6.4 MECHANICAL, ELECTRICAL, AND PLUMBING COMPONENTS

6.4.1 MECHANICAL EQUIPMENT

6.4.1.4 HVAC EQUIPMENT WITHOUT VIBRATION ISOLATION

This includes dry-side HVAC equipment, typically of sheet metal construction, that is rigidly mounted to the floor, wall or roof. Current codes require anchorage for all equipment weighing over 400 pounds, equipment weighing over 100 pounds that are subject to overturning, and items weighing over 20 pounds that are mounted more than 4 feet above the floor.

TYPICAL CAUSES OF DAMAGE

- Unanchored or inadequately anchored items can slide, tilt, overturn, or fall.
- Connections of fuel lines, electrical lines or ductwork may be damaged; machinery may cease to function due to misalignment.

Damage Examples

Figure 6.4.1.4-1 Poorly anchored compressor jumped off the undersized anchor bolts in the 2010 magnitude-8.8 Chile Earthquake (Photo courtesy of Eduardo Fierro, BFP Engineers).

Figure 6.4.1.4-2 Unanchored rooftop units thrown off their supports during an earthquake (Photo courtesy of Maryann Phipps, Estructure).

Figure 6.4.1.4-3 Numerous poorly anchored rooftop units toppled in the 2010 Chile Earthquake (Photos courtesy of Rodrigo Retamales, Rubén Boroschek & Associates).

SEISMIC MITIGATION CONSIDERATIONS

- See Section 6.4.1.1 for rigid floor mount details and Section 6.4.1.3 for vibration isolation floor mount details.
- Special consideration is needed for rooftop units. Such units are typically mounted on curbs or platforms to facilitate waterproofing and flashing. Curbs may be custom-built on site or premanufactured. Detailing for seismic restraints must include a connection between the equipment and the curb and the curb and the roof framing. In addition, the curb itself must be sufficiently strong to deliver earthquake forces from the unit to the roof.
- See FEMA 412 *Installing Seismic Restraints for Mechanical Equipment* (2002) and FEMA 414 *Installing Seismic Restraints for Duct and Pipe* (2004) for details for wall-mounts,

roof-mount with flashing details, ducts and piping, and additional information regarding hardware and installation.

Mitigation Details

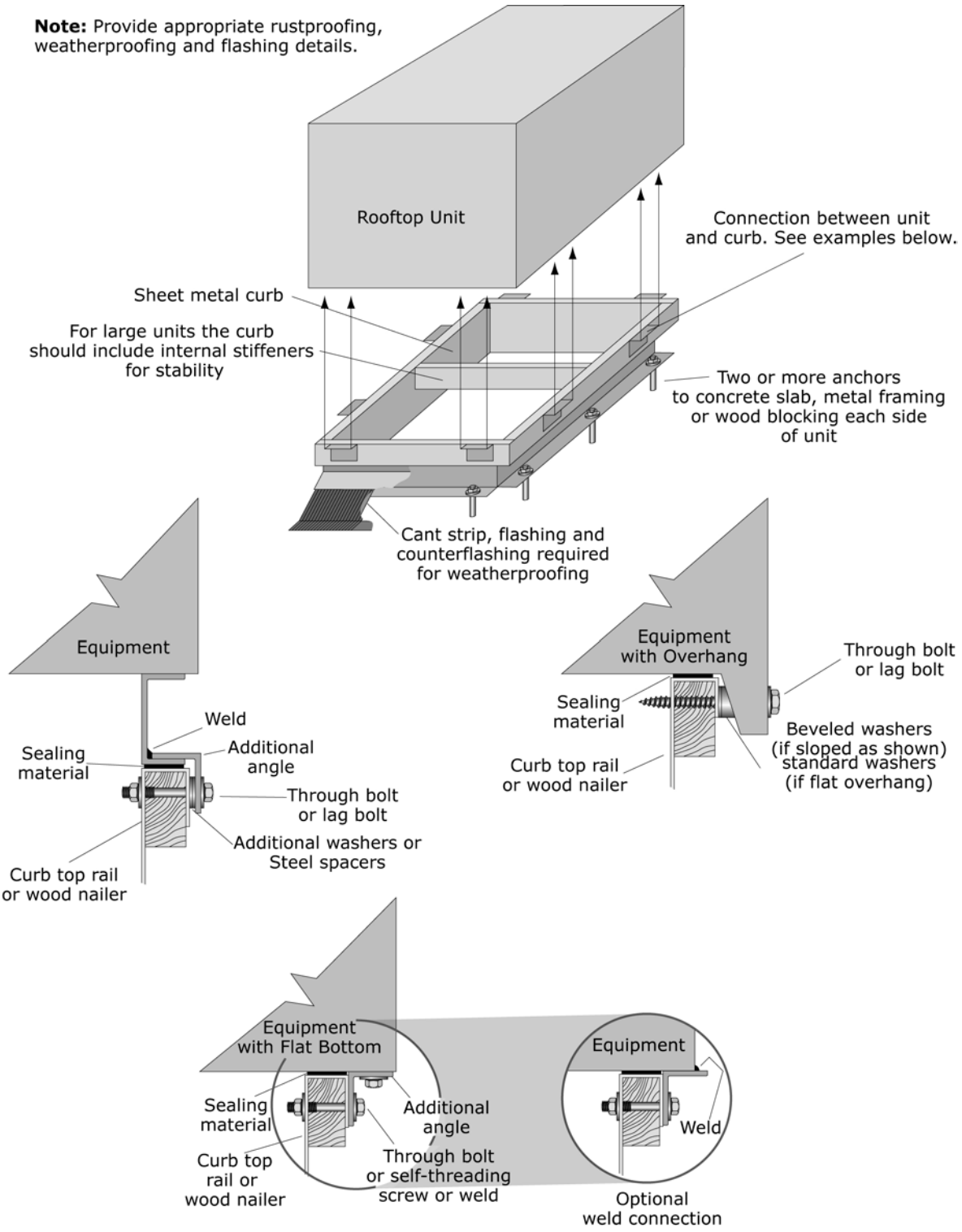

Figure 6.4.1.4-4 Rooftop HVAC equipment (ER).