CHAPTER 3:
WOOD-FRAMED WALL WITH ANCHORED MASONRY VENEER

Masonry system 3 is a rainscreen wall with wood-framed wall structure and anchored masonry veneer. The components of this system, from interior to exterior, are described in Fig. 3-1. This system is appropriate for many applications including low- or mid-rise residential or commercial buildings. An example project application of this system is shown in Fig. 3-2 on page 3-2.

Building Enclosure and 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:

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

Fig. 3-1 Typical System 3 components from interior to exterior
• 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. 3-3 illustrates the water-shedding surface and control layer locations for this system. The water-shedding surface and control layers are also shown on typical system details provided adjacent to each detail at the end of this chapter.

As shown in Fig. 3-3, 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 later. The water control layer and air control layer occur at the same location exterior of the wall sheathing. The thermal control layer occurs at the framed wall cavity insulation. The vapor control layer is located at the interior (warm-in-winter side) of the wood-framed structure.

**Water-Shedding Surface**

The water-shedding surface is a system that serves to reduce the water load on the enclosure. 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 within the wall system include sheet-metal flashings and drip edges, sealant joints, and fenestration systems as shown on the details included 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. Continuously seal movement joints and joints around fenestrations and penetrations with backer rod and sealant or counterflash them with a sheet-metal flashing to deflect wind-driven rain and shed water away from the rainscreen cavity.

**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 water-resistive barrier (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 typically has Class IV vapor permeance properties and may be a mechanically attached sheet membrane, a self-adhered sheet membrane, or a 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. An air barrier and WRB system with Class IV vapor permeance allows this wall system to dry to the exterior. Drying ability to the exterior is not only beneficial during the service life of the building but also helps relieve any construction-related moisture in the wood framing or wood-based sheathing products. A vapor-permeable air barrier and WRB system with mechanically attached field membrane is depicted in the details at the end of this chapter. An example of this system is shown in Fig. 3-4 on page 3-4.

Physical properties of WRB system products, are discussed 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.
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; seal them 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.

Air Barrier System

The air barrier system provides the air control layer. In addition to controlling air, this layer assists with controlling liquid water, heat, and water vapor. A general overview of the air control layer and the air barrier system is provided in the Air Control Layer discussion on page i-26.

For this wall system, the air barrier system is the same field membrane and many of the components that also serve as the WRB system. As discussed in the introductory chapter, 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, merely shingle-lapped.

Mechanically attached sheet-applied air barrier and WRB system materials should be attached per manufacturer recommendations to minimize the risk of membrane displacement and damage during wind events. Often masonry ties are relied upon to provide this membrane support; however, other manufacturer-approved fasteners such as washer head nails or fasteners may be necessary to secure the membrane until ties are placed. It is recommended that any temporary fasteners remain in place or that holes at any evacuated fasteners are repaired as required by the membrane manufacturer.

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.

The vapor control layer of this system is located on the interior (warm-in-winter side) of the wall and is typically at the face of or just behind the interior gypsum board. The vapor retarder for this wall system should comply with Section 1405.3 of the governing International Building Code (IBC). In the Northwest, typical vapor retarder products include PVA vapor-retarding primer, asphalt-coated kraft paper, or a polyamide film retarder membrane. Refer to the Vapor Control Layer discussion on page i-28 for additional information on vapor retarder products.

Low-permeance (Class I, Class II, and sometimes Class III vapor permeance) flashing membranes are commonly used in WRB systems that have vapor-permeable WRB system field membranes. These flashing membranes can be effective on horizontal or low-slope transitions such as window and door rough opening sills or to detail around penetrations and other transitions; however, it is recommended that the use of such membranes is minimized when a vapor-permeable WRB system field membrane is used. This may be achieved by reducing the installation of low-permeance membranes to less than 10 percent of the wall area and by avoiding concentrated areas of low-permeance membranes at wall areas that would otherwise benefit from drying to the exterior (such as in wood-framed systems).
Thermal Control Layer

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

In this wall system, the low-conductivity wood framing and wall cavity insulation form the thermal control layer. At transition details, the thermal control layer also includes parapet cavity insulation and insulation at the roof assembly, slab, and foundation elements. Windows and doors that penetrate this wall system are also part of the thermal control layer. Exterior insulation may also be used with this system as shown in Fig. 3-5 to improve thermal performance.

Additional thermal insulation information is provided in the Thermal Control Layer discussion on page i-30 of the introductory chapter.

Insulation Selection

The cavity insulation in this system is typically fiberglass or mineral fiber batt insulation product.

The exterior insulation in this system is typically semi-rigid mineral fiber board insulation (R-4.2/inch), which is hydrophobic, tolerates moisture, and has free-draining capabilities. Its vapor permeance allows it to be acceptable for use exterior of a the Class IV vapor-permeable WRB system. The semi-rigid properties of the insulation allow it to be fit tightly around penetrations such as masonry veneer ties.

Exterior insulation with relatively low vapor permeance properties (e.g., XPS or polyisocyanurate) may be avoided in this wall system because it can limit system drying to the exterior.

Refer to the Insulation Products discussion on page i-30 for information on various insulation types and additional considerations.

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 regarding vertical and lateral flame propagation as it relates to a combustible WRB system may require acceptance criteria for NFPA 285. 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 chapter system is typically classified as a “wood-framed and other” above-grade wall for energy code compliance purposes. Prescriptive energy code compliance values for this system are summarized in Table 3-2 on page 3-13 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, the equivalent effective R-value of this U-factor has been calculated and is denoted in parenthesis ( ) for easy comparison to thermal modeling results in this chapter.

Wood-framed walls are typically constructed with 16-inch on-center stud spacing for standard framing or 24-inch on-center stud spacing for advanced framing methods. Nominal 2x6 framing accommodates up to an R-21 fiberglass or R-23 mineral fiber batt insulation and nominal 2x8 framing up to an R-30 mineral fiber batt insulation. When continuous insulation requirements are to be met, this system will have insulation exterior of the wood frame structure, wall sheathing, and Class IV vapor permeance air barrier and WRB system, as shown in Fig. 3-5.

For all energy code compliance strategies except the prescriptive insulation R-value method strategy, this wall system's U-factor will need to be calculated or determined from table values; however, it may or may not be required to be less than the prescriptive U-factors in Table 3-2.

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, COMcheck, the appendices of the 2015 WSEC, 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 system, as determined through the modeling results, are also discussed.

**System Effective Thermal Performance**

Exterior insulation in this system may or may not be required to meet project-specific energy targets; however, when exterior insulation is used, cladding attachments and supports (e.g., masonry ties and shelf angle supports) will penetrate the exterior insulation and create areas of thermal bridging (i.e., heat loss).

Examples of typical standoff shelf angle and anchored masonry veneer ties are shown are shown in Fig. 3-10 and Fig. 3-11.

An example of the thermal bridging created by shelf angle supports, whether continuous or stand-off, is described by Fig. 3-6 through Fig. 3-9. Fig. 3-7 shows dark blue (colder temperature) at the floor line edge for the continuous floor line shelf angle, whereas the floor line with a standoff shelf angle is light blue and yellow, indicating warmer temperatures. 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 support 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 system:

- **Framing and Cavity Insulation:** 2x6 with R-21 batt insulation or 2x8 with R-30 batt insulation. Modeling results include a full-height wood-framed wall and floor line. Standard framing allowance for 77% insulated cavity and 23% framing members such as studs, plates, and headers is used.

- **Masonry Ties:** Various tie types are considered at 16-inches by 16-inches on-center spacing. Tie types are shown in Fig. 3-11 and include:
  - Thermally optimized screw tie with stainless 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:** This system is considered with and without exterior insulation and includes insulation materials with either a thermal resistance of R-4.2/inch or R-6/inch in thicknesses of 1-, 2-, and 3-inches. 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 in Fig. 3-6 and Fig. 3-7 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. 3-8 and Fig. 3-9.

Thermal Modeling: Results

Modeling results are shown in Table 3-1, Fig. 3-12, and Fig. 3-13 (see page 3-12 and page 3-13) and demonstrate the system’s effective R-value under various conditions; Fig. 3-12 and Fig. 3-13 graphically represent the results summarized in Table 3-1.

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 3-1 for ties only, the system’s effective R-value is reduced by 2 and 12%. Reducing the frequency of ties will increase the effective thermal performance of the system but will also need to be coordinated with structural requirements.

  - As determined from Table 3-1 for ties only, stainless-steel plate ties and thermally optimized screw ties reduce the system’s effective R-value 2 to 7%, whereas galvanized-steel plate ties reduce the effective R-value by 3 to 12%. Galvanized-steel plate ties provide a lesser effective R-value than both the stainless-steel or thermally optimized screw tie options as shown in Fig. 3-12. Both stainless-steel and thermally optimized screw ties provide similar effective R-value performance. Whether galvanized-steel hooks or stainless-steel hooks are used for thermally optimized tie selection makes little difference; however, stainless-steel hooks provide better corrosion resistance. A standard all–stainless-steel tie may prove to be a cost-effective option when compared to a thermally improved proprietary tie, and it also provides a highly corrosion-resistant attachment.

  - A shelf angle further reduces the system’s effective R-value after ties are considered as shown in Table 3-1 and Fig. 3-13. When considering ties, the system’s effective R-value is reduced by 4 to 20% with a continuous shelf angle and 3 to 13% with a standoff shelf angle. As determined from Fig. 3-13, up to an additional half-inch of insulation may be required to achieve the same effective thermal performance for this system if a continuous angle is used in lieu of a standoff shelf angle. Use of a standoff shelf angle in lieu of the continuous shelf angle improves the effective thermal performance of this system and may allow for thinner insulation thicknesses when meeting thermal performance targets.

Sheathing Selection

The exterior sheathing of this system is typically a wood- or gypsum-based product and is designated by structural requirements. Where wood-based products are used, plywood is generally recommended for its moisture tolerance. Where gypsum board is used, a product resistant to organic growth and moisture is recommended. Fiberglass-faced gypsum board products are commonly used; avoid paper face products.

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.
### Table 3-1 System 3 thermal modeling results

<table>
<thead>
<tr>
<th>Tie Type</th>
<th>Tie Penetration Area</th>
<th>Exterior Insulation Thickness</th>
<th>System Nominal Insulation R-value (Cavity + Exterior Insulation)</th>
<th>3D Thermal Modeling Effective R-Value of System (ft² °F·hr/Btu)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Without Penetrations (Through Exterior Insulation)</td>
<td>With Masonry Tie Penetrations Considered @ 16” x 16” O.C.</td>
</tr>
<tr>
<td>Thermally Optimized Screw Tie - Stainless-Steel Hook</td>
<td>0.05%</td>
<td></td>
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<td></td>
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<tr>
<td>Thermally Optimized Screw Tie - Galvanized-Steel Hook</td>
<td>0.05%</td>
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<tr>
<td>Plate Tie (14 ga) - Stainless Steel</td>
<td>0.05%</td>
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<td></td>
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<td>Plate Tie (14 ga) - Galvanized Steel</td>
<td>0.05%</td>
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<tr>
<td>Plate Tie (14 ga) - Galvanized Steel</td>
<td>0.05%</td>
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#### 2x8 Framing, R-30 Batts, No Exterior Insulation

<table>
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<tr>
<th>Tie Type</th>
<th>Tie Penetration Area</th>
<th>Exterior Insulation Thickness</th>
<th>System Nominal Insulation R-value (Cavity + Exterior Insulation)</th>
<th>3D Thermal Modeling Effective R-Value of System (ft² °F·hr/Btu)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Without Penetrations (Through Exterior Insulation)</td>
<td>With Masonry Tie Penetrations Considered @ 16” x 16” O.C.</td>
</tr>
</tbody>
</table>

### Table 3-2 System 3 prescriptive energy code compliance values excerpted from Table i-1 of the introductory chapter

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<td>Group R</td>
<td>All Other</td>
<td>Group R</td>
<td>All Other</td>
</tr>
<tr>
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<td>Wood-Framed Wall with Anchored Masonry Veneer</td>
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<td>R-21 int</td>
<td>R-21 int</td>
<td>R-21 int</td>
<td>R-21 int</td>
</tr>
<tr>
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<td></td>
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<td>0.005</td>
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</table>

**Fig. 3-13 System 3 effective R-value comparison of a galvanized steel plate tie and shelf angle options**

**Fig. 3-12 System 3 effective R-value modeling results for various tie types and R-4.2/inch insulation**
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; however, the risk that mortar droppings will block the air cavity increases with smaller cavities. A 1-inch cavity may be considered when a strict quality control program is implemented to minimize the likelihood that mortar droppings will block the cavity; however, a 2-inch air cavity is best practice.

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 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. Example weep and weep/vent locations are shown in Fig. 3-14.

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. Avoid weep tubes because they provide far less ventilation and are blocked easily with debris.

Use mortar collection nets 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 located 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), floor line shelf angles, and the foundation. These flashings assist with draining the rainscreen cavity and also serve to protect fluid-applied or flexible flashing membranes that may exist beneath them. Counterflashings sheet-metal components assist only with water shedding and are typically located at

windowsill and parapet top conditions; they protect the cavity from water ingress while still allowing for cavity ventilation.

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 support system, the wood-framed members will shrink due to moisture loss. To minimize the risk of veneer damage, breaks must be provided in the veneer to compensate for any differential movement between the cladding and the support wall. Expansion joints also must 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

Fig. 3-14 Mesh weep/vents located within the head joints of a soldier course of lip brick. The base of each weep/vent is tight to an underlying cross-cavity sheet-metal flashing, which is concealed by the lip brick.
Expansions/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 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 3/16-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.

Structural Considerations

The wood framing provides the primary structure of this wall 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 reinforced elements and supports/ties is demonstrated within the details of this chapter and is provided for diagrammatic purposes only.

Masonry Ties

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

Building codes provide prescriptive requirements for masonry ties secured to concrete or masonry that includes spacing, size, placement, and tie type. These requirements are summarized in Table 3-3 and are based on TMS 402-16 provisions for adjustable ties (i.e., anchors). Use of these prescriptive requirements is limited to masonry veneer assemblies with a weight less than 40 psf, with a cavity depth no more than 6-3/4-inches, and where the ASCE-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.

Prescriptive spacing requirements for anchored masonry veneer walls are included in Table 3-3 for 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. 3-15 on page 3-18. For wood-framed walls, the code does not restrict the use of any tie type.
• 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.

• Adjustable L-bracket triangular wire ties are acceptable but may not be preferred by installers because the vertical tie orientation can complicate exterior insulation installation by requiring vertical insulation boards.

• TMS 402-16\(^6\) does not allow non-adjustable ties, including corrugated and nonadjustable surface-mounted ties, for this system.

To prevent pull-out or push-through of the tie, TMS 402-16\(^6\) requires ties be embedded a minimum of 1-1/2-inches into the veneer, with at least 5/8-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 1/4-inches.

TMS 402-16\(^6\) requires that masonry ties are fastened directly to the wood framing through the exterior sheathing. Masonry anchors are not to be fastened to the sheathing alone. The code requires the use of 8d common nails or fasteners with equivalent or greater pull-out strength. However, in Seismic Design Categories D, E, and F, the code requires the use of 8d ring-shank nails or No. 10 corrosion-resistant screws with a minimum nominal shank diameter of 0.190-inches. While the code may allow a horizontal anchor spacing up to 32-inches on-center, spacing anchors horizontally is recommended for alignment with the typical stud spacing, typically 16-inches on center.

Vertical Supports

Anchored masonry veneers are supported vertically by the building’s foundation or other structural components such as shelf angles and lintels; examples of vertical supports are shown in Fig. 3-16.

Vertical supports are designed to eliminate the possibility of cracking and deflection within the veneer; the support design considers the design loads, material type, moisture control, movement provisions, and constructibility. When vertical supports span horizontally, the deflection of these supports is limited to L/600 per TMS 402-16\(^6\).

For wood-framed backings, TMS 402-16 allows anchored masonry veneer supported vertically by noncombustible construction to be installed up to a height of 30 feet (or 38 feet at a gable). Wherever the masonry veneer is supported by wood construction, it must be supported every 12 feet. Best practice for commercial wood-framed construction is to support the lowest portion of the masonry cladding directly on the concrete foundation wall.

At moderately sized openings within the system (e.g., windows and doors), the masonry veneer is typically supported with loose lintels above the opening. Galvanized steel angles are commonly used; however, reinforced masonry or precast concrete lintels may be considered for appearance. Steel angle lintels...
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 Record’s responsibility to appropriately select a level of corrosion resistance for project-specific application/exposure and the expected longevity of the masonry system.

It is common to provide hot-dipped galvanized carbon steel masonry veneer ties that comply with ASTM A 153 Class B-2, AISI Type 304, or AISI Type 316 stainless steel per ASTM A580. Steel support angles such as shelf angle supports and loose lintels are at minimum hot-dipped galvanized and comply with ASTM A123.

Best practice is to use sheet-metal flashing components of ASTM A666 Type 304 or 316 stainless steel, which is nonstaining and resistant to the alkaline content of mortar materials. Where stainless steel sheet-metal flashing components are not 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 and comply with ASTM A653 or minimum AZ50 galvalume coating in conformance with ASTM A792.

Coating the exposed top finish of the sheet metal with an architectural-grade coating conforming to AAMA 621 is recommended.

Fasteners used with metal components should be corrosion-resistant, either hot-dipped galvanized steel or stainless steel to match adjacent metal components. When used with preservative-treated wood, also consider fastener selection to prevent galvanic corrosion.

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 and are severe weather (SW) grade. When using concrete facing brick, anchored veneer units are to comply with ASTM C1634. Hollow concrete masonry units used for veneer applications are typically 4-inches deep and comply with ASTM C90.

Mortar designed for the anchored masonry veneer units is to conform to ASTM C270 and be the appropriate type for the veneer application. Type N mortar is acceptable for most anchored masonry veneer applications. Select the lowest compressive strength (softest) mortar that satisfies the project requirements.

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

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 on Table 3-4 on page 3-24. 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 exterior wall sheathing and provides no evaluation for interior finishes (including vapor retarder), framing/sheathing, or cavity insulation. Pricing is valid for 2018. Current pricing is also available at www.masonrysystmesguide.com.

Online Availability

The content of this guide and additional resources may be accessed online at www.masonrysystmesguide.com. Also available online are downloadable versions of two- and three-dimensional system details and cutaway sections, sample project specifications, and ongoing updates to references and resources included within this guide.
Chapter References


### System 3: Wood Framed Wall with Anchored Masonry Veneer

<table>
<thead>
<tr>
<th>System Component</th>
<th>Baseline Product</th>
<th>Alternate (call for estimate)</th>
<th>Baseline Cost/ft² (incl. labor)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INTERIOR</strong></td>
<td></td>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>1. Interior gypsum board</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Vapor retarder</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Wood-framed wall with batt insulation</td>
<td></td>
<td>Fluid-applied membrane system</td>
<td>$1.50</td>
</tr>
<tr>
<td>4. Exterior sheathing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5*. Air and water-resistant barrier (AB/WRB)</td>
<td>Fully adhered or mechanically attached sheet-applied membrane</td>
<td>Fluid-applied membrane system</td>
<td>$1.50</td>
</tr>
<tr>
<td>6. Air cavity</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>-</td>
</tr>
<tr>
<td>7*. Anchored masonry veneer (without ties)</td>
<td>SW brick masonry modular unit (3-5/8&quot; x 2-1/4&quot; x 7-5/8&quot;) FBX, running bond; Type S or N mortar</td>
<td>No specified alternate</td>
<td>$25.00</td>
</tr>
<tr>
<td>8*. Anchored masonry veneer ties</td>
<td>14-gauge hot-dipped galvanized or stainless-steel plate tie, including fasteners</td>
<td>Thermally optimized screw tie with stainless or hot-dipped galvanized hook</td>
<td>$2.50</td>
</tr>
<tr>
<td>9*. Clear water repellent</td>
<td>Silane/siloxane blend</td>
<td>Antigraffiti clear water repellent</td>
<td>$1.75</td>
</tr>
<tr>
<td><strong>EXTERIOR</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total cost to install 10,000 sq ft wall area w/easy drive-up access --&gt;</strong></td>
<td></td>
<td></td>
<td>$30.75</td>
</tr>
</tbody>
</table>

**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 are for typical units as noted. Pricing can vary based on size, color, and finish and should be confirmed with the unit manufacturer.
- *See the Resources section of this guide for a list of resources related to this component.
**LEGEND**

1. Typical Assembly:
   - Interior gypsum board
   - Vapor retarder
   - Wood-framed wall with batt insulation
   - Exterior sheathing
   - Sheet-applied air barrier and WRB field membrane
   - Air cavity
   - Anchored masonry veneer
   - 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. Continuous air barrier sealant

5. Hot-dipped galvanized-steel loose lintel (or continuous shelf angle support)

6. Sheet- or fluid-applied air barrier and WRB prestrip membrane

7. Weep/vent at maximum 24-inches on-center

8. Sheet-metal flashing with hemmed drip edge and end dams beyond

9. Sealant over backer rod

10. Air barrier sealant over backer rod, tie to continuous seal at window perimeter

11. Flanged window

---

**Detail Discussion**

- Air and water control layer continuity is provided by the sheet-applied air barrier and WRB field membrane, sheet-applied or fluid-applied air barrier and WRB prestrip membrane, continuous air barrier sealant, and air barrier sealant transition to the window.

- A flanged window is depicted. Consider using a non-flanged window unit to facilitate future window repair and replacement without the need to remove the anchored masonry veneer. Refer to window strap anchor detailing in Chapter 2 details when a non-flanged window is used.

- Refer Fig. i-41 on page i-53 of the introductory chapter of this guide for lip brick detailing options which can minimize the appearance of the sheet-metal flashing shown in this detail.

- Weep/vents located above the angle support provide rainscreen cavity drainage and assist with ventilation. The mortar collection mesh minimizes the risk that mortar dropping will block weep/vents.

---

**Water-Shedding Surface and Control Layers**

- **Control Layers:**
  - Water
  - Air
  - Vapor
  - Thermal

* Where a Class IV permeance (and sometimes Class III permeance) air barrier and WRB system exist and a vapor retarder is located inboard of wall framing

---

**Typical Window Head**

Detail 3-A
**LEGEND**

1. Typical Assembly:
   - Interior gypsum board
   - Vapor retarder
   - Wood-framed wall with batt insulation
   - Exterior sheathing
   - Sheet-applied air barrier and WRB field membrane
   - Air cavity
   - Anchored masonry veneer with
   - Clear water repellent
2. Flanged window
3. Sealant over backer rod
4. Minimum 1/4-inch-thick intermittent shims
5. Minimum 1/8-inch-thick intermittent shims behind sill flange for drainage
6. Sloped precast sill, sealant over backer rod (beyond), where applicable
7. Self-adhered or fluid-applied flashing membrane
8. Masonry veneer tie, fastened through air barrier sealant, fluid-applied flashing membrane, or self-adhered membrane patch per WRB system manufacturer recommendations
9. Continuous air barrier sealant tied to continuous seal at window perimeter
10. Continuous back dam angle at rough opening sill, minimum 1-inch tall. Fasten window through back dam angle per window manufacturer recommendations.

**Detail Discussion**

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

- A flanged window is depicted. Consider using a non-flanged window unit to facilitate future window repair and replacement without the need to remove the anchored masonry veneer. Refer to window strap anchor detailing in Chapter 2 details when a non-flanged window is used.

- 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.

*Where a Class IV permeance (and sometimes Class III permeance) air barrier and WRB system exist and a vapor retarder is located inboard of wall framing*
**Water-Shedding Surface and Control Layers**

1. **Typical Assembly:**
   - Interior gypsum board
   - Vapor retarder
   - Wood-framed wall with batt insulation
   - Exterior sheathing
   - Sheet-applied air barrier and WRB field membrane
   - Air cavity
   - Anchored masonry veneer with
   - Clear water repellent

2. **Flanged window**
3. **Sealant over backer rod**
4. **Minimum 1/4-inch drainage path, fill with free-draining compressible material**
5. **Sheet- or fluid-applied 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**

**Detail Discussion**

- Air and water control layer continuity is provided by the sheet-applied air barrier and WRB field membrane, sheet-applied or fluid-applied air barrier and WRB prestrip membrane, and air barrier sealant transition to the window.

- Maintain a clear drainage cavity between the brick return and the air barrier and WRB system by placing a free-draining material such as semi-rigid mineral fiberboard insulation between the masonry veneer and sheet-applied or fluid-applied air barrier and WRB prestrip membrane. Avoid filling this space with mortar.

- When exterior insulation is used with this wall system, consider the Chapter 2 rough opening details with sheet-metal jamb trim and sill flashing. Chapter 2 details are a thermally improved alternative to returning the masonry veneer at the jamb. This alternative allows for consistent exterior insulation thickness at the window perimeter.
**Detail Discussion**

- Air and water control layer continuity is provided by the sheet-applied air barrier and WRB field membrane, self-adhered or fluid-applied flashing membranes, and continuous air barrier sealant.

- Mortar collection mesh and weep/vents and vents are provided to encourage drainage and ventilation of the rainscreen cavity.

- The floor line is insulated with a closed-cell spray foam, which provides both thermal control layer continuity and vapor control layer continuity (when the insulation is installed to a depth at which it performs as a vapor retarder).

- Refer Fig. 1-41 on page i-53 of the introductory chapter of this guide for lip brick detailing options which can minimize the appearance of the sheet-metal flashing shown in this detail. Note that this joint is necessary for differential movement that may occur between the structure and anchored masonry veneer.

*Where a Class IV permeance (and sometimes Class III permeance) air barrier and WRB system exist and a vapor retarder is located inboard of wall framing*
Parapet at Conventional Roof System with Air Barrier Prestrip

**Detail Discussion**

- In this detail, air control layer continuity is provided by the roof membrane air/vapor barrier prestrip membrane, the self-adhered or fluid-applied transition membrane, and the sheet-applied air barrier and WRB field membrane.

- Vents are located at the top masonry course to encourage ventilation of the rainscreen cavity. The sheet-metal parapet coping with hemmed drip edge is held off the anchored masonry veneer face to minimize blocking air flow through the vents. The sheet-metal coping also protects the vent opening from wind-driven rain.

- Refer to the next pages for a typical parapet detail with an alternative roof-to-wall air control layer transition.
**LEGEND**

1. Parapet Assembly
   - Roof membrane
   - Exterior sheathing
   - Vented wood-framed parapet
   - Exterior sheathing
   - Sheet-applied air barrier and WRB field membrane
   - Air cavity
   - Anchored masonry veneer with
   - Clear water repellent
2. Conventional roof assembly
3. Sloped standing-seam sheet-metal coping with gasketed washer fasteners
4. High-temperature self-adhered membrane
5. Compressible filler
6. Vent at maximum 24-inches on-center
7. 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
8. Continuous air barrier sealant between sheathing and sheet air barrier and WRB field membrane
9. Insect screen
10. Preservative-treated blocking
* Size gap for project-specific movement, minimum ¼-inch

**Detail Discussion**

- In this detail, air control layer continuity is provided by the roof assembly air/vapor barrier membrane, closed-cell spray foam insulation within the parapet cavity, the continuous air barrier sealant, and the sheet-applied air barrier and WRB field membrane.

- At minimum, parapet cavity and roof insulation R-values should be equivalent.

- The sheet-metal parapet cap is offset from the face of the masonry veneer to avoid blocking the ventilation path. A ½-inch gap is recommended.
**Detail Discussion**

- Masonry wall system installation often precedes roof membrane installation. As a result, the sequence of roof-to-wall transition detailing needs to be considered. As shown, the self-adhered flashing membrane behind the ledger may be left long, to hang below the ledger, to lap over the roof base flashing termination once installed. This membrane provides continuity of the air barrier system between the wall and roof assemblies.

- The roof termination bar and sheet-metal counterflashing conceal the self-adhered flashing from UV exposure.

† Where a Class IV permeance (and sometimes Class III permeance) air barrier and WRB system exist and a vapor retarder is located inboard of wall framing.
LEGEND

1. Wood-framed wall with batt insulation
2. Exterior sheathing
3. Vented wood-framed parapet
4. Closed-cell spray foam insulation
5. Sloped preservative-treated blocking
6. Sheet-applied air barrier and WRB field membrane
7. Sheet-applied or fluid-applied air barrier and WRB prestrip membrane
8. Masonry veneer tie, fastened through air barrier sealant, fluid-applied flashing membrane, or self-adhered membrane patch per WRB system manufacturer recommendations
9. Anchored masonry veneer
10. Hot-dipped galvanized-steel loose lintel
11. Sheet-metal head flashing with hemmed drip edge and end dams beyond
12. Continuous air barrier sealant
13. Conventional roof assembly
14. High-temperature self-adhered membrane over
15. Sloped standing-seam sheet-metal coping with gasketed washer fasteners
16. Closed-cell spray foam insulation
17. Flanged window

3-D Detail Discussion (Details 3-H, 3-I, 3-J)

- Three-dimensional cutaway sections on the next three pages represent two-dimensional details of this system with the exception

- In all details, water control layer elements are shingle-lapped to encourage drainage within the rainscreen cavity.

- As shown in Detail 3-G, the lintel is placed above the window head and shingle-lapped into the air barrier and WRB field membrane. The continuous air barrier sealant above this location provides air barrier continuity between the sheet-applied or fluid-applied air barrier and WRB prestrip membrane field membrane.

- As shown in Detail 3-G, air control layer continuity at the roof-to-wall interface is maintained with the line of continuous air barrier sealant at the parapet and the closed-cell spray foam insulation within the parapet framing. These components transfer the air control layer from the roof assembly to wall system.

- Terminate the sheet-metal head flashing in Detail 3-G at a masonry veneer head joint. This allows for an end dam to be formed at the termination.

- Weep/vents at the floor line continuous shelf angle support shown in Detail 3-H provide both drainage and ventilation of the rainscreen cavity above. Mortar collection mesh helps keep the weeps and the base of the rainscreen cavity free of mortar droppings.

- Detail 3-I describes a typical rough opening with continuous sill back dam angle. The back dam angle creates a sill pan below the window; intermittent shims encourage drainage at the sill and into the rainscreen cavity.

Parapet Assembly Cutaway Section
Detail 3-H
Floor Line Cutaway Section
Detail 3-I

1. Wood-framed wall with batt insulation
2. Closed-cell spray foam insulation
3. Exterior sheathing
4. Self-adhered or fluid-applied flashing membrane
5. Sheet-metal flashing with hemmed drip edge over hot-dipped galvanized-steel continuous shelf angle support anchored to structure
6. Self-adhered or fluid-applied flashing membrane
7. Continuous air barrier sealant
8. Sheet-applied air barrier and WRB field membrane
9. Continuous mortar collection mesh
10. Masonry veneer tie, fastened through air barrier sealant, fluid-applied flashing membrane, or self-adhered membrane patch per WRB system manufacturer recommendations
11. Anchored masonry veneer
12. Sealant over backer rod (movement joint)
13. Weep/vent at maximum 24-inches on-center

Typical Windowsill and Jamb Cutaway Section
Detail 3-J

1. Continuous back dam angle at rough opening sill, minimum 1-inch tall. Fasten window through back dam angle per window manufacturer recommendations.
2. Sheet-applied air barrier and WRB field membrane
3. Self-adhered or fluid-applied flashing membrane
4. Sheet-applied or fluid-applied air barrier and WRB prestrip membrane
5. Minimum ¼-inch-thick intermittent shims
6. Continuous air barrier sealant, tie to continuous seal at window perimeter
7. Masonry veneer tie, fastened through air barrier sealant, fluid-applied flashing membrane, or self-adhered membrane patch per WRB system manufacturer recommendations
8. Anchored masonry veneer
9. Flanged window with minimum ¼-inch-thick intermittent shims beneath sill flange
10. Sloped precast concrete sill
11. Sealant over backer rod between precast sill and window frame, continuous at window perimeter
1. Wood-framed wall with batt insulation  
2. Exterior sheathing  
3. Self-adhered or fluid-applied flashing membrane  
4. Sheet-applied air barrier and WRB field membrane  
5. Parapet saddle flashing membrane, extend onto sloped parapet blocking beyond brick face and over wall beyond  
6. Hot-dipped galvanized-steel continuous shelf angle support, bolted to structure  
7. Self-adhered or fluid-applied flashing membrane  
8. Sheet-metal flashing with hemmed drip edge  
9. Continuous mortar collection mesh  
10. High-temperature self-adhered membrane over sloped, preservative-treated blocking  
11. Sloped standing-seam sheet-metal coping, end dam at anchored masonry veneer face beyond  
12. Batt insulation  
13. Conventional roof assembly with roof membrane  
14. Sheet-metal counterflashing with spring-lock inserted into mortar bed beyond, seal with a sanded sealant over backer rod  
15. Roof assembly air/vapor barrier prestrip membrane below parapet frame and roof structure and between parapet framing and wall structure  
16. Self-adhered or fluid-applied transition membrane  
17. Mortar weep/vent at maximum 24-inches on-center

**3-D Detail Discussion (Detail 3-K)**

- The saddle flashing in this detail is often a fluid-applied flashing. A self-adhered saddle flashing membrane may be difficult to form continuously at the parapet to wall interface. The saddle flashing membrane extends onto the wall structure/sheathing and shingle-laps the high-temperature self-adhered membrane at the parapet and the transition membrane at the wall.

- The continuous hot-dipped galvanized-steel shelf angle support is anchored directly back to the structure where exterior insulation is not used. Where exterior insulation is used, a stand-off shelf angle support is recommended. The ledger is located above the parapet blocking; the separation distance between the blocking and ledger is sized to accommodate any anticipated building movement during construction or occupancy.

- The sloped parapet below the ledger encourages drainage of water away from the parapet saddle transition.

- The standing-seam sheet-metal coping end dams at the anchored masonry veneer face and deflects water away from the parapet saddle transitions.

- The sheet-metal counterflashing with spring-lock is inserted into a mortar bed joint at the anchored masonry veneer and is sealed with a sanded sealant joint. Installation of the counterflashing can occur following installation of the anchored masonry veneer. The sanded sealant joint may be cut and counterflashing removed as needed for roof and parapet membrane repair and replacement.

- Refer to Detail 2-J in Chapter 2 for a similar cutaway section at the inside parapet face.