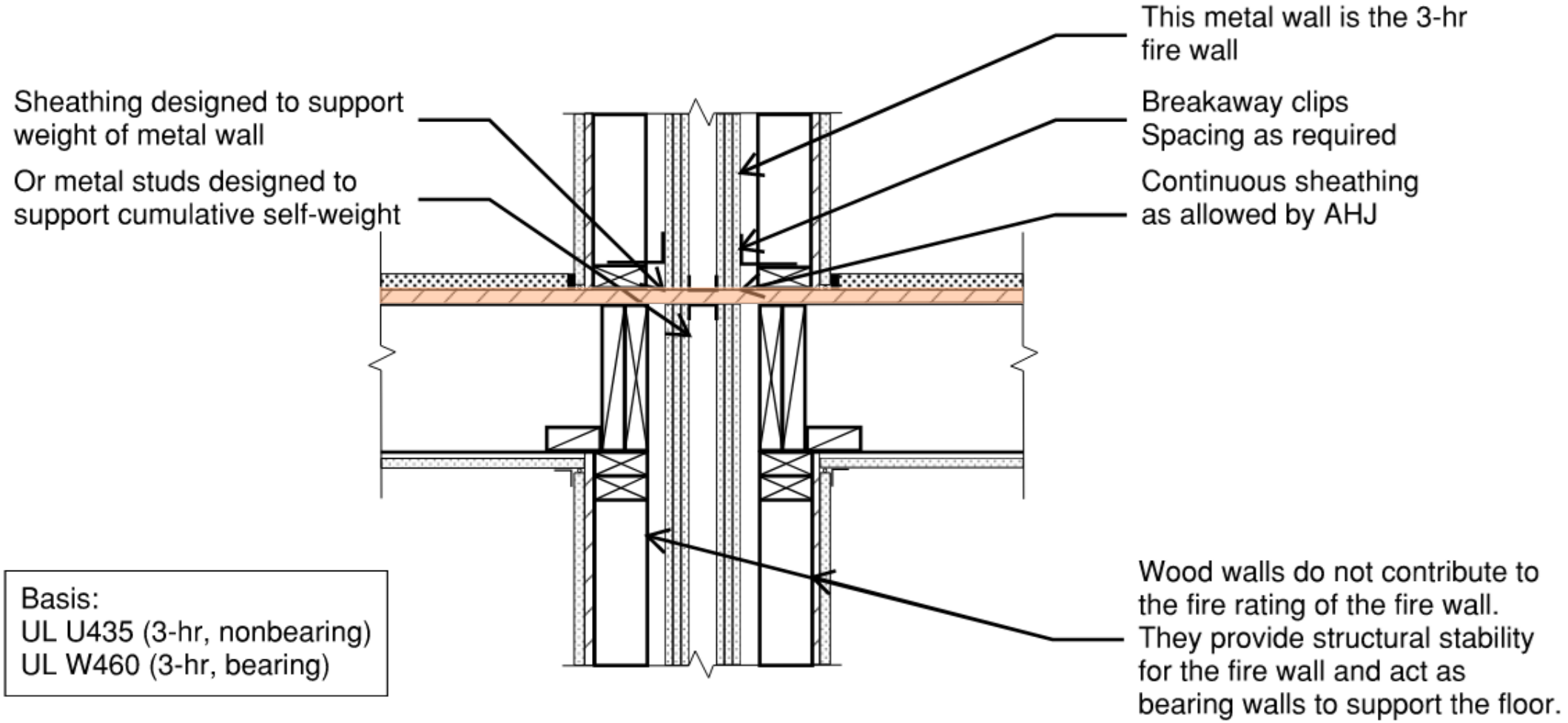
Opinion: The continuity of plywood diaphragm sheathing should be maintained across the air gap commonly encountered in double stud Firewalls of 2 or 3 hour construction. The intent is to ensure that structural continuity is not significantly reduced in the roof and floor diaphragms.

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

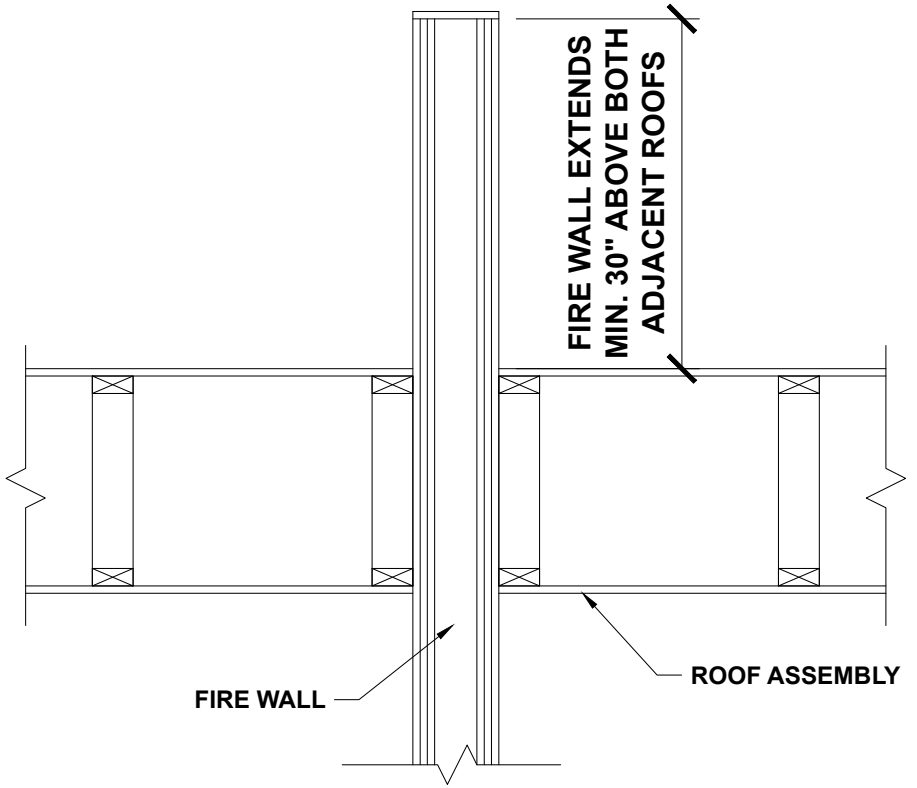


Basis:
UL U435 (3-hr, nonbearing)
UL W460 (3-hr, bearing)

3-hr Wall Detail
Sheathing Continuous

Fire Walls – Vertical Continuity

- Fire walls are required to be continuous from foundation to roof

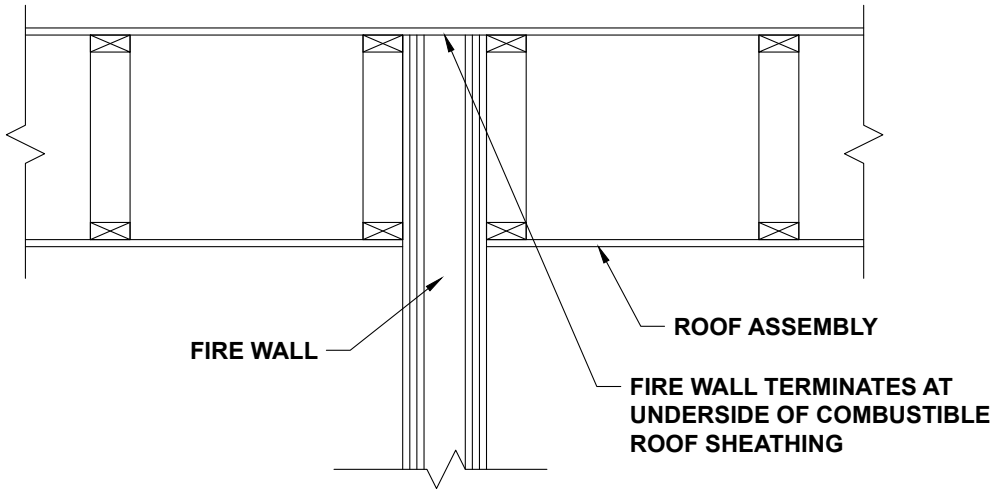


FIRE WALL TO ROOF: OPTION 1

Fire Walls – Vertical Continuity

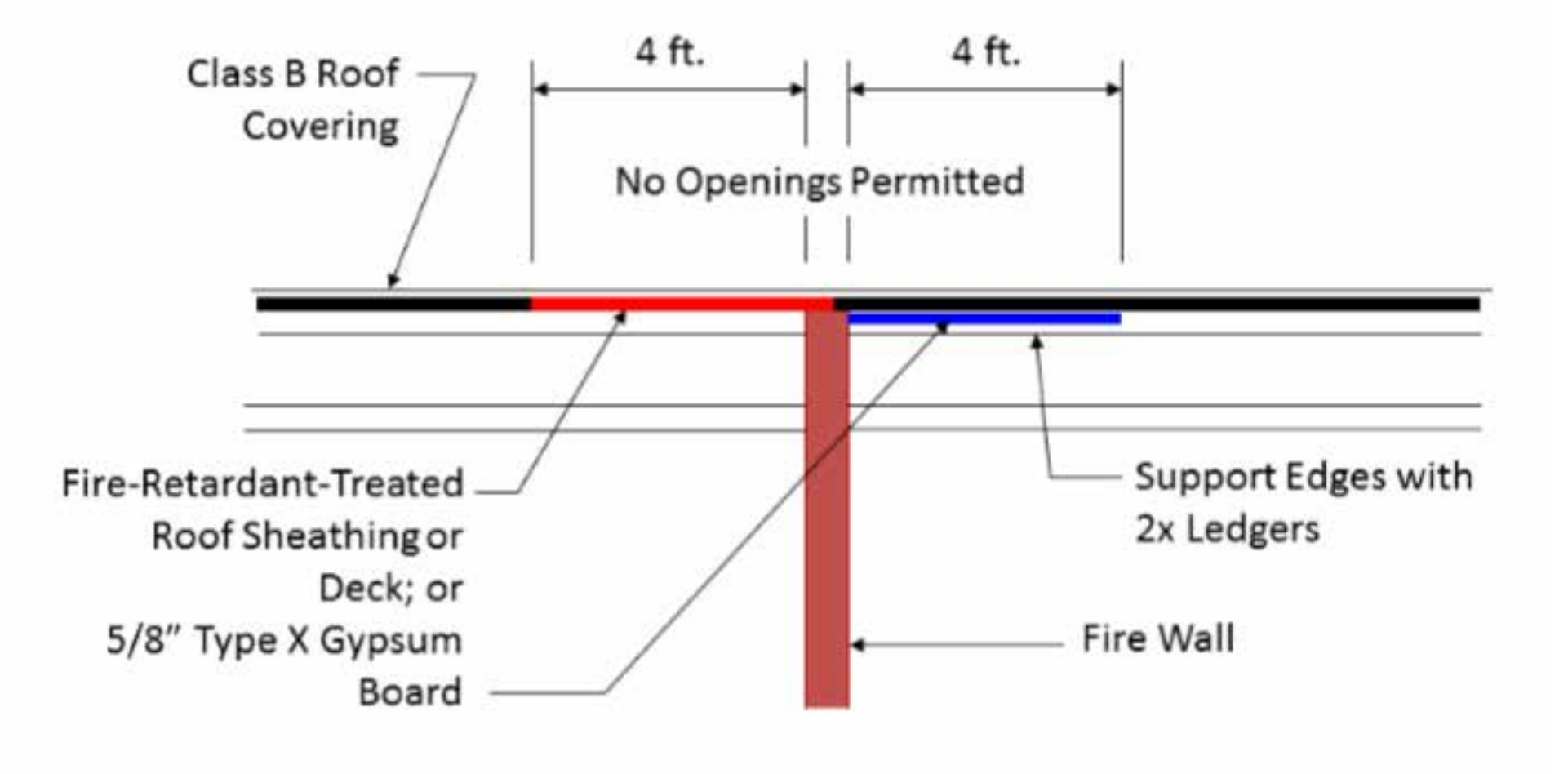
IN CONSTRUCTION TYPES III, IV OR V

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



FIRE WALL TO ROOF: OPTION 2

Fire Walls – Vertical Continuity



Are the studs required to be FRT?

No!

Could we use FRT in lieu of noncombustible?

Exterior Walls – Materials

602.3 Type III.

Type III construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of any material permitted by this code. Fire-retardant-treated wood framing and sheathing complying with Section 2303.2 shall be permitted within exterior wall assemblies of a 2-hour rating or less.

Commentary:

Although fire-retardant-treated wood (FRTW) does not meet the specifications of the code as a noncombustible material, it is permitted as a substitute for noncombustible materials for framing and sheathing within exterior wall assemblies of Type III construction. …the required fire-resistance rating of the exterior wall must not be greater than 2 hours.

Fire Walls – Materials

706.3 Materials.

Fire walls shall be of any approved noncombustible materials.

Exception: Buildings of Type V construction.

Commentary:

This section requires that fire walls be constructed of noncombustible materials unless both buildings are of Type V (combustible) construction. This is consistent with the provisions of Section 602, which require exterior walls of buildings of Type I, II, III and IV to be built of noncombustible construction, while buildings of Type V construction are permitted to be built of combustible exterior walls.

Fire Walls – Ratings

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.

QUESTIONS?

This concludes The American Institute of Architects Continuing Education Systems Course

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