SAINT LOUIS COUNTY
Transportation and Public Works

Code Enforcement Division

Notice to Industry

Seismic Requirements

Rules, Regulations and Interpretations
On
Earthquake Resistant Architectural,
Mechanical, Electrical and Plumbing System Components

Highlighted Changes between 3/14/11 and 6/30/20 for 2015 IBC

6/30/20

Introduction

Background Information/History

In September 2005 St. Louis County adopted the 2003 International Building Code (IBC). Section 1621 of the 2003 IBC required that the provisions of Section 9.6 of the ASCE 7-02 "Minimum Design Loads for Buildings and other Structures" be utilized for required seismic resistance of Architectural, Mechanical, Electrical and Plumbing Components. Those 2003 IBC seismic provisions were substantially different than the previous County Building Code (1999 BOCA) and were subject to varying interpretations.

Following public comment a document dated 12/1/05 entitled "St. Louis County Rules and Regulations on Seismic Anchorage and Sway Bracing Mechanical, Electrical and Plumbing System Components", including Attachments A, B and C was published. In February of 2006, St. Louis County published Rules and Regulations on Earthquake Resistant Acoustical Lay-in Panel Ceilings, entitled "Seismic Bracing Details for Acoustical Lay-in Panel Ceilings". The County's Rules and Regulations were further clarified by revisions in November 2006 and May 2010.

Current Situation/State

St. Louis County has again updated the Building Code by adopting the 2015 International Building Code (IBC) which became effective July 1, 2020. Section 1613 of the 2015 IBC references ASCE 7-10 for design requirements for the structure. The newly adopted building code required St. Louis County's "Rules and Regulations on Earthquake Resistant Architectural, Mechanical, Electrical, and Plumbing Components" to be reformatted and updated.

These **Revised Rules and Regulations become effective immediately** and shall be utilized for projects now required to be designed in accordance with the 2015 IBC.

Primary Changes Since March 2011 Revised Publication

The organization and format of the Rules and Regulations have been changed to be more user-friendly.

In addition, the following lists the more significant technical changes that have been added, revised, or modified as a result of the County's adoption of the 2015 International Building Code, which references ASCE 7 – 10:

- The values for S_S and S_1 have been updated to S_S=0.48g and S_1=0.18g. Note: It is unacceptable to use lower values. When working in municipalities that contract with St. Louis County for plan review and inspection services, it is advisable the structural engineer use the higher values required between the two jurisdictions. Subcontractors bidding on MEP, sprinklers, or elevators typically "borrow" the S_S and S_1 values from the structural code block, but the project may be delayed if lesser/incorrect values are used for the discipline or component design.

- The example Seismic Code Blocks found at the end of Chapter 3 as referenced by Section 3.1, Item 1, Construction Documents, have been updated.

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CHAPTER 1

General Concerns
Earthquake Resistant Architectural
and MEP System Components

Section 1.1 – Authority for Rules, Regulations and Interpretations

Rules, Regulations and Interpretations concerning Architectural and Mechanical, Electrical, and Plumbing (MEP) components are established pursuant to Sections 104 and 1613 of the St. Louis County Building Code (2015 IBC) and Section 104 of the St. Louis County Existing Building Code (2015 IEBC). Rules, Regulations and Interpretations concerning MEP components are also established pursuant to Sections 104 and 301 of the County Mechanical Code; Sections 1102-80-2(E) and 1102-80-7(E) of the County Electrical Code and Sections 1103.P-108, 1103.P-114, and 1103.P-128 of the County Plumbing Code.

Section 1.2 – Application of Rules, Regulations and Interpretations

1) The requirements of the Building Code for earthquake resistance and related anchorage and sway bracing of Architectural and MEP components do not apply to residential 1 and 2 family dwellings, townhouses or their accessory structures that are regulated by the Residential Code.

2) The requirements of the Building Code for earthquake resistance and these Rules, Regulations and Interpretations apply to all Architectural and MEP components installed in newly constructed buildings and building additions as well as all new or replaced components in existing buildings.

   Exception: *The requirements of the Building Code for earthquake resistance do not apply to the repair of components for the purpose of maintenance, including related replacement of damaged, dilapidated or inoperative components that are not seismically restrained/supported.*

3) Mixed Use (Occupancy Categories):
   When a building contains multiple uses or occupancy classifications it shall comply with the seismic resistance provisions of the Building Code and these Rules and Regulations for the highest occupancy classification that is not structurally separated from the other occupancy classification(s). Where the occupancy classifications are structurally separated, each shall comply with the seismic resistance requirements applicable to its occupancy classification except as follows: When the separated uses share life safety components with another use having a higher occupancy classification all such occupancy classifications shall comply with the seismic resistance requirements applicable to the higher occupancy classification.

4) Change of Occupancy Classification in Existing Buildings:
In general, the requirements of the Building Code and its referenced standard ASCE 7-10 for seismic resistance and these Rules, Regulations and Interpretations apply retroactively to all equipment and system components of existing buildings or portions of existing buildings when they are occupied by a new use that is a higher occupancy classification. Under certain conditions, some exceptions may apply. See Table 1604.5 (Table 4.1 in Chapter 4 of these rules) ~~and Section 3408 in the Building Code~~, Appendix 11B in ASCE 7-10 and the Existing Building Code.

Section 1.3 – Alternative Materials, Design or Methods of Construction

In accordance with the provisions of Section 104.11 of the 2015 IBC, these Rules, Regulations and Interpretations shall not prohibit the design professional from utilizing alternative materials, design or methods of construction to provide the equivalent of that prescribed by the Building Code in quality, strength, effectiveness, fire resistance, durability and safety.

Section 1.4 – General Approvals

St. Louis County will not review manufacturer's materials or equipment data sheets, reports, manuals, guidelines or details for the purposes of general approval and use of products. The County will however, review International Code Product Listing Reports provided under the ICC Evaluation Service Program for general acceptance in the County. In general, St. Louis County will accept products that have been tested and listed under the ICC Evaluation Service Program, as long as they are installed in accordance with the provisions and limitations of the ICC Listing Report. The County has also generally approved Accepted Engineering Practice Manuals as further described in Chapter 3, Section 3.2, paragraphs 3) and 4).

Source: Code Enforcement Division Administrative Policy 2.02 – Originally Released 06/01/98, Updated 02/20/07

Section 1.5 – Designs by Responsible Design Professionals

These Rules, Regulations and Interpretations represent the opinion of St. Louis County's staff concerning the minimum requirements of the County's Construction Codes. These minimum requirements shall not cancel or set aside more conservative design or installation requirements of the responsible design professional.

Section 1.6 – Related Interpretations

1) Application of Seismic Provisions of County Building Code in Municipalities Enforcing Another Building Code:

   Question: Are we required to comply with the seismic provisions of the County Building Code in a municipality where the County is not enforcing the Building

Code, but is enforcing the County Mechanical and/or Electrical and/or Plumbing Codes?

Answer: Yes.

Comment: The County Mechanical and/or Electrical and/or Plumbing Codes adopted by municipalities pursuant to a code enforcement contract, with the County, specifically include a provision, which requires that the seismic provisions of the County Building Code apply. See also Section 1.1 above, Authority for Rules, Regulations and Interpretations.

Source: Interpretation Issued 11/30/06

CHAPTER 2

Earthquake Resistant Architectural Components

Section 2.1 – Acoustical Lay-In Panel Ceilings

1) Details shall be provided on the construction documents showing how the ceiling will be constructed to resist the earthquake loads prescribed by Section 1613 of 2015 IBC, Section 13.5.6 of ASCE 7-10, ASTM C635/C635M-13, ASTM C636/C636M-08 and ~~Ceilings and Interior Systems Construction Association (CISCA) manual for Seismic Zones 3 and 4, 2004 edition~~ ASTM E580-2006.

2) All new or replaced acoustical lay-in panel ceiling grid systems greater than 144 square feet in area shall be constructed in accordance with the following criteria:

   a) Grid Systems: A heavy duty T-bar grid system shall be used.

   Source: ~~CISCA-04~~ ASTM E580

   b) Perimeter Support: The perimeter of the new or replaced grid system shall be supported by a closure angle. The width of the closure angle shall be not less than 2 inches. One end of the ceiling grid shall be attached to the closure angle in each orthogonal horizontal direction. The other end shall have a 0.75 inch clearance from the wall and shall rest upon and be free to slide on the 2 inch closure angle. The main and cross runners of the ceiling system shall be tied together to prevent twisting.

   Source: ~~CISCA-04~~ ASTM E580

   c) Vertical Support: Where new or replaced main or cross runners rest on the 2 inch closure angle described above, they shall be provided with No. 12 gauge vertical support wires for each main and cross runner at a maximum distance of 8 inches from walls. Additional No. 12 gauge vertical support wires shall be provided on 4 foot center spacing along all new or replaced main runners.

   Source: ~~CISCA-04~~ ASTM E580

   d) Light Fixtures: New or replaced light fixtures must be positively attached to the ceiling grid with an attachment capable of carrying 100 percent of the weight of the light fixture acting in any direction. This attachment shall consist of four equally spaced attachment points using screws, rivets, bolts or other approved positive attachment devices. In addition, the following supports shall be provided:

i) Light fixtures weighing less than 10 pounds shall have one No. 12 gauge wire connected to the center of the fixture housing and the structure above. This wire may be installed slack.

ii) Light fixtures weighing 10 pounds or more but less than 56 pounds shall have two No. 12 gauge wires. These wires shall be connected to opposite corners of the fixture housing and the structure above. These wires may be installed slack.

iii) Light fixtures weighing 56 pounds or more, shall be independently supported directly from the structure above, by approved hangers. In addition, other applicable requirements of the County Building Code and Rules for earthquake resistant electrical system components shall apply.

Exceptions:

1. *Light fixtures that are not components of a stand-by or emergency lighting system and weigh less than 20 pounds and powered using approved flexible cable assemblies no less than 3 feet long connected to such fixtures, are not required to have the additional support wire(s) described above. Such fixtures are required to be positively attached to the ceiling grid as described above.*

2. *Light fixtures installed in the existing ceiling grid of existing buildings are not required to have the additional vertical support wires described above, when all of the following conditions are met.*

   a) *The light fixture(s) are replacing fixture(s) that are damaged, dilapidated or inoperative as part of general maintenance, and*

   b) *The existing ceiling grid is capable of providing adequate vertical support for the light fixtures, and*

   c) *Existing light fixtures are not provided with the additional vertical support wires described above, and*

   d) *The light fixtures are positively attached to the ceiling grid as described above.*

Source: Policy; ~~CISCA-04~~

e) Mechanical Air Terminals (Grills, Diffusers, etc.): New and replaced mechanical air terminals must be positively attached to the ceiling grid with an attachment capable of carrying 100 percent of the weight of the mechanical air terminal acting in any direction. This attachment shall consist of four equally spaced attachment points using screws, rivets, bolts or other

approved positive attachment devices. In addition, the following supports shall be provided:

i) Air terminals weighing 20 pounds or more but less than 56 pounds shall have two No. 12 gauge wires connecting opposite corners of the mechanical air terminal device to the structure above. These wires may be installed slack.

ii) Mechanical air terminals weighing 56 pounds or more shall be independently supported directly from the structure above, by approved hangers. In addition, other applicable requirements of the County Building Code and Rules for earthquake resistant mechanical system components shall apply.

Exception:

Mechanical air terminals (grills, diffusers, etc.) installed in the existing ceiling grid of existing buildings are not required to have the additional vertical support wires described above, when all of the following conditions are met.

(1) The mechanical air terminal(s) are replacing terminal(s) that are damaged, dilapidated or inoperative as part of general maintenance, and

(2) The existing ceiling grid is capable of providing adequate vertical support for the mechanical air terminal, and

(3) Existing mechanical air terminals are not provided with the additional vertical support wires described above, and

(4) The mechanical air terminals are positively attached to the ceiling grid as described above.

Source: Policy, ~~CISCA-04~~

f) Sprinkler Heads and Other Penetrations: Sprinkler heads and other penetrations of ceiling tile in new or replaced suspended ceiling grid shall have a 2 inch oversize ring, sleeve, or adaptor through the ceiling tile to allow for free movement of at least 1 inch in all horizontal directions. Note: Section 13.5.6.3 ASCE 7-10 permits alternatives to providing large clearances around sprinkler system penetrations through ceiling systems, which are designed by a registered design professional.

Source: ASCE 7-10, ~~Section 13.5.6.2.2, item e~~, Section 13.5.6.3, NFPA 13-13 Section 9.3.4.2

g) Lateral Force Bracing: In addition to items a through f above, when the area of the new or replaced ceiling grid exceeds 1,000 square feet in area, such grid shall be provided with a lateral force bracing system of splayed wires and struts placed at a maximum of 12 feet on center in both directions with the first point within 6 feet from each wall. This lateral force bracing system shall be installed as further described below.

i) These splayed wires shall consist of four No.12 gauge wires secured to the main runner within 2 inches of the cross runner intersection. These wires shall be splayed 90 degrees from each other and installed at an angle not exceeding 45 degrees from the plane of the ceiling.

ii) In addition, a vertical strut shall be provided near the connection of the splayed wires described above. This strut shall be fastened to the main runner and extended and fastened to the structural members supporting the roof or floor above. The strut shall be adequate to resist the vertical component induced by the bracing wires. These splayed wires and struts shall be placed a maximum of 12 feet on center in both directions, with the first point within 6 feet from each wall.

Source: ASCE 7-10, ~~Section 13.5.6.2.2, item c~~; ~~CISCA-04~~ ASTM E580

h) Separation Joints: In addition to items a through g above, when the area of the new or replaced ceiling grid exceeds 2,500 square feet, there shall be a separation joint or a full height wall or partition separating the suspended ceiling grid into areas no greater than 2,500 square feet.

Source: ASCE 7-10, Section 13.5.6.2.2, item b; ~~CISCA-04~~ ASTM E580

Section 2.2 – Other Architectural Components

Details shall be provided on the construction documents showing how the other Architectural Components will be constructed to resist the seismic loads prescribed by Section 13.5 of ASCE 7-10.

Section 2.3 - Basis of Rules, Regulations and Interpretations:

The above Rules, Regulations and Interpretations have been determined after review of:

1) Sections 13.5.1, and 13.6.1 of ASCE 7-10 referenced by Section 1613 of the 2015 IBC.

2) ~~The 2004 edition of the Ceiling and Interior Systems Construction Association (CISCA) manual for direct hung acoustical tile and lay-in panel ceilings referenced by ASCE 7-05.~~ The provisions of ASTM E580-06.

3) The provisions of ~~Chapter 34 on Existing Structures of the 2015 IBC and the provisions of~~ the 2015 IEBC.

Section 2.4 - Related interpretations:

1) Alternate Materials for Vertical Support Wires:

   Question: Can the additional vertical support wire assemblies that may be installed slack as described in paragraphs d) and e) above, and the splayed lateral bracing wires described in paragraph g) above, be constructed of materials other than No.12 gauge wire?

   Answer: Yes, when such assemblies can be shown by a Missouri registered design professional to provide the equivalent quality, strength, effectiveness, fire resistance, durability and safety. See also Chapter 1, Section 1.3 on alternative materials, design or methods of construction.

   Source: Interpretation Issued 11/30/06

2) Listed Seismic Fixture Clamps:

   Questions:

   Do seismic fixture clamps evaluated in ICC-ES Reports or other listed lighting fixture (luminaire) attachment devices satisfy the seismic resistance requirements of the County Building Code for lighting fixtures in suspended ceilings?

   Answer: Yes, subject to the conditions identified in the comments below.

   Comments: Note that all the conditions and limitations of the listing report must be observed and the requirements of Chapter 2, Section 2.1, 2), d), Exception 1 must be met. See also Chapter 1, Section 1.3 on alternative materials, design or methods of construction, Section 1.4 on general approvals and Chapter 3, Section 3.2.

   Source: Interpretation Issued 11/30/06, updated 01/06/11

3) Oversized Holes For Fire Sprinkler Heads:

   Question: Are oversized holes for fire sprinkler heads required when using listed flexible sprinkler connections that are attached to the ceiling grid?

   Answer: No

   Comment: Because the flexible sprinkler connections are attached to the ceiling grid, they will move with the grid and allow for differential movement between the grid and branch-line piping and are not required to have oversized holes.

Note: Flexible sprinkler connections are not considered to be an alternative to seismic restraints for branch-lines.

Source: Interpretation Issued 11/30/06; ASCE 7-10, Section 13.5.6.3

CHAPTER 3

Earthquake Resistant Mechanical, Electrical and Plumbing (MEP) System Components

Section 3.1 – Construction Documents

1) Seismic Code Block on MEP Plans: The cover pages (i.e. the 1st page) of Mechanical, Electrical and Plumbing (MEP) plans accompanying permit applications shall contain a seismic code block prepared in substantially the same form and content as shown in Tables 3.1 and 3.2 of these Rules and Regulations. The Seismic Code Block requires that the engineer responsible for the design of the mechanical, electrical and plumbing systems identify the location of the details of anchorage and sway bracing of equipment and system components on the plans, or indicate that they will be furnished by subsequent submission. The responsible engineer will prepare or review these later submissions.

   The engineer who seals and is responsible for the design of the MEP systems does not necessarily have to be the same engineer who seals and is responsible for the design of the anchorage and sway bracing of MEP system components. These rules and regulations allow any engineer to prepare subsequent submissions of details of anchorage and sway bracing after approval of the plans and specifications and issuance of permits. When this occurs however, the design professional responsible for MEP systems shall review the subsequent submissions which have been prepared and sealed by other engineers to insure consistency with the plans, specifications and Seismic Code Block and forward four sets of them to the County for approval prior to inspection in the field. The submission forwarded to the County shall be accompanied by a cover letter identifying the project name, address and applicable MEP permit numbers. This submission needs to take place a minimum of two weeks prior to the planned installation in order to allow for plan review and forwarding to inspectors. In the event that this submission is deficient additional time may become necessary.

   Anchorage and sway bracing shall not be installed until the County has approved the subsequent submissions of the sway bracing and anchorage details. Installations made prior to County approval are at the installers own risk and are subject to a Stop Work Order. Anchorage and sway bracing shall not be covered or concealed until inspection approval is received.

   Exception: *These rules and regulations do not require that the engineer responsible for the design of mechanical systems review subsequent submissions of fire sprinkler system plans, for consistency and forwarding to the County. They do however, require that the fire sprinkler system plans*

accompanying permit applications contain an abbreviated Seismic Code Block indicating the location of the details of anchorage and sway bracing on such plans.

Source: Policy; ASCE 7-10, Section 13.2

2) Details of Anchorage and Sway Bracing: Details of anchorage and sway bracing of equipment and system components must be provided in documents which bear the seal of a Missouri licensed engineer.

   Details of anchorage shall include the following:

   a) Specific information relating to the type and size of anchorage (anchor bolts, etc.)

   b) Specific location of such anchorage

   c) Details of sway bracing to include:

      i) Materials used for sway bracing

      ii) Attachment of the sway bracing to the structure and component being braced

      iii) Location of transverse and longitudinal sway bracing and rod stiffeners

   Source: Policy; ASCE 7-10, Section 13.2

3) Examples of completed Seismic Code Blocks: Examples of a completed Seismic Code Block format are shown in Table 3.1 (Example 1: Mechanical and Plumbing Equipment Components Code Block, Example 2: Plumbing System Components Code Block) and Table 3.2 (Example: Electrical System Components Code Block). Each listed item in the Seismic Code Block shall be addressed in every column of the table:

   a) List all specified equipment and components

   b) Check appropriate column to identify what will be provided

   c) If “not provided” is checked, use “Comments” column to list the appropriate Exemption from Table 4.4

   d) Identify location of seismic details and calculations for the listed items, choosing one of the columns, ~~“Drawing No.” or “Shop Drawing”~~ “On Const. Documents” or “Subsequent Submittal”

Refer to the examples of Table 3.1 and Table 3.2 that show how to fill out the Seismic Code Block and notes that could accompany these documents where appropriate.

Source: Policy

Section 3.2 – Design of Anchorage and Sway Bracing

1) Design Guideline: Chapter 4 of these Rules and Regulations, contains a series of tables summarizing the provisions of the International Building Code and ASCE 7-10, concerning this subject. Chapter 4 also contains various statements of accepted engineering practice related to compliance with the Code. Design professionals may assume that the information contained in Chapter 4 represents accepted engineering practice in satisfying the seismic provisions of the St. Louis County Building Code.

   Source: Policy

2) Use of Design Manuals: The requirements of these rules and regulations concerning submission of specific information and details on anchorage and sway bracing cannot be satisfied by a general reference to Design Manuals.

   However, design professionals may utilize these manuals as a basis of their design. This would include authorized abstracting of applicable tables and details and incorporating them into their professional sealed design and submissions for approvals. Except as described below, related to abstracting details of Accepted Engineering Practice, this would require that the abstracted details bear the seal of the design professional.

   Source: Policy

3) Alternative Designs Using Accepted Engineering Practice: The requirements of these Rules and Regulations may also be satisfied by design professionals preparing submissions which include details of anchorage and sway bracing contained in the Accepted Engineering Practice publications listed in paragraph 4) below. This may be accomplished by assembling appropriate abstracts of details from these publications for each applicable MEP component and size of component and by preparing a sealed cover letter or coversheet identifying the project, project address, applicable component(s) and containing a statement substantially the same as follows:

   “I have reviewed the earthquake load provisions of the St. Louis County Building Code, the St. Louis County Rules and Regulations on Seismic Anchorage and Sway Bracing Mechanical, Electrical and Plumbing System Components and the (insert name of Accepted Engineering Practice publication used). The attached details have been abstracted from this publication. These details represent Anchorage and Sway Bracing of Mechanical, Electrical and Plumbing System

Components that meets or exceeds the earthquake load resistance requirements of the St. Louis County Building Code as well as applicable St. Louis County Rules and Regulations."

Source: Policy

4) Accepted Engineering Practice: The most current editions of the following anchorage and sway bracing publications shall be considered to represent Accepted Engineering Practice:

   a) Guidelines and details that have been evaluated and reported under the International Code Council (ICC) Evaluation Service Program

   b) Seismic Restraint Manuals, Guidelines and details that have been approved by the California Office of Statewide Health Planning and Development (OSHPD) under their pre-approval program for anchorage and sway bracing systems. This would include the OSHPD approved edition of the Seismic Restraint Manual Guidelines for Mechanical Systems published by SMACNA.

      Notes:

      i) Submissions of details from OSHPD approved manuals and guidelines may require that St. Louis County be furnished with copies of entire manuals or guidelines for initial submissions.

      ii) St. Louis County will not review manufacturer's manuals, guidelines or details of anchorage or sway bracing for inclusion in the above list of Accepted Engineering Practice publications.

   Source: Policy

5) Automatic Sprinkler Systems: Automatic sprinkler systems shall be designed and constructed to resist the effects of earthquake motions in accordance with Section 9.3 of NFPA 13-13 or Section 13.6.8 of ASCE 7-10. ~~For piping lighter than schedule 10 piping, the design and construction may be in accordance with all of the earthquake protection provisions of NFPA 13-13 or be structurally designed.~~ Note: When using 13.6.8 of ASCE 7, the designer shall not use any of the exceptions listed under Section 13.6.8.3.

   Source: ASCE 7-10, Section 13.6.8.2

6) Precautions: The above procedures for use of design manuals and Accepted Engineering Practice publications, do not allow design professionals or installers to utilize the provisions of these manuals or publications in order to omit anchorage or sway bracing prescribed by the Code, Code Referenced Standards or these Rules and Regulations.

Source: Policy; 2015 IBC, Section 101.3

Section 3.3 – Related Interpretations

The following interpretations relate to Sections 3.1 and 3.2 above, including Tables 3.1 and 3.2 and Chapter 4.

1) Mechanical, Electrical and Plumbing System Components:

   a) Structural Calculations:

      Question: Are structural calculations, verifying that MEP System Components are properly anchored and sway braced, required to be submitted for every anchorage and sway braced detail?

      Answer: No.

      Comment: The County does not routinely require that structural calculations accompany every submission for anchorage or sway bracing of MEP System Components. The County may however, require the submission of structural calculations, engineering reports, test data, and/or specifications when it appears that improper or inadequate anchorage or sway bracing has been detailed.

      Source: Interpretation Issued 11/30/06

   b) Flexible Connections of Ductwork Piping and Conduit to Equipment :

      Question: Are all connections of ductwork, piping and conduit to equipment required to be flexible connections?

      Answer: No.

      Comment: Flexible connections are only required when the exceptions listed in Table 4.4 of Chapter 4 are used to omit anchorage and/or sway bracing seismic resistance.

      Source: Interpretation Issued 11/30/06

2) Mechanical System Components:

   a) Replacement of Rooftop Heating and Air Conditioning Units (RTUs):

      Question: Are RTUs that are replacing damaged, dilapidated or inoperative RTUs, on existing buildings, required to be designed and installed to resist earthquake loads?

Answer: No, as long as such replacement RTUs are of the same nominal capacity, basic size and location as the existing equipment and all deteriorated supports such as curbs are properly repaired or replaced and the unit being replaced is not seismically restrained/supported.

Comment: This is treated as a repair to the mechanical system, for the purposes of maintenance. See Chapter 1, Section 1.2, *Exception* for replacement of components in existing buildings.

Precautionary Note: If the entire system is being replaced or renovated such as RTUs, ductwork, electrical service, gas supply, etc., then the RTU and other system components would be treated the same as a new installation and would be required to be designed and installed to resist earthquake loads. In addition, the installation of a replacement RTU of a larger nominal capacity or significantly different size or new location is required to comply with code requirements for seismic load resistance. When any of these conditions occur, the unit will need to be anchored to the curb and the curb anchored to the structural elements of the roof in such a manner to resist and transfer the earthquake loads into the structural elements of the roof.

Source: Interpretation Issued 11/30/06

b) Seismic Restraint of Existing Fire Sprinkler Systems That Are Modified :

Question: When relocating or adding sprinkler heads to an existing sprinkler system because the rooms or spaces protected have been re-arranged, do new armovers or branch lines need to be seismically restrained?

Answer: No, as long as the existing armovers and branch lines are not seismically restrained and the hazard classification of the system is not increased.

Comment: If the existing sprinkler system is seismically restrained, then all new work must also be seismically restrained. If the hazard classification of the system is increased, then the entire system (mains and cross-mains, branch-lines, armovers, etc.) must meet the seismic requirements of NFPA 13-13. If a new area that is to be sprinkler protected is added to an existing sprinkler system, then all sprinkler piping within the newly added area will be required to meet the seismic requirements of NFPA 13-13.

Source: Interpretation Issued 11/30/06, updated 01/06/11

3) Electrical System Components:

Pendant Style Light Fixtures:

Question: Are pendant style light fixture required to be sway braced?

Answer: No, as long as the fixture will not collide with other fixtures, equipment or building elements when it swings to an angle of 45 degrees from vertical.

Comment: The vertical support for this type fixture shall be designed with a minimum factor of safety required by Table 4.4.

Source: Interpretation Issued 11/30/06, updated 01/06/11

4) Plumbing System Components:

There are no Plumbing System Component interpretations at this time.

Provide a seismic code block on the first sheet of the Mechanical and Plumbing plans signed and sealed by a Missouri Professional Engineer:

Table 3.1

MECHANICAL AND PLUMBING EQUIPMENT COMPONENTS EARTHQUAKE LOAD RESISTANCE

Occupancy Category ( ) **Seismic Design Category ( )**

LISTING OF EQUIPMENT AND SYSTEM COMPONENTS	ANCHORAGE TO FLOORS, ROOFS, ETC. (See Note 1 below)		SWAY BRACING (See Note 1 below)		LOCATION OF PROFESSIONALLY SEALED ANCHORAGE AND SWAY BRACING DETAILS		COMMENTS
					ON CONST. DOCUMENTS	SUBSEQUENT SUBMITTAL Separate Permit & Plans (See Note 2 below)	
	Not Provided For Project	Provided For Project	Not Provided For Project	Provided For Project	Drawing No. or Spec. Section		
FIRE PROTECTION, DETECTION & ALARM EQUIPMENT & SYSTEM COMPONENTS; * See Chapter 4, Table 4.1 (List items such as; fire sprinkler system equipment & system components, smoke control & evacuation equipment & system components)							
HAZARDOUS EQUIPMENT & SYSTEM COMPONENTS; * See Chapter 4, Table 4.1 (List items such as; gas piping, piping containing flammable, combustible liquids & gasses or toxic chemicals. Include items such as flammable & combustible tanks, vats & other industrial equipment containing hazardous or toxic liquids, gasses, chemicals, etc.)							
OTHER EQUIPMENT & SYSTEM COMPONENTS NEEDED FOR CONTINUED OPERATION OF OCCUPANCY CATEGORY IV FACILITIES OR WHOSE FAILURE COULD IMPAIR THEIR CONTINUED OPERATION * See Chapter 4, Table 4.1 (List items)							
OTHER GENERAL EQUIPMENT & SYSTEM COMPONENTS (List items such as; boilers, furnaces, AHU's, tanks, heat exchangers and pressure vessels, suspended piping, water heaters, VAV boxes, HVAC ducts, drain, waste & vent piping, pumps, etc.)							

Notes:

1. It is the basic intent of this Code Block to declare whether or not anchorage and sway bracing is being provided on the project. If so, to declare whether or not the details are shown on the plans or will be shown on a subsequent submission. If seismic restraint of a component is not required by code this should be stated in comments. If seismic restraint, which is not required by code, is being provided due to owner/designer requirements this should also be stated in the comments.
2. ~~Shop drawings~~ Plans signed and sealed by a Missouri Professional Engineer along with a separate permit application need to be submitted to the County a minimum of two weeks prior to the planned installation to allow for plan review and distribution to the inspector. Additional time may be needed if such submissions are deficient.

EXAMPLE: Seismic code block on the first sheet of the Mechanical and Plumbing plans signed and sealed by a Missouri Professional Engineer:

Table 3.1, EXAMPLE 1 CODE BLOCK

MECHANICAL AND PLUMBING EQUIPMENT COMPONENTS
EARTHQUAKE LOAD RESISTANCE

Occupancy Category (II) **Seismic Design Category (D)**

(To identify the Occupancy Category and Seismic Design Category refer to Tables 4.1 and 4.2)

LISTING OF EQUIPMENT AND SYSTEM COMPONENTS	ANCHORAGE TO FLOORS, ROOFS, ETC.		SWAY BRACING		LOCATION OF PROFESSIONALLY SEALED ANCHORAGE AND SWAY BRACING DETAILS		COMMENTS
					ON CONST. DOCUMENTS	SUBSEQUENT SUBMITTAL Separate Permit & Plans	
	Not Provided For Project	Provided For Project	Not Provided For Project	Provided For Project	Drawing No. or Spec. Section		
FIRE PROTECTION, DETECTION & ALARM EQUIPMENT & SYSTEM COMPONENTS; I_p = 1.5 (To identify I_p refer to Table 4.1) Fire Sprinkler Piping	X		X			X	
HAZARDOUS EQUIPMENT & SYSTEM COMPONENTS; I_p = 1.5 (To identify I_p refer to Table 4.1) Gas piping 1" or less (interior and exterior)	X		X				5, 6
Gas piping > 1" or non-ductile (interior)	X			X	M - ___.		
Exterior gas piping > 1"	X		X				9
Kitchen Grease Hood		X		X		X	by kitchen contractor
Kitchen Exhaust Fan		X		X		X	
Hazardous Medical Gas piping	X			X	M - ___.		
OTHER EQUIPMENT & SYSTEM COMPONENTS NEEDED FOR CONTINUED OPERATION OF OCCUPANCY CATEGORY IV FACILITIES OR WHOSE FAILURE COULD IMPAIR THEIR CONTINUED OPERATION							N/A, no Occupancy Category IV in the project
OTHER GENERAL EQUIPMENT & SYSTEM COMPONENTS I_p = 1.0 <u>Roof Top:</u> RTU, EF, MUA, CU > 400 lbs. RTU, EF, MUA, CU ≤ 400 lbs.	X	X	X			X	12 1
<u>Floor Mounted:</u> AHU, Boiler, Chiller > 400 lbs. Furnace, FCU, etc. ≤ 400lbs.	X	X	X X		M - ___.	X	12, 13
<u>Equipment suspended from the structure:</u> EF, FCU, VAV, FTU > 20 lbs. EF, Air terminal units ≤ 20 lbs.	X	X	X	X	M - ___.		2
<u>Wall mounted equipment:</u> FCU, UV, UH, etc.	X		X				14

(continued)

Table 3.1, EXAMPLE 1 CODE BLOCK – continued

MECHANICAL & PLUMBING EQUIPMENT COMPONENTS
EARTHQUAKE LOAD RESISTANCE

Occupancy Category (II) **Seismic Design Category (D)**

(To identify the Occupancy Category and Seismic Design Category refer to Tables 4.1 and 4.2)

LISTING OF EQUIPMENT AND SYSTEM COMPONENTS	ANCHORAGE TO FLOORS, ROOFS, ETC.		SWAY BRACING		LOCATION OF PROFESSIONALLY SEALED ANCHORAGE AND SWAY BRACING DETAILS		COMMENTS
					ON CONST. DOCUMENTS	SUBSEQUENT SUBMITTAL Separate Permit & Plans	
	Not Provided For Project	Provided For Project	Not Provided For Project	Provided For Project	Drawing No. or Spec. Section		
Fire dampers, louvers	X		X				10, 14
Ductwork	X		X				4
Piping ≤ 3”	X		X				7, 8
Piping > 3” or non-ductile	X			X	M - ___.		
Air devices	X		X				10, 14

- It is the basic intent of this Code Block to declare whether or not anchorage and sway bracing is being provided on the project. If so, to declare whether or not the details are shown on the plans or will be shown on a subsequent submission. If seismic restraint of a component is not required by code this should be stated in comments. If seismic restraint, which is not required by code, is being provided due to owner/designer requirements this should also be stated in the comments.
- ~~Shop drawings~~ Plans signed and sealed by a Missouri Professional Engineer along with a separate permit application need to be submitted to the County a minimum of two weeks prior to the planned installation to allow for plan review and distribution to the inspector. Additional time may be needed if such submissions are deficient.

1. Table 4.4, item 1, a, exception for 3 feet minimum of flex connection between components, mounted 4 feet or less above the floor level and weighs 400 pounds or less .
2. Table 4.4, item 1, b, exception for 3 feet minimum of flex connection between components and weighs 20 pounds or less.
3. Table 4.4, item 1, b, exception for less than 5 lb/ft (copper piping – 2 ½ inches or less, schedule 40 and 80 CPVC – 3 inches or less). 3 foot flex connections for suspended equipment.
4. Table 4.4, item 3, exception for ductwork “a” (or “b”). Refer to installation detail on drawing # ____.
5. Table 4.4, item 4, exception for piping suspended from hangers 12 inches or less. Refer to installation detail on drawing # ____.
6. Table 4.4, item 4, exception for ductile piping 1inch or less (Seismic Design Category D).
7. Ductile piping: steel, copper piping and tubing joined by welding, brazing/soldering or flanges. Refer to Table 4.4, item 4.
8. Table 4.4, item 4, exception for ductile piping 3 inches or less (Seismic Design Category D).
9. Table 4.4, item 5, exception for exterior gas piping on roof, 2 psi or less: seismic shut-off valve or flex connectors within 5 feet of the beginning of the run, at connections to equipment and at 42 foot or less intervals.
10. Components shall be positively attached with mechanical fasteners.
11. Seismic calculations are attached to set of drawings.
12. ~~Contractor shall provide shop drawings to the engineer of record for review and approval prior to submittal to the plan reviewer.~~ Plans signed and sealed by a Missouri Professional Engineer to be submitted separately with permit application for review.
13. ~~Typical seismic anchorage (or sway bracing) is provided on the drawings for reference only. Shop drawings are required.~~ Typical seismic anchorage (or sway bracing) provided on drawings is for reference only. Plans signed and sealed by a Missouri Professional Engineer to be submitted separately with permit application for review.
14. Refer to installation detail on drawing # ____.

EXAMPLE: Seismic code block on the first sheet of the Plumbing plans signed and sealed by a Missouri Professional Engineer:

Table 3.1, EXAMPLE 2 CODE BLOCK

PLUMBING SYSTEM COMPONENTS
EARTHQUAKE LOAD RESISTANCE

Occupancy Category (II) **Seismic Design Category (D)**

(To identify the Occupancy Category and Seismic Design Category refer to Tables 4.1 and 4.2)

LISTING OF EQUIPMENT AND SYSTEM COMPONENTS	ANCHORAGE TO FLOORS, ROOFS, ETC.		SWAY BRACING		LOCATION OF PROFESSIONALLY SEALED ANCHORAGE AND SWAY BRACING DETAILS		COMMENTS
					ON CONST. DOCUMENTS	SUBSEQUENT SUBMITTAL	
	Not Provided For Project	Provided For Project	Not Provided For Project	Provided For Project	Drawing No. or Spec. Section	Separate Permit & Plans	
Waste Piping	X		X				2a
Vent Piping	X		X				2a
Water Piping	X		X				2c
Storm Piping		X		X		X	2b
Water Heater (more than 400 pounds)		X		X			
Water Heater (less than or equal to 400 pounds)	X		X				1

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- ~~Shop drawings~~ Plans signed and sealed by a Missouri Professional Engineer along with a separate permit application need to be submitted to the County a minimum of two weeks prior to the planned installation to allow for plan review and distribution to the inspector. Additional time may be needed if such submissions are deficient.

1. Table 4.4, item 1, a, Ip = 1.0, component does not weigh more than 400 pounds and flexible connections are provided.
2. Table 4.4, note 2:
   a. The following sanitary drain, waste and vent pipe:
      Schedule 40 PVC, 6 inches or less in diameter; Schedule 80 PVC, 4 inches or less in diameter; service weight and no hub cast iron, 2 inches or less in diameter
   b. The following storm drain pipe:
      Schedule 40 and 80 PVC, 3 inches or less in diameter; service weight and no hub cast iron, not applicable.
   c. The following water pipe:
      Type L and M copper, 2 ½ inches or less in diameter; Schedule 40 and 80 CPVC, 3 inches or less in diameter.
   d. Flexible connections are not required for connections to appliances or plumbing fixtures that are mounted to walls or floors.
3. ~~Contractor shall provide shop drawings to the engineer of record for review and approval prior to submittal to the plan reviewer.~~ Plans signed and sealed by a Missouri Professional Engineer to be submitted separately with permit application for review.
4. Seismic details are attached to the set of drawings.
5. ~~Typical seismic anchorage (or sway bracing) is provided on the drawings for reference only. Shop drawings are required.~~ Typical seismic anchorage (or sway bracing) provided on drawings is for reference only. Plans signed and sealed by a Missouri Professional Engineer to be submitted separately with permit application for review.

Provide a seismic code block on the first sheet of the Electrical plans signed and sealed by a Missouri Professional Engineer:

Table 3.2

ELECTRICAL SYSTEM COMPONENTS
EARTHQUAKE LOAD RESISTANCE

Occupancy Category ( ) **Seismic Design Category ( )**

LISTING OF EQUIPMENT AND SYSTEM COMPONENTS	ANCHORAGE TO FLOORS, ROOFS, ETC. (See Note 1 below)		SWAY BRACING (See Note 1 below)		LOCATION OF PROFESSIONALLY SEALED ANCHORAGE AND SWAY BRACING DETAILS		COMMENTS
					ON CONST. DOCUMENTS	SUBSEQUENT SUBMITTAL Separate Permit & Plans (See Note 2 below)	
	Not Provided For Project	Provided For Project	Not Provided For Project	Provided For Project	Drawing No. or Spec. Section		
FIRE PROTECTION, DETECTION & ALARM EQUIPMENT & SYSTEM COMPONENTS; * See Chapter 4, Table 4.1 (List items such as fire alarm panels, electric conductors powering fire protection equipment, etc.)							
EMERGENCY OR STANDBY EQUIP. AND SYSTEM COMPONENTS; * See Chapter 4, Table 4.1 (List items such as emergency generators, panel boards, single hanger and trapeze supported system components, bus-ducts, primary cable systems, motors control centers and devices, switch-gears, transformers, unit substations, cable tray, conduit, lighting fixtures, etc.)							
OTHER EQUIPMENT & SYSTEM COMPONENTS NEEDED FOR CONTINUED OPERATION OF OCCUPANCY CATEGORY IV FACILITIES OR WHOSE FAILURE COULD IMPAIR THEIR CONTINUED OPERATION * See Chapter 4, Table 4.1 (List items)							
OTHER GENERAL EQUIPMENT & SYSTEM COMPONENTS (list items such as panel boards, single hanger & trapeze supported system components, communication systems, electrical bus ducts, primary cable systems, electrical motor control centers, motor control devices, switchgear, transformers, unit substations, cable tray, conduit, lighting fixtures, etc.)							

Notes:

1. It is the basic intent of this Code Block to declare whether or not anchorage and sway bracing is being provided on the project. If so, to declare whether or not the details are shown on the plans or will be shown on a subsequent submission. If seismic restraint of a component is not required by code this should be stated in comments. If seismic restraint, which is not required by code, is being provided due to owner/designer requirements this should also be stated in the comments.
2. ~~Shop drawings~~ Plans signed and sealed by a Missouri Professional Engineer along with a separate permit application need to be submitted to the County a minimum of two weeks prior to the planned installation to allow for plan review and distribution to the inspector. Additional time may be needed if such submissions are deficient.

EXAMPLE: Seismic code block on the first sheet of the Electrical plans signed and sealed by a Missouri Professional Engineer:

Table 3.2, EXAMPLE CODE BLOCK

ELECTRICAL SYSTEM COMPONENTS
EARTHQUAKE LOAD RESISTANCE

Occupancy Category (II) **Seismic Design Category (D)**

(To identify the Occupancy Category and Seismic Design Category refer to Tables 4.1 and 4.2)

LISTING OF EQUIPMENT AND SYSTEM COMPONENTS	ANCHORAGE TO FLOORS, ROOFS, ETC.		SWAY BRACING		LOCATION OF PROFESSIONALLY SEALED ANCHORAGE AND SWAY BRACING DETAILS		COMMENTS
					ON CONST. DOCUMENTS	SUBSEQUENT SUBMITTAL	
	Not Provided For Project	Provided For Project	Not Provided For Project	Provided For Project	Drawing No. or Spec. Section	Separate Permit & Plans	
FIRE PROTECTION, DETECTION & ALARM EQUIPMENT & SYSTEM COMPONENTS;							
Fire Alarm Panel		X		X	E - ___.		11
Fire Alarm Wiring		X		X			
EMERGENCY OR STANDBY EQUIPMENT AND SYSTEM COMPONENTS:							
Emergency Generator	X		X				N/A, no emergency or standby equipment in the project
Automatic Transfer Switch	X		X				
Emergency Distribution Panel	X		X				
Conduit and Wiring	X		X				
OTHER EQUIPMENT AND SYSTEM COMPONENTS NEEDED FOR CONTINUED OPERATION OF SEISMIC USE GROUP III FACILITIES OR WHOSE FAILURE COULD IMPAIR THEIR CONTIUED OPERATION:							
Hazardous Areas Equipment/Wiring	X		X				N/A, no Occupancy Category IV in the project
Patient Care Areas Equipment/Wiring	X		X				
OTHER GENERAL EQUIPMENT & SYSTEM COMPONENTS:							
Main Switchgear		X		X		X	9
Transformers		X		X		X	9
Distribution Panels		X	X	X		X	9
Lighting Fixtures	X						1
Conduit and Wiring	X		X				5, 6

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- ~~Shop drawings~~ Plans signed and sealed by a Missouri Professional Engineer along with a separate permit application need to be submitted to the County a minimum of two weeks prior to the planned installation to allow for plan review and distribution to the inspector. Additional time may be needed if such submissions are deficient.

1. Light fixtures less than 20 pounds not part of stand-by or emergency lighting system powered with flexible cable less than 3 feet, fixture shall be mechanically attached to ceiling grid.
2. Pendant type fixtures do not require sway bracing when it can swing at an angle of 45° from vertical without impacting other components.
3. Table 4.4, exception for $I_p = 1.0$, weight less than 400 pounds.
4. Table 4.4, exception for $I_p = 1.0$, weight less than 20 pounds.
5. Table 4.4, exception for $I_p = 1.0$, weight 5lbd/ft or less.
6. Flexible connection required between equipment and components if installation other than mounted to walls and floors.

(continued)

Table 3.2, EXAMPLE CODE BLOCK – continued

ELECTRICAL SYSTEM COMPONENTS
EARTHQUAKE LOAD RESISTANCE

7. Table 4.4, item 2, d, rigid steel IMC conduit ≤ 1 1/2 inches in diameter, and EMT or aluminum conduit ≤ 2 inches in diameter.
8. Seismic calculations and details are attached to the set of drawings.
9. ~~Contractor shall provide shop drawings to the engineer of record for review and approval prior to submittal to the plan reviewer.~~ Plans signed and sealed by a Missouri Professional Engineer to be submitted separately with permit application for review.
10. ~~Typical seismic anchorage (or sway bracing) is provided on the drawings for reference only. Shop drawings are required.~~ Typical seismic anchorage (or sway bracing) provided on drawings is for reference only. Plans signed and sealed by a Missouri Professional Engineer to be submitted separately with permit application for review.
11. Refer to installation detail on drawing # E -____.

CHAPTER 4

Summary of Building Code
Seismic Design Requirements

Section 4.1 – General

This chapter provides a tabulated summary of the seismic design requirements of the St. Louis County Building Code.

Design professionals who desire to independently design anchorage or sway bracing as identified in the 2015 IBC and the referenced ASCE 7-10 standard should be aware that the County's code adoptive ordinances have designated the S_s and S_1 spectral responses for St. Louis County to be S_s = 0.48 and S_1= 0.18 regardless of the location of the project within the County. In the absence of a Missouri Professional Engineer signed and sealed subsurface soil investigation report, a Site class D shall be assumed unless there is knowledge of a Site Class E or F present at the site.

Section 4.2 – Design Tables

Table 4.1 on Occupancy Categories and Component Importance Factors is provided in order to apply the Rules and Regulations, which vary, based on these factors.

Table 4.2 on Seismic Design Categories and Site Classes is provided in order to apply the Rules and Regulations, which vary, based on these factors and to determine the basic application of these Rules and Regulations to Mechanical and Electrical System Components.

Table 4.3 is provided to list the definitions of material deformability.

Table 4.4 is provided to list general exemptions to the seismic design requirements.

Table 4.5 is provided as a guideline to calculate the seismic design forces of mechanical and electrical components.

Table 4.6 on component a_p-R_p values is provided to use in conjunction with Table 4.5 in determining the horizontal and vertical seismic loads on system components.

Table 4.7 is provided to list general seismic design requirements of mechanical and electrical component supports and attachments.

Table 4.8 is provided to list general seismic design requirements of mechanical components.

Table 4.9 is provided to list general seismic design requirements of electrical components.

Table 4.1
OCCUPANCY CATEGORY OF BUILDINGS AND COMPONENT IMPORTANCE FACTORS (I_P)

(Table 1604.5 of 2015 IBC; Table 1.5-1 and Section 13.1.3 of ASCE 7-10)

Risk Category	Nature of Occupancy	Component Importance Factors (I_P)
I	Buildings and other structures that represent a low hazard to human life in the event of failure, including but not limited to: • Agricultural facilities. • Certain temporary facilities. • Minor storage facilities.	1.0
	The following components/systems must be designed with an importance factor of 1.5 when located in any of the above occupancies: • The component is required to function for life-safety purposes after an earthquake, including: fire protection systems such as fire sprinkler systems, smoke control systems, fire stand pipe systems, fire alarm systems including electrical and mechanical equipment and system components supporting such systems and emergency or standby electrical system components. • Means of egress stairways. • The component contains hazardous content such as tanks, pressure vessels and piping containing flammable, combustible or highly toxic liquids and gases, including natural gas piping.	1.5
II	Buildings and other structures except those listed in Occupancy Categories I, III and IV	1.0
	The following components/systems must be designed with an importance factor of 1.5 when located in any of the above occupancies: • The component is required to function for life-safety purposes after an earthquake, including: fire protection systems such as fire sprinkler systems, smoke control systems, fire stand pipe systems, fire alarm systems including electrical and mechanical equipment and system components supporting such systems and emergency or standby electrical system components. • Means of egress stairways. • The component contains hazardous content such as tanks, pressure vessels and piping containing flammable, combustible or highly toxic liquids and gases, including natural gas piping.	1.5

(continued)

Table 4.1 - continued
OCCUPANCY CATEGORY OF BUILDINGS AND COMPONENT IMPORTANCE FACTORS (I_P)

(Table 1604.5 of 2015 IBC; Table 1.5-1 and Section 13.1.3 of ASCE 7-10)

Risk Category	Nature of Occupancy	Component Importance Factors (I_P)
III	Buildings and other structures that represent a substantial hazard to human life in the event of failure, including but not limited to: • Buildings and other structures whose primary occupancy is public assembly with an occupant load greater than 300. • Buildings and other structures containing ~~elementary school, secondary school or day care facilities~~ educational occupancies with an occupant load greater than 250. • Buildings and other structures containing ~~adult education facilities, such as college and university~~ educational occupancies for students above the 12th grade with an occupant load greater than 500. • ~~Healthcare facilities~~ Group I-2 occupancies with an occupant load of 50 or more resident ~~patients~~ care recipients but not having surgery or emergency treatment facilities. • ~~Jails and detention facilities~~ Group I-3 occupancies. • Any other occupancy with an occupant load greater than 5,000 • Power-generating stations, water treatment facilities for potable water, waste water treatment facilities and other public utility facilities not included in Occupancy Category IV. • ~~•~~ Buildings and other structures not included in Occupancy Category IV ~~(including, but not limited to, facilities that manufacture, process, handle, store, use or dispose of such substances as hazardous fuels, hazardous chemicals, hazardous waste or explosives) containing sufficient quantities of toxic or explosive substances to be dangerous to the public if released.~~ containing quantities of toxic or explosive materials that: a. Exceed maximum allowable quantities per control area as given in Table 307.1(1) or 307.1(2) or per outdoor control area in accordance with the International Fire Code and b. Are sufficient to pose a threat to the public if released	1.0
	The following components/systems must be designed with an importance factor of 1.5 when located in any of the above occupancies: • The component is required to function for life-safety purposes after an earthquake, including: fire protection systems such as fire sprinkler systems, smoke control systems, fire stand pipe systems, fire alarm systems including electrical and mechanical equipment and system components supporting such systems and emergency or standby electrical system components. • Means of egress stairways. • The component contains hazardous content such as tanks, pressure vessels and piping containing flammable, combustible or highly toxic liquids and gases, including natural gas piping.	1.5

(continued)

Table 4.1 - continued
OCCUPANCY CATEGORY OF BUILDINGS AND COMPONENT IMPORTANCE FACTORS (I_P)

(Table 1604.5 of 2015 IBC; Table 1.5-1 and Section 13.1.3 of ASCE 7-10)

Risk Category	Nature of Occupancy	Component Importance Factors (I_P)
IV	Buildings and other structures designated as essential facilities including, but not limited to: • ~~Hospitals and other health care facilities~~ I-2 occupancies having surgery or emergency treatment facilities. • Fire, rescue, ambulance, and police stations and emergency vehicle garages. • Designated earthquake, hurricane or other emergency shelters • Designated emergency preparedness, communication, and operation centers and other facilities required for emergency response. • Power generating stations and other public utility facilities required ~~in an emergency~~ as emergency backup facilities for Risk Category IV structures. • ~~Ancillary structures (including, but not limited to, communication towers, fuel storage tanks, cooling towers, electrical substation structures, fire water storage tanks or other structures housing or supporting water, or other fire-suppression material or equipment) required for operation of Category IV structures during an emergency.~~ • Buildings and other structures containing quantities of highly toxic materials that: a. Exceed maximum allowable quantities per control area as given in Table 307.1(2) or per outdoor control area in accordance with the International Fire Code and b. Are sufficient to pose a threat to the public if released • Aviation control towers, air traffic control centers, and emergency aircraft hangars. • Water storage facilities and pump structures required to maintain water pressure for fire suppression • Buildings and other structures having critical national defense functions. ~~Buildings and other structures (including, but not limited to, facilities that manufacture, process, handle, store, use, or dispose of such substances as hazardous fuels, hazardous chemicals, or hazardous waste) containing highly toxic substances where the quantity of the material exceeds a threshold quantity established by the authority having jurisdiction.~~ All components of buildings or structures needed for continued operation of the facility or whose failure could impair the continued operation of the facility. It will be assumed that all mechanical, electrical and plumbing system components in Seismic Occupancy Category IV buildings or structures are necessary for the continued operation of the facility unless otherwise specifically justified by the responsible design professional.	1.5

Table 4.2
SEISMIC DESIGN CATEGORY

(Tables 1613.3.5(1), 1613.3.5(2) of 2015 IBC;
Table 20.3-1, Sections 11.4 and 11.6 of ASCE 7-10)

SITE CLASS	SOIL PROFILE NAME	Occupancy Category I , II & III	Occupancy Category IV
A	Hard Rock	B	C
B	Rock	~~C~~ B	~~D~~ C
C	Very dense soil or Soft Rock	C	D
D	Stiff soil	D	D
E	Soft clay soil	D	D
F	Soil with serious problems *(~~Table 1613.5.2 of 2009 IBC;~~ Section 20.3.1 of ASCE 7-10)*	For occupancy categories I through IV with a seismic design category of E or F a site-specific design is required. *(Chapter 21 of ASCE 7-10)*	

1. The above table is an abbreviated excerpt from the code, for additional soil requirements and clarifications refer to Table 20.3-1 and Section 20.3.1 of ASCE 7-10.
2. A soil investigation report prepared by a registered design professional is required for all site classes (Section 1803.1 of 2015 IBC).
3. Where the soil properties are not known in sufficient detail to determine the site class, Site Class D shall be used (Section 1613.3.2 of 2015 IBC and Section 20.1 of ASCE 7-10).
4. The earthquake spectral response acceleration parameters for St. Louis County are: earthquake spectral response acceleration at short periods S_S= 0.48 and earthquake spectral response acceleration at 1-second periods S_1=0.18 (Section 1613.3.1 of 2015 IBC as amended by St. Louis County).

Table 4.3
DEFORMABILITY DEFINITIONS

High Deformability Piping Systems	steel and copper piping and tubing joined by welding, brazing/soldering or by bolted steel flanges
Limited Deformability Piping Systems	steel and copper piping and tubing joined by threading, bonding, compression couplings or grooved couplings
Low Deformability Piping Systems	systems that are composed of cast iron, glass, ceramic and nonductile plastic piping, as well as systems composed of any piping joined with cast iron fittings, or other methods of joining that rely on friction

Table 4.4
SEISMIC DESIGN REQUIREMENT EXEMPTIONS FOR MECHANICAL, ELECTRICAL AND PLUMBING COMPONENTS

(Chapter 13 of ASCE 7-10, Policy)

1. General Exemptions	Seismic Design Category A, B.	*Section 13.1.4 of ASCE 7-10*
	Seismic Design Category C and the component importance factor I_P=1.0.	
	Seismic Design Category D, E or F, and the component importance factor I_P=1.0, and components have approved flexible connections no less than 3 feet in length to the associated ductwork, piping, and conduit, and the components are either: a. Mounted 4 feet or less above the floor level and weigh 400 pounds or less, (~~See Note 1 below~~), or b. Weigh 20 pounds or less, or for distribution systems weighing 5lb/ft or less. (See Note 2 below)	
2. Light fixture, Sign and Ceiling Fan Exemptions	Not connected to ducts or piping, supported by chains or otherwise suspended from the structure, provided all of the following criteria are met: a. The design load for such items shall be equal to 1.4 times the operating weight acting down with a simultaneous horizontal load equal to 1.4 times the operating weight. The horizontal load shall be applied in the direction that results in the most critical loading for design. b. Seismic interaction effects shall be considered per Section 13.2.3 of ASCE 7-10. c. The connection to the structure shall allow a 360 degree range of motion in the horizontal plane.	*Section 13.6.1 of ASCE 7-10*
3. Duct Exemptions	Ducts not part of hazardous exhaust systems or fire protection systems such as smoke control or evacuation systems when either: a. Trapeze assemblies are used to support ductwork and the total weight of the ductwork supported by the trapeze assemblies is less than 10 lb/ft. b. HVAC ducts suspended from hangers 12 inches or less in length; ~~hangers shall be detailed to avoid significant bending of the hangers and their attachments~~ when rod hangers are used, they shall be equipped with swivels to prevent inelastic bending in the rod; or c. HVAC ducts having a cross-sectional area of less than 6 square feet. See Section 13.6.7 ASCE7-10 for ductwork crossing a seismic joint	~~*Section 1613.6.8 of 2009 IBC and*~~ *Section 13.6.7 of ASCE 7-10*
4. Piping System Exemption	Piping or trapeze carrying pipes that are supported by rod hangers; hangers in the pipe/trapeze run are 12 inches or less in length from the top of the pipe/trapeze to the supporting structure; ~~hangers are detailed to avoid bending of the hangers and their attachments; and provisions are made for piping to accommodate expected deflections~~ where rod hangers are used, they shall be equipped with swivels, eyenuts, or other devices to prevent bending in the rod.	*Section 13.6.8 of ASCE 7-10*

(continued)

Table 4.4 - continued
SEISMIC DESIGN REQUIREMENT EXEMPTIONS FOR MECHANICAL, ELECTRICAL AND PLUMBING COMPONENTS

(Chapter 13 of ASCE 7-10, Policy)

	~~High-deformability (Table 4.3) piping is used; provisions are made to avoid impact with larger piping or mechanical components or to protect the piping in the event of such impact; and the nominal pipe sizes are limited to:~~ Trapeze assemblies are used to support piping wherby no single pipe exceeds the limits set below under a, b, or c below. Note in order to use this exception, the total weight of the piping supported by the trapeze assembly shall be less than 10 lb/ft (all pipe sizes are nominal): a. 1 inch or less for Seismic Design Category D, E, or F, and $I_P > 1.0$. b. 2 inches or less for Seismic Design Category C, and $I_P > 1.0$. c. 3 inches or less for Seismic Design Category D, E, or F, and $I_P = 1.0$. Piping constructed of high-or limited-deformability materials (see Table 4.3) meeting the limits set below under a, b, or c. Note: Provision shall be made to avoid the impact of the pipe with other structural or nonstructural components or to protect the pipe in the event of a seismic impact. All pipe sizes are nominal a. 1 inch or less for Seismic Design Category D, E, or F, and $I_P > 1.0$. b. 2 inches or less for Seismic Design Category C, and $I_P > 1.0$. c. 3 inches or less for Seismic Design Category D, E, or F, and $I_P = 1.0$	
5. Gas Piping System Exemptions	All types of exterior gas piping installed on roofs in seismic design category C,D,E or F, when such piping will supply gas under no more than 2 psi and is protected by one of the two following methods(see Notes 3 and 4 below): a. An approved seismic shut-off valve is installed within 5 feet of the beginning of the run of gas pipe on the roof, or other approved location; OR b. Approved flexible piping no less than 3 feet in length is installed within 5 feet of the beginning of the run of gas pipe on the roof and at the connection to the equipment served by the pipe and at intervals along the run of no more than 42 feet	*Policy 11/30/06*

1. ~~Flexible connections are not required for connections to appliances or electrical or plumbing fixtures that are mounted to walls or floors.~~
2. Distribution systems would include the following code complying components:
   a. The following sanitary drain, waste and vent pipe:
      Schedule 40 PVC, 6 inches or less in diameter; Schedule 80 PVC, 4 inches or less in diameter; service weight and no hub cast iron, 2 inches or less in diameter.
   b. The following storm drain pipe:
      Schedule 40 and 80 PVC, 3 inches or less in diameter; service weight and no hub cast iron, not applicable.
   c. The following water pipe:
      Type L & M copper, 2 ½ inches or less in diameter; Schedule 40 and 80 CPVC, 3 inches or less in diameter.
   d. The following electrical conduit:
      Rigid steel and intermediate metal conduit (IMC), 1 1/2 inches and less in diameter; EMT conduit and rigid aluminum conduit 2 inches and less in diameter.
   e. Flexible electrical wiring methods weighing 5 lbs/ foot or less.
3. High-deformability exception, above, would include interior and exterior gas piping such as gas piping serving RTUs.
4. Seismic shut-off valves are not considered to be an acceptable alternative to seismic support/restraint of gas piping on the interior of buildings or gas piping under more than 2 psi of pressure.
5. As indicated in Table 4.8, elevator piping systems shall satisfy the requirements of Section 13.6.10 of ASCE 7 – 10.

TABLE 4.5
SEISMIC DESIGN FORCES FOR MECHANICAL, ELECTRICAL AND PLUMBING COMPONENTS

(Section 13.3.1 of ASCE 7-10)

Seismic Design Category	Component Importance Factor I_P	Site Class	Maximum Design Force *(Eq. 13.3-2 of ASCE 7-10)*	Seismic Design Force F_P *(Eq. 13.3-1 of ASCE 7-10)*	Minimum Design Force *(Eq. 13.3-3 of ASCE 7-10)*
C	1.5	A	~~0.69~~ 0.61 W_P	~~0.17~~ 0.15 $W_P\, a_P\, (1+2\, z/h) / R_P$	~~0.13~~ 0.12 W_P
		B	~~0.86~~ 0.77 W_P	~~0.22~~ 0.19 $W_P\, a_P\, (1+2\, z/h) / R_P$	~~0.16~~ 0.14 W_P
		C	~~1.02~~ 0.94 W_P	~~0.26~~ 0.23 $W_P\, a_P\, (1+2\, z/h) / R_P$	~~0.19~~ 0.18 W_P
D	1.0	B	~~0.58~~ 0.51 W_p	~~0.14~~ 0.13 $W_P\, a_P\, (1+2\, z/h) / R_P$	~~0.11~~ 0.10 W_P
		C	~~0.68~~ 0.62 W_P	~~0.17~~ 0.16 $W_P\, a_P\, (1+2\, z/h) / R_P$	~~0.13~~ 0.12 W_P
		D	~~0.79~~ 0.72 W_P	~~0.20~~ 0.18 $W_P\, a_P\, (1+2\, z/h) / R_P$	~~0.15~~ 0.14 W_P
		E	~~0.93~~ 0.90 W_P	~~0.23~~ 0.23 $W_P\, a_P\, (1+2\, z/h) / R_P$	~~0.17~~ 0.17 W_P
	1.5	B	~~0.86~~ 0.77 W_P	~~0.22~~ 0.19 $W_P\, a_P\, (1+2\, z/h) / R_P$	~~0.16~~ 0.14 W_P
		C	~~1.02~~ 0.94 W_P	~~0.26~~ 0.23 $W_P\, a_P\, (1+2\, z/h) / R_P$	~~0.19~~ 0.18 W_P
		D	~~1.18~~ 1.08 W_P	~~0.30~~ 0.27 $W_P\, a_P\, (1+2\, z/h) / R_P$	~~0.22~~ 0.20 W_P
		E	~~1.40~~ 1.35 W_P	~~0.35~~ 0.34 $W_P\, a_P\, (1+2\, z/h) / R_P$	~~0.26~~ 0.25 W_P
E or **F**	I.0		1.60 $S_{DS}\, W_P$	0.40 $S_{DS} W_P\, a_P\, (1+2\, z/h) / R_P$	0.30 $S_{DS}\, W_P$
	1.5		2.40 $S_{DS}\, W_P$	0.60 $S_{DS} W_P\, a_P\, (1+2\, z/h) / R_P$	0.45 $S_{DS}\, W_P$

1. The earthquake spectral response acceleration parameters for St. Louis County are: earthquake spectral response acceleration at short periods S_S= 0.48 and earthquake spectral response acceleration at 1-second periods S_1=0.18 (Section 1613.3.1 of 2015 IBC as amended by St. Louis County).
2. W_P = component operating weight;
   z = height in structure of point of attachment of component with respect to the base, z = 0 if item at or below the base;
   h = average roof height of structure with respect to the base; (z/h) ≤1.0;
3. For a_P and R_P see Table 4.6.
   a_p is the component amplification factor that varies from 1.00 to 2.50
   R_p is the component response modification factor that varies from 1.00 to 12.00
4. The force F_P shall be applied independently in at least two orthogonal horizontal directions in combination with service loads associated with the component, as appropriate.
5. The components shall be designed for a concurrent vertical force of $\pm$ 0.2 $S_{DS} W_p$ per Section 13.3.1 of ASCE 7-10.
6. S_{DS} is Design Spectral Acceleration Parameter at short periods from the site-specific design. See Section 1613 of 2015 IBC and Chapter 21 of ASCE 7-10 for design formulas.
7. When allowable stress design is used, F_p may be multiplied by 0.7 per Section 13.1.7 of ASCE 7-10.

Table 4.6
SEISMIC COEFFICIENTS FOR MECHANICAL, ELECTRICAL AND PLUMBING COMPONENTS

(Table 13-6-1 of ASCE 7-10)

Mechanical and Electrical Components	a_p	R_p
Air-side HVAC, fan, air handlers, air conditioning units, cabinet heaters, air distribution boxes and other mechanical components constructed of sheet metal framing.	2.5	6.0
Wet-side HVAC, boilers, furnaces, atmospheric tanks and bins, chillers, water heaters, heat exchangers, evaporators, air separators, manufacturing or process equipment and other mechanical components constructed of high-deformability (Table 4.3) materials.	1.0	2.5
Engines, turbines, pumps, compressors and pressure vessels not supported on skirts.	1.0	2.5
Skirt-supported pressure vessels.	2.5	2.5
Elevator and escalator components.	1.0	2.5
Generators, batteries, inverters, motors, transformers and other electrical components constructed of high-deformability (Table 4.3) materials.	1.0	2.5
Motor control centers, panel boards, switch gear, instrumentation cabinets and other components constructed of sheet metal framing.	2.5	6.0
Communication equipment, computers, instrumentation and controls.	1.0	2.5
Roof-mounted chimneys, stacks, cooling and electrical towers laterally braced below their center of mass.	2.5	3.0
Roof-mounted chimneys, stacks, cooling and electrical towers laterally braced above their center of mass.	1.0	2.5
Lighting fixtures.	1.0	1.5
Other mechanical or electrical components	1.0	1.5
Vibration Isolated Components and Systems		
Components and systems isolated using neoprene elements and neoprene isolated floors with built-in or separate elastomeric snubbing devices or resilient perimeter stops.	2.5	2.5
Spring isolated components and systems and vibration isolated floors closely restrained using built-in or separate elastomeric snubbing devices or resilient perimeter stops.	2.5	2.0
Internally isolated components and systems.	2.5	2.0
Suspended vibration isolated equipment including in-line duct devices and suspended internally isolated components.	2.5	2.5
Distribution Systems		
Piping in accordance with ASME B31, including in-line components with joints made by welding or brazing.	2.5	12.0
Piping in accordance with ASME B31, including in-line components constructed of high- or limited-deformability (Table 4.3) materials, with joints made by threading, bonding, and compression coupling, or grooved couplings.	2.5	6.0
Piping and tubing not in accordance with ASME B31, including in-line components, constructed of high-deformability (Table 4.3) materials, with joints made by welding or brazing.	2.5	9.0
Piping and tubing not in accordance with ASME B31, including in-line components, constructed of high- or limited-deformability (Table 4.3) materials, with joints made by threading, bonding, and compression coupling or grooved couplings.	2.5	4.5
Piping and tubing constructed of low-deformability (Table 4.3) materials, such as cast iron, glass, and non-ductile plastics.	2.5	3.0
Ductwork, including in-line components, constructed of high-deformability (Table 4.3) materials, with joints made by welding or brazing.	2.5	9.0
Ductwork, including in-line components, constructed of high- or limited-deformability (Table 4.3) materials, with joints made by means other than welding or brazing.	2.5	6.0
Ductwork, including in-line components, constructed of low-deformability (Table 4.3) materials, such as cast iron, glass and non-ductile plastic.	2.5	3.0
Electrical conduit, ~~bus ducts, rigidly mounted~~ and cable trays ~~and plumbing~~.	~~1.0~~ 2.5	~~2.5~~ 6.0
Manufacturing or process conveyors (non-personnel).	2.5	3.0
~~Suspended cable trays~~ Plumbing	~~2.5~~ 1.0	~~6.0~~ 2.5
Bus Ducts	1.0	2.5

1. A lower $1.0 \leq a_P \leq 2.5$ is permitted where justified by detailed dynamic analysis.
2. Components mounted on vibration isolators shall have a bumper restraint or snubber in each horizontal direction.

TABLE 4.7
SEISMIC DESIGN FOR THE SUPPORT AND ATTACHMENT OF MECHANICAL, ELECTRICAL AND PLUMBING COMPONENTS

(Section 13.2, 13.4 & 13.6 of ASCE 7-10)

1. Component Supports	a. Component support including all the structural members, braces, frames, etc. shall be designed by either load rating (testing) or for calculated seismic forces from Table 4.5. b. A continuous load path of sufficient strength and stiffness between the component and the supporting structure shall be provided. c. The cold-formed steel members as component support shall be checked for weak-axis bending. d. Materials comprising supports shall be in conformance with a nationally recognized standard, suitable for the application including the effects of service condition (i.e. low temperature).	*Sections 13.4 and 13.6.5 of ASCE 7 - 10*
2. Component Attachments	a. Component attachments shall be bolted, welded or otherwise positively fastened. b. ~~Oversized plate washers or other reinforcement shall be provided at bolted connections through a sheet metal base.~~ Reinforcement (e.g. stiffeners or Belleville washers) shall be provided at bolted connections through sheet metal equipment housings as required to transfer the equipment seismic loads specified in this section from the equipment to the structure. Where equipment has been certified per ASCE 7-10 Section 13.2.2, 13.2.5, or 13.2.6, anchor bolts or other fasteners and associated hardware as included in the certification shall be installed in conformance with the manufacturer's instructions. For those cases where no certification exists or where instructions for such reinforcement are not provided, reinforcement methods shall be as specified by a registered design professional or as approved by the authority having jurisdiction. c. Components mounted on vibration isolators shall have a bumper restraint or snubber in each horizontal direction, and vertical restraints for overturning. Isolator housing and restraints shall be constructed of ductile materials. A viscoelastic pad or similar material of appropriate thickness shall be used between the bumper and components to limit the impact load.	*Section 13.4 and 13.6.5 of ASCE 7 - 10*
3. Anchors in Concrete or Masonry	~~a. Anchors embedded in concrete or masonry shall be designed with seismic design force $=1.3 F_p$, or the maximum force that can be transferred to the anchor by the component and its support.~~ ~~b. $R_p \leq 1.5$ unless the anchorage is designed to be governed by the strength of a ductile steel element, or the post-installed anchorage per *ACI 355.2*, or the anchorage to precast concrete per *Section 14.2.2.4 of ASCE 7-10*.~~ ~~c. Power actuated fasteners shall not be used for tension load applications in Seismic Design Categories D, E and F.~~ a. Anchors in concrete shall be designed in accordance with ASCE 7-10 Appendix D or ACI 318. b. Anchors in masonry shall be designed in accordance with TMS 402/ACI 503/ASCE 5. Anchors shall be designed to be governed by the tensile or shear strength of a ductile steel element. Exception: Anchors shall be permitted to be designed so that the attachment that the anchor is connecting to the structure undergoes ductile yielding at a load level corresponding to anchor forces not greater than their design strength, or the minimum design strength of the anchors shall be at least 2.5 times the factored forces transmitted by the component. c. Post-installed anchors in concrete shall be prequalified for seismic applications in accordance with ACI 355.2 or other approved qualification procedures. Post-installed anchors in masonry shall be prequalified for seismic applications in accordance with approved qualification procedures.	*Section 13.4.2 of ASCE 7 - 10*

TABLE 4.8
SEISMIC REQUIREMENTS FOR MECHANICAL AND PLUMBING COMPONENTS

(Sections 13.6.3 - 13.6.5 of ASCE 7-10)

1. Requirements for Components with $I_P = 1.5$	a. Provisions shall be made to eliminate seismic impact between components. b. The possibility of loads imposed on components by attached utility or service lines, due to differential movement of support points on separated structures, shall be evaluated. c. Where piping or HVAC ductwork components are attached to structures that could displace relative to one another and for isolated structures where such components cross the isolation interface, the components shall be designed to accommodate the seismic relative displacement.	*Section 13.6.3 of ASCE 7-10*
2. HVAC Ductwork	a. Duct systems fabricated and installed in accordance with SMACNA Seismic Restraint Manual – OSHPD (Latest Edition), ~~2009~~ shall be deemed to meet the lateral bracing requirements. b. Components that are installed in-line with the duct system and have an operating weight greater than 75 pounds, such as fans, heat exchangers, and humidifiers, shall be supported and laterally braced independent of the duct system and such bracing shall meet the force requirements from Table 4.5. • In line equipment (fans, heat exchangers, VAV boxes, humidifiers , etc.) weighing more than 20 pounds must have seismic restraints even if the ductwork does not require seismic restraints. See also Table 4.4, General Exemptions. c. Appurtenances such as dampers, louvers and diffusers shall be positively attached with mechanical fasteners. Unbraced piping attached to in-line equipment shall be provided with adequate flexibility to accommodate differential displacement.	*Section 13.6.7 of ASCE 7-10*
3. Piping System	a. Piping systems fabricated and installed in accordance with ASTM B31 or braced per SMACNA Seismic Restraint Manual – OSHPD (Latest Edition), ~~2009~~ shall be deemed to meet the lateral bracing requirements. b. Automatic sprinkler systems designed and installed in accordance with NFPA 13 shall be deemed to meet the lateral bracing requirement.	*Section 13.6.8 of ASCE 7-10 and ~~Section 1613.6.3 of 2009 IBC~~*
4. Boilers & Vessels	a. Boilers or pressure vessels designed in accordance with ASTM BPVC shall be deemed to meet the lateral bracing requirement. b. Anchors for piping, boilers, and pressure vessels shall be suitable for cyclic loads.	*Section 13.6.9 of ASCE 7-10*
5. Elevators	Elevators and escalators designed in accordance with ASTM A17.1 shall be deemed to meet the lateral bracing requirement, provided: a. Escalators, elevators, and hoistway structural systems shall be designed to meet the force requirements from Table 4.5. b. Escalator equipment and control supports and attachments shall be designed to meet the force requirements from Table 4.5. c. Seismic switches shall be provided for elevators operating with a speed of 150 ft/min. or greater per Section 13.6.10.3 of ASCE 7-10. d. Retainer plates are required at the top and bottom of the car and counterweights. e. Elevator piping systems shall satisfy the requirements of Section 13.6.10 of ASCE 7-10.	*Section 13.6.10 of ASCE 7-10*
6. Certification	a. Special certification for seismic design when the $I_p > 1.0$ compliance is required for: • Active mechanical equipment that must remain operable following the design earthquake. • Mechanical components with hazardous contents. b. Manufacturer's certification for seismic design compliance is required if mechanical components are not designed and constructed in accordance with nationally recognized standard referenced by ASCE 7-10.	*Sections 13.2.1 and 13.2.2 of ASCE 7-10*

TABLE 4.9
SEISMIC REQUIREMENTS FOR ELECTRICAL COMPONENTS

(Sections 13.6.4 and 13.6.5 of ASCE 7-10)

1. Special Requirement for Components with $I_P = 1.5$	a. Provisions shall be made to eliminate seismic impact between components. b. The possibility of loads imposed on components by attached utility or service lines, due to differential movement of support points on separated structures, shall be evaluated. c. Batteries on racks shall have wrap-around restraints to ensure that the batteries will not fall from the rack. Spacers shall be used between restraints and cells to prevent damage to the case. Racks shall be evaluated for sufficient lateral load capacity. d. Internal coils of dry type transformers shall be positively attached to their supporting substructure within the transformer enclosure. e. Electrical control panels, computer equipment, and other items with slide-out components shall have a latching mechanism to hold the components in place. f. Electrical cabinets design shall comply with NEMA Standard. g. The attachments for additional external items weighing more than100 pounds shall be specifically evaluated if not provided by the manufacturer. h. Where conduit, cable trays, or similar electrical distribution components are attached to structures that could displace relative to one another and for isolated structures where such components cross the isolation interface, the components shall be designed to accommodate the seismic relative displacement in accordance with Section 13.3.2.2 of ASCE 7-10.	*Section 13.6.4 of ASCE 7-10*
2. Electrical Distribution Components	The supports for electrical distribution components shall be designed for the seismic force requirements from Table 4.5 if any of the following conditions apply: a. Conduit diameter is great than 2.5 inches trade size ~~and $I_P = 1.5$~~ unless flexible connections are provided at panels, cabinets, or other equipment subject to seismic relative displacement. b. Trapeze assemblies ~~supporting conduit, and bus ducts or cable tray where $I_P = 1.5$~~ used to support raceways, and total weight of the ~~bus duct, cable tray, or conduit~~ raceway supported by trapeze assemblies exceeds 10 lb/ft. ~~c. Supports are cantilevered up from the floor, or have bracing to limit deflection, or constructed as rigid welded frames.~~ ~~d. Attachments into concrete utilize nonexpanding insets, power actuated fasteners, or cast iron embedment.~~ ~~e. Attachments utilize spot welds, plug welds, or minimum size welds as defined by AISC~~. c. The raceway is supported by hangers and each hanger in the raceway run exceeds 12 in. in length from the raceway support point to the supporting structure. Where rod hangers are used, they shall be equipped with swivels to prevent inelastic bending in the rod.	*Section 13.6.5 .6 of ASCE 7-10*
3. Certification	a. Special certification for seismic design compliance when the $I_p > 1.0$ is required for: • Active electrical equipment that must remain operable following the design earthquake. • Electrical components with hazardous contents. b. Manufacturer's certification for seismic design compliance is required if electrical components are not designed and constructed in accordance with nationally recognized standards referenced by *ASCE 7-10*.	*Sections 13.2.1 and 13.2.2 of ASCE 7-10*

Section 4.3 – Special requirements of ASCE 7-10

Section 13.2.2 of ASCE 7-10 requires that Active mechanical and electrical equipment in Designated Seismic Systems ~~(Ip > 1.0)~~ in Seismic Design Categories C through F, which must remain operable following a design earthquake shall be certified by the supplier as operable based on approved shake table testing or experience data.

This section of ASCE 7-10 also requires that components with hazardous contents in Seismic Design Categories C through F be certified by the supplier to maintain containment following the design earthquake by analysis, approved shake table testing or experience data.

CHAPTER 5

SEISMIC RESTRAINT GUIDELINES FOR MECHANICAL SYSTEMS

Section 5.1 General Requirements

The following general requirements shall apply to all installations:

1) Material used for seismic sway bracing such as cables, rods, frames, angles, hangers or anchors shall be in conformance with a nationally recognized standard.

2) Seismic sway bracing shall be not be installed with bracing angles greater than 60 degrees or less than 45 degrees from horizontal, with a maximum of 2.5 degrees of variation from parallel or perpendicular to the run.

3) Equipment with an operating weight over 75 pounds, such as fans, heat exchangers and humidifiers, installed rigidly in-line with the duct system, shall be restrainted independently of the duct system. *Source: Section 13.6.7 of ASCE 7-10*

4) Use either cable or solid bracing for all situations. Do not mix bracing types.

5) All runs will have a minimum of two transverse braces and one longitudinal brace (a run is defined as a length of duct or pipe without any change in direction).

Source: Section 3.1 of SMACNA Seismic Restraint Manual – OSHPD Edition, 2009 (except as noted)

Section 5.2 Location and Spacing of Required Sway Bracing

The location and maximum distance between sway braces shall be determined by the responsible design professional. The design professional shall consider the strength of the sway brace assembly, including its attachment to the sway braced component and fastening device at the structure, the strength of the bracing fastener/anchorage to the structure, the strength of structural element that the assembly is attached to and the structural ability of the system component with its connections/fittings to transfer the code prescribed lateral/horizontal earthquake loads, applied in any direction, between sway braces.

Unless otherwise substantiated, by an approved engineering analysis prepared by a registered/ licensed design professional confirming strengths relative to all the above considerations, sway bracing shall be installed at an angle of no less than 30 degrees from vertical and in the bracing locations identified below under the heading 1) Basic Sway Bracing Locations as well as at the maximum intervals between bracing listed below under the heading 2) Maximum Spacing Of Transverse and Longitudinal Sway Bracing.

1) Basic Sway Bracing:

   a) Suspended rectangular units of equipment shall be provided with a minimum of one sway brace at each corner.

   b) Suspended runs of pipe, conduit, ducts, bus, etc. shall be provided with transverse and longitudinal sway bracing meeting the spacing limitations. Provide a transverse and longitudinal sway brace at the beginning and end of each continuous run greater than 12 feet; and within 24 inches of one end of each horizontal off-set (horizontal change in direction) of 45 degrees or more; and within 24 inches of the top and bottom of each vertical offset (vertical change in direction).

   c) A four way sway brace shall be provided at the top of all pipe risers exceeding 3 feet in length and at intervals not exceeding 25 feet.

   d) Lateral/transverse sway braces shall be installed within 24 inches of every other flexible coupling not required for flexibility due to differential movement of pipe or conduit.

   e) Lateral/transverse sway braces shall be installed at the end of each run (runout/arm over) of pipe, conduit, duct, etc. 6 feet or longer in length.

   f) When rod stiffeners are required, sway bracing shall be located within 6 inches of hangers with rod stiffeners.

   g) Hangers for platforms, trapezes and similar multiple hanger supported equipment or system components shall be provided with rod stiffeners or, by structural analysis performed verifying that rod stiffeners are not required.

2) Maximum Spacing of Transverse and Longitudinal Sway Bracing:

   Additional transverse and longitudinal bracing shall be installed at the maximum intervals along the length of a suspended run of pipe, conduit or duct as follows:

   Note: The maximum spacing of sway braces for materials which are not listed below shall be calculated by the responsible licensed design professional.

   a) Schedule 10 and stronger steel pipe (including galvanized pipe)

      Single hanger supported runs of pipe less than 2 ½ inches in diameter:
      Transverse sway bracing: Maximum spacing 30 feet
      Longitudinal sway bracing: Maximum spacing 60 feet

Single hanger supported runs of pipe 2½ inches and larger in diameter:
Transverse sway bracing: Maximum spacing 40 feet
Longitudinal sway bracing: Maximum spacing 80 feet

b) Cast Iron & Plastic Pipe

Single hanger supported runs less than 2½ inches in diameter:
Transverse sway bracing: Maximum spacing 20 feet
Longitudinal sway bracing: Maximum spacing 40 feet

Single hanger supported runs 2½ inches and larger in diameter:
Transverse sway bracing: Maximum spacing 30 feet
Longitudinal sway bracing: Maximum spacing 60 feet

c) Copper or Brass Pipe or Tube

Single hanger supported runs less than 2½ inches in diameter:
Transverse sway bracing: Maximum spacing 30 feet
Longitudinal sway bracing: Maximum spacing 60 feet

Single hanger supported runs 2½ inches and larger in diameter:
Transverse sway bracing: Maximum spacing 40 feet
Longitudinal sway bracing: Maximum spacing 80 feet

d) Code Complying Sheet Metal Ducts

With a cross sectional area > 6 square feet
Transverse sway bracing: Maximum spacing 40 feet
Longitudinal sway bracing: Maximum spacing 80 feet

e) Steel Conduit

Single hanger supported runs of steel conduit less than 2 ½ inches in diameter:

Transverse sway bracing: Maximum spacing 30 feet
Longitudinal sway bracing: Maximum spacing 60 feet

Single hanger supported runs of steel conduit 2 ½ inches and larger in diameter:

Transverse sway bracing: Maximum spacing 40 feet
Longitudinal sway bracing: Maximum spacing 80 feet

Note: For EMT use one half of the above maximum spacing

f) Trapeze Supports: Trapeze Supported Pipe, Sheet Metal Ducts, Conduit, Bus-Duct, Cable Tray, etc.

Transverse sway bracing: Maximum spacing 40 feet
Longitudinal sway bracing: Maximum spacing 40 feet

Note: All pipe(s), sheet metal ducts, conduit, bus-duct, cable tray, etc., not individually sway braced, shall be securely anchored to the trapeze type supports being sway braced.

Source: Policy