CHAPTER 1:

CMU WALL WITH ANCHORED MASONRY VENEER

Masonry system 1 is a rainscreen wall system with concrete masonry unit (CMU) or concrete wall structure and anchored masonry veneer. The components of this system, from interior to exterior, are described in Fig. 1-1. This system is appropriate for many applications including low-, mid-, or high-rise residential or commercial structures. An example project application of this system is shown in Fig. 1-2 on page 1-2. This system with a concrete backup wall alternative is also depicted in Fig. 1-3 on page 1-2 and contains similar typical components to that described in Fig. 1-1.

Building Enclosure Control Layers

As noted in the Introduction, an above-grade wall system controls liquid water, air, heat, and possibly water vapor to function as an effective and durable environmental separator. Control of these elements, specific to this wall system, is provided by the following control layer systems and/or materials:

- The water control layer, comprising the water-resistive barrier (WRB) system
- The air control layer, comprising the air barrier system

INTERIOR

- Single-wythe CMU (or concrete) wall
- Air and water-resistive barrier membrane
- Exterior insulation
- Air cavity
- Anchored masonry veneer with
- Clear water repellent

EXTERIOR

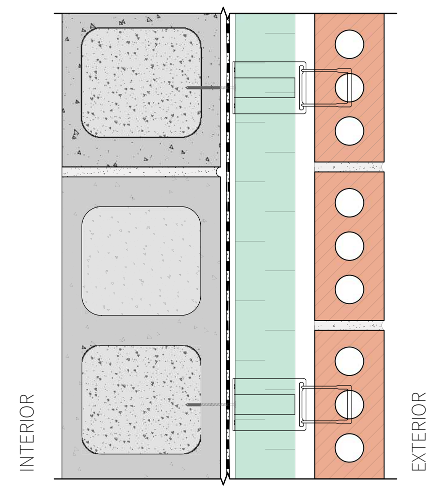


Fig. 1-1 Typical System 1 components from interior to exterior

Fig. 1-2 CMU wall with anchored masonry veneer example project application

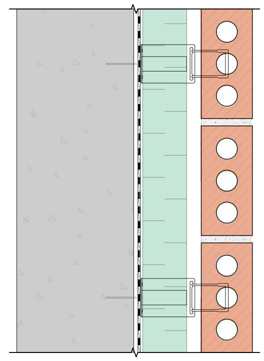


Fig. 1-3 System 1 with concrete backup wall alternative

- Thermal control layer, comprising thermal insulation and other low-conductivity materials
- Vapor control layer, comprising vapor retarding materials

For a summary of the relationship between building enclosure loads, control layers, and associated systems and materials, refer to Fig. i-13 on page i-21 of the introductory chapter.

Fig. 1-4 and the typical system details provided adjacent to each detail at the end of this chapter illustrate the water-shedding surface and control layer locations for this system.

As shown in Fig. 1-4, the water-shedding surface occurs at the anchored masonry veneer, with most water-shedding occurring at the wall face while some water will be stored within the masonry veneer to be released at a later time. The water control layer, the air control layer, and the vapor control layer occur at the same location at the exterior face of the CMU wall structure. The thermal control is mostly provided by the exterior insulation.

Water-Shedding Surface

The water-shedding surface reduces the water load on the enclosure layers. A general discussion of the water-shedding surface is provided in the Water-Shedding Surface discussion on page i-19.

The anchored masonry veneer cladding, including both mortar joints and masonry veneer units, is the primary water-shedding surface of the wall system. Additional water-shedding surface components include sheet-metal flashings and drip edges, sealant joints, and fenestration systems as shown in the details at the end of this chapter.

To promote water-shedding at the masonry veneer face, mortar joints should be installed with a tooled concave (preferred) or V shape.

The water-shedding surface is most effective when free of gaps except where providing drainage and/or ventilation. Movement joints and joints around fenestrations and penetrations are recommended to be continuously sealed with backer rod and sealant or counterflashed with a sheet-metal flashing to deflect wind-driven rain and shed water away from the rainscreen cavity.

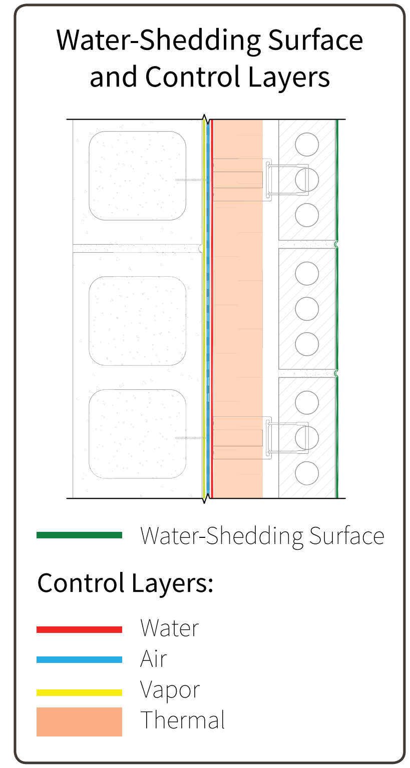


Fig. 1-4 System 1 (CMU wall structure) water-shedding surface and control layer locations

Water Control Layer

The water control layer is a continuous control layer that is designed and installed to act as the innermost boundary against water intrusion. In a rainscreen wall system, the WRB system is the last line of defense against water intrusion. A general discussion of the WRB system is provided in the Water Control Layer discussion on page i-24.

In this wall system, the WRB system is typically a self-adhered sheet or fluid-applied system that also functions as the air barrier system; thus the WRB system is often referred to as the air barrier and WRB system. Either a self-adhered sheet or fluid-applied system is depicted in the details at the end of this chapter. An example of a fluid-applied air barrier and WRB system over a concrete backup wall is shown in Fig. 1-5 on page 1-4. This membrane may have Class I, Class II, Class III, or Class IV vapor permeance properties because it is located interior of the system's thermal insulation. Physical properties of the WRB system products are discussed in detail in the Water Control Layer discussion on page i-24. Vapor permeability of materials is addressed in the Vapor Control Layer discussion on page i-28.

Fig. 1-5 Fluid-applied air barrier and WRB system field membrane over a concrete backup wall. Double eye and pintle masonry veneer ties penetrate through the exterior semi-rigid mineral fiber insulation.

The WRB system must be continuous across the wall system to provide effective water control. In addition to the field membrane, the WRB system includes fluid-applied or self-adhered flashing membranes, sealants, sheet-metal flashings, and penetrations such as windows and doors as shown in the detail drawings that follow this chapter discussion. Where sheet-metal flashing components occur within the system, the back leg of the sheet-metal flashing is shingle-lapped into the WRB system to facilitate drainage at the face of the WRB system and to the exterior of the cladding.

Masonry veneer ties in this system will penetrate the WRB system and should be sealed as required by the WRB system manufacturer's installation requirements. Typically, plate ties are bed in a compatible sealant or fluid-applied flashing product or are attached through a self-adhered membrane patch, whereas screw ties with gasketing washers are typically not required to be sealed.

Where a ladder eye-wire masonry veneer attachment method is used, a fluid-applied WRB system is recommended; each wire penetration through the membrane should be sealed with a sealant, fluid-applied flashing material, or liberal application of fluid-applied field membrane as recommended by the membrane manufacturer.

Air Control Layer

The air barrier system serves as the air control layer. By controlling air, this layer also assists with controlling liquid water, heat, and water vapor.

A mechanically attached air barrier and WRB membrane may be used for this wall system where recommended by the manufacturer for installation over a CMU or concrete wall substrate.

For this wall system, the air barrier system is the same field membrane and many of the components that serve as the WRB system. A general discussion of the air control layer and the air barrier system is provided in the Air Control Layer discussion on page i-26.

As discussed in the Introduction, the air barrier system must be continuous and fully sealed to resist air flow, whereas the WRB system is not required to be continuously sealed to be effective, but merely shingle-lapped.

Vapor Control Layer

The vapor control layer retards or greatly reduces (e.g., vapor barrier) the flow of water vapor due to vapor pressure differences across enclosure assemblies. Unlike the other control layers presented in this guide, the vapor control layer is not always necessary or required to be continuous.

For this system, a vapor control layer is not necessary; the risk of condensation development or damage to the structure due to outward vapor drive and condensation is unlikely due to all of the system's thermal insulation being located exterior of the wall structure and the air barrier and WRB system.

Note that Fig. 1-4 identifies the vapor control layer at the exterior face of the CMU wall. This represents the exterior-most plane of the CMU wall structure, which has some vapor resistance. It would also represent the location of a vapor control layer if relatively low vapor permeance (Class I or II) air barrier and WRB systems were used.

Thermal Control Layer

The thermal control layer controls heat flow and assists with controlling water vapor.

In this wall system, the exterior insulation is the primary material that forms the thermal control layer. At transition details, the thermal control layer includes the exterior insulation across bond beams; peripheral floor lines; and insulation at the roof assembly, slab, and foundation elements. Windows and doors that penetrate this system are also part of the thermal control layer.

The location of the insulation in this wall system, exterior of the wall structure:

1. Allows for the exterior insulation to extend across floor lines (which are typically required to meet similar energy code compliance requirements as this wall system).

2. Keeps the structure warm, which reduces the risk that condensation may develop inboard of the WRB system.
3. Protects the air barrier and WRB systems from extreme temperature cycles and damage during veneer installation.

The CMU (or concrete) in this system is also a thermal mass, thus it may provide some thermal mass benefit.

Additional thermal control layer information is provided in the Thermal Control Layer discussion on page i-30 of the Introduction.

Insulation Selection

In the Northwest region, the exterior insulation for this system is typically semi-rigid mineral fiber board insulation; moisture-tolerant rigid board insulation (e.g., polyisocyanurate or XPS as shown in Fig. 1-6) may also be used. Refer to the Insulation Products discussion on page i-30 for a discussion on various insulation types and additional considerations.

Fig. 1-6 XPS rigid board exterior insulation behind an anchored masonry veneer

Although masonry is defined as a noncombustible cladding material, the use of a combustible air barrier and WRB system or foam plastic insulation within a wall cavity can trigger fire propagation considerations and requirements. Depending on the local jurisdiction, IBC Section 1403.5[1] (regarding vertical and lateral flame propagation as it relates to a combustible WRB system) may require acceptance criteria for NFPA 285.[2] The use of foam plastic insulation within a wall cavity should also be addressed for IBC Chapter 26 provisions.

Thermal Performance and Energy Code Compliance

This wall system is typically classified as a mass above-grade opaque wall system for energy code compliance purposes. Prescriptive energy code compliance values for this wall system are summarized in Table 1-2 on page 1-13 and describe:

- Minimum insulation R-values for a *prescriptive insulation R-value method* strategy.
- Maximum system U-factors for a *prescriptive assembly U-factor method* strategy. Note that the equivalent effective R-value of this U-factor has been calculated and is denoted in parenthesis ( ) for easy comparison to thermal modeling results included within this chapter.
- Footnote (2) for compliance by *exception*. The ability to use this option depends on the jurisdiction, building's use, and availability of CMU cores to be filled with insulation. If this exception is to be used, refer to the Chapter 4 Thermal Performance and Energy Code Compliance discussion on page 4-5.

For all energy code compliance strategies except the *prescriptive insulation R-value method strategy*, the system's thermal performance will need to be determined as a U-factor through either calculation or from tables; however, it may or may not be required to be less than the prescriptive U-factors shown in Table 1-2.

Project-specific thermal performance values for an opaque above-grade wall should be used for energy code compliance and determined from a source that is approved by the authority having jurisdiction. Thermal performance sources may include ASHRAE 90.1,[3] COMcheck,[4] the appendices of the 2015 WSEC,[5] thermal modeling and calculation exercises, or other industry resources.

The Thermal Performance and Energy Code Compliance discussion on page i-33 and Fig. i-26 on page i-39 of the introductory chapter describes the typical process of navigating energy code compliance options. Additionally, the thermal modeling results demonstrated in this chapter may be used to assist with selecting wall system components (e.g., tie type, insulation R-value/inch, etc.) to achieve a target U-factor. Options for thermally optimizing this wall system, as determined through the modeling results, are also discussed.

System Effective Thermal Performance

Masonry ties and floor line shelf angles penetrate the exterior insulation in this system and create areas of thermal bridging; thermal bridging reduces the system's actual thermal performance.

Examples of typical anchored masonry veneer ties and a standoff shelf angle support are shown in Fig. 1-7 and Fig. 1-8 on page 1-8; examples of the relative thermal bridging that these components can have when penetrating exterior insulation are described by Fig. 1-9 through Fig. 1-14 on page 1-9.

Where shown in Fig. 1-10, Fig. 1-12, and Fig. 1-14, the lighter blue thermal gradient color at the attachment locations describes a warmer temperature than the

Fig. 1-7 Masonry tie types used for modeling—from left to right: ladder eye-wire tie, thermally optimized screw tie, double-eye and pintle plate tie

adjacent darker blue insulation face—an indicator of heat loss at the penetration through the insulation. This thermal bridging reduces the system's effective thermal performance.

Three-dimensional thermal modeling demonstrates this system's effective thermal performance with various insulation thicknesses, insulation R-values, masonry veneer ties, and standoff shelf angle options. A discussion on the modeling performed for this guide is included in the Appendix.

Thermal Modeling: Variables

The following are modeling variables specific to this wall system:

- **Wall Structure** – An 8-inch medium-weight block. Modeling results are not presented for a concrete backup wall structure; however, similar results would be expected for this alternative backup wall type because the overall performance is driven by the insulation and thermal bridging. Modeling results consider a concrete slab bypass condition with and without a shelf angle.

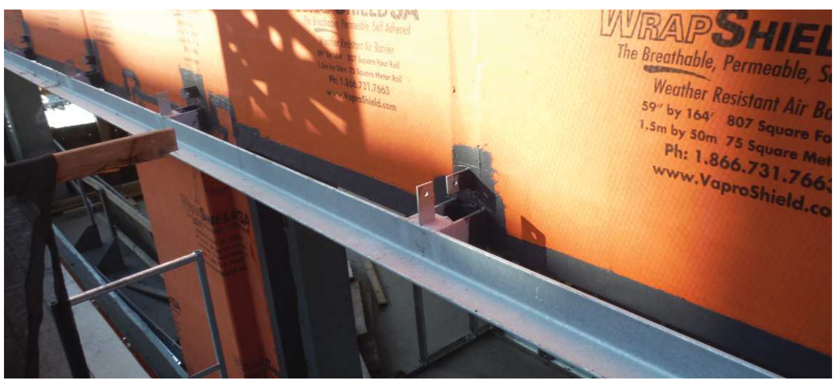


Fig. 1-8 Hot-dipped galvanized standoff shelf angle

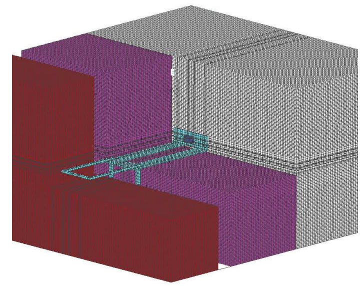
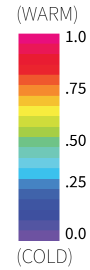


Fig. 1-9 Three-dimensional model of a galvanized-steel masonry tie through exterior insulation



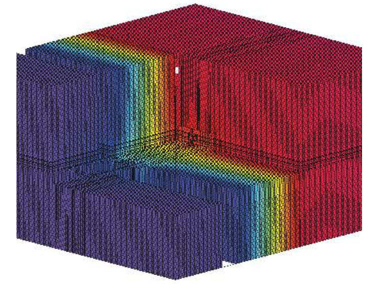


Fig. 1-10 Three-dimensional thermal image of the galvanized-steel masonry tie through exterior insulation shown in Fig. 1-9

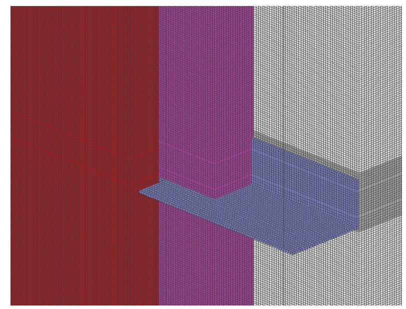


Fig. 1-11 Three-dimensional model of a continuous floor line shelf angle bridging exterior insulation

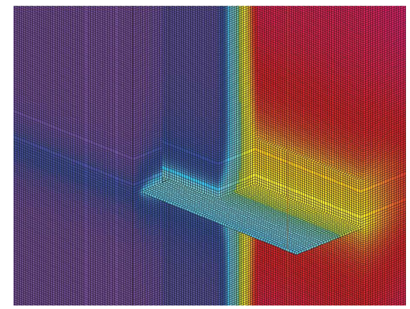


Fig. 1-12 Three-dimensional thermal image of the continuous floor line shelf angle shown in Fig. 1-11

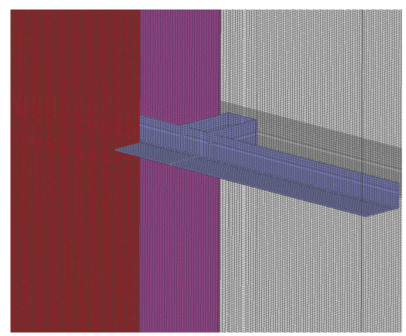


Fig. 1-13 Three-dimensional model of a floor line standoff shelf angle bridging exterior insulation

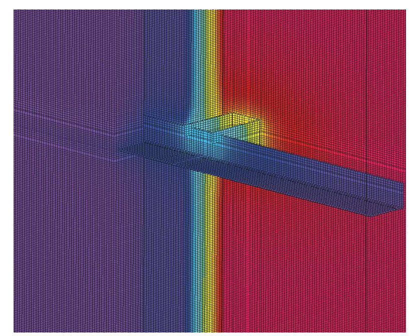


Fig. 1-14 Three-dimensional thermal image of floor line standoff shelf angle shown in Fig. 1-13

- **Masonry Ties** – Tie types are considered at 16-inch–by–16-inch spacing. Tie types are shown in Fig. 1-7 and include:
  - Ladder eye-wire tie (3⁄16-inch diameter) with cross-rods at 16-inches on-center made of hot-dipped galvanized steel or Type 304 stainless steel. Hooks are either hot-dipped galvanized steel or Type 304 stainless steel to match the ladder wire.
  - Thermally optimized screw tie with stainless steel barrel and carbon steel fastener. Hooks are either hot-dipped galvanized steel or Type 304 stainless steel.
  - Double eye and pintle plate tie (14-gauge). Hooks are either hot-dipped galvanized steel or Type 304 stainless steel to match the tie plate.
- **Exterior Insulation** – R-4.2/inch or R-6/inch insulation product. Insulation thicknesses of 3-, 4-, and 5-inches are considered. The R-values selected demonstrate the lower and upper thermal resistance of typical exterior insulation products.
- **Shelf Angle Supports** – Hot-dipped galvanized steel shelf angles. Either attached tight to the floor line structure (i.e., continuous shelf angle) as shown similar in Fig. 1-11 and Fig. 1-12 or offset to the depth of the exterior insulation and supported by intermittent hollow steel sections (HSS) at 4 feet on-center (i.e., standoff shelf angle) as shown similar in Fig. 1-13 and Fig. 1-14.

Thermal Modeling: Results

Modeling results are shown in Table 1-1, Fig. 1-15, and Fig. 1-16 on page 1-12 and page 1-13 and demonstrate the system's effective R-value under various conditions. Fig. 1-15, and Fig. 1-16 graphically represent the results summarized in Table 1-1.

Below is a discussion of the results. Where reductions in the system's effective R-value are discussed, these values are as compared to the system's effective R-value "Without Penetrations" such as ties and shelf angles.

- As determined from Table 1-1 for ties only, masonry ties of any cross-sectional area reduce the system's effective R-value by 7 to 38%. Galvanized steel masonry plate ties provide the greatest reduction in the system's effective R-value at 23 and 38%. *The most thermally efficient option modeled is the stainless-steel ladder wire tie, followed by the thermally improved screw tie and the stainless-steel plate tie.* Note that a 16-inch–by–16-inch on-center spacing is modeled for this guide; *greater spacing of non-ladder eye wire ties can increase the system's effective R-value; however, spacing needs to be coordinated with structural requirements.*
- Table 1-1 and Fig. 1-16 demonstrate that the system's effective R-value with ties only is similar for both thermally optimized screw tie and stainless-steel plate tie options. *Performance targets can be met without proprietary cladding attachment systems. Stainless-steel tie options provide a highly corrosion-resistant attachment and may prove to be cost-effective.*
- As determined from Table 1-1 with ties only, an R-19 wall target could be provided by one of the scenarios listed below when using R-6/inch exterior insulation. *As a result, the tie used can effect the wall thickness without compromising the system's effective R-value.*
  - 3-inches of insulation with a stainless-steel ladder wire
  - 4-inches with a stainless-steel plate tie or thermally optimized screw tie
  - 5-inches with a galvanized-steel plate tie
- A continuous shelf angle support reduces the system's effective R-value significantly, as shown in Fig. 1-15. When considered with galvanized-steel plate ties, a continuous shelf angle support reduces the systems' effective R-value by 47 to 65%. When a standoff angle support is considered, a lesser reduction of 31 to 48% is achieved. *As shown in Fig. 1-15, a standoff shelf angle support performs better thermally than a continuous shelf angle support.*

Drainage, Ventilation, and Water Deflection

The anchored masonry veneer is expected to shed most water it is exposed to; however, some moisture is expected to penetrate the cladding and enter the air cavity. This moisture is drained through the air cavity and exits the cladding system where cross-cavity flashings are provided.

Drainage and Ventilation

In this system, the air cavity between the anchored masonry veneer and the exterior insulation provides drainage behind the cladding as well as ventilation when vent ports are provided at the top and bottom of the air cavity. The code-minimum air cavity depth is 1-inch as required per TMS 402-16;[6] however, the risk that mortar droppings will block the air cavity increases with smaller cavities. A 1-inch cavity may be considered where a strict quality control program is

Table 1-1 System 1 thermal modeling results

8" CMU Wall with Anchored Masonry Veneer, R-4.2/in - R-6/in Exterior Insulation							
				3D Thermal Modeling Effective R-Value of System (ft²·°F·hr/Btu)			
Tie Type	Tie Penetration Area	Exterior Insulation Thickness	Nominal Exterior Insulation R-Value	Without Penetrations (Through Exterior Insulation)	With Masonry Tie Penetrations @ 16" x 16" O.C.		
					Ties Only	Ties + Standoff Shelf Angle	Ties + Continuous Shelf Angle
Embedded Wire Tie (e.g., ladder style) – Stainless Steel	0.02%	3"	12.6–18	15.9–21.3	14.9–19.3	13.1–16.2	9.5–10.9
		4"	16.8–24	20.2–27.5	18.7–24.6	16.0–19.9	11.0–12.5
		5"	21–30	24.4–33.4	22.4–29.7	18.8–23.4	12.3–13.9
Embedded Wire Tie (e.g., ladder style) – Galvanized Steel	0.02%	3"	12.6–18	15.9–21.3	13.2–16.4	11.8–14.1	8.8–9.9
		4"	16.8–24	20.2–27.5	16.3–20.4	14.2–17.1	10.1–11.3
		5"	21–30	24.4–33.4	19.3–24.2	16.5–19.8	11.3–12.6
Thermally Optimized Screw Tie – Stainless-Steel Hook	0.05%	3"	12.6–18	15.9–21.3	14.1–17.9	12.4–15.2	9.2–10.4
		4"	16.8–24	20.2–27.5	17.4–22.2	15.1–18.4	10.5–11.9
		5"	21–30	24.4–33.4	20.6–26.3	17.4–21.2	11.7–13.1
Thermally Optimized Screw Tie – Galvanized-Steel Hook	0.05%	3"	12.6–18	15.9–21.3	14.0–17.8	12.4–15.1	9.2–10.4
		4"	16.8–24	20.2–27.5	17.4–22.1	15.0–18.3	10.5–11.9
		5"	21–30	24.4–33.4	20.5–26.2	17.4–21.2	11.7–13.1
Plate Tie (14 ga) – Stainless Steel	0.05%	3"	12.6–18	15.9–21.3	14.1–18.0	12.5–15.3	9.2–10.5
		4"	16.8–24	20.2–27.5	17.7–22.8	15.3–18.7	10.7–12.0
		5"	21–30	24.4–33.4	21.1–27.2	17.8–21.8	11.9–13.3
Plate Tie (14 ga) – Galvanized Steel	0.05%	3"	12.6–18	15.9–21.3	12.2–14.8	11.0–12.9	8.4–9.3
		4"	16.8–24	20.2–27.5	14.8–17.9	13.0–15.3	9.5–10.5
		5"	21–30	24.4–33.4	17.1–20.7	14.9–17.4	10.5–11.6

Table 1-2 System 1 prescriptive energy code compliance values excerpted from Table i-1 of the introductory chapter

OPAQUE ABOVE-GRADE WALL - THERMAL ENVELOPE REQUIREMENTS											
		Energy Code	2012 SEC		2012 WSEC		2014 OEESC		2012 IECC			
		Climate Zone	5 and Marine 4		5, 6 and Marine 4		5 and Marine 4		5 and Marine 4		6	
Guide Assembly #		Classification	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R
1A 1B	CMU (or Concrete) Wall	Mass	Exterior: R-16ci[1] *U-0.057 (R-17.5)*	Exterior: R-16ci[1] *U-0.057 (R-17.5)*	R-9.5ci[2] *U-0.104[2] (R-9.6)*	R-13.3ci[2] *U-0.078 (R-12.8)*	R-11.4ci *U-0.150[2] (R-6.7)*	R-13.3ci *U-0.090[2] (R-11.1)*	R-11.4ci *U-0.078 (R-12.8)*	R-13.3ci *U-0.078 (R-12.8)*	R-13.3ci *U-0.078 (R-12.8)*	R-15.2ci *U-0.071 (R-14.1)*

[1] When using interior insulation: R-13 + R-6 ci for wood studs or R-13 + R-10 ci for metal stud; when using exterior insulation: R-16 ci

[2] Exception: integrally insulated concrete block complying with ASTM C90 with all cores filled, with at least 50% of block cores are filled with vermiculite (or equivalent fill insulation), and enclosing one of the following uses: gymnasium, auditorium, church chapel, arena, kennel, manufacturing plant, indoor swimming pool, pump station, water and wastewater treatment facility, storage facility, warehouse (storage and retail), motor vehicle service facility, mechanical/electrical structures (OEESC only), and restroom/concessions (OEESC only). Under the WSEC, where additional uses not listed (such as office, retail, etc.) are contained within the building, the exterior walls that enclose these areas may not utilize this exception.

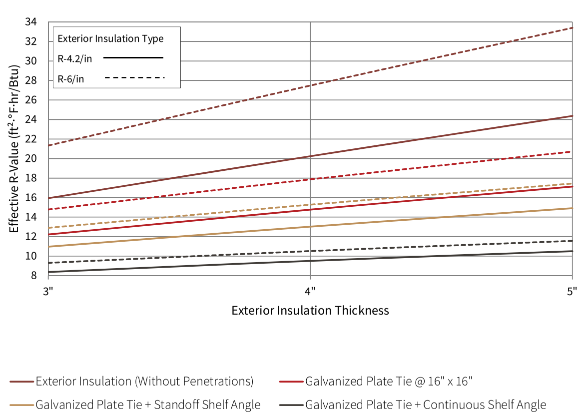


Fig. 1-15 System 1 effective R-value comparison of galvanized steel plate tie and shelf angle options

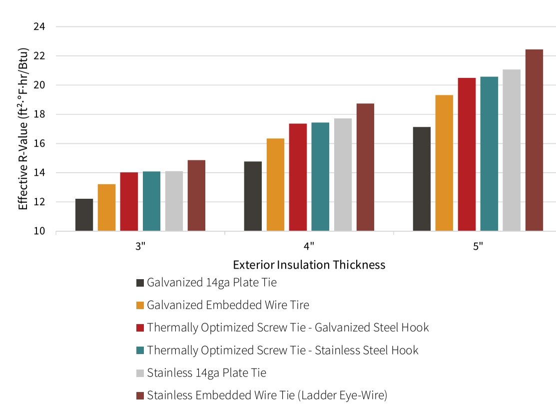


Fig. 1-16 System 1 effective R-values for R-4.2/inch insulation, various tie types, and without shelf angles

implemented to minimize the likelihood that mortar droppings block the cavity; however, a 2-inch air cavity is best practice. Fig. 1-17 on page 1-14 demonstrates a typical air cavity for this system.

Fig. 1-17 Typical rainscreen cavity at CMU wall with anchored masonry veneer

Where the air cavity is reduced, which commonly occurs at fenestration rough openings with return brick, a compressible free-draining filler is recommended such as semi-rigid mineral fiber insulation. Mortar should not be packed within these cavities.

The air cavity is ventilated through vents located at the top and bottom coursing of each wall section. Top vents typically occur just below the parapet blocking and below intermittent bearing elements such as floor line shelf angles. Bottom vents, which also serve as **weeps** and may be referred to as weep/vents, also assist with draining moisture within the air cavity. These weep/vents are typically located just above bearing elements such as loose-lintels, floor line shelf-angles, or foundation walls.

Vents and weep/vents are recommended to be spaced a maximum of 24-inches on-center (i.e., every two to three masonry units) and filled with a cellular or mesh product that fills the head joint of a standard brick unit. It is important that weep fillers extend into the bed joint of the course to facilitate drainage. Weep tubes are avoided as they provide far less ventilation and are blocked easily with debris.

Mortar collection nets are recommended at all veneer-bearing locations to prevent mortar from blocking the rainscreen cavity and weep/vents. Generally, a trapezoidal open-weave, moisture-tolerant net is used.

Sheet-Metal Components

Sheet-metal components used with this system are reflected throughout the details at the end of this chapter. Cross-cavity sheet-metal components are typically located at all bearing elements such as the head of a penetration (e.g., window head), the floor line shelf-angles, and the foundation. These flashings assist with draining the rainscreen cavity and also serve to protect fluid-applied or self-adhered flashing membranes that may exist beneath them. Counterflashing sheet-metal components assist with water shedding and are typically located at windowsill and parapet top conditions; they protect the cavity from water ingress while allowing ventilation of the air cavity.

Refer to the Sheet-Metal Flashing Components discussion on page i-46 for general recommendations on sheet-metal flashing products, including design considerations and materials.

Movement Joints

For this system, anchored clay masonry will expand over time as a result of irreversible moisture gain, and mortar joints will shrink slightly overtime. In the CMU wall structure, shrinkage will occur over time due to initial drying and carbonation. To minimize the risk of damage to the veneer or other wall components, differential movement between the wall structure and veneer must be considered. Expansion joints must also be provided to allow for overall expansion of the clay masonry veneer; control joints must be provided for shrinkage where concrete masonry veneer units are used.

Differential vertical movement between the structure and the veneer is accommodated with a horizontal gap between the veneer and elements that are directly attached to the wall structure, such as shelf angle supports, parapet blocking, and windows. Either a backer rod and sealant joint or cross-cavity sheet-metal flashing is placed at each horizontal gap. The sizing and location of joints will vary depending on the expected differential movement between the wall and veneer.

Expansion/shrinkage of the veneer or differential movement between the veneer, penetrations, and different cladding materials is accommodated with vertical joints in the veneer system as shown similar in Fig. 1-18 on page 1-16. Vertical gaps minimize stresses between

Expansion joints (clay masonry veneer) or control joints (concrete masonry veneer) minimize stresses within the veneer, between dissimilar materials such as at window jamb to veneer interfaces.

the veneer and other components to provide crack control for the masonry veneer. Vertical gaps are typically sealed with a backer rod and sealant.

Typical locations of joints for the purposes of accommodating movement, drainage, and/or rainscreen cavity ventilation are identified with an asterisk (*) in chapter details. In general, a minimum gap dimension of ⅜-inch is recommended; however, it is the Designer of Record's responsibility to appropriately locate and size all movement joints.

Refer to the Movement Joints discussion on page i-48 for more information on locating veneer joints and sealant joint best practices.

Fig. 1-18 Typical vertical brick expansion joint aligned with window jambs. Each joint continues the full height of the building and is awaiting backer rod and sealant joint installation.

Structural Considerations

The CMU block (or concrete) wall of this system provides the primary structure of this system. It is the responsibility of the Designer of Record to ensure that all structural elements of the backup wall and veneer are designed to meet project-specific loads and local governing building codes. Generic placement of the grout, reinforced elements, and supports/ties are demonstrated within the details of this chapter and are provided for diagrammatic purposes only.

Masonry Ties

Masonry ties (i.e., masonry anchors) are used to connect the veneer to the masonry (or concrete) wall structure. They are designed to resist the out-of-plane loads applied to the wall, typically wind and seismic loads. At the same time, ties must be flexible to allow the veneer to move in-plane relative to the backing wall.

Building codes provide prescriptive requirements for masonry ties secured to concrete or masonry that include spacing, size, placement, and tie type. These requirements are summarized in Table 1-3 and are based on TMS 402-16[6] provisions for adjustable ties (i.e., anchors). The use of these prescriptive requirements are limited to masonry veneer assemblies with a weight less than 40 psf, with a cavity depth no more than 6⅝-inches, and where the ASCE-7[7] wind velocity pressure (qz) is less than 55 psf (previously wind speed less than 130 mph). Wall assemblies that exceed these criteria require the design professional to evaluate the building loads and materials and rationally design the anchorage system accordingly. The majority of masonry tie manufacturers have empirical testing data available to support the use of their anchorage systems when the cavity depth or loads exceed these criteria.

Table 1-3 Prescriptive spacing requirements for anchored masonry veneer ties based on TMS 402-16[2] provisions

Prescriptive Spacing for Adjustable Two-Piece Masonry Veneer Ties			
Spacing Designation	**Requirement Category** (use more stringent spacing requirement where applies)		
	General	Seismic Design Categories D, E, and F[1]	High Wind[2]
Maximum Wall Area per Anchor	**2.67 ft^2**	**2.00 ft^2** (75% of General Requirement Max.)	**1.87 ft^2** (70% of General Requirement Max.)
Maximum Horizontal Spacing	**32 inches**	**32 inches**	**18 inches**
Maximum Vertical Spacing	**25 inches**	**25 inches**	**18 inches**
Maximum Spacing at Opening[3]	**36 inches**	**36 inches**	**24 inches**
Maximum Distance from Openings	**12 inches**	**12 inches**	**12 inches**

[1] Seismic design categories as determined by ASCE 7
[2] High wind includes wind velocity pressures between 40 psf and 55 psf as determined by ASCE 7 and when the building's mean roof height is less than or equal to 60 feet
[3] For openings larger than 16 inches in either dimension

Included in Table 1-3 are TMS 402-16[6] prescriptive spacing requirements for anchored masonry veneers with special requirements for Seismic Design Categories D, E, and F and high wind zones with velocity pressures (qz) between 40 and 55 psf. These higher seismicity and wind speed areas are common to some parts of the Northwest and are dependent on the geography and building occupancy category. Refer to local building code requirements to ensure seismicity and wind speed criteria are properly evaluated for the building occupancy and site conditions.

Common tie types for reference are shown in Fig. 1-19 on page 1-18. For masonry and concrete walls, adjustable ties are required and may include embedded wire or joint reinforcement or surface-mounted connectors with adjustable ties.

Fig. 1-19 Masonry veneer tie types. Top row, left to right: standard double eye and pintle plate tie, thermally optimized double eye and pintle screw tie, ladder eye-wire tie. Bottom row, left to right: corrugated masonry ties, adjustable L-bracket, nonadjustable surface-mounted tie.

- Based on local preference, double eye and pintle type ties (whether a plate or screw type) are commonly used. Double eye and pintle ties are available from a number of manufacturers in a variety of sizes to meet project requirements in the Northwest.
- Embedded joint reinforcement ties (i.e., ladder eye-wire) may also be used with masonry backup walls. The joint reinforcement includes two eye wires that protrude out from the face of the backup wall at a nominal spacing, extending through the exterior insulation. This tie type is common with CMU backup walls but offers less adjustability and additional coordination for successful placement and use.
- Adjustable L-bracket triangular wire ties are acceptable but may not be preferred by installers because the vertical tie orientation can complicate the exterior insulation installation process by requiring vertical insulation boards.
- Corrugated masonry ties and nonadjustable surface-mounted ties are not allowed by TMS 402-16 for this system.

To prevent pull-out or push-through of the tie, TMS 402-16[6] requires ties to be embedded a minimum of 1½-inches into the veneer, with at least ⅝-inch mortar or grout cover at the outside face. The mortar bed thickness is to be at least twice the thickness of the tie. To prevent excess movement between connecting parts of adjustable tie systems, the clearance between components is limited to a maximum 1⁄16-inch. The vertical offset of adjustable pintle-type ties may not exceed 1¼-inches.

Vertical Support

Anchored masonry veneers are supported vertically by the building's foundation or other structural components such as shelf-angle and lintels. An example of both structural-bearing and loose lintel vertical support elements is shown in Fig. 1-20 on page 1-20. Vertical supports are designed to minimize the possibility of cracking and deflection within the veneer; the support design considers the design loads, material type, moisture control, movement provisions, and constructibility.

Per TMS 402-16[6], anchored masonry veneer with concrete and masonry backings should be supported vertically by noncombustible construction. Best practice for concrete- and masonry-backed veneers is to support the lowest portion of the masonry cladding directly on the concrete foundation.

TMS 402-16[6] does not place any height restrictions or requirements for intermediate support of masonry with concrete or masonry backings, with the exception of Seismic Design Categories D, E, and F where the veneer is to be supported at each floor line. However, the design should to provide intermediate support to accommodate movement and prevent cracking of the veneer associated with differential movement of the veneer, ties, building structure, and other building components. Unless dictated by the code, this guide recommends that intermediate supports are provided every 20 feet or every 2 floors, whichever is greater, for structural considerations and to facilitate drainage and ventilation of the rainscreen cavity.

This guide recommends that intermediate supports for masonry are provided with galvanized-steel shelf angles anchored to the structure as needed to limit deflection to less than L/600 as required by TMS 402-16.[6] As noted in the Movement Joints sections in this chapter and the introductory chapter, a joint is recommended beneath the angle and closed off from the rainscreen cavity with elastomeric sealant.

Where masonry is supported at openings within the veneer (e.g., windows and doors), shelf angles for larger openings or loose lintels at smaller openings are typically provided. Galvanized-steel loose lintels are recommended except where architectural design dictates reinforced masonry or precast concrete lintels for appearance. Steel angle lintels span the opening; TMS 402-16[6] requires the lintel bear a minimum of 4-inches onto the adjacent masonry at the **jambs** of the opening.

Refer to the details at the end of this chapter for detailing of typical support elements.

Corrosion Resistance

It is best practice to match the durability and longevity of metal components within this system to that expected of the masonry veneer. Metal components within this system include veneer ties, vertical support ledgers and lintels, sheet-metal flashings, and fasteners. This guide includes discussion for common corrosion-resistant materials; however, it is the Designer of Records' responsibility to select a level of corrosion resistance appropriate for project-specific application/exposure and the expected longevity of the masonry system.

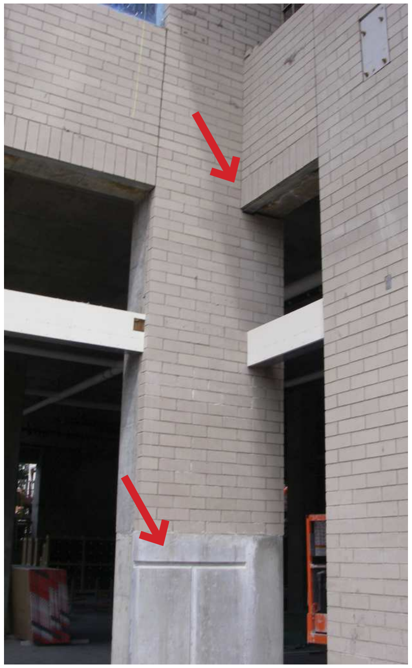


Fig. 1-20 Masonry veneer bears on concrete foundation elements below and loose lintel elements above openings as indicated

It is common to provide hot-dipped galvanized carbon steel masonry veneer ties that comply with ASTM A 153[8] Class B-2 or AISI Type 304 or 316 stainless steel per ASTM A580,[9] such as that shown in Fig. 1-21. At minimum, steel support angles such as shelf angle supports and loose lintels are hot-dipped, galvanized, and comply with ASTM A123.[10]

Best practice is to use sheet-metal flashing components of ASTM A666[11] Type 304 or 316 stainless steel, which is nonstaining and resistant to the alkaline content of mortar materials. Whereas the use of stainless steel sheet-metal flashing components is not always economically feasible or aesthetically desirable, prefinishing sheet-metal may be considered. Where used, this guide recommends the base sheet metal is a minimum G90 hot-dipped, galvanized coating in conformance with ASTM A653[12] or minimum AZ50 galvalume coating in conformance with ASTM A792.[13] This guide also recommends that the exposed top finish of the sheet metal be coated with an architectural-grade coating conforming to AAMA 621[14] is recommended.

Fasteners used with all metal components should be corrosion-resistant, either hot-dipped galvanized steel or stainless steel to match adjacent metal components.

Masonry Veneer

There are several types of anchored masonry veneer products that may be used with this system. Those most typical within the Northwest include facing brick made of clay or shale. Concrete facing brick and concrete masonry units are also used.

For facing brick made from clay or shale, use anchored veneer units that comply with ASTM C216[15] and are severe weather (SW) grade. When using concrete facing brick, anchored veneer units are to comply with ASTM C1634.[16] Hollow concrete masonry units used for veneer applications are typically 4-inches deep and comply with ASTM C90.[17]

Mortar designed for the anchored masonry veneer units is to conform to ASTM C270;[18] the type selected should be appropriate for the veneer application. Type N mortar is acceptable for most anchored masonry veneer applications. When selecting mortar, the lowest compressive strength (softest) mortar that satisfies the project requirements should be used.

Fig. 1-21 Thermally optimized screw tie with stainless-steel hook and barrel as observed at a freestanding mock-up

Appropriate product selection of masonry veneer unit and mortar materials is necessary to provide a durable and water-resistive cladding system. Install the masonry veneer units and mortar joints in conformance with industry standard best practices and manufacturer requirements. Have the specifics of architectural characteristics and structural properties of the masonry veneer units, mortar, and reinforcing designed and reviewed by a qualified Designer of Record.

Various industry resources are available to assist with veneer design and are listed in the Resources section at the back of this guide.

Clear Water Repellents

Application of a clear water repellent to the anchored masonry veneer of this system is common in the Northwest. Refer to the Surface-Applied Clear Water Repellents discussion on page i-59 for more information on selecting an appropriate clear water repellent and for best practice installation guidelines.

Pricing Summary

A pricing summary for this system is provided in Table 1-4 on page 1-24 of this chapter. Pricing demonstrates the relative price per square foot and is based on a 10,000 square foot wall area with easy drive-up access. Pricing includes all components outboard of the CMU wall structure and provides no evaluation for interior finishes or CMU wall structure. Pricing for this system is for a CMU backup wall structure; a concrete backup wall structure is expected to be comparable. Pricing is valid for the 2018 calendar year. Current pricing is also available at www.masonrysystemsguide.com.

Online Availability

The content of this guide and additional resources may be accessed at www.masonrysystemsguide.com, along with downloadable versions of two- and three-dimensional system details and cutaway sections as well as sample project specifications and ongoing updates to references and resources included within this guide.

Chapter References

1. International Code Council. *2015 International Building Code.* (Country Club Hills, IL: International Code Council, Inc., 2014).

2. National Fire Protection Association. *NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.* (Quincy, MA: National Fire Protection Association, 2012).

3. American Society of Heating, Refrigerating, and Air-Conditioning Engineers. *ANSI/ASHRAE/IES Standard 90.1-2016 Energy Standard for Buildings Except Low-Rise Residential Buildings, IP ed.* (Atlanta: ASHRAE, 2016).

4. U.S. Department of Energy. *COMcheck* (version 4.0.7). Windows or Online. Washington, D.C.: U.S. Department of Energy, 2017, https://www.energycodes.gov/comcheck

5. 2015 Washington State Energy Code, Commercial Provisions. Chapter 51-11C WAC (filed by Washington State Legislature, January 19, 2016).

6. The Masonry Society. *TMS-402/602-16 Building Code Requirements and Specification for Masonry Structures.* (n.p.: The Masonry Society, 2016).

7. American Society of Civil Engineers. *Minimum Design Loads for Buildings and Other Structures, ASCE/SEI 7-10.* (Reston, VA: ASCE Press, 2013).

8. ASTM International. *ASTM A153/A153M-16a Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.* (West Conshohocken, PA: ASTM International, 2016).

9. ASTM International. *ASTM A580/580M-16 Standard Specification for Stainless Steel Wire.* (West Conshohocken, PA: ASTM International, 2016).

10. ASTM International. *ASTM A123/A123M-15 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.* (West Conshohocken, PA: ASTM International, 2015).

11. ASTM International. *ASTM A666-15 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.* (West Conshohocken, PA: ASTM International, 2015).

12. ASTM International. *ASTM A653/A653M-15e1 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.* (West Conshohocken, PA: ASTM International, 2015).

13. ASTM International. *ASTM A792 /A792M-10(2015) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.* (West Conshohocken, PA: ASTM International, 2015).

14. American Architectural Manufacturers Association. *AAMA 621-02 Voluntary Specification for High-Performance Organic Coatings in Coil-Coated Architectural Hot-Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates.* (Schaumburg, IL: American Architectural Manufacturers Association, 2002).

15. ASTM International. *ASTM C216-17 Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale.* (West Conshohocken, PA: ASTM International, 2017).

16. ASTM International. *ASTM C1634-16 Standard Specification for Concrete Facing Brick.* (West Conshohocken, PA: ASTM International, 2016).

17. ASTM International. *ASTM C90-16a Standard Specification for Loadbearing Concrete Masonry Units.* (West Conshohocken, PA: ASTM International, 2016).

18. ASTM International. *ASTM C270-14a Standard Specification for Mortar for Unit Masonry.* (West Conshohocken, PA: ASTM International, 2014).

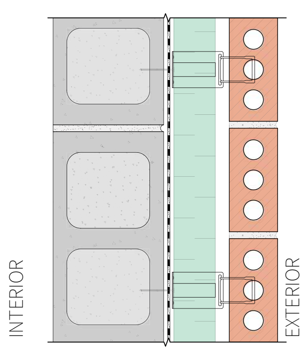
Table 1-4 System 1A and System 1B CMU (or concrete alternative) wall with anchored masonry veneer pricing summary

System 1A and 1B: CMU (or concrete) Wall with Anchored Masonry Veneer					
	System Component	Baseline Product	Alternate (call for estimate)	Baseline Cost/ft^2 (incl. labor)	
				Low	High
INTERIOR					
1	Structural CMU (or concrete) wall	No evaluation of these components provided.			
2*	Air and water-resistant system	Fully adhered sheet-applied membrane system	Fluid-applied membrane system	$1.50	$3.75
3*	Exterior insulation	Rigid XPS board insulation; 2-inch thickness	No specified alternate	$2.75	$3.25
4	Air cavity	Not applicable	Not applicable		
5*	Anchored masonry veneer (without ties)	SW brick masonry modular unit (3-5/8" x 2-1/4" x 7-5/8") FBX, running bond; Type S or N mortar	No specified alternate	$25.00	$27.80
6*	Anchored masonry veneer ties	14 ga hot-dipped galvanized or stainless-steel plate tie, including fasteners	Thermally optimized screw tie with stainless or hot-dipped galvanized hook	$2.50	$5.00
7*	Clear water repellent	Silane/siloxane blend	Antigraffiti clear water repellent	$1.75	$2.50
EXTERIOR					
Total cost to install 10,000 sq ft wall area w/easy drive-up access -->				$33.50	$42.30

Pricing Summary Discussion

- Low and high baseline costs are based on baseline products and installed labor costs. Call for an estimate for alternative product pricing.
- Baseline costs provided will vary based on product-specific conditions as well as project location and should be used as an estimate only.
- Veneer unit prices is for typical units as noted. Pricing will vary based on size, color, and finish and should be confirmed with the unit manufacturer.
- *See the Resources Section of this guide for product recommendation

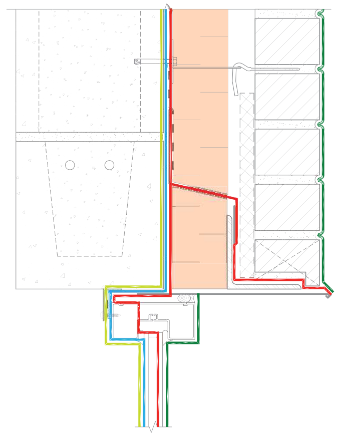
System Plan View



LEGEND

1. Typical Assembly:
   - Single-wythe CMU wall
   - Self-adhered sheet- or fluid-applied air barrier and WRB field membrane
   - Exterior insulation
   - Air cavity
   - Anchored masonry veneer with
   - Clear water repellent
2. Masonry veneer tie, fastened through air barrier sealant, fluid-applied flashing membrane, or self-adhered membrane patch per air barrier and WRB system manufacturer recommendations
3. Continuous mortar collection mesh
4. Self-adhered sheet or fluid-applied air barrier and WRB prestrip membrane
5. Hot-dipped galvanized-steel loose lintel
6. Vent/weep at maximum 24-inches on-center
7. Two-piece sheet-metal head flashing with hemmed drip edge and end dams (beyond)
8. Sheet-metal trim
9. Sealant over backer rod
10. Continuous air barrier sealant tied to continuous seal at window perimeter
11. Continuous back dam angle at rough opening perimeter, minimum 1-inch tall with window fastened through back dam angle per window manufacturer recommendations
12. Storefront window

Water-Shedding Surface and Control Layers



Water-Shedding Surface

Control Layers:*

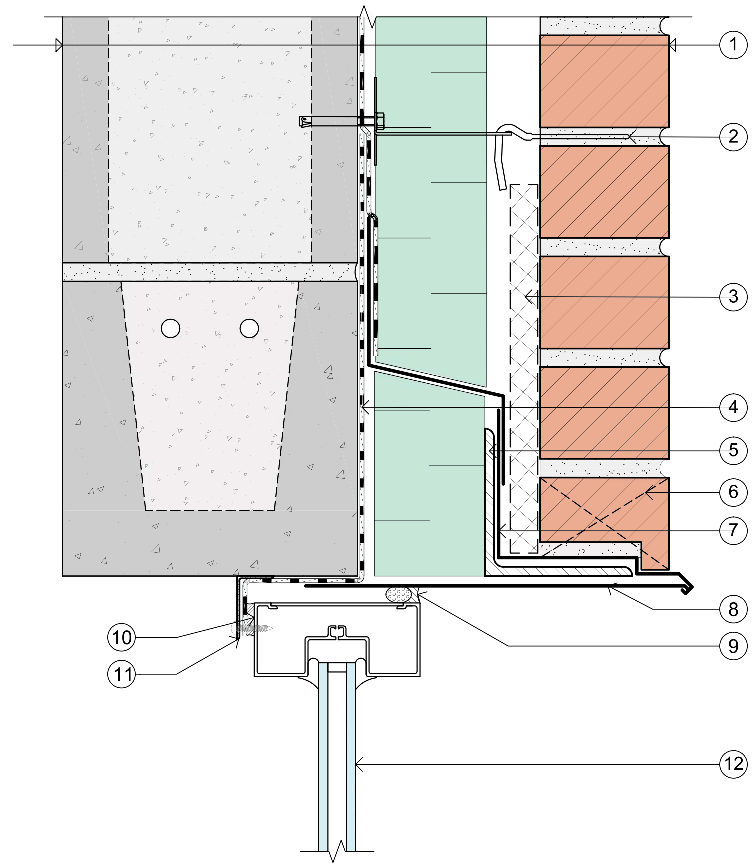
Water

Air

Vapor

Thermal

*Where a Class I or II permeance (and sometimes Class III permeance) air barrier and WRB field and prestrip membrane exist



Typical Loose Lintel at Window Head

Detail 1-A

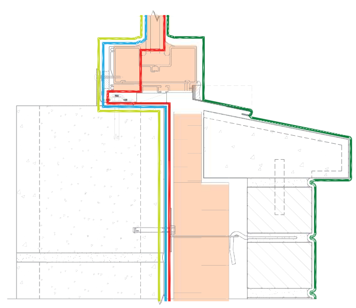
Detail Discussion

- Air and water control layer continuity is provided by the self-adhered sheet- or fluid-applied air barrier and WRB field membrane, prestrip membrane, and air barrier sealant transition to the storefront window.
- The hot-dipped galvanized-steel loose lintel location allows exterior insulation to be continuous up to the rough opening. It may be replaced with a standoff shelf angle support where vertical support is required (such as at a floor line).
- For a thermal improvement, the two-piece sheet-metal flashing may be replaced with a self-adhered flashing membrane as shown similarly in Fig. i-31 on page i-47. Where replaced, the self-adhered flashing membrane should be compatible with the air barrier and WRB system.
- The hemmed drip edge of the sheet-metal head flashing sheds water from the anchored masonry veneer above before it reaches the window and sill.

LEGEND

1. Typical Assembly:
   - Single-wythe CMU wall
   - Self-adhered sheet or fluid-applied air barrier and WRB field membrane
   - Exterior insulation
   - Air cavity
   - Anchored masonry veneer with
   - Clear water repellent
2. Storefront window on minimum ¼-inch-thick intermittent shims
3. Sealant over backer rod
4. Sloped sheet-metal sill flashing with hemmed edge and end dams (beyond)
5. Sloped precast sill, sealant over backer rod (beyond), where applicable
6. Masonry veneer tie, fastened through air barrier sealant, fluid-applied flashing membrane, or self-adhered membrane patch per WRB system manufacturer recommendations
7. Continuous air barrier sealant tied to continuous seal at window perimeter
8. Continuous back dam angle at rough opening perimeter, minimum 1-inch tall, with window fastened through back dam angle per window manufacturer recommendations
9. Fluid-applied or self-adhered flashing membrane

Water-Shedding Surface and Control Layers



Water-Shedding Surface

Control Layers:*

Water

Air

Vapor

Thermal

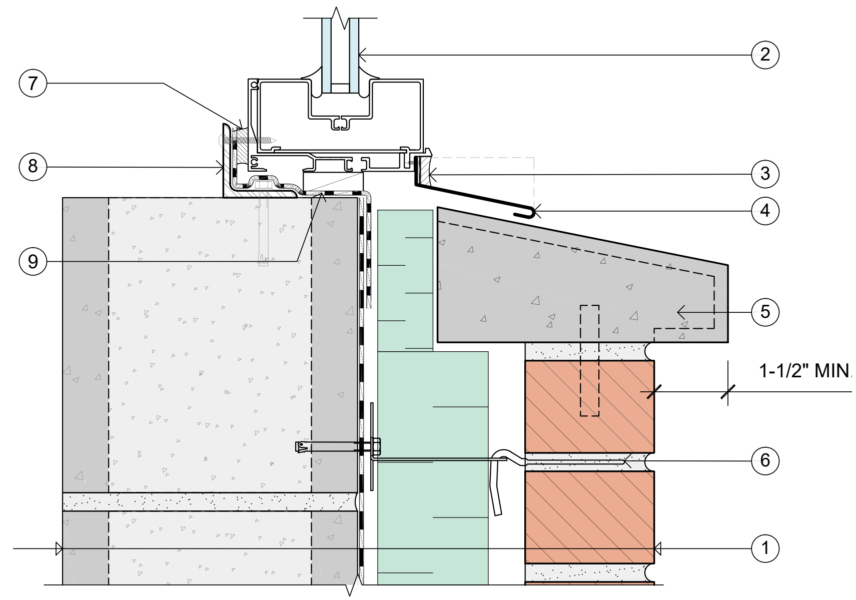
*Where a Class I or II permeance (and sometimes Class III permeance) air barrier and WRB field and prestrip membrane exist

Detail Discussion

- Air and water control layer continuity is provided by the self-adhered sheet- or fluid-applied air barrier and WRB field membrane, fluid-applied or self-adhered flashing membrane at the sill, and air barrier sealant transition to the storefront window.

- The sheet-metal sill flashing conceals the rainscreen cavity and protects the cavity insulation from UV exposure. Terminate the sheet-metal sill flashing with end dams at each jamb and counterflash each end dam with the sheet-metal jamb trim to close off the rainscreen cavity and complete the water-shedding surface.

- This guide recommends that a sheet-metal flashing is ***not*** placed below the precast sill. It can prematurely degrade the mortar bed beneath the precast element.



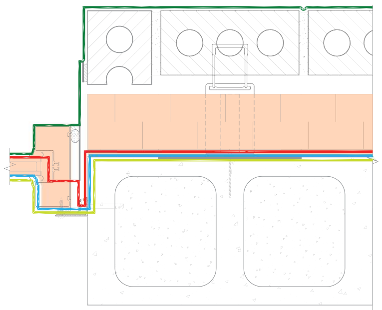
Typical Precast and Sheet-Metal Windowsill

Detail 1-B

LEGEND

1. Typical Assembly:
   - Single-wythe CMU wall
   - Self-adhered sheet- or fluid-applied air barrier and WRB field membrane
   - Exterior insulation
   - Air cavity
   - Anchored masonry veneer with
   - Clear water repellent
2. Storefront window
3. Sealant over bond breaker
4. Sheet-metal jamb trim, attached to intermittent L-angles at window per manufacturer recommendations. Counterflash sheet-metal sill flashing end dams (beyond). Bed sheet-metal trim in sealant at anchored masonry veneer return.
5. Self-adhered or fluid-applied sheet air barrier and WRB prestrip membrane
6. Masonry veneer tie, fastened through air barrier sealant, fluid-applied flashing membrane, or self-adhered membrane patch per WRB system manufacturer recommendations
7. Continuous air barrier sealant, tie to continuous seal at window perimeter
8. Continuous back dam angle at rough opening perimeter, minimum 1-inch tall. Fasten window through back dam angle per window manufacturer recommendations

Water-Shedding Surface and Control Layers



Water-Shedding Surface

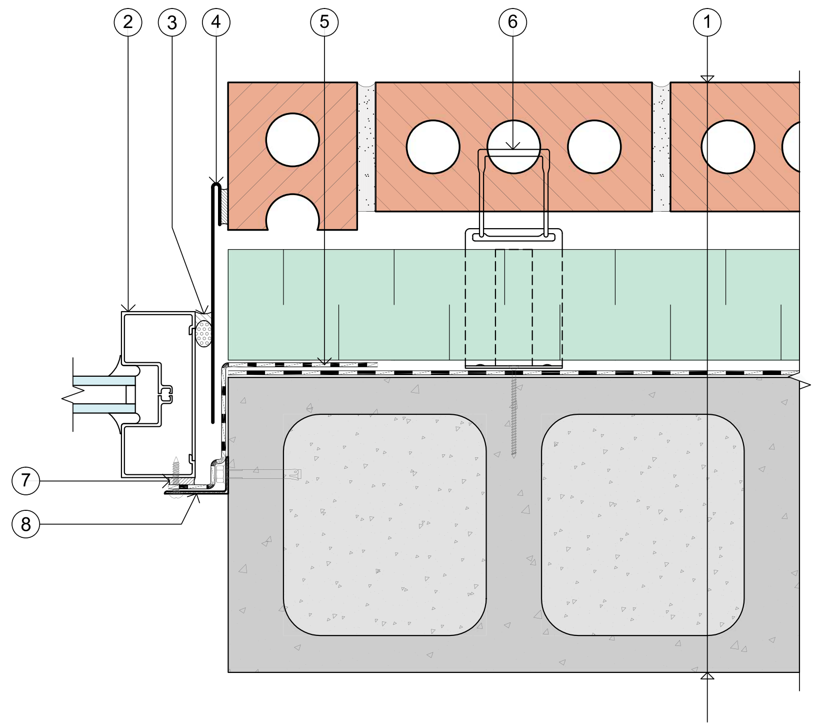
Control Layers:*

- Water
- Air
- Vapor
- Thermal

*Where a Class I or II permeance (and sometimes Class III permeance) air barrier and WRB field and prestrip membrane exist

Detail Discussion

- Air and water control layer continuity is provided by the self-adhered sheet- or fluid-applied air barrier and WRB field membrane, prestrip membrane, and air barrier sealant transition to the storefront window.
- The sheet-metal jamb trim is bed in continuous sealant against the anchored masonry veneer to provide water-shedding surface continuity.
- Exterior insulation should be tightly installed around all penetrations including masonry ties.



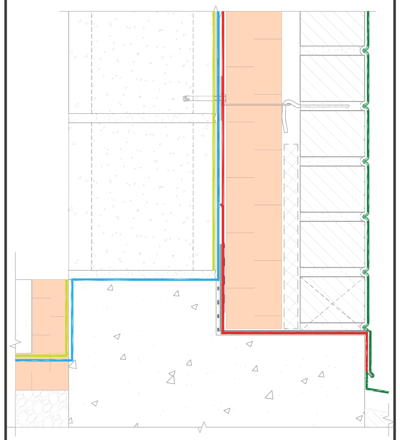
Typical Window Jamb

Detail 1-C

LEGEND

1. Typical Assembly:
   - Single-wythe CMU wall
   - Self-adhered sheet or fluid-applied air barrier and WRB field membrane
   - Exterior insulation
   - Air cavity
   - Anchored masonry veneer with
   - Clear water repellent
2. Masonry veneer tie, fastened through air barrier sealant, fluid-applied flashing membrane, or self-adhered membrane patch per WRB system manufacturer recommendations
3. Continuous mortar collection mesh
4. Sheet-metal flashing with hemmed drip edge and end dams beyond
5. Fluid-applied or high temperature self-adhered flashing membrane
6. Vent/weep at maximum 24-inches on-center
7. Typical Assembly:
   - Concrete floor slab
   - Vapor barrier
   - Rigid XPS insulation
   - Capillary break
8. Rigid XPS insulation thermal break

Water-Shedding Surface and Control Layers



Water-Shedding Surface

Control Layers:*

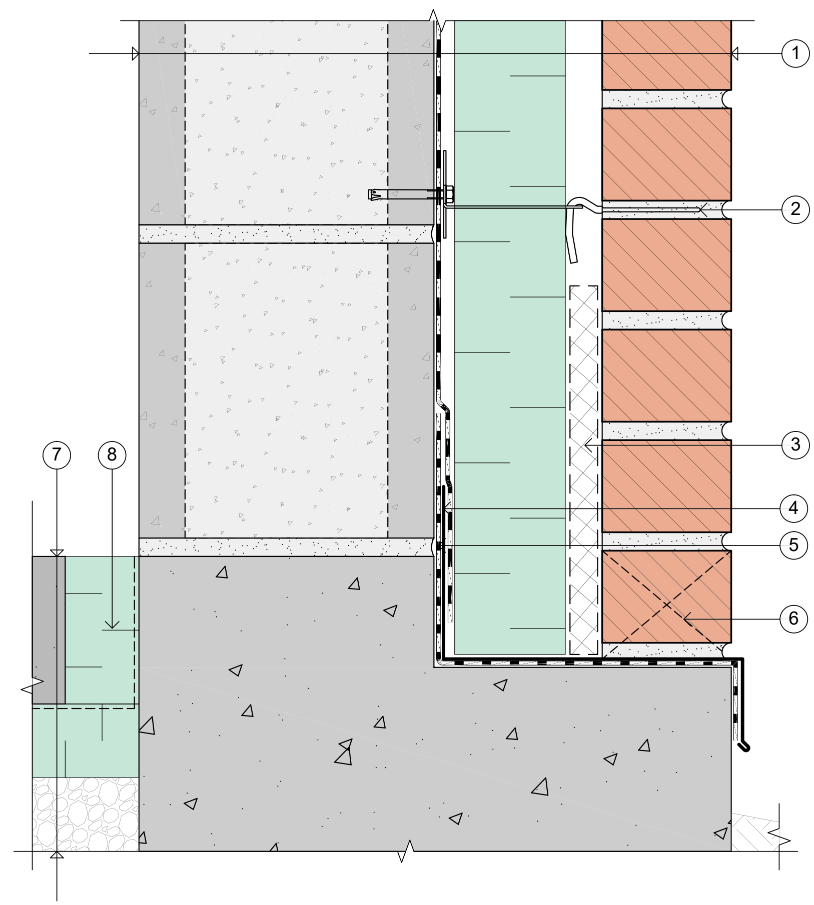
- Water
- Air
- Vapor
- Thermal

*Where a Class I or II permeance (and sometimes Class III permeance) air barrier and WRB field and prestrip membrane exist

Detail Discussion

- A significant thermal bridge occurs at the foundation element. The insulation between the concrete floor slab and concrete foundation wall is typically referred to as a thermal break and helps reduce the amount of heat loss at the floor slab perimeter and concrete foundation element.

- Vents/weeps at the wall base drain the rainscreen cavity and assist with air cavity ventilation. The mortar collection mesh helps keep vents/weeps clear of mortar droppings.



Typical Foundation Detail

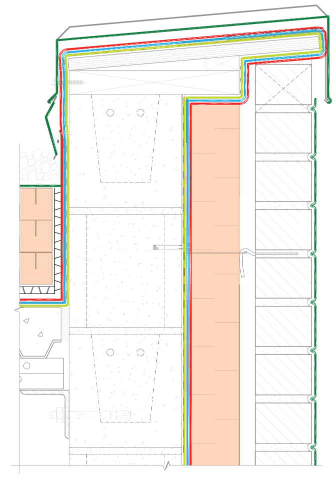
Detail 1-D

LEGEND

1. Typical Assembly
   - Single-wythe CMU wall
   - Self-adhered sheet or fluid-applied air barrier and WRB field membrane
   - Exterior insulation
   - Air cavity
   - Anchored masonry veneer with
   - Clear water repellent
2. Inverted roof membrane assembly
3. Sloped standing-seam sheet-metal coping with gasketed washer fasteners
4. High-temperature self-adhered membrane
5. Preservative-treated wood blocking
6. Compressible filler
7. Vents at maximum 24-inches on-center
8. Masonry veneer tie, fastened through air barrier sealant, fluid-applied flashing membrane, or self-adhered membrane patch per WRB system manufacturer recommendations

* Size gap for project specific movement, minimum ⅜-inch

Water-Shedding Surface and Control Layers



Water-Shedding Surface

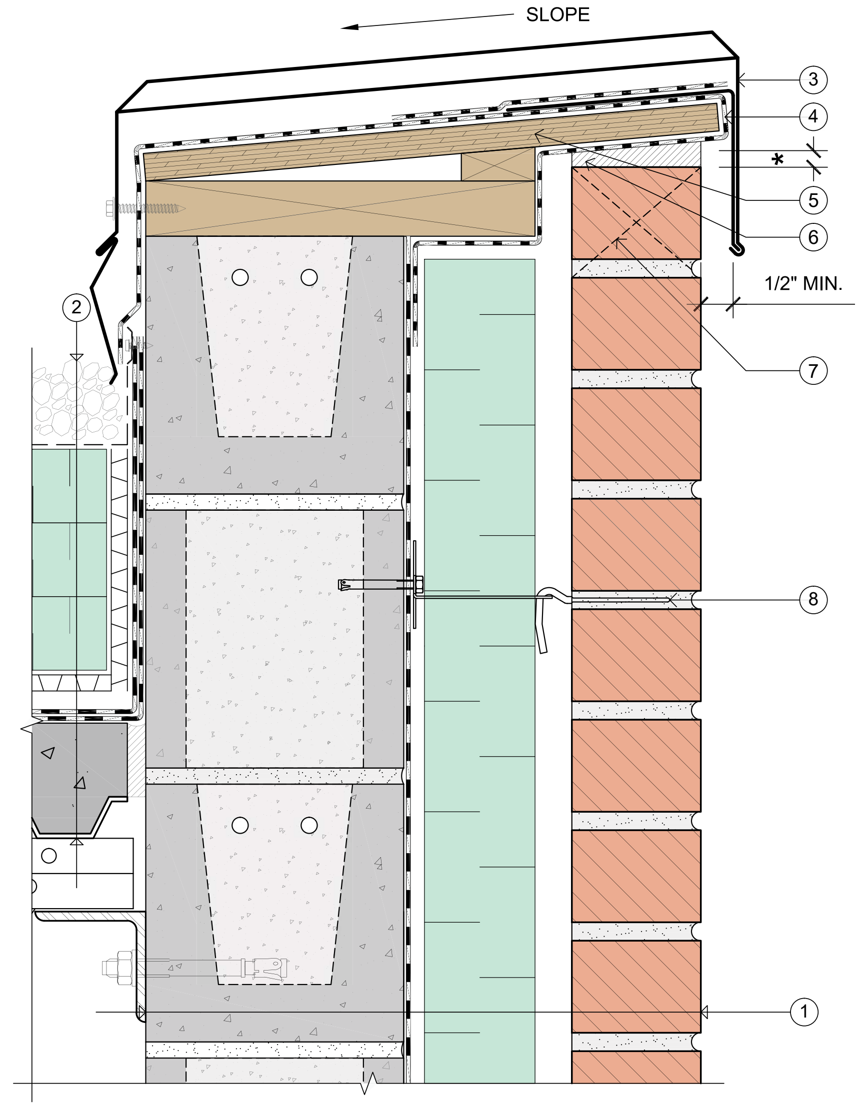
Control Layers:†

- Water
- Air
- Vapor
- Thermal

†Where a Class I or II permeance (and sometimes Class III permeance) air barrier and WRB field and prestrip membrane exist

Detail Discussion

- The sheet-metal parapet coping with hemmed drip edge is held off the anchored masonry veneer face to minimize disruption of air flow through the vents. A ½-inch gap is recommended.
- The self-adhered sheet or fluid-applied air barrier and WRB field membrane, high temperature self-adhered membrane, and roof membrane provide the air and water control layers in this detail.
- A compressible filler is used between the anchored masonry veneer and parapet blocking to allow building movement while preventing insects and debris from entering the rainscreen cavity.
- This detail may be thermally improved by framing the parapet on top of the roof structure and insulating the parapet cavity similar to Detail 2-E.



Typical Parapet at Inverted Roof Membrane Assembly

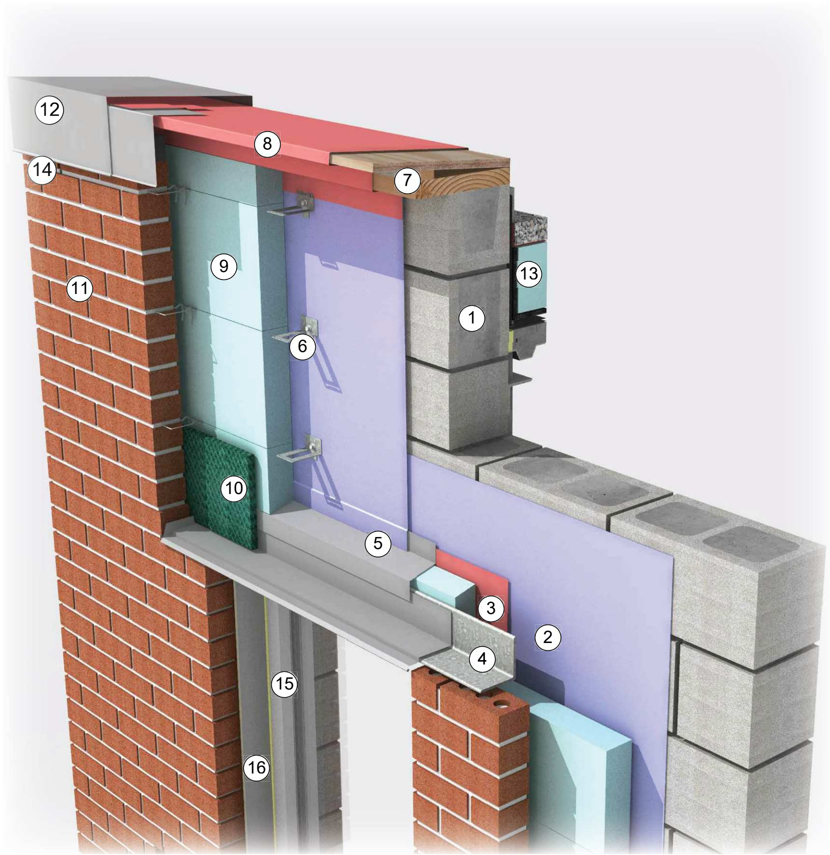
Detail 1-E

LEGEND

1. Single-wythe CMU wall
2. Self-adhered sheet or fluid-applied air barrier and WRB field membrane
3. Self-adhered sheet or fluid-applied air barrier and WRB prestrip membranes
4. Hot-dipped galvanized-steel loose lintel
5. Two-piece sheet-metal head flashing with hemmed drip edge and end dams
6. Masonry veneer tie, fastened through air barrier sealant, fluid-applied flashing membrane, or self-adhered membrane patch per WRB system manufacturer recommendations
7. Sloped preservative-treated wood blocking
8. High-temperature self-adhered membrane
9. Exterior insulation
10. Continuous mortar collection mesh
11. Anchored masonry veneer
12. Sloped standing-seam sheet-metal coping with gasketed washer fasteners
13. Inverted roof membrane assembly and roof structure
14. Vents at maximum 24-inches on-center
15. Storefront window
16. Sheet-metal jamb trim and sealant over bond breaker

3-D Detail Discussion

- Three-dimensional cutaway sections on the next three pages represent two-dimensional details of this system.
- In all details, water control layer elements are shingle-lapped to encourage liquid water drainage.
- As shown in Detail 1-F, horizontally oriented ties, such as a double eye and pintle plate ties, allow exterior insulation to be installed in horizontal strips between ties. This orientation can improve the efficiency of the anchored masonry veneer installation.
- The two-piece sheet-metal flashing at the window head, as shown in Detail 1-F, allows the upper flashing to be installed and integrated into the air barrier and WRB system prior to installation of the lower sheet-metal flashing and hot-dipped galvanized-steel loose lintel.
- As shown in Detail 1-F, the sheet-metal flashing above the lintel ends at a head joint. This location allows the sheet-metal head flashing to terminate with an end dam.
- Vents/weeps at the wall base, as shown in Detail 1-G provide both drainage and ventilation of the rainscreen cavity. Mortar collection mesh helps keep the vents/weeps and base flashing area free of mortar droppings.
- Detail 1-H describes a typical rough opening with continuous back dam angle. The back dam angle creates a sill pan below the window; intermittent shims below the storefront window promote drainage at the sill and into the rainscreen cavity.
- The sheet-metal jamb trim shown in all details conceals the rainscreen cavity from water exposure and protects the insulation from UV exposure.
- Exterior insulation should be tightly installed around all penetrations, including masonry ties.

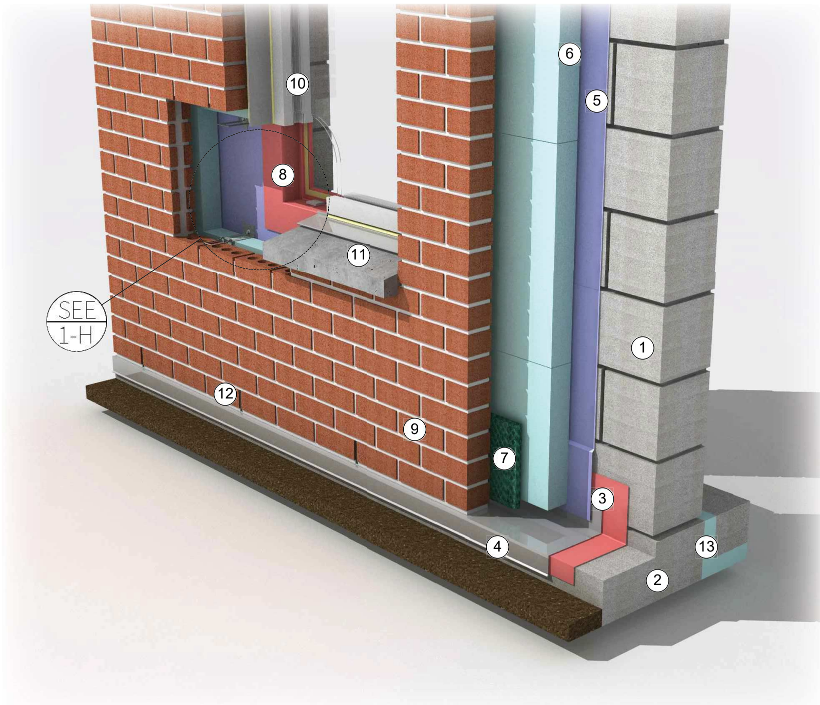


Parapet Cutaway Section

Detail 1-F

LEGEND

1. Single-wythe CMU wall
2. Concrete foundation element
3. Fluid-applied or self-adhered flashing membrane
4. Sheet-metal base flashing with hemmed drip edge and end dams (beyond)
5. Self-adhered sheet- or fluid-applied air barrier and WRB field membrane
6. Exterior insulation
7. Continuous mortar collection mesh
8. Self-adhered sheet- or fluid-applied air barrier and WRB prestrip membrane and fluid-applied or self-adhered flashing sill membrane
9. Anchored masonry veneer
10. Storefront window
11. Sloped precast concrete sill with sloped sheet-metal sill flashing
12. Vent/weep at maximum 24-inches on-center
13. Rigid XPS insulation thermal break

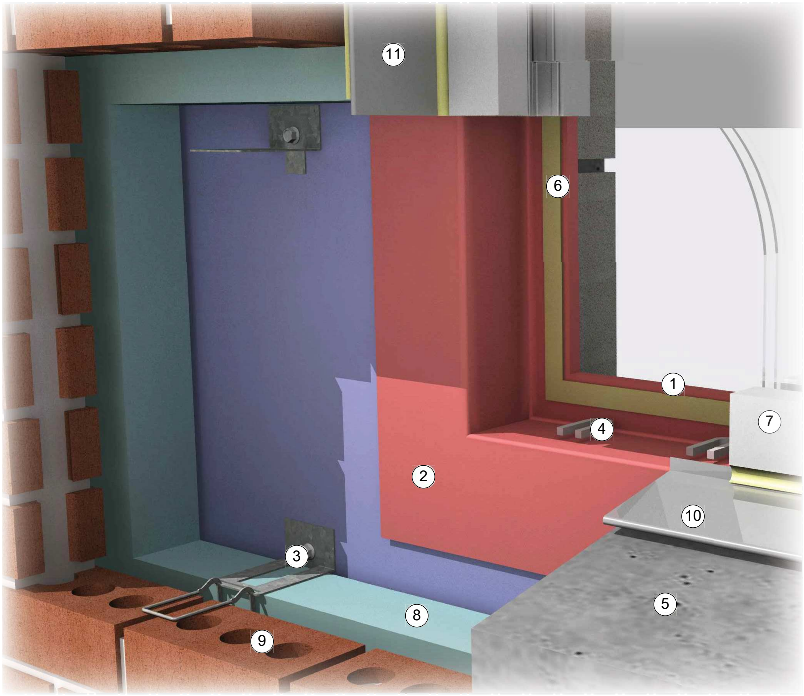


Base of Wall Cutaway Section

Detail 1-G

LEGEND

1. Continuous back dam angle at rough opening perimeter, minimum 1-inch tall, with window fastened through back dam angle per window manufacturer recommendations
2. Self-adhered sheet- or fluid-applied air barrier and WRB prestrip membranes at jamb and sill
3. Masonry veneer tie, fastened through air barrier sealant, fluid-applied flashing membrane, or self-adhered membrane patch per WRB system manufacturer recommendations
4. Minimum ¼-inch thick intermittent shims
5. Sloped precast concrete sill
6. Continuous air barrier sealant tied to continuous seal at window perimeter
7. Storefront window
8. Exterior insulation
9. Anchored masonry veneer
10. Sloped sheet-metal sill flashing with hemmed edge
11. Sheet-metal jamb trim with hemmed edge, bed in sealant against anchored masonry veneer



Typical Window and Jamb Cutaway Section

Detail 1-H