

No. 10-01
Construction Requirements for Suspended Ceiling Systems

Code Edition: 2014 Oregon Structural Specialty Code (OSSC)
ASCE 7-10

Code Section: OSSC Section 1613.1
ASCE 7-10 Section 13.5.6

Date: July 1, 2010 (Issued)
July 1, 2014 (Updated)

Subject: Construction requirements for Suspended Ceiling Systems.

Question:

What are the minimum requirements of the Oregon Structural Specialty Code for the construction of suspended ceiling systems?

Answer:

I. The following options are available:

- a. An engineered ceiling system designed for appropriate forces,
- b. Prescriptive ceiling systems per CISCA standards as provided below, except for ceiling systems in structures classified as Risk category III or IV:
 1. in Seismic Design Category C, construction in accordance with CISCA standards for seismic zones 0-2.
(All of the notes in section IV of this interpretation shall be applicable in addition to the CISCA requirements.)
 2. in Seismic Design Categories D through F, construction in accordance with CISCA standard for seismic zones 3 and 4 with modifications as noted in ASCE 7-10 standard.
(All of the notes in sections IV and V of this interpretation shall be applicable in addition to the requirements contained in ASCE 7-10 and the CISCA standards for Seismic Design Categories D through F.)
- c. Two additional compliance options are available based upon ASCE 7-10 Sections 13.2.5 and 13.2.6:
 1. Shake table testing of components and their supports, to determine their seismic capacities, in accordance with ICC Acceptance criteria 156. {Section 13.2.5 of the

In accordance with OAR 918-008-0110, the information contained in this statewide code interpretation is legally binding on any party involved in activities regulated by applicable Oregon law, applicable Oregon regulations or the state building code. If the information contained in this statewide code interpretation is cited as a basis for a civil infraction, a representative of the jurisdiction must cite the interpretation number found in this document.



ASCE 7-10.}, or

2. Seismic qualification by experience data based on nationally recognized procedures.
{Section 13.2.6 of the ASCE 7-10.}

II. Northwest Wall & Ceiling Bureau - Technical Bulletin 401: In structures other than those classified as occupancy category III or IV, suspended ceilings installed in accordance with the prescriptive provisions of *NWCB TB 401* are deemed to comply with this interpretation.

NWCB TB 401 contains information compiled from the different applicable documents such as ASCE Standard 7-05, IBC 2009, ASTM Standard C635, ASTM E 580 and CISCA and is available at the following internet address:

[https://www.nwcb.org/sites/default/files/resources/401%20Suspension%20Systems%20for%20Acoustical%20Lay-in%20Ceilings\(2009\).pdf](https://www.nwcb.org/sites/default/files/resources/401%20Suspension%20Systems%20for%20Acoustical%20Lay-in%20Ceilings(2009).pdf)

All of the notes in sections IV and V of this interpretation shall be applicable in addition to the requirements contained in NWCB TB 401.

III. The Seismic restraint for suspended ceiling systems in structures classified as Risk Category III and IV, are required to be designed for the specific project and the anchorage of the ceiling system is required to be periodically special inspected in Seismic Design Categories D, E, and F in accordance with the provisions of the current edition of the Oregon Structural Specialty Code.

IV. GENERAL NOTES. The following notes are applicable to sections I and II:

- a. **SPECIALTY CEILINGS. Specialty ceilings, must be installed using an engineered design and may not use the provisions of this interpretation.** Specialty ceilings include but are not limited to those:
 1. Incorporating arched ceilings, curved or curvilinear ceilings or sloped ceilings; or ii. Having no direct connection to the surrounding walls or supports, such as "free floating" or "cloud" ceiling elements.
- b. **TILES.** Suspended ceilings installed to this interpretation may use either standard acoustical lay-in ceiling panels, tegular or kerfed ceiling panels.
- c. **SPREADER BARS.**
 1. Wire ties are deemed equivalent to spreader bars
 2. Spreader bars are not required if a 90 degree intersecting cross or main is within 8 inches of the perimeter wall.
 3. Spreader bars are not required at perimeters where ceiling grid ends are attached to closure angles.
- d. **WIRE GAUGE:** The minimum wire size shall be US Steel Wire Gage #12 (0.1055 inch).

V. Notes Specific to Design Categories D through F

- a. Lateral force bracing is required for ceilings over 1000 square feet.
- b. Ceilings with interstitial spaces less than 12 inches to framing are not required to have lateral force bracing.
- c. **GRID ATTACHMENT:** The suspended ceiling grid *shall be attached to two adjacent walls.* Soffits complying D (ii) (2) are deemed to be equivalent to walls. The other end of the grid in each horizontal direction shall have a 0.75 in (19 mm) clearance from the wall and shall rest

upon and be free to slide on a closure angle.

d. SEISMIC JOINTS

1. For ceiling areas exceeding 2,500 square feet, a seismic separation joint shall be provided. The layout and location of seismic separation joints shall be per the designer of record and noted on the plans.
 2. In lieu of seismic separation joints, the ceiling may be divided into areas less than 2,500 square feet by the use of partitions or soffits as described below.
 - a) Partitions. Where used, 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.
 - b) Soffits. Where used, 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.
 3. Other than partitions and soffits, seismic joints may not be used as part of a fire rated ceiling assembly unless substantiating documentation is provided.
 4. The minimum movement that must be accommodated at seismic joints is 3/4 of an inch.
- e. PERIMETER CLIPS: Where substantiating documentation is provided, perimeter clips may be used to satisfy the following requirements:
1. 2 inch closure angle
 2. Spreader bar requirements
- f. Sprinkler Heads: Flexible head design that can accommodate 1 inch free movement in any direction shall be permitted as an alternate to the requirement for 2 inch oversize rings, sleeves or adapters through the ceiling tile.

Powder driven shot-in-anchors" when used for seismic application as part of the prescriptive path in Seismic Design Categories D, E, & 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. Anchors for kicker wires (*splayed wires installed for purposes other than seismic restraint*) are exempt from this requirement.

As of the issuance of this interpretation, approved load testing values for the use of "powder driven shot-in- anchors" in normal-weight concrete over a metal pan deck have not been established. Until such time as approved load testing values are established, an on-site pull-test of such assemblies is required. The test shall demonstrate that the anchor can support a minimum 250 lbs for not less than 10 seconds and be conducted by an approved testing agency. At a minimum, such testing shall be performed on 5% of the total number of wires but not less than 5. Test samples shall be selected from dispersed locations.

On Site Test Failures.

In case of pull test failures, the testing agency shall notify the local jurisdiction. An increased level of testing, as described below, shall be conducted. All failed anchors shall be replaced.

Increased testing requirements.

1. A minimum of 6 anchors in the immediate vicinity of the failed anchor shall be tested.
 2. In the event of any additional failure, all anchors placed on the same day shall be tested.
- Load testing results are required to be submitted to the local jurisdiction for approval prior to the ceiling grid inspections.

VI. Upgrading of Existing Ceilings;

- a. *Ceilings without Seismic Bracing.* Where existing ceilings are without seismic bracing, the ceiling system shall be brought into substantial compliance with current code requirements when 50% or more of the *ceiling tile* is altered, repaired or replaced as part of a general space alteration, or if all of the *ceiling system* is removed.

Substantial Compliance means installation of the following items where required in new construction;

1. lateral force bracing (splayed wires)
2. compression struts
3. slack wires on all light fixtures and air terminals.

This requirement does not trigger the need for;

1. 2 inch closure angle as specified in section II
2. Seismic separation joints
3. 1 inch movement in all directions around sprinkler pendants

These upgrades **are not required** when:

1. removing portions of tiles or panels and/or grid to alter ductwork, sprinkler pipe, etc.
2. portions of a ceiling are removed only to facilitate the installation of sprinkler piping.

- b. *Ceilings without Compression Struts.* Where existing ceilings have seismic bracing but do not have compression struts at the center of the splayed wires, the addition of compression struts will only be required when and where the grid is replaced, altered, raised or lowered.

Analysis:

Building Codes Division staff has obtained clarifications from both the ASCE and CISCA staff regarding the intent of provisions in their respective documents. Both documents intended to allow the prescriptive construction of suspended ceilings in accordance with the methodology provided in the appropriate CISCA standard along-with the modifications listed in ASCE 7-10.

Contact:

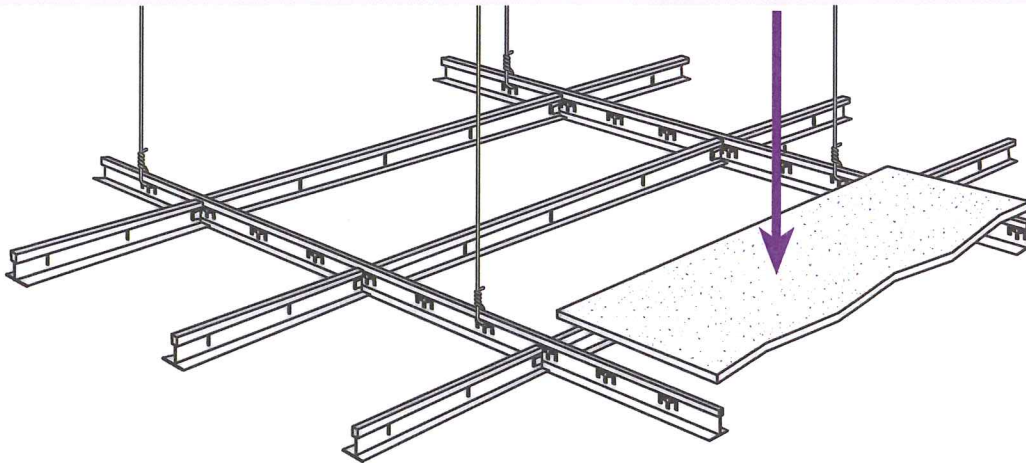
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This document has been revised based on current Building Code standards. In all buildings, other than structures classified as essential facilities, **suspended ceilings installed in accordance with the prescriptive provisions of the 401 document are 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 ft² 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*

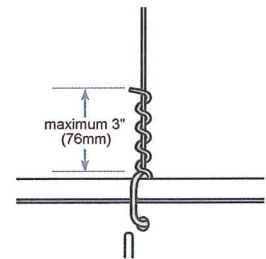


figure 1

figure 2
Lateral force Bracing

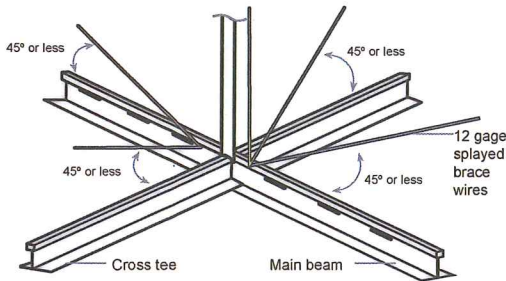


figure 3
Maximum Recommended Lengths for Vertical Struts

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 2 ½" metal stud (20 gage)	up to 13' 6"
Back-to-back 2 ½" 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

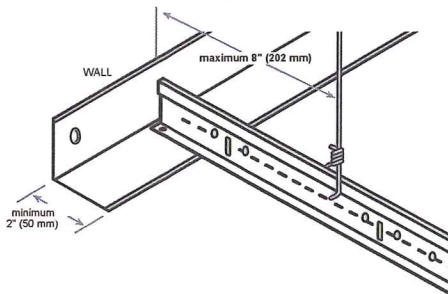
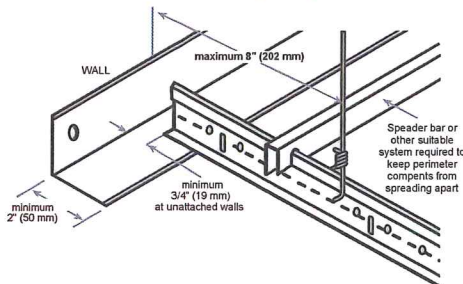


figure 4b
Unattached Wall Molding Requirements



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 ft² 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 ¼ 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

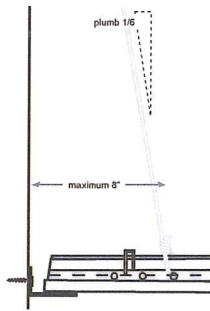


figure 5b • Countersloping

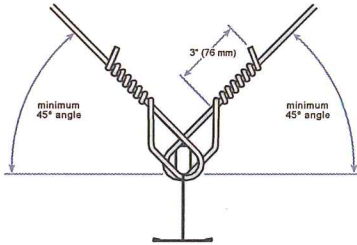


figure 6a

Vertical hanger wire attachment

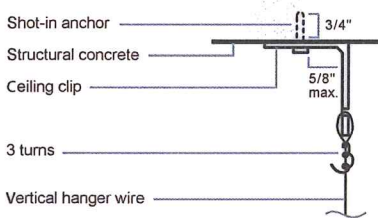
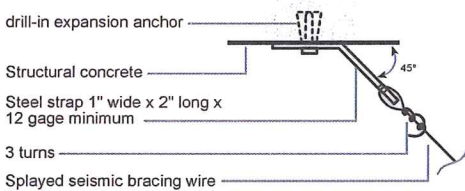


figure 6b

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*

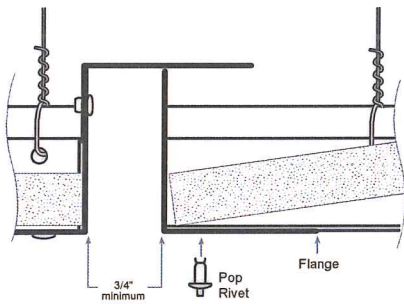
Electrical fixtures

- 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.

The NWCB has been serving the construction industry for over forty years. It is recognized as a technical authority, educational body and spokesperson for the wall and ceiling industry. It provides services to architects and the construction community on all matters relating to the diversified wall and ceiling industry. As the industry's development and coordination organization, the NWCB saw the need to establish a document to provide clarification and the intent of NEHRP (National Earthquake Hazards Reduction Program) an agency of FEMA (Federal Emergency Management Agency). It is meant to serve as a set of recommendations and is not intended for any specific construction project. This technical document is to serve as a guideline and it is not intended for any specific construction projects. NWCB makes no express or implied warranty or guarantee of the techniques, construction methods or materials identified herein.