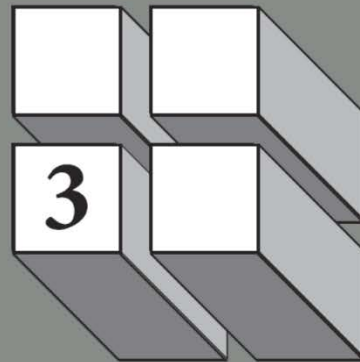


Design for Code Acceptance



Fire-Resistance-Rated Wood-Frame Wall and Floor/Ceiling Assemblies

Building Code Requirements

For occupancies such as stores, apartments, offices, and other commercial and industrial uses, building codes commonly require floor/ceiling and wall assemblies to be fire-resistance rated in accordance with standard fire tests. This document is intended to aid in the design of various wood-frame walls and wood-frame floor/ceiling assemblies, where such assemblies are required by code to be fire-resistance-rated.

Depending on the application, wall assemblies may need to be fire-resistance-rated for exposure from either one side or both sides. Exterior walls are required to be rated for both interior and exterior fire exposure where the wall has a fire separation distance of 10 feet or less. For exterior walls with a fire separation distance of greater than 10 feet, the required fire-resistance-rating applies only to exposure from the interior. The designer should note that some state and local building code amendments may require fire resistance rating for exposure from both sides of exterior walls, regardless of fire separation distance; however, the solutions and example details provided in this document are based on compliance with national model building codes.

Code recognition of one and two-hour wood-frame wall systems is also predicated on successful fire and hose stream testing in accordance with ASTM E119, *Standard Test Methods for Fire Tests of Building Construction Materials*.

Fire Tested Assemblies

Fire-resistance-rated wood-frame assemblies can be found in a number of sources including the *International Building Code (IBC)*, Underwriters Laboratories (UL) *Fire Resistance Directory*, Intertek Testing Services' *Directory of Listed Products*, and the Gypsum Association's *Fire Resistance Design Manual (GA 600)*. The American Wood Council (AWC) and its members have tested a number of wood-frame fire-resistance-rated assemblies (see photos). Descriptions of successfully tested lumber wall assemblies are provided in [Table 1](#) for one-hour fire-resistance-rated wall assemblies and [Table 2](#) for two-hour fire-resistance-rated wall assemblies. Lumber shall be identified by the grade mark of a lumber grading or inspection agency that has been approved by an accreditation body that complies with the *American Softwood Lumber Standard (PS 20)*. The fire-resistance-rated assemblies described in this document, as well as those listed in other sources are not species- or grade-specific unless specifically noted as such.

Descriptions of successfully tested I-joist floor assemblies are provided in [Table 3](#) for one-hour fire-resistance-rated floor/ceiling assemblies and [Table 4](#) for two-hour fire-resistance-rated floor/ceiling assemblies. I-joists are required to comply with ASTM D5055, *Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists*. Where resilient channels are specified, single-leg (RC-1) resilient channels shall be used. Alternatively, two-leg

(RC-2) resilient channels are permitted to be used provided only one leg is attached to the supporting structure.

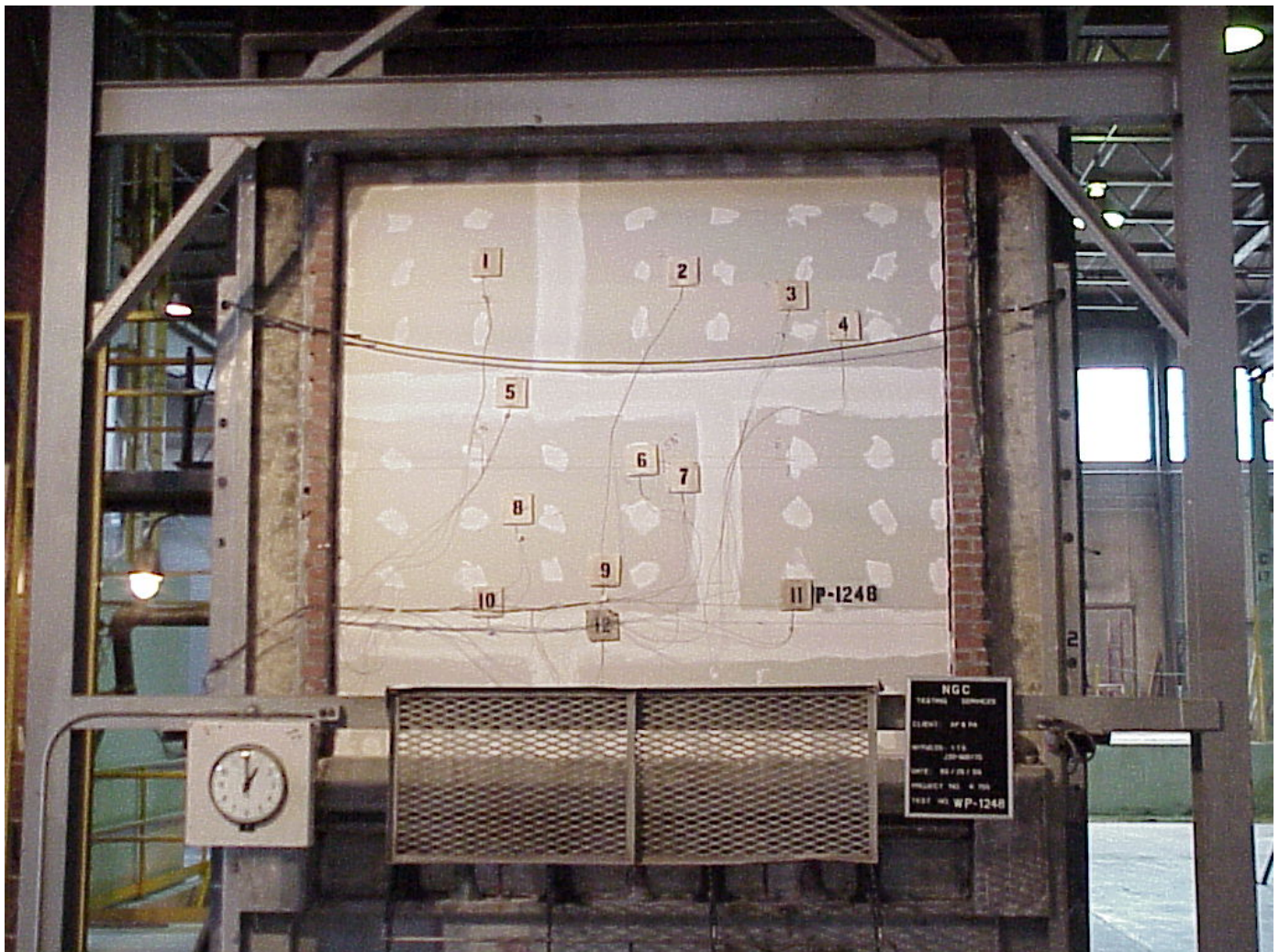
Exterior Wall - Floor Intersection Details

Example details for code-compliant exterior wall-floor intersections in Type III-A platform construction are provided in [Figures 1A through 1C](#). An example detail for an exterior wall-floor intersection in Type III-B construction is provided in [Figure 2](#).

Conclusions

Wood-frame assemblies are used in architectural designs because of their adaptability to style prefer-

ences, ease and economies of construction, environmental attributes, and energy-saving performance. To fully realize the advantages of wood-frame construction in buildings that require fire-resistance-rated assemblies, a variety of wood-frame wall and floor/ceiling assemblies have been successfully tested and shown to meet either a one-hour or two-hour fire-resistance rating. This document is intended to assist building designers with fire-resistance requirements by providing details of tested assemblies, along with corresponding STC and IIC sound ratings for floor/ceiling assemblies. Examples of exterior wall-floor intersection details for Type III construction are also provided.



ASTM E 119 fire test on wall assembly Detail WS4-1.1 at 100% design load after one hour of fire exposure.

Table 1 One-Hour Fire-Resistance-Rated Loadbearing Wood-Frame Wall Assemblies

Assemblies Rated from Both Sides						
Studs	Insulation	Sheathing on Both Sides		Fasteners	Details	IBC Assembly ^a
2x4 @ 16" o.c.	3½" mineral wool batts	5/8" Type X Gypsum Wallboard (H)		2¼" #6 Type S drywall screws @ 12" o.c.	WS4-1.1	15-1.15
2x6 @ 16" o.c.	(none)	5/8" Type X Gypsum Wallboard (H)		2¼" #6 Type S drywall screws @ 7" o.c.	WS6-1.1	15-1.14
2x6 @ 16" o.c.	5½" mineral wool batts	5/8" Type X Gypsum Wallboard (H)		2¼" #6 Type S drywall screws @ 12" o.c.	WS6-1.2	15-1.12
2x6 @ 16" o.c.	R-19 fiberglass insulation	5/8" Type X Gypsum Wallboard (V)		2¼" #6 Type S drywall screws @ 12" o.c.	WS6-1.4	15-1.13
Assemblies Rated from One Side (Fire on Interior Only)						
Studs	Insulation	Sheathing		Fasteners	Details	IBC Assembly ^a
2x4 @ 16" o.c.	3½" mineral wool batts	I	5/8" Type X Gypsum Wallboard (H)	2¼" #6 Type S drywall screws @ 12" o.c.	WS4-1.2	16-1.1
		E	3/8" wood structural panels (V)	6d common nails @ 6" edges/12" field		
2x4 @ 16" o.c.	4 mil polyethylene 3½" mineral wool batts	I	5/8" Type X Gypsum Wallboard (V)	6d cement coated box nails @ 7" o.c.	WS4-1.3	
		E	1/2" fiberboard (V)	1½" roofing nails @ 3" edges/6" field		
			3/8" hardboard shiplapped panel siding	8d galv. nails @ 4" edges/8" field		
2x6 @ 16" o.c.	5½" mineral wool batts	I	5/8" Type X Gypsum Wallboard (H)	2¼" #6 Type S drywall screws @ 12" o.c.	WS6-1.3	16-1.2
		E	7/16" wood structural panels (V)	6d common nails @ 6" edges/12" field		
2x6 @ 16" o.c.	R-19 fiberglass insulation	I	5/8" Type X Gypsum Wallboard (V)	2¼" #6 Type S drywall screws @ 7" o.c.	WS6-1.5	16-1.3
		E	3/8" wood structural panels (V)	6d common nails @ 6" edges/12" field		
2x6 @ 24" o.c.	R-19 fiberglass insulation	I	5/8" Type X Gypsum Wallboard (V)	2¼" #6 Type S drywall screws @ 7" o.c.	WS6-1.6	
		E	15/32" wood structural panels (V)	6d common nails @ 6" edges/12" field		
H - applied horizontally with vertical joints over studs I - Interior sheathing V - applied vertically with vertical joints over studs E - Exterior sheathing						

^a Item number of comparable assembly from IBC Table 721.1(2).

Table 2 Two-Hour Fire-Resistance-Rated Loadbearing Wood-Frame Wall Assemblies

Assemblies Rated from Both Sides						
Studs	Insulation	Sheathing on Both Sides		Fasteners	Details	IBC Assembly ^a
2x6 @ 24" o.c.	5½" mineral wool batts	B	5/8" Type X Gypsum Wallboard (H)	2¼" #6 Type S drywall screws @ 24" o.c.	WS6-2.1	15-1.16
		F	5/8" Type X Gypsum Wallboard (H)	2¼" #6 Type S drywall screws @ 8" o.c.		
H - applied horizontally with vertical joints over studs; B - Base layer sheathing; F - Face layer sheathing						

^a Item number of comparable assembly from IBC Table 721.1(2).

4 FIRE-RESISTANCE-RATED WOOD-FRAME WALL AND FLOOR/CEILING ASSEMBLIES

Table 3 One-Hour Fire-Resistance-Rated Wood Floor/Ceiling Assemblies

Wood I-Joist Assemblies							
Joists	Insulation	Furring	Ceiling Sheathing		Fasteners	Details	IBC Assembly ^a
I-joists @ 24" o.c. maximum Min. flange depth: 1-1/2" Min. flange area: 5.25 sq. in. Min. web thickness: 3/8" Min. I-joist depth: 9-1/4"	1-1/2" mineral wool batts (2.5 pcf-nominal) Resting on hat-shaped channels	Hat-shaped channels or Resilient channels	F	5/8" Type C Gypsum Wall-board (GWB)	1-1/8" Type S drywall screws spaced 12" o.c. in GWB field spaced 8" o.c. at GWB end joints <i>(see fastening details)</i>	WIJ-1.1	24-1.1
I-joists @ 24" o.c. maximum Min. flange depth: 1-1/2" Min. flange area: 5.25 sq. in. Min. web thickness: 7/16" Min. I-joist depth: 9-1/4"	1-1/2" mineral wool batts (2.5 pcf-nominal) Resting on resilient channels	Resilient channels	F	5/8" Type C Gypsum Wall-board (GWB)	1" Type S drywall screws spaced 12" o.c. in GWB field spaced 8" o.c. at GWB end joints <i>(see fastening details)</i>	WIJ-1.2	25-1.1
I-joists @ 24" o.c. maximum Min. flange depth: 1-5/16" Min. flange area: 2.25 sq. in. Min. web thickness: 3/8" Min. I-joist depth: 9-1/4"	2" mineral wool batts (3.5 pcf-nominal) Resting on 1x4 setting strips	Resilient channels	F	5/8" Type C Gypsum Wall-board (GWB)	1-1/8" Type S drywall screws spaced 7" o.c. in GWB field spaced 7" o.c. at GWB end joints <i>(see fastening details)</i>	WIJ-1.3	23-1.1
I-joists @ 24" o.c. maximum Min. flange depth: 1-1/2" Min. flange area: 3.45 sq. in. Min. web thickness: 3/8" Min. I-joist depth: 9-1/4"	1" mineral wool batts (6 pcf-nominal) Resting on hat-shaped channels under I-joist bottom flange	Hat-shaped channels supported by CSC clips	F	1/2" Type C Gypsum Wall-board (GWB)	1" Type S drywall screws spaced 12" o.c. in GWB field spaced 6" o.c. at GWB end joints <i>(see fastening details)</i>	WIJ-1.4	
I-joists @ 24" o.c. maximum Min. flange depth: 1-1/2" Min. flange area: 2.25 sq. in. Min. web thickness: 3/8" Min. I-joist depth: 9-1/4"	(none)	(none)	B	1/2" Type C Gypsum Wall-board (GWB)	1" Type S drywall screws spaced 12" o.c. in GWB field spaced 12" o.c. at GWB end joints	WIJ-1.5	
			F	1/2" Type C Gypsum Wall-board (GWB)	1-5/8" Type S drywall screws spaced 12" o.c. in GWB field spaced 8" o.c. at GWB end joints 1-1/2" Type G drywall screws spaced 8" o.c. at GWB end joints <i>(see fastening details)</i>		
I-joists @ 24" o.c. maximum Min. flange depth: 1-5/16" Min. flange area: 1.95 sq. in. Min. web thickness: 3/8" Min. I-joist depth: 9-1/2"	(none)	Resilient channels	B	1/2" Type X Gypsum Wall-board (GWB)	1-1/4" Type S drywall screws spaced 12" o.c. in GWB field spaced 12" o.c. at GWB end joints	WIJ-1.6	27-1.1
			F	1/2" Type X Gypsum Wall-board (GWB)	1-5/8" Type S drywall screws spaced 12" o.c. in GWB field spaced 12" o.c. at GWB end joints 1-1/2" Type G drywall screws spaced 8" o.c. at GWB end joints <i>(see fastening details)</i>		
I-joists @ 24" o.c. maximum Min. flange depth: 1-1/2" Min. flange area: 2.25 sq. in. Min. web thickness: 3/8" Min. I-joist depth: 9-1/2"	Fiberglass batts Resting on resilient channels	Resilient channels	B	1/2" Type X Gypsum Wall-board (GWB)	1-1/4" Type S drywall screws spaced 12" o.c. in GWB field spaced 12" o.c. at GWB end joints	WIJ-1.7	30-1.1
			F	1/2" Type X Gypsum Wall-board (GWB)	1-5/8" Type S drywall screws spaced 12" o.c. in GWB field spaced 12" o.c. at GWB end joints 1-1/2" Type G drywall screws spaced 8" o.c. at GWB end joints <i>(see fastening details)</i>		
B - Base layer sheathing; F - Face layer sheathing							

^a Item number of comparable assembly from IBC Table 721.1(3).

Table 4 Two-Hour Fire-Resistance-Rated Wood Floor/Ceiling Assemblies

Wood I-Joist Assemblies							
Joists	Insulation	Furring	Ceiling Sheathing		Fasteners	Details	IBC Assembly ^a
I-joists @ 24" o.c. maximum Min. flange depth: 1-1/2" Min. flange area: 2.25 sq. in. Min. web thickness: 3/8" Min. I-joist depth: 9-1/4"	3-1/2" fiberglass insulation Supported by stay wires spaced 12" o.c.	(none)	B	5/8" Type C Gypsum Wallboard (GWB)	1-5/8" Type S drywall screws spaced 12" o.c. in GWB field spaced 12" o.c. at GWB end joints	WIJ-2.1	28-1.1
		Hat-shaped channels or Resilient channels	M	5/8" Type C Gypsum Wallboard (GWB)	1" Type S drywall screws spaced 12" o.c. in GWB field spaced 12" o.c. at GWB end joints		
			F	5/8" Type C Gypsum Wallboard (GWB)	1-5/8" Type S drywall screws spaced 8" o.c. in GWB field spaced 8" o.c. at GWB end joints <i>(see fastening details)</i>		
B - Base layer sheathing (direct attached); M - Middle layer sheathing; F - Face layer sheathing							

28-1.1

^a Item number of comparable assembly from IBC Table 721.1(3).

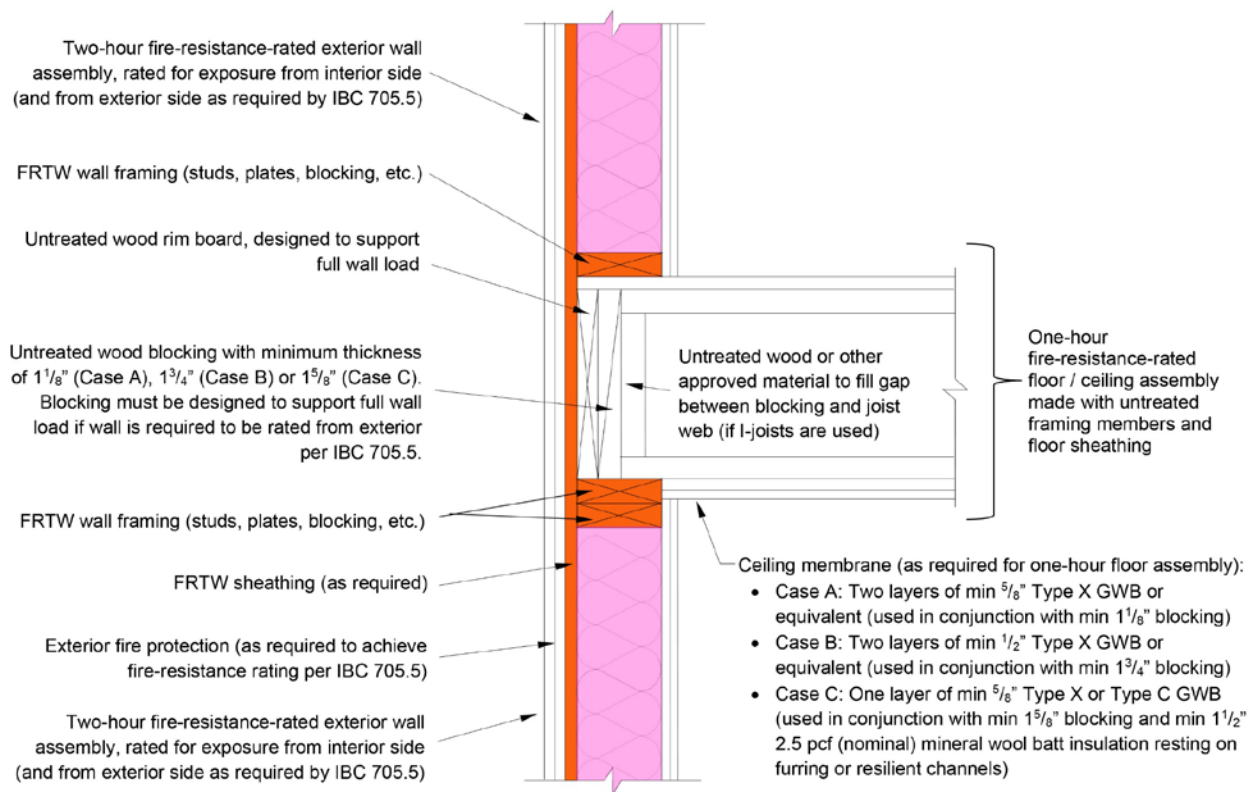


Figure 1A: Example detail for Type III-A exterior wall-floor intersection with rim board and blocking

Methodology:

Fire-resistance for exposure from interior side:

- Case A: Minimum 1 1/8-inch-thick wood blocking plus two layers of minimum 5/8 in. Type X GWB in the ceiling membrane provides 2 hours of protection to the rim board, based on the NDS-calculated time for the char depth to reach the rim board / blocking interface plus 40 minutes for each layer of 5/8 in. Type X GWB (per IBC Table 722.6.2(1)).
- Case B: Minimum 1 3/4-inch-thick wood blocking plus two layers of minimum 1/2 in. Type X GWB in the ceiling membrane provides 2 hours of protection to the rim board, based on the NDS-calculated time for the char depth to reach the rim board / blocking interface plus 25 minutes for each layer of 1/2 in. Type X GWB (per IBC Table 722.6.2(1)).
- Case C: Minimum 1 5/8-inch-thick wood blocking plus one layer of minimum 5/8 in. Type X GWB in the ceiling membrane plus minimum 1 1/2-inch-thick, 2.5 pcf (nominal) mineral wool batt insulation provides 2 hours of protection to the rim board, based on the NDS-calculated time for the char depth to reach the rim board / blocking interface, plus 40 minutes for the 5/8 in. Type X GWB (per IBC Table 722.6.2(1)), plus 15 minutes for the mineral wool batt insulation.

The rim board must be designed to support the load from the wall above.

Fire-resistance for exposure from exterior side (where required per IBC Section 705.5): A combination of exterior fire protection, FRTW sheathing, and rim board is used to provide two hours of protection to the wood blocking. For example, where 1 1/8-inch-thick rim board is used, the rim board provides 40 minutes of protection to the blocking, and the exterior GWB and FRTW sheathing layers must be sufficient to provide at least 80 minutes of protection to the rim board. The wood blocking must be designed to support the load from the wall above.

Note: NDS® is the 2018 National Design Specification® for Wood Construction

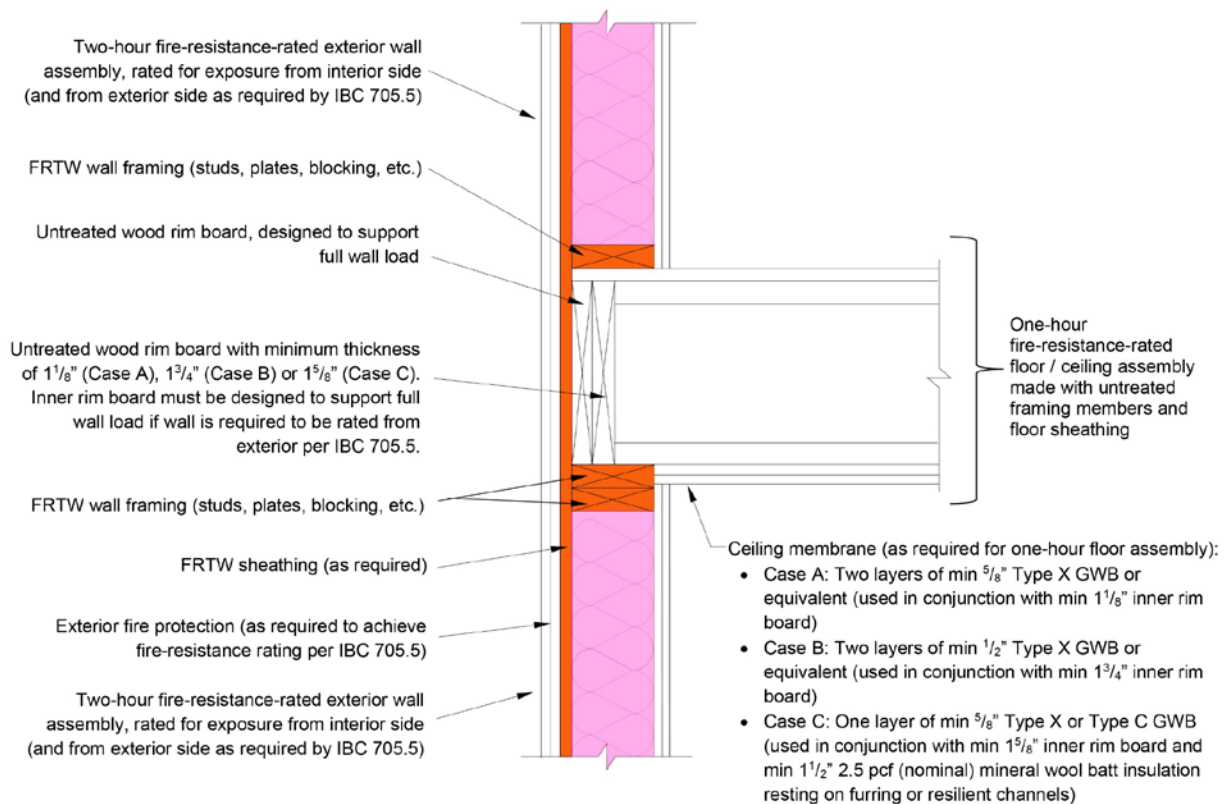


Figure 1B: Example detail for Type III-A exterior wall-floor intersection with two rim boards

Methodology:

Fire-resistance for exposure from interior side:

- Case A: Minimum $1\frac{1}{8}$ -inch-thick inner rim board plus two layers of minimum $\frac{5}{8}$ in. Type X GWB in the ceiling membrane provides 2 hours of protection to the outer rim board, based on the NDS-calculated time for the char depth to reach the inner rim board / outer rim board interface plus 40 minutes for each layer of $\frac{5}{8}$ in. Type X GWB (per IBC Table 722.6.2(1)).
- Case B: Minimum $1\frac{3}{4}$ -inch-thick inner rim board plus two layers of minimum $\frac{1}{2}$ in. Type X GWB in the ceiling membrane provides 2 hours of protection to the outer rim board, based on the NDS-calculated time for the char depth to reach the inner rim board / outer rim board interface plus 25 minutes for each layer of $\frac{1}{2}$ in. Type X GWB (per IBC Table 722.6.2(1)).
- Case C: Minimum $1\frac{5}{8}$ -inch-thick inner rim board plus one layer of minimum $\frac{5}{8}$ in. Type X GWB in the ceiling membrane plus minimum $1\frac{1}{2}$ -inch-thick, 2.5 pcf (nominal) mineral wool batt insulation provides 2 hours of protection to the outer rim board, based on the NDS-calculated time for the char depth to reach the inner rim board / outer rim board interface, plus 40 minutes for the $\frac{5}{8}$ in. Type X GWB (per IBC Table 722.6.2(1)), plus 15 minutes for the mineral wool batt insulation.

The outer rim board must be designed to support the load from the wall above.

Fire-resistance for exposure from exterior side (where required per IBC Section 705.5): A combination of exterior fire protection, FRTW sheathing, and outer rim board is used to provide two hours of protection to the inner rim board. For example, where $1\frac{1}{8}$ -inch-thick outer rim board is used, the outer rim board provides 40 minutes of protection to the inner rim board, and the exterior GWB and FRTW sheathing layers must be sufficient to provide at least 80 minutes of protection to the outer rim board. The inner rim board must be designed to support the load from the wall above.

Note: *NDS*[®] is the 2018 *National Design Specification*[®] for Wood Construction

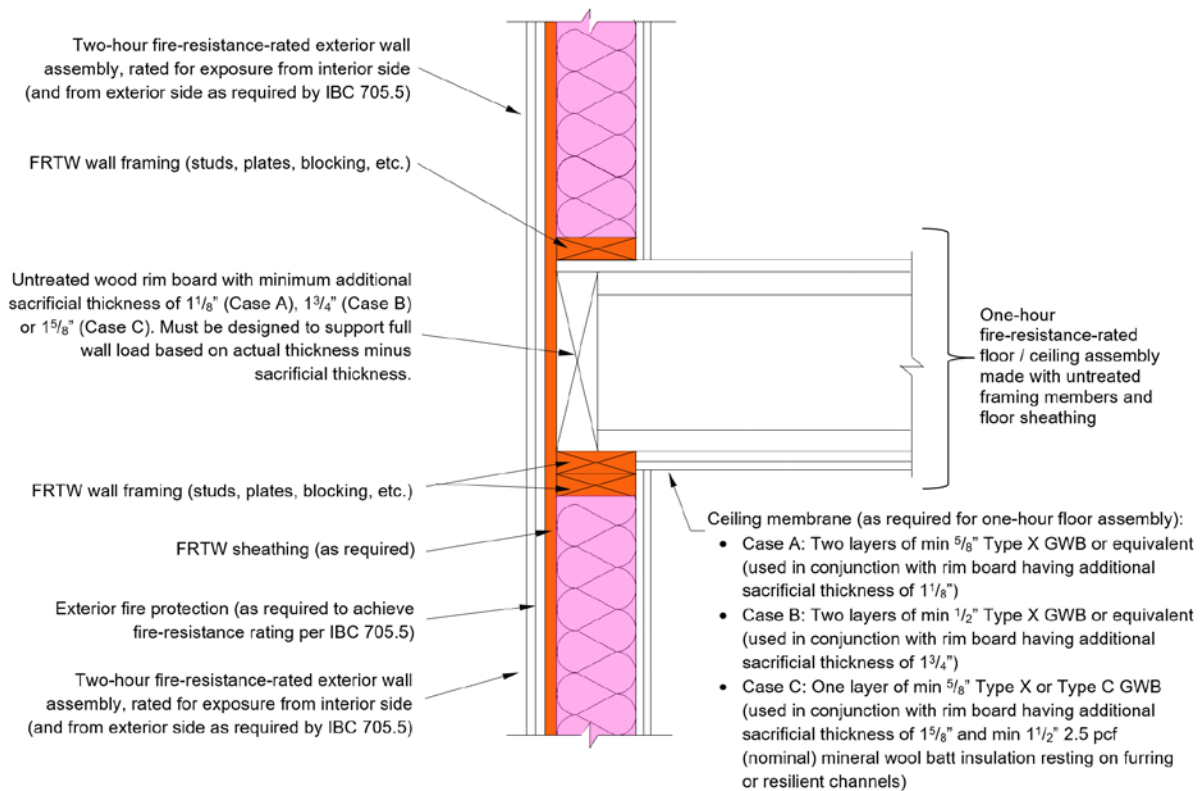


Figure 1C: Example detail for Type III-A exterior wall-floor intersection with single rim board

Methodology:

Fire-resistance for exposure from interior side:

- Case A: The minimum $1\frac{1}{8}$ -inch additional sacrificial rim board thickness plus two layers of minimum $\frac{5}{8}$ in. Type X GWB in the ceiling membrane provides 2 hours of protection to the remaining rim board section, based on the NDS-calculated time for the char depth to reach $1\frac{1}{8}$ -inch within the rim board plus 40 minutes for each layer of $\frac{5}{8}$ in. Type X GWB (per IBC Table 722.6.2(1)).
- Case B: The minimum $1\frac{3}{4}$ -inch additional sacrificial rim board thickness plus two layers of minimum $\frac{1}{2}$ in. Type X GWB in the ceiling membrane provides 2 hours of protection to the remaining rim board section, based on the NDS-calculated time for the char depth to reach $1\frac{3}{4}$ -inch within the rim board plus 25 minutes for each layer of $\frac{1}{2}$ in. Type X GWB (per IBC Table 722.6.2(1)).
- Case C: The minimum $1\frac{5}{8}$ -inch additional sacrificial rim board thickness plus one layer of minimum $\frac{5}{8}$ in. Type X GWB in the ceiling membrane plus minimum $1\frac{1}{2}$ -inch-thick, 2.5 pcf (nominal) mineral wool batt insulation provides 2 hours of protection to the remaining rim board section, based on the NDS-calculated time for the char depth to reach $1\frac{5}{8}$ -inch within the rim board, plus 40 minutes for the $\frac{5}{8}$ in. Type X GWB (per IBC Table 722.6.2(1)), plus 15 minutes for the mineral wool batt insulation.

The remaining thickness of rim board (i.e., total thickness minus sacrificial thickness) must be designed to support the load from the wall above.

Fire-resistance for exposure from exterior side (where required per IBC Section 705.5): A combination of exterior fire protection, FRTW sheathing, and the additional sacrificial wood thickness of the rim board is used to provide two hours of protection. For example, where the additional sacrificial thickness of the rim board is $1\frac{1}{8}$ inch, the sacrificial portion of the rim board provides 40 minutes of protection to the load-carrying portion of the rim board, and the exterior GWB and FRTW sheathing layers must be sufficient to provide at least 80 minutes of protection to the rim board. The remaining thickness of rim board (i.e., total thickness minus sacrificial thickness) must be designed to support the load from the wall above.

Note: *NDS®* is the 2018 *National Design Specification®* for Wood Construction

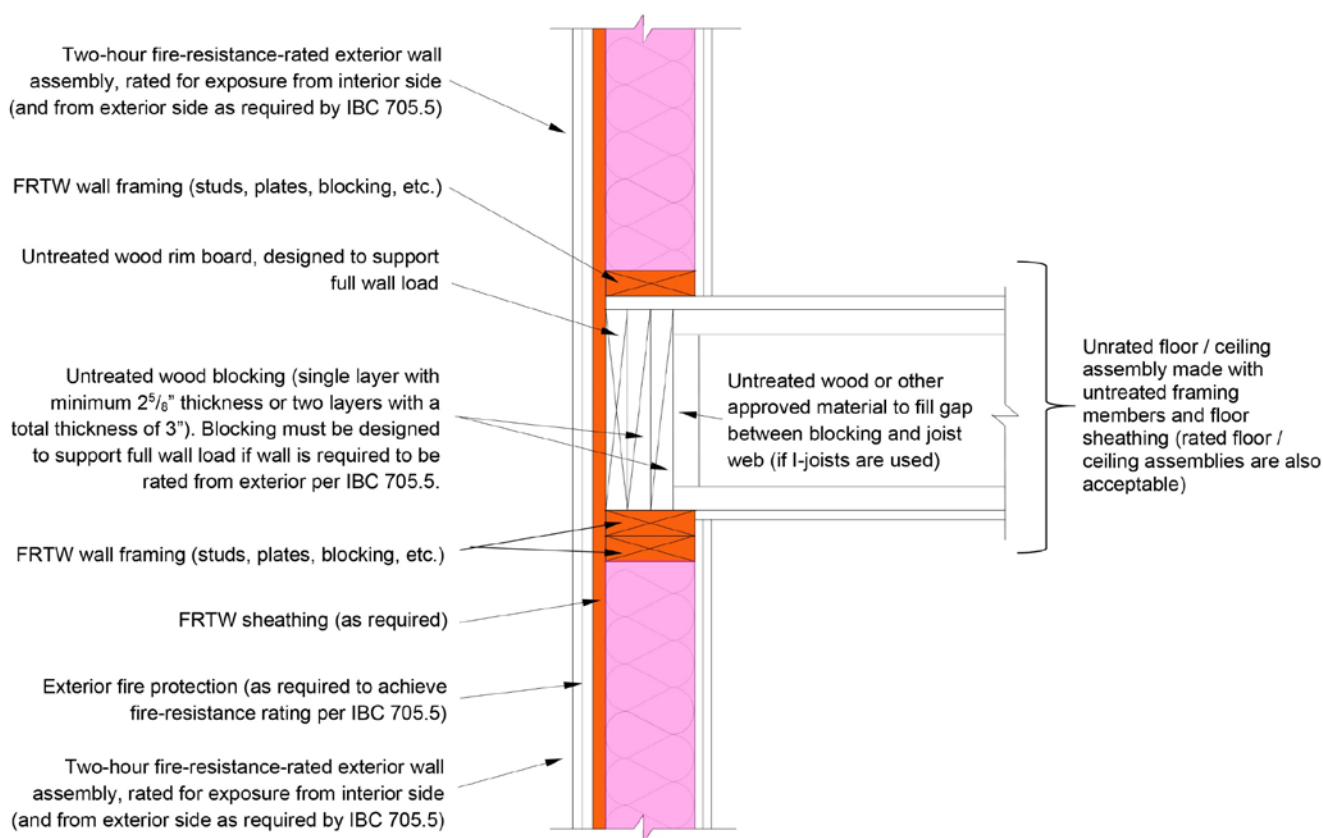


Figure 2: Example detail for Type III-B exterior wall-floor intersection with rim board and blocking

Methodology:

Fire-resistance for exposure from interior side: One layer of blocking with a minimum thickness of $2\frac{5}{8}$ inches or two layers of blocking with a minimum combined thickness of 3 inches provides 2 hours of protection to the rim board based on the NDS-calculated time for the char depth to reach the rim board / blocking interface. Additional protection from the ceiling membrane (if any) is neglected. (Continuous rim board may be used in lieu of the blocking depicted in this example, provided it meets the minimum thickness requirement and the minimum bearing length requirements of the joists are met.) The wood rim board must be designed to support the load from the wall above.

Fire-resistance for exposure from exterior side (where required per IBC Section 705.5): A combination of exterior fire protection, FRTW sheathing, and rim board is used to provide two hours of protection to the wood blocking. For example, where $1\frac{1}{8}$ -inch-thick rim board is used, the rim board provides 40 minutes of protection to the blocking, and the exterior GWB and FRTW sheathing layers must be sufficient to provide at least 80 minutes of protection to the rim board. The wood blocking must be designed to support the load from the wall above.

Note: *NDS®* is the 2018 *National Design Specification®* for Wood Construction

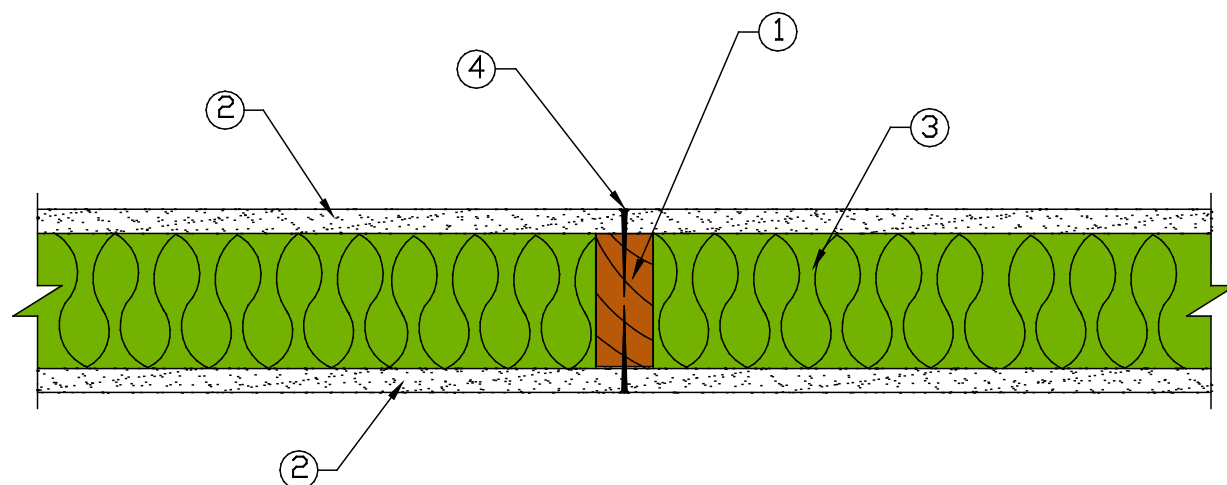
While every effort has been made to ensure the accuracy of the information presented, the American Wood Council and its members do not assume responsibility for a particular design prepared from this publication.

For additional information or assistance contact:



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January 2009, March 2010, June 2017, February 2018, March 2019, July 2019, and February 2021 Revisions

WS4-1.1 One Hour Fire-Resistance-Rated Wood-Frame Wall Assembly**2x4 Wood Stud Wall – 100% Design Load – ASTM E 119/NFPA 251**

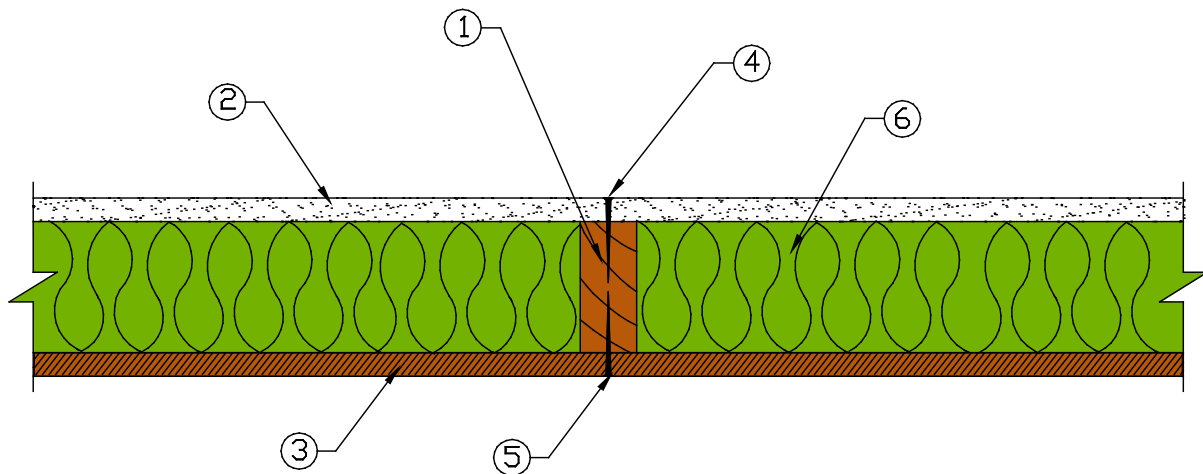
1. Framing - Nominal 2x4 wood studs, spaced 16 in. o.c., double top plates, single bottom plate
2. Sheathing - 5/8 in. Type X gypsum wallboard, 4 ft. wide, applied horizontally. Horizontal joints are unblocked. Horizontal application of wallboard represents the direction of least fire resistance as opposed to vertical application.
3. Insulation - 3-1/2-inch-thick mineral wool insulation (2.5 pcf, nominal)
4. Fasteners - 2-1/4 in. #6 Type S drywall screws, spaced 12 in. o.c.
5. Joints and Fastener Heads - Wallboard joints covered with paper tape and joint compound, fastener heads covered with joint compound

Tests conducted at the Fire Test Laboratory of National Gypsum Research Center

Test No:	WP-1248 (Fire Endurance)	March 29, 2000
	WP-1246 (Hose Stream)	March 09, 2000

Third Party Witness: Intertek Testing Services
Report J20-06170.1

This assembly was tested at 100% design load, calculated in accordance with the 2018 *National Design Specification® for Wood Construction*. The authority having jurisdiction should be consulted to assure acceptance of this report.

**WS4-1.2 One-Hour Fire-Resistance-Rated Wood-Frame Wall Assembly
(Rated from gypsum wallboard side)****2x4 Wood Stud Wall – 100% Design Load – ASTM E 119/NFPA 251**

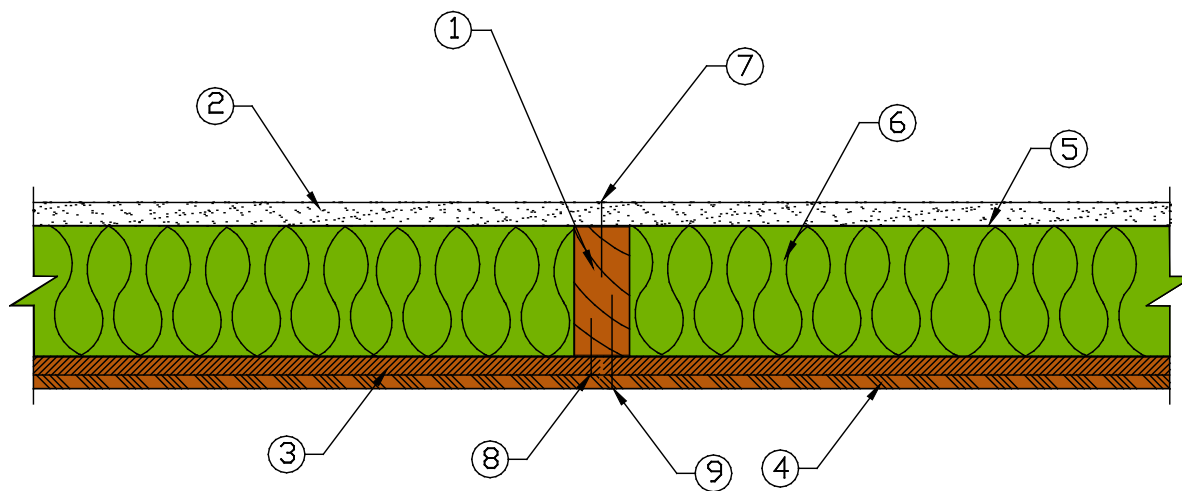
- 1 Framing - Nominal 2x4 wood studs, spaced 16 in. o.c., double top plates, single bottom plate
2. Interior Sheathing - 5/8 in. Type X gypsum wallboard, 4 ft. wide, applied horizontally. Horizontal joints are unblocked. Horizontal application of wallboard represents the direction of least fire resistance as opposed to vertical application.
3. Exterior Sheathing - Minimum 3/8 in. wood structural panels (oriented strand board), applied vertically, horizontal joints blocked
4. Gypsum Fasteners - 2-1/4 in. #6 Type S drywall screws, spaced 12 in. o.c.
5. Panel Fasteners - 6d common nails (bright) - 12 in. o.c. in the field, 6 in. o.c. panel edges
6. Insulation - 3-1/2-inch-thick mineral wool insulation (2.5 pcf, nominal)
7. Joints and Fastener Heads - Wallboard joints covered with paper tape and joint compound, fastener heads covered with joint compound

Tests conducted at the Fire Test Laboratory of National Gypsum Research Center

Test No: WP-1261 (Fire Endurance & Hose Stream) November 1, 2000

Third Party Witness: Intertek Testing Services
Report J20-006170.2

This assembly was tested at 100% design load, calculated in accordance with the 2018 *National Design Specification® for Wood Construction*. The authority having jurisdiction should be consulted to assure acceptance of this report.

**WS4-1.3 One-Hour Fire-Resistance-Rated Wood-Frame Wall Assembly
(Rated from gypsum wallboard side)**
2x4 Wood Stud Wall – 78% Design Load – ASTM E 119/NFPA 251


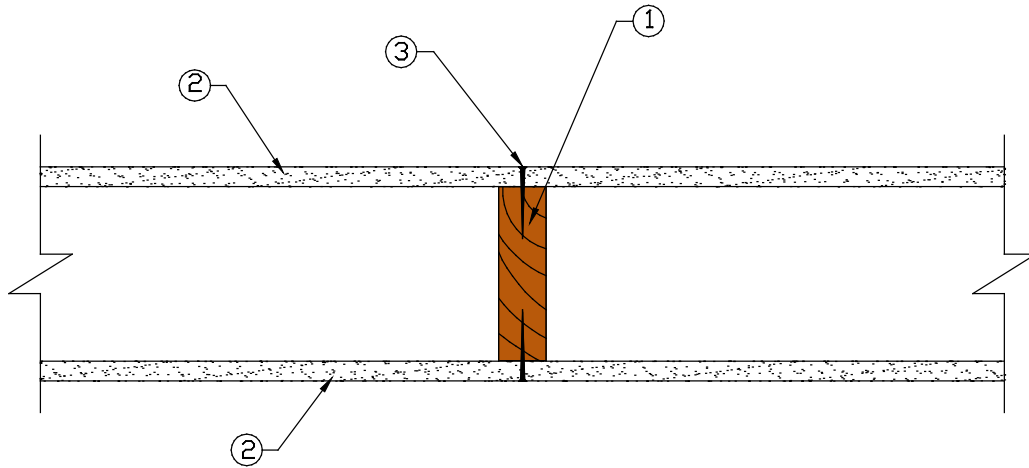
1. Framing - Nominal 2x4 wood studs, spaced 16 in. o.c., double top plates, single bottom plate
2. Interior Sheathing - 5/8 in. Type X gypsum wallboard, 4 ft. wide, applied vertically, unblocked
3. Exterior Sheathing - Minimum 1/2 in. fiberboard sheathing. *Alternate construction - minimum 1/2 in. lumber siding or 1/2 in. wood based sheathing.*
4. Exterior Siding - 3/8 in. hardboard shiplap edge panel siding. *Alternate construction - lumber, wood based, vinyl, or aluminum siding.*
5. Vapor Barrier - 4-mil polyethylene sheeting
6. Insulation - 3-1/2-inch-thick mineral wool insulation (2.5 pcf, nominal)
7. Gypsum Fasteners - 6d cement coated box nails spaced 7 in. o.c.
8. Fiberboard Fasteners - 1-1/2 in. galvanized roofing nails - 6 in. o.c. in the field, 3 in. o.c. panel edges
9. Hardboard Fasteners - 8d galvanized nails - 8 in. o.c. in the field, 4 in. o.c. panel edges
10. Joints and Fastener Heads - Wallboard joints covered with paper tape and joint compound, fastener heads covered with joint compound

Tests conducted at the Gold Bond Building Products Fire Testing Laboratory

Test No: WP-584 (Fire Endurance & Hose Stream) March 19, 1981

Third Party Witness: Warnock Hersey International, Inc.
Report WHI-690-003

This assembly was tested at 78% design load using an l_e/d of 33, calculated in accordance with the 2018 *National Design Specification® for Wood Construction*. The authority having jurisdiction should be consulted to assure acceptance of this report.

WS6-1.1 One-Hour Fire-Resistance-Rated Wood-Frame Wall Assembly**2x6 Wood Stud Wall – 100% Design Load – ASTM E 119/NFPA 251**

1. Framing - Nominal 2x6 wood studs, spaced 16 in. o.c., double top plates, single bottom plate
2. Sheathing - 5/8 in. Type X gypsum wallboard, 4 ft. wide, applied horizontally. Horizontal joints are unblocked. Horizontal application of wallboard represents the direction of least fire resistance as opposed to vertical application.
3. Fasteners - 2-1/4 in. #6 Type S drywall screws, spaced 7 in. o.c.
4. Joints and Fastener Heads - Wallboard joints covered with paper tape and joint compound, fastener heads covered with joint compound

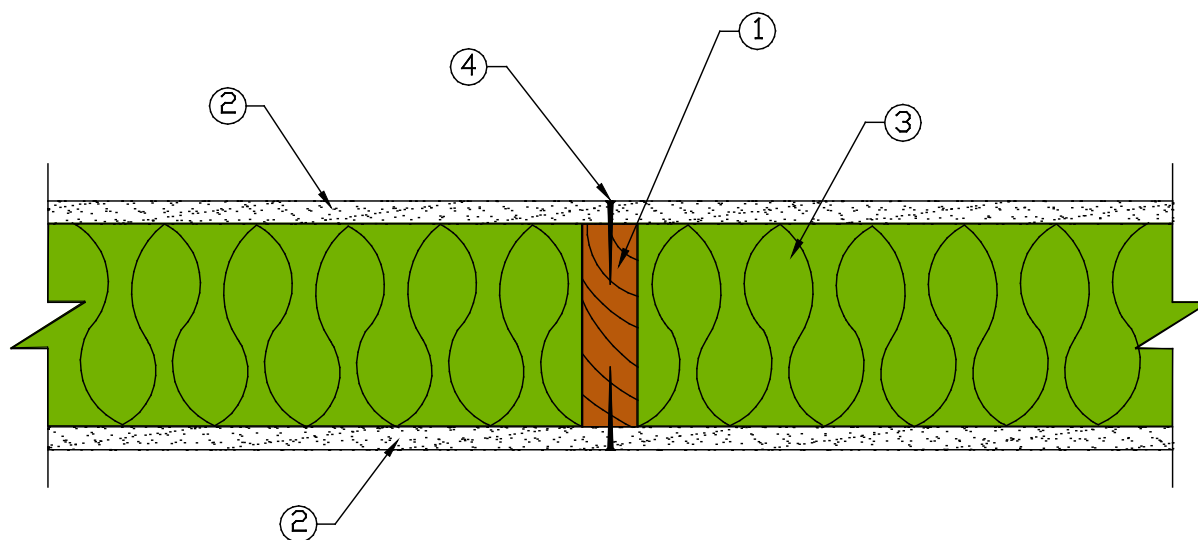
Tests conducted at the Fire Test Laboratory of National Gypsum Research Center

Test No: WP-1232 (Fire Endurance) September 16, 1999

WP-1234 (Hose Stream) September 27, 1999

Third Party Witness: Intertek Testing Services
Report J99-22441.2

This assembly was tested at 100% design load, calculated in accordance with the 2018 *National Design Specification® for Wood Construction*. The authority having jurisdiction should be consulted to assure acceptance of this report.

WS6-1.2 One-Hour Fire-Resistance-Rated Wood-Frame Wall Assembly**2x6 Wood Stud Wall – 100% Design Load – ASTM E 119/NFPA 251**

1. Framing - Nominal 2x6 wood studs, spaced 16 in. o.c., double top plates, single bottom plate
2. Sheathing - 5/8 in. Type X gypsum wallboard, 4 ft. wide, applied horizontally. Horizontal joints are unblocked. Horizontal application of wallboard represents the direction of least fire resistance as opposed to vertical application.
3. Insulation - 5-1/2-inch-thick mineral wool insulation (2.5 pcf, nominal)
4. Fasteners - 2-1/4 in. #6 Type S drywall screws, spaced 12 in. o.c.
5. Joints and Fastener Heads - Wallboard joints covered with paper tape and joint compound, fastener heads covered with joint compound

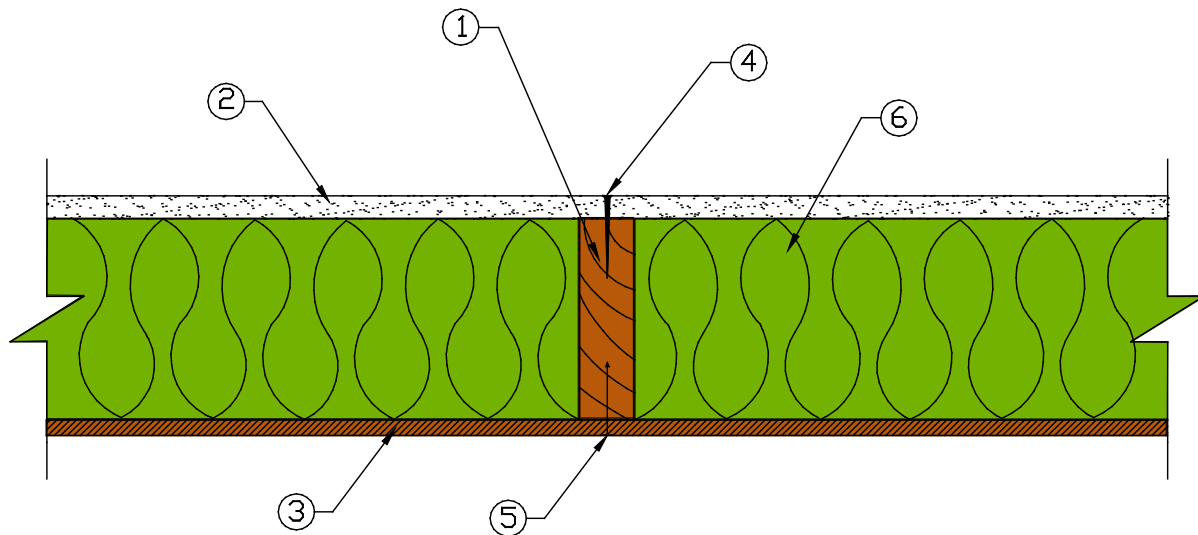
Tests conducted at the Fire Test Laboratory of National Gypsum Research Center

Test No: WP-1231 (Fire Endurance) September 14, 1999

WP-1230 (Hose Stream) August 30, 1999

Third Party Witness: Intertek Testing Services
Report J99-22441.1

This assembly was tested at 100% design load, calculated in accordance with the 2018 *National Design Specification® for Wood Construction*. The authority having jurisdiction should be consulted to assure acceptance of this report.

**WS6-1.3 One-Hour Fire-Resistance-Rated Wood-Frame Wall Assembly
(Rated from gypsum wallboard side)****2x6 Wood Stud Wall – 100% Design Load – ASTM E 119/NFPA 251**

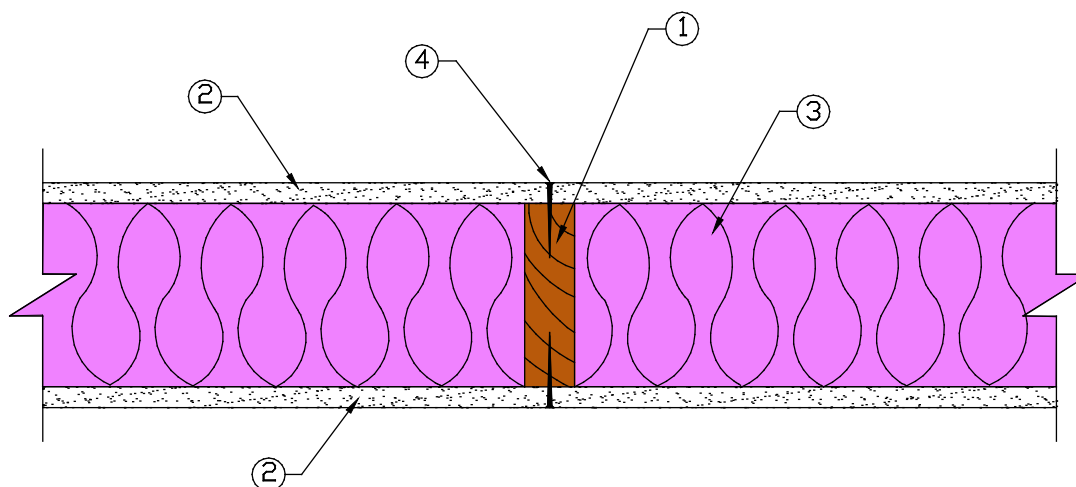
1. Framing - Nominal 2x6 wood studs, spaced 16 in. o.c., double top plates, single bottom plate
2. Interior Sheathing - 5/8 in. Type X gypsum wallboard, 4 ft. wide, applied horizontally. Horizontal joints are unblocked. Horizontal application of wallboard represents the direction of least fire resistance as opposed to vertical application.
3. Exterior Sheathing - Minimum 7/16 in. wood structural panels (oriented strand board), applied vertically, horizontal joints blocked
4. Gypsum Fasteners - 2-1/4 in. #6 Type S drywall screws, spaced 12 in. o.c.
5. Panel Fasteners - 6d common nails (bright) - 12 in. o.c. in the field, 6 in. o.c. panel edges
6. Insulation - 5-1/2-inch-thick mineral wool insulation (2.5 pcf, nominal)
7. Joints and Fastener Heads - Wallboard joints covered with paper tape and joint compound, fastener heads covered with joint compound

Tests conducted at the Fire Test Laboratory of National Gypsum Research Center

Test No: WP-1244 (Fire Endurance & Hose Stream) February 25, 2000

Third Party Witness: Intertek Testing Services
Report J99-27259.2

This assembly was tested at 100% design load, calculated in accordance with the 2018 *National Design Specification® for Wood Construction*. The authority having jurisdiction should be consulted to assure acceptance of this report.

WS6-1.4 One-Hour Fire-Resistance-Rated Wood-Frame Wall Assembly**2x6 Wood Stud Wall – 100% Design Load – ASTM E 119/NFPA 251**

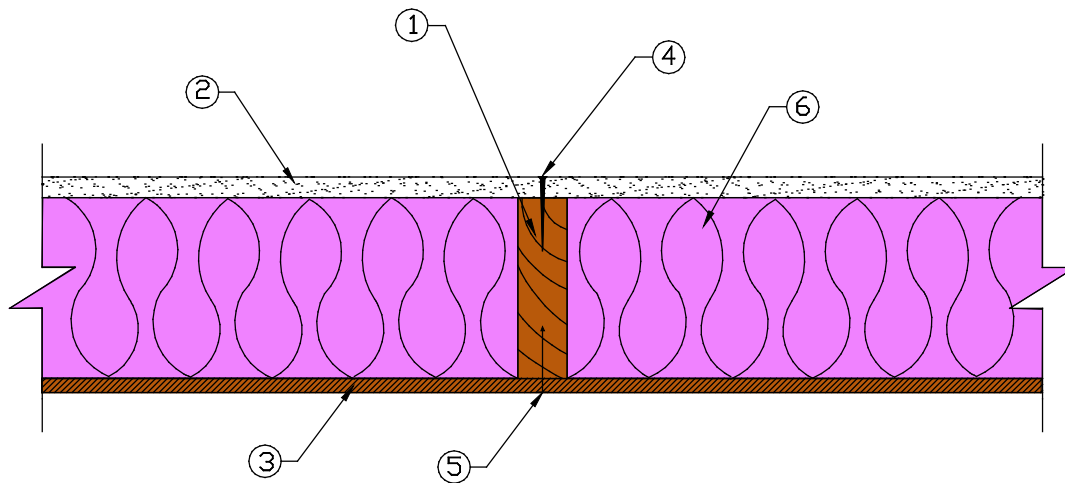
1. Framing - Nominal 2x6 wood studs, spaced 16 in. o.c., double top plates, single bottom plate
2. Sheathing - 5/8 in. Type X gypsum wallboard, 4 ft. wide, applied vertically. All panel edges backed by framing or blocking.
3. Insulation - R-19 fiberglass insulation
4. Fasteners - 2-1/4 in. #6 Type S drywall screws, spaced 12 in. o.c.
5. Joints and Fastener Heads - Wallboard joints covered with paper tape and joint compound, fastener heads covered with joint compound

Tests conducted at NGC Testing Services

Test No: WP-1346 (Fire Endurance) August 22, 2003
WP-1351 (Hose Stream) September 17, 2003

Third Party Witness: NGC Testing Services

This assembly was tested at 100% design load, calculated in accordance with the 2018 *National Design Specification® for Wood Construction*. The authority having jurisdiction should be consulted to assure acceptance of this report.

**WS6-1.5 One-Hour Fire-Resistance-Rated Wood-Frame Wall Assembly
(Rated from gypsum wallboard side)****2x6 Wood Stud Wall – 100% Design Load – ASTM E 119/NFPA 251**

1. Framing - Nominal 2x6 wood studs, spaced 16 in. o.c., double top plates, single bottom plate
2. Interior Sheathing - 5/8 in. Type X gypsum wallboard, 4 ft. wide, applied vertically. All panel edges backed by framing or blocking.
3. Exterior Sheathing - Minimum 3/8 in. wood structural panels (oriented strand board), applied vertically, horizontal joints blocked
4. Gypsum Fasteners - 2-1/4 in. #6 Type S drywall screws, spaced 7 in. o.c.
5. Panel Fasteners - 6d common nails (bright) - 12 in. o.c. in the field, 6 in. o.c. panel edges
6. Insulation - R-19 fiberglass insulation
7. Joints and Fastener Heads - Wallboard joints covered with paper tape and joint compound, fastener heads covered with joint compound

Tests conducted at the NGC Testing Services

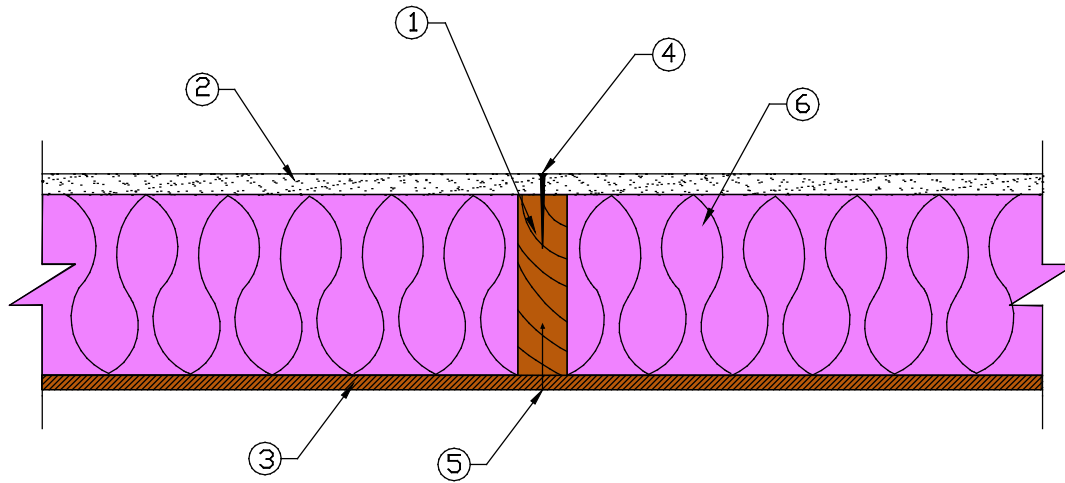
Test No: WP-1408 (Fire Endurance & Hose Stream) August 13, 2004

Third Party Witness: NGC Testing Services

This assembly was tested at 100% design load, calculated in accordance with the 2018 *National Design Specification® for Wood Construction*. The authority having jurisdiction should be consulted to assure acceptance of this report.

WS6-1.6 One-Hour Fire-Resistance-Rated Wood-Frame Wall Assembly (Rated from gypsum wallboard side)

2x6 Wood Stud Wall – 100% Design Load – ASTM E 119/NFPA 251



1. Framing - Nominal 2x6 wood studs, spaced 24 in. o.c., double top plates, single bottom plate
2. Interior Sheathing - 5/8 in. Type X gypsum wallboard, 4 ft. wide, applied vertically. All panel edges backed by framing or blocking.
3. Exterior Sheathing - Minimum 15/32 in. wood structural panels, applied vertically, horizontal joints blocked
4. Gypsum Fasteners - 2-1/4 in. #6 Type S drywall screws, spaced 7 in. o.c.
5. Panel Fasteners - 6d common nails (bright) - 12 in. o.c. in the field, 6 in. o.c. panel edges
6. Insulation - minimum R-19 fiberglass insulation
7. Joints and Fastener Heads - Wallboard joints covered with paper tape and joint compound, fastener heads covered with joint compound

Tests conducted at Western Fire Center

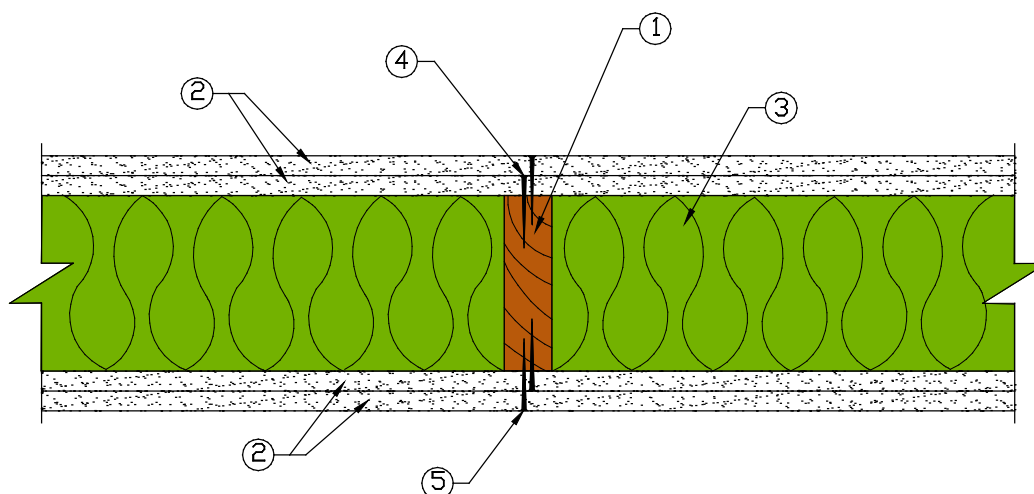
Test No: WFCi Report #18090r1 (Fire Endurance & Hose Stream) February 22, 2019

Third Party Witness: Western Fire Center, Inc.

This assembly was tested at 100% design load, calculated in accordance with the 2018 *National Design Specification® for Wood Construction*. The authority having jurisdiction should be consulted to assure acceptance of this report.

WS6-2.1 Two-Hour Fire-Resistance-Rated Wood-Frame Wall Assembly

2x6 Wood Stud Wall – 100% Design Load – ASTM E 119/NFPA 251



1. Framing - Nominal 2x6 wood studs, spaced 24 in. o.c., double top plates, single bottom plate.
2. Sheathing:
 - Base Layer - 5/8 in. Type X gypsum wallboard, 4 ft. wide, applied horizontally, joints staggered on opposite sides of the wall.
 - Face Layer - 5/8 in. Type X gypsum wallboard, 4 ft. wide, applied horizontally, joints staggered with base layer.
 - Horizontal joints are unblocked. Horizontal application of wallboard represents the direction of least fire resistance as opposed to vertical application.
3. Insulation - 5-1/2-inch-thick mineral wool insulation (2.5 pcf, nominal)
4. Gypsum Fasteners: Base Layer - 2-1/4 in. #6 Type S drywall screws, spaced 24 in. o.c.
5. Gypsum Fasteners: Face Layer - 2-1/4 in. #6 Type S drywall screws, spaced 8 in. o.c.
6. Joints and Fastener Heads - Wallboard joints covered with paper tape and joint compound, fastener heads covered with joint compound

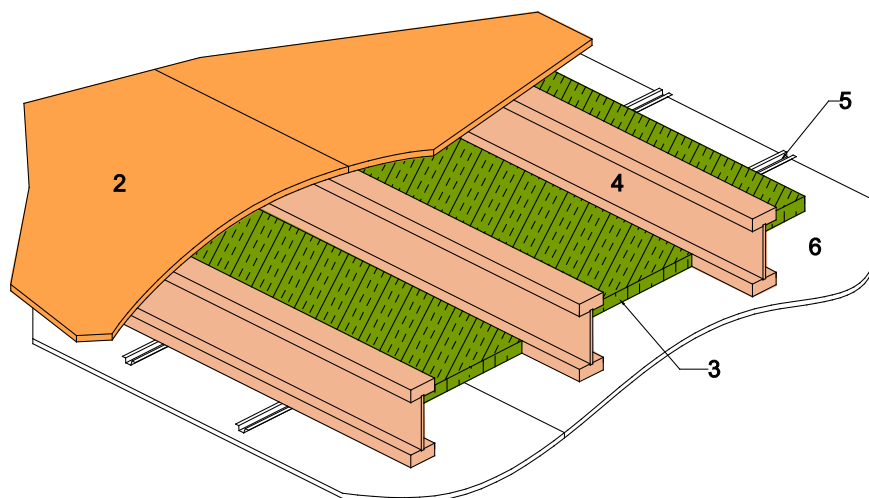
Tests conducted at the Fire Test Laboratory of National Gypsum Research Center

Test No: WP-1262 (Fire Endurance) November 3, 2000

WP-1268 (Hose Stream) December 8, 2000

Third Party Witness: Intertek Testing Services
Report J20-006170.3

This assembly was tested at 100% design load, calculated in accordance with the 2018 *National Design Specification® for Wood Construction*. The authority having jurisdiction should be consulted to assure acceptance of this report.

WIJ-1.1 One-Hour Fire-Resistance-Rated Ceiling AssemblyFloor^a/Ceiling - 100% Design Load - 1 Hour Rating - ASTM E 119 / NFPA 251

1. **Floor Topping (optional, not shown):** Gypsum concrete, lightweight or normal concrete topping.
2. **Floor Sheathing:** Minimum 23/32-inch-thick tongue-and-groove wood sheathing (Exposure 1). Installed per code requirements with minimum 8d common nails and glued to joist top flanges with AFG-01 construction adhesive.
3. **Insulation:** Minimum 1-1/2-inch-thick mineral wool batt insulation – 2.5 pcf (nominal), supported by furring channels.
4. **Structural Members:** Wood I-joists spaced a maximum of 24 inches on center. See ASTM D 5055 for qualification requirements. Additional requirements are as follows:
 Minimum I-joist flange depth: 1-1/2 inches Minimum I-joist flange area: 5.25 inches²
 Minimum I-joist web thickness: 3/8 inch Minimum I-joist depth: 9-1/4 inches
5. **Furring Channels:** Minimum 0.026-inch-thick galvanized steel hat-shaped furring channels, attached perpendicular to I-joists using 1⁵/₈-inch-long drywall screws. Furring channels spaced 16 inches on center and doubled at each wallboard end joint extending to the next joist. Based on ASTM E2032, minimum 0.019-inch-thick galvanized steel resilient channels may be used in lieu of hat-shaped furring channels if installed at the same spacing and attached in the same manner. In order to achieve the sound ratings given below, resilient channels must be used in lieu of hat-shaped furring channels.
6. **Gypsum Wallboard:** Minimum 5/8-inch-thick Type C gypsum wallboard installed with long dimension perpendicular to furring channels and fastened to each channel with minimum 1-1/8-inch-long Type S drywall screws. Fasteners spaced 12 inches on center in the field of the wallboard, 8 inches on center at wallboard end joints, and 3/4 inches from panel edges and ends. End joints of wallboard staggered.
7. **Finish System (not shown):** Face layer joints covered with tape and coated with joint compound. Screw heads covered with joint compound.

Fire Test conducted at Gold Bond Building Products Research Center
 Third Party Witness: Warnock Hersey International, Inc.

February 9, 1990
 Report No: WHI-651-0311.1

STC and IIC Sound Ratings (with Resilient Channels)

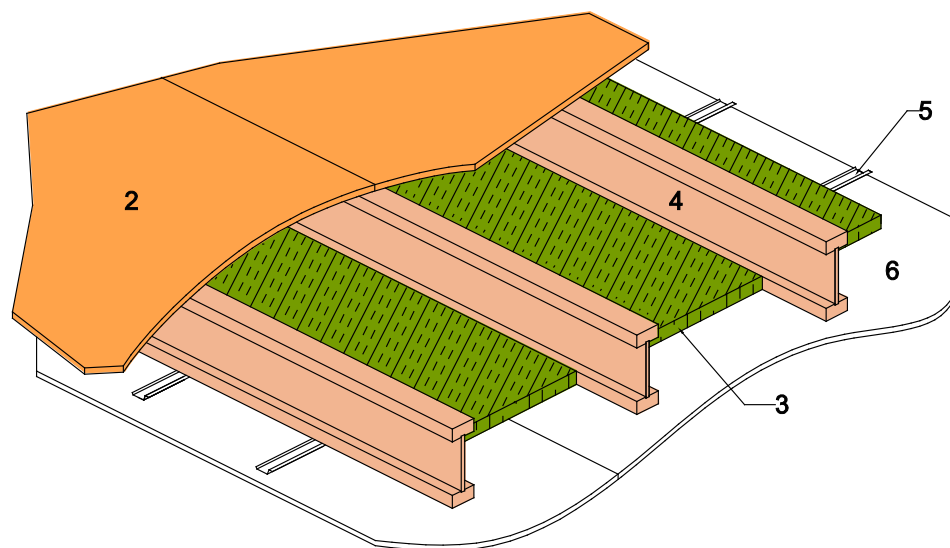
Joist/ RC Spacing ^c	Without Gypsum Concrete				With 1" Gypsum Concrete			
	Cushioned Vinyl		Carpet & Pad		Cushioned Vinyl		Carpet & Pad	
	STC	IIC	STC	IIC	STC	IIC	STC	IIC
24"o.c./16"o.c.	48 (51) ^b	42 (43) ^b	48 (51) ^b	61 (63) ^b	63 (65) ^b	50 (52) ^b	63 (65) ^b	65 (67) ^b
16"o.c./16"o.c.	44 (46) ^b	37 (39) ^b	44 (46) ^b	60 (61) ^b	56 (57) ^b	46 (47) ^b	56 (57) ^b	58 (59) ^b

^a This assembly may also be used in a fire-rated roof/ceiling application, but only when constructed exactly as described.

^b STC and IIC values established by engineering analysis using the AWC Technical Report 15 (TR15) model, assuming 1.5"-thick mineral wool batt insulation (values in parentheses assume 3.5"-thick mineral wool batt) and resilient channels at 16" o.c.

^c STC and IIC values for assemblies with a joist spacing of 16" o.c. may be used for assemblies with joist spacings between 16" o.c. and 24" o.c..

WIJ-1.2 One-Hour Fire-Resistance-Rated Ceiling Assembly

Floor^a/Ceiling - 100% Design Load - 1 Hour Rating - ASTM E 119 / NFPA 251


1. **Floor Topping (optional, not shown):** Gypsum concrete, lightweight or normal concrete topping.
2. **Floor Sheathing:** Minimum 23/32-inch-thick tongue-and-groove wood sheathing (Exposure 1). Installed per code requirements with minimum 8d common nails and glued to joist top flanges with AFG-01 construction adhesive.
3. **Insulation:** Minimum 1-1/2-inch-thick mineral wool batt insulation – 2.5 pcf (nominal), supported by resilient channels.
4. **Structural Members:** Wood I-joists spaced a maximum of 24 inches on center. See ASTM D 5055 for qualification requirements. Additional requirements are as follows:
Minimum I-joist flange depth: 1-1/2 inches Minimum I-joist flange area: 5.25 inches²
Minimum I-joist web thickness: 7/16 inch Minimum I-joist depth: 9-1/4 inches
5. **Resilient Channels:** Minimum 0.019-inch-thick galvanized steel resilient channels, attached perpendicular to I-joists using 1-5/8-inch-long drywall screws. Resilient channels spaced 16 inches on center and doubled at each wallboard end joint extending to the next joist.
6. **Gypsum Wallboard:** Minimum 5/8-inch-thick Type C gypsum wallboard installed with long dimension perpendicular to resilient channels and fastened to each channel with minimum 1-inch-long Type S drywall screws. Fasteners spaced 12 inches on center in the field of the wallboard, 8 inches on center at wallboard end joints, and 3/4 inches from panel edges and ends. End joints of wallboard staggered.
7. **Finish System (not shown):** Face layer joints covered with tape and coated with joint compound. Screw heads covered with joint compound.

Fire Test conducted at Gold Bond Building Products Research Center
Third Party Witness: Warnock Hersey International, Inc.

June 19, 1984
Report No: WHI-694-0159

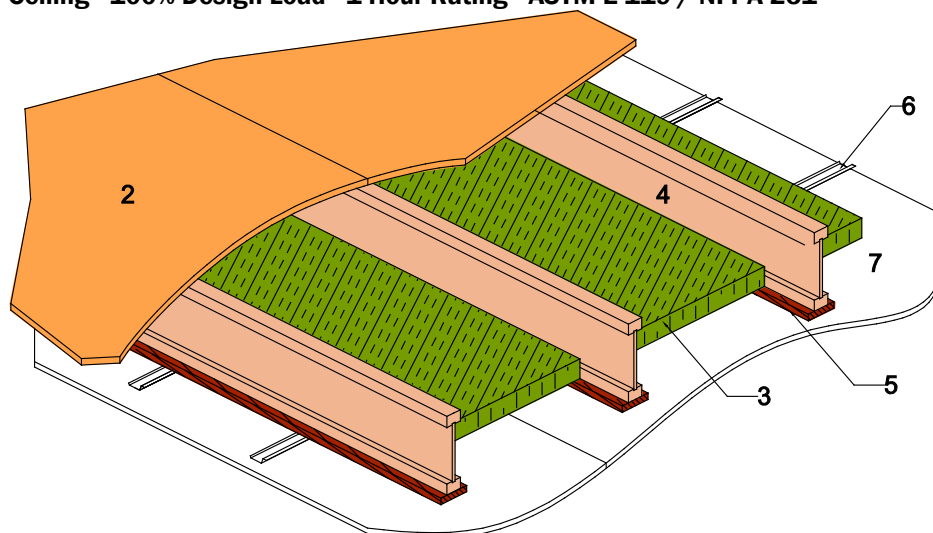
STC and IIC Sound Ratings

Joist/ RC Spacing ^c	Without Gypsum Concrete				With 1" Gypsum Concrete			
	Cushioned Vinyl		Carpet & Pad		Cushioned Vinyl		Carpet & Pad	
	STC	IIC	STC	IIC	STC	IIC	STC	IIC
24"o.c./16"o.c.	48 (51) ^b	42 (43) ^b	48 (51) ^b	61 (63) ^b	63 (65) ^b	50 (52) ^b	63 (65) ^b	65 (67) ^b
16"o.c./16"o.c.	44 (46) ^b	37 (39) ^b	44 (46) ^b	60 (61) ^b	56 (57) ^b	46 (47) ^b	56 (57) ^b	58 (59) ^b

^a This assembly may also be used in a fire-rated roof/ceiling application, but only when constructed exactly as described.

^b STC and IIC values established by engineering analysis using the AWC Technical Report 15 (TR15) model, assuming 1.5"-thick mineral wool batt insulation (values in parentheses assume 3.5"-thick mineral wool batt).

^c STC and IIC values for assemblies with a joist spacing of 16"o.c. may be used for assemblies with joist spacings between 16"o.c. and 24"o.c..

WIJ-1.3 One-Hour Fire-Resistance-Rated Ceiling AssemblyFloor^a/Ceiling - 100% Design Load - 1 Hour Rating - ASTM E 119 / NFPA 251

1. **Floor Topping (optional, not shown):** Gypsum concrete, lightweight or normal concrete topping.
2. **Floor Sheathing:** Minimum 23/32-inch-thick tongue-and-groove wood sheathing (Exposure 1). Installed per code requirements.
3. **Insulation:** Minimum 2-inch-thick mineral wool batt insulation – 3.5 pcf (nominal), supported by setting strip edges, friction-fitted between the sides of the I-joist flanges.
4. **Structural Members:** Wood I-joists spaced a maximum of 24 inches on center. See ASTM D 5055 for qualification requirements. Additional requirements are as follows:

Minimum I-joist flange depth: 1-5/16 inches	Minimum I-joist flange area: 2.25 inches ²
Minimum I-joist web thickness: 3/8 inch	Minimum I-joist depth: 9-1/4 inches
5. **Setting Strips:** Minimum 1x4 (nominal) wood setting strips attached with 1-1/2-inch-long drywall screws at 24 inches on center along the bottom flange of I-joist creating a ledge to support insulation.
6. **Resilient Channels:** Minimum 0.019-inch-thick galvanized steel resilient channels, attached perpendicular to I-joists using 1-7/8-inch-long drywall screws. Resilient channels spaced 16 inches on center and doubled at each wallboard end joint extending to the next joist.
7. **Gypsum Wallboard:** Minimum 5/8-inch-thick Type C gypsum wallboard installed with long dimension perpendicular to resilient channels and fastened to each channel with minimum 1-1/8-inch-long Type S drywall screws. Fasteners spaced 7 inches on center and 3/4 inches from panel edges and ends. End joints of wallboard staggered.
7. **Finish System (not shown):** Face layer joints covered with tape and coated with joint compound. Screw heads covered with joint compound.

Fire Test conducted at National Gypsum Testing Services, Inc.

September 28, 2001

Third Party Witness: Underwriter's Laboratories, Inc.

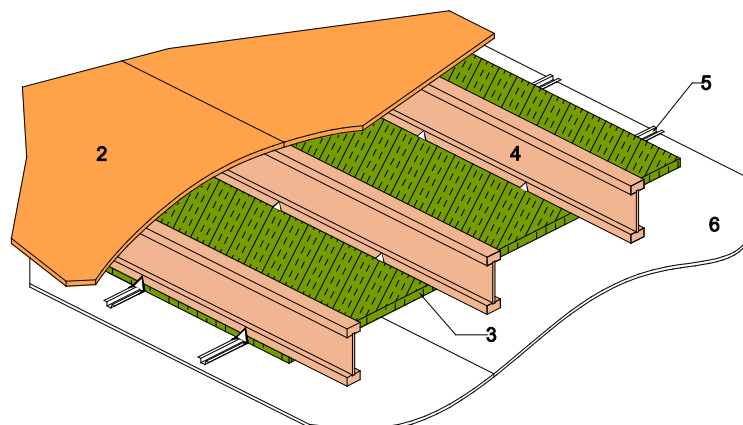
Report No: NC3369

STC and IIC Sound Ratings

Joist/ RC Spacing ^c	Without Gypsum Concrete				With 1" Gypsum Concrete			
	Cushioned Vinyl		Carpet & Pad		Cushioned Vinyl		Carpet & Pad	
	STC	IIC	STC	IIC	STC	IIC	STC	IIC
24"o.c./16"o.c.	50 (51) ^b	43 (43) ^b	52	66	63 (65) ^b	51 (52) ^b	63 (65) ^b	67 (67) ^b
16"o.c./16"o.c.	45 (46) ^b	38 (39) ^b	45 (46) ^b	60 (61) ^b	57 (57) ^b	46 (47) ^b	57 (57) ^b	59 (59) ^b

^a This assembly may also be used in a fire-rated roof/ceiling application, but only when constructed exactly as described.^b STC and IIC values established by engineering analysis using the AWC Technical Report 15 (TR15) model, assuming 2"-thick mineral wool batt insulation (values in parentheses assume 3.5"-thick mineral wool batt) and neglecting the influence (if any) of the setting strips.^c STC and IIC values for assemblies with a joist spacing of 16"o.c. may be used for assemblies with joist spacings between 16"o.c. and 24"o.c..

WIJ-1.4 One-Hour Fire-Resistance-Rated Ceiling Assembly

Floor^a/Ceiling - 100% Design Load - 1 Hour Rating - ASTM E 119 / NFPA 251


1. **Floor Topping (optional, not shown):** Gypsum concrete, lightweight or normal concrete topping.
2. **Floor Sheathing:** Minimum 23/32-inch-thick tongue-and-groove wood sheathing (Exposure 1). Installed per code requirements with minimum 8d common nails.
3. **Insulation:** Minimum 1-inch-thick mineral wool batt insulation – 6 pcf (nominal), with width equal to the on-center spacing of the I-joists. Batts installed on top of furring channels and under bottom flange of I-joists with the sides butted against support clips. Abutted ends of batts centered over furring channels with batts tightly butted at all joints.
4. **Structural Members:** Wood I-joists spaced a maximum of 24 inches on center. See ASTM D 5055 for qualification requirements. Additional requirements are as follows:
 - Minimum I-joist flange depth: 1-1/2 inches
 - Minimum I-joist web thickness: 3/8 inch
 - Minimum I-joist flange area: 3.45 inches²
 - Minimum I-joist depth: 9-1/4 inches
5. **Furring Channels:** Minimum 0.019-inch-thick galvanized steel hat-shaped furring channels, attached perpendicular to I-joists spaced 24 inches on center. At channel splices, adjacent pieces overlapped a minimum of 6 inches and tied with a double strand of No. 18 gage galvanized steel wire at each end of the overlap. Channels secured to I-joists with Simpson Type CSC support clips at each intersection with the I-joists. Clips nailed to the side of I-joist bottom flange with one 1-1/2-inch-long No. 11 gage nail. A row of furring channel located on each side of wallboard end joints and spaced 2.25 inches from the end joint (4.5 inches on center).
6. **Gypsum Wallboard:** Minimum 1/2-inch-thick Type C gypsum wallboard. Wallboard installed with long dimension perpendicular to furring channels and fastened to each channel with minimum 1-inch-long Type S drywall screws. Fasteners spaced 12 inches on center in the field of the wallboard, 6 inches on center at wallboard end joints, and 3/4 inches from panel edges and ends. End joints of wallboard staggered. For staggered wallboard end joints, furring channels extend a minimum of 6 inches beyond each end of the joint.
7. **Finish System (not shown):** Face layer joints covered with tape and coated with joint compound. Screw heads covered with joint compound.

Fire Test conducted at Underwriter's Laboratories, Inc.
Third Party Witness: Underwriter's Laboratories, Inc.

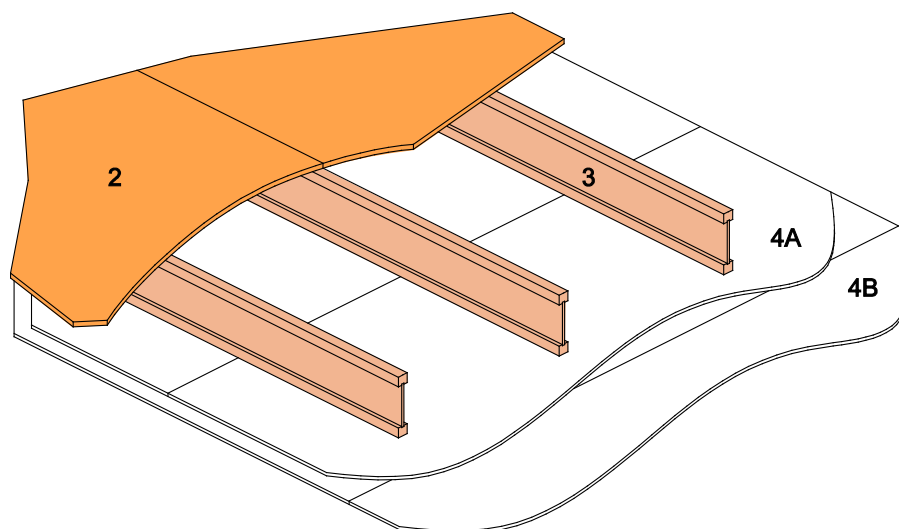
May 11, 1983
Report No: UL R10371-1

STC and IIC Sound Ratings^b

Joist /RC Spacing	Without Gypsum Concrete				With 3/4" Gypsum Concrete			
	Cushioned Vinyl		Carpet & Pad		Cushioned Vinyl		Carpet & Pad	
	STC	IIC	STC	IIC	STC	IIC	STC	IIC
24"o.c./24"o.c.	-	-	46	68	51	47	50	73

^a This assembly may also be used in a fire-rated roof/ceiling application, but only when constructed exactly as described.

^b Tabulated STC and IIC sound ratings are based tests of assemblies having 5/8-inch-thick gypsum wallboard.

WIJ-1.5 One-Hour Fire-Resistance-Rated Ceiling AssemblyFloor^a/Ceiling - 100% Design Load - 1 Hour Rating - ASTM E 119 / NFPA 251

- 1. Floor Topping (optional, not shown):** Gypsum concrete, lightweight or normal concrete topping.
- 2. Floor Sheathing:** Minimum 23/32-inch-thick tongue-and-groove wood sheathing (Exposure 1). Installed per code requirements with minimum 8d common nails.
- 3. Structural Members:** Wood I-joists spaced a maximum of 24 inches on center. See ASTM D 5055 for qualification requirements. Additional requirements are as follows:

Minimum I-joist flange depth: 1-1/2 inches	Minimum I-joist flange area: 2.25 inches ²
Minimum I-joist web thickness: 3/8 inch	Minimum I-joist depth: 9-1/4 inches
- 4. Gypsum Wallboard:** Two layers of minimum 1/2 inch Type C gypsum wallboard attached with the long dimension perpendicular to the I-joists as follows:
 - 4a. Wallboard Base Layer:** Base layer of wallboard attached to bottom flange of I-joists using 1 inch Type S drywall screws at 12 inches on center. End joints of wallboard centered on bottom flange of the I-joist and staggered.
 - 4b. Wallboard Face Layer:** Face layer of wallboard attached to bottom flange of I-joists through base layer using 1-5/8 inch Type S drywall screws spaced 12 inches on center on intermediate joists and 8 inches on center at end joints. Edge joints of wallboard face layer offset 24 inches from those of base layer. End joints centered on bottom flange of I-joists and offset a minimum of 48 inches from those of base layer. Additionally, wallboard face layer attached to base layer with 1-1/2 inch Type G drywall screws spaced 8 inches on center with a 4" stagger, placed 6 inches from face layer end joints.
- 5. Finish System (not shown):** Face layer joints covered with tape and coated with joint compound. Screw heads covered with joint compound.

Fire Test conducted at NGC Testing Services, Inc

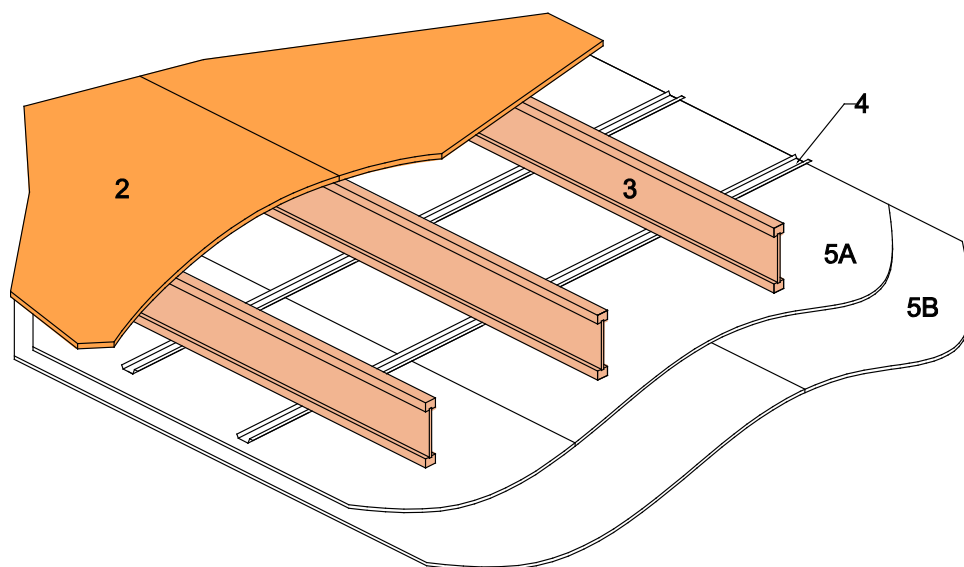
Report No. FC-687 January 25, 2007

STC and IIC Sound Ratings

Joist Spacing	Without Gypsum Concrete				With 3/4" Gypsum Concrete			
	Cushioned Vinyl		Carpet & Pad		Cushioned Vinyl		Carpet & Pad	
	STC	IIC	STC	IIC	STC	IIC	STC	IIC
24"o.c.	-	-	-	-	-	-	49 ^b	55 ^b

^a This assembly may also be used in a fire-rated roof/ceiling application, but only when constructed exactly as described.^b STC and IIC values established by engineering analysis performed by David L. Adams Associates, Inc.

WIJ-1.6 One-Hour Fire-Resistance-Rated Ceiling Assembly

Floor^a/Ceiling - 100% Design Load - 1 Hour Rating - ASTM E 119 / NFPA 251


1. **Floor Topping (optional, not shown):** Gypsum concrete, lightweight or normal concrete topping.
2. **Floor Sheathing:** Minimum 23/32-inch-thick tongue-and-groove wood sheathing (Exposure 1). Installed per code requirements with minimum 8d common nails.
3. **Structural Members:** Wood I-joists spaced a maximum of 24 inches on center. See ASTM D 5055 for qualification requirements. Additional requirements are as follows:

Minimum I-joist flange depth: 1-5/16 inches	Minimum I-joist flange area: 1.95 inches ²
Minimum I-joist web thickness: 3/8 inch	Minimum I-joist depth: 9-1/2 inches
4. **Resilient Channels^b:** Minimum 0.019-inch-thick galvanized steel resilient channel attached perpendicular to the bottom flange of the I-joists with one 1-1/4 inch drywall screw. Channels spaced a maximum of 16 inches on center [24 inches on center when I-joists are spaced a maximum of 16 inches on center].
5. **Gypsum Wallboard:** Two layers of minimum 1/2 inch Type X gypsum wallboard attached with the long dimension perpendicular to the resilient channels as follows:
 - 5a. **Wallboard Base Layer:** Base layer of wallboard attached to resilient channels using 1-1/4 inch Type S drywall screws at 12 inches on center.
 - 5b. **Wallboard Face Layer:** Face layer of wallboard attached to resilient channels through base layer using 1-5/8 inch Type S drywall screws spaced 12 inches on center. Edge joints of wallboard face layer offset 24 inches from those of base layer. Additionally, wallboard face layer attached to base layer with 1-1/2 inch Type G drywall screws spaced 8 inches on center, placed 1-1/2 inches from face layer end joints.
6. **Finish System (not shown):** Face layer joints covered with tape and coated with joint compound. Screw heads covered with joint compound.

Fire Test conducted at National Research Council of Canada Report No. A-4440.1 June 24, 1997

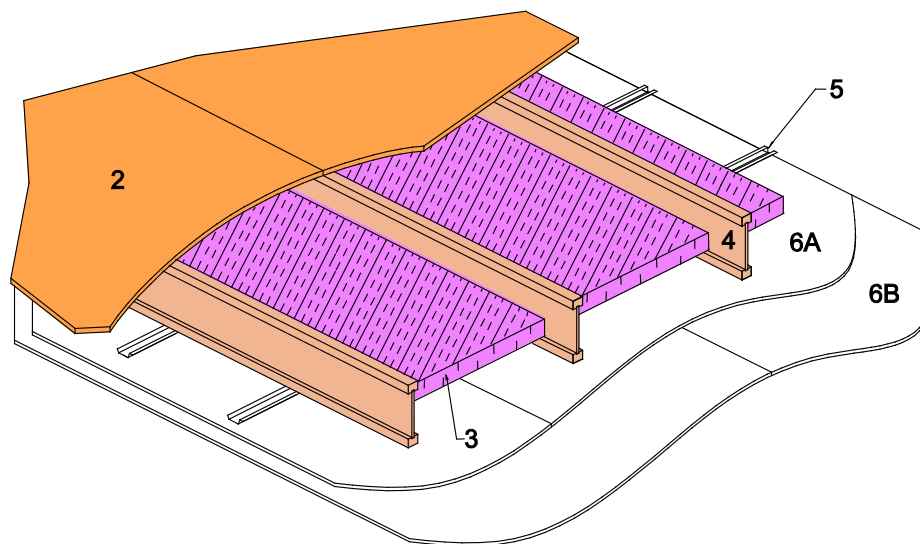
STC and IIC Sound Ratings ^b								
Joist/ RC Spacing ^c	Without Gypsum Concrete				With 1" Gypsum Concrete			
	Cushioned Vinyl		Carpet & Pad		Cushioned Vinyl		Carpet & Pad	
	STC	IIC	STC	IIC	STC	IIC	STC	IIC
24"o.c./16"o.c.	46 ^c	44 ^c	46 ^c	61 ^c	58 ^c	47 ^c	58 ^c	67 ^c
16"o.c./24"o.c.	47 ^c	43 ^c	47 ^c	64 ^c	60 ^c	49 ^c	60 ^c	67 ^c

^a This assembly may also be used in a fire-rated roof/ceiling application, but only when constructed exactly as described.

^b Direct attachment of gypsum wallboard in lieu of attachment to resilient channels is typically deemed acceptable. When gypsum wallboard is directly attached to the I-joists, the wallboard should be installed with long dimension perpendicular to the I-joists and sound ratings for WIJ-1.5 should be used.

^c STC and IIC values established by engineering analysis using the AWC Technical Report 15 (TR15) model.

^c STC and IIC values for assemblies with a joist spacing of 16"o.c. may be used for assemblies with joist spacings between 16"o.c. and 24"o.c..

WIJ-1.7 One-Hour Fire-Resistance-Rated Ceiling AssemblyFloor^a/Ceiling - 100% Design Load - 1 Hour Rating - ASTM E 119 / NFPA 251

- 1. Floor Topping (optional, not shown):** Gypsum concrete, lightweight or normal concrete topping.
- 2. Floor Sheathing:** Minimum 23/32-inch-thick tongue-and-groove wood sheathing (Exposure 1). Installed per code requirements with minimum 8d common nails.
- 3. Insulation:** Fiberglass insulation placed between I-joists supported by the resilient channels.
- 4. Structural Members:** Wood I-joists spaced a maximum of 24 inches on center. See ASTM D 5055 for qualification requirements. Additional requirements are as follows:

Minimum I-joist flange depth: 1-1/2 inches	Minimum I-joist flange area: 2.25 inches ²
Minimum I-joist web thickness: 3/8 inch	Minimum I-joist depth: 9-1/2 inches
- 5. Resilient Channels:** Minimum 0.019-inch-thick galvanized steel resilient channel attached perpendicular to the bottom flange of the I-joists with one 1-1/4 inch drywall screw. Channels spaced a maximum of 16 inches on center [24 inches on center when I-joists are spaced a maximum of 16 inches on center].
- 6. Gypsum Wallboard:** Two layers of minimum 1/2 inch Type X gypsum wallboard attached with the long dimension perpendicular to the resilient channels as follows:
 - 6a. Wallboard Base Layer:** Base layer of wallboard attached to resilient channels using 1-1/4 inch Type S drywall screws at 12 inches on center.
 - 6b. Wallboard Face Layer:** Face layer of wallboard attached to resilient channels through base layer using 1-5/8 inch Type S drywall screws spaced 12 inches on center. Edge joints of wallboard face layer offset 24 inches from those of base layer. Additionally, wallboard face layer attached to base layer with 1-1/2 inch Type G drywall screws spaced 8 inches on center, placed 1-1/2 inches from face layer end joints.
- 7. Finish System (not shown):** Face layer joints covered with tape and coated with joint compound. Screw heads covered with joint compound.

Fire Test conducted at National Research Council of Canada Report No. A-4219.13.2 March 23, 1998

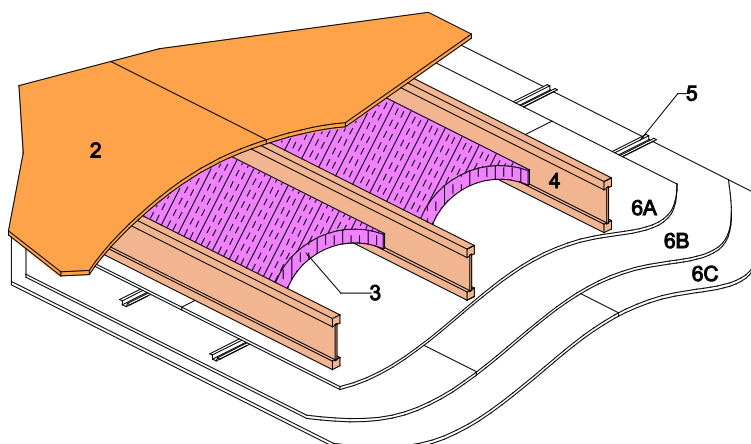
STC and IIC Sound Ratings

Joist/ RC Spacing	Without Gypsum Concrete				With 1" Gypsum Concrete			
	Cushioned Vinyl		Carpet & Pad		Cushioned Vinyl		Carpet & Pad	
	STC	IIC	STC	IIC	STC	IIC	STC	IIC
24"o.c./16"o.c.	56 ^b	51 ^b	56 ^b	69 ^b	64 ^b	53 ^b	64 ^b	71 ^b
16"o.c./24"o.c.	55 ^b	48 ^b	55 ^b	67 ^b	64 ^b	54 ^b	64 ^b	67 ^b

^a This assembly may also be used in a fire-rated roof/ceiling application, but only when constructed exactly as described.^b STC and IIC values established by engineering analysis using the AWC Technical Report 15 (TR15) model, assuming minimum 3.5"-thick fiberglass insulation is used.^c STC and IIC values for assemblies with a joist spacing of 16"o.c. may be used for assemblies with joist spacings between 16"o.c. and 24"o.c.

WIJ-2.1 Two-Hour Fire-Resistance-Rated Ceiling Assembly

Floor^a/Ceiling - 100% Design Load - 2 Hour Rating - ASTM E 119 / NFPA 251



1. **Floor Topping (optional, not shown):** Gypsum concrete, lightweight or normal concrete topping.
2. **Floor Sheathing:** Minimum 23/32-inch-thick tongue-and-groove wood sheathing (Exposure 1). Installed per code requirements.
3. **Insulation:** Minimum 3-1/2-inch-thick unfaced fiberglass insulation fitted between I-joists supported by stay wires spaced 12 inches on center.
4. **Structural Members:** Wood I-joists spaced a maximum of 24 inches on center. See ASTM D 5055 for qualification requirements. Additional requirements are as follows:

Minimum I-joist flange depth: 1-1/2 inches	Minimum I-joist flange area: 2.25 inches ²
Minimum I-joist web thickness: 3/8 inch	Minimum I-joist depth: 9-1/4 inches
5. **Furring Channels:** Minimum 0.0179-inch-thick galvanized steel hat-shaped furring channels, attached perpendicular to I-joists using 1⁵/₈-inch-long drywall screws. Furring channels spaced 16 inches on center (furring channels used to support the second and third layers of gypsum wallboard). Based on ASTM E2032, minimum 0.019-inch-thick galvanized steel resilient channels may be used in lieu of hat-shaped furring channels if installed at the same spacing and attached in the same manner. In order to achieve the sound ratings given below, resilient channels must be used in lieu of hat-shaped furring channels.
6. **Gypsum Wallboard:** Three layers of minimum 5/8 inch Type C gypsum wallboard as follows:
 - 6a. **Wallboard Base Layer:** Base layer of wallboard attached to bottom flange of I-joists using 1-5/8 inch Type S drywall screws at 12 inches on center with the long dimension of wallboard perpendicular to I-joist. End joints of wallboard centered on bottom flange of the I-joist and staggered from end joints in adjacent sheets.
 - 6b. **Wallboard Middle Layer:** Middle layer of wallboard attached to furring channels using 1 inch Type S drywall screws spaced 12 inches on center with the long dimension of wallboard perpendicular to furring channels. End joints staggered from end joints in adjacent sheets.
 - 6c. **Wallboard Face Layer:** Face layer of wallboard attached to furring channels through middle layer using 1-5/8 inch Type S drywall screws spaced 8 inches on center. Edge joints of face layer of wallboard offset 24 inches from those of middle layer. End joints of face layer of wallboard staggered with respect to the middle layer.
7. **Finish System (not shown):** Face layer joints covered with tape and coated with joint compound. Screw heads covered with joint compound.

Fire Test conducted at Gold Bond Building Products Research Center

December 16, 1992

Third Party Witness: PFS Corporation

Report No: #92-56

STC and IIC Sound Ratings (with Resilient Channels)								
Joist /RC Spacing	Without Gypsum Concrete				With 1" Gypsum Concrete			
	Cushioned Vinyl		Carpet & Pad		Cushioned Vinyl		Carpet & Pad	
	STC	IIC	STC	IIC	STC	IIC	STC	IIC
24"o.c./16"o.c.	-	-	49 ^b	54 ^b	58	45	58	64

^a This assembly may also be used in a fire-rated roof/ceiling application, but only when constructed exactly as described.

^b STC and IIC values established by engineering analysis performed by David L. Adams Associates, Inc.