

## 6.4 MECHANICAL, ELECTRICAL, AND PLUMBING COMPONENTS

### 6.4.6 DUCTWORK

#### 6.4.6.1 SUSPENDED DUCTWORK

This category covers suspended HVAC ducts; see Section 6.4.1.5 for suspended HVAC equipment.

#### TYPICAL CAUSES OF DAMAGE

- Unbraced ducts may swing and impact other items. They may become damaged at restraints or “hard spots” along the duct path such as at connections of braced in-line equipment, at connections to floor-mounted equipment, or at wall or slab penetrations. Inadequately supported ducts may come loose from the HVAC equipment or diffusers to which they are connected and fall.
- Ducts may be damaged by differential movement such as at building separations.

## Damage Examples



Figure 6.4.6.1-1 Unbraced ducts separated at bend in the 1994 magnitude-6.7 Northridge Earthquake (Photo courtesy of Mason Industries).

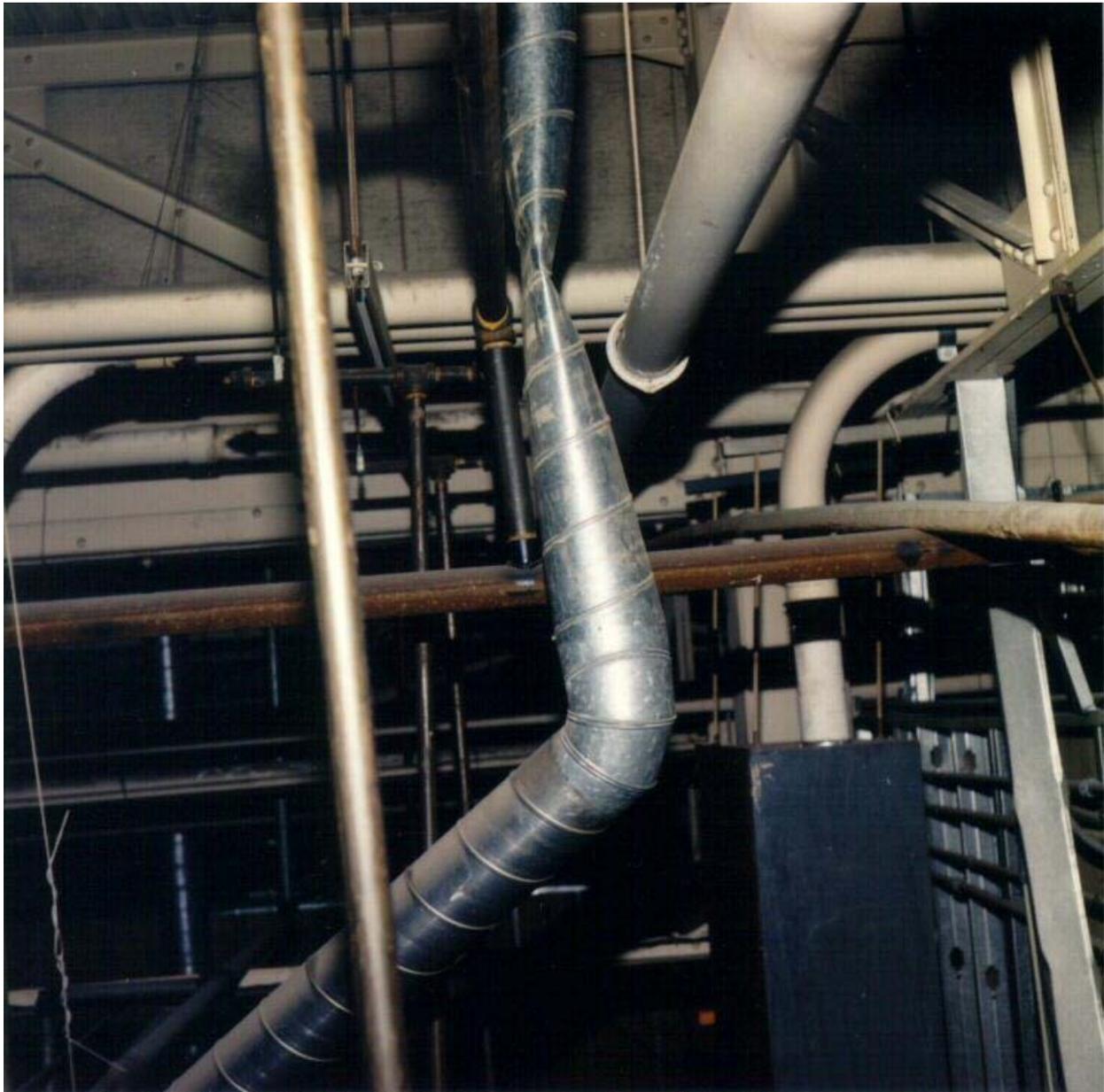


Figure 6.4.6.1-2 Unbraced duct damaged by impact with piping in 1994 Northridge Earthquake (Photo courtesy of Mason Industries).

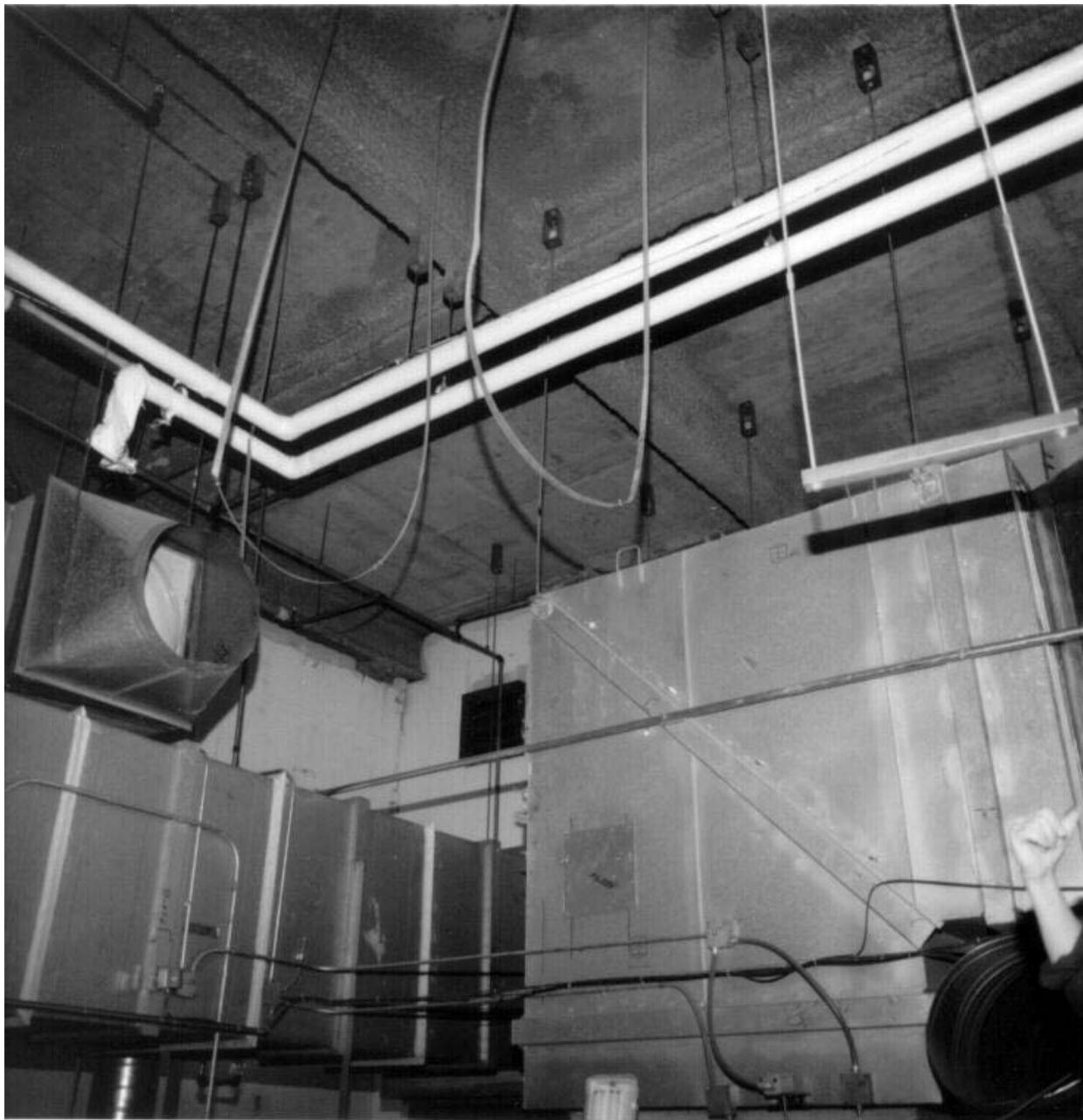


Figure 6.4.6.1-3 Collapsed unbraced ducts and hangers dangling from floor above in the 1994 Northridge Earthquake (Photo courtesy of Mason Industries).

## SEISMIC MITIGATION CONSIDERATIONS

- Details shown here are for suspended ducts. Ducts may also be floor-, wall- or roof-mounted, may cross building separations, or may be located in vertical chases. Refer to FEMA 414 *Installing Seismic Restraints for Duct and Pipe* (2004) for attachment details, for other conditions and general information about installation.

- 2006 IBC *International Building Code* (ICC, 2006) and ASCE/SEI 7–10 *Minimum Loads for Buildings and Other Structures* (ASCE, 2010) include several exemptions for suspended ducts: seismic restraints are not required under certain circumstances such as if the vertical hangers are less than 12 inches long or if the ducts have a cross-sectional area less than 6 square feet, as long as flexible duct connections are provided at connections to braced equipment. Refer to ASCE/SEI 7–10 Section 13.6.7 for more information.
- Ductwork required for HVAC systems in hospitals or other essential facilities may be classified as designated seismic systems with a component importance factor of 1.5. Such designated seismic systems may require engineering calculations, equipment certification, and additional inspections. Check ASCE 7–10 and the jurisdiction for specific requirements.

### Mitigation Examples

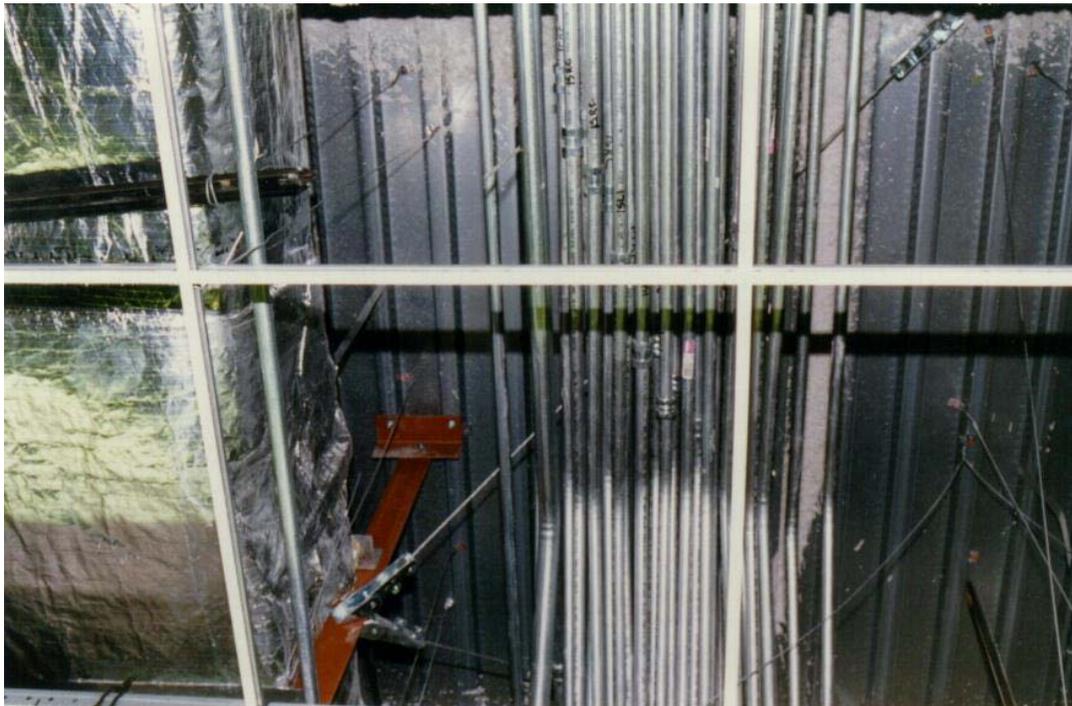


Figure 6.4.6.1-4 Rectangular duct supported by steel shapes with cable braces (Photo courtesy of Mason Industries).



Figure 6.4.6.1-5 Floor-mounted rectangular duct supported on braced support stand built up from steel angles (Photo courtesy of Maryann Phipps, Estructure).



Figure 6.4.6.1-6 Roof-mounted rectangular duct supported on braced support stand built up from steel channels (Photo courtesy of Maryann Phipps, Estructure).

## Mitigation Details

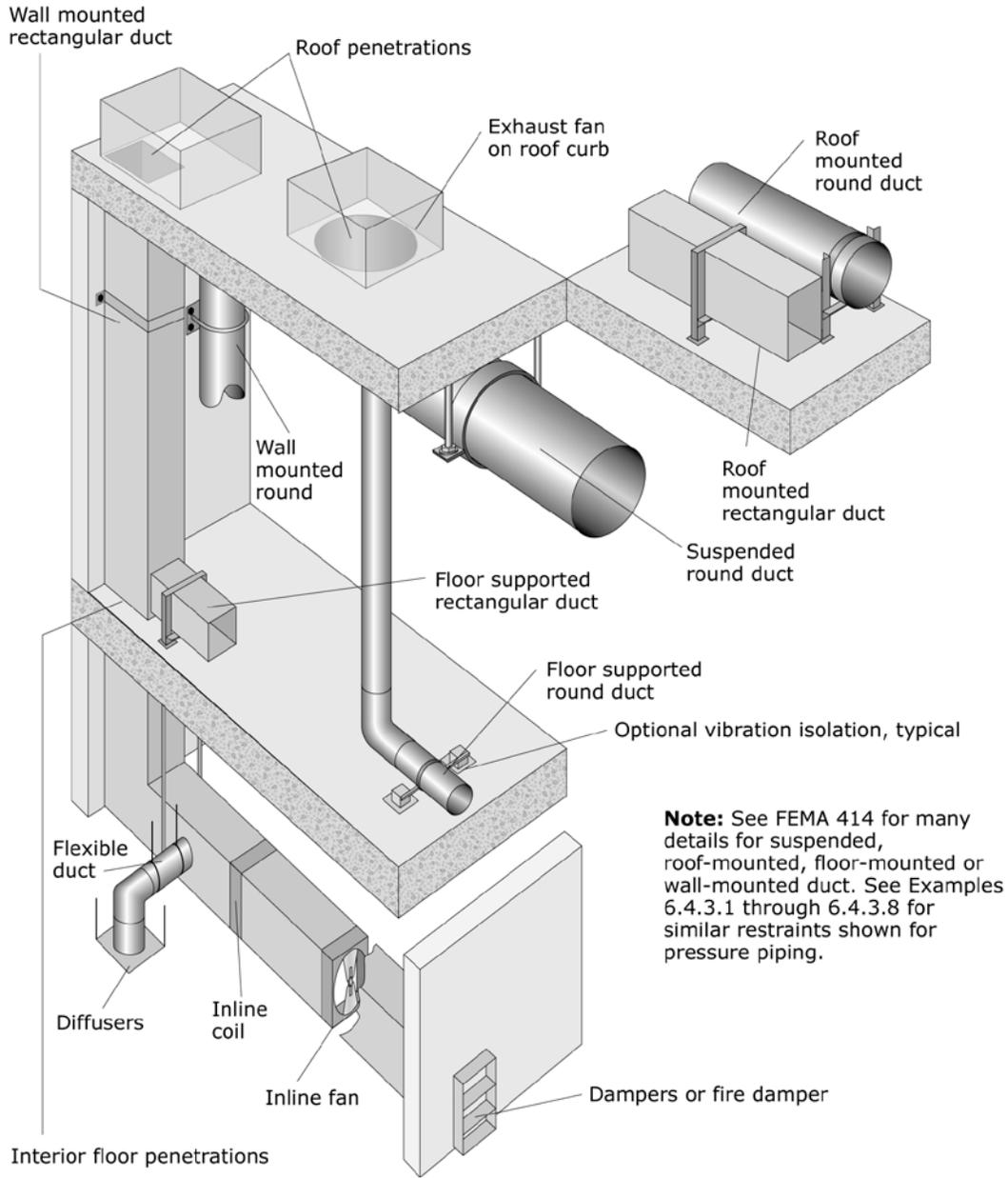
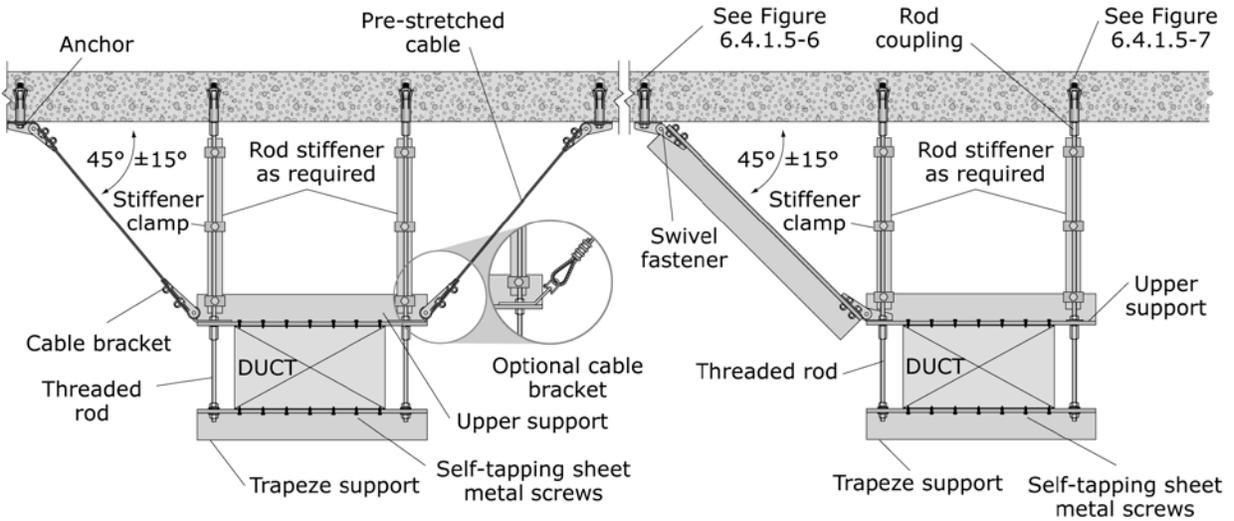


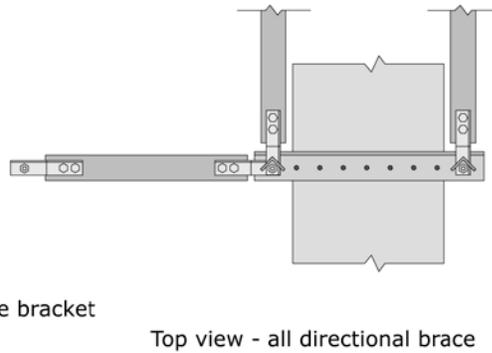
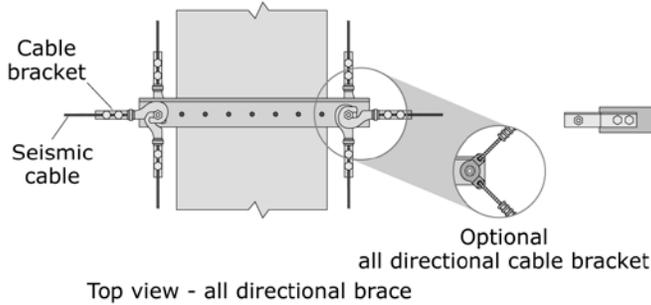
Figure 6.4.6.1-7 Overview of ductwork restraints (ER).



Shown in transverse direction for clarity. Additional cables are required for longitudinal support as shown in top view below.

**Front View**

**Front View**



**Cable Duct Bracing**

**Rigid Duct Bracing**

Figure 6.4.6.1-8 Suspended ductwork (ER).