
METAL SUSPENSION SYSTEMS FOR LAY-IN PANEL CEILINGS: 2007 CBC

IR 25-2.07

References:

California Code of Regulations (CCR), Title 24, Part 2
2007 California Building Code, Sections 803.9.1.1,
1614A.1.12 and 2506.2.1

Revised 05-18-11
Issued 06-22-09 as IR 25-5

Discipline: Structural

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 in the document at <http://www.dgs.ca.gov/dsa/Resources/IRManual.aspx> at the time of plan submittal to DSA are considered applicable.

Purpose: The purpose of this IR is to provide guidelines for the installation of metal suspension systems for lay-in ceilings for projects approved under the 2007 CBC. For projects submitted under the 2001 CBC or the 2010 CBC, see [IR 25-2.01](#) or [IR 25-2.10](#) respectively.

1. General Requirements: The following requirements apply to ceiling systems whose total weight, including ceiling mounted air terminals, services and light fixtures, does not exceed four (4) psf. Heavier systems, and those supporting lateral loads from partitions, will require special design details.

- 1.1** #12 gage wire shall be 0.106 inches in diameter conforming to ASTM A641. #12 gage wire shall be soft annealed, galvanized steel wire with a class 1 coating.
- 1.2** #12 gage hanger wires may be used for up to and including 4 ft. by 4 ft. grid spacing and shall be attached to main runners.
- 1.3** 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.
- 1.4** 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. Hanger wires that are more than 1 (horizontal) in 6 (vertical) out of plumb are to have counter-sloping wires.
- 1.5** Ceiling grid members shall be attached to two (2) adjacent walls per ASCE 7-05, Section 13.5.6.2(b). 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.
- 1.6** The width of the perimeter supporting closure angle shall be not less than 2 inches.
- 1.7** 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 strut or a #16 gage wire with a positive mechanical connection to the runner may be used. Where the perpendicular distance from the wall to the first parallel runner is 12 inches or less, this interlock is not required.
- 1.8** Expansion joints shall be provided in the ceiling at intersections of corridors and at junctions of corridors with lobbies or other similar areas. See Figure 7 Detail A.

- 1.9** 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).
- 1.10** The spacing of the bracing assemblies must be shown on the construction documents. Provide bracing assemblies at locations not more than one half (1/2) the calculated spacing in each direction from each perimeter wall and at the edges of any change in elevation of the ceiling.
- Substantiating calculations or test reports for the bracing assemblies are waived if the following requirements are met:
- Bracing assemblies spaced at a maximum of 12 feet by 12 feet on centers for school buildings and 8 feet by 12 feet on centers for essential services buildings, and
 - The maximum slenderness ratio (kL/R) of the compression strut is 200 or less.
- 1.11** 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 special DSA approval.
- 1.12** Compression struts shall not be more than 1 (horizontal) in 6 (vertical) out of plumb.
- 1.13** Suspended acoustical ceiling systems with a ceiling area of 144 square feet or less, and fire rated suspended acoustical ceiling systems with a ceiling area of 96 square feet or less, surrounded by walls which connect directly to the structure above or walls independently braced above ceiling to structure above, do not require bracing assemblies when attached to two adjacent walls.
- 1.14** For ceiling areas exceeding 2500 square feet a seismic separation joint shall be provided in accordance with Figure 7 Detail A to divide the ceiling into areas not exceeding 2500 square feet. Alternatively, structural analysis shall be performed to demonstrate compliance with ASCE 7-05, Section 13.5.6.2.2(d).
- 1.15** 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, swing joints may be provided per ASCE 7-05, Section 13.5.6.2.2(e).
- 1.16** Fasten #12 hanger wires with not less than three (3) tight turns. Fasten #10 or #12 bracing wires with four (4) tight turns. Make all tight turns within a distance of 1-1/2 inches. Hanger or bracing wire anchors 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.
- Note:** Wire turns made by machine where both strands have been deformed or bent in wrapping can waive the 1-1/2 inch requirement, but the number of turns should be maintained, and be as tight as possible.
- 1.17** Separate all ceiling hanger and bracing wires at least six (6) inches from all unbraced ducts, pipes, conduit, etc.
- 1.18** When drilled-in concrete anchors or shot-in anchors 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. Shot-in anchors in concrete are not permitted for bracing wires.
- Note:** Drilled-in or shot-in anchors require special DSA approval prior to use in prestressed concrete.

1.19 Attach all light fixtures and ceiling mounted air terminals, to the ceiling grid runners to resist a horizontal force equal to the weight of the fixtures. Screws or approved fasteners are required.

1.20 Flush or recessed light fixtures, weighing less than 56 lbs. and mechanical terminals and services, weighing less than 20 lbs., may be supported directly on the runners of a heavy duty grid system but, in addition, they must have a minimum of two (2) #12 gage slack safety wires attached to the fixture at diagonal corners and anchored to the structure above. All 4 ft. x 4 ft. light fixtures must have slack safety wires at each corner.

All flush or recessed light fixtures weighing 56 lbs. or more and mechanical terminals and services, weighing 20 lbs. or more, must be independently supported by not less than four (4) taut #12 gage wires, each attached to the fixture 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.

1.21 Support surface mounted light fixtures by at least two positive devices which surround the ceiling runner and which are each supported from the structure above by a #12 gage wire. Spring clips or clamps that connect only to the runner are not acceptable.

Provide additional supports when light fixtures are 8 ft. or longer. Maximum spacing between supports shall not exceed 8 feet.

1.22 Support pendant mounted light fixtures directly from the structure above with hanger wires or cables passing through each pendant hanger and capable of supporting two (2) times the weight of the fixture. 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 horizontal force. If the pendant mounted light fixture is directly and independently braced below the ceiling, i.e. aircraft cables to walls, then brace assembly is not required above the ceiling. See [IR 16-9](#) for additional requirement for pendant mounted fixtures.

1.23 The ceiling grid system must be rated as heavy duty as defined by ASTM C635. A list of acceptable grid systems must be shown on the drawings. The grid systems specified must be acceptable in accordance with IR A-5. The following information must 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 (1) (2).

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

(1) Runners must be rated as heavy duty.

(2) Show manufacturer, duty classification and catalog numbers.

2. ADDITIONAL REQUIREMENTS:

2.1 For Fire Rated Ceilings:

Provide a detail and design number for rated ceiling assemblies from an authorized testing agency listed by the State Fire Marshal (SFM) or from Chapter 7 of the 2007 CBC. A list of the SMF authorized testing agencies is available on the following website: <http://osfm.fire.ca.gov/strucfireengineer/pdf/lab/approvedtestinglabs.pdf>

The components and installation details must conform in every respect with the listed detail and number or with the components listed in the 2007 CBC, Chapter 7

for the design number specified. Details shall clearly depict all components, including insulation materials, of the design so that the assembly can be constructed and inspected accordingly. Custom designs which combine components from different approved designs but have not been tested as a complete assembly are not acceptable.

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

2.2 For Metal and Other Panels:

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

2.3 For Essential Services Buildings:

In exitways 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.

2.4 For 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.

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

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

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

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

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

1. The architect or structural engineer in general responsible charge must submit to DSA a detail and specification describing how the splice is to be made.
2. All new wires, after being spliced to the existing wires, must be field tested per Items 3.2 and 3.3 above.
3. All field tests must be performed in the presence of the project inspector.

4. 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.

5. DSA ACCEPTANCE: DSA no longer issues Acceptance Reports for products. Ceiling grid systems or components, with valid evaluation reports issued by qualified evaluation agencies in accordance with DSA [IR A-5](#), are accepted by DSA, provided the system or component meets the requirements of CBC Section 1614A.1.12 and ASCE 7-05, Section 13.5.6. Where 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.

Figure 1

SUSPENDED CEILING BRACING ASSEMBLY

Compression struts:

Compression struts shall not replace hanger wires. Maximum KL/R ratio of 200 or less. 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

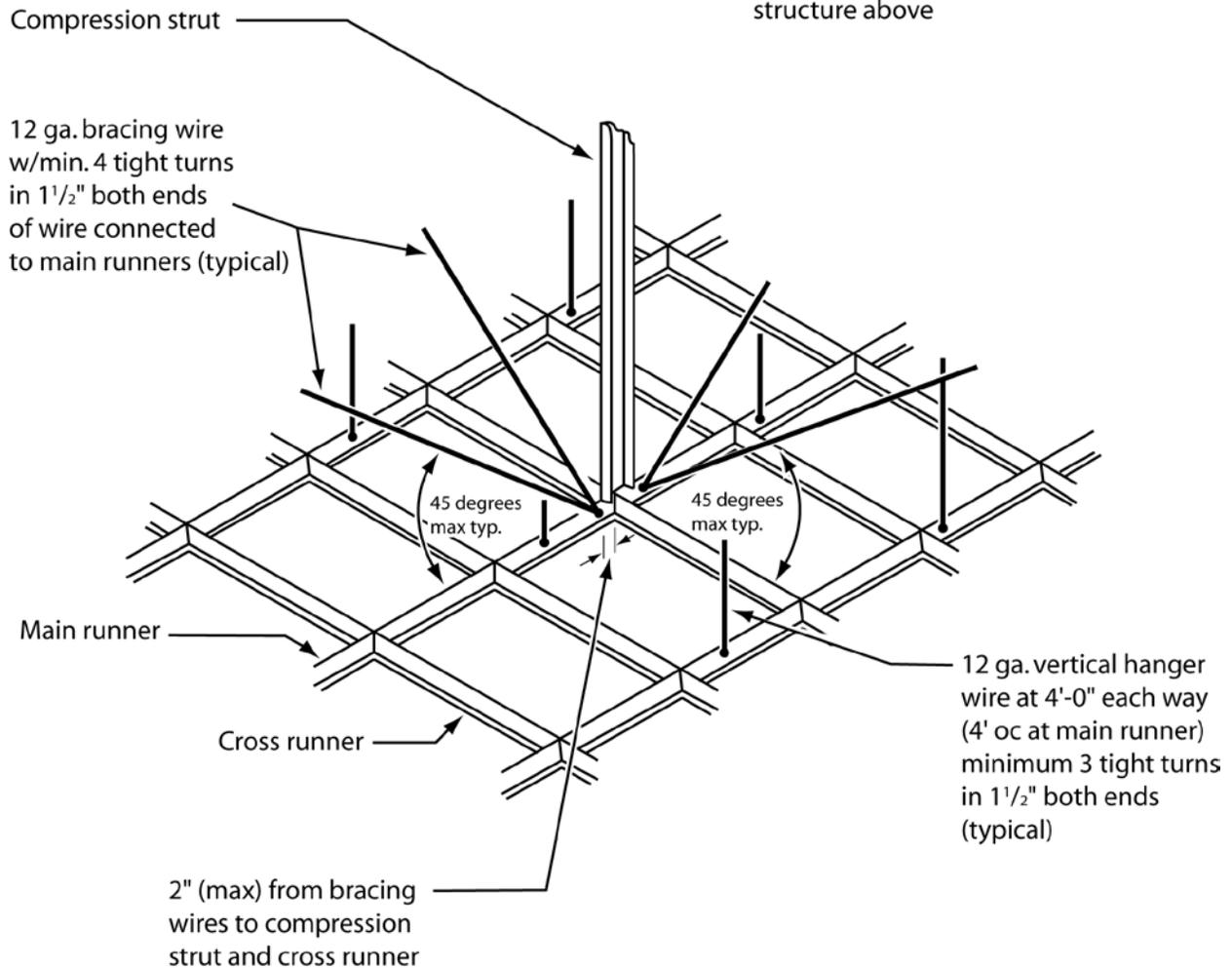
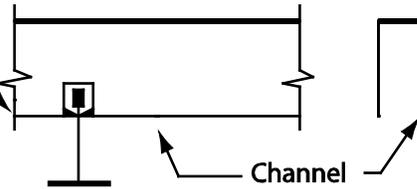
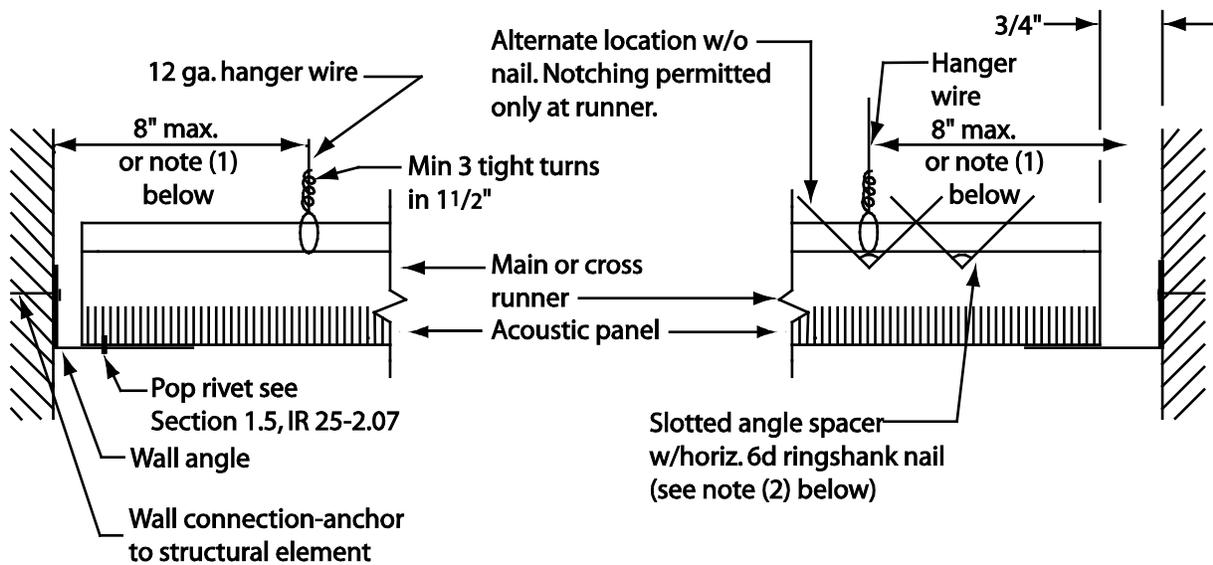


Figure 2
CEILING HANGER DETAILS

Spacers may be slotted angles or channels with "diamond points" of spring steel which snap tight to prevent movement of strut.

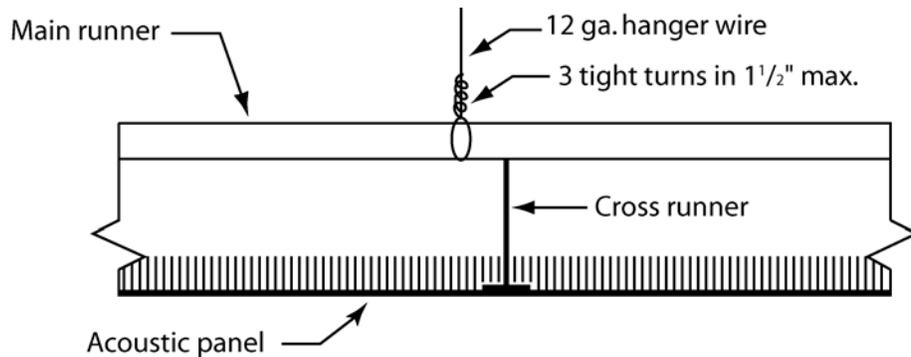


(A) Alternate Horizontal Strut



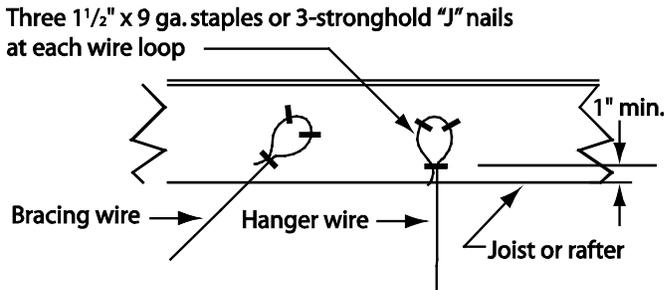
(B) Horizontal strut - typical (see Section 1.7)

- 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.

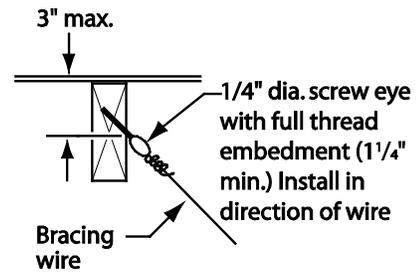


(C) Typical hanger wire to grid

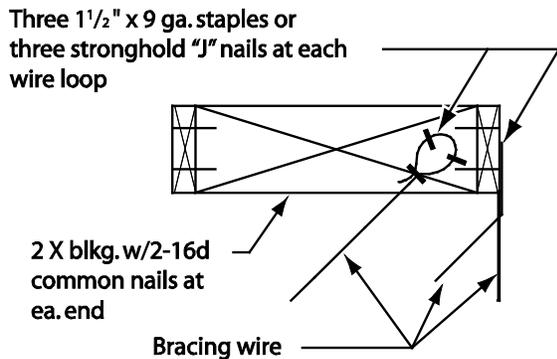
Figure 3A
ACCEPTABLE DETAILS - WIRE CONNECTIONS TO WOOD FRAMING



(A) Wood joist or rafter

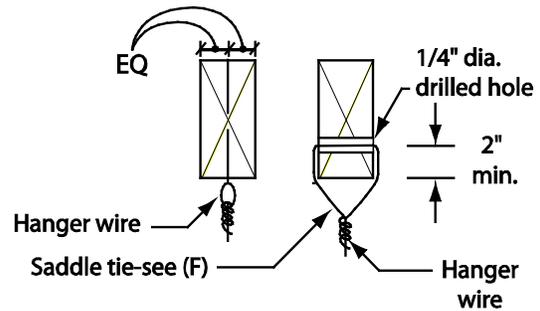


(B) Wood joist or rafter

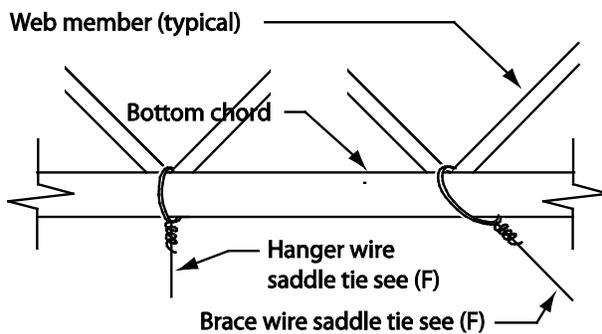


(C) Wood joist or block

For bracing wires - fully embed screw eye threads in direction of wire



(D) At bottom of joist



(E) Bracing wire parallel to wood truss

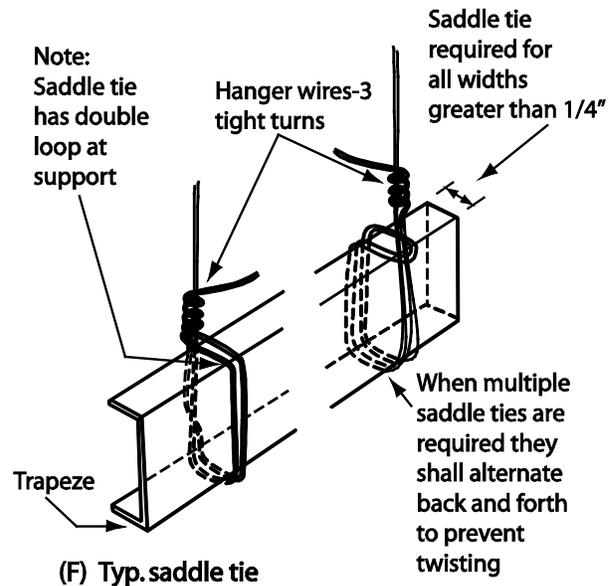
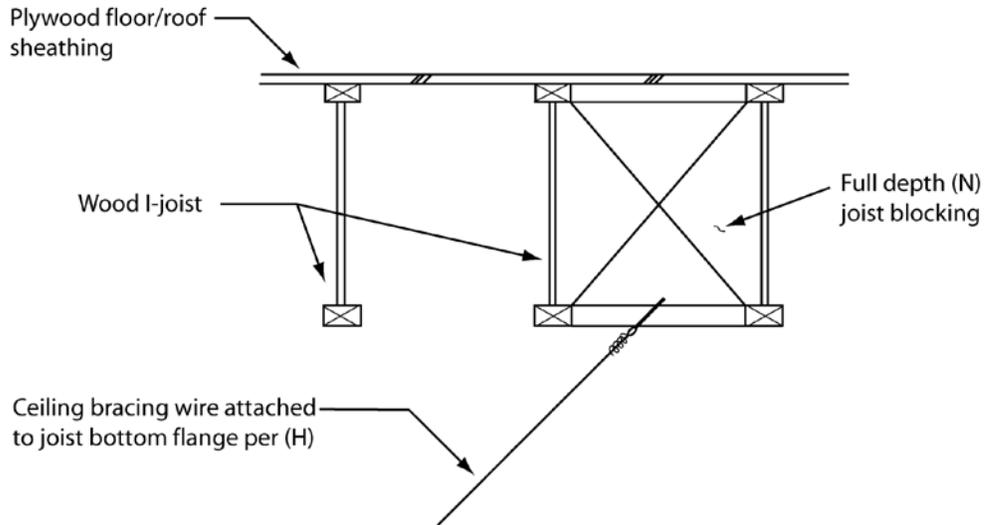
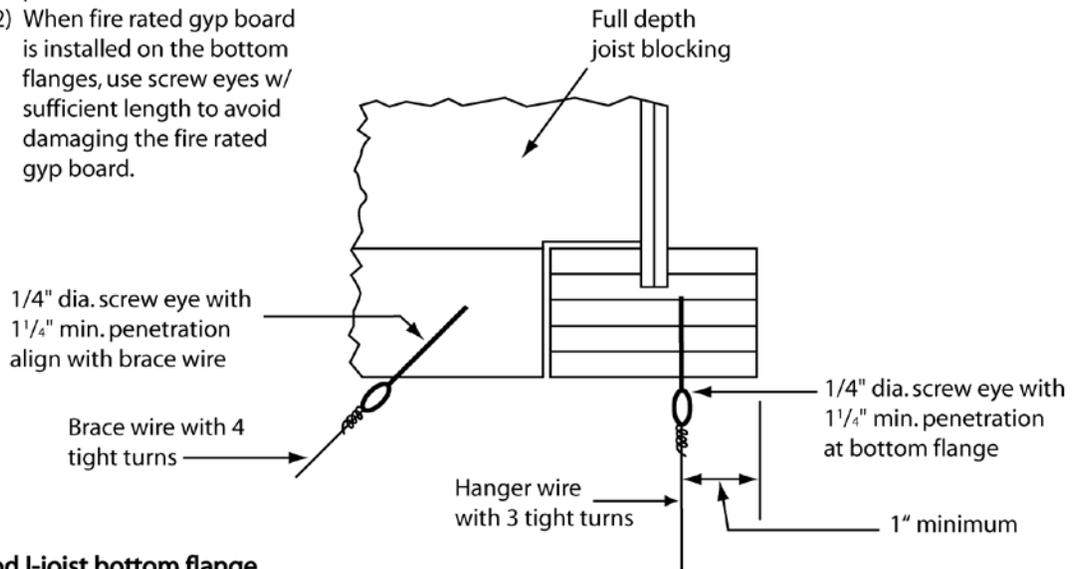


Figure 3B
ACCEPTABLE DETAILS - WIRE CONNECTION AT WOOD FRAMING



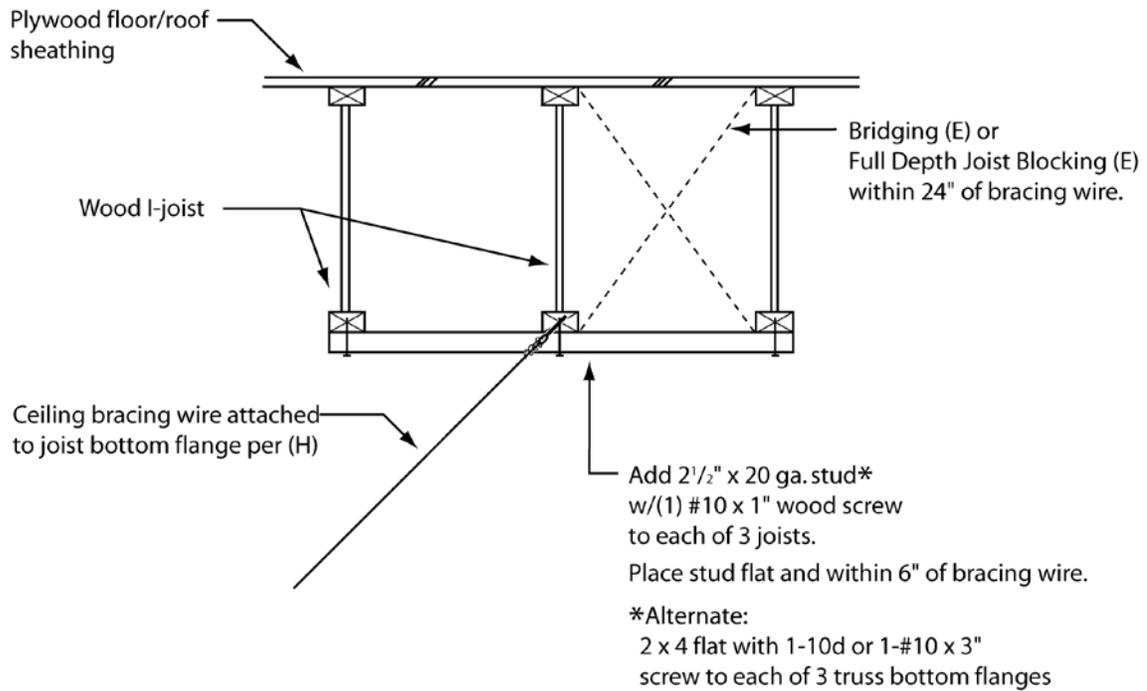
(G) Wood I-joint

- 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



(G) Wood I-joist

- 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.

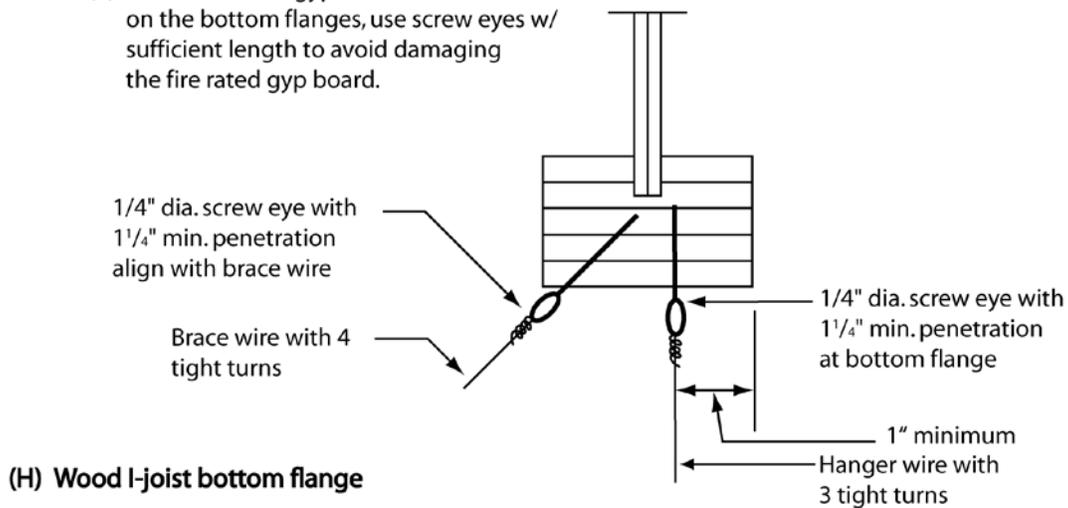
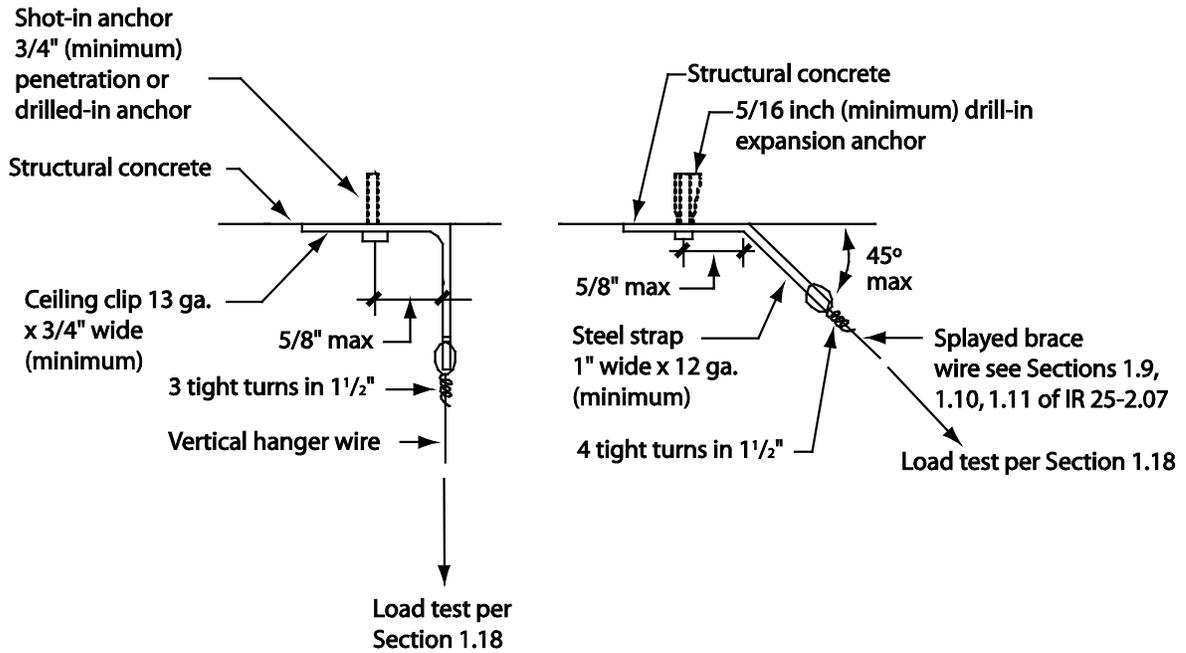


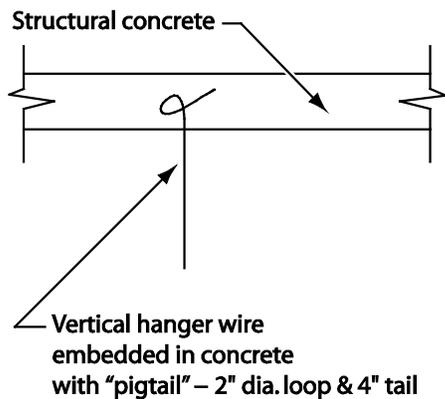
Figure 4
ACCEPTABLE DETAILS - WIRE CONNECTION TO CAST-IN-PLACE CONCRETE

Shot-in anchors not allowed for bracing wires

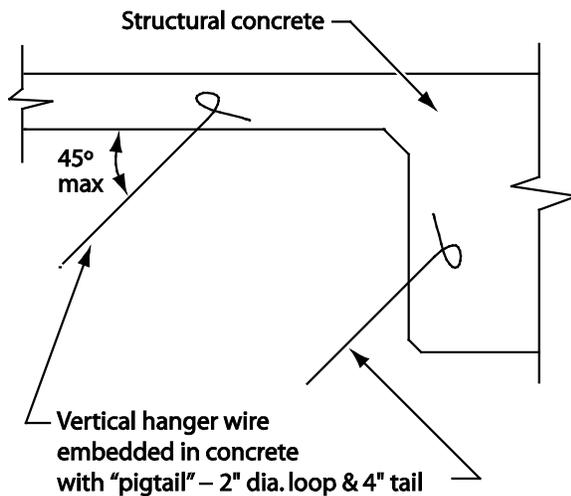


(A) Vertical hanger wire clip attachment

(B) Splayed bracing wire clip attachment

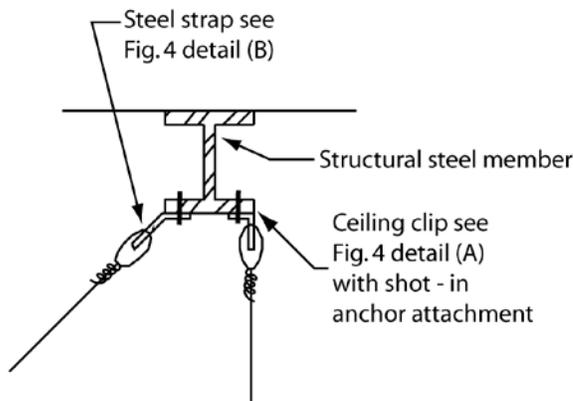


(C) Hanger wire at C.I.P. concrete

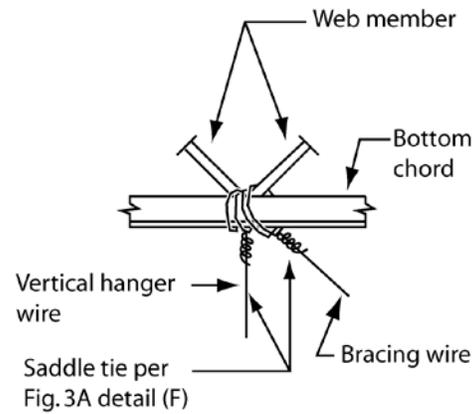


(D) Brace wire at C.I.P. concrete

Figure 5
ACCEPTABLE DETAILS - WIRE CONNECTIONS TO STEEL FRAMING

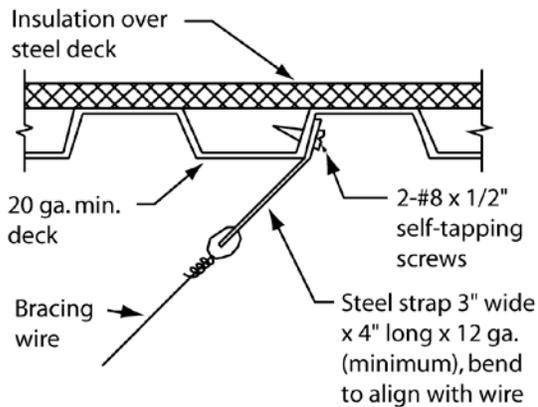


(A) At steel beams

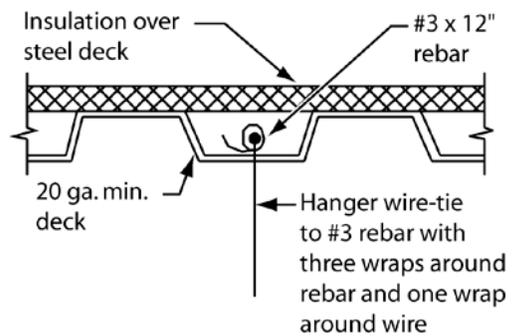


Brace wires parallel to joist.
Brace wires can not be perpendicular to joist

(B) At open-web steel joist



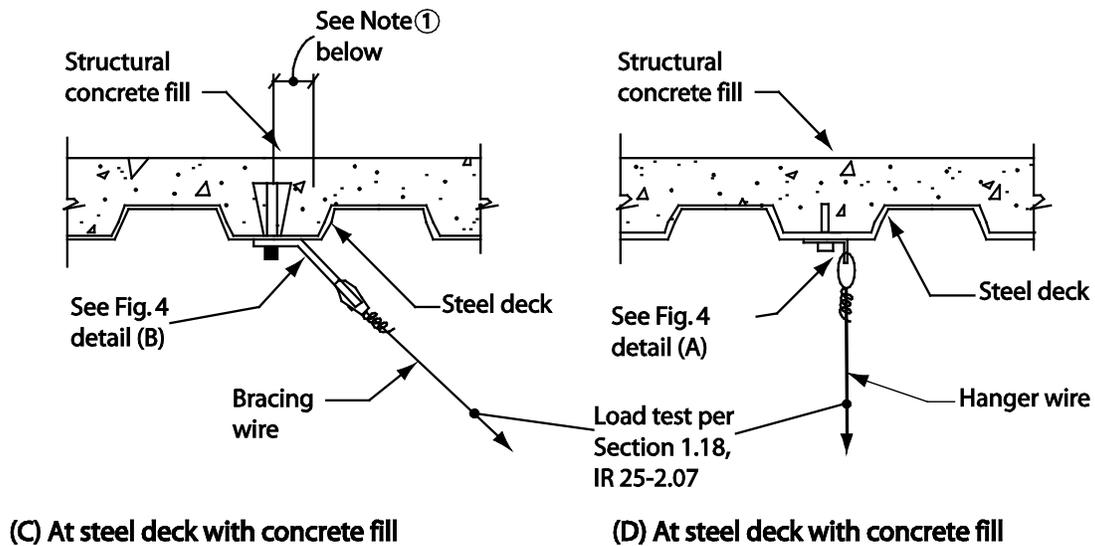
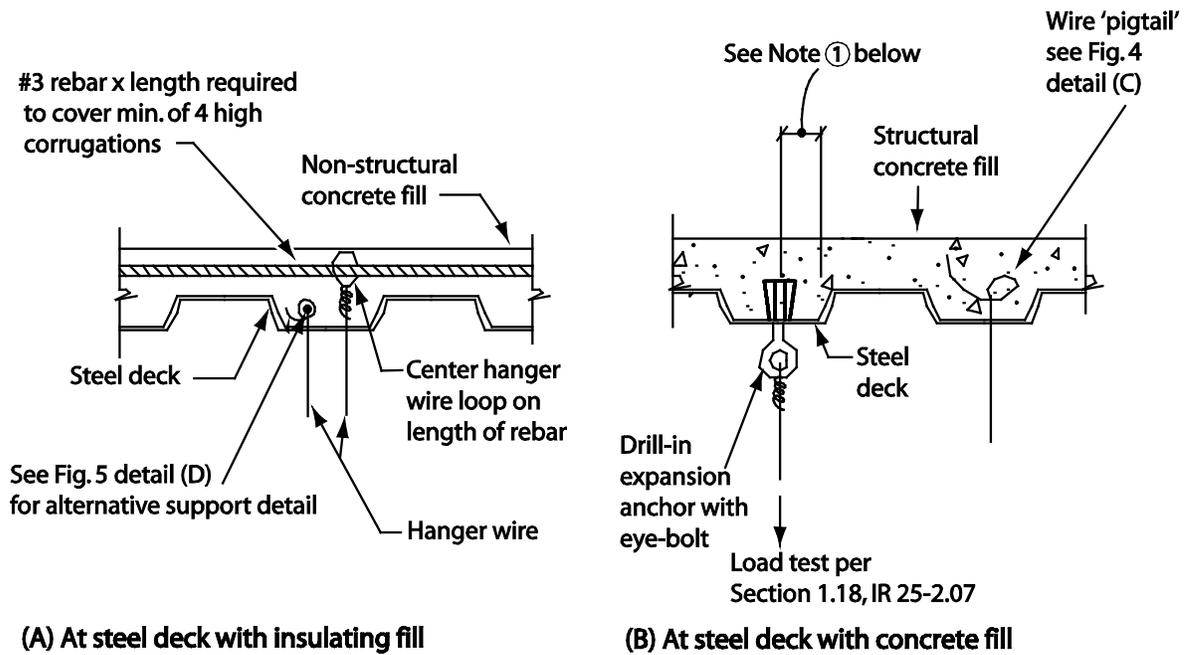
(C) At steel roof deck



(D) At steel roof deck

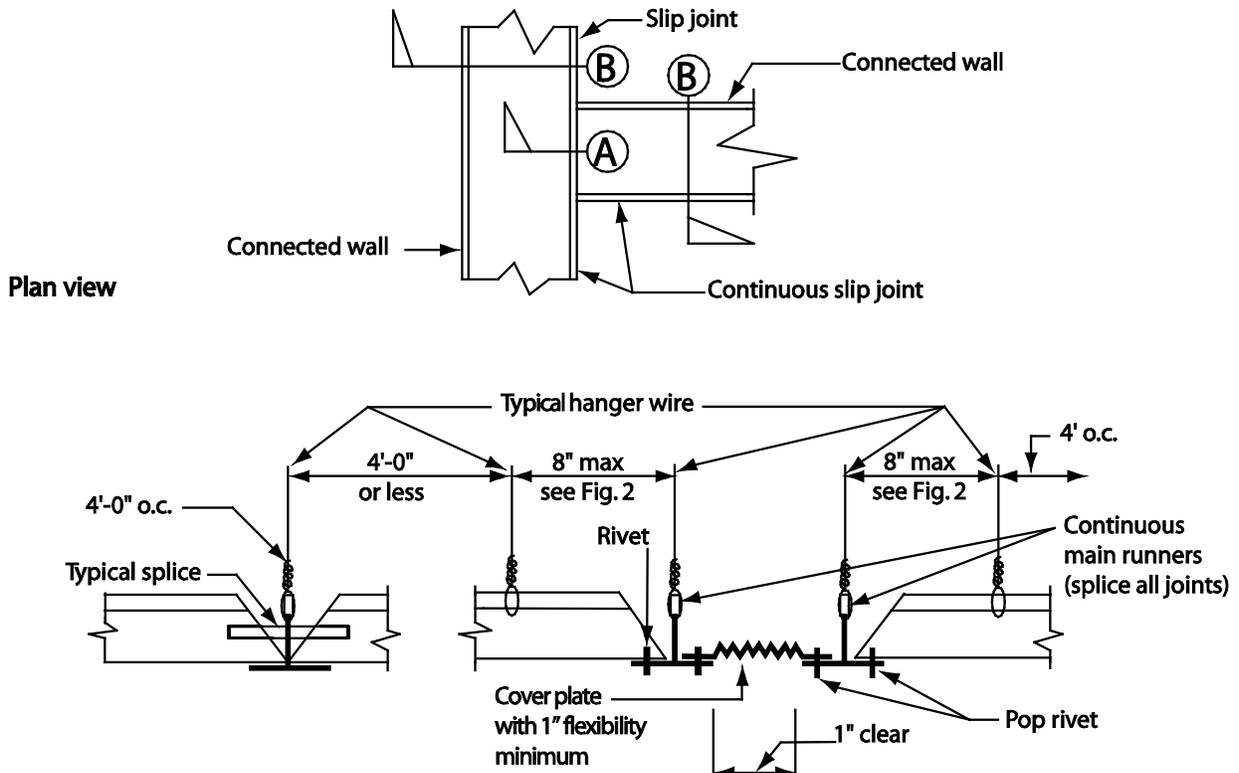
Note: If self-tapping screws are used with concrete fill, set screws before placing concrete

Figure 6
ACCEPTABLE DETAILS - WIRE CONNECTIONS TO STEEL DECK

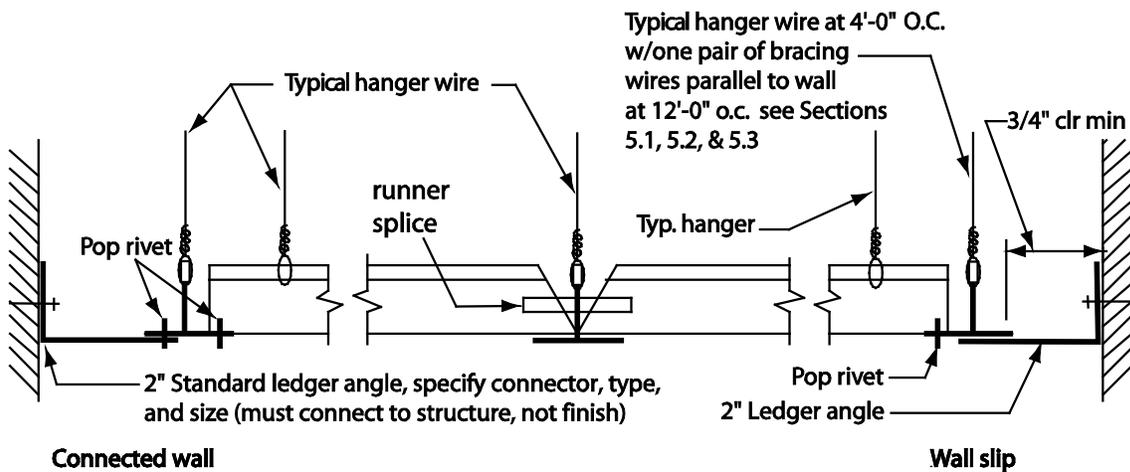


Note: ① Show minimum required distance per manufacturer's evaluation report issued by ICC-ES or other qualifying evaluation agency per IR A-5.

Figure 7
ACCEPTABLE LOCATION OF SLIP JOINTS IN EXITWAYS



(A) Slip joint at exitways intersection or expansion joint for ceiling area over 2500 sq. ft.



(B) Acceptable exitways details