



## Installing Acoustical Lay-in Type Ceilings in Seismic Regions

This document covers the installation practices recognized by TSIB for installation of a suspension system for a lay-in acoustical tile ceiling compliant with the 2006 International Building Codes. The practices listed herein are for ceilings in Seismic Design Categories D, E or F.

### REFERENCED DOCUMENTS, AGENCIES AND STANDARDS:

International Building Code (IBC)

California Building Code (CBC)

American Society of Testing Materials (ASTM)

American Society Civil Engineers (ASCE)

CISCA (Ceiling and Interior Systems Construction Association)

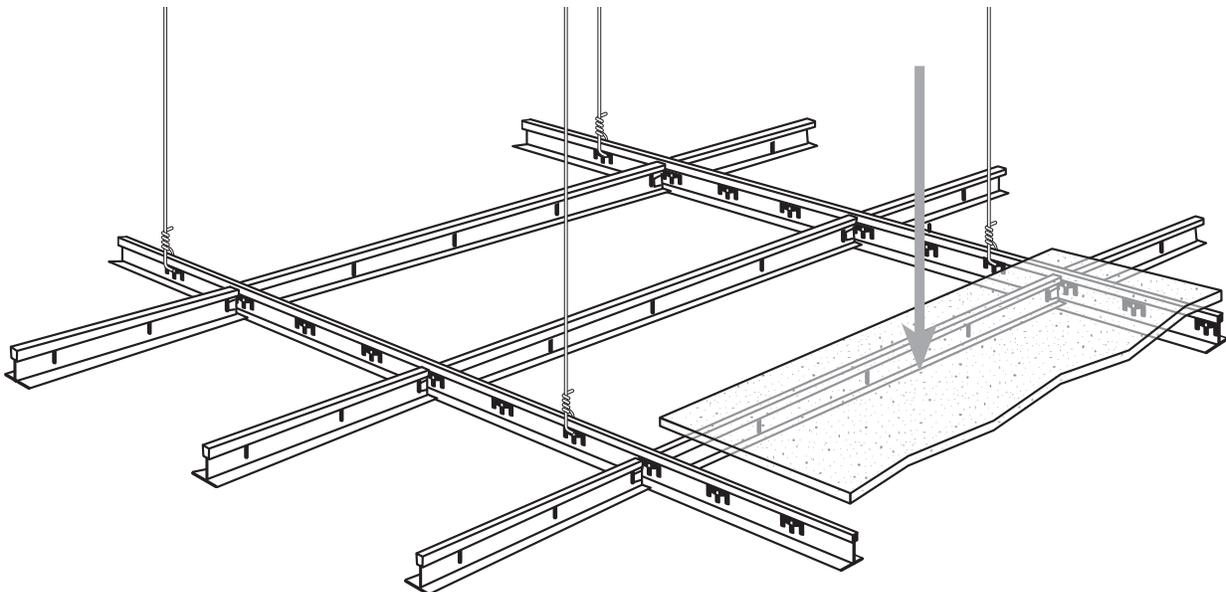
National Earthquake Hazards Reduction Program (NEHRP)

Office of Statewide Planning and Development (OSHPD)

Division of State Architects – Structural Safety (DSA–SS)

### GENERAL:

- These recommendations are intended for suspended ceilings to receive lay-in tiles not weighing more than 4 pounds per square foot including grid panels/tile, light fixtures air terminals and other accessories supported by the suspension system. (*ASCE 7-05 item 13.5.6.1*)
- For OSHPD and DSA–SS projects, lay-in panels weighing more than 1/2 pound per square foot shall be positively attached to the main or cross beams.
- The suspension system for lay-in ceilings shall not be used to permanently brace non-load bearing partitions, unless approved by an engineer. Attachment to the suspension system for alignment purposes is acceptable. (*ASCE 7-05 section 13.5.8.1*) Refer to TSIB Technical Bulletin 20.100 for bracing options.
- All main beams are to be heavy duty (HD) rated. (*ASCE 7-05 section 13.5.6.2.2*)
- Suspension systems shall be installed per manufacturer's recommendations.



### HANGER/PERIMETER WIRES:

- Twelve (12) gage hanger wire shall be spaced no more than 4 feet on center along main carrying beams. All wire ties to be three (3) tight turns. See figure 1. (*ASTM C-636*) OSHPD and DSA-SS projects require 3 tight turns within 1 1/2 inches. (*CBC Section 1614A.1.12 item 5*)
- Hanger and perimeter wires must be plumb within 1 in 6 unless counter sloping wires are provided. See figures 2a and 2b. (*ASTM C-636*)
- Connection devices for hanger/perimeter wires shall be capable of carrying no less than 100 pounds. (*CISCA zones 3-4*)
- For essential facilities and OSHPD projects, hanger wire connections shall be capable of carrying 200 pounds. (*DSA-IR M-3*)
- Powder actuated fasteners may be used, if approved for such loading (*ASCE 7-05 section 13.4.5*)
- Terminal ends of each main beam and cross tee must be supported within 8 inches of each wall by a “perimeter” wire. See figures 2b and 3. (*CISCA zones 3-4*)

### LATERAL FORCE BRACING (LFB):

- Lateral force bracing is the use of vertical struts (compression posts) and splay wires to minimize ceiling uplift of light-weight lay-in ceilings. See figure 4.
- Suspended ceilings of lath/plaster or gypsum board, screw or nail attached to the suspended members are exempt from lateral force bracing requirements. This exemption is only for ceilings on one level and that extend from wall to wall. (*CISCA zones 3-4*)
- Rooms less than 1,000 square feet are exempt from LFB, provided the suspended ceiling is surrounded (encased) by four perimeter walls and perimeter closure angles or alternate methods are installed. (*ASCE 7-05 section 13.5.6.2.2 item c and NEHRP commentaries*).
- LFB shall be spaced 12 feet on center (maximum) and begin no further than 6 feet from perimeter walls. (*DSA-SS, CISCA zones 3-4*)
- LFB for OSHPD 1 & 4 shall be spaced no more than 8 feet by 12 feet on center.
- Splay wires are to be to four 12 gage wires attached to the main beam. Splay wires are to be arrayed 90° from each other and at an angle not exceeding 45° from the plane of the ceiling. (*CISCA zones 3-4*)
- Vertical struts may be metal studs, EMT conduit, or a proprietary compression post. See Table 1.

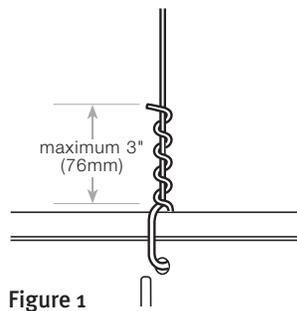


Figure 1

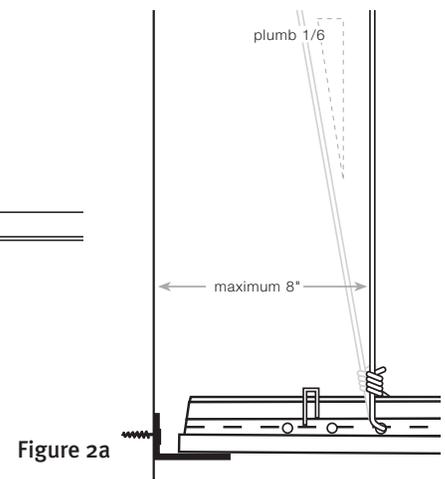


Figure 2a

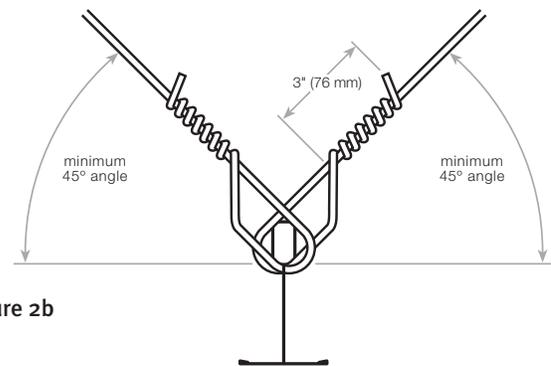


Figure 2b

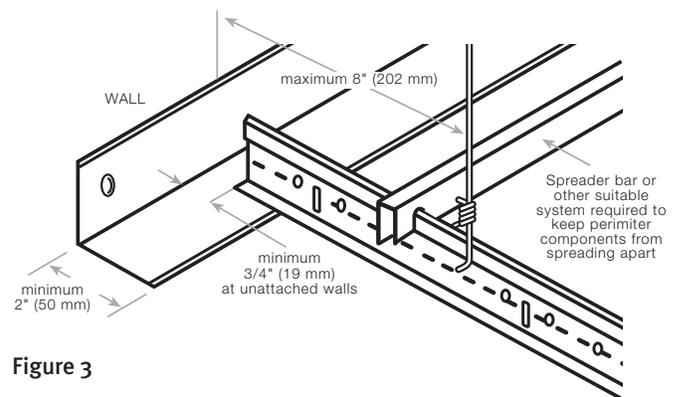


Figure 3

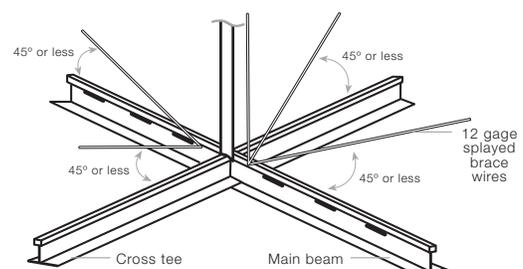


Figure 4

- Vertical struts must be positively attached to the suspension system and structure above. (CISCA zones 3-4)
- Splay or bracing wires shall be installed 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. (CISCA zones 3-4)
- Splay (restraint) wires for OSHPD projects shall have wire ties 4 tight turns within 1 1/2 inches. (CBC 1614A1.12 item 6b)
- For essential facilities and OSHPD projects splay and bracing wire connections must be capable of carrying 440 pounds.
- Shot-in (powder actuated) anchors are not permitted for splay/bracing wires in essential facilities or OSHPD projects. See figures 5a and 5b.
- Splay wires are to be within 2 inches of the vertical strut connection to the suspended ceiling. (CISCA zones 3-4)

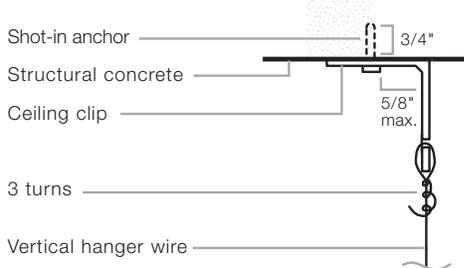
**Table 1: Maximum Recommended Lengths for Vertical Struts**

EMT Conduit	
1/2" EMT conduit	up to 6 feet, 0 inches
3/4" EMT conduit	up to 8 feet, 6 inches
1" EMT conduit	up to 10 feet, 0 inches
1 Metal Stud	
1-5/8" metal stud (25 gage)	up to 6 feet, 2 inches
2-1/2" metal stud (25 gage)	up to 10 feet, 6 inches

Note:  
Plenum areas greater than 11 feet require engineering calculations.

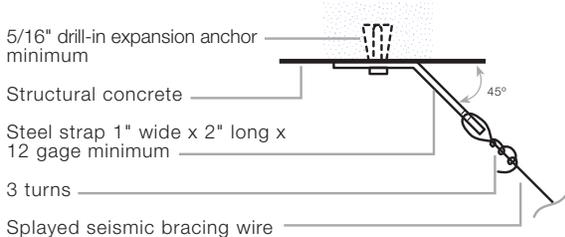
**Figure 5a**

**Vertical hanger wire attachment**



**Figure 5b**

**Splayed seismic bracing wire attachment**



- Rigid bracing may be used in lieu of splay wires. (ASCE section 13.5.6.2.2 exceptions)
- Ceilings with plenums less than 12 inches in height are not required to have LFB.

**PERIMETERS**

- Wall moldings (perimeter closure angles) are required to have a two (2) inch horizontal resting flange. Alternate methods to the 2 inch molding are allowed if approved by the designer of record, building official and/or OSHPD Inspector of Record. Two adjacent walls shall have the suspension grid attached to the molding and opposite ends shall have inch clearance from the wall and allowed to slide. (ASCE section 13.5.6.2.2 item b)
- The use of proprietary slide clips in lieu of 2 inch wall molding does not exempt the use of perimeter wires.
- The grid on two adjacent walls may be pop riveted for attachment. Alternate methods of positive attachment must be approved. (CISCA zones 3-4)

**SPREADER BARS**

- Spreader or spacer bars are use to prevent the ends of the grid system from opening and allowing tiles to fall during seismic event.
- The installation of perimeter wires do not exempt the use of spreader bars.
- Wire tying is acceptable in lieu of spreader bars.
- Proprietary slide clips used in lieu of 2 inch wall molding may be used in lieu of spreader bars if so approved by the manufacturer of the clip.
- Spreader bars are not required if a 90 degree intersecting cross or main beam is within 8 inches of the perimeter wall.

**ELECTRICAL FIXTURES**

- Light fixtures weighing less than 10 pounds shall have one 12 gage hanger wire connected from the fixture to the structure above, wire may be slack. (CISCA zones 3-4)
- Light fixtures weighing more than 10 pounds and less than 56 pounds shall two (2) 12 gage wires attached at opposing ends (corners) of the fixture to the structure above, wires may be slack. (CISCA zones 3-4)
- Light fixtures weighing in excess of 56 pounds must be supported independently from the structure above, wire must be taught. (CISCA zones 3-4)
- Tandem fixtures may utilize common wires.

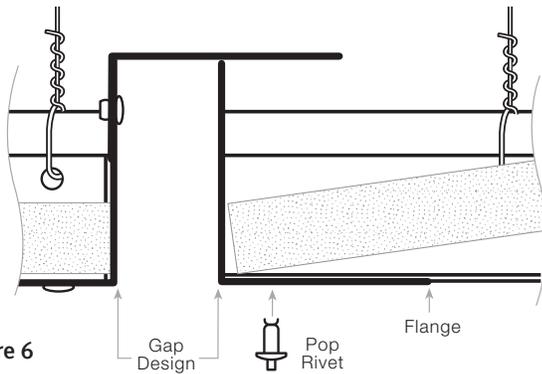


Figure 6

## MECHANICAL SERVICES

- Ceiling mounted terminals or services weighing more than 20 pounds but less than 56 pounds must have two (2) 12 gage connecting them to the ceiling system hangers or the structure above, wires may be slack. (*CISCA zones 3-4*)
- Terminals or services weighing more than 56 pounds must be independently supported directly from structure above, wires must be taut. (*CISCA zones 3-4*)

## SEISMIC SEPARATION JOINTS

- Suspended ceilings in excess of 2,500 square feet require a seismic separation joint or full height wall partition dividing areas not to exceed 2,500 sq. ft, unless analysis by the designer of record is provided that the bracing is sufficient to accommodate the anticipated lateral displacement. See figure 6. (*ASCE 7-05 Section 13.5.6.2.2 item d*)
- A seismic separation joint is intended to have the same closure angles required at the perimeter of walls.
- Proprietary seismic separation joints may be used if manufacturer's installation recommendations are strictly followed.
- The amount of free movement (gap design) is determined by the designer of record.

## SPECIAL INSPECTIONS

- Special inspections of the suspension systems may be required by the jurisdiction or municipality. (*ASCE 7-05 section 13.5.6.2.2 item h*)

## SPRINKLERS

- Ceilings without braces to limit lateral movement will require penetrations, such as sprinkler heads, free movement of 1 inch in all horizontal directions. Flexible sprinklers heads that allow a minimum 1 inch in all horizontal directions shall be allowed a substitution.

## GLOSSARY OF TERMS

- CLOSURE ANGLES:** Perimeter wall molding that is integral with the suspension system.
- CROSS TEES:** The cross member that interlocks with the main beams. Also known as cross T's or cross runners.
- DIFFUSER:** A circular or rectangular grill used in a suspended ceiling system in conjunction with an air duct system.
- ESSENTIAL SERVICE BUILDINGS:** Any building designed to be used by public agencies as a fire station, police station, emergencies operations center, state patrol office, sheriff's office or emergency communication dispatch center.
- GRID:** The main beams and cross tees of the suspension system. Often referred to as a grillage or a T-bar system.
- HANGER WIRE:** 10 or 12 gage soft annealed wire used as the primary support for the grid system. Also known as suspension wires.
- LATERAL FORCE BRACING:** The bracing used for horizontal restraint to prevent ceiling uplift and limit lateral movement during a seismic event. Lateral force bracing includes vertical struts and splay wires.
- MAIN BEAM:** The primary suspension member supported by the hanger wires. Also known as main runners, mains, carrying Tees.
- MOLDING:** A light gage metal angel or channel fastened to the wall or partition to support the perimeter of the lay-in acoustical tile.
- PERIMETER WIRES:** Hanger wires placed within eight inches of the surrounding walls.
- PLENUM:** The space between the horizontal plane of the suspended ceiling and the structure above.
- SLACK WIRE:** A 12 gage wire that is not taut or tight.
- SPREADER or SPACER BAR:** A bar with notches installed on top of the grid around the perimeter to prevent the suspension system from separating during a seismic event.
- SPLAY WIRES:** Wires installed at an angle rather than perpendicular to the suspension system. Also known as bracing wires.
- VERTICAL STRUTS:** The rigid vertical member used in lateral force bracing of the suspension system. Also known as compression posts, seismic pods or seismic struts. Common materials are electrical conduit (EMT), metal studs or proprietary posts.

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