

## 6.4 MECHANICAL, ELECTRICAL, AND PLUMBING COMPONENTS

### 6.4.7 ELECTRICAL AND COMMUNICATIONS EQUIPMENT

#### 6.4.7.1 CONTROL PANELS, MOTOR CONTROL CENTERS, AND SWITCHGEAR

This category includes tall, narrow floor-mounted electrical items in sheet metal cabinets such as electrical control panels, motor control centers, switchgear, and substations.

#### TYPICAL CAUSES OF DAMAGE

- Overturning or sliding due to lack of anchorage or inadequate anchorage.
- Loss of function due to failure of internal components caused by inertial forces.
- Damaged electrical equipment may cause electrical hazards and fire hazards.

## Damage Example



Figure 6.4.7.1-1 Overturned equipment in the 1985 magnitude-8 Mexico Earthquake (Photo courtesy of Degenkolb Engineers).



Figure 6.4.7.1-2 Unanchored electrical cabinets overturned in a paper products plant during the 1999 magnitude-7.4 Izmit, Turkey earthquake (Photo courtesy of NISEE Izmit Collection, No. IZT-682, photograph by Halil Sezen).



Figure 6.4.7.1-3 Damage to unanchored electrical cabinets at power plant in Port-au-Prince in the 2010 magnitude-7 Haiti Earthquake (Photos courtesy of Eduardo Fierro, BFP Engineers).

## 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.
- Many of these components can be supplied with shop welded brackets or predrilled holes for base or wall anchorage. For any new equipment, request items that can be supplied with seismic anchorage details.
- See Section 6.4.1.1 for additional base anchorage details. Refer to FEMA 413 *Installing Seismic Restraints for Electrical Equipment* (2004) for general information on seismic anchorage of electrical equipment.

### Mitigation Examples



Figure 6.4.7.1-4 Equipment cabinets retrofitted with unidirectional snubbers at base (Photo courtesy of Mike Griffin).



Figure 6.4.7.1-5 Installation that performed well in the 2010 magnitude-8.8 Chile Earthquake; cabinets anchored at base. Some cabinets tied together side by side using existing lifting hooks at top of cabinets (Photos courtesy of Rodrigo Retamales, Ruben Boroschek & Associates).



Figure 6.4.7.1-6 Close up of snubbers (Photo courtesy of Mike Griffin).



Figure 6.4.7.1-7 Postearthquake strengthening of anchorage for electrical cabinets from the 2001 magnitude-8.4 Peru Earthquake (Photo courtesy of Eduardo Fierro, BFP Engineers).



Figure 6.4.7.1-8 Detail of postearthquake strengthening from the 2001 Peru Earthquake (Photo courtesy of Eduardo Fierro, BFP Engineers).



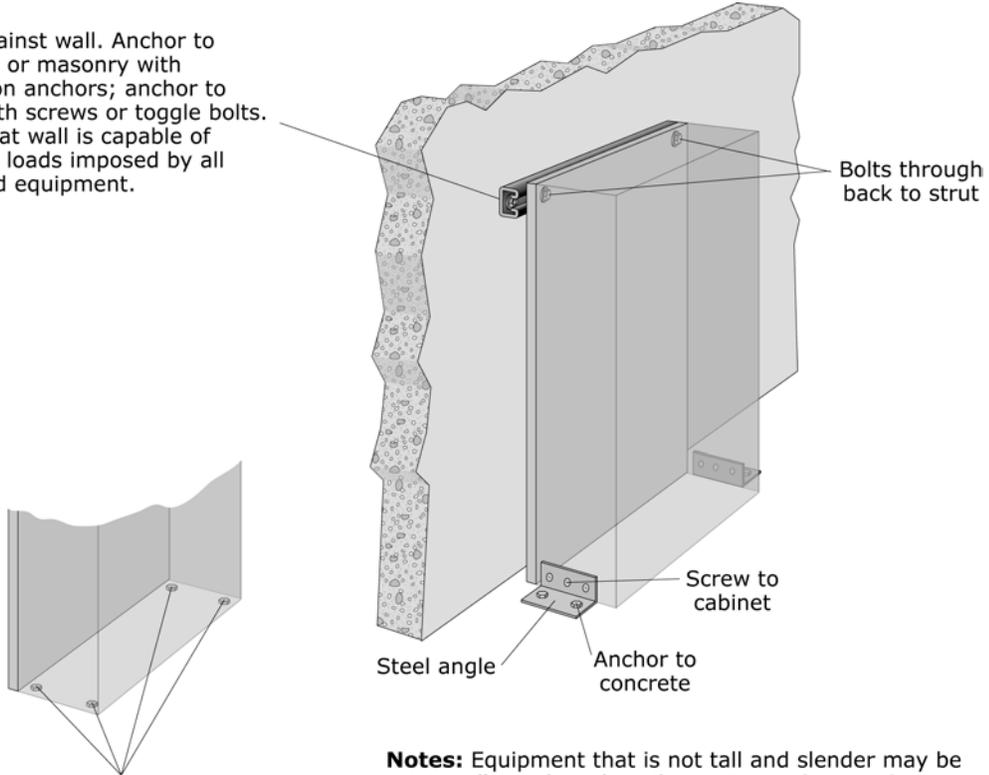
Figure 6.4.7.1-9 Anchorage for electrical cabinets. Anchorage to wall at top of cabinets is also present but not visible (Photo courtesy of Maryann Phipps, Estructure).



Figure 6.4.7.1-10 Detail of cabinet base anchorage (Photo courtesy of Maryann Phipps, Estructure).

## Mitigation Details

Strut against wall. Anchor to concrete or masonry with expansion anchors; anchor to studs with screws or toggle bolts. Verify that wall is capable of resisting loads imposed by all anchored equipment.



Alternate: anchor directly through base if unit is premanufactured for base anchorage and access is available

**Notes:** Equipment that is not tall and slender may be seismically anchored similar to Figure 6.4.1.1-6 or 6.4.1.1-7

Turn off all power to equipment before proceeding with any work

Figure 6.4.7.1-11 Electrical control panels, motor controls centers, or switchgear (ER).

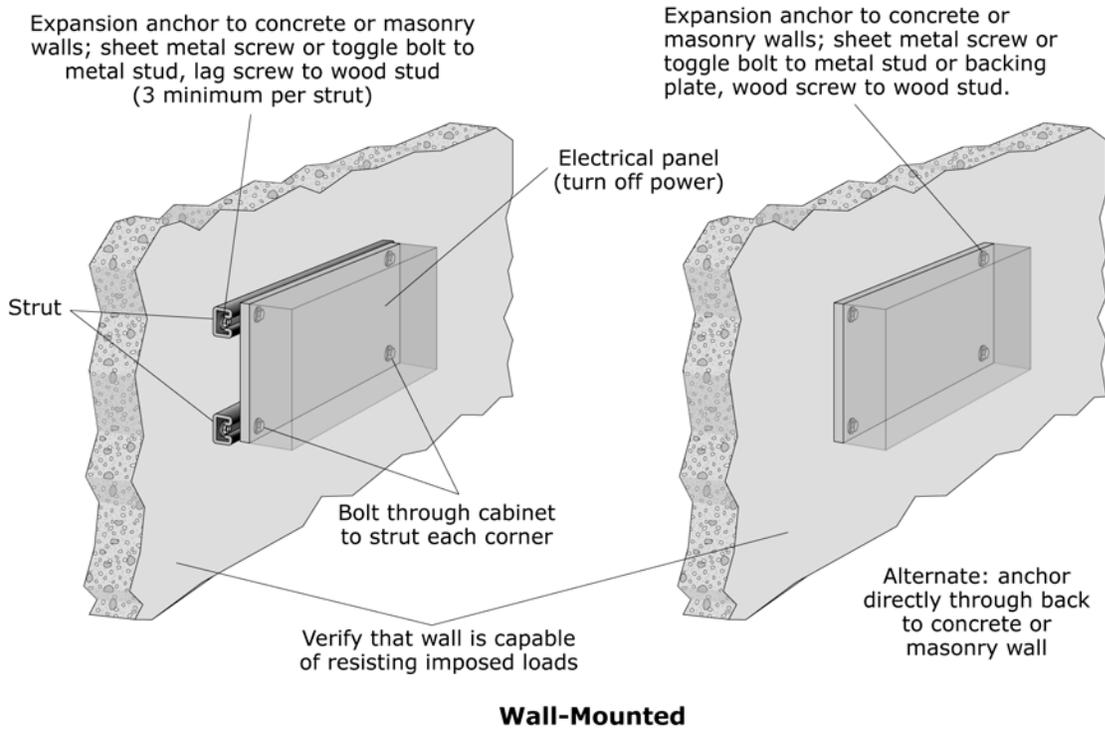
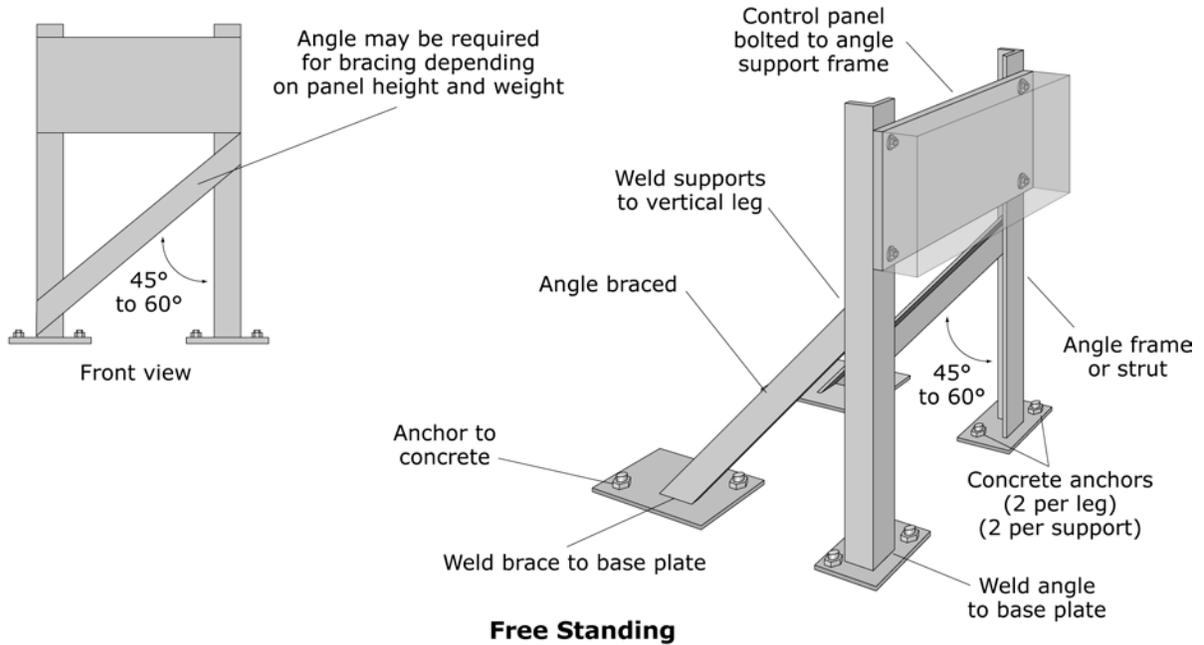


Figure 6.4.7.1-12 Free-standing and wall-mounted electrical control panels, motor controls centers, or switchgear (ER).