The following details can be used to help prevent the effects of earthquakes on:

- **Mechanical Systems**
  - Piping
  - Ductwork
  - Suspended Equipment
  - Floor Mounted Equipment

- **Electrical Systems**
  - Cable Trays, Bus Ducts
  - Conduit

- **Plumbing Systems**
  - Piping

- **Fire Protection Systems**
  - Piping
Suspended systems such as piping, equipment and ductwork need seismic braces to keep them from swaying during an earthquake. Seismic braces can be flexible using aircraft quality cables, or rigid (solid) using steel sections such as pipe, angles, or strut channels. Braces are typically installed 30-40 ft (10-13 m) apart, at system turns and at the end of runs. Braces are attached to the pipe/duct at horizontal supports such as clevis’s or trapezes. The other end is attached to structure such as overhead concrete slabs or structural steel. Suspended equipment requires a minimum of four braces, one at each corner. Floor mounted equipment needs to be anchored to the structural slab. This also includes equipment that is Vibration Isolated with seismic snubbers.

**Pipe, Cable Trays, Bus Ducts & Conduit Bracing Details**

**Cable Bracing**

![Diagram of Cable Bracing](image)

**Figure 1** Transverse & Longitudinal Cable Brace for Horizontal Suspended Pipe
Rigid or Solid Bracing

**FIGURE 2**

**CABLE BRACE FOR TRAPEZE SUSPENDED PIPE**

- **SWIVEL FASTENER (TYP.)**
- **CABLE BRACE**
- **SEISMIC FORCE**
- **PIPE SECURED TO TRAPEZE**
- **STIFFENER CLAMP**
- **HANGER ROD**
- **ROD STIFFENER (WHEN REQUIRED)**

**FIGURE 3**

**SOLID BRACE IN COMPRESSION FOR INDIVIDUALLY SUPPORTED PIPE**

- **SWIVEL FASTENER (TYP.)**
- **SOLID BRACE**
- **CLEVIS STIFFENER**
- **SEISMIC FORCE**
- **STIFFENER CLAMP**
- **HANGER ROD**
- **ROD STIFFENER (WHEN REQUIRED)**

**FIGURE 4**

**SOLID BRACE IN COMPRESSION FOR TRAPEZE PIPE**

- **SWIVEL FASTENER (TYP.)**
- **SOLID BRACE**
- **SEISMIC FORCE**
- **PIPE SECURED TO TRAPEZE**
- **STIFFENER CLAMP**
- **HANGER ROD**
- **ROD STIFFENER (WHEN REQUIRED)**
Cable Bracing

CABLE BRACING OF SUSPENDED DUCTWORK

FIGURE 5

Rigid or Solid Bracing

SOLID BRACE OF DUCTWORK ON TRAPEZE

FIGURE 6
Suspended equipment requires bracing as shown in Figure 8 using rigid steel sections or Figure 7 using cables. Connections to the equipment such as piping, conduit or ductwork should be made with flexible connections.
Floor Supported Equipment

Floor mounted equipment may be bolted down if no vibration isolation is required. If the equipment is isolated then the equipment must either have bumpers as shown in Figure 9 or snubbers as shown in Figure 10.

![Figure 9: Anchor Bracket Connected to Equipment](image)

![Figure 10: Supplemental Base - Open Springs and Snubbers](image)
Anchor Bolts

Anchor bolts are one of the most important parts of a correctly designed and installed Seismic Restraint System. The most widely used anchors for seismic restraints are the wedge, adhesive and undercut.

Proper installation of anchors is important.

Basic installation methods for shell and adhesive anchors is shown in Figure 12.
This publication was written by ASHRAE’s Technical Committee TC 2.7, Seismic and Wind Restraint Design. All details in this document are from ASHRAE’s Publication,” A Practical Guide to Seismic Restraint”, 2000, or FEMA Document 412