



~~Designation: E580/E580M-06~~ Designation: E 580/E 580M – 08

# ~~Standard Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint~~Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions<sup>1</sup>

This standard is issued under the fixed designation E 580/E 580M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the Department of Defense.*

## 1. Scope

~~1.1 This practice covers acoustical ceiling suspension systems and their additional requirements for application in areas subject to light to moderate seismic disturbance such as Uniform Building Code Seismic Zone 2, the BOCA Basic National Building Code where  $A_v$  is less than 0.20 but greater than 0.10, and the Standard Building Code (SBC) where  $A_v$  is less than 0.20 but greater than 0.05. This practice also covers areas subject to moderate to severe seismic disturbance such as Uniform Building Code Seismic Zones 3 and 4, the BOCA Basic National Building Code where  $A_v$  is greater than 0.20, and the SBC where  $A_v$  is greater than 0.20. The application of this practice is to be determined by local authorities. Current seismic maps published by recognized authorities such as those previously mentioned, should be consulted. Related material such as Open File 82-1033 and MS-812 Seismicity Map may also be consulted.~~

~~1.2 Specification C635~~

~~1.1 This practice covers installation of suspended ceiling systems and their additional requirements for two groups of buildings that are constructed to resist the effects of earthquake motions as defined by ASCE 7 and the International Building Code. These groupings are for Seismic Design Category C and Seismic Design Categories D, E and F.~~

~~1.2 The authority having jurisdiction shall determine the applicability of this practice.~~

~~1.3 Specification C 635 and Practice C 636 cover suspension systems and their application without special regard to seismic restraint needs. They remain applicable and should be followed when this practice is specified.~~

~~1.3 This practice is not intended to stifle research and development of new products or methods which may simplify this specified application method. A variation, however, must be substantiated by verifiable engineering data.~~

~~1.4 A ceiling area of 144 ft<sup>2</sup> cover suspension systems and their installation without special regard to seismic lateral restraint needs. They remain applicable and shall be followed when this practice is specified.~~

~~1.4 This practice is not intended to stifle research and development of new products or methods. This practice is not intended to prevent the installation of any material or prohibit any design or method of construction not prescribed in this practice, provided that any such alternative has been substantiated by verifiable engineering data or full-scale dynamic testing that is acceptable to the authority having jurisdiction.~~

~~1.5 Ceiling areas of 1000 ft<sup>2</sup> [13m<sup>2</sup>] or less, surrounded by walls that connect directly to the structure above shall be exempt from this practice.~~

~~1.5] or less shall be exempt from the lateral force bracing requirements of 5.2.8.~~

~~1.6 Ceilings constructed of lath and plaster or gypsum board which is screw or nail attached to suspended members that support a ceiling on one level extending from wall to wall shall be exempt from the lateral force bracing requirements of 5.2.8.~~

~~1.7 Free floating ceilings (those not attached directly to any structural walls) supported by chains or cables from the structure are not required to satisfy the seismic force requirements provided they meet the following requirements:~~

~~1.7.1 The design load for such items shall equal 1.4 times the vertical operating weight.~~

~~1.7.2 Seismic interaction effects shall be considered in accordance with 5.7.~~

~~1.7.3 The connection to the structure shall allow a 360° range of motion in the horizontal plane.~~

~~1.8 The values stated in either inch-pound or SI units are to be regarded as standard. Within the text, the SI units are shown~~

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee E33 on Building and Environmental Acoustics and is the direct responsibility of Subcommittee E33.04 on Application of Acoustical Materials and Systems.

Current edition approved July 15, 2006; May 1, 2008. Published July 2006; June 2008. Originally approved in 1976. Last previous edition approved in 2002 as E580-02<sup>ε1</sup>-E 580 – 06.

in brackets. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems result in nonconformance with the specification.

1.9 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1.6 The values stated in either inch-pound or SI units are to be regarded as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

C 635 Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings

C 636 Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels

### 2.2 Other Standards:

National Electric Code, 1993-ASCE 7 Minimum Design Loads for Buildings and Other Structures<sup>3</sup>

Uniform Building Code, 1994-CISCA Recommendations for Direct-hung Acoustical Tile and Lay-in Ceilings, Seismic Zones 0-2<sup>4</sup>

BOCA Basic Building Code, 1993-CISCA Guidelines for Seismic Restraint for Direct Hung Suspended Ceiling Assemblies, Seismic Zones 3 & 4<sup>4</sup>

International Building Code<sup>5</sup>

NFPA 70 National Electric Code<sup>6</sup>

## 3. Areas Subject to Light to Moderate Seismic Disturbance

### 3.1 Significance and Use

3.1 This practice is a prescriptive set of installation methods to be used for suspended ceilings and is often used in lieu of designing a separate lateral restraint system. The authority having jurisdiction shall determine the applicability of this practice to local code requirements.

3.2 This practice covers installation of suspended ceiling systems and related components in areas that require resistance to the effects of earthquake motions as defined by ASCE 7 and the International Building Code.

<sup>2</sup> Open File 82-1033 Probabilistic Estimate of Maximum Acceleration in Rock published by United States Geological Survey.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> MS-8125 Seismicity Map of the Conterminous United States and Adjacent Areas, 1965-1974 published by United States Geological Survey.

<sup>3</sup> Available from American Society of Civil Engineers (ASCE), 1801 Alexander Bell Drive, Reston, VA 20191 or www.pubs.asce.org.

<sup>4</sup> For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>4</sup> Available from Ceiling & Interior Systems Construction Association (CISCA), 1500 Lincoln Hwy, Suite 202, St. Charles, IL 60174.

<sup>5</sup> Available from National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

<sup>5</sup> Available from International Code Council (ICC), 4051 West Flossmoor Road, Country Club Hills, IL 60478-5795.

<sup>6</sup> Available from International Conference of Building Officials, 5360 S. Workman Mill Rd., Whittier, CA 90601.

<sup>6</sup> Available from National Fire Prevention association (NFPA), 1 Batterymarch Park, Quincy, MA 02269-9101.

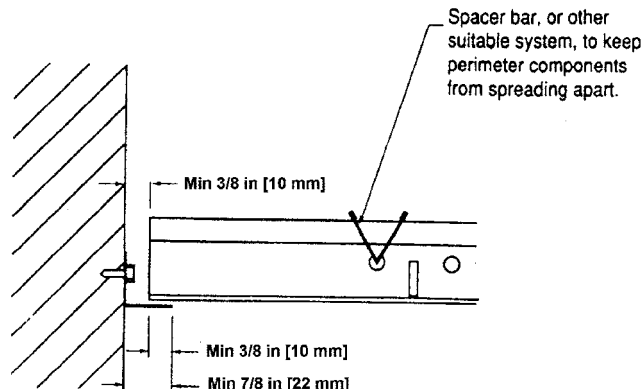


FIG. 1 Light to ModerCategory C Treatment of Cross Runners, Main Runners, and Wall Closures at Terminal Ends

3.3 The practice is broken into two main sections. The first section covers areas with light to moderate earthquake potential (Seismic Design Category C) while the second deals with severe earthquake potential (Seismic Design Category D, E & F).

3.4 This practice includes requirements from multiple sources including previous versions of this practice, CISCA Seismic Recommendations for Direct-hung Acoustical Tile and Lay-in Ceilings, Seismic Zones 0-2 and CISCA Guidelines for Seismic Restraint for Direct Hung Suspended Ceiling Assemblies, Seismic Zones 3 & 4, suspended ceiling requirements from the International Building Code and ASCE 7. The purpose is to combine the requirements from these sources into a single comprehensive document.

#### **4. Seismic Design Category C**

NOTE 1—This section is intended to provide an unrestrained (free-floating) ceiling system that will accommodate the movement of the structure during a seismic event.

##### *4.1 Suspension System Components :*

3.1.1 The actual average weight of the ceiling system, including grid, panel or tile, light fixtures, and air terminals must be 2.5 lb/ft<sup>2</sup> [12 N/m<sup>2</sup>]

4.1.1 The recommendations in this section are for ceilings systems with an average weight over the entire ceiling of 2.5 lb/ft<sup>2</sup> [12 N/m<sup>2</sup>] or less. All other services must be supported independently from the ceiling system. For ceilings that have an average weight greater than 2.5 lb/ft<sup>2</sup> or less. This average weight includes suspension members, panels or tiles, light fixtures, supported flexible sprinkler drops and air terminals. (See 4.4 and 4.5 for details on lights and mechanical services.) Ceilings with an average weight over the entire ceiling greater than 2.5 lb/ft<sup>2</sup> [12 N/m<sup>2</sup>], the ceiling may be installed as specified in Section 4. Other deviations or variations must be substantiated by verifiable engineering data.

3.1.2 The main runners and cross runners of the ceiling system and their splices, intersection connectors, and expansion devices shall be designed and constructed to carry a mean ultimate test load of not less than 60 lb [27 kg] in tension with a 5° misalignment of the members in any direction and in compression. Instead of a 5° misalignment, the load may be applied with a 1-in. [25mm] eccentricity on a sample not more than 24 in. [600 mm] long on each side of the splice.

3.1.3 Evaluation of test results shall be made on the basis of the mean values resulting from tests of not fewer than three identical specimens, provided the deviation of any individual test result from the mean value does not exceed ±10%.

3-2] shall be installed as specified in Section 5 taking into account the design lateral forces appropriate for Category C. Other deviations or variations shall be substantiated by verifiable engineering data or full-scale dynamic testing.

4.1.2 The main runners and cross runners of the ceiling system and their splices, intersection connectors, and expansion devices shall be designed and constructed to carry a mean ultimate test load of not less than 60 lb [27 kg] in tension and in compression. Allow for a 5° misalignment of the connection in each direction. Instead of a 5° misalignment, the load can be applied with a 1-in. [25-mm] eccentricity on a sample not more than 24 in. [600 mm] long on each side of the splice.

4.1.3 Evaluation of test results shall be made on the mean values resulting from tests on a minimum of three identical specimens. If the deviation of any individual test result exceeds ±10 % from the mean value, three additional samples shall be tested. After the required testing on the six specimens is complete. Drop the high and low test values and use the remaining four test results to obtain the mean test value average. If one of the remaining test results still exceeds the ±10 % mean value, the lowest individual test value recorded from the six test will be used as the reported test result.

##### *4.2 Suspension System Application :*

3.2.1 All perimeter closure angles or channels shall provide a support ledge of approximately 7/8 in. [22 mm] or greater.

3.2.2 The end of a grid member (or tile) that rests on the ledge or molding shall have at least 3/8-in. [10 mm] clearance from an edge or wall as shown in Fig. 1. Reveal (shadow) edge wall closures should accommodate these clearances as shown in Fig. 2. Ends of main runners and cross members shall be tied together to prevent their spreading.

3.2.3 Direct concealed suspended ceiling systems shall have positively connected stabilizer struts or mechanically connected cross runner at a maximum spacing of 60 in. [1500 mm] perpendicular to the main runners (see

4.2.1 Unless perimeter members meet the structural load carrying requirements and have been approved as a structural part of the system, wall angles or channels shall be considered as aesthetic closers and shall have no structural value assessed to themselves or their method of attachment to the walls.

4.2.2 All perimeter closure angles or channels shall provide a support ledge of 7/8 in. [22 mm] or greater unless the perimeter ends of each cross runner and main runner shall be independently supported as specified in 4.2.1.

4.2.3 When a perimeter closure angle that provides less than 7/8 in. [22 mm] has been approved for use, the perimeter ends of each cross runner and main runner shall be independently supported within 8 in. [200 mm] from each wall or ceiling discontinuity (see Fig. 3). Stabilizer bars shall occur within 24 in. [600 mm] of each wall.

3.2.4.

4.2.4 The terminal ends of suspension members shall have a minimum of 3/8-in. [9-mm] clearance from the wall as shown in Fig. 1. Reveal (shadow) edge wall closures with these clearances are shown in Fig. 2.

4.2.5 Terminal ends of main runners and cross members shall be tied together to prevent their spreading 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. [200 mm] of each wall.

4.2.6 Permanent runner end attachment (i.e., pop rivets) for grid alignment purposes shall not be permitted.

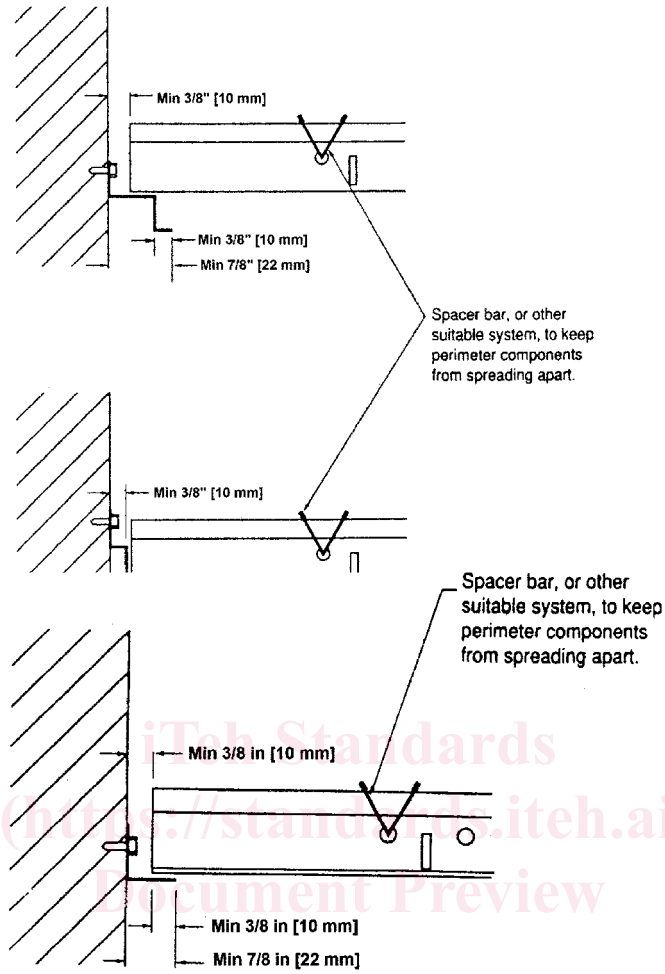
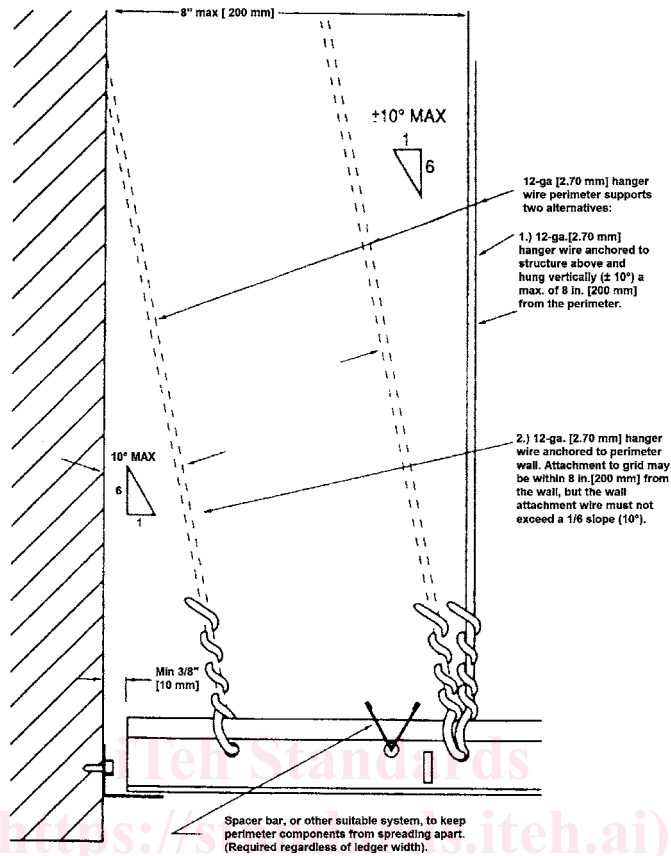


FIG. 2 Category C Treatment of Cross Runners and Main Runners at Terminal Ends When Using Reveal (Shadow) Edge Wall Closures



**FIG. 3 Category C Treatment of Cross Runners and Main Runners at Terminal Ends When Support Ledge of Perimeter Closure is Less Than Minimum 7/8 in. [22 mm]**

4.2.7 All ceiling penetrations (columns, sprinklers, etc.) and independently supported fixtures or services shall have a minimum of 0.375-in. [9-mm] clearance on all sides by using suitable escutcheons or perimeter closure details.

#### 4.3 Suspension Wire Application :

3.2.4.1 Suspension wires of soft, annealed, galvanized steel wire shall not be smaller than No. 12 gage [2.70 mm] spaced at 4 ft [1200 mm] on center or No. 10 gage [3.40 mm] at 5 ft [1500 mm] on center along each main runner unless calculations justifying the increased spacing are provided.

3.2.4.2 Each vertical wire shall be attached to the ceiling suspension member and to the support above with a minimum of three turns with a connection device capable of carrying not less than a 100-lb [45 kg] allowable load.

3.2.4.3 Suspension wires shall not hang more than one in six out of plumb unless countersloping wires are provided.

3.2.4.4 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 a minimum of back-to-back 1¼-in. [32 mm] cold-rolled channels for spans exceeding 48 in. [1200 mm].

3.2.4.5 For perimeter closure angles that provide a support ledge of less than 7/8 in. [22 mm], the terminal ends of each cross runner or main runner shall be independently supported within 8 in. [200 mm] from each wall or ceiling discontinuity as shown in Fig. 3. This support may be a No. 12-gage [2.70 mm] hanger wire or other support that prevents the grid from falling. This wire does not need to be vertical but should not have a slope greater than one in six out of plumb. A 3/8-in. [10 mm] grid end clearance from a wall should be maintained.

3.2.5 The intent of the preceding provisions is to provide an unrestrained ceiling system that will accommodate the movement of the structure during a seismic event. The objective is to have a free-floating ceiling. Nothing may be installed which prevents the ceiling system from moving. All ceiling penetrations (columns, sprinklers, etc.) and independently supported fixtures or services are to be considered as perimeter closures that also must allow the noted clearances by using suitable escutcheons or closure details.

3.2.6 For essential facilities, perimeter support of each cross runner and main runner, as mentioned in 3.2.4.5, is required. In addition, a ½-in. [12 mm] grid end clearance from a wall should be maintained.

#### 3-3

4.3.1 Suspension wires that are a minimum of No. 12 gauge [2.70 mm] galvanized, soft-annealed, mild steel wire shall be

spaced at 4 ft [1200 mm] on center along each main runner, unless engineering calculations justifying increased spacing are provided.

4.3.2 Each vertical wire shall be attached to the ceiling suspension member and to the support above such that the wire loops shall be tightly wrapped and sharply bent to prevent any vertical movement or rotation of the member within the loops. The wire must be wrapped around itself a minimum of three full turns (360° each) within a 3-in. length. Connection devices to the supporting construction shall be capable of carrying not less than a 100-lb (45-kg) allowable load.

4.3.3 Suspension wires shall not hang more than one in six out of plumb unless countersloping wires are provided.

4.3.4 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 Category C.

4.4 *Light Fixture Application:*

3.3.1 All lighting fixtures shall be positively attached to the suspended ceiling system by mechanical means as specified in the National Electrical Code, Section 410-16(c) unless independently supported. The attachment device, a minimum of two per fixture, shall have a capacity of 100% of the lighting fixture weight acting in any direction.

3.3.2 Surface-mounted lighting fixtures shall be attached to the ceiling system with positive clamping devices that completely surround the supporting members. Safety wires shall be attached between the clamping device and the adjacent ceiling hanger or to the structure above. In no case shall the fixture exceed the design carrying capacity of the supporting members.

3.3.3 Pendant-hung lighting fixtures shall be supported directly from the structure above using No. 9-gage [3.80 mm] wire or an approved alternate support without using the ceiling suspension system for direct support.

3.3.4 Lighting fixtures weighing less than 56 lb [25 kg] shall have, in addition to the requirements outlined in 3.3, two No. 12-gage [2.70 mm] hangers connected from the fixture housing to the structure above. These wires may be slack.

3.3.5 Lighting fixtures weighing 56 lb [25 kg] or more shall be supported directly from the structure above by approved hangers.

3.3.6 Rigid conduit is not permitted for attachment of the fixtures.

3.4 *Services Within the Ceiling*

4.4.1 All lighting fixtures shall be positively attached to the suspended ceiling system by mechanical means as specified in the National Electrical Code unless independently supported. The attachment device shall have the capacity of supporting 100 % of the lighting fixture weight acting in any direction. A minimum of two attachment devices are required for each fixture.

4.4.2 Surface-mounted lighting fixtures shall be attached to the ceiling system with a positive clamping device that completely surround the supporting members. Safety wires shall be attached between the clamping device and the adjacent ceiling hanger or to the structure above. In no case shall the fixture exceed the design carrying capacity of the supporting members.

4.4.3 Lighting fixtures weighing less than 10 lb [5 kg] shall have one, No. 12-gauge hanger wire connected from the fixture housing (not the detachable end plates) to the structure above. This wire shall be slack. Supplementary hanger wires shall not be required.

4.4.4 Lighting fixtures weighing less than 56 lb [25 kg] shall have, in addition to the requirements outlined in 5.4.1, two No. 12-gauge [2.70 mm] hanger wires connected from the fixture housing to the structure above. These wires shall be either slack or taut.

4.4.5 Lighting fixtures weighing 56 lb [25 kg] or more shall be supported directly from the structure above by approved hangers.

4.4.6 Pendant-hung lighting fixtures shall be supported directly from the structure above using no less than No. 9-gauge [3.80 mm] wire or an approved alternate support. The ceiling suspension system shall not provide any direct support.

4.4.7 Rigid conduit is not permitted for attachment of the fixtures.

4.5 *Services within the Ceiling :*

3.4.1

4.5.1 Ceiling-Flexible sprinkler hose fittings, ceiling mounted air terminals or other services weighing less than 20 lb [9 kg] shall be positively attached to the ceiling suspension main runners or cross runners that have the same carrying capacity as the main runners.

3.4.2 Air-4.5.2 Flexible sprinkler hose fittings, air terminals or other services weighing more than 20 lb [9 kg] but ~~not more less~~ than 56 lb [25 kg] shall have, in addition to the requirements in 3.4.1, 4.5.1, two No. 12-gauge [2.70 mm] hangers connected from the terminal or service to the ceiling system hangers or to the structure above. These wires ~~may~~ shall be slack.

3.4.3 Air-4.5.3 Flexible sprinkler hose fittings, air terminals or other services weighing more than 56 lb [25 kg] shall be supported directly from the structure above by approved hangers.

3.5.4.6 *Partition Application to Suspended Ceilings:*

3.5.1 The

4.6.1 The ceiling system ~~cannot be used to~~ shall not provide lateral support for walls or partitions. Walls or partitions ~~may~~ shall only be attached to the ceiling ~~grid~~ suspension provided they allow the ceiling membrane to move laterally to accommodate the required clearance as specified in Section 4.2.4.

#### **4. Areas Subject to Severe Seismic Disturbance**

4.1