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.

Depending on the application, wall assemblies may need to be rated either from one side or both sides. For specific exterior wall applications, the 2000 International Building Code (IBC), the 1999 National Building Code (NBC), and the 1999 Standard Building Code (SBC) allow wood-frame, wood-sided walls to be tested for exposure to fire from the inside only. Rating for both interior and exterior exposure is only required when the wall has a fire separation distance of less than 5 feet. 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-rated wood-frame assemblies can be found in a number of sources including the IBC, Underwriters Laboratories (UL) *Fire Resistance Directory*, Intertek Testing Services' *Directory of Listed Products*, and the Gypsum Association's *Fire Resistance Design Manual*. The American Forest & Paper Association (AF&PA) and its members have tested a number of wood-frame fire-rated assemblies. Descriptions of these successfully tested assemblies are provided in *Table 1* for one-hour rated wall assemblies, *Table 2* for two-hour rated wall assemblies, *Table 3* for one-hour rated floor/ceiling assemblies, and *Table 4* for two-hour rated floor/ceiling assemblies. Additional tests are being conducted and the Tables will be updated periodically.

Conclusions
Wood-frame assemblies are used in architectural designs because of their adaptability to style preferences, ease and economies of construction, and energy-saving performance. The assemblies described in this webpage are intended to assist the designer in meeting specified fire endurance requirements.
### Table 1: One-Hour Fire-Rated Loadbearing Wood-Frame Wall Assemblies

#### Assemblies Rated From Both Sides

<table>
<thead>
<tr>
<th>Studs</th>
<th>Insulation</th>
<th>Sheathing on Both Sides</th>
<th>Fasteners</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>2x4 @ 16&quot; o.c.</td>
<td>3½&quot; mineral fiber batts</td>
<td>5/8&quot; Type X Gypsum Wallboard (H)</td>
<td>2¼&quot; #6 Type S drywall screws @ 12&quot; o.c.</td>
<td>WS4-1.1</td>
</tr>
<tr>
<td>2x6 @ 16&quot; o.c.</td>
<td>(none)</td>
<td>5/8&quot; Type X Gypsum Wallboard (H)</td>
<td>2¼&quot; #6 Type S drywall screws @ 7&quot; o.c.</td>
<td>WS6-1.1</td>
</tr>
<tr>
<td>2x6 @ 16&quot; o.c.</td>
<td>5½&quot; mineral fiber batts</td>
<td>5/8&quot; Type X Gypsum Wallboard (H)</td>
<td>2¼&quot; #6 Type S drywall screws @ 12&quot; o.c.</td>
<td>WS6-1.2</td>
</tr>
<tr>
<td>2x6 @ 16&quot; o.c.</td>
<td>R-19 fiberglass insulation</td>
<td>5/8&quot; Type X Gypsum Wallboard (V)</td>
<td>2¼&quot; #6 Type S drywall screws @ 12&quot; o.c.</td>
<td>WS6-1.4</td>
</tr>
</tbody>
</table>

#### Assemblies Rated From One Side (Fire on Interior Only)

<table>
<thead>
<tr>
<th>Studs</th>
<th>Insulation</th>
<th>Sheathing</th>
<th>Fasteners</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>2x4 @ 16&quot; o.c.</td>
<td>3½&quot; mineral fiber batts</td>
<td>I 5/8&quot; Type X Gypsum Wallboard (H)</td>
<td>2¼&quot; #6 Type S drywall screws @ 12&quot; o.c.</td>
<td>W4-1.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E 3/8&quot; wood structural panels (V)</td>
<td>6d common nails @ 6&quot; edges/12&quot; field</td>
<td></td>
</tr>
<tr>
<td>2x4 @ 16&quot; o.c.</td>
<td>4 mil polyethylene 3½&quot; mineral fiber batts</td>
<td>I 5/8&quot; Type X Gypsum Wallboard (V)</td>
<td>6d cement coated box nails @ 7&quot; o.c.</td>
<td>W4-1.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E ½&quot; fiberboard (V)</td>
<td>1½&quot; roofing nails @ 3&quot; edges/6&quot; field</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3/8&quot; hardboard shiplapped panel siding</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>8d galv. nails @ 4&quot; edges/8&quot; field</td>
<td></td>
</tr>
<tr>
<td>2x6 @ 16&quot; o.c.</td>
<td>5½&quot; mineral fiber batts</td>
<td>I 5/8&quot; Type X Gypsum Wallboard (H)</td>
<td>2¼&quot; #6 Type S drywall screws @ 12&quot; o.c.</td>
<td>W6-1.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E 7/16&quot; wood structural panels (V)</td>
<td>6d common nails @ 6&quot; edges/12&quot; field</td>
<td></td>
</tr>
<tr>
<td>2x6 @ 16&quot; o.c.</td>
<td>R-19 fiberglass insulation</td>
<td>I 5/8&quot; Type X Gypsum Wallboard (V)</td>
<td>2¼&quot; #6 Type S drywall screws @ 12&quot; o.c.</td>
<td>W6-1.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E 3/8&quot; wood structural panels (V)</td>
<td>6d common nails @ 6&quot; edges/12&quot; field</td>
<td></td>
</tr>
</tbody>
</table>

- **H**: applied horizontally with vertical joints over studs
- **I**: Interior sheathing
- **V**: applied vertically with vertical joints over studs
- **E**: Exterior sheathing

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

#### Assemblies Rated From Both Sides

<table>
<thead>
<tr>
<th>Studs</th>
<th>Insulation</th>
<th>Sheathing on Both Sides</th>
<th>Fasteners</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>2x6 @ 24&quot; o.c.</td>
<td>5½&quot; mineral fiber batts</td>
<td>5/8&quot; Type X Gypsum Wallboard (H)</td>
<td>2¼&quot; #6 Type S drywall screws @ 24&quot; o.c.</td>
<td>W6-2.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B 5/8&quot; Type X Gypsum Wallboard (H)</td>
<td>2¼&quot; #6 Type S drywall screws @ 8&quot; o.c.</td>
<td></td>
</tr>
</tbody>
</table>

- **H**: applied horizontally with vertical joints over studs
- **B**: Base layer sheathing
- **F**: Face layer sheathing
### Table 3: One-Hour Fire-Rated Wood Floor/Ceiling Assemblies

<table>
<thead>
<tr>
<th>Joists</th>
<th>Insulation</th>
<th>Furring</th>
<th>Ceiling Sheathing</th>
<th>Fasteners</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-joists @ 24&quot; o.c.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. flange thickness: 1-1/2&quot;</td>
<td>1-1/2&quot; mineral fiber batts (2.5 pcf - nominal)</td>
<td></td>
<td>Hat-shaped channels</td>
<td>1-1/8&quot; Type S drywall screws @ 12&quot; o.c.</td>
<td>WIJ-1.1</td>
</tr>
<tr>
<td>Min. flange area: 5.25 sq. in.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. web thickness: 3/8&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. I-joist depth: 9-1/4&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-joists @ 24&quot; o.c.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. flange thickness: 1-1/2&quot;</td>
<td>1-1/2&quot; mineral fiber batts (2.5 pcf - nominal)</td>
<td></td>
<td>Resilient channels</td>
<td>1&quot; Type S drywall screws @ 8&quot; o.c.</td>
<td>WIJ-1.2</td>
</tr>
<tr>
<td>Min. flange area: 5.25 sq. in.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. web thickness: 7/16&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. I-joist depth: 9-1/4&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-joists @ 24&quot; o.c.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. flange thickness: 1-5/16&quot;</td>
<td>2&quot; mineral fiber batts (3.5 pcf - nominal)</td>
<td></td>
<td>Resilient channels</td>
<td>1-1/8&quot; Type S drywall screws @ 8&quot; o.c.</td>
<td>WIJ-1.3</td>
</tr>
<tr>
<td>Min. flange area: 2.25 sq. in.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. web thickness: 3/8&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. I-joist depth: 9-1/4&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-joists @ 24&quot; o.c.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. flange thickness: 1-1/2&quot;</td>
<td>1&quot; mineral fiber batts (6 pcf - nominal)</td>
<td></td>
<td>Hat-shaped channels supported by CSC clips</td>
<td>1&quot; Type S drywall screws @ 12&quot; o.c.</td>
<td>WIJ-1.4</td>
</tr>
<tr>
<td>Min. flange area: 3.45 sq. in.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. web thickness: 3/8&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. I-joist depth: 9-1/4&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-joists @ 24&quot; o.c.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. flange thickness: 1-1/2&quot;</td>
<td>(none)</td>
<td></td>
<td></td>
<td>B 1/2&quot; Type X Gypsum Wallboard</td>
<td>WIJ-1.5</td>
</tr>
<tr>
<td>Min. flange area: 2.25 sq. in.</td>
<td></td>
<td></td>
<td></td>
<td>F 1/2&quot; Type X Gypsum Wallboard</td>
<td></td>
</tr>
<tr>
<td>Min. web thickness: 3/8&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. I-joist depth: 9-1/4&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-joists @ 24&quot; o.c.</td>
<td></td>
<td>(optional)</td>
<td></td>
<td>B 1/2&quot; Type X Gypsum Wallboard</td>
<td>WIJ-1.6</td>
</tr>
<tr>
<td>Min. flange thickness: 1-5/16&quot;</td>
<td></td>
<td></td>
<td></td>
<td>F 1/2&quot; Type X Gypsum Wallboard</td>
<td></td>
</tr>
<tr>
<td>Min. flange area: 1.95 sq. in.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. web thickness: 3/8&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. I-joist depth: 9-1/2&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B- Base layer sheathing  
F- Face layer sheathing

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

<table>
<thead>
<tr>
<th>Joists</th>
<th>Insulation</th>
<th>Furring</th>
<th>Ceiling Sheathing</th>
<th>Fasteners</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-joists @ 24&quot; o.c.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. flange thickness: 1-1/2&quot;</td>
<td>3-1/2&quot; fiberglass insulation</td>
<td></td>
<td>Hat-shaped channels</td>
<td>1-5/8&quot; Type S drywall screws @ 12&quot; o.c.</td>
<td>WIJ-2.1</td>
</tr>
<tr>
<td>Min. flange area: 2.25 sq. in.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. web thickness: 3/8&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. I-joist depth: 9-1/4&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-joists @ 24&quot; o.c.</td>
<td></td>
<td>(none)</td>
<td></td>
<td>B 5/8&quot; Type C Gypsum Wallboard</td>
<td>WIJ-2.2</td>
</tr>
<tr>
<td>Min. flange thickness: 1-1/2&quot;</td>
<td></td>
<td></td>
<td></td>
<td>F 5/8&quot; Type C Gypsum Wallboard</td>
<td></td>
</tr>
<tr>
<td>Min. flange area: 2.25 sq. in.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. web thickness: 3/8&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. I-joist depth: 9-1/4&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B- Base layer sheathing (direct attached)  
M- Middle layer sheathing  
F- Face layer sheathing

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While every effort has been made to insure the accuracy of the information presented, the American Forest & Paper Association and its members do not assume responsibility for a particular design prepared from this publication.

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WS4-1.1 One-Hour Fire-Resistive Wood 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, unblocked. Horizontal application of wallboard represents the direction of least fire resistance as opposed to vertical application.
3. Insulation - 3-1/2 in. thick mineral wool insulation (2.5 pcf, nominal)
4. Fasteners - 2-1/4 in. 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 9, 2000

Third Party Witness: Intertek Testing Services
Report J20-06170.1

This assembly was tested at 100% design load, calculated in accordance with the 1997 National Design Specification® for Wood Construction. The authority having jurisdiction should be consulted to assure acceptance of this report.
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, unblocked. Horizontal application of wallboard represents the direction of least fire resistance as opposed to vertical application.
3. Exterior Sheathing - 3/8 in. wood structural panels (oriented strand board), applied vertically, horizontal joints blocked
4. Gypsum Fasteners - 2-1/4 in. 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 in. 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 1997 National Design Specification® for Wood Construction. The authority having jurisdiction should be consulted to assure acceptance of this report.
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 - 1/2 in. fiberboard sheathing. Alternate construction - minimum 1/2 in. lumber siding or 1/2 in. wood based sheathing.
5. Vapor Barrier - 4-mil polyethylene sheeting
6. Insulation - 3-1/2 in. 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

Report WHI-690-003

This assembly was tested at 78% design load using an \( l_e / d \) of 33, calculated in accordance with the 1997 National Design Specification® for Wood Construction. The authority having jurisdiction should be consulted to assure acceptance of this report.
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, unblocked. Horizontal application of wallboard represents the direction of least fire resistance as opposed to vertical application.
3. Fasteners - 2-1/4 in. 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 1997 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-Resistive Wood 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, unblocked. Horizontal application of wallboard represents the direction of least fire resistance as opposed to vertical application.
3. Insulation - 5-1/2 in. thick mineral wool insulation (2.5 pcf, nominal)
4. Fasteners - 2-1/4 in. 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 1997 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-Resistive Wood 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. Interior Sheathing - 5/8 in. Type X gypsum wallboard, 4 ft. wide, applied horizontally, unblocked. Horizontal application of wallboard represents the direction of least fire resistance as opposed to vertical application.
3. Exterior Sheathing - 7/16 in. wood structural panels (oriented strand board), applied vertically, horizontal joints blocked
4. Gypsum Fasteners - 2-1/4 in. 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 in. 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 1997 National Design Specification® for Wood Construction. The authority having jurisdiction should be consulted to assure acceptance of this report.
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. 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 1997 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-Resistive Wood 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. 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 - 3/8 in. wood structural panels (oriented strand board), applied vertically, horizontal joints blocked
4. Gypsum Fasteners - 2-1/4 in. 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 2001 National Design Specification® for Wood Construction. The authority having jurisdiction should be consulted to assure acceptance of this report.
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, unblocked.
   - Face Layer - 5/8 in. Type X gypsum wallboard, 4 ft. wide, applied horizontally, unblocked.
   Horizontal application of wallboard represents the direction of least fire resistance as opposed to vertical application.
3. Insulation - 5-1/2 in. thick mineral wool insulation (2.5 pcf, nominal)
5. Gypsum Fasteners: Face Layer - 2-1/4 in. 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 1997 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-Resistive 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 insulation batts – 2.5 pcf (nominal), supported by furring channels.
   - Minimum I-joist flange depth: 1-1/2 inches
   - Minimum I-joist flange area: 5.25 inches
   - 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 1-5/8 inch long drywall screws. Furring 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 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.

Fire Test conducted at Gold Bond Building Products Research Center
February 9, 1990
Report No: WHI-651-0311.1

<table>
<thead>
<tr>
<th>STC and IIC Sound Ratings for Listed Assembly</th>
<th>Without Gypsum Concrete</th>
<th>With Gypsum Concrete</th>
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<tbody>
<tr>
<td>Cushioned Vinyl STC</td>
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<td>Cushioned Vinyl IIC</td>
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<td>Carpet &amp; Pad STC</td>
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<td>Carpet &amp; Pad IIC</td>
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<td>59 b</td>
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</table>

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 estimated by David L. Adams Associates, Inc
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 insulation butts – 2.5 pcf (nominal), supported by resilient channels.

4. **Structural Members:** Wood I-joists spaced a maximum of 24 inches on center.
   - 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.

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**Fire Test conducted at Gold Bond Building Products Research Center**


**Report No:** WHI-694-0159

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**STC and IIC Sound Ratings for Listed Assembly**

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<td><strong>Cushioned Vinyl</strong></td>
<td><strong>Carpet &amp; Pad</strong></td>
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<td>46ᵇ</td>
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ᵇ 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 estimated by David L. Adams Associates, Inc
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 insulation batts – 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.
   - Minimum I-joist flange depth: 1-5/16 inches
   - Minimum I-joist flange area: 2.25 inches
   - Minimum I-joist depth: 9-1/4 inches

5. **Setting Strips:** Nominal 1x4 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.

8. **Finish System (not shown):** Face layer joints covered with tape and coated with joint compound. Screw heads covered with joint compound.

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**Fire Test conducted at National Gypsum Testing Services, Inc.**

Third Party Witness: Underwriter’s Laboratories, Inc.

Report No: NC3369

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<td>Cushioned Vinyl</td>
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*This assembly may also be used in a fire-rated roof/ceiling application, but only when constructed exactly as described.

STC and IIC values estimated by David L. Adams Associates, Inc
WIJ-1.4 One-Hour Fire-Resistive Ceiling Assembly
Floora/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 insulation batts - 6 pcf (nominal) with width equal to the on-center spacing of the I-joists. Batt 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.
   - Minimum I-joist flange depth: 1-1/2 inches
   - Minimum I-joist flange area: 3.45 inches
   - 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 shall be 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 continuous or 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.

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**STC and IIC Sound Ratings for Listed Assembly**

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<th>Without Gypsum Concrete</th>
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*This assembly may also be used in a fire-rated roof/ceiling application, but only when constructed exactly as described.*
WIJ-1.5 One-Hour Fire-Resistive Ceiling Assembly
Floor/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.
   - Minimum I-joist flange depth: 1-1/2 inches
   - Minimum I-joist web thickness: 3/8 inch
   - Minimum I-joist flange area: 2.25 inches
   - Minimum I-joist depth: 9-1/4 inches
4. **Gypsum Wallboard:** Two layers of minimum 1/2 inch Type X 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 1-5/8 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 2 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 one joist spacing 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 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.

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**STC and IIC Sound Ratings for Listed Assembly**

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September 29, 1978
Report No: FC-268
July 28, 1986

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

*STC and IIC values estimated by David L. Adams Associates, Inc*
WIJ-1.6 One-Hour Fire-Resistive Ceiling Assembly
Floor\textsuperscript{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 (optional, not shown):** Insulation fitted between I-joists supported by the resilient channels.
4. **Structural Members:** Wood I-joists spaced a maximum of 24 inches on center.
   - Minimum I-joist flange depth: 1-5/16 inches
   - Minimum I-joist flange area: 1.95 inches\textsuperscript{2}
   - Minimum I-joist web thickness: 3/8 inch
   - Minimum I-joist depth: 9-1/2 inches
5. **Resilient Channels\textsuperscript{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].
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 6 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

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<thead>
<tr>
<th>STC and IIC Sound Ratings for Listed Assembly</th>
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<tr>
<td>Without Insulation</td>
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\textsuperscript{a} This assembly may also be used in a fire-rated roof/ceiling application, but only when constructed exactly as described.

\textsuperscript{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 insulation should not be supported by the wallboard.

\textsuperscript{c} STC and IIC values estimated by David L. Adams Associates, Inc
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.
   - Minimum I-joist flange depth: 1-1/2 inches
   - Minimum I-joist flange area: 2.25 inches
   - 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 1-5/8 inch long drywall screws. Furring channels spaced 16 inches on center (furring channels used to support the second and third layers of gypsum wallboard).

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.

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**STC and IIC Sound Ratings for Listed Assembly**

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<tr>
<td><strong>With Carpet &amp; Pad</strong></td>
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*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 estimated by David L. Adams Associates, Inc