A. SPECIFICATION

This appendix contains Specification Section 130541, Seismic Restraint Requirements for Nonstructural Components. This Section is intended to aggregate requirements for seismic restraint of nonstructural components and should be cross referenced from each specification section that includes nonstructural components requiring seismic protection. This specification has been written to address nonstructural components for which the Contractor is assigned responsibility for both design and construction. Items that have been explicitly designed by the design team and included on the drawings may be removed from this section, or the relevant section may be modified to indicate that the Contractor is required to furnish and install restraints only.

The specification is intended to be used in conjunction with the responsibility matrices provided in Appendix B to facilitate compliance with nonstructural performance objectives.

The specification is also provided as a Microsoft Word file (.doc) file for download on this CD-ROM and should be customized for use in projects.

SECTION 130541

SEISMIC RESTRAINT REQUIREMENTS FOR NONSTRUCTURAL COMPONENTS

[NOTE TO SPECIFIER: This section is intended to aggregate requirements for seismic restraint of nonstructural components. It should be cross referenced from each specification section that includes nonstructural components requiring seismic protection. This specification has been written to address nonstructural components for which the Contractor is assigned responsibility for both design and construction. Items that have been explicitly designed by the design team and included on the drawings may be removed from this section, or the relevant section may be modified to indicate that the Contractor is required to furnish and install restraints only.]

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide seismic restraint of nonstructural components to withstand seismic forces and seismic deformations without displacing or overturning. For designated nonstructural components, provide installations capable of providing post-earthquake functionality.

B. Work in this section includes furnishing and installing complete seismic restraint systems. Work in this section may also include the seismic restraint design and/or equipment/product certifications to be submitted for review by the registered design professional.

1.2 SCOPE

A. The architectural, mechanical, electrical, and plumbing components and systems identified on the following Responsibility Matrix shall be designed and constructed for seismic demands.

[NOTE TO SPECIFIER: Insert the Responsibility Matrix appropriate for the project Seismic Design Category (see Section 1.3A). Explicitly list those components requiring seismic design, specify each component importance factor, I_p, identify the parties responsible for design, preparation of shop drawings and seismic calculations and indicate which components require Special Seismic Certification.]

[NOTE TO SPECIFIER: The items listed above are generally consistent with the scope of items regulated by building codes per ASCE 7. Items not governed by Building Codes may be added to the scope to create a complete project-specific list (for example, shelf- and counter-mounted contents may be excluded completely or may be excluded except for designated items). It is the responsibility of the design team to create the list and identify the party/parties responsible for verifying compliance with this specification section.]

1.3 DEFINITIONS

1. Professional Engineer - A professional engineer is one who is legally qualified to practice in the jurisdiction where the Project is located, who is experienced in providing

engineering services of the kind indicated, and is registered with the state where the Project is located.

2. Seismic Forces: Forces acting in any direction on a nonstructural component and related system due to the action of an earthquake as defined in the Building Codes currently in effect where the Project is located.

3. Seismic Deformations: Drifts, deflections and seismic relative displacements determined in accordance with the applicable seismic requirements of the Building Codes currently in effect where the Project is located.

4. Restraint/Bracing: Bracing or anchorage used to limit movement under seismic forces. Cables or rigid elements (strut, pipe, angles, etc) used to resist forces by uniaxial tension or compression. The term “bracing” may also be used to describe design to resist lateral forces through the use of wall or frame elements.

5. Support: Elements used to support the weight (gravity load) of an item. Where the support is located at a seismic brace, the element may also resist tension/compression reactions from the restraint system.

6. Anchorage: Connection to structure typically through the use of welding, bolts, screws, post-installed anchors or other fasteners selected to meet the Building Codes currently in effect where the Project is located.

7. Designated Seismic System: Those architectural, electrical and mechanical systems and their components that require seismic design in accordance with ASCE 7 and for which the component importance factor, I_p, is 1.5 according to ASCE 7 or listed as 1.5 in Section 130541.1.2.

8. Inspection Body: Organization or individual accredited to ISO 17020 and regularly engaged in factory inspection services for seismic restraint of non-structural components and equipment.

9. Special Inspector: An IAS accredited IBC special inspection agency or qualified professional engineer who demonstrates competence, to the satisfaction of the building official (or Authority Having Jurisdiction [AHJ]), for inspection of the designated seismic systems. The owner or the registered design professional in responsible charge acting as the owner’s agent shall employ one or more special inspectors to provide periodic inspections during installation of designated seismic systems.

10. AHJ: Authority Having Jurisdiction – The governmental agency or subagency that regulates the construction process. This may be a local building department, state agency, federal entity or other body or bodies having statutory authority.

11. OSHPD: California Office of Statewide Health, Planning and Development

12. ICC-ES: International Code Council Evaluation Service

13. IAS: International Accreditation Service, Inc.

14. IBC: International Building Code

15. VISCMA: Vibration Isolation and Seismic Control Manufacturers Association

1.4 RELATED SECTIONS

[NOTE TO SPECIFIER: List all sections of the specifications that have related requirements governing installation. The following sections follow the Construction Specifications Institute format for "[Sound], Vibration, and Seismic Control." To avoid confusion and inconsistent design criteria, it is recommended that all seismic design criteria be aggregated in this section or that care is taken to ensure that seismic design criteria for all components are consistently addressed.]

A. Coordinate and comply with the requirements of the following:
1. Section XXX – Vibration and seismic controls for fire suppression piping and equipment
2. Section XXX – Vibration and seismic controls for plumbing piping and equipment
3. Section XXX – Vibration and seismic controls for HVAC duct, piping and equipment
4. Section XXX – Vibration and seismic controls for electrical systems and equipment
5. Section XXX –Vibration and seismic controls for communications systems and equipment
6. Section XXX – Vibration and seismic controls for electronic safety and security
7. Section XXX – Vibration and seismic controls for communications systems
8. Section XXX – Vibration and seismic controls for medical gas piping and equipment

1.5 APPLICABLE PUBLICATIONS

A. The most recent edition of publications listed below (including amendments, addenda revisions, supplements and errata) form a part of this specification to the extent referenced unless otherwise noted. The publications are referenced in text by basic designation only.

[NOTE TO SPECIFIER: Verify and edit applicable publications to indicate all referenced guidelines/standards. Where the most recent edition does not apply, provide specific instruction.]

B. American Concrete Institute (ACI):
1. 355.2 Qualification for Post-Installed Mechanical Anchors in Concrete and Commentary
2. 318 Appendix D Anchoring to Concrete

C. American Institute of Steel Construction (AISC): Load and Resistance Factor Design American Society of Civil Engineers Minimum Design Loads for Building and Other Structures

D. American Society for Testing and Materials (ASTM):
1. A/36/A36M Standard Specification for Carbon Structural Steel
2. A/53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

3.	A307	Standard Specification for Carbon Steel Bolts and Studs; 600,000 PSI Tensile Strength
4.	A325	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
5.	A325M	Standard Specification for High-Strength Bolts for Structural Steel Joints (Metric)
6.	A490	Standard Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
7.	A490M	Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
8.	A500/A500m	Standard Specification for Cold-Form Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
9.	A501	Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
10.	A615/A615M	Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
11.	A992/A992M	Standard Specification for Steel for Structural Shapes for Use in Building Framing
12.	A996/A996M	Standard Specification for Rail-Steel and Axel-Steel Deformed Bars for Concrete Reinforcement.
13.	E488-96	Standard Test Method for Strength of Anchors in Concrete and Masonry Elements
14.	E580	Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions

E. American National Standards Institute (ANSI) and Rack Manufacturers' Institute (RMI): Specification For The Design, Testing and Utilization of Industrial Steel Storage Racks (ANSI MH16.1)

F. American Welding Society (AWS):

1.	AWS D1.1	Structural Welding Steel
2.	AWS D1.3	Structural Welding Sheet Steel

G. International Code Council Evaluation Service (ICC-ES): Index of Reports can be found at http://www.icc-es.org/reports/index.cfm

H. National Fire Protection Association: Installation of Sprinkler Systems (NFPA-13)

I. OSHPD Code Application Notice 2-1708A.5 – Certification of Equipment and Nonstructural Components

J. Americal Society of Mechanical Engineers (ASME)

1.	Standard B31	Standards for Pressure Piping

[NOTE TO DESIGNER AND SPECIFIER: Add additional local or statewide code references.]

1.6 REGULATORY REQUIREMENTS

A. Comply with the International Building Code (IBC) latest adopted Edition by the jurisdiction where the Project is located and applicable local and/or statewide adopted amendments.

B. Special Seismic Certification – Provide certification in accordance with IBC, Chapter 17 and ASCE 7 Chapter 13 requirements for designated seismic systems as indicated on the Responsibility Matrix.

[NOTE TO DESIGNER AND SPECIFIER: It is the project design professional's responsibility to identify components for which the Contractor is required to submit Special Seismic Certification. The "Responsibility Matrix" provided in Appendix B is provided as a tool to identify and track these items. (Note: Certification should be addressed by the design team prior to construction to ensure component has been certified or will be certified to suit the project schedule.)]

1.7 PROJECT SEISMIC DESIGN CRITERIA

A. Seismic Design Category – X

[NOTE TO DESIGNER AND SPECIFIER: Seismic Design Category is defined in ASCE 7 Table 11.6-1. It is dependent on the site seismicity and building occupancy. The project designer is responsible for identifying the building specific seismic design category.]

B. Seismic Design Force – Calculation of seismic design force shall be based on the requirements of Chapter 13 of ASCE 7 with the following seismic design parameters

1. S_{DS} = X.XX
2. $I_{building}$ = X
3. I_p = X.X (1.0 or 1.5 as indicated in ASCE 7 Section 13.1.3)
4. a_P, R_P = in accordance with ASCE 7 Tables 13.5-1 and 13.6-1
5. z = XX (roof elevation)
6. h_1 = XX (floor 1 elevation)
   h_2 = XX (floor 2 elevation)
   h_3 = XX (floor 3 elevation)
   etc.

C. Seismic Relative Displacement – Design shall accommodate seismic relative displacement of 0.02 times the story height in addition to thermal movement that may be present.

[NOTE TO DESIGNER AND SPECIFIER: Design for the maximum permitted code displacement as indicated in ASCE 7 Table 12.12-1. Alternatively, provide interstory drift for each story of the building based on project-specific structural analysis. For example, replace above requirement with: Use the following interstory drifts to compute the relative seismic displacement that the component must be designed to accommodate.

Δ1-2 = interstory drift between floors 1 and 2 = X.XX
Δ2-3 = interstory drift between floors 2 and 3 = X.XX
Δ3-Roof = interstory drift between floors 2 and 3 = X.XX]

D. Seismic Separation between Independent Structures – Components crossing seismic separations shall be designed to accommodate relative seismic movement between structures. Locations of seismic separations are shown on the drawings. Use the following to determine the range of movement required at each floor. Components shall be independently anchored to each structure.

1. $D_{A1\text{-}B1}$ = XX" (i.e. +/- xx"/2)
2. $D_{A2\text{-}B2}$ = XX" (i.e. +/- xx"/2)
3. $D_{A3\text{-}B3}$ = XX" (i.e. +/- xx"/2)
4. $D_{ARoof\text{-}BRoof}$ = XX" (i.e. +/- xx"/2)

[NOTE TO DESIGNER AND SPECIFIER: Provide seismic separation for each floor for each seismic joint based on project-specific structural analysis and as required by ASCE 7 Section 12.12-3. Alternatively, specify seismic separation based on maximum interstory drift permitted by code.]

[NOTE TO DESIGNER AND SPECIFIER: The following list contains a sample list of nonstructural components for which the contractor may be assigned responsibility for design and construction. Items that have been explicitly designed by the design team and included on the drawings should be identified as such on the Responsibility Matrix and may be removed from this section. Items for which seismic restraint is not required should be removed. Add additional items as required for project-specific scope.]

1.8 QUALITY CONTROL

A. Shop-Drawing Preparation:

1. Seismic restraint shop drawings shall be prepared or their preparation shall be overseen by a professional engineer experienced in designing seismic restraints for nonstructural components as required by the authority having jurisdiction. The use of proprietary restraint systems with a certificate of compliance verified and listed by an IAS accredited inspection body is acceptable.

B. Seismic Calculations Preparation:

1. Seismic restraint calculations shall be prepared and stamped by a registered professional engineer experienced in the area of seismic restraint for nonstructural components. Comply with the applicable code specified in Paragraph 1.6.

[NOTE TO SPECIFIER: If desired or required by the authority having jurisdiction, restrict design to professional engineers registered in the state where the project is located or to licensed Structural Engineers, or both.]

C. Special Seismic Certification of Mechanical and Electrical Equipment and Distribution Systems:

1. Each manufacturer of designated seismic system components shall provide a certificate of compliance indicating that the component and its mounting system or anchorage have been tested or analyzed to withstand required seismic loads and maintain operability. Qualification shall be by an actual test on a shake table with three-dimensional shock tests, an analytical method using dynamic characteristics and forces and/or experience data based upon nationally recognized procedures acceptable to the authority having jurisdiction. Certificate must be verified by an IAS accredited inspection body or other independent inspection entity acceptable to the Authority Having Jurisdiction. Components shall be labeled with an identification applied on a product by the manufacturer that contains the name of the manufacturer, the function and performance characteristics of the product or material, and the name and identification of an accredited agency that indicates that the representative sample of the product or material and its testing have been evaluated and listed by an accredited inspection body agency.

   If a particular component has no manufacturer available that has been evaluated and listed by an accredited inspection body agency, then qualification must be by analysis performed be a professional engineer registered in the jurisdiction where the Project is located. Professional engineer must be approved by the authority having jurisdiction and experienced in providing engineering services of the kind indicated. Analysis must include an evaluation of stress and deflection developed through the entire load path from the center of applied seismic load to the equipment anchorage. Analysis must consider dynamic characteristics and the response spectrum required by code.

Special Seismic Certification for distribution systems such as piping and ductwork shall include a stress analysis of the pipe/duct, supports, bracing and anchors. The stress analysis shall include gravity and seismic demands and shall include an analytical assessment of connections and consideration of movement of points of attachment. The effects of in-line devices, where present, shall be considered in the analysis. Conformance with NFPA 13 2010 will satisfy Special Seismic Certification requirements for fire protection piping.

D. Coordination:
1. Do not install seismic restraints until seismic restraint submittals have been reviewed and accepted by the entity/entities identified on the Responsibility Matrix.
2. Verify that multiple systems installed in the same vicinity can be installed without conflict.
3. Verify tolerances between installed items to confirm that unbraced components will not come into contact with restrained equipment or structural members during an earthquake. When contact is possible, provide seismic restraint or provide justification to the satisfaction of the registered design professional in responsible charge of the project that contact will not cause unacceptable damage to the components in contact, their supports, finishes or other elements that are contacted.

[NOTE TO DESIGNER AND SPECIFIER: (1) The requirement to regulate tolerances between installed unbraced items may not be necessary to protect components and systems that are inherently rugged, lightweight or where contact is unlikely to cause unacceptable damage. Consider project specific requirements and those imposed by the authority having jurisdiction. (2) Where contact between adjacent items is specified, consider explicitly specifying tolerance for unbraced equipment. (3) See 3.9.D.9.(4) Unless otherwise specified, the Structural Engineer of Record is responsible for confirming that the structure is capable of supporting the gravity and seismic demands imposed by nonstructural components.]

PART 2 - PRODUCTS

2.1 STEEL

A. Structural steel: ASTM A36, A36M, A992

B. Structural tubing: ASTM A500, Grade B

C. Steel pipe: ASTM A53/A53M, Grade B

D. Bolts and nuts: ASTM, A307, A325, A325M, A490, A490M, ASTM A563

E. Lag bolts and screws: ASME B18.2.1 (ASME B18.2.3.8M), ASTM A563

F. Powder driven anchors: NES NER-272

G. Nails: ASTM F1667

2.2 LIGHT GAGE NON-LOAD BEARING METAL FRAMING

A. Metal studs: A653 Grade 33, ASTM A1011 Grade 33, ASTM A446 Grade A or D, or ASTM A570

B. Tie wires: ASTM A641/A641M

C. Screws for fastening to cold-formed metal framing: ANSI B18.6.4

2.3 WELDING

A. Welding filler metal: AWS A5.1

2.4 POST-INSTALLED ANCHORS

A. Expansion or sleeve anchors: Pre-qualified for use in seismic applications per ASTM E488

B. Adhesive anchors: Pre-qualified for use in seismic applications per ASTM E488

2.5 SEISMIC RESTRAINT CABLES

A. Prestretched galvanized carbon steel cable 7x19 strand core, ASCE-19, ASTM A-1023 1A, ASTM A-603 or stainless steel

2.6 CHANNEL STRUT AND FITTINGS

A. Strut: ASTM A 1011SS Gr 33 or ASTM A 653 Gr 33

B. Fittings: ASTM A 575, A 576, A36 or A 635

PART 3 - EXECUTION

3.1 CONSTRUCTION, GENERAL

A. For items identified in the Responsibility Matrix furnish and install supports, braces, connections, hardware and anchoring devices to withstand code-required seismic forces and seismic deformations without shifting or overturning. For components with Ip = 1.5, in addition to providing code-required seismic forces and deformations, provide installations capable of providing post-earthquake functionality.

B. Construct seismic restraints and anchorages that do not inhibit thermal expansion and contraction of distribution systems. Utilize ASME Standard B31 when utilizing common supports for both thermal and seismic loading.

C. Maintain fire ratings of assemblies as specified elsewhere or on the drawings in addition to compliance with the criteria set forth below.

[NOTE TO DESIGNER AND SPECIFIER: It is the structural engineer of record's responsibility to provide a structure capable of accommodating the design demands from nonstructural components. The submittal requirements of these specifications require the contractor to provide the numerical values of gravity and seismic forces imposed on the structure from components. The structural engineer of record must verify that the structure is capable of accommodating the demands. Any limitations of the structural system that would alter the manner or location in which components are supported or braced should be clearly shown on the drawings and/or described in the specifications below.]

3.2 NONSTRUCTURAL EXTERIOR WALL COMPONENTS

A. Nonstructural exterior wall framing
   1. Design framing to resist out-of-plane seismic design force, movement due to temperature changes and relative vertical movement between floors.
   2. Design framing to accommodate code-required interstory drift without damage that compromises the exterior wall water, moisture and thermal barriers.
   3. Design framing with sufficient out-of-plane stiffness to prevent damage to cladding or veneer when subjected to code-required out-of-plane forces.

B. Veneer
   1. Fasten veneer to substrate to accommodate out-of-plane seismic design force and deformation of supporting framing.
   2. Anchored veneer shall be detailed to prevent moisture penetration from weather that could corrode anchors.

C. Nonstructural prefabricated panels
   1. Design prefabricated panels and connections capable of resisting in-plane and out-of-plane forces and story drift deformations in accordance with ASCE-7.

D. Glazing
   1. Design glazing to resist out-of-plane seismic design force
   2. Design glazing to accommodate relative displacement to resist fallout as set forth in ASCE 7 Section 13.5.9.1 and not less than 0.5".
   3. Drift limit for glass components shall be determined in accordance with AAMA 501.6 or by engineering analysis.
   4. In lieu of calculations, compliance with design criteria may be established by testing in accordance with AAMA 501.4.

3.3 INTERIOR PARTITIONS

A. Heavy partitions (masonry, glass block, etc.):
   1. Design wall and connections to resist out-of-plane seismic design force.
   2. Provide connection detail between the building structure and heavy partition to accommodate seismic relative displacement between partition and structure.
   3. Maintain fire rating at connections in rated construction.

B. Light partitions (metal stud or wood stud):
   1. Design partitions to resist out-of-plane seismic design force. Design force shall be based on the weight of the partition framing, finishes, soffits, connected casework or equipment, and ceilings for which it provides bracing. Out-of-plane design force shall not be less than 5 psf.
   2. Design partitions to accommodate interstory drift.
   3. Fasten veneer to partition framing to resist code required forces and deformation of studs.
   4. Where partition does not extend to the structure, the partition height does not exceed 9 feet, the linear weight of the partition does not exceed the product of 10 pounds times the height in feet of the partition and the partition horizontal load does not exceed 5 psf, lateral bracing to the building structural is not required. For all other conditions, provide supplemental bracing or framing to resist out-of-plane seismic design force. Such bracing or framing shall be independent of splayed wire ceiling bracing. Design wall bracing or framing for compatibility with ceiling deflection requirements, fire ratings and architectural treatments.

3.4 CEILINGS

A. Suspended acoustic tile ceilings:
   1. Design and install ceiling in accordance with ASTM E580.

2. For Seismic Design Categories D, E and F, provide bracing at regular intervals to resist code design forces and limit vertical and lateral movement. Suspended ceilings with areas less than or equal to 144 square feet and that are surrounded by walls or soffits that are laterally braced to the structure above are exempt from seismic design requirements.
3. Where ceilings are unbraced or splayed wire bracing is used to resist seismic forces and limit lateral deflections, provide 1 inch clearance around all penetrations through the ceiling sprinkler drops. If flexible sprinkler drops are used and have been certified to accommodate 1 inch of movement, the 1 inch clearance requirement may be waived.
4. Provide independent support of lighting fixtures, diffusers, cable trays, electrical conduit and other ceiling appurtenances.
5. Ceiling system design load Wp shall be taken as not less than 4 psf.

B. Ceilings directly fastened to structural framing or furred with materials that are directly applied to structural framing
1. Fasten ceiling to framing to resist the vertical seismic design forces and the weight of the ceiling and all connected light fixtures, sprinklers, HVAC appurtenances.

3.5 PARAPETS, ROOF SCREEN WALLS, APPENDAGES, CANOPIES, MARQUEES, SIGNS, CHIMNEYS, AND STACKS

A. Exterior appendages
1. Design component and connections to resist out-of-plane seismic design force and code wind force.
2. Design and provide supplementary framing and/or backing as required to support and anchor to structural framing.
3. Provide details that do not compromise water, moisture and thermal barriers.

3.6 ACCESS FLOORS

1. Provide restraint to resist seismic design force in any direction. Use components that have been tested in accordance with CISCA “Recommended Test Procedures for Access Floors.”
2. The use of adhesive-only anchorage of pedestals is prohibited in Seismic Design Categories D through F.

3.7 STAIRWAYS

A. Stairs (including treads, risers, landings and enclosures)
1. Design components and connections to resist seismic design force
2. Design stairs to accommodate interstory drift. Acceptable means shall include isolating the stair from experiencing internal stresses due to interstory drift or provide substantiating evidence to demonstrate that stair can accommodate interstory drift.
3. Design and provide supplementary framing as required to support and anchor to structural framing.
4. Design components and connections to maintain fire rating when subjected to seismic design forces and deformations.

3.8 FREESTANDING WALLS OR FENCES

A. Freestanding walls and fences:
1. Design wall/fence and foundation capable of resisting out-of-plane seismic design force and code wind forces including out-of-plane forces.

3.9 MECHANICAL AND PLUMBING COMPONENTS

A. Floor and base-mounted mechanical equipment (boilers, furnaces, pumps, chillers, manufacturing, process machinery, etc.), vibration isolated equipment and associated system vibration and seismic controls for connections.
   1. Design equipment anchorage to resist seismic design force in any direction.
   2. Design vibration and seismic controls for equipment to include base and isolator requirements.
   3. Provide flexible connection between equipment and interconnected piping.
   4. Where equipment is mounted on vibration isolators and restraints, use isolators and restraints designed for amplified code forces per ASCE 7 and with demonstrated ability to resist required forces including gravity, operational and seismic forces.
   5. Provide supplemental steel or concrete base as required for mounting equipment on isolators. Where equipment is not designed to be point loaded, provide base capable of transferring gravity and seismic demands from equipment to isolator base plate anchorage.
   6. Where concrete floor thickness is less than required for expansion anchor installation per ICC-ESR, install through bolt in lieu of expansion anchor. Where timber/wood floor or other substrate is inadequate for installation of lag bolts, screws or other mechanical fasteners, furnish and install supplemental framing or blocking to transfer loads to structural elements.

B. Suspended mechanical equipment
   1. Design support and bracing to resist seismic design force in any direction.
   2. Provide flexible connection between equipment and interconnected piping.
   3. Brace equipment hung from spring mounts using cable or other bracing that will not transmit vibration to the structure.
   4. As an alternate to project-specific design of seismic bracing, use of proprietary restraint systems with a certificate of compliance verified and listed by an accredited inspection body is acceptable. Use of a certified product does not preclude the requirement for shop drawings.

[NOTE TO DESIGNER AND SPECIFIER: The California Office of Statewide Health Planning and Development (OSHPD) runs a "Preapproval" program in which it conducts an internal technical review of proprietary components or system seismic design submittals and approves them for use in California hospitals. OSHPD preapprovals are accepted by some jurisdictions.]

C. Wall-mounted mechanical equipment
   1. Design support and bracing to resist seismic design force in any direction.
   2. Install backing plates or blocking as required to deliver load to primary wall framing members. Do not anchor to gypsum wallboard, plaster or other wall finish that has not been engineered to resist imposed loads.

D. Piping
   1. Provide seismic bracing for piping as required by Section 1.2.
   2. Provide supports, braces and anchors to resist gravity and seismic design forces.
   3. Design piping and piping risers to accommodate interstory drift.
   4. Provide flexible connections between floor-mounted equipment and suspended piping; between unbraced piping and restrained suspended items; as required for thermal movement; at building separations and seismic joints; and wherever relative differential movements could damage pipe in an earthquake.
   5. Brace resiliently-supported pipe with cable bracing or alternate means designed to prevent transmission of vibrations and noise to structure.
   6. Brace every run (5' or more in length) with two transverse and one longitudinal bracing locations. For pipes and connections constructed of ductile materials (copper, ductile iron, steel or aluminum and brazed, welded or screwed connections) provide transverse

bracing at not more than 40 feet on center and longitudinal bracing at spacing not more than 80 feet on center. For pipes and their connections constructed of nonductile materials (cast iron, no-hub pipe and plastic or non-UL listed grooved coupling pipe), provide transverse bracing at not more than 20 feet on center and longitudinal bracing at spacing not more than 40 feet on center. Alternatively, explicitly design piping and connections to resist gravity and seismic forces and seismic deformations.

[NOTE TO DESIGNER AND SPECIFIER: Add additional pipe types or alternate requirements as required to cover project specific scope and performance requirements.]

7. Provide lateral restraint for risers at not more than 30 feet on center or as required for horizontal runs, whichever is less.
8. Where piping is explicitly exempt from seismic bracing requirements, provide flexible connections between piping and connected equipment, including in-line devices such as VAV boxes and reheat coils.
9. Where piping is explicitly exempt from seismic bracing requirements, install piping such that swinging of the pipes will not cause damaging impact with adjacent components, finishes or structural framing. This will be considered satisfied if there is horizontal clear distance of at least 2/3 the hanger length between subject components. If swinging of exempted piping can cause damaging contact with adjacent components, finishes or structural framing, add swing restraints as required to eliminate contact.

[NOTE TO DESIGNER AND SPECIFIER: The concern for damage caused by unbraced pipes should be considered on a project specific basis. ASCE 7 13.6.8 allows pipe bracing to be omitted if “high deformability piping is used; (and) provisions are made to protect the piping in the event of such impact.” The measures described above are one way to meet these requirements. In many jurisdictions, this is not a focus of concern.]

10. As an alternate to project-specific design of seismic bracing, use of proprietary restraint systems with a certificate of compliance verified and listed by an accredited inspection body is acceptable. Use of a certified product does not preclude the requirement for shop drawings.

[NOTE TO DESIGNER AND SPECIFIER: The California Office of Statewide Health Planning and Development (OSHPD) runs a “Preapproval” program in which it conducts an internal technical review of proprietary components or system seismic design submittals and approves them for use in California hospitals. OSHPD preapprovals are accepted by some jurisdictions.]

11. Re-use of existing hangers: Where pipes are being installed in existing facilities, the re-use of existing hangers at locations of seismic bracing will be judged on a case-by-case basis by the registered project design professional. Unless otherwise shown on the drawings, it shall be assumed that all hangers supporting new piping and located at a seismic brace will be installed new.

E. Ductwork

1. Provide seismic bracing for ducts with cross sectional area greater than 6 square feet (independent of the duct contents) and for ducts containing hazardous materials.
2. Provide supports, braces and anchors to resist gravity and seismic design forces.
3. Design ducts and duct risers to accommodate interstory drift.
4. Provide independent support for in-line devices weighing more than 20 pounds. Provide independent support and bracing for all in-line devices weighing more than 75 pounds. Unbraced piping attached to braced in-line equipment shall be provided with adequate flexibility to accommodate differential displacements.

5. Appurtenances such as dampers, louvers and diffusers shall be positively attached to the ductwork with mechanical fasteners.
6. Duct supports shall be designed to resist not less than 150% of the weight of the duct. For seismic design categories D, E and F, ducts weighing over 10 plf shall not be hung using power driven fasteners.
7. As an alternate to project-specific design of seismic bracing, use of proprietary restraint systems with a certificate of compliance verified and listed by an IAS accredited inspection body or otherwise accepted by the Authority Having Jurisdiction is acceptable. Use of a certified product does not preclude the requirement for shop drawings.

[NOTE TO DESIGNER AND SPECIFIER: The California Office of Statewide Health Planning and Development (OSHPD) runs a "Preapproval" program in which it conducts an internal technical review of proprietary components or system seismic design submittals and approves them for use in California hospitals. OSHPD preapprovals are accepted by some jurisdictions. "Preapproved by OSHPD" may be added to item 7 after "IAS accredited inspection body" if desired.]

F. Tanks
1. Design tank anchorage to resist seismic design force.
2. Design tank legs or supporting structure to resist seismic design force.
3. Provide flexible connections between tank and interconnected piping.

G. Fire suppression equipment and piping
1. See requirements for suspended piping.
2. See requirements for floor-mounted and wall-mounted equipment.
3. Satisfy requirements of NFPA 13 and the force and displacement requirements of ASCE 7. All components shall be UL listed.
4. Provide end of line restraint as required by NFPA 13.

3.10 ELECTRICAL EQUIPMENT

A. Electrical equipment
1. Design equipment to resist seismic design force in any direction
2. Batteries on racks shall be provided with acid resistant and corrosion resistant wrap-around restraints or shall be otherwise prevented from movement within battery rack. Racks shall be designed to resist seismic design force.
3. Electrical cabinet design shall comply with the applicable National Electrical Manufacturers Association (NEMA) standards.
4. Supports shall be designed to accommodate the seismic relative displacement between points of support.
5. Where equipment is mounted on vibration isolators and restraints, use isolators and restraints designed for amplified code forces and with demonstrated ability to resist required forces including gravity, operational and seismic forces.

B. Conduit, cable tray, bus duct, raceways, bundled cabling
1. Provide supports and anchoring so that, upon application of seismic forces and deformations, conduit/cable tray/bus duct/raceway/bundled cabling will not displace sufficiently to cause damage to wires, connections, adjacent or connecting equipment, building members or finishes.
2. Provide seismic bracing of conduit/cable tray/bus duct/raceway/bundled cabling to resist gravity and seismic design forces.
3. Provide gravity support for conduit/cable tray/bus duct/raceway/bundled cabling that is independent of suspended ceiling framing.
4. Design conduit/cable tray/bus duct/raceway/bundled cabling to accommodate interstory drift.

5. As an alternate to project-specific design of seismic bracing, use of proprietary restraint systems with a certificate of compliance verified and listed by an accredited inspection body is acceptable. Use of a certified product does not preclude the requirement for shop drawings.

   [NOTE TO DESIGNER AND SPECIFIER: The California Office of Statewide Health Planning and Development (OSHPD) runs a "Preapproval" program in which it conducts an internal technical review of proprietary component or system seismic design submittals and approves them for use in California hospitals. OSHPD preapprovals are accepted by some jurisdictions.]

6. Provide flexible connections wherever relative differential movement could damage conduit/cable tray/bus duct/raceway/bundled cabling in an earthquake.

C. Light fixtures
   1. Design fixture connections to resist seismic design force.
   2. For lights in suspended ceilings:
      a. For lights weighing 56 pounds or less, provide positive mechanical connection between fixtures and ceiling framing to resist seismic design force and gravity load. Provide 2 independent wires at diagonally opposite corners connected to structural framing. For lights weighing more than 56 pounds, provide independent support and bracing.
   3. For lights in light framed ceilings and walls:
      a. For lights weighing 56 pounds or less, provide positive mechanical connection between the fixture and the ceiling/wall framing capable of resisting required gravity and seismic demands. Provide ceiling and wall framing capable of delivering demands from the light fixture to the structure.
   4. For pendant mounted fixtures:
      a. Verify that fixture will not displace in such a manner as to hit adjacent lighting and/or architectural elements or other suspended items. Connection to the structure shall allow a 360 degree range of motion. If pendant fixture could come in contact another item when swinging in a 45 degree arc from vertical in any direction, provide bracing to limit movement and avoid interaction. Design load shall be 1.4 times the operating weight acting down with a simultaneous horizontal load of 1.4 times the operating weight.

D. Communication systems including alarm systems
   1. See requirements for electrical equipment and conduit, cable tray, bus duct, raceways, bundled cabling.

3.11 TRANSPORTATION COMPONENTS

A. Elevator and escalators
   1. Design for conformance with seismic requirements of ASME A17.1.
   2. Design to resist seismic design force specified herein. The more stringent design force shall govern.
   3. Elevator/escalator equipment and controller supports and attachments shall be designed to resist seismic design force.
   4. Elevators travelling with a speed of 150 ft/min or greater shall be provided with a seismic switch in accordance with ASCE 7.
   5. Provide retainer plate at the top and bottom of the car and counterweight.

3.12 STORAGE RACKS AND SHELVING

A. Light duty storage racks and shelving
   1. Provide restraint to resist seismic design force in any direction.

2. Where restraint is provided by anchorage to a wall, verify that wall has adequate strength to resist anchor demands. Install backing plates or blocking as required to deliver load to primary wall framing members. Do not anchor directly to gypsum wallboard, plaster or other wall finish that has not been engineered to resist imposed loads.

B. Industrial storage racks

1. Design for conformance with latest version of Rack Manufacturers Institute (RMI) Specification for the Design, Testing and Utilization of Industrial Steel Storage Racks and the seismic design requirements of ASCE 7. Where design criteria conflict, the more stringent shall apply.

3.13 TELEVISIONS, MONITORS

1. Design support and bracing for wall-mounted and suspended televisions/monitors to resist seismic design force in any direction.
2. Where restraint is provided by anchorage to a wall, verify that was has adequate strength to resist anchor demands. Install backing plates or blocking as required to deliver load to primary wall framing members. Do not anchor directly to gypsum wallboard, plaster or other wall finish that has not been engineered to resist imposed loads.
3. Use mounting brackets certified for resistance to seismic loads.

[NOTE TO DESIGNER AND SPECIFIER: 1. These provisions address wall-mounted and suspended televisions/monitors. If large or critical monitors are counter-mounted, specific seismic restraint provisions could be added to restrain them. 2, The California Office of Statewide Health Planning and Development (OSHPD) runs a “Preapproval” program in which it conducts an internal technical review of proprietary component or system seismic design submittals and approves them for use in California hospitals. OSHPD preapprovals for television mounting brackets are accepted by some jurisdictions and may be a useful source for selecting and specifying mounting hardware.]

3.14 DESKTOP COMPUTERS

1. Provide straps, high friction pads, snubbers or other mechanisms as required to resist seismic design forces.
2. All connections shall be readily demountable and shall not damage computer housing.

[NOTE TO DESIGNER AND SPECIFIER: Desktop computers are not regulated by the building code. The need for restraint should be considered on a project-by-project basis.]

3.15 COMPUTER AND COMMUNICATIONS RACKS, CABINETS AND BOARDS

1. Design equipment anchorage to resist seismic design force in any direction
2. Where cable tray is connected to the top of racks or cabinets, design seismic restraint to include the tributary weight of the cable tray and components.
3. Interconnect adjacent cabinets to cause them to respond together when resisting lateral forces.
4. Where equipment is supported on raised access flooring, provide bracing and anchorage to the supporting floor below.

[NOTE TO DESIGNER AND SPECIFIER: There are many approaches to providing seismic restraint for computer and communications equipment. Where specific design requirements are desired, they should be clearly specified. For example, the use of isolation bases or independent support frames may be specified.]

3.16 KITCHEN EQUIPMENT

1. Design equipment anchorage to resist seismic design force in any direction.
2. Connections shall enable the equipment to be readily disengaged to enable the equipment to be relocated for cleaning.
3. Provide flexible connections between connected piping and kitchen equipment. If kitchen equipment is restrained with removable "tethers," provide sufficient flexibility in connections to accommodate full range of movement associated with tether.

3.17 DEMOUNTABLE PARTITIONS

1. Use system engineered for use in regions of seismicity. Anchor to structure to resist seismic design force in any direction.

3.18 SHELF- AND COUNTER-MOUNTED CONTENTS

1. Provide straps, mechanical barriers, high friction pads, snubbers or other mechanisms as required to resist seismic design forces.
2. All connections shall be readily demountable and shall not damage or permanently alter contents.
3. Restraints shall not prevent items from being added to or removed from shelf or counter.

[NOTE TO DESIGNER AND SPECIFIER: Shelf- and counter-mounted contents are not regulated by the building code. The need for restraint should be considered on a project-by-project basis.]

3.19 FIELD QUALITY CONTROL

Provide a quality assurance plan as required by ASCE 7, Appendix 11A for installation of the following per IBC Chapter 17. Reference 130541.1.3 for the definition of special inspector. A minimum of 3 special inspections shall be performed (pre-construction, mid-construction, and final inspection):

1. Seismic Design Category C
   a. Heating, ventilating and air-conditioning (HVAC) ductwork containing hazardous materials or smoke control and anchorage of such ductwork.
   b. Piping systems and mechanical units containing flammable, combustible or highly toxic materials.
   c. Anchorage of electrical equipment used for emergency or standy power systems.
   d. Vibration-isolated systems and associated seismic restraints where indicated on the construction documents or submittals. All restraints require a nominal clearance of 0.25" or less between the equipment support frame and restraint.
2. Seismic Design Category D
   a. All systems required for Seismic Design Category C
   b. Exterior wall panels and their anchorage
   c. Suspended ceiling system and their anchorage
      1) Verify member type and size, verify that bracing elements such as splayed wires and compression struts are installed as detailed; test anchorage to structure
   d. Steel storage racks 8' or higher

1) Verify that connections of the racks to the structure are installed as detailed on the drawings. Spot check the connection of horizontal beams to uprights verifying fastener tightness

e. Access floors
1) Verify that anchorage matches detail on the drawings
2) Verify connection of access floor framing to support posts
3) Inspect installation of post-installed anchors
4) Test post installed anchors

3. Seismic Design Categories E and F
a. All systems required for Seismic Design Categories C and D
b. All electrical equipment

[NOTE TO DESIGNER AND SPECIFIER: This specification assumes that the requirements for testing and inspection of post-installed anchors are covered elsewhere in the specifications or drawings. If not, specific test requirements should be added here.]

B. Special Seismic Certifications
1. Verify that the label, anchorage or mounting conforms to the certificate of compliance for designated seismic systems defined in Section 130541.1.2 and 1.3.

END OF SECTION 130541