CONCRETE MASONRY VENEER DETAILS

TEK 5-1B

Details   (2003)

Keywords: architectural details, cavity walls, connectors, construction details, flashing, parapets, wall openings, wall ties, weep holes

INTRODUCTION

A wall constructed with two or more wythes of masonry can technically be classified in one of three ways, depending on how each individual wythe is designed and detailed. These three wall systems are composite, noncomposite or veneer walls. A true veneer is nonstructural—any contribution of the veneer to the wall's out-of-plane load resistance is neglected.

Building Code Requirements for Masonry Structures (ref. 1) defines veneer as a masonry wythe which provides the exterior finish of a wall system and transfers out-of-plane loads directly to the backing, but is not considered to add load resisting capacity to the wall system.

Noncomposite walls, on the other hand, are designed such that each wythe individually resists the loads imposed on it. Bending moments (flexure) due to wind or gravity loads are distributed to each wythe in proportion to its relative stiffness.

Composite walls are designed so that the wythes act together as a single member to resist structural loads. This requires that the two masonry wythes be connected by masonry headers or by a mortar or grout filled collar joint and wall ties to help ensure adequate load transfer between the two wythes.

The primary function of anchored veneers is to provide an architectural facade and to prevent water penetration into the building. As such, the structural properties of veneers are neglected in veneer design. The veneer is assumed to transfer out-of-plane loads through the anchors to the backup system. *Building Code Requirements for Masonry Structures* Chapter 6 (ref. 1) includes requirements for design and detailing anchored masonry veneer.

A masonry veneer with masonry backup and an air space between the masonry wythes is commonly referred to as a cavity wall. The continuous air space, or cavity, provides the wall with excellent resistance to moisture penetration and wind driven rain as well as a convenient location for insulation. This TEK addresses concrete masonry veneer with concrete masonry backup.

DESIGN CONSIDERATIONS

Masonry veneers are typically composed of architectural units such as: concrete or clay facing brick; split, fluted, glazed, ground face or scored block; or stone veneer. Most commonly, anchored masonry veneers have a nominal thickness of 4 in. (102 mm), although 3 in. (76 mm) veneer units may be available as well.

Although structural requirements for veneers are minimal, the following design considerations should be accounted for: crack control in the veneer, including deflection of the backup and any horizontal supports; adequate anchor strength to transfer applied loads; differential movement between the veneer and backup; and water penetration resistance.

The continuous airspace behind the veneer, along with flashing and weeps, must be detailed to collect any moisture that may penetrate the veneer and direct it to the outside. A minimum 1 in. (25 mm) air space between wythes is required (ref. 1), and is considered appropriate if special precautions are taken to keep the air space clean (such as by beveling the mortar bed away from the cavity or by placing a board in the cavity to catch and remove mortar droppings and fins while they are still plastic). Otherwise, a 2 in. (51 mm) air space is preferred. As an alternative, proprietary insulating drainage products can be used.

Although veneer crack control measures are similar to those for other concrete masonry wall constructions, specific crack control recommendations have been developed for concrete masonry veneers. These include: locating control joints to achieve a maximum panel length to height ratio of $1^{1}/_{2}$ and a maximum spacing of 20 ft (6,100 mm), as well as where stress concentrations occur; incorporating joint reinforcement at 16 in. (406 mm) on center; and using Type N mortar for maximum flexibility. See *Crack Control for Concrete Brick and Other Concrete Masonry Veneers* for more detailed information (ref. 3).

Because the two wythes in a veneer wall are designed to be relatively independent, crack control measures should be employed as required for each wythe. It is generally not necessary for the vertical movement joints in the veneer wythe to exactly align with those in the backup wythe, provided that the ties allow differential in-plane lateral movement.

Wall ties may be joint reinforcement or wire wall ties.

Wall ties for veneers transfer lateral loads to the structural wythe and also allow differential in-plane movement between wythes. This second feature is particularly important when the two wythes are of materials with different thermal and moisture expansion characteristics (such as concrete masonry and clay brick), or in an insulated cavity wall which tends to have differential thermal movement between the wythes. When horizontal joint reinforcement is used to tie the two wythes together, hot-dipped ladder type reinforcement is preferred over truss type, because the ladder shape accommodates differential in-plane movement and facilitates placing vertical reinforcement, grout and loose fill insulation. Because veneers rely on the backup for support, wall ties must be placed within 12 in. (305 mm) of control joints and wall openings to ensure the free ends of the veneer are adequately supported. More information on ties for veneers can be found in TEK 3-6B, *Concrete Masonry Veneers* (ref. 4).

The distance between the inside face of the veneer and the outside face of the masonry backup must be a minimum of 1 in. (25 mm) and a maximum of 4 1/2 in. (114 mm). For glazed masonry veneer, because of their impermeable nature, a 2 in. (51 mm) wide airspace is recommended with air vents at the top and bottom of the wall to enhance drainage and help equalize air pressure between the cavity and the exterior of the wall. Vents can also be installed at the top of other masonry veneer walls to provide natural convective air flow within the cavity to facilitate drying. For vented cavities, it is prudent to create baffles in the cavity at the building corners to isolate the cavities from each other. This helps prevent suction being formed in the leeward cavities.
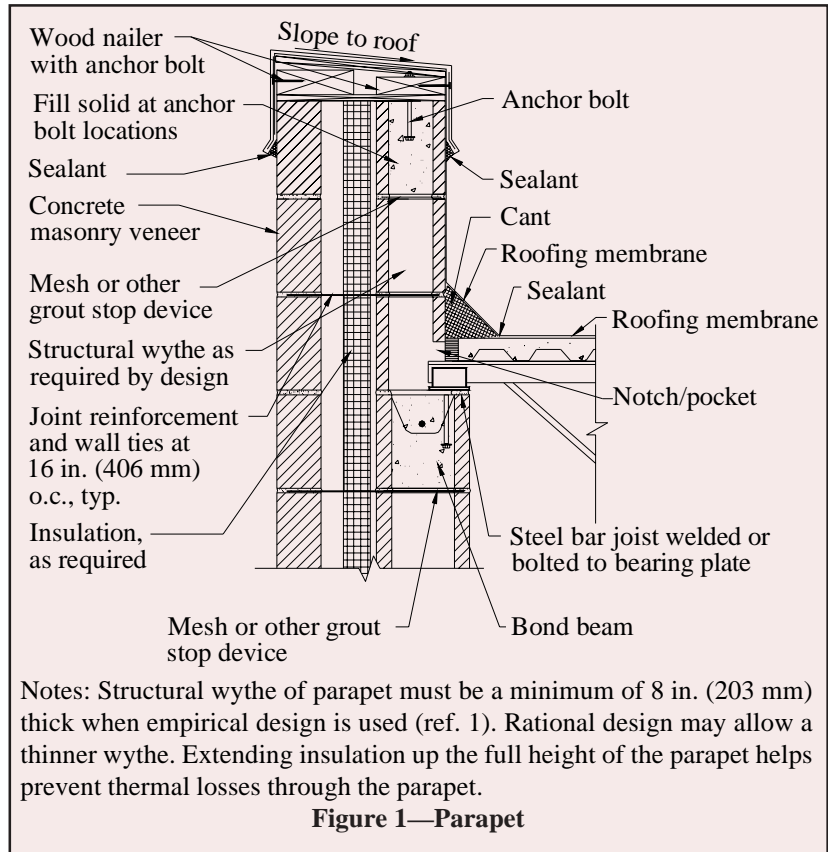

Notes: Structural wythe of parapet must be a minimum of 8 in. (203 mm) thick when empirical design is used (ref. 1). Rational design may allow a thinner wythe. Extending insulation up the full height of the parapet helps prevent thermal losses through the parapet.

Figure 1—Parapet

Note: Local codes may restrict the use of foam plastic insulation below grade in areas where the hazard of termite damage is very heavy.

Figure 2—Foundation

Airspace, 1 in. (25 mm), min.

Insulation, as required

Flashing

Concrete masonry veneer

1 in. (25 mm) weeps at 32 in. (813 mm) o.c., partially open "L" shaped head joint

Drip edge

Sealant

Backer material

Lateral support

Window frame

Insulated glass

Vapor retarder, per local practice

Horizontal joint reinforcement at 16 in. (406 mm) o.c., typ.

Concrete masonry backup

Concrete masonry lintel

Finish varies

Ceiling support

Cavity filter or other mortar collection device

Finish varies

Sealant and backer material

(a) Head

Window frame

Min. slope 15°

Concrete masonry sill unit or precast concrete sill

Weeps 24 in. (610 mm) o.c.

Drip edge

1 ½ in. (38 mm) min.

Concrete masonry veneer

Airspace, 1 in. (25 mm), min.

Vapor retarder, per local practice

Insulation, as required

Sealant

Upside down lintel unit or solid unit

Flashing

Concrete masonry backup

Horizontal joint reinforcement at 16 in. (406 mm) o.c., typ.

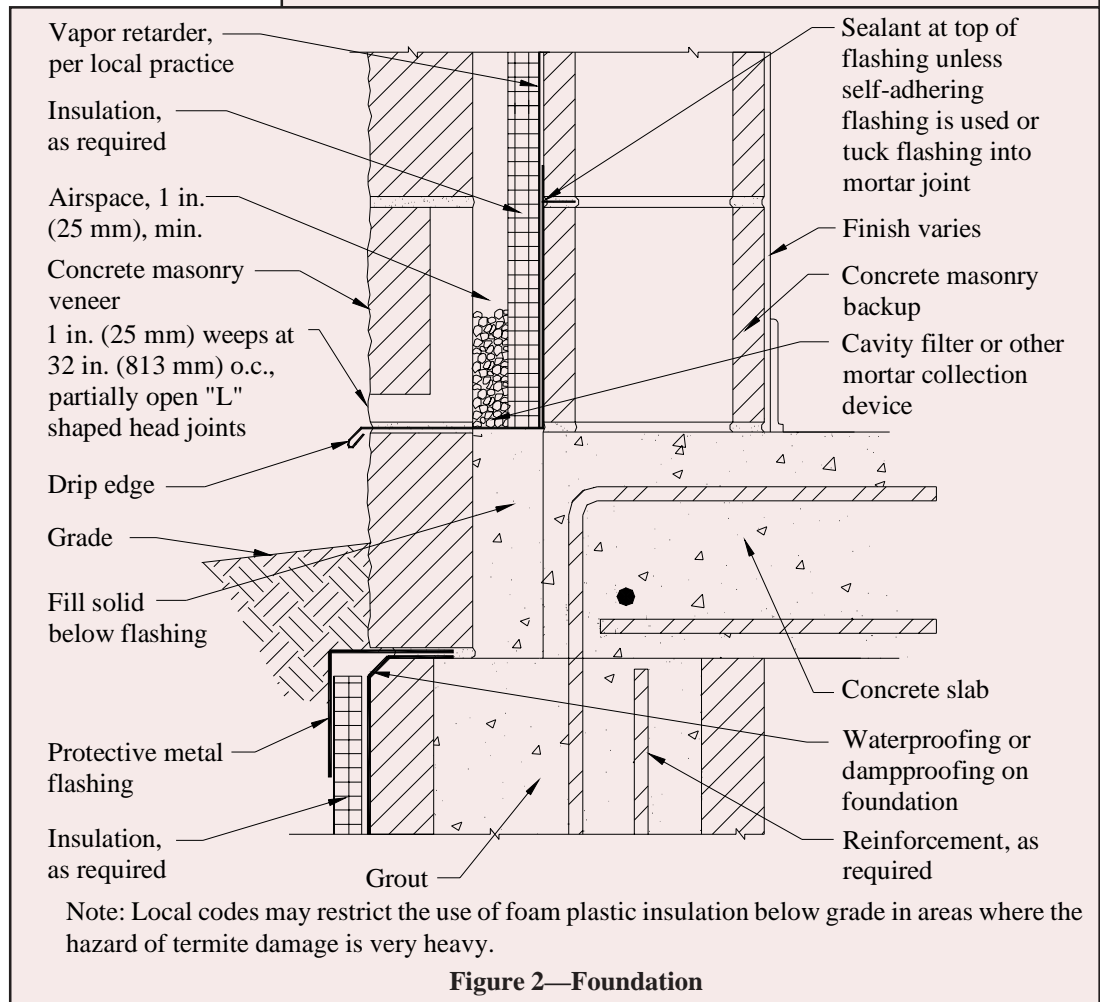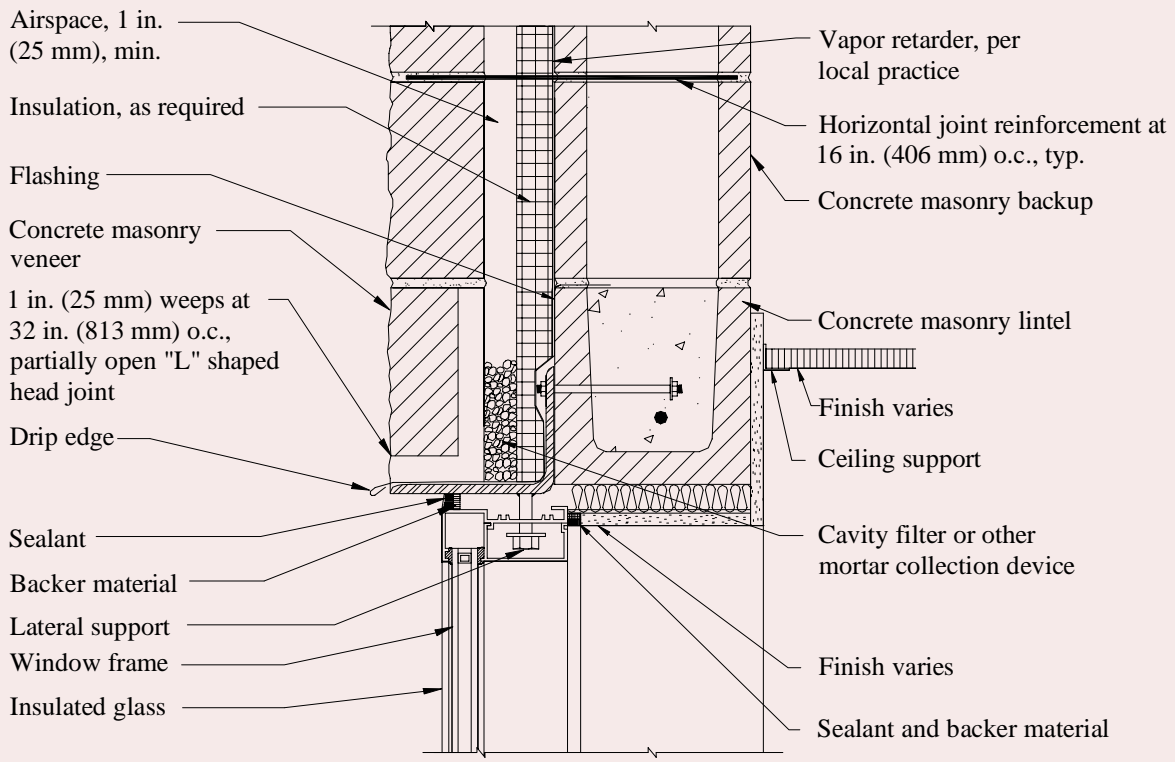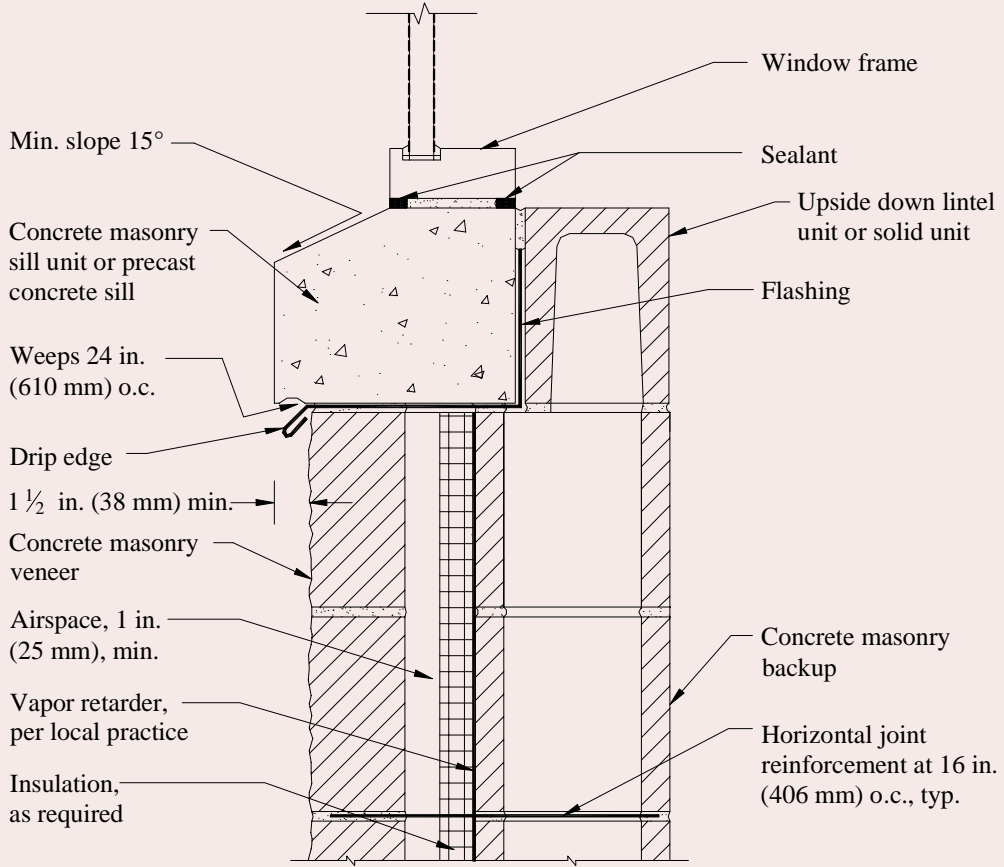**(b) Sill**

Figure 3—Window Opening

Notes: In the backup wythe, the cell adjacent to the door should be filled solid. This is typically accomplished by slushing mortar into the cell as the wall is erected. A form board, or similar, is used at the edge of the cavity to confine the mortar or grout fill to the hollow metal jamb. For larger cavities where part of the cavity will not be covered by the door jamb, masonry units may be cut and mortared into place to provide a solid backing for the door jamb.
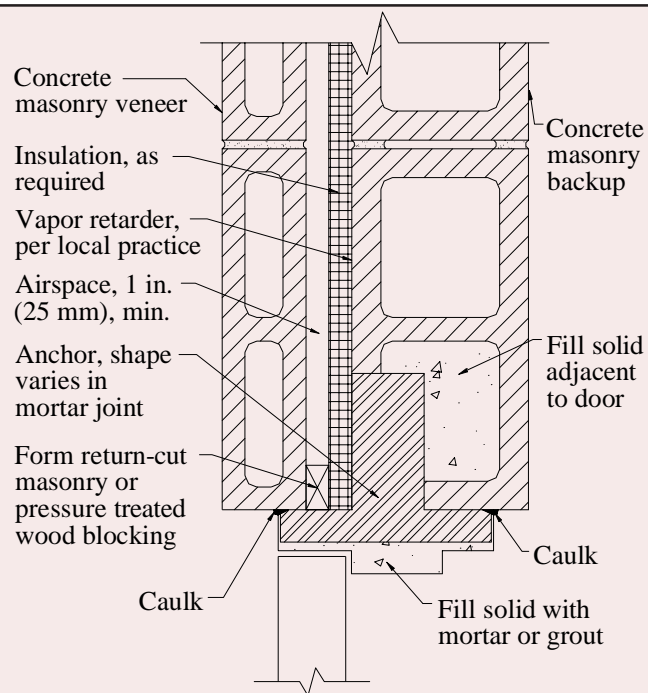
Concrete masonry veneer

Insulation, as required

Vapor retarder, per local practice

Airspace, 1 in. (25 mm), min.

Anchor, shape varies in mortar joint

Form return-cut masonry or pressure treated wood blocking

Caulk

Concrete masonry backup

Fill solid adjacent to door

Caulk

Fill solid with mortar or grout

Figure 4—Metal Door Jamb

REFERENCES
1. *Building Code Requirements for Masonry Structures*, ACI 530-02/ASCE 5-02/TMS 402-02. Reported by the Masonry Standards Joint Committee, 2002.
2. *Annotated Design and Construction Details for Concrete Masonry*, TR 90B. National Concrete Masonry Association, 2003.
3. *Crack Control for Concrete Brick and Other Concrete Masonry Veneers*, TEK 10-4. National Concrete Masonry Association, 2001.
4. *Concrete Masonry Veneers*, TEK 3-6B. National Concrete Masonry Association, 2003.