6.5 Furniture, Fixtures, Equipment and Contents

6.5.3 Computer and Communication Equipment

6.5.3.2 Computer and Communication Racks

Steel racks for servers or communications equipment may be open or closed, wall or floor mounted or portable. To prevent damage and loss of communication links, racks should be braced, anchored, or tethered with equipment firmly secured to the rack and cables arranged with adequate slack.

In recent shake table testing of a full scale 5-story building performed at UC San Diego (see Section 6.1.3), 3 servers that were operating and connected on line at the time of the shaking were subjected to severe earthquake motions. The servers were anchored per code requirements. With the exception of the largest test motion, the servers continued functioning during and following the earthquake motion without a problem. For the largest test motion, the servers momentarily went off line, reset themselves, automatically reconnected themselves and then continued functioning.

Provisions

BUILDING CODE PROVISIONS

Seismic loads for computer and communication racks are determined using ASCE/SEI 7-10, *Minimum Design Loads for Buildings and Other Structures*, (ASCE, 2010) Chapter 13. The principal objective is to prevent the racks from toppling or buckling under seismic loads,

- ASCE/SEI 7-10 requires anchorage for all equipment in Seismic Design Categories D, E, and F weighing over 400 pounds, and items weighing over 20 pounds that are mounted over 4 feet above the floor. Lighter items may be exempt if the component Importance Factor $I_p = 1.0$.
- Items that are exempt from the anchorage requirements noted above are still required to be positively anchored to the structure. The anchorage need not be designed or detailed on the construction documents. Flexible connections must be provided between the equipment and associated conduit or raceways.
- The racks themselves should be checked for adequate strength and stiffness.

RETROFIT STANDARD PROVISIONS

ASCE/SEI 41-06, *Seismic Rehabilitation of Existing Buildings*, (ASCE, 2007) classifies computer and communication racks as force controlled. These components are subject to the provisions of the standard when the performance level is Immediate Occupancy. Acceptance criteria for electrical equipment focus on providing adequate anchorage for seismic forces. Buckling or racking failure of rack framing components must also be considered.

Typical Causes of Damage

- Unbraced, unanchored, or poorly anchored racks can slide, tip, overturn or collapse. Equipment may slide, bang, or fall and suffer internal damage; cable connections may pull loose and get scrambled.

DAMAGE EXAMPLES

Figure 6.5.3.2-1 Damage to communication and computer racks (Photo courtesy of Degenkolb Engineers).

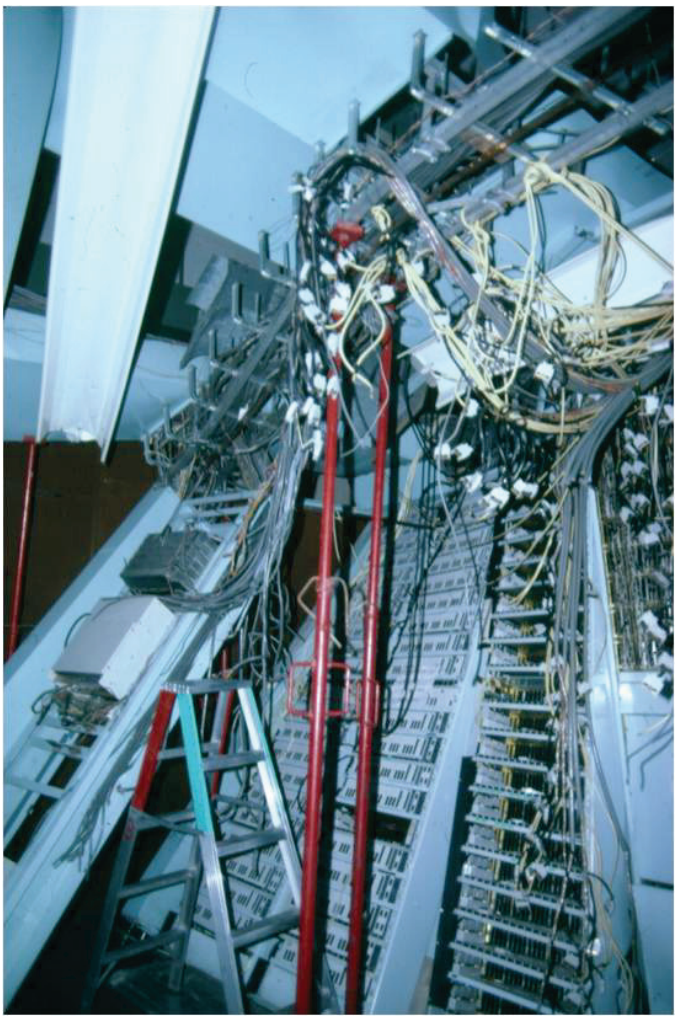

Figure 6.5.3.2-2 Damage to communication and computer racks (Photo courtesy of Degenkolb Engineers).

Seismic Mitigation Considerations

- Check suppliers for seismic rated cabinet racks or server racks that come with predrilled holes and hardware for floor or wall anchorage. Where items are anchored to a partition wall, make sure that the wall and wall anchorage or bracing to the structure above are adequate to resist the imposed loads. Cables and wiring should be installed with sufficient slack to allow for some seismic deformations.
- See also Section 6.5.3.1 for equipment on access floors; see Section 6.4.7.1 for details for anchorage of electrical cabinets. Also refer to FEMA 413, *Installing Seismic Restraints for Electrical Equipment* (2005), for general guidelines for anchorage of electrical items.
- Develop a backup and recovery plan for all electronic data including offsite backup to a location not likely to be affected by the same earthquake.

MITIGATION EXAMPLES

Figure 6.5.3.2-3 Base anchorage details for data cabinets; top photos shows internal anchorage, bottom photo shows external anchorage (Photos courtesy of Maryann Phipps, Estructure).

MITIGATION DETAILS

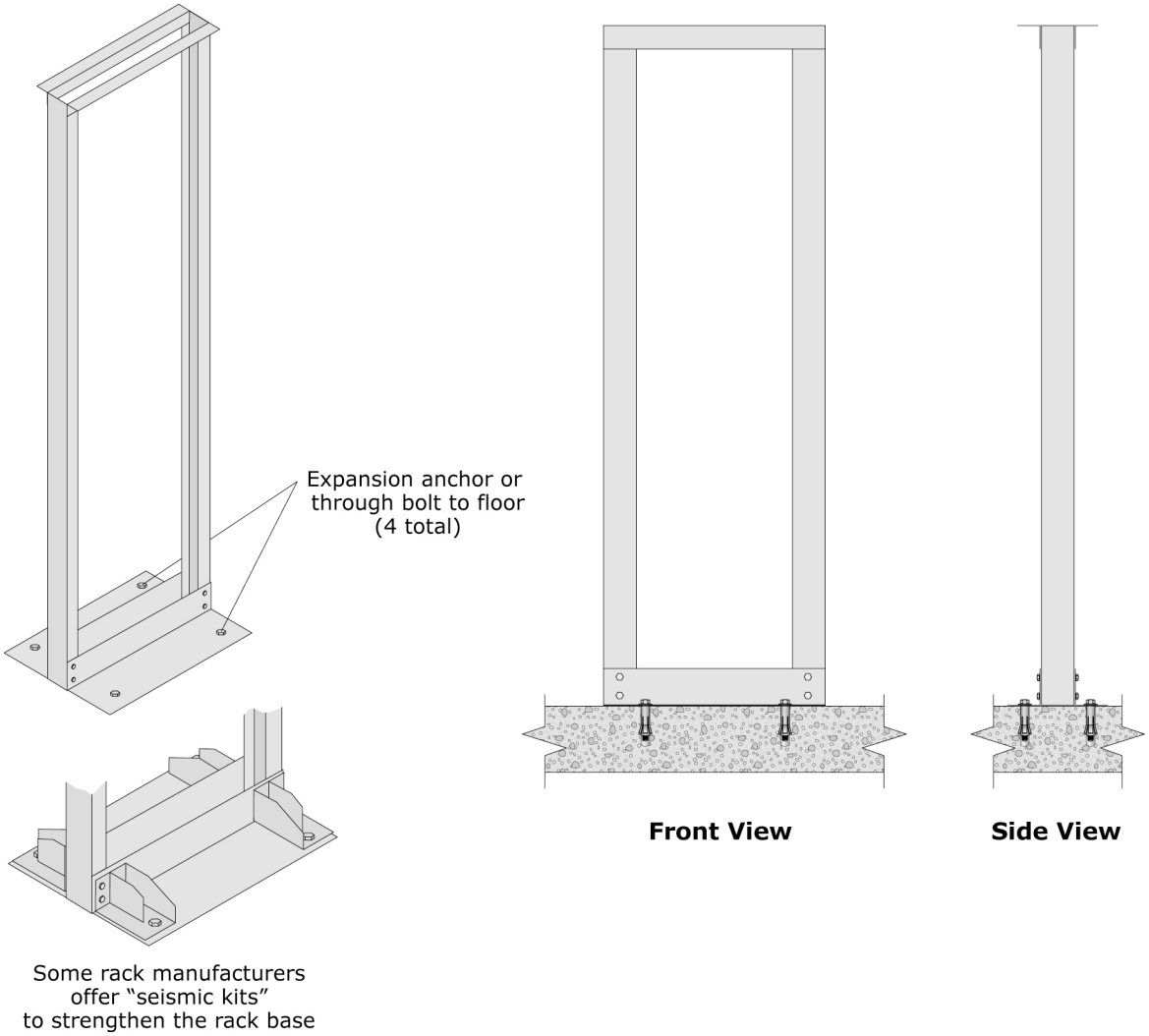

Figure 6.5.3.2-4 Data rack (ER).

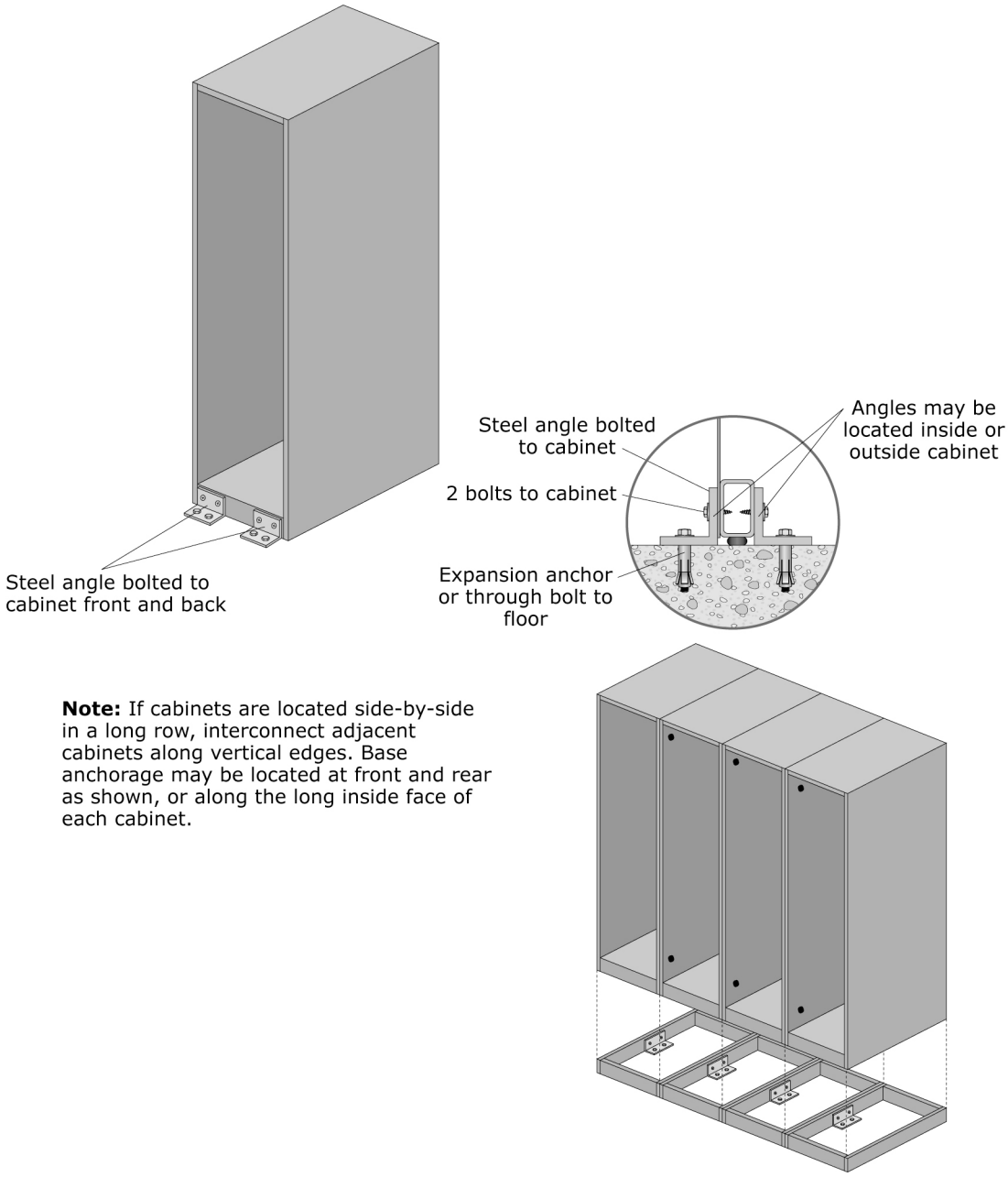

Figure 6.5.3.2-5 Data cabinet (ER).