6.4 Mechanical, Electrical, and Plumbing Components

6.4.8 Electrical and Communications Distribution Equipment

6.4.8.1 Electrical Raceways, Conduit, and Cable Trays

This category covers electrical raceways, conduit, cable trays, and bus ducts. These items may be suspended from above or be floor-, chase-, wall- or roof-mounted.

Provisions

BUILDING CODE PROVISIONS

Seismic loads for electrical raceways, conduit, cable trays, and bus ducts are determined using ASCE/SEI 7-10, *Minimum Design Loads for Buildings and Other Structures,* (ASCE, 2010), Chapter 13. The principal objective for suspended and wall-mounted systems is to prevent them from falling. Depending on the configuration of the system, it may also be sensitive to building displacements if it is connected to multiple levels in the same structure, or is supported by adjacent structures.

- ASCE/SEI 7-10 exempts electrical raceways, conduit, cable trays, and bus ducts from seismic bracing requirements in Seismic Design Category C if $I_p = 1.0$.
- ASCE/SEI 7-10 requires seismic design for all distribution systems in Seismic Design Categories D, E, and F that weighs more than 5 pounds per linear foot, except as noted below.
- Unbraced electrical raceways, conduit, cable trays, and bus ducts attached to in-line equipment must be provided with flexibility adequate to accommodate seismic relative displacements.
- Conduit greater than 2.5 inches (64 mm) trade size and attached to panels, cabinets or other equipment subject to seismic relative displacement, must be provided with flexible connections or designed for seismic forces and seismic relative displacements.
- Design for the seismic forces is not required for raceways where trapeze assemblies are used to support raceways and the total weight of the raceway supported by trapeze assemblies is less than 10 lb/ft.
- The raceways that are supported by hangers where each hanger in the raceway run is 12 inches or less in length from the raceway support point to the supporting structure are also exempt from bracing requirements. The rod hangers used must be equipped with swivels to prevent inelastic bending in the rod.

- Design for seismic forces is not required for conduit, regardless of the value of I_p, where the conduit is less than 2.5 inches trade size.

RETROFIT STANDARD PROVISIONS

ASCE/SEI 41-06, *Seismic Rehabilitation of Existing Buildings*, (ASCE, 2007) classifies electrical and communication distribution components as force controlled, meaning that the principal objective is to prevent the systems from falling. Where the system runs between floors or crosses seismic joints it as also deformation controlled. Electrical and communication distribution components are subject to the provisions of the standard when:

- The performance level is Immediate Occupancy.
- The requirements also apply when the performance level is Life Safety in high and moderate seismicity areas, the systems form part of an emergency lighting, power, and/or communications system.

When applicable, electrical and communication distribution components must meet the force and deformation requirements of the standard. Rehabilitation may utilize prescriptive standards, such as *Seismic Restraint Manual: Guidelines for Mechanical Systems* (SMACNA, 2009) or *A Practical Guide to Seismic Restraint* (ASHRAE, 2012).□

Typical Causes of Damage

- Items may swing and impact structural or other nonstructural elements; they may fall and create electrical hazards.
- Vulnerable locations include seismic separations; wall, floor, or roof penetrations; and attachments to rigidly mounted equipment.

DAMAGE EXAMPLES

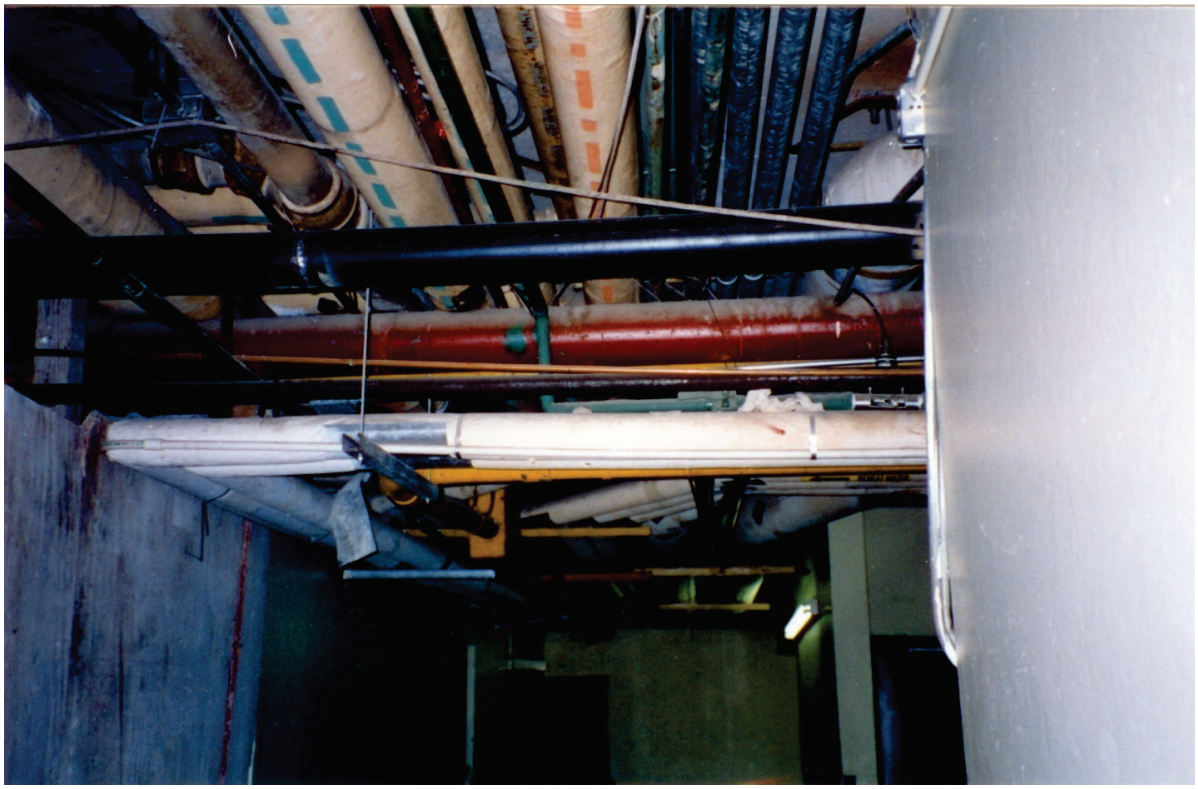

Figure 6.4.8.1-1 Unbraced suspended piping and conduit (Photo courtesy of Wiss, Janney, Elstner Associates).

Seismic Mitigation Considerations

- Working around electrical equipment can be extremely hazardous. Read the Electrical Danger Warning and Guidelines in Section 6.6.8 of this document before proceeding with any work.
- Individual conduit is usually braced using the same design approach and details as piping. The weight of the conduit plus the conductors is approximately the same as water-filled pipe of similar diameter.
- Two trapeze anchorage details are shown. See Section 6.4.3.1 for additional pipe anchorage details; the same type of bracing is typically used for electrical distribution lines. Refer to FEMA 413 *Installing Seismic Restraints for Electrical Equipment* (2004) for general information on seismic anchorage of electrical equipment and to FEMA 414 *Installing Seismic Restraints for Duct and Pipe* (2004) for many different anchorage configurations for raceways, conduit and cable trays.
- Several engineered seismic bracing systems are available and can be customized for most applications. This is particularly useful for large scale projects or essential applications.

MITIGATION EXAMPLES

Figure 6.4.8.1-2 Rigid strut bracing provides restraint against earthquake forces perpendicular to the piping. Similar bracing is required in the direction parallel to the conduit (Photo courtesy of Maryann Phipps, Estructure).

Figure 6.4.8.1-3 Rigid strut bracing for trapeze supporting electrical conduit; conduit attached to trapeze with conduit clamp that provides lateral and longitudinal restraint (Photo courtesy of Maryann Phipps, Estructure).

Figure 6.4.8.1-4 Lateral and longitudinal rigid strut bracing for trapeze supporting electrical raceways (Photo courtesy of Maryann Phipps, Estructure).

MITIGATION DETAILS

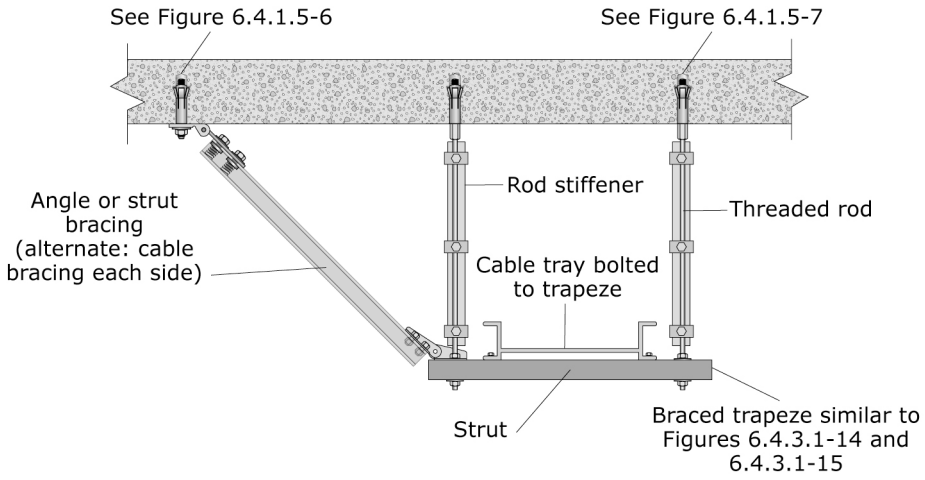

Figure 6.4.8.1-5 Cable tray on braced trapeze (ER).