

6.3 ARCHITECTURAL COMPONENTS

6.3.3 Interior Veneers

6.3.3.1 Stone, Tile and Masonry Veneer

Interior veneer may be either adhered or anchored; both types are addressed here. Veneer made of thin materials such as ceramic tile, masonry, corian or similar solid surface, and stone can be attached to a backing substrate with adhesive. Heavy veneers such as masonry, stone, or stone slab units weighing more than 20 psf must be anchored to the structure by mechanical means. To avoid becoming a falling hazard, veneers and their connections must be designed to accommodate the anticipated seismic drift. Alternatively, they must be attached to interior partitions which are isolated from the anticipated seismic drift of the structure.

Provisions

BUILDING CODE PROVISIONS

Building code provisions for adhered and anchored veneers are prescriptive, and contain a number of prescriptive requirements and limitations. Design provisions are found in both 2012 IBC, *International Building Code*, (ICC, 2012) and TMS402-11/ACI530/ASCE 5-11, *Building Code Requirements for Masonry Structures* (ACI, 2011). There are limits on the thickness, size, and weight of veneers. In general, the provisions for interior veneer are identical to those for exterior veneers (see Section 6.3.1.1 and 6.3.1.2), with some additional limits on unit size and weight

RETROFIT STANDARD PROVISIONS

ASCE/SEI 41-06, *Seismic Rehabilitation of Existing Buildings* (ASCE, 2007) classifies interior veneers as primarily deformation sensitive, but it may also become detached due to out-of-plane acceleration.

- Interior veneer is subject to the requirements of ASCE/SEI 41-06 when:
 - The performance level is Immediate Occupancy,
 - The performance level is Life Safety, except that ceramic tile need not be evaluated, or
 - The performance level is Hazards Reduced and heavy interior veneer is located over areas of public access or egress.

- Acceptance criteria focus on limiting the in-plane deflections of the veneer, and verifying that the anchorage is adequate for seismic loading.

Typical causes of damage

- Adhered veneers are deformation sensitive and may crack or become dislodged due to deformation of the backing substrate. Veneer adhered directly to structural elements may be particularly vulnerable, for example, veneer adhered to a concrete or masonry shear wall may be damaged when the wall deforms. Poorly adhered veneer may come loose due to direct acceleration. Where veneer, such as tile, is used to provide a water barrier, such as in kitchens, restrooms, or showers, the adhesive and backing substrate may be damaged due to water intrusion if the mortar joints are cracked or deteriorated. In this case, whole sections of tile might come loose.
- Anchored veneers and their connections may be damaged by inertial forces and by building distortion, especially when located at corners and openings. Rigid connections may distort or fracture if they do not have sufficient flexibility to accommodate the seismic drift. In addition, veneer units may crack, spall, or become completely dislodged and fall.

DAMAGE EXAMPLES



Figure 6.3.3.1-1 Damage to adhered tile veneer in residential bathroom and kitchen in the 2010 magnitude-8.8 Chile Earthquake (Photo courtesy of Antonio Iruretagoyena, Ruben Boroschek & Associates). Tile is adhered to CMU infill partitions.



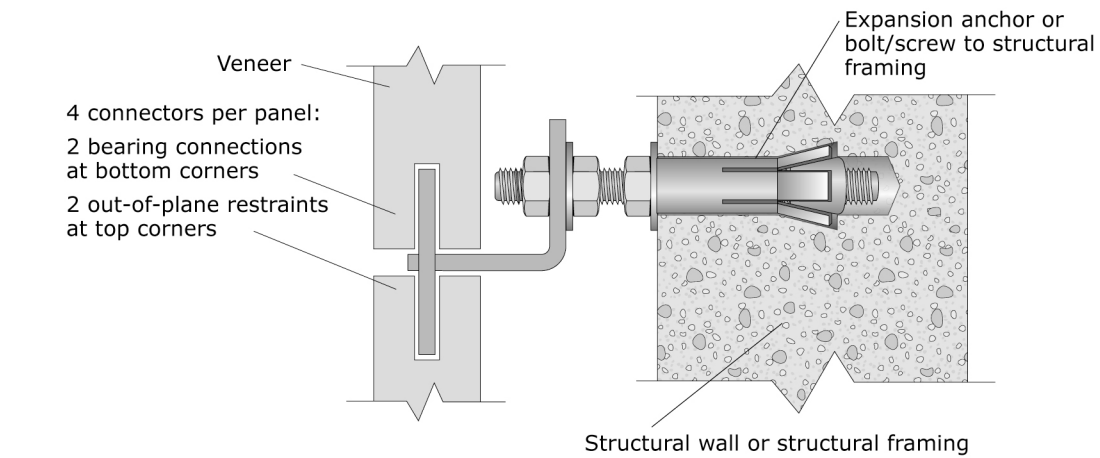
Figure 6.3.3.1-2 Damage to adhered tile veneer in locker room and kitchen at industrial facility in the 2001 Peru Earthquake (Photo courtesy of Eduardo Fierro, BFP Engineers). Tile was adhered to CMU partitions which were built integral with the concrete frame. While only a limited number of tiles were broken, equipment had to be disconnected and many tiles removed to repair cracks in the wall and facilitate the repair of the veneer.

Seismic Mitigation Considerations

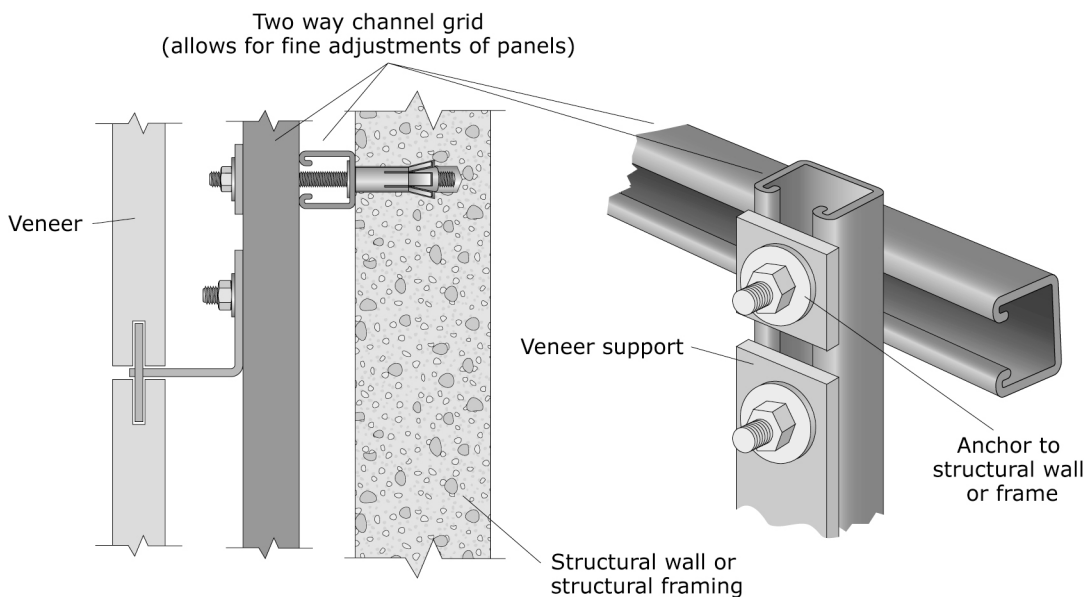
- Where interior veneer is attached to nonstructural walls or partitions, these partitions must be designed with adequate in-plane and out-of-plane support but detailed to accommodate the anticipated inter-story drift of the structural frame. Sections 6.3.1.1 and 6.3.1.2 provide additional information about adhered and anchored exterior veneers; the details used for interior veneers are similar, although interior and exterior finishes are typically installed by different trades.
- 2012 IBC contains a number of prescriptive requirements and limitations on the use of veneer. These include height limits, drift limits, deflection limits, limits on the use of combustible structural supports such as wood, mortar bed minimum thickness limits, and minimum tie spacing limits. Check the applicable code requirements when considering seismic mitigation options.
- Care must be taken in detailing corners, openings, edges and joints between structural elements and nonstructural substrates, such as a corner where a concrete masonry infill wall with veneer abuts a concrete column. While joints between individual tiles or stones may be grouted, movement joints may require a flexible sealant and bond breaker. Check manufacturer's recommendations for detailing under these special conditions.
- Adhered veneer placed directly on concrete or masonry shear walls is likely to be damaged during a design level earthquake since the shear wall is designed to deform to resist seismic loading. Cracking or spalling of adhered veneer on a shear wall is a sign that the shear wall has been damaged and may also be in need of repair.
- There are many vendors who supply veneer adhesion or anchoring systems. Some seismic veneer anchor examples for exterior veneers are shown in Section 6.3.1.2, and others can be found online. Figure 6.3.3.1–3 shows two examples of anchoring schemes for thin stone slabs as typically installed by specialty contractors. Both the supporting structure and the anchorage assembly must be designed to accommodate the anticipated inter-story drift.
- 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 be installed to reduce the falling hazards. Adhered veneer used to provide a water barrier must also be periodically inspected and maintained; if not repaired, water intrusion may cause corrosion or deterioration of the backing substrate or structural supports.
- It may be prudent to remove interior veneer in exit corridors or above exits, especially if larger units are mounted above 10 feet.

MITIGATION DETAILS

Note: Anchorage hardware typically supplied by specialty contractors. Both supporting structure and anchorage details must be designed to accommodate anticipated drift.



(a) anchorage directly to reinforced concrete or reinforced masonry substrate



(b) anchorage to special purpose two-way channel grid

Figure 6.3.3.1-3 Detail for anchored interior veneer (ER).