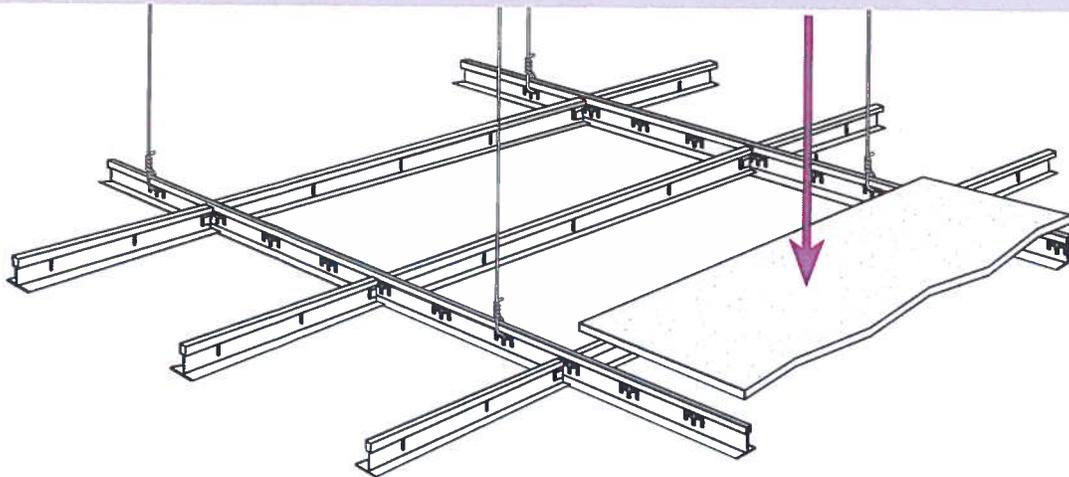


SUSPENDED CEILINGS  
401

Suspension Systems for Acoustical Lay-in Ceilings  
Seismic Design Categories D, E & F

This document has been revised based on current Building Code standards. In all buildings, other than structures classified as essential facilities, **suspended ceilings installed in accordance with the prescriptive provisions of the 401 document are deemed to comply with the current building code interpretation.**

This document provides the IBC-2012 referenced standards for the installation of suspension systems for acoustical lay-in ceilings. Incorporation of this document will provide a more uniform standard for installation and inspection. This document is designed to accomplish the intent of the International Building Code (IBC) with regard to the requirements for seismic design category D, E and F for suspended ceilings and related items. Unless supported by engineering, the suspension system shall be installed per these requirements and those of the referenced documents. Manufacturers' recommendations should be followed where applicable.



### General Recommendations

- Referenced sources per hierarchy: 2012 International Building Code (IBC), American Society of Civil Engineers (ASCE 7-10), American Society of Testing Materials (ASTM C 635, ASTM C 636, ASTM E 580/E 580M), and Ceilings and Interior Systems Construction Association (CISCA).
- Partitions that are tied to the ceiling and all partitions greater than 6 feet in height shall be laterally braced to the structure. Bracing shall be independent of the ceiling splay bracing system. *Source: ASCE 7-10 Section 13.5.8.1*
- For further information on bracing of non-load bearing partitions refer to NWCB Technical Document #200-501.
- All main beams are to be Heavy Duty (HD). *Source: ASTM E580 Section 5.1.1*
- Ceilings less than or equal to 144 ft<sup>2</sup> and surrounded by walls connected to the structure above are exempt from the seismic design requirements. *Source: ASTM E580 Section 1.4*
- These recommendations are intended for suspended ceilings and related components in areas that require resistance to the effects of earthquake motions. *Source: ASTM E580 Section 3.2*
- All wire ties are to be three tight turns around itself within three inches. Twelve gage Hanger wire spaced 4 foot on center (figure 1). *Source: ASTM C636 Section 2.3.4*
- Changes in ceiling planes will require positive bracing. *Source: ASTM E580 Section 5.2.8.6*

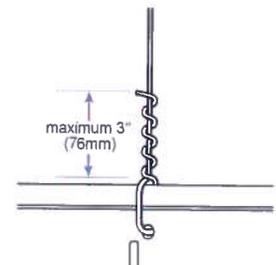


figure 1

figure 2  
Lateral force Bracing

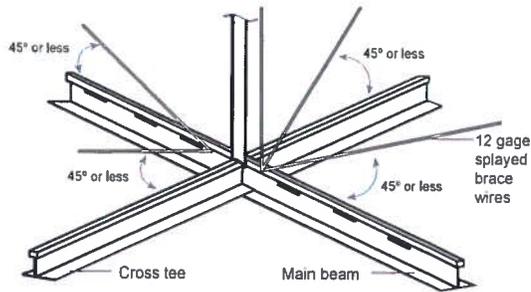


figure 3  
Maximum Recommended Lengths for Vertical Struts

| EMT CONDUIT                           |              |
|---------------------------------------|--------------|
| ½" EMT conduit                        | up to 5' 10" |
| ¾" EMT conduit                        | up to 7' 8"  |
| 1" EMT conduit                        | up to 9' 9"  |
| METAL STUDS                           |              |
| Single 1½" metal stud (20 gage)       | up to 12' 0" |
| Back-to-back 1½" metal stud (20 gage) | up to 15' 0" |
| Single 2½" metal stud (20 gage)       | up to 13' 6" |
| Back-to-back 2½" metal stud (25 gage) | up to 15' 0" |

Source: Portland Building Department

Note: Plenum areas greater than 15' 0" will require engineering calculations.

figure 4a  
Attached Wall Molding Requirements

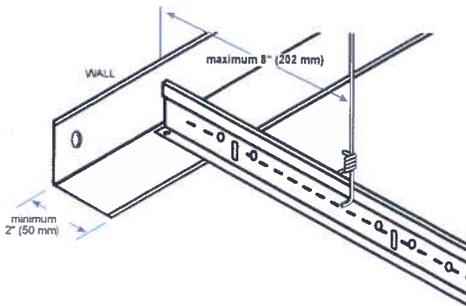
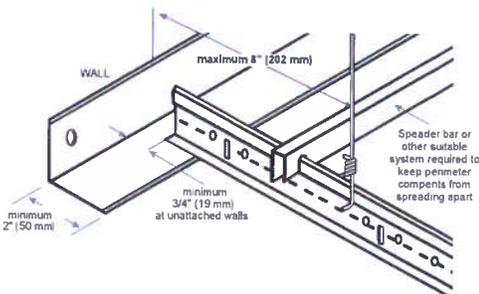


figure 4b  
Unattached Wall Molding Requirements



## Lateral Force Bracing (figures 2 and 3)

- Ceilings constructed of screw-or-nail-attached gypsum board on one level that are surrounded by and connected to walls or soffits that are laterally braced to the structure above are exempt from seismic design requirements. *Source: ASCE 7-10 Section 13.5.6.2.2 Exception 2, ASTM E580 Section 1.7*
- Ceiling areas of 1000 ft<sup>2</sup> or less shall be exempt from lateral force bracing requirements. *Source: ASTM E580 Section 1.6*
- Lateral force bracing is the use of vertical struts (compression posts) and splay wires (see figure 2).
- Lateral Force Bracing shall be 12 feet on center (maximum) and begin no farther than 6 feet from walls. *Source: ASTM E580 Section 5.2.8.2*
- Seismic splay wires are to be four 12 gage wires attached to the main beam. Wires are arrayed 90° from each other and at an angle not exceeding 45° from the plane of the ceiling. *Source: ASTM E580 Section 5.2.8.2*
- Seismic splay wires shall be attached to the grid and to the structure in such a manner that they can support a design load of not less than 200 pounds or the actual design load, with a safety factor of 2, whichever is greater (figure 6b). *Source: CISCA zones 3-4*
- Power Actuated Fasteners (PAF's), when used for seismic application as part of the prescriptive path in Seismic Design Categories D, E and F, shall have an ICC-ES approval for seismic applications and shall require "special inspection" irrespective of the type of occupancy category the structure is in. PAF anchors for kicker wires (splayed wires installed for purposes other than seismic restraint) are exempt from this requirement. *Source: State of Oregon, Building Codes Division*
- Splay wires are to be within 2 inches of the connection of the vertical strut to suspended ceiling. *Source: ASTM E580 Section 5.2.8.2*
- Rigid bracing may be used in lieu of splay wires. *Source: ASTM E580 Section 5.2.8.4*
- Ceilings with plenums less than 12 inches to structure are not required to have lateral force bracing. *Source: Portland Building Department*
- Vertical struts must be positively attached to the suspension systems and the structure above. *Source: ASTM E580 Section 5.2.8.2*
- The vertical strut may be EMT conduit, metal studs or a proprietary compression post (see figure 3).

## Wall Moldings (figures 4a and 4b)

- Wall moldings (perimeter closure angles) are required to have a horizontal flange 2 inches wide. One end of the ceiling grid shall be attached to the wall molding, the other end shall have a ¾ inch clearance from the wall and free to slide. *Source: ASTM E580 Section 5.2.2, Section 5.2.3*
- Where substantiating documentation has been provided to the local jurisdiction, perimeter clips may be used to satisfy the requirements for the 2-inch closure angle. *Source: State of Oregon, Building Codes Division*
- The grid shall be attached at two adjacent walls (pop rivets or approved method). Soffits extending to a point at least level with the bottom plane of the grid and independently supported and laterally braced to the structure above are deemed to be

figure 5a

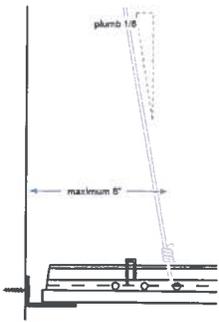


figure 5b • Countersloping

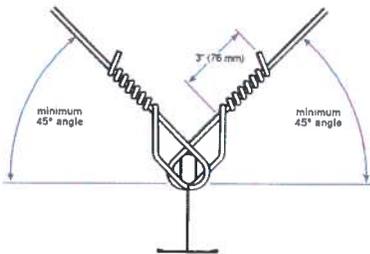


figure 6a

Vertical hanger wire attachment

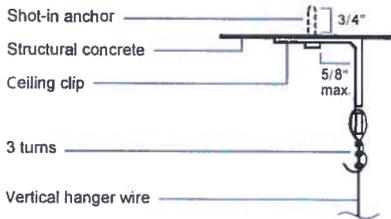
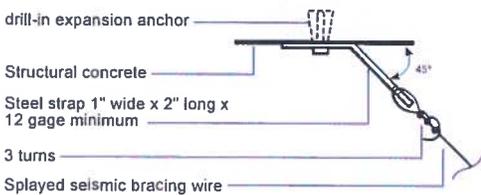


figure 6b

Splayed seismic bracing wire attachment



equivalent to walls. *Source: State of Oregon, Building Codes Division, ASTM E580 Section 5.2.3, Section 5.2.9.1*

### Spreader Bars (figure 4b)

- Terminal ends of main runners and cross members shall be tied together or have some other approved means to prevent their spreading. Stabilizer bars, cross tees or other means to prevent spreading shall occur within 8 in. of each wall. *Source: ASTM E580 Section 5.2.4*
- Spreader bars are not required at perimeters where runners are attached directly to closure angles.
- Spreader bars are not required if a 90 degree intersecting cross or main is within 8 inches of the perimeter wall.
- Where substantiating documentation has been provided to the local jurisdiction, perimeter clips may be used to satisfy the requirements for spreader bars. *Source: State of Oregon, Building Codes Division*

### Hanger (Suspension) Wires (figures 5a and 5b)

- Hanger and perimeter wires must be plumb within 1 in 6 unless (figure 5a) counter sloping wires are provided (figure 5b). *Source: ASTM C636 Section 2.1.4*
- Hanger wires shall be 12 gage and spaced 4 feet on center or 10 gage spaced 5 feet on center. *Source: ASTM C636 Section 2.1*
- Any connection device at the supporting construction shall be capable of carrying not less than 100 pounds. *Source: Cisca zones 3-4*
- Powder Actuated Fasteners (PAFs) are an approved method of attachment for hanger wires. *Source: State of Oregon, Building Codes Division*
- Terminal ends of each main beam and cross tee must be supported within 8 inches of each wall with a perimeter wire (see figure 4 & 5 a). *Source: ASTM E580 Section 5.2.6*
- Wires shall not attach to or bend around interfering material or equipment. A trapeze or equivalent device shall be used where obstructions preclude direct suspension. Trapeze suspensions shall be sized to resist the dead load and lateral forces appropriate for the seismic category. *Source: ASTM E580 Section 5.2.7.4*

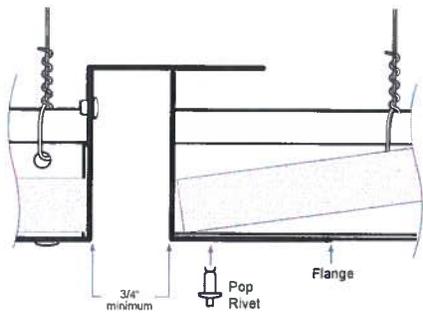
### Electrical fixtures

- Light fixtures weighing less than 10 pounds shall have one 12 gage hanger wire connected from the fixture to the structure above. This wire may be slack. *Source: ASTM E580 Section 5.3.4*
- Light fixtures weighing more than 10 pounds and less than 56 lbs. shall have two 12 gage wires attached at opposing corners of the light fixture to the structure above. These wires may be slack. *Source: ASTM E580 Section 5.3.5*
- Light Fixtures weighing more than 56 lbs. shall be supported directly from the structure above by approved hangers. *Source: ASTM E580 Section 5.3.6*
- Pendant mounted fixtures shall be directly supported from the structure above using a 9 gage wire or an approved alternate support without using the ceiling suspension system for direct support. *Source: ASTM E580 Section 5.3.7*
- Tandem fixtures may utilize common wires.

### Mechanical Services

- Terminals or services weighing less than 20 lbs. shall be positively attached to the ceiling suspension main runners or to cross runners that have the same carrying capacity as the main runners. *Source: ASTM E580 Section 5.4.1*

figure 7



- Terminals or services weighing 20 lbs. but not more than 56 lbs. shall have, in addition to 5.4.1, two 12 gage wires connecting them to the ceiling system hangers or the structure above. These wires may be slack. *Source: ASTM E580 Section 5.4.2*
- Terminals or services weighing more than 56 lbs. shall be supported directly from the structure above by approved hangers. *Source: ASTM E580 Section 5.4.3*

### Seismic Separation Joints (figure 7)

- For ceiling areas exceeding 2,500 square feet, a seismic separation joint or full height wall partition that breaks the ceiling shall be provided unless analyses are performed of the ceilings bracing system, closure angles and penetrations to provide sufficient clearance. *Source: ASCE 7-10 Section 13.5.6.2.2 b*

- The layout and location of the seismic separation joint shall be per the designer of record and noted on the plans. If a seismic separation joint is required by the designer, the designer may use the generic joint detailed in this document or a proprietary joint. The amount of free movement (gap design) shall be a minimum of 3/4 inch. *Source: State of Oregon. Building Codes Division*
- In lieu of seismic separation joints, the ceiling may be divided into areas less than 2500 square feet by the use of partitions or soffits as follows: partitions shall extend a minimum of 6 inches above the level of the plane of the grid and shall be independently braced to the structure above. Soffits shall extend to a point at least level with the bottom plane of the grid and shall be independently supported and laterally braced to the structure above. *Source: State of Oregon Building Codes Division, ASTM E580 Section 5.2.9.1*

### Sprinklers

- For ceilings without rigid bracing, sprinkler head penetrations shall have a 2 inch oversize ring, sleeve or adapter through the ceiling tile to allow free movement of at least 1 inch in all horizontal directions. Flexible head design that can accommodate 1 inch free movement shall be permitted as an alternate. *Source: ASTM E580 Section 5.2.8.5*

## Glossary for this Document (regional terminology may vary)

**CROSS TEES** The cross member that interlock with the main beams, also known as cross runners or cross T-bars.

**DIFFUSER** A circular or rectangular metal grill used for the passage of air from a ducted system.

**ESSENTIAL SERVICE BUILDINGS** Any buildings designed to be used by public agencies as a fire station, police station, emergency operations center, State Patrol office, sheriff's office, or emergency communication dispatch center.

**GRID** The main beams and cross tees of the suspension system.

**HANGER WIRE** 10 or 12 gage soft annealed wire used as primary support for the grid system. Also called suspension wires.

**LATERAL FORCE BRACING** The bracing method used to prevent ceiling uplift or restrict lateral movement during a seismic event. Lateral force bracing consists of vertical struts and splay wires.

**MAIN BEAM** The primary suspension member supported by hanger wires, also known as the main runner, carrying tee, carrying runner or mains.

**MOLDING/CLOSURE ANGLE** A light gauge metal angle or channel fastened to the perimeter wall or partition to support the

perimeter ends of an accoustical ceiling grid.

**PERIMETER CLIPS** Proprietary angle bracket attached directly to the wall molding/closure angle which allows for 3/4" movement in the event of seismic activity and interlocks properly with ends of grid system.

**PERIMETER WIRES** Hanger wires placed within eight inches of the surrounding walls.

**PLENUM** The space above a suspended ceiling.

**SLACK WIRE** A 12 gage wire that is not tight or taut.

**SPREADER or SPACER BAR** A bar with notches to prevent the suspension system from separating, also called a stabilizer bar.

**SPLAY WIRES** Wires installed at an angle rather than perpendicular to the grid.

**VERTICAL STRUTS** The rigid vertical member used in lateral force bracing of the suspension system. Also known as compression posts, seismic pods, seismic struts. Common materials are electrical conduit (EMT), metal studs or proprietary products.

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