

GYP SUM BOARD CEILING SUSPENSION CONVENTIONAL CONSTRUCTION – ONE LAYER

References:

California Code of Regulations (CCR), Title 24
Part 2: California Building Code (CBC) 2013 CBC, Section 2508
ASTM C754-04, ASTM C840-07, ASTM E580-10a
ASCE 7-10

Disciplines: Structural**History:**

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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 and 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.

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

PURPOSE: This Interpretation of Regulations (IR) describes prescriptive methods for the installation of suspended gypsum board ceiling systems. These methods represent a means of complying with the California Code of Regulations, Title 24 Part 2, and are acceptable to the Division of the State Architect (DSA). This IR does not preclude the designer from using other methods of installation, including proprietary systems discussed in Section 6, if submitted to and approved by the DSA.

This IR is applicable to projects submitted to the DSA for review under the 2013 edition of the California Building Code (CBC). For projects submitted for review under the 2007 and 2010 CBC see IR 25-3.

1. MATERIALS: Materials are to comply with CBC Section 2508 and applicable ASTM standards. Gypsum wallboard is either 1/2 inch or 5/8 inch in thickness. Cold-formed steel sections specified in this IR are identified by a product designator which has been standardized by the American Iron and Steel Institute (AISI) in collaboration with the Steel Stud Manufacturers Association (SSMA).

2. DESIGN: The prescriptive requirements of this IR shall be taken as the minimum requirements and apply to a ceiling that is not accessible, has a single layer of gypsum board not exceeding 5/8" thick, and has a total ceiling weight not to exceed four (4) pounds per square foot (psf). A ceiling that is required by CCR Title 24 to be accessible, or otherwise does not meet these limitations, shall be designed to meet the applicable requirements of CBC Sections 1607A and 2508.1, and ASCE 7-10, Section 13.3.1.

3. DETAILS OF CONSTRUCTION:

3.1 General: Gypsum board ceilings shall not support building components other than air conditioning/heating grills or light fixtures. All such components shall be supported either directly from main runners, or by supplemental framing which is supported by main runners. No vertical loads other than gypsum board dead load shall be applied to cross-furring.

3.2 Vertical Support System: There are many possible variations of main runner sizes, spacings, and spans listed in ASTM C754-04, Table 7. All of the combinations are acceptable, provided the main runner spacing does not exceed 4'-0" and the ceiling area supported by a hanger wire does not exceed 16 square feet.

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3.2.1 Main Runner Spacing and Span: The main runner most frequently used is a 1-1/2 inch cold rolled channel designated 150U050-54 (1-1/2 inch cold rolled channels weighing 0.414 lbs/ft) spaced no more than 4'-0" o.c. with a hanger wire spacing not to exceed 4'-0" o.c. and no more than 6" from each end of the main runner.

3.2.2 Vertical hanger wires: Ceiling wire shall be Class 1 zinc coated (galvanized) carbon steel conforming to ASTM A641. Wire shall be #9 gage (0.148" diameter) with soft temper and minimum tensile strength = 70 ksi.

3.2.3 Cross-furring: 7/8 inch galvanized steel hat sections, designated 087F125-18, at 24 inches o.c. maximum.

3.3 Connecting Hanger Wires, Steel Framing and Furring:

3.3.1 Hanger wires shall be saddle-tied to the main runners per IR 25-2.13 Figure 3A(F).

3.3.2 Cross furring shall be saddle-tied to the main runners with at least one strand of #16 gage, or two strands of #18 gage tie wire.

3.3.3 Main runners shall be spliced by lapping and interlocking flanges and installing two (2) #8 screws at each end of splice. The lap must be a minimum of 12 inches long.

3.3.4 Cross furring shall be spliced by lapping and interlocking the pieces and installing two (2) #8 screws at each end of splice. The lap must be a minimum of eight (8) inches long.

3.4 Installation and Anchorage of Hanger and Bracing Wires: Fasten hanger wires with not less than three (3) tight turns within a distance of three 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). Fasten bracing wires with four (4) tight turns within a distance of one and one-half (1-1/2) inches. Hanger and bracing wire anchors shall be installed in such a manner that the direction of the anchor aligns as closely as possible with the direction of the wire.

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

3.4.2 When drilled-in concrete anchors or power actuated fasteners are used in reinforced concrete for hanger wires, 1 out of 10 must be field tested for 200 lbs. in tension. When drilled-in concrete anchors are used for bracing wires, 1 out of 2 must be field tested for 440 lbs in tension. Power actuated fasteners in concrete are not permitted for bracing wires. If any power actuated fastener or drilled-in anchor fails, see 2013 CBC Section 1913A.7.1 or 1913.2.11.1*.

Note: Drilled-in anchors or power actuated fasteners embedment depth shall be limited in prestressed concrete to not impinge tensioned reinforcement or special procedures shall be developed to locate and clear tensioned reinforcement.

3.4.3 Provide trapeze or other supplementary support members at obstructions to typical hanger spacing. Provide additional hangers, struts or braces as required at all ceiling breaks, soffits or discontinuous areas. Hanger wires that are more than 1 in 6 out of plumb are to have counter-sloping wires.

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4. CEILING FIXTURES, TERMINALS, AND DEVICES:

- 4.1** All recessed or drop-in light fixtures, as well as ceiling mounted mechanical air terminals and services, shall be supported directly by main runners or by supplemental framing which is supported by main runners and positively attached with screws or other approved connectors to resist a horizontal force equal to the weight of the component. A minimum of two attachments are required at each fixture and component.
- 4.2** Surface mounted fixtures shall be attached to a main runner with a positive clamping device made of material with a minimum of 14 gage. Rotational spring clamps do not comply.
- 4.3** Light fixtures, grilles, mechanical terminals, and flexible sprinkler hose fittings or other services weighing greater than 20 lbs. must be independently supported by not less than two (2) taut #12 gage wires where less than 56 pounds, and four (4) taut #12 gage wires where greater than or equal to 56 pounds, and attached to the housing and to the structure above. The wires, including their attachment to the structure above, must be capable of supporting four (4) times the weight of the unit.
- 4.4** All lightweight miscellaneous devices, such as strobe lights, occupancy sensors, speakers, exit signs, etc., shall be attached to the ceiling per Section 4.1 of this IR. Devices weighing more than 20 lbs. shall be supported from the structure above per Section 4.3 of this IR.
- 4.5** 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 1 inch of ceiling movement shall be permitted to be used in lieu of the oversized ring, sleeve, or adapter.
- 4.6 Access Panels:** Access to the space between the ceiling and the floor or roof above shall not be allowed. Small access panels for the inspection, adjustment or repair of utility switches, valves, sensor, etc. may be allowed if the panel is less than 300 square inches. Such panels shall also have a permanently attached warning label as follows:

“Warning: 1) Do not climb, walk, or crawl on the gypsum board ceiling panels or metal framing.
 2) Do not store or stow anything on the gypsum board ceiling panels or metal framing.”

If fire fighter access is required per CBC Section 1209.2 in attics of combustible construction, the prescriptive suspended ceiling system prescribed in this IR is not applicable, and the ceiling shall be framed and designed for such loading.

5. LATERAL SYSTEM:

A gypsum board ceiling greater than 144 square feet in area shall be designed to resist its own seismic loads, per Section 2 above, and shall not be permitted to be used to resist primary structural loads or other loads. There are two optional lateral systems for this purpose:

- The brace wire system, per Section 5.1.
- The diaphragm system, per Section 5.2.

Either or both options may be shown on plans or noted in the specifications.

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Notes:

1. If both options are shown on the plans or noted in the specifications, only one option can be used for each separate ceiling area.
2. Fire-rated systems shall be installed per rated listing (i.e. UL, Factory Mutual, etc.) and manufacturers’ instruction, and the rated listing may dictate the optional lateral system used.

5.1 Brace Wire System: Lateral force bracing assemblies shall consist of a compression strut and four (4) #12 gage splayed bracing wires oriented 90 degrees from each other (see IR 25-2.13 Figure 1). 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.

5.1.1 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 edge 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.

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

5.1.3 Ceiling grid members may be attached to not more than two (2) adjacent walls. Ceiling grid members shall be at least 1 inch free 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 1 inch clear of wall.

5.1.4 Suspended ceiling systems with an area of 144 square feet or less, surrounded by walls which connect directly to the structure above, do not require bracing assemblies when attached to at least two adjacent walls and the perimeter walls are designed to carry the ceiling lateral forces.

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5.2 Diaphragm System: A suspended gypsum board ceiling may be designed as a horizontal diaphragm to resist its own seismic loads as prescribed in this section. Gypsum board shall not be used in diaphragm ceilings to resist lateral forces imposed by partitions.

5.2.1 Diaphragm Ratios:

Horizontal 2:1 maximum

Vertical 1:1 maximum

5.2.2 A maximum diaphragm shear equal to 50 lbs/ft is allowed with 1 inch or 1-1/4 inch Hi-Lo Type S, or S-12, bugle head screws at 12 inches o.c. at all gypsum board edges (3/8 inch screw edge distance) and at all intermediate supports. A wall constructed similarly can resist the same shear force provided the gypsum board is on the same side of the studs as the ceiling is, and a positive connection between the ceiling and the wall is detailed. The gypsum board diaphragms are to resist lateral loads due to their own weight and/or the ceiling diaphragm(s) only.

5.2.3 Details are required providing for lateral load transfer from the gypsum board to shear walls, or other lateral load resisting elements, on all four sides of the diaphragm. There shall be no steps or vertical offsets in the ceiling plane.

6. DSA ACCEPTANCE OF EVALUATION REPORTS: At the discretion of the DSA, proprietary systems may be accepted under all the following conditions:

- Acceptance will be granted on a project specific basis.
- Proprietary systems must meet the requirements of the CBC.
- Proprietary systems must have valid evaluation reports meeting the provisions of DSA IR A-5.

In accordance with DSA IR A-5, DSA will accept OSHPD Preapproved Details (OPD) "2013 CBC Standard Gypsum Board Ceiling Details for Suspended and Joist Framing Construction."