6.3 Architectural Components

6.3.1 Exterior Wall Components

6.3.1.2 Anchored Veneer

Anchored veneers are typically masonry, stone or stone slab units that are attached to the structure by mechanical means. These units and their connections must be designed to accommodate the anticipated seismic drift; otherwise they may pose a significant falling hazard.

Provisions

BUILDING CODE PROVISIONS

2012 IBC, *International Building Code*, (ICC, 2012) and TMS 402-11/ACI 530/ASCE 5-11, *Building Code Requirements for Masonry Structures* (ACI, 2011) contain a number of prescriptive requirements and limitations on the use of anchored veneer. These include height limits, drift limits, deflection limits, limits on the use of combustible structural supports such as wood, limits on basic wind speed, cavity size limits, mortar bed minimum thickness limits, and minimum tie spacing limits.

- Seismic loads for anchored veneer are calculated using ASCE/SEI 7-10, *Minimum Design Loads for Buildings and Other Structures* (ASCE, 2010), Chapter 13.
- The seismic provisions for masonry veneer in TMS 402-11/ACI 530/ASCE 5-11 are organized based on the severity of potential ground shaking at the site. The requirements are cumulative, adding requirements in areas of higher risk. The provisions require the veneer to be isolated from the structure to prevent accidental loading and accommodate building deformation. Veneer anchors (sometimes referred to as ties) are designed to allow movement in the plane of the wall but resist out-of-plane forces. Spacing of the anchors is dependent on the weight of the veneer and the seismic load.
- Seismic provisions for stone veneer are found in Chapter 14 of the 2012 IBC.
- The structural element or backing supporting anchored veneer (usually a wall) must have sufficient strength and stiffness to support the vertical and lateral loads imposed by the veneer. Many of the prescriptive limits for anchored veneer are triggered by the nature of the support backing. Veneer anchored directly to concrete or masonry walls

has the fewest limitations. Anchored veneer supported by wood or light frame steel walls has more restrictions.

RETROFIT STANDARD PROVISIONS

ASCE/SEI 41-06, *Seismic Rehabilitation of Existing Buildings* (ASCE, 2007) classifies anchored veneers as both acceleration and deformation sensitive.

- Anchored veneer is subject to the requirements of ASCE/SEI 41-06 when it is over 48 inches above the ground or adjacent exterior area. and
  - The performance level is Immediate Occupancy or Life Safety.
  - The performance level is Hazards Reduced and heavy veneer is located over areas of public access or egress.
- Acceptance criteria focus on checking the anchorage of the veneer under seismic loading and limiting in-plane deflections.

Typical Causes of Damage

- Anchored veneers and their connections may be damaged by inertial forces and by building distortion; units located at corners and around openings are particularly vulnerable.
- Rigid connections may distort or fracture if they do not have sufficient flexibility to accommodate the seismic drift; veneer units may crack, spall, or become completely dislodged and fall.
- Deterioration or corrosion of the mechanical connections is a significant concern; corroded connections may fail prematurely. Maintaining watertightness at joints is important for the longevity of the anchors.

DAMAGE EXAMPLES

Figure 6.3.1.2-1 Fallen sandstone veneer as a result of a magnitude-4.4 earthquake in northern California. Post-earthquake investigation revealed missing dovetail anchors, missing pencil rods, and weak stone-to-mortar bond (Photo courtesy of Simpson Gumpertz and Heger).

Figure 6.3.1.2-2 Fallen sandstone veneer as a result of a magnitude-4.4 earthquake (Photo courtesy of Simpson Gumpertz and Heger).

Figure 6.3.1.2-3 Rubble from failed anchored veneer as a result of the 1994 Northridge Earthquake (Photo courtesy of Robert Reitherman).

Seismic Mitigation Considerations

- Check the applicable code requirements when considering seismic mitigation options.
- Existing veneer anchors should be checked periodically and corroded anchors should be replaced. Tie spacing should be compared with current code requirements to evaluate whether the anchorage is sufficient. Additional anchors may reduce the falling hazards.
- There are many vendors who supply veneer anchors; these are typically metal wires or clips with a positive attachment to the structural backing that are embedded in the veneer mortar bed. The seismic version of these anchors requires an additional horizontal wire placed in the mortar bed and attached to the anchor. Some examples of these seismic veneer anchors are shown, others can be found online.

MITIGATION EXAMPLES

Figure 6.3.1.2-4 Installation of stone veneer showing anchorage to steel dovetail clips which are fastened to steel studs bolted to the grouted reinforced masonry wall behind (Photo courtesy of Simpson Gumpertz and Heger).

MITIGATION DETAILS

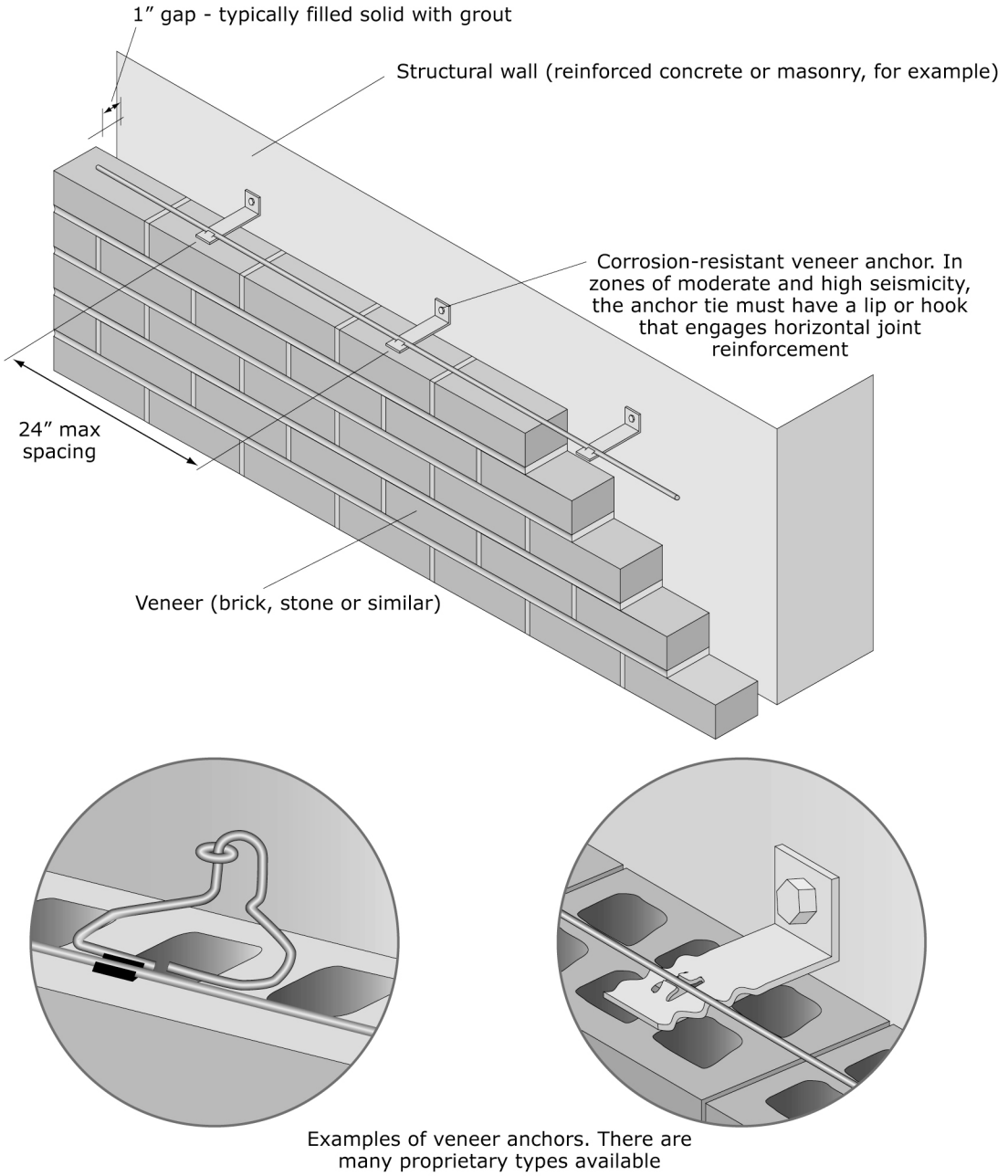

Figure 6.3.1.2-5 Anchored veneer (ER).