

METAL SUSPENSION SYSTEMS FOR LAY-IN PANEL CEILINGS: 2013 CBC

References:

California Code of Regulations (CCR), Title 24,
Part 2: 2013 California Building Code (CBC), Section 1616A.1.20, 1616.10.16*
ASTM C635-07, C636-08, and E580-10a

Disciplines: Structural

History:

Revised 04-08-14 Revised in its entirety 05-18-11
Revised 05-16-13 Issued 06-22-09 as IR 25-5
Revised 12-21-12

This Interpretation of Regulations (IR) is intended for use by the Division of the State Architect (DSA) staff, and as a resource for design professionals, to promote more uniform statewide criteria for plan review and construction inspection of projects within the jurisdiction of DSA which includes State of California public elementary and secondary schools (grades K-12), community colleges and state-owned or state-leased essential services buildings. This IR indicates an acceptable method for achieving compliance with applicable codes and regulations, although other methods proposed by design professionals may be considered by DSA.

This IR is reviewed on a regular basis and is subject to revision at any time. Please check the DSA web site for currently effective IRs. Only IRs listed on the DSA website at www.dgs.ca.gov/dsa/Resources/IRManual.aspx at the time of plan submittal to DSA are considered applicable.

*Indicates alternative 2013 CBC sections that may be used by community colleges, per 2013 CBC Section 1.9.2.2.

PURPOSE: The purpose of this Interpretation of Regulations (IR) is to provide guidelines for the installation of metal suspension systems for lay-in ceilings on projects approved under the 2013 California Building Code (CBC). For projects submitted to the DSA for review under the 2007 or 2010 CBC, see IR 25-2.07 or IR 25-2.10, respectively.

1. GENERAL REQUIREMENTS: CBC Section 1616A.1.20 (1616.10.16*) requires the design and installation to be in compliance with ASTM C635, C636, and E580, Section 5, as amended by 2013 CBC Section 1616A.1.20 (1616.10.16*).

Note: Amendments in CBC Section 1616A.1.20 (1616.10.16*) replace ASCE 7, Section 13.5.6.

The requirements in this IR apply to flat and level ceiling systems whose total weight, including ceiling mounted air terminals, services and light fixtures, does not exceed four (4) psf. Heavier systems, systems that are not flat and level, and those supporting lateral loads from partitions are beyond the scope of this IR and will require special design and details.

2. SUSPENSION SYSTEM COMPONENTS: Shall comply with ASTM C635 and Section 5.1 of ASTM E580.

2.1 The ceiling grid system must be rated heavy duty as defined by ASTM C635.

2.2 Ceiling wire shall be Class 1 zinc coated (galvanized) carbon steel conforming to ASTM A641. Wire shall be #12 gage (0.106" diameter) with soft temper and minimum tensile strength = 70 ksi.

2.3 Main runners, cross runners, splices, expansion devices, and intersection connectors shall be designed to carry a mean ultimate test load of not less than 180 lbs. in compression and tension per ASTM E580 Section 5.1.2.

3. SUSPENSION SYSTEM INSTALLATION: Shall comply with ASTM C636 and Section 5.2 of ASTM E580.

3.1 #12 gage hanger wires may be used for up to and including a 4 foot by 4 foot grid spacing and shall be attached to main runners.

3.2 Provide #12 gage hanger wires at the ends of all main and cross runners within eight (8) inches of the support or within one-fourth (1/4) of the length of the end tee, whichever is least, for the perimeter of the ceiling area (see Figure 2). Perimeter wires are not required when the length of the end tee is eight (8) inches or less.

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3.3 Ceiling grid members shall be attached to two (2) adjacent walls per ASTM E580, Section 5.2.3. Ceiling grid members shall be at least 3/4 inch clear of other walls. If walls run diagonally to ceiling grid system runners, one end of main and cross runners should be free, and a minimum of 3/4 inch clear of wall.

3.4 The width of the perimeter supporting closure angle shall be not less than two inches. Grid systems with specialty or proprietary angles and support clips may be acceptable in accordance with Section 11 below.

3.5 At the perimeter of the ceiling area, where main or cross runners are not connected to the adjacent wall, provide interconnection between the runners at the free end to prevent lateral spreading. A metal spreader strut or a #16 gage wire with a positive mechanical connection to the runner may be used and placed within eight (8) inches of the wall. Where the perpendicular distance from the wall to the first parallel runner is eight (8) inches or less, this interlock is not required.

4. EXPANSION JOINTS, SEISMIC SEPARATION JOINTS, AND PENETRATIONS:

4.1 Expansion joints shall be provided in the ceiling at intersections of corridors and at junctions of corridors and lobbies or other similar areas (see Figure 7, Detail A).

4.2 For ceiling areas exceeding 2,500 square feet, a seismic separation joint shall be provided in accordance with Figure 7, Detail A, to divide the ceiling into areas not exceeding 2,500 square feet. Alternatively, comply with ASTM E580, Section 5.2.9.

4.3 Penetrations through the ceiling for sprinkler heads and other similar devices that are not integrally tied to the ceiling system in the lateral direction shall have a two (2) inch oversized ring, sleeve or adapter through the ceiling tile to allow free movement of one (1) inch in all horizontal directions. Alternatively, per ASTM E580, Section 5.2.8.5, a flexible sprinkler hose fitting that can accommodate one (1) inch of ceiling movement shall be permitted to be used in lieu of the oversized ring, sleeve, or adapter.

5. LATERAL FORCE BRACING: Lateral force bracing is required per this section for all ceiling areas. The spacing of the bracing assemblies must be shown on the construction documents.

Exception: Lateral force bracing may be omitted for suspended acoustical ceiling systems with a ceiling area of 144 square feet or less, when perimeter support, in accordance with Section 3.3 of this IR or with ASTM E580 Sections 5.2.2 and 5.2.3, are provided and perimeter walls are designed to carry the ceiling lateral forces.

5.1 Provide lateral force bracing assemblies consisting of a compression strut and four (4) #12 gage splayed bracing wires oriented 90 degrees from each other (see Figure 1).

5.2 Lateral force bracing assemblies shall be spaced per Table 1 for all values of the component importance factor (I_p) of the ceiling.

**TABLE 1
LATERAL FORCE BRACE ASSEMBLY SPACING**

Design Spectral Acceleration Parameter S_{DS}	Brace Assembly Spacing
Less than or equal to 1.15	12'x12' Full building Height
Greater than 1.15 and less than or equal to 1.73	8'x12' for z/h greater than 0.5 12'x12' for z/h less than or equal to 0.5
Greater than 1.73	8'x8' for z/h greater than 0.5 8'x12' for z/h less than or equal to 0.5

Where, as defined in ASCE 7-10, Section 13.3.1:

z = height in structure of point of attachment of ceiling with respect to the base.

h = average roof height of the structure with respect to the base.

Where different brace spacing is specified at various stories, the respective ceiling plan shall clearly indicate the brace spacing.

There shall be a brace assembly a distance of not more than one half of the above spacing from each surrounding wall, expansion joint and at the edges of any ceiling **vertical offset**. For example, where the brace spacing is 8'x12', the distance shall be 4 feet in the direction of the 8 foot spacing and 6 feet in the direction of the 12 foot spacing.

5.3 The slope of bracing wires shall not exceed 45 degrees from the plane of the ceiling and wires shall be taut. Splices in wires are not permitted without DSA approval.

5.4 Compression struts shall be adequate to resist the vertical component induced by the bracing wires, and shall not be more than one (horizontal) in six (vertical) out of plumb.

6. ATTACHMENT OF HANGER AND BRACING WIRES:

6.1 Fasten hanger wires with not less than three (3) tight turns in three (3) inches. Hanger wire loops shall be tightly wrapped and sharply bent to prevent any vertical movement or rotation of the member within the loops (see ASTM E580, Section 5.2.7.2).



6.2 Fasten bracing wires with four (4) tight turns. Make all tight turns within a distance of one and one-half (1-1/2) inches.



6.3 Hanger or bracing wire anchored to the structure should be installed in such a manner that the direction of the anchor aligns as closely as possible with the direction of the wire.

6.4 Separate all ceiling hanger and bracing wires at least six (6) inches from all unbraced ducts, pipes, conduit, etc.

6.5 Hanger wires shall not attach to or bend around interfering material or equipment. Provide trapeze or other supplementary support members at obstructions to typical hanger spacing (see Figure 3A, Detail F). Provide additional hangers, struts or braces as required at all ceiling breaks, soffits, or discontinuous areas.

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6.6 Hanger wires that are more than one (horizontal) in six (vertical) out of plumb shall have counter-sloping wires. Perimeter hanger wires at main runners that are positively attached to the perimeter closure angle, counter-sloping is optional.

Note: See ASTM C636, Figure 1, for counter-sloping methods.

6.7 When connection details differ from those in the attached figures, attachment of bracing wires to the structure above and to the main runners shall be adequate for the load imposed. The weight (W_p) shall be taken as not less than four (4) psf for calculating seismic forces (F_p).

6.8 When drilled-in concrete anchors or power actuated fasteners are used in reinforced concrete for hanger wires, 1 out of 10 wire/anchor assemblies must be field tested for 200 lbs. in tension. When drilled-in concrete anchors are used for bracing wires, 1 out of 2 wire/anchor assemblies must be field tested for 440 lbs. in tension in the direction of the wire. Power actuated fasteners in concrete are not permitted for bracing wires.

Note: Drilled-in anchors or power actuated fasteners require DSA approval prior to use in prestressed concrete.

7. CEILING FIXTURES, TERMINALS, AND DEVICES: All fixtures, terminals, and other devices shall be mounted in a manner that will not compromise ceiling performance in accordance with Section 13.5.6.2.2(5) of ASCE 7-10 as amended by 2013 CBC Section 1616A.1.20 (1616.10.16*) and ASTM E580 Sections 5.3 and 5.4.

7.1 Ceiling panels shall not support any light fixtures, air terminals or devices.

7.2 Light Fixtures:

7.2.1 All light fixtures shall be positively attached to the ceiling suspension systems by mechanical means to resist a horizontal force equal to the weight of the fixture. Screws or approved fasteners are required. A minimum of two attachments are required at each light fixture, per ASTM E580, Section 5.3.1.

7.2.2 Light fixtures weighing less than or equal to 10 lb. shall have a minimum of one (1) #12 gage slack safety wire connected from the fixture housing to the structure above.

7.2.3 Light fixtures weighing greater than 10 lb. but less than or equal to 56 lbs. may be supported directly on the ceiling runners, but they shall have a minimum of two (2) #12 gage slack safety wires connected from the fixture housing at diagonal corners and anchored to the structure above.

7.2.4 Light fixtures weighing greater than 56 lb. shall be independently supported by not less than four (4) taut #12 gage wires attached to the housing and to the structure above. The four (4) taut #12 gage wires, including their attachment to the structure above, must be capable of supporting four (4) times the weight of the unit.

7.2.5 All four foot x four foot light fixtures must have slack safety wires at each corner unless supported per Section 7.2.4.

7.2.6 Surface-mounted fixtures shall be attached to the main runner with at least two positive clamping devices made of material with a minimum #14 gage. Rotational spring catches do not comply. A #12 gage suspension wire shall be attached to each clamping device to the structure above. Provide additional supports when light fixtures are eight (8) feet or longer. Maximum spacing between supports shall not exceed eight (8) feet.

7.2.7 Support pendant-mounted light fixtures directly from the structure above with hanger wires or cables passing through each pendant hanger and capable of

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supporting two (2) times the weight of the fixture. See [IR 16-9](#) for additional requirements for pendent mounted fixtures.

If the pendant mounted light fixture is directly and independently braced below the ceiling, i.e., aircraft cables to walls, then a brace assembly is not required above the ceiling.

If the pendant mounted light fixture is not directly and independently braced below the ceiling, then a bracing assembly, per Figure 1, is required where the pendant hanger penetrates the ceiling. Special details are required to attach the pendant hanger to the bracing assembly to transmit the horizontal force. Exception: Where the weight of the fixture is less than 20 pounds, the compression post shown in Figure 1 is not required.

7.2.8 Rigid conduit shall not be used for attachment of the fixtures.

7.3 Services within the Ceiling:

7.3.1 All flexible sprinkler hose fittings, ceiling-mounted air terminals or other services shall be positively attached to the ceiling suspension systems by mechanical means to resist a horizontal force equal to the weight of the component. Screws or approved fasteners are required. A minimum of two attachments are required at each component.

7.3.2 Flexible sprinkler hose fittings, ceiling-mounted air terminals or other services weighing less than or equal to 20 lb. shall have one (1) #12 gage slack safety wire attached to the terminal or service to the structure above.

7.3.3 Flexible sprinkler hose fittings, ceiling-mounted air terminals or other services weighing more than 20 lb. but less than or equal to 56 lb. shall have two (2) #12 gage slack safety wires attached to the terminal or service to the structure above.

7.3.4 Flexible sprinkler hose fittings, ceiling-mounted air terminals or other services weighing more than 56 lb. shall be supported directly from the structure above by not less than four (4) taut #12 gage wires attached to the terminal or service and to the structure above. The four (4) taut #12 gage wires, including their attachment to the structure above, must be capable of supporting four (4) times the weight of the unit.

7.4 Other Devices within the Ceiling:

7.4.1 All lightweight miscellaneous devices, such as strobe lights, occupancy sensors, speakers, exit signs, etc., shall be attached to the ceiling grid per Section 7.3.1 of this IR. In addition, devices weighing more than 10 lbs. shall have a #12 gage slack safety wire anchored to the structure above per Section 7.2.2 of this IR. Devices weighing more than 20 lbs. shall be supported from the structure above per Section 7.3.4 of this IR.

8. ADDITIONAL REQUIREMENTS:

8.1 Fire Rated Ceilings:

Provide a detail and design number for rated ceiling assemblies from an authorized testing agency. The components and installation details must conform in every respect with the listed detail and number. Details shall clearly depict all components, including insulation materials, framing and attachment of the design so that the assembly can be constructed and inspected accordingly.

Pop rivets, screws, or other attachments are not acceptable unless specifically detailed on the drawings and approved by U.L. and State Fire Marshal (SFM) recognized laboratories.

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Metal panels and panels weighing more than one-half (1/2) psf, other than mineral fiber acoustical tile, are to be positively attached to the ceiling suspension runners.

8.3 Essential Services Buildings:

Exitways shall be installed in accordance with Section 13.5.6.2.2(1) of ASCE 7-10 as amended by 2013 CBC Section 1616A.1.20 (1616.10.16*). A main or cross runner shall be installed on all sides of each piece of tile, board or panel and each light fixture or grill (see Figure 7, Detail B). Splices or intersection of such runners shall be attached with through connectors such as pop rivets, screws, pins, plates with end tabs or other approved connectors.

8.4 Suspended Acoustical Ceilings Below Gypsum Board Ceilings:

Where gypsum board or other ceiling finishes are attached to the framing, specific details will be required for the vertical hanger wire and lateral bracing wire support connections to the framing.

9. RE-USE OF EXISTING CEILING HANGER WIRES AND BRACING WIRES:

9.1 The gage and spacing of the wires must comply with the current applicable codes.

9.2 All existing ceiling hanger wire/anchor assemblies must be tested to 200 lbs.

9.3 All existing bracing wire/anchor assemblies must be field tested to 440 lbs.

9.4 If a new wire is to be spliced to an existing wire, the following is required:

- The architect or structural engineer in general responsible charge must submit to the DSA for approval a detail and specification describing how the splice is to be made.
- All new wires, after being spliced to the existing wires, must be field tested per Sections 9.2 and 9.3 above.
- All field tests must be performed in the presence of the project inspector.

10. MODERNIZATION AND ALTERATION: The entire ceiling shall be upgraded to meet the current requirements of the CBC and this IR if any portion of the grid system is cut or altered.

Exception: The replacement of existing ceiling panels with panels of the same materials and light fixtures of the same size, locations, and weights does not require an upgrade to the ceiling grid and suspension system.

11. DSA ACCEPTANCE OF EVALUATION REPORTS: Ceiling grid systems or components, with valid evaluation reports issued by qualified evaluation agencies, in accordance with DSA [IR A-5](#), are accepted by the DSA, provided the system or component meets the requirements of CBC Section 1616A.1.20 (1616.10.16*), ASTM C635, C636 and E580. Where a qualified evaluation report is utilized, the installation shall comply with all the requirements specified in the evaluation report, i.e. connections, member sizes, perimeter details, special clips to wall angles, etc.

In accordance with DSA IR A-5, DSA will accept OSHPD Preapproved Details (OPD) "2013 CBC Standard Suspended Ceiling Details for Acoustical Tile or Lay-in Panel Ceilings."

12. CONSTRUCTION DOCUMENTS: Drawings and specifications shall clearly identify all systems and shall define or show all supporting details, lighting fixture attachment, lateral force bracing, partition bracing, seismic separations, etc.

Where accepted proprietary devices, clips, wall angles, etc. are utilized, the details on the approved construction documents shall clearly indicated the installation details as necessary to show compliance with all evaluation report requirements.

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Where differences occur between provisions of this IR and the CBC, the provisions of the CBC shall apply.

A list of acceptable grid systems must be shown on the drawings. The grid systems specified shall have valid evaluation reports in accordance with IR A-5. The following information shall be included on the drawings for each acceptable grid system specified:

Classification of ceiling grid is heavy duty.

Manufacturer's catalog number - main runner (1) (2).

Manufacturer's catalog number - cross runner (2) (3).

Manufacturer's catalog numbers of detail for runner splice (2).

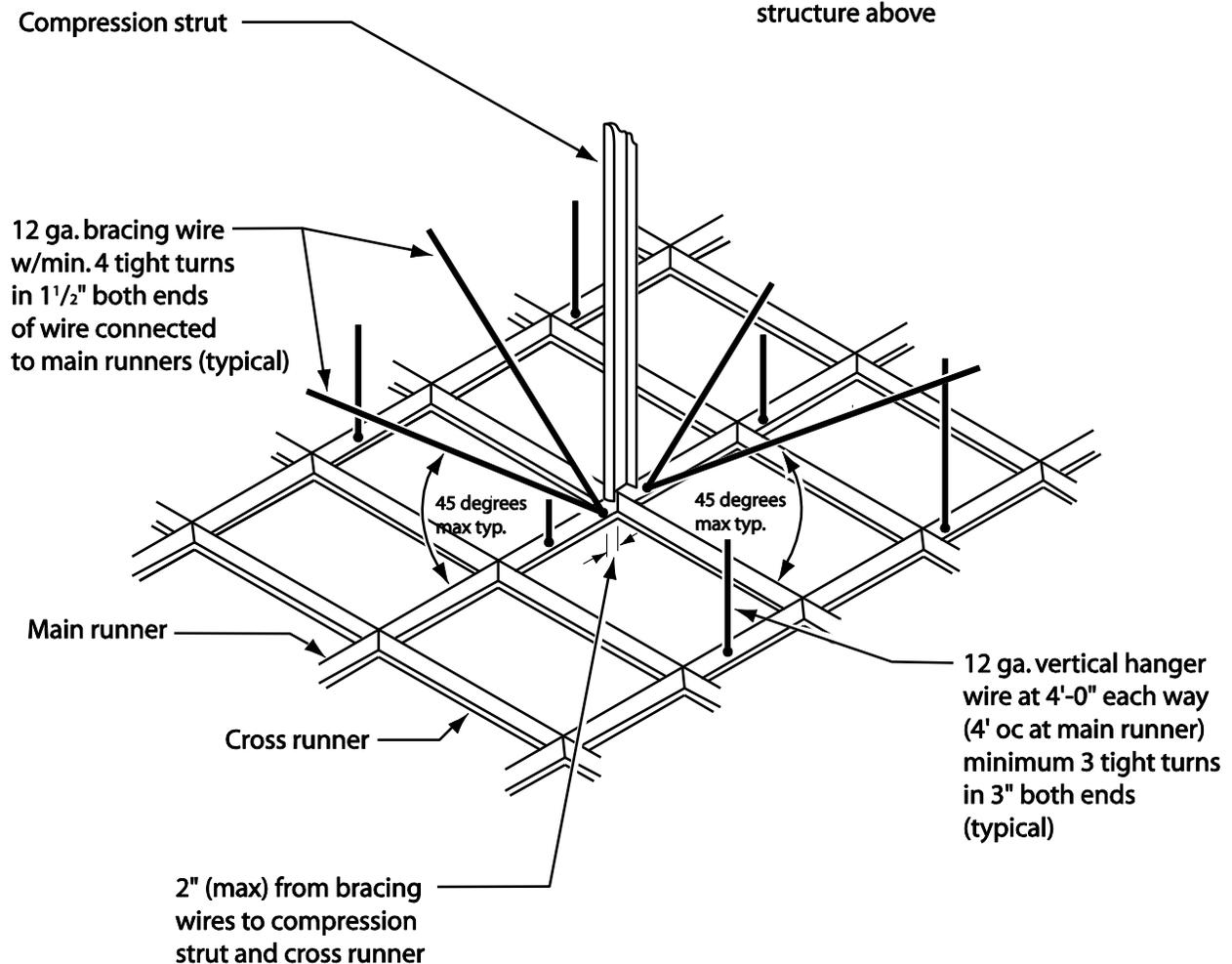
- Notes:**
- (1) Main runners must be rated as heavy duty.
 - (2) Show manufacturer, duty classification and catalog numbers.
 - (3) If a cross runner supports light fixtures, air terminals, or other cross runners, it shall be considered a main runner for the purpose of structural classification.

**Figure 1
SUSPENDED CEILING BRACING ASSEMBLY**

Compression Struts:

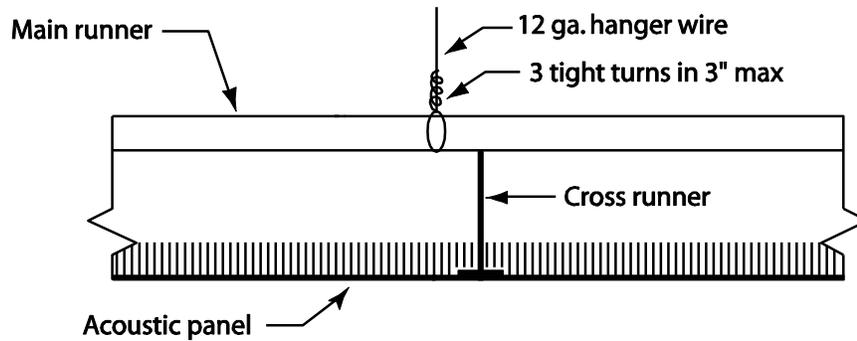
Compression struts shall not replace hanger wires. The sizes of compression struts must be shown on construction documents by the engineer or architect. Attach compression struts to main runners within 2" of cross runner. Details of attachment at both ends must be designed and shown on construction documents by the engineer or architect. The attachment at the top shall be capable of supporting four times the weight of the strut.

Note:
See Figures 3, 4, 5, or 6 for connections of bracing and hanger wire to the structure above

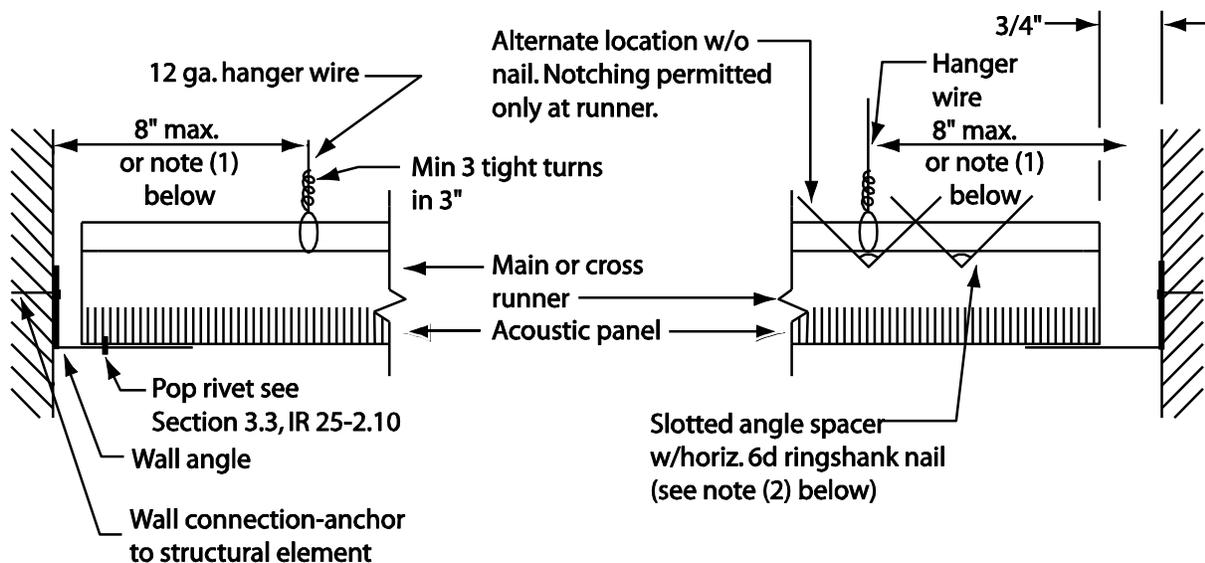


**Figure 2
CEILING HANGER DETAILS**

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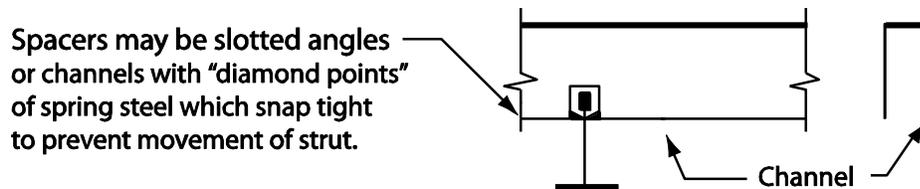


(A) Typical hang wire grid



(B) Perimeter details - typical (see Section 3.5)

- Notes:
- (1) 1/4 of the length of the end runner whichever is less.
 - (2) Nails at the end of horizontal struts are to be placed with nail head toward centerline of span of strut.
 - (3) Hanger wire not required for cross runners less than 8" long between main runner and wall.

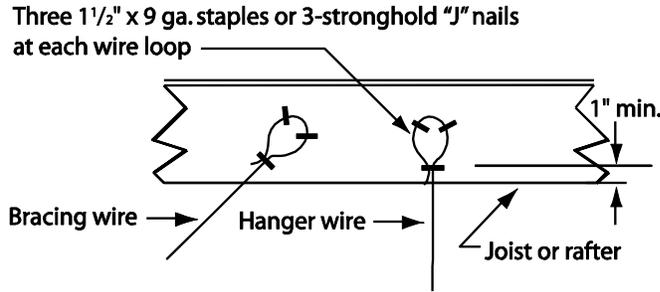


(C) Alternate Spreader Strut

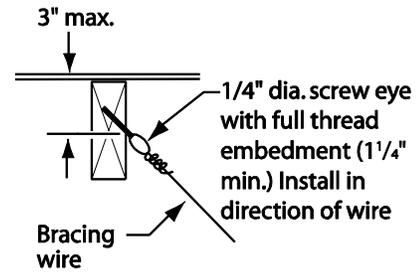
Figure 3A

ACCEPTABLE DETAILS - WIRE CONNECTIONS TO WOOD FRAMING

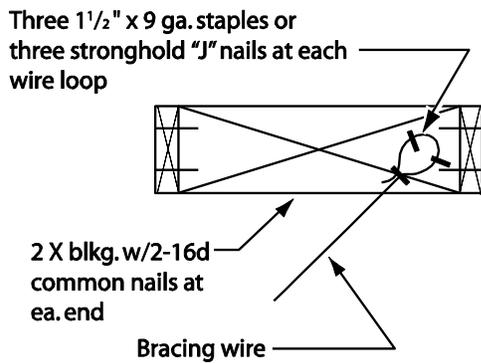
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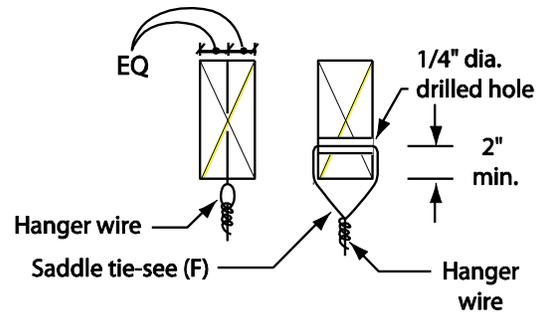
(A) Wood joist or rafter



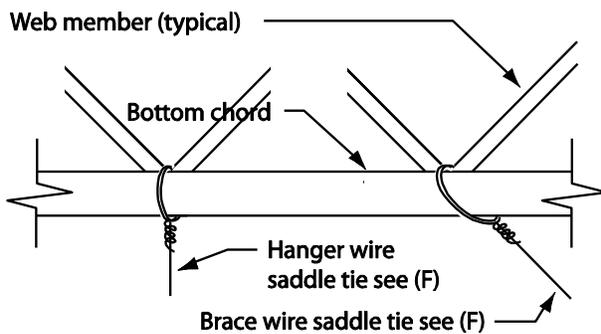
(B) Wood joist or rafter



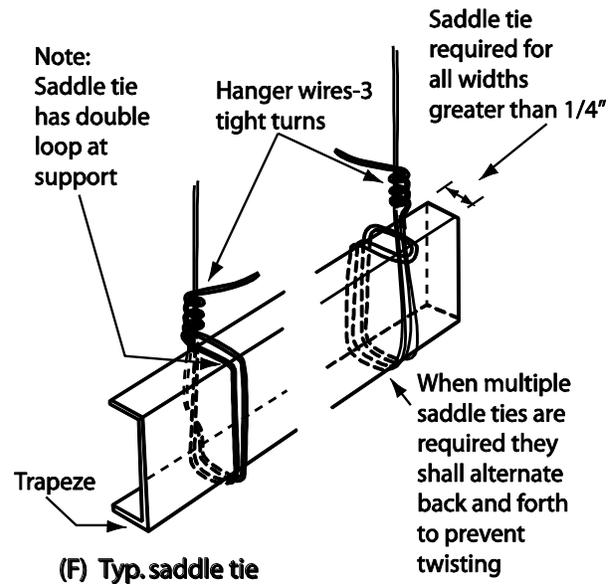
(C) Wood joist or block



(D) At bottom of joist



(E) Bracing wire parallel to wood truss

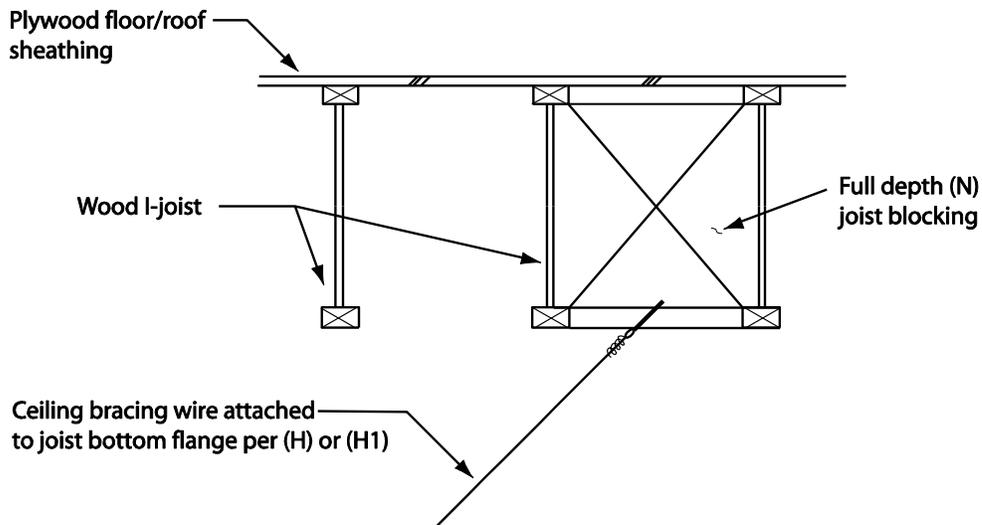


(F) Typ. saddle tie

Figure 3B

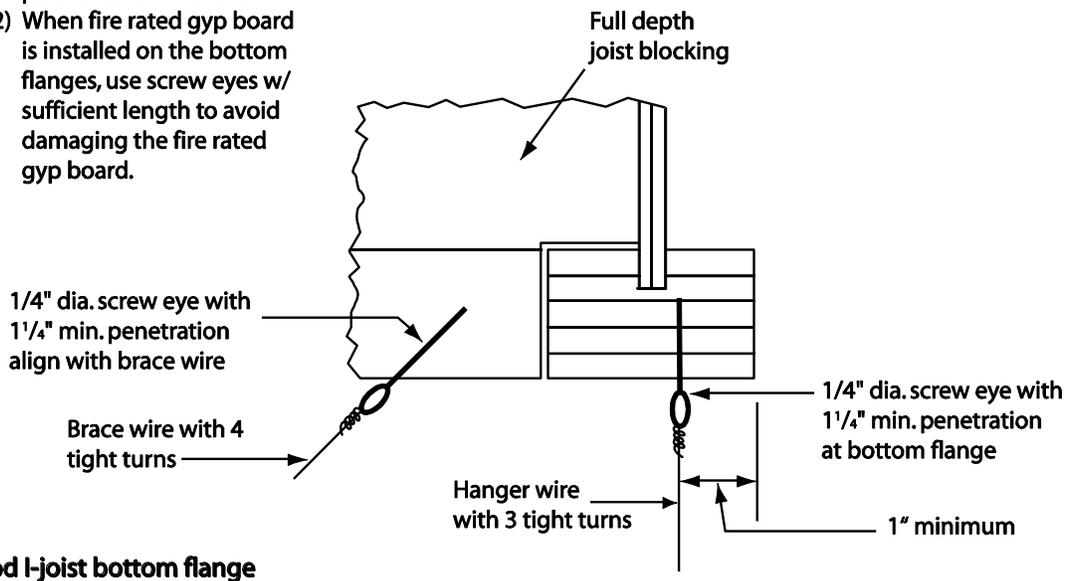
ACCEPTABLE DETAILS - WIRE CONNECTION AT WOOD FRAMING

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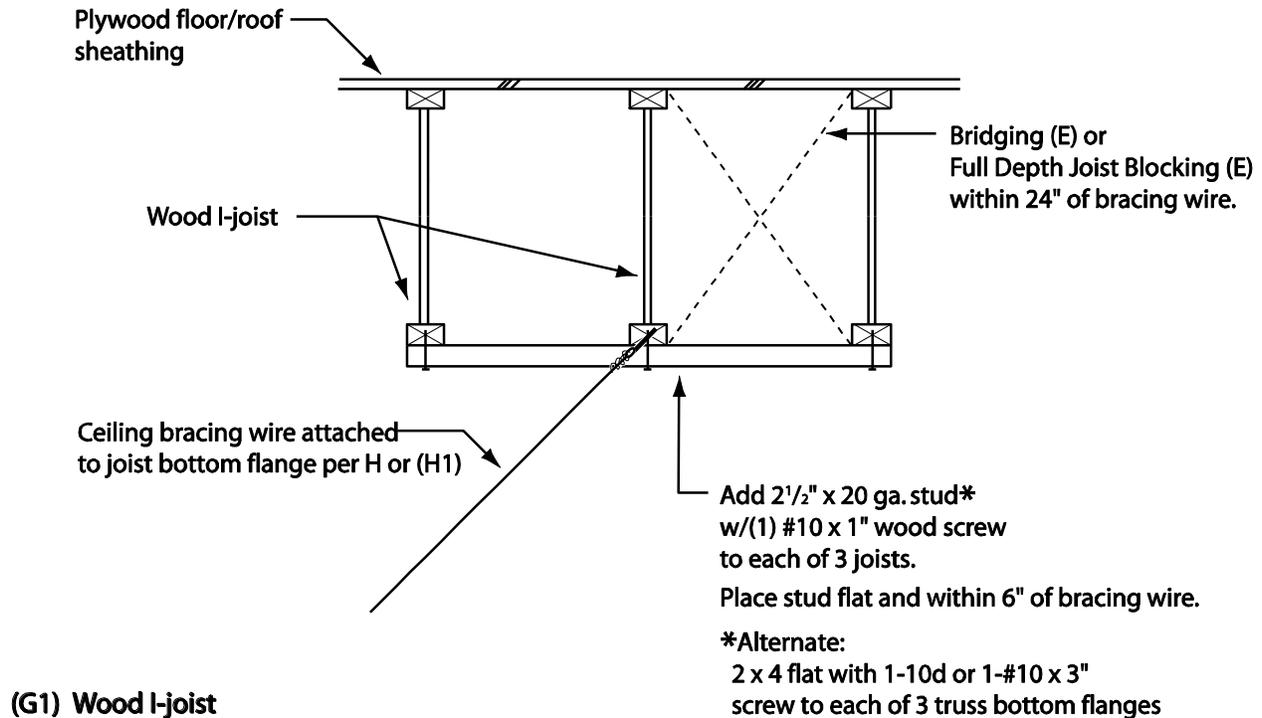
(G) Wood I-joint

- Notes: (1) Do not insert screw eyes parallel to laminations
 (2) When fire rated gyp board is installed on the bottom flanges, use screw eyes w/ sufficient length to avoid damaging the fire rated gyp board.



(H) Wood I-joint bottom flange

Figure 3C
ACCEPTABLE DETAILS - WIRE CONNECTION AT WOOD FRAMING



Note: (1) Do not insert screw eyes parallel to laminations.
 (2) When fire rated gyp board is installed on the bottom flanges, use screw eyes w/ sufficient length to avoid damaging the fire rated gyp board.

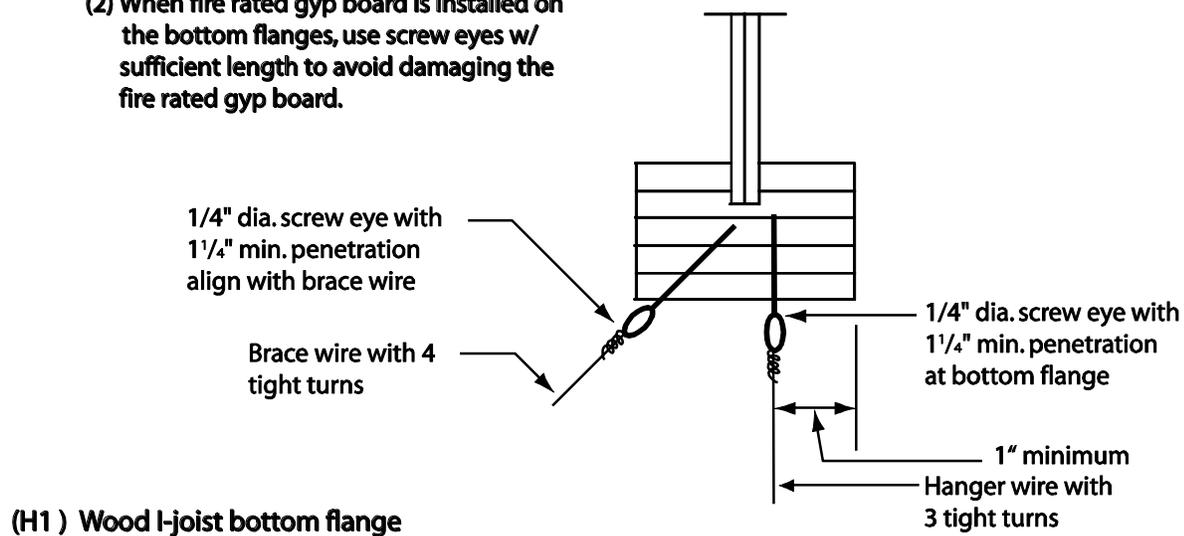
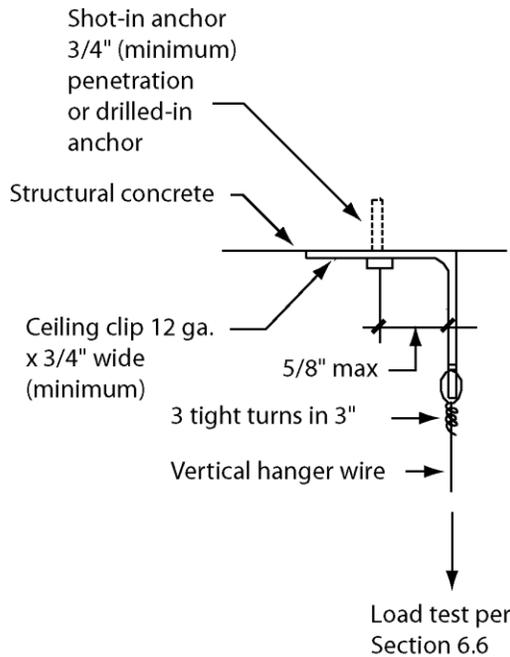


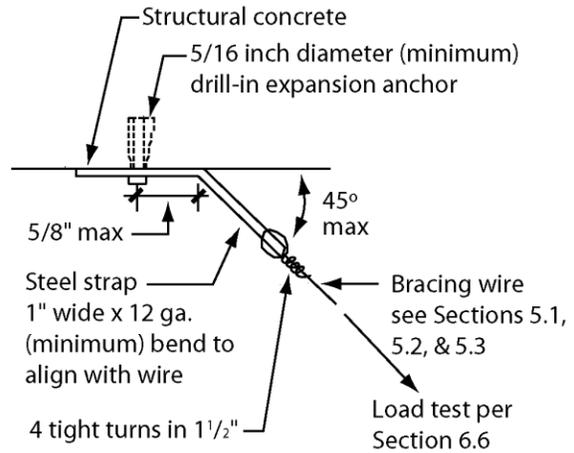
Figure 4
ACCEPTABLE DETAILS - WIRE CONNECTION TO CAST-IN-PLACE CONCRETE

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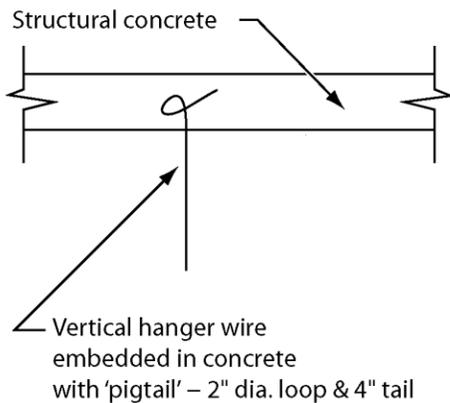
Shot-in anchors not allowed for bracing wires



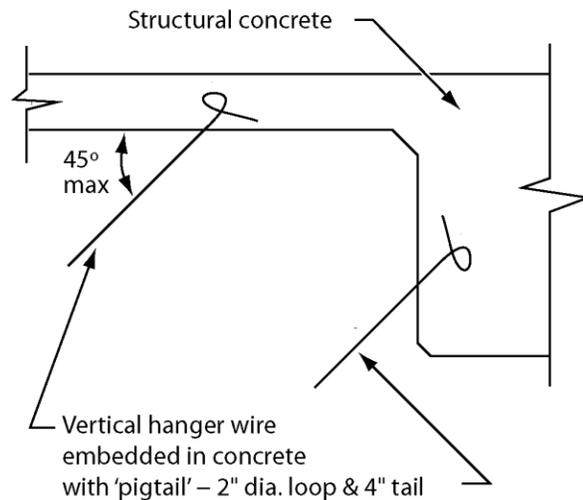
**(A) Vertical hanger wire
clip attachment**



**(B) Splayed bracing wire
clip attachment**

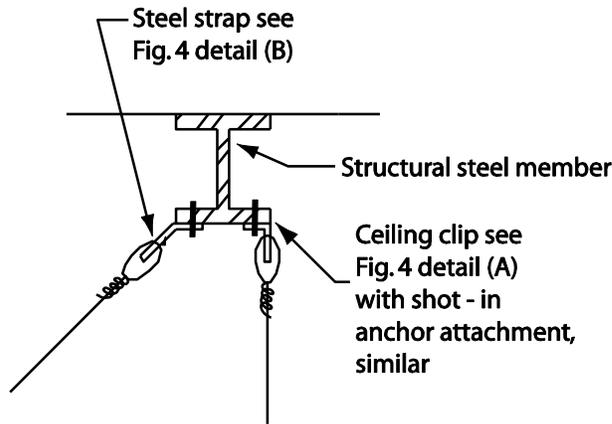


(C) Hanger wire at C.I.P. concrete

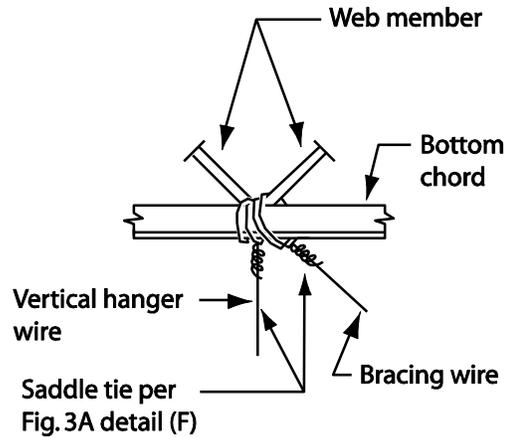


(D) Brace wire at C.I.P. concrete

Figure 5
ACCEPTABLE DETAILS - WIRE CONNECTIONS TO STEEL FRAMING

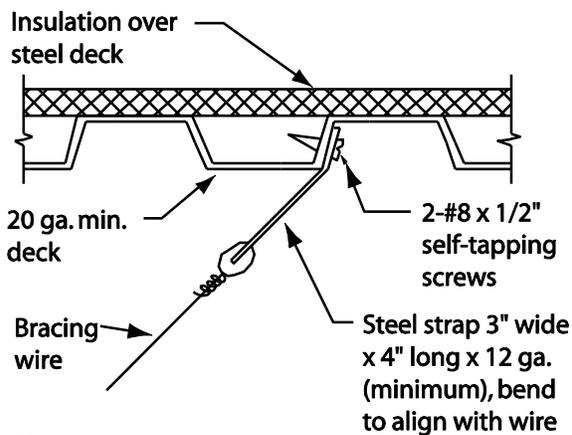


(A) At steel beams

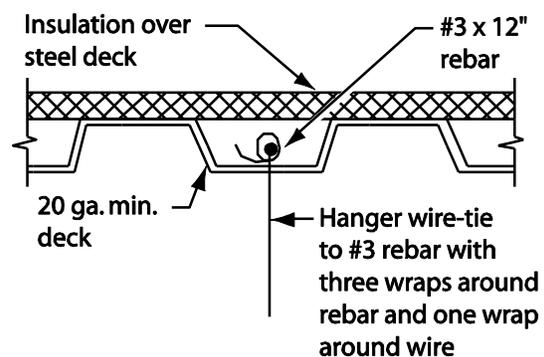


Brace wires parallel to joist.
Brace wires can not be perpendicular to joist.

(B) At open-web steel joist



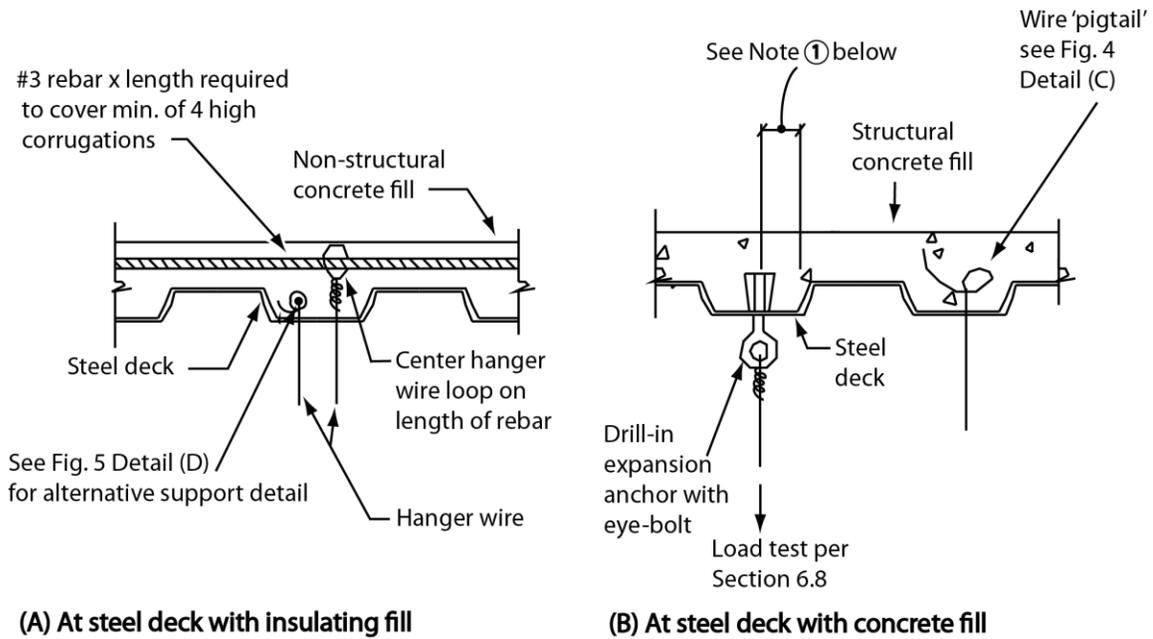
(C) At steel roof deck



(D) At steel roof deck

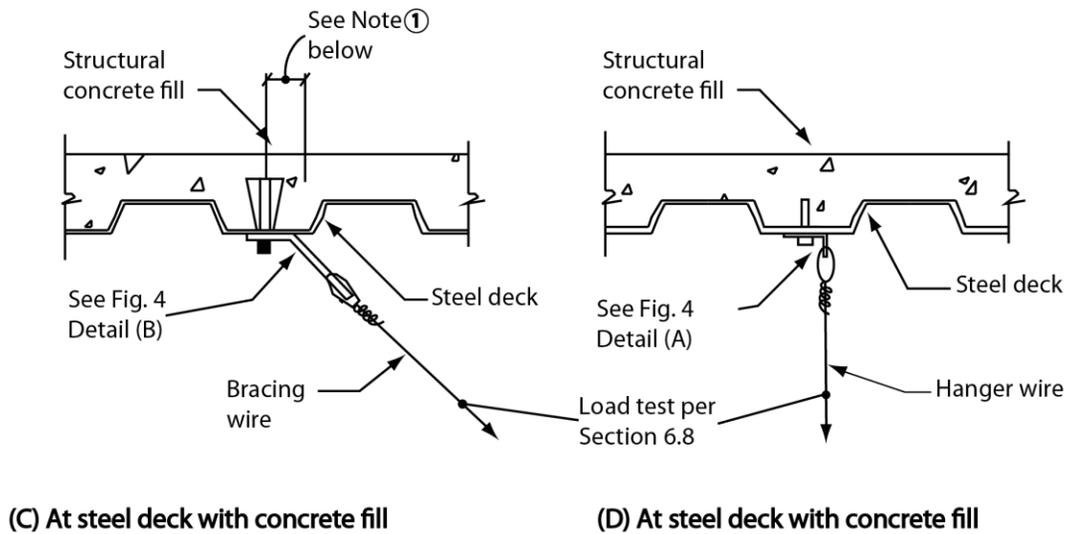
Note: If self-tapping screws are used with concrete fill, set screws before placing concrete

Figure 6
ACCEPTABLE DETAILS - WIRE CONNECTIONS TO STEEL DECK



(A) At steel deck with insulating fill

(B) At steel deck with concrete fill

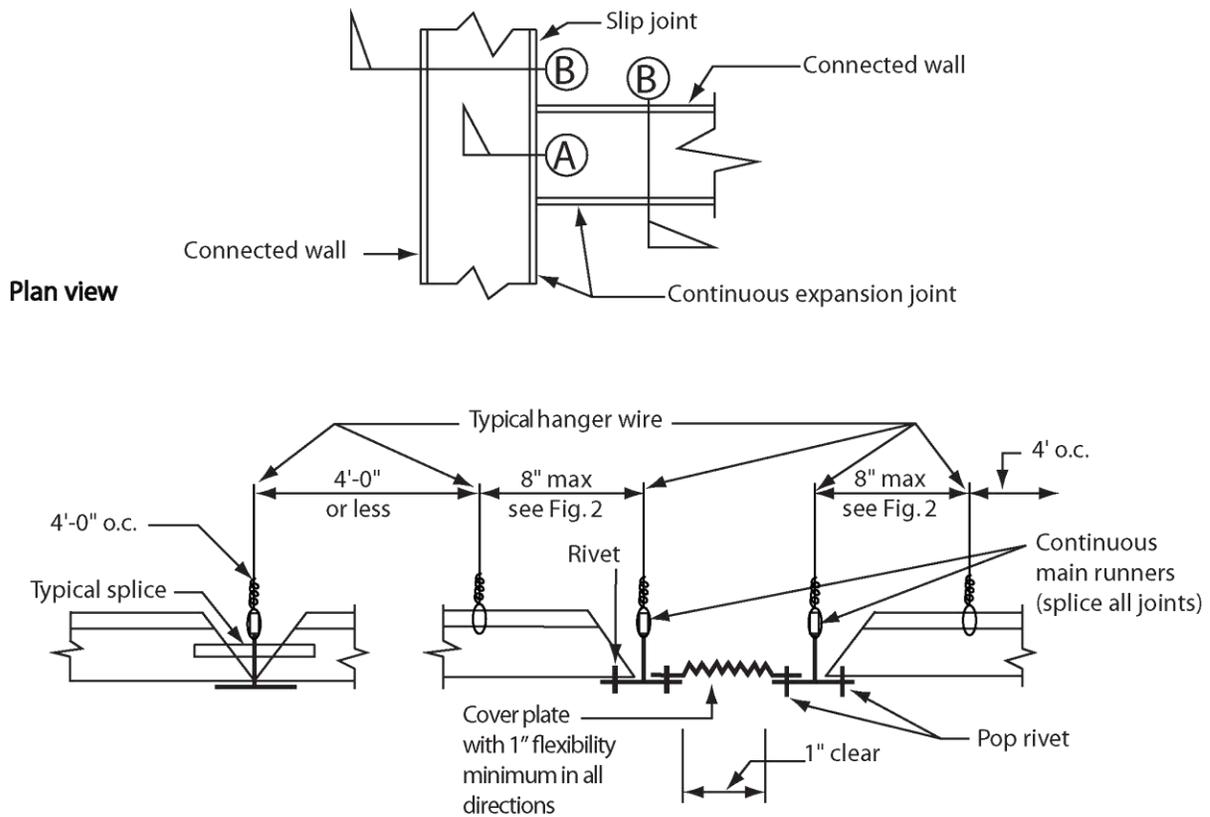


(C) At steel deck with concrete fill

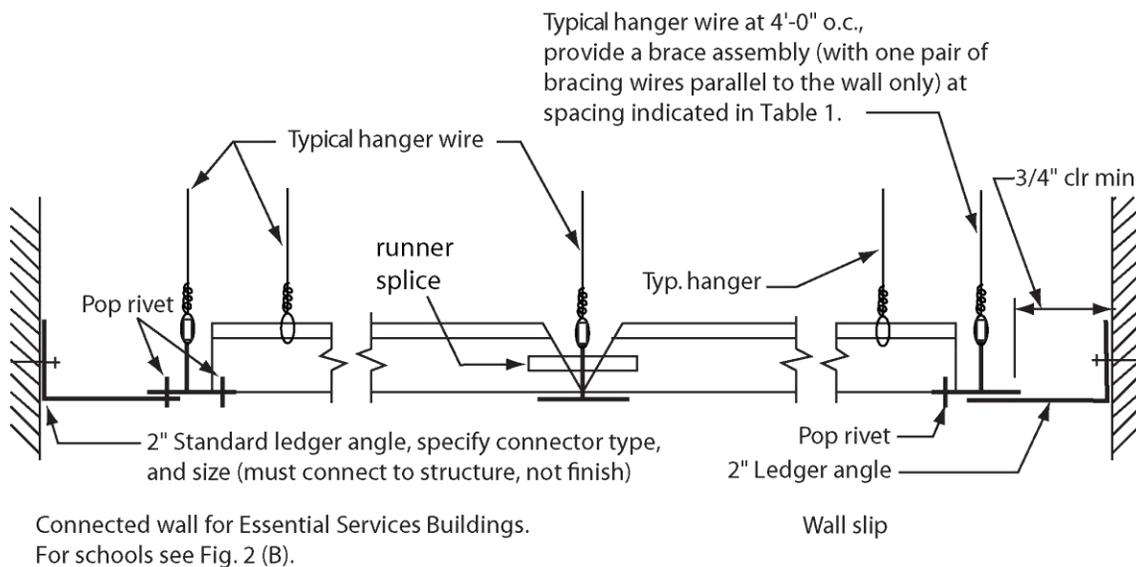
(D) At steel deck with concrete fill

Note: ① Show minimum required distance per manufacturer's evaluation report issued by ICC-ES or other qualifying evaluation agency per IR A-5.

Figure 7
ACCEPTABLE LOCATION OF EXPANSION JOINTS IN EXITWAYS



(A) Expansion joint at intersections of corridors, junctions of corridors and lobbies, similar areas and ceiling areas over 2500 sq. ft.



(B) Acceptable exitways details