

SECTION 13 05 41

SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. Contractor is to provide gravity and seismic restraint/anchorage design for non-structural components in accordance with the requirements of this section in order to maintain the integrity of nonstructural components of the building and utility structures so that they remain safe and functional in case of seismic event. (AD#01)
- B. ~~DELETED The design to resist seismic load shall be based on Seismic Design Categories per section 4.0 of the VA Seismic Design Requirements (H-18-8) dated August 2013, <http://www.cfm.va.gov/til/etc/seismic.pdf>.~~ (AD#01)
- C. Definitions: Non-structural components are components or systems that are not part of the building's or utility structures' structural system whether inside or outside, above or below grade. Non-structural components include:
1. Architectural Elements: Facades that are not part of the structural system and its shear resistant elements; exterior wall framing; cornices and other architectural projections and parapets that do not function structurally; glazing; nonbearing partitions; suspended ceilings; stairs isolated from the basic structure; cabinets; bookshelves; medical equipment; and storage racks.
  2. Lab and Vivarium Equipment: All equipment designated as Contractor furnished and installed (CC). VA furnished and Contractor installed equipment (VC) is to be anchored as detailed on the construction documents. VA furnished and installed (VV) equipment is by others and is not part of this work. Refer to the equipment schedules in the construction documents for designations.
  3. Electrical Elements: Power and lighting systems; substations; switchgear and switchboards; auxiliary engine-generator sets; transfer switches; motor control centers; motor generators; selector and controller panels; fire protection and alarm systems; special life support systems; and telephone and communication systems.
  4. Mechanical Elements: Heating, ventilating, and air-conditioning systems; medical gas systems; plumbing systems; sprinkler systems; steam piping; chilled water piping; pneumatic systems; boiler equipment and components.
  5. Transportation Elements: Mechanical, electrical and structural elements for transport systems, i.e., elevators and dumbwaiters, including hoisting equipment and counterweights.

**1.2 RELATED WORK:**

- A. Refer to all other divisions contained in these specifications for information related to the non-structural components defined above.

**1.3 QUALITY CONTROL:**

A. Shop-Drawing Preparation:

1. Have gravity and seismic-force-restraint shop drawings and calculations prepared by a professional structural engineer experienced in the area of seismic force restraints. The professional structural engineer shall be registered in the state of California.
2. Submit design tables and information used for the design-force levels, stamped and signed by a professional structural engineer registered in the State of California.

B. Coordination:

1. Do not install gravity supports or seismic restraints until submittals are approved by the Resident Engineer.
2. Coordinate and install trapezes or other multi-pipe hanger systems prior to pipe installation.

C. Seismic Certification:

1. In structures assigned to IBC Seismic Design Category C, D, E, or F, permanent equipments and components are to have Special Seismic Certification in accordance with requirements of section 13.2.2 of ASCE 7 except for equipment that are considered rugged as listed in section 2.2 OSHPD code application notice CAN No. 2-1708A.5, and shall comply with section 13.2.6 of ASCE 7.

**1.4 SUBMITTALS:**

A. Submit a coordinated set of equipment anchorage drawings prior to installation including:

1. Description, layout, and location of items to be anchored or braced with anchorage or brace points noted and dimensioned.
2. Details of anchorage or bracing at large scale with all members, parts brackets shown, together with all connections, bolts, welds etc. clearly identified and specified.
3. Numerical value of design seismic brace loads imparted onto structure.
4. For expansion bolts, include design load and capacity if different from those specified. Provide current ICC-ES reports for anchors showing compliance with referenced codes and approved for use in cracked concrete (seismic). Refer to Section 05 12 00 STRUCTURAL STEEL FRAMING for additional wedge anchor criteria.
5. Seal of registered structural engineer responsible for the design.

B. Submit prior to installation, a coordinated set of bracing drawings for seismic protection of piping, with data identifying the various support-to-structure connections and seismic bracing structural connections, include:

1. Single-line piping diagrams on a floor-by-floor basis. Show all suspended piping for a given floor on the same plain.
  2. Type of pipe (Copper, steel, cast iron, insulated, non-insulated, etc.).
  3. Pipe contents.
  4. Structural framing.
  5. Location of all gravity load pipe supports and seismic braces and spacing requirements.
  6. Numerical value of gravity and seismic load reactions imparted onto structure.
  7. Type of connection (Vertical support, vertical support with seismic brace etc.).
  8. Seismic brace reaction type (tension or compression): Details illustrating all support and bracing components, methods of connections, and specific anchors to be used.
  9. Seal of registered structural engineer responsible for the design.
- C. Submit prior to installation, bracing drawings for seismic protection of suspended ductwork and suspended electrical and communication cables, include:
1. Details illustrating all support and bracing components, methods of connection, and specific anchors to be used.
  2. Numerical value of applied gravity and seismic loads and seismic loads acting on the structure from support and bracing components.
  3. Maximum spacing of hangers and bracing.
  4. Seal of registered structural engineer responsible for design.
- D. Submit design calculations prepared and sealed by the registered structural engineer specified above in paragraph 1.3A.
- E. Prior to installation, submit details for typical ceiling and lighting fixture seismic bracing, and any special details for locations where typical details do not apply.
- F. Submit for concrete anchors, the appropriate ICC evaluation reports, OSHPD pre-approvals, or lab test reports verifying compliance with OSHPD Interpretation of Regulations 28-6.

#### **1.5 APPLICABLE PUBLICATIONS:**

- A. The Publications listed below (including amendments, addenda revisions, supplements and errata) form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only.
- B. American Concrete Institute (ACI):
1. 318-11 Building Code Requirements for Structural Concrete and Commentary.
  2. 355.2-07 Qualification for Post-Installed Mechanical Anchors in Concrete and Commentary
- C. American Institute of Steel Construction (AISC):

1. Load and Resistance Factor Design, Volume 1, Second Edition
- D. American Society for Testing and Materials (ASTM):
  1. A36/A36M-08 Standard Specification for Carbon Structural Steel
  2. A53/A53M-10 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
  3. A307-10 Standard Specification for Carbon Steel Bolts and Studs; 60,000 PSI Tensile Strength.
  4. A325-10 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
  5. A325M-09 Standard Specification for High-Strength Bolts for Structural Steel Joints [Metric]
  6. A490-10 Standard Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
  7. A490M-10 Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints [Metric]
  8. A500/A500M-10 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
  9. A501-07 Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
  10. A615/A615M-09 Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
  11. A992/A992M-06 Standard Specification for Steel for Structural Shapes for Use in Building Framing
  12. A996/A996M-09 Standard Specification for Rail-Steel and Axel-Steel Deformed Bars for Concrete Reinforcement
  13. E488-96(R2003) Standard Test Method for Strength of Anchors in Concrete and Masonry Elements
- E. American Society of Civil Engineers (ASCE 7) Latest Edition.
- F. International Building Code (IBC) Latest Edition
- G. ~~DELETED VA Seismic Design Requirements, H-18-8, August 2013~~ (AD#01)
- H. National Uniform Seismic Installation Guidelines (NUSIG)
- I. Sheet Metal and Air Conditioning Contractors National Association
  1. (SMACNA): Seismic Restraint Manual - Guidelines for Mechanical Systems 1998 Edition and Addendum

**1.6 REGULATORY REQUIREMENT AND SEISMIC DESIGN CRITERIA:** (AD#01)

- A. IBC Latest Edition and ASCE 7-10.  ~~$I_p=1.5$~~ , ~~unless otherwise noted on the drawings.~~ (AD#01)
- B. Short-period acceleration, SDS, for use in calculation of seismic anchorage and bracing forces as required by the IBC, shall be taken per the design drawings.
- C. Seismic Restraint Exceptions: As specified in Chapter 13 of ASCE 7-10, with the following modifications. (AD#01)
  1. Delete paragraph 13.1.4-6-a "The component importance factor,  $I_p$

is equal to 1.0". (AD#01)

## **PART 2 - PRODUCTS**

### **2.1 STEEL:**

- A. Structural Steel: ASTM A36.
- B. Structural Tubing: ASTM A500, Grade B.
- C. Steel Pipe: ASTM A53/A53M, Grade B.
- D. Bolts & Nuts: ASTM A307.
- E. Wedge (Expansion) Anchors: Tested and qualified for use in cracked concrete per ACI 355.2 and ICC-ES AC 193. Anchors to have a current ICC-ES report approved for cracked concrete (seismic) use under the 2012 IBC. Install anchors in accordance with the ICC-ES report and manufacturer's instructions. Provide stainless steel anchors for exterior use or when exposed to weather. Provide stainless steel anchors where installed at Vivarium Level and Lab areas. Provide galvanized carbon steel anchors at other locations, unless otherwise noted.
- F. Provide stainless steel components for anchorage at Vivarium Level and Lab area. Includes, but is not limited to anchors, angles, strut, channels, etc.

### **2.2 CAST-IN-PLACE CONCRETE:**

- A. Concrete: 28 day strength,  $f'c = 30$  MPa (4,000 psi).
- B. Reinforcing Steel: ASTM A615/615M or ASTM A996/A996M deformed.

## **PART 3 - EXECUTION**

### **3.1 CONSTRUCTION, GENERAL:**

- A. Provide equipment supports and anchoring devices to withstand the seismic and gravity design forces, so that when seismic design forces are applied, the equipment cannot displace, overturn, or become inoperable.
- B. Provide anchorages in conformance with recommendations of the equipment manufacturer and as shown on approved shop drawings and calculations.
- C. Construct seismic restraints and anchorage to allow for thermal expansion.
- D. Testing Before Final Inspection:
  - 1. Test 10-percent of anchors in concrete per ASTM E488, and ACI 355.2 to determine that they meet the required load capacity. If any anchor fails to meet the required load, test the next 20 consecutive anchors, which are required to have zero failure, before resuming the 10-percent testing frequency.
  - 2. Before scheduling Final Inspection, submit a report on this testing indicating the number and location of testing, and what anchor-loads were obtained.

- E. Anchorage, bracing and connection details shown on the drawings indicate the general design intent. The final anchorage and bracing design for non-structural components is to be determined by the registered structural engineer specified above in paragraph 1.3A.

### 3.2 EQUIPMENT RESTRAINT AND BRACING:

- A. See construction documents for equipment to be restrained or braced.
- B. Design criteria per Part 1.6. (AD#01)

### 3.3 MECHANICAL DUCTWORK AND PIPING; BOILER PLANT STACKS AND BREACHING; ELECTRICAL BUSWAYS, CONDUITS, AND CABLE TRAYS; AND TELECOMMUNICATION WIRES AND CABLE TRAYS

- A. Support and brace mechanical ductwork and piping; electrical busways, conduits and cable trays; and telecommunication wires and cable trays including boiler plant stacks and breeching to resist directional forces (lateral, longitudinal and vertical).
- B. Brace duct and breeching branches with a minimum of 1 brace per branch.
- C. Provide supports and anchoring so that, upon application of seismic forces, piping remains fully connected as operable systems which will not displace sufficiently to damage adjacent or connecting equipment, or building members.
- D. ~~Seismic Restraint of Piping:~~ (AD#01)
  - 1. Design criteria: Per Part 1.6. (AD#01)
    - a. ~~DELETED IBC 2012 seismic criteria and ASCE 7-10.~~ (AD#01)
    - b. ~~DELETED VA H18-8 Seismic Design Requirements.~~ (AD#01)
    - c. ~~DELETED See the structural drawings for additional seismic design criteria.~~ (AD#01)
  - 2. ~~DELETED Provide seismic restraints according to one of the following options:~~ (AD#01)
- E. Piping Connections: Provide flexible connections where pipes connect to equipment. Make the connections capable of accommodating relative differential movements between the pipe and equipment under conditions of earthquake shaking.

### 3.4 PARTITIONS:

- A. In buildings with flexible structural frames, anchor partitions to only structural element, such as a floor slab, and separate such partition by a physical gap from all other structural elements.
- B. Connections to structure to allow for lateral seismic drift and vertical deflection movement.

### 3.5 CEILINGS AND LIGHTING FIXTURES:

- A. At regular intervals, laterally brace suspended ceilings against lateral and vertical movements, and provide with a physical separation at the walls. Lateral bracing of ceilings it to comply with all applicable code requirements for the specified seismic design category.

- B. Independently support and laterally brace all lighting fixtures. Refer to applicable portion of lighting specification, Section 26 51 00, INTERIOR LIGHTING.

**3.6 FACADES AND GLAZING:**

- A. Tie brick veneers to a separate wall that is independent of the steel frame as shown on construction drawings to ensure strength against applicable seismic forces at the project location.
- B. Install attachments to structure for all façade materials as shown on construction drawings to ensure strength against applicable seismic forces at the project location.

**3.7 STORAGE RACKS, CABINETS, AND BOOKCASES:**

- A. Install storage racks to withstand earthquake forces and anchored to the floor or laterally braced from the top to the structural elements.
- B. Anchor medical supply cabinets to the floor or walls and equip them with properly engaged, lockable latches.
- C. Anchor filing cabinets that are more than 2 drawers high to the floor or walls, and equip all drawers with properly engaged, lockable latches.
- D. Anchor bookcases that are more than 30 inches high to the floor or walls, and equip any doors with properly engaged, lockable latches.

- - - E N D - - -