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CONCRETE MASONRY VENEERS

TEK 3-6B
Construction (2005)

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INTRODUCTION

In addition to its structural use as through-the-wall units, or as the exterior wythe of composite and noncomposite walls, concrete brick and architectural facing units are also used as veneer over various backing surfaces. The variety of surface textures, colors, and patterns available makes concrete masonry a versatile and popular exterior facing material. Architectural units such as split-face, scored, fluted, ground face, and slump are available in a variety of colors and sizes to complement virtually any architectural style.

VENEER—GENERAL

Veneer is a nonstructural facing of brick, stone, concrete masonry or other masonry material securely attached to a wall or backing. Veneers provide the exterior wall finish and transfer out-of-plane loads directly to the backing, but they are not considered to add to the load-resisting capacity of the wall system. Backing material may be masonry, concrete, wood studs or steel studs.

For the purposes of design, veneer is assumed to support no load other than its own weight. The backing must be designed to support the vertical and lateral loads imposed by the veneer in addition to the design loads on the wall since it is assumed the veneer does not add to the strength of the wall.

Masonry veneers may be designed using engineered design methods to proportion the stiffness properties of the veneer and the backing to limit stresses in the veneer and achieve compatibility (ref. 4). As an alternative, prescriptive code requirements have been developed based on judgement and successful performance. The prescriptive requirements relate to size and spacing of anchors and methods of attachment, and are described in the following sections.

In addition to structural requirements, differential movement between the veneer and its supports must be accommodated. Movement may be caused by tempera-

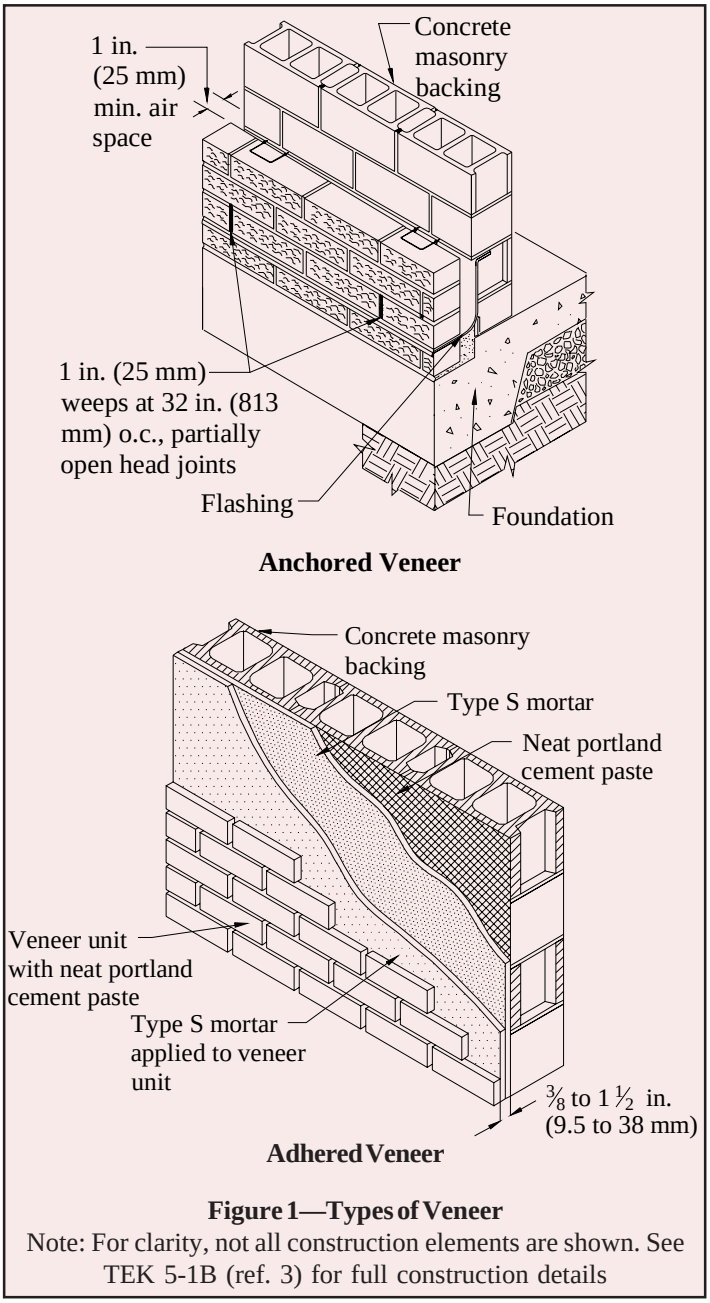


Figure 1—Types of Veneer
Note: For clarity, not all construction elements are shown. See TEK 5-1B (ref. 3) for full construction details

ture changes, moisture-volume changes, or deflection. In concrete masonry, control joints and horizontal joint reinforcement effectively relieve stresses and accommodate small movements. Control joints should be placed in the veneer at the same locations as those in the backing, or as required to prevent excessive cracking. See *Crack Control for Concrete Brick and Other Concrete Masonry Veneers* (ref. 6) for further information.

For exterior veneer, water penetration through the veneer is anticipated. Therefore, the backing system must be designed and detailed to resist water penetration and prevent water from entering the building. Flashing and weep holes in the veneer collect any water that penetrates the veneers and redirect it to the exterior. Partially open head joints are one preferred type of weep hole. They should be at least 1 in. (25 mm) high and spaced not more than 32 in. (813 mm) on center. If necessary, insects can be thwarted by inserting stainless steel wool into the opening or by using proprietary screens. For anchored veneer, open weep holes can also serve as vents, allowing air circulation in the cavity to speed the rate of drying. Additional vents may be installed at the tops of walls to further increase air circulation. More detailed information is contained in *Concrete Masonry Veneer Details* and *Flashing Details for Concrete Masonry Walls* (refs. 3, 5).

Two types of veneer are discussed—anchored veneer and adhered veneer, as illustrated in Figure 1. They differ by the method used to attach the veneer to the backing. Unless otherwise noted, veneer requirements are those contained in *Building Code Requirements for Masonry Structures* (ref. 2).

ANCHORED VENEER

Anchored veneer is veneer which is supported laterally by the backing and supported vertically by the foundation or other structural elements. Anchors are used to secure the veneer and to transfer loads to the backing. Anchors and supports must be noncombustible and corrosion-resistant. In areas where the basic wind speed exceeds 110 mph (145 km/hr), the veneer must be designed using engineering philosophies, and the following prescriptive requirements may not be used. In areas where seismic activity is a factor, anchored veneer and its attachments must meet additional requirements to assure adequate performance in the event of an earthquake.

Masonry units used for anchored veneer must be at least 2 5/8 in. (67 mm) thick.

The height and length of the veneered area is typically not limited by building code requirements. The exception is when anchored veneer is applied over frame construction. For wood stud backup, veneer height is limited to 30 ft (9.14 m) (height at plate) or 38 ft (11.58 m) (height at gable). Similarly, masonry veneer over steel stud backing must be supported by steel shelf angles or other noncombustible construction for each story above the first 30 ft (9.14 m) (height at plate) or 38 ft (11.58 m) (height at gable) (ref. 2). This support does not necessarily have to occur at the floor height, but instead can be provided at a window head or other convenient location.

Where anchored veneers are not self-supporting, such as over openings, the veneer must be supported by noncombustible lintels or supports attached to noncombustible framing. Deflection of these horizontal supports is limited to 1/600 of the span or 0.3 in. (7.6 mm), whichever is smaller. Floors that support anchored veneers are subject to the same deflection limit.

A 1 in. (25 mm) minimum air space must be maintained between the anchored veneer and backing to facilitate drainage. A 1 in. (25 mm) air space is considered appropriate if special precautions are taken to keep the air space clean (such as beveling the mortar bed away from the cavity). Otherwise, a 2 in. (51 mm) air space is preferred. As an alternative, proprietary insulating drainage products can be used.

The maximum distance between the inside face of the veneer and the outside face of the backing is limited to 4 1/2 in. (114 mm), except for corrugated anchors used with wood

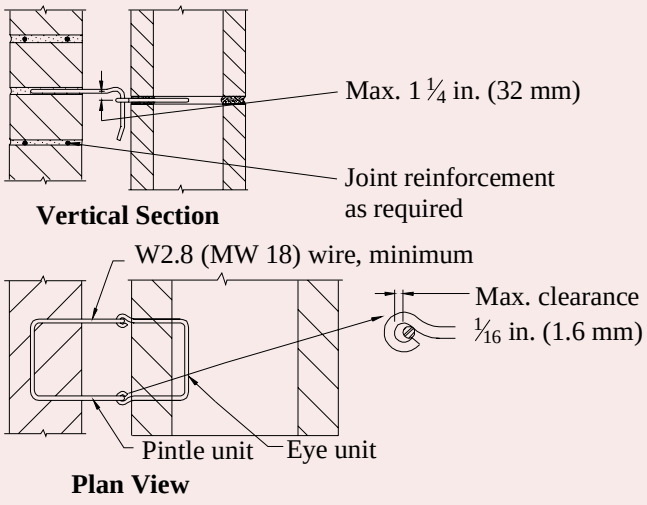
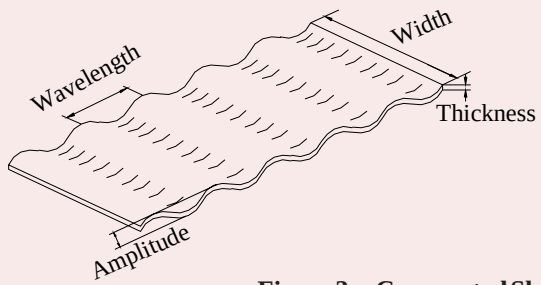


Figure 2—Adjustable Anchors



Minimum width	=	7/8 in. (22 mm)
Minimum thickness	=	0.03 in. (0.76 mm)
Wavelength	=	0.3 - 0.5 in. (7.6 - 13 mm)
Amplitude	=	0.06 - 0.10 in. (1.5 - 2.5 mm)
Minimum embedment, solid units	=	1 1/2 in. (38 mm)
Minimum cover from exterior	=	5/8 in. (16 mm)

Figure 3—Corrugated Sheet Metal Anchor Requirements (ref. 2)

backing, where the maximum distance is 1 in. (25 mm).

When anchored veneer is used as an interior finish supported on wood framing, the veneer weight is limited to 40 lb/ft^2 (195 kg/m^2).

Anchors

Veneers may generally be anchored to the backing using corrugated sheet metal anchors, sheet metal anchors, wire anchors, joint reinforcement or adjustable anchors, although building codes may restrict the use of some anchors. Requirements for the most common anchor types are summarized in Figures 2 through 4.

Attachment to Backing

When masonry veneer is anchored to wood backing, each anchor is attached to the backing with a corrosion-resistant 8d common nail, or a fastener with equivalent or greater pullout strength. For proper fastening of corrugated sheet metal anchors, the nail or fastener must be located within 1/2 in. (13 mm) of the 90° bend in the anchor. The exterior sheathing must be either water repellent with taped joints or be protected with a water repellent membrane, such as building paper ship lapped a minimum of 6 in. (152 mm) at seams, to protect the backing from any water which may penetrate the veneer.

When masonry veneer is anchored to steel backing, adjustable anchors must be used to attach the veneer. Each anchor is attached with corrosion-resistant screws that have a minimum nominal shank diameter of 0.19 in. (4.8 mm). Cold-formed steel framing must be corrosion resistant and should have a minimum base metal thickness of 0.043 in. (1.1 mm). Sheathing requirements are the same as those for wood stud backing.

Masonry veneer anchored to masonry backing may be attached using wire anchors, adjustable anchors or joint reinforcement. Veneer anchored to a concrete backing must be attached with adjustable anchors.

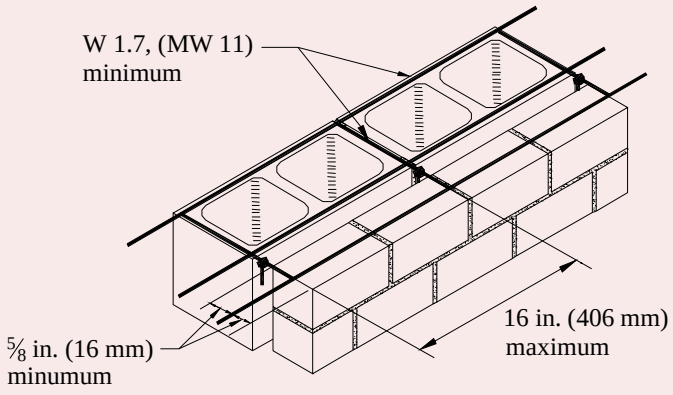
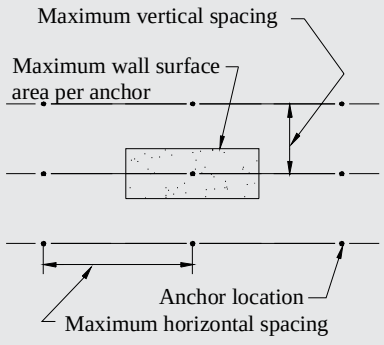


Figure 4—Requirements for Joint Reinforcement Used to Anchor Veneer (ref. 2)

ADHERED VENEER

Adhered veneer is veneer secured and supported through adhesion to a bonding material applied over the backing. Masonry units used in this application are limited to 2 5/8 in. (67 mm) thickness, 36 in. (914 mm) in any face dimension, 5 ft^2 (0.46 m^2) in total face area and 15 lb/ft^2 (73 kg/m^2) weight (ref. 2). In addition, the *International Building Code* (ref. 1) includes requirements for adhered masonry veneers used on interior walls. In this application, the code stipulates a maximum weight of 20 lb/ft^2 (97 kg/m^2). When the interior

Table 1—Anchor Spacing Requirements (ref. 2)



Backing	Type of anchor	Max. wall surface area, ft^2 (m^2)[a]	Anchor spacing Max. vertical spacing, in. (mm)	Max. horizontal spacing, in. (mm)
Masonry	wire, adjustable, or joint reinforcement	2.67 (0.25)	18 (457)	32 (813)
Concrete	adjustable	2.67 (0.25)	18 (457)	32 (813)
Wood stud	adjustable two-piece, anchors of wire size W 1.7 (MW 11), or 22 gauge (0.8 mm) corrugated sheet metal	2.67 (0.25)	18 (457)	32 (813)
	all other anchors	3.5 (0.33)	18 (457)	32 (813)
Steel stud	adjustable	2.67 (0.25)	18 (457)	32 (813)

Additional requirements:

- When anchored veneer is laid in other than running bond, the veneer shall have joint reinforcement of at least one W1.7 (MW 11) wire, spaced at a maximum of 18 in. (457 mm) on center vertically to increase the flexural strength of the veneer in the horizontal span.
- Around openings larger than 16 in. (406 mm) in either dimension, space anchors around perimeter of opening at a maximum of 3 ft (0.91 m) on center, and place anchors within 12 in. (305 mm) of opening.

[a] For Seismic Design Categories D, E and F, reduce maximum wall area supported by each anchor to 75% of values shown .

veneer is supported by wood construction, the wood backup must be designed for a maximum deflection of 1/600 of the span of the supporting wood member.

Adhered veneer and its backing must also be designed to either have sufficient bond to withstand a shearing stress of 50 psi (345 kPa) based on the gross unit surface area after curing 28 days (refs. 1, 2), or be installed according to the following.

A paste of neat portland cement is brushed on the backing and on the back of the veneer unit immediately prior to applying the mortar coat. This cement coating provides a good bonding surface for the mortar. Type S mortar is then applied to the backing and to each veneer unit in a layer slightly thicker than 3/8 in. (9.5 mm). Sufficient mortar should be used so that a slight excess is forced out the edges of the units. The units are then tapped into place to eliminate voids between the units and the backing which could reduce bond. The resulting thickness of mortar between the backing and veneer must be between 3/8 and 1 1/4 in. (9.5 and 32 mm). Mortar joints are tooled with a round jointer when the mortar is thumbprint hard.

Backing materials for adhered veneer must be continuous and moisture-resistant (wood or steel frame backing with adhered veneer must be backed with a solid water repellent sheathing). Backing may be masonry, concrete, metal lath and portland cement plaster applied to masonry, concrete, steel framing or wood framing. Note that care must be taken when adhered masonry veneer is used on steel frame or wood frame backing to limit deflection of the backing, which can cause veneer cracking or loss of adhesion. The surface of the backing material must be capable of securing and supporting the imposed loads of the veneer. Materials that may affect bond, such as dirt, grease, oil, or paint (except portland cement paint) should be cleaned off the backing surface prior to adhering the veneer.

REFERENCES:

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3. *Concrete Masonry Veneer Details*, TEK 5-1B. National Concrete Masonry Association, 2003.
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6. *Crack Control for Concrete Brick and Other Concrete Masonry Veneers*, TEK 10-4. National Concrete Masonry Association, 2001.