Avoiding Common Oversights in Design and Construction of Mid-Rise Wood-Framed Buildings

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Abstract

This presentation will describe and provide examples of all-too-common problems in the design and construction of mid-rise wood-framed buildings that can arise from differential movement between brick veneer and wood-framing, the use of multistory brick veneer, complicated interfaces that involve different cladding materials, and problematic details at decks and balconies. This intermediate-level presentation, which will be of interest to building owners, designers, and contractors, is based upon the experience gained by the authors investigating and repairing exterior envelope-related problems on mid-rise wood-framed buildings over the past 30 years, and will include a discussion of proper detailing considerations to mitigate these problems.

Speaker


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**ABSTRACT**

All too often, the exterior envelope of today’s mid-rise commercial and multifamily/mixed-use wood-framed buildings experiences unnecessary problems with water infiltration. This infiltration often results in damaged interior finishes, mold growth, and hidden deterioration leading to significant repair and legal costs, owner disruption, lost revenue, and wounded reputations. This paper describes and provides examples of frequent problems arising from differential movement between brick veneer and wood-framing, the use of multistory brick veneer on mid-rise buildings, complicated horizontal and vertical interfaces that involve different cladding materials, and susceptible details at decks and balconies. This paper is based upon the experience gained by the authors performing design peer reviews and investigating and repairing a wide variety of problems with the exterior envelope of mid-rise wood-framed buildings in the upper Midwest over the past 30 years. The objective of this paper is to help the reader 1) develop an awareness of common detailing and construction problems relating to the exterior envelope of mid-rise wood-framed buildings, 2) understand the design and construction considerations necessary to minimize the risk of water infiltration, 3) recognize potentially problematic details in new construction, and 4) understand repair approaches for dealing with existing problems.

**MULTISTORY BRICK VENEER**

Multifamily, mixed-use four- and five-story buildings are frequently built using wood-frame construction above a concrete podium. Brick veneer is commonly used on these structures, and on some projects, the brick veneer extends the full height of the building (i.e., over 30 feet). Vertical expansion joints are often present in these walls to account for horizontal volumetric expansion of brick masonry; however, no horizontal expansion joints are present to accommodate the vertical expansion.

The International Building Code (i.e., 2012 IBC and the referenced Sections 6.1 and 6.2 of TMS 402/ACI 530/ASCE 5) limits the height of anchored brick veneer backed by wood framing to 30 feet. However, greater heights are permitted provided the veneer is designed rationally and certain requirements are met. These requirements include giving consideration—in the design, detailing, and construction—to issues such as differential movement, water penetration, proper cavity drainage, corrosion, air and vapor transmission, and anchor design. When differential movement is not properly accommodated and water penetration is not properly addressed, a host of problems can result, including the crushing of window frames, back-pitched metal flashings and masonry sills, disengagement of veneer anchors, water infiltration, biological growth, and wood decay.

**Differential Movement Between Brick Veneer and Wood Framing**

Fired clay brick units expand when exposed to moisture and do not return to their original size upon drying—a phenomenon known as irreversible expansion due to moisture. The volumetric change of each individual brick in the wall results in long-term, irreversible growth in the height and width of the veneer cladding system. Additional growth occurs due to increases in temperature (i.e., thermal expansion). The calculated magnitude of expansion due

<table>
<thead>
<tr>
<th>Type of Movement</th>
<th>Magnitude of Movement,1 inches per floor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irreversible expansion due to moisture</td>
<td>0.036</td>
</tr>
<tr>
<td>Thermal expansion</td>
<td>0.034</td>
</tr>
</tbody>
</table>

1. Calculated using the coefficients of moisture and thermal expansion provided in TMS 402/ACI 530/ASCE 5, p. C-25, a temperature change from 70° to 140°F (Δ = 70°F) for a dark-colored brick, and a 10-ft. floor-to-floor height. If using the coefficient recommended in BIA Technical Note 18, the moisture expansion is 0.060 in. instead of 0.036 in.

**Table 1 – Expansion of brick veneer.**

<table>
<thead>
<tr>
<th>Framing System</th>
<th>Description</th>
<th>Magnitude of Movement, inches per floor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Floor with engineered-wood I-joists and solid-sawn lumber wall framing when components are installed and kept relatively dry (at or below 19% moisture content) during construction</td>
<td>0.25</td>
</tr>
<tr>
<td>2</td>
<td>Same as Framing System 1, except framing components allowed to get wet during construction (i.e., above 19% moisture content)</td>
<td>0.375 to 0.5</td>
</tr>
<tr>
<td>3</td>
<td>Solid-sawn joists (magnitude of movement varies with moisture content during construction)</td>
<td>0.5 to 1.0</td>
</tr>
</tbody>
</table>

**Table 2 – Shrinkage and settlement due to the closing of construction gaps over time between stacked wall components such as studs, plates, and floor decking.**
Cumulative Movement, Inches

<table>
<thead>
<tr>
<th>Top of Floor Level</th>
<th>Brick (Expansion)</th>
<th>Wood Framing (Shrinkage/Settlement)</th>
<th>Total Differential Movement, Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Moisture</td>
<td>Temperature</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.036</td>
<td>0.034</td>
<td>0.25</td>
</tr>
<tr>
<td>3</td>
<td>0.072</td>
<td>0.068</td>
<td>0.50</td>
</tr>
<tr>
<td>4</td>
<td>0.108</td>
<td>0.102</td>
<td>0.75</td>
</tr>
<tr>
<td>5</td>
<td>0.144</td>
<td>0.136</td>
<td>1.00</td>
</tr>
<tr>
<td>Roof</td>
<td>0.180</td>
<td>0.170</td>
<td>1.25</td>
</tr>
</tbody>
</table>

3. The magnitude of movement is based upon the values shown in Table 1.

Table 3 – Differential movement.

to each of these effects is shown in Table 1.

Wood-frame shrinkage is due to wood drying from its moisture content at the time of installation to its equilibrium moisture content once the building is complete and the interior environment is established. Wood-frame settlement is caused by the closing of gaps between stacked wall-framing components such as studs, plates, floor trusses, and floor decking. The magnitude of wood-frame shrinkage and wood-frame settlement can vary from building to building and is dependent upon a number of variables, which can include framing details, the type of wood framing, wood moisture content at the time of installation, exposure to moisture during construction, and construction means and methods. The recommended design values for the magnitude of shrinkage and settlement of common, conventional light-frame construction are shown in Table 2 (Martin and Anderson, 2010).

The differential vertical movement that results from shrinkage and settlement of the wood framing and expansion of the brick masonry is cumulative, increasing in magnitude with each floor level, with the greatest differential movement occurring at the higher floor levels, as shown in Table 3.

The following conditions are some examples of potential problems that may occur if differential vertical movement between the wood frame and brick veneer is not accommodated:

- Crushing of window frames along the sill
- Failed sealant joints at window heads and jambs (Figure 1)
- Cracking and displacement of veneer along horizontal interfaces with other cladding materials (Figure 2)
- Failed sealant joints where masonry abuts other cladding materials
- Back-pitched metal flashing and masonry sills (Figure 3)
- Back-pitched dryer exhaust ducts

Figure 1 – Failed sealant joint at window head due to differential movement between the wood frame and brick veneer (arrow).

Figure 2 – Cracking, rotation, and displacement of brick veneer at horizontal interface with stucco cladding and Juliet balcony due to differential movement.
and fireplace flue ducts
• Deformed/disengaged veneer anchors
• Damage at and around support brackets for balcony hanger rods that extend through the brick veneer
• Water infiltration into the wall construction

Potential Solutions
• Differential movement should be carefully considered in the design, detailing, and construction process, particularly on buildings that are three stories or more in height.
• Consideration should be given to minimizing the differential movement that occurs. Differential movement between the brick veneer and wood structure can be reduced in several ways, including: 1) proper storage of lumber on-site to minimize exposure to moisture, 2) protecting the wood structure from moisture during construction, and 3) erection of as much of the building as possible to promote drying and settlement of the wood structure before starting construction of the masonry veneer.
• A reasonable magnitude of shrinkage and settlement of the wood frame should be anticipated and accommodated in the design. Further, the design should account for anticipated movements by providing 1) horizontal sheet metal flashings that can accommodate the expected movement, 2) sufficiently sized gaps to allow for movement where rigid elements such as windows, brackets, beams, and duct pipes extend through the masonry, and 3) adjustable veneer anchor ties.
• Consideration should be given to incrementally increasing the spacing between masonry sills and window units at each successive floor as the building height increases to accommodate movement. Where possible, consider supporting slip sills with a shelf angle and a tall vertical leg on the metal flashing below.
• Sealant failures should be expected at brick masonry penetrations and interfaces with other cladding materials, even with proper joint detailing. The owner should be made aware that annual maintenance inspections and sealant replacement will be necessary and especially important in the first several years after construction.

Water Infiltration
The use of multistory brick veneer poses special challenges to the designer and contractor with regard to water infiltration. Proper design, detailing, and construction are essential to minimize the risk of water leakage into occupied portions of a building and into the wall construction. Leakage can result in wet insulation, biological growth, musty odors, damage to interior finishes, and decay of sheathing and framing members. When brick veneer is installed continuously over the full height of a wood-framed building—a height often ranging to four or five stories—it is typically uninterrupted from the top of the foundation to the top of the walls. Because there are generally no relief angles provided at each floor line, such as commonly done in concrete and steel-framed buildings, through-wall flashing is only provided at the base of the walls and at lintels above windows and doors. The often long distance to the through-wall flashing provided at the base of the wall makes it crucial to minimize water penetration that occurs through the brick veneer and to provide a properly designed and constructed moisture drainage system to manage water that penetrates the brick veneer.

Water penetration should be expected through the brick veneer (TMS 402/ACI 530/ASCE 5). When water penetrates the masonry, it usually does so through minute separations existing between the brick and the mortar. Water penetration can also occur to a much lesser degree through the masonry units and mortar, and on a more localized basis through cracks in the masonry and failed sealant joints. The volume of water that penetrates new brick veneer can vary considerably from project to project and is dependent upon the quality of workmanship, masonry materials used and their properties, mortar joint profile, and architectural detailing. Limited amounts of water can normally be accommodated without leakage to the interior or adverse effects on the materials that make up the wall. However, when the volume of water that penetrates the masonry wall is significant, problems can result. If the drainage cavity behind the veneer or the through-wall flashing system is unable to handle the volume of water that penetrates
the masonry wall, water can enter into the backup wall or interior spaces. And, if large quantities of water penetrate the wall on a regular basis, the water may accelerate the corrosion of anchor ties due to the numerous wetting and drying cycles. Unsightly efflorescence can develop, as well as accelerated weathering of the masonry units and mortar, which can exacerbate water penetration. Minimizing the amount of water penetrating a brick veneer wall system requires proper design and detailing, construction of an effective wall and cavity drainage system, exercising good workmanship during construction, and maintaining sealant joints.

The proper tooling of mortar joints provides a more dense and watertight surface that reduces water penetration, with concave tooled joints recommended for exterior brickwork. Because of their poor water penetration resistance, raked and struck joints are not recommended. Unlike concave tooled joints, the mortar in a raked joint is not forced against the bond surfaces of the brick. The front portion of the mortar joint is removed with a tool that can open up voids in the head and bed joints, and this increases water penetration. A ledge is also formed on the top surface of the brick unit at the base of the bed joints. Water flowing down the face of the wall during a rain collects on this ledge—similar to what occurs at a recessed brick course or rowlock course—and this increases water penetration through the masonry. Like raked joints, struck joints are generally recommended for interior applications only and not exterior masonry work because of their poor water penetration-resistance and durability.

Full, well-compacted, and tooled head joints are necessary for an exterior masonry wall to resist water penetration. Partially filled head joints—joints that are not completely filled and that contain voids—have much less resistance to water penetration and provide a pathway for water to pass through the veneer (Figure 4). More water penetration through the veneer results in a greater volume of water reaching the drainage cavity, which in turn can cause a greater amount of moisture in the masonry and backup wall, as well as water leakage to the interior of the building. The authors have tested brick veneer walls with partially filled head joints that have exhibited water penetration rates as great as 0.8 gallons/hour/square foot. Head joints in soldier courses are particularly difficult to fill and compact, when compared to brick units installed in a running bond or similar pattern; as a result, these joints generally experience greater water penetration.

Water that gets past the veneer is intended to be managed by a drainage cavity and related flashings. Water within the drainage cavity is intended to flow freely to the bottom of the cavity or penetrations in the wall system such as windows and doors, where flashing diverts it to the exterior through weeps. Mortar bridges can prevent the proper functioning of the drainage cavity. Mortar bridges are globs of...
mortality that bridge across the airspace (i.e., drainage cavity) between the masonry and the water-resistant barrier/exterior sheathing (Figure 5).

Recessed brick courses reduce the width of the drainage cavity and increase the potential for mortar bridging and obstruction of the drainage cavity. When significant mortar bridging is present, there are several adverse effects on wall performance:

1) It impedes the downward flow of water within the drainage cavity and allows the water to remain in the wall for longer periods of time.
2) It permits water penetrating the exterior masonry to flow across the cavity, wetting the face of the water-resistant barrier (WRB), covering the sheathing (e.g., felt or building paper), and increasing the potential for water intrusion.
3) It impedes air circulation.
4) It can clog weeps.

If there is enough water accumulation in the drainage cavity due to mortar bridging, water can soak into the WRB and underlying wall assembly. Some of this absorbed moisture evaporates to the exterior side of the wall. However, moisture can also be absorbed within the wall, turning to vapor when the masonry wall is heated by sunlight. The elevated humidity levels within the drainage cavity produce a vapor pressure that is higher than the air-conditioned interior space. In a northern climate, this vapor pressure differential causes water vapor to migrate toward the cold (indoor) side of the wall, where it can condense on the outboard side of the vapor retarder and can result in wet insulation and increased risk of biological growth. The installation of a drainage material installed over the full height of the building, and through-wall flashing is only provided at the bottom of the wall, it is essential to minimize the amount of water accumulating within the drainage cavity. A wider drainage cavity or a cavity drainage material installed over the full height of the wall (BIA Technical Note 7A) should be considered to minimize mortar bridging, improve functioning of the weeps, and improve evaporative drying and air circulation within the cavity.

The designer should clearly indicate the width of the required cavity on the drawings—either shown as a nominal dimension or defined by way of overall wall depth on the exterior wall-type detail drawings.

The use of recessed brick courses that reduce the width of the drainage cavity, and projecting brick courses that create a ledge on the exterior surface of the wall, should be avoided when possible. If projecting brick courses are used, the top surface should be sloped away from the wall to drain.

The installation of a properly detailed and installed WRB is essential to prevent water infiltration into the wall and occupied portions of the building. The WRB should be properly integrated with fenestration flashings, and construction mock-ups should be considered to verify the proper installation details at windows, as well as other penetrations such as scuppers, flue ducts, dryer vent ducts, and balcony hanger bracket assemblies.

Potential Solutions

- When brick veneer extends the full height of the building, and through-wall flashing is only provided at the bottom of the wall, it is essential to minimize the amount of water accumulating within the drainage cavity. A wider drainage cavity or a cavity drainage material installed over the full height of the wall (BIA Technical Note 7A) should be considered to minimize mortar bridging, improve functioning of the weeps, and improve evaporative drying and air circulation within the cavity.

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Potential Solutions

- Through-wall flashing should extend to the exterior face of the wall, terminating with a metal drip edge, and installed with end dams, sealed lap joints, and proper support to prevent sagging where the flashing spans across the drainage cavity.

- Particularly on taller walls, the use of cellular weeps to more quickly move water from the cavity and assist in air movement and promote drying within the cavity should be considered.

**CLADDING INTERFACES**

Mid-rise wood-frame buildings constructed today use multiple cladding materials that can include clay brick masonry, adhered manufactured stone veneer, Portland cement plaster (stucco), fiber cement lap and panel siding, vinyl siding, metal siding, resin panels, wood, and engineered wood siding. The physical properties of these materials vary; therefore, each material behaves differently when exposed to moisture and changes in temperature. Architectural features can result in additional complexity at cladding interfaces. It is the authors’ experience that errors are more common at cladding interfaces and result from inadequate detailing, as well as poor coordination between the various trades installing the different cladding materials.

**Horizontal Cladding Interfaces**

Horizontal transitions between siding materials installed on the upper portions of a building and masonry veneer installed along the base of the building sometimes occur within the height of the windows. The masonry commonly includes a natural stone or cast stone (precast) concrete water table to deflect water running down the face of the wall and to serve as a horizontal transition between the different cladding materials. To prevent water from migrating behind the water table elements, an L-shaped, prefinished metal flashing is typically installed along the horizontal cladding interface. When the metal flashing is at the same elevation as the windowsills, the flashing is commonly terminated at the window or extended below the window in some fashion by cutting or folding the flashing (Figure 6).

In areas where the horizontal flashing intersects a door/window or other wall opening, incorporation of end dams at the
interface is critical to prevent water from spilling off the ends of the flashing where it can potentially migrate behind the cladding below. End dams also divert water flowing down the window or doorjamb out and away from the wall. It is the authors’ experience that end dams, while typically specified generically within the project documents, are often not fully understood by the installers and are not adequately discussed during preconstruction meetings and cladding mock-ups. Without a proactive plan, these interfaces are either filled with sealant or, more commonly, not addressed and are left open. While sealant does provide some initial resistance to water penetration, the typical joint configuration results in a poor sealant detail, resulting in three-sided sealant adhesion and often premature failure of the sealant. Thermal movements within the cladding and moisture movements in the structure are often sufficient to fail the sealant early in the life of the structure. In addition, sealant installed at these locations is typically not accessible, making both identification of the sealant failures and implementation of sealant repairs infeasible.

Other potential problems can result if the horizontal flashing leg installed over the masonry water table is allowed to lift, permitting water to penetrate beneath the flashing and behind the cladding below. Flat or back-pitched flashing can also collect water along the heel of the flashing, increasing the volume of water that can spill off the ends of the flashing if proper end dams either are not incorporated or penetrate unsealed lap joints. In the authors’ geographical region, these flashings can become back-pitched toward the building due to the following primary causes:

- Hemmed edges, while necessary to conceal the cut edge of the flashing, can raise the front edge of the flashing, either reducing or eliminating any downward slope of the flashing leg, particularly if the flashing is placed over a horizontal surface.
- Differential vertical movement along the joint caused by drying shrinkage and settlement of the wood frame and irreversible moisture-related expansion of clay brick masonry can reduce or eliminate any positive slope originally provided in the flashing.

**Potential Solutions**

- The termination of horizontal cladding interfaces at windows and other openings should be avoided through design, where possible.
- Construction of flashing end dams at window and door interfaces should be properly detailed and reviewed during preconstruction meetings. Mock-ups should be considered to ensure constructability and proper sequencing of flashing materials. End dams should incorporate sealed corners that allow the WRB and self-adhering membrane flashings to lap over the top edge of the metal flashing. Shop fabrication of the flashing end dams is recommended to ensure consistency and properly sealed corners. While soldered seams provide the highest level of performance, sealant can also be utilized, provided the overlapping pieces of flashing are secured and remain in intimate contact.
- Ensure that sufficient slope of the horizontal metal flashing is provided. One simple technique that can be utilized consists of prebending the flashing so that the angle between the flashing legs exceeds the installed slope of the flashing. Sometimes referred to as compression flashing, the flashing is installed by sliding the vertical leg down to preload the sloped flashing leg in compression. Installed in this manner, the flashing is less prone to lifting after installation and can accommodate some amount of differential vertical movement between the wood frame and cladding, which can reduce the slope of the flashing after initial construction.
- Cladding designs that utilize masonry sills with a sloped top surface can help to ensure a consistent and sufficient slope away from the building and avoid problems that can occur with masonry units that must be placed on a sloped bed joint to achieve a sloped top surface. Masonry sills should also incorporate a drip to minimize wetting of the masonry below.
- Utilize a suitable flashing gauge to ensure a sufficiently stiff flashing; refer to the Sheet Metal & Air Conditioning Contractors’ National Association (SMACNA) guidelines.

**Vertical Cladding Interfaces**

Vertical cladding interfaces can also be problematic, resulting in an increased potential for water infiltration. While it is inevitable that sealants placed along these interfaces will eventually fail, when brick masonry is present along one side of the interface, the sealant typically fails prematurely due to the differential vertical movement that occurs from the effects of wood-frame shrinkage and settlement and moisture-related brick expansion, as previously discussed.

For aesthetic reasons, sealant installed along vertical cladding interfaces is often installed in a configuration that is not maintainable over the life of the structure. In addition, the uneven surface of masonry, and in particular adhered manufactured stone veneer, makes the installation of a properly configured and maintainable sealant joint more difficult.

Considering the potential for sealant failures along this joint, it is especially important that laps within the WRB do not
align behind the vertical cladding interface. Sequencing is important at these interfaces to ensure the WRB behind one cladding material (e.g., brick masonry) extends a sufficient distance behind the adjacent cladding material (e.g., fiber cement siding) for a continuous line of protection behind the sealant joint.

**Potential Solutions**

- Proper sequencing or coordination of the work should ensure that laps between layers of building paper and WRB extend behind the areas of siding, away from vertical cladding interfaces.
- Sealant joints placed along vertical cladding interfaces should be designed to be maintainable.
- To provide a smooth and adequate bond surface and to ensure a proper sealant profile, consider installation of a metal L-shaped trim along the interface when adhered masonry is used. The metal trim should be designed and configured to provide an edge termination for the masonry and a proper sealant joint profile between the metal trim and the siding.

**DECKS AND BALCONIES**

The terms “exterior deck” and “balcony” are often used synonymously; however, the distinction between these two building components is important, as some building codes and structural design standards require a higher minimum design live load for a balcony. While a deck is supported on at least two opposing sides by posts or other independent supports, a balcony does not contain these additional supports. In contrast, balconies are supported by the structure using cantilevered joists, external tension cables/rods, ledger boards, exterior beams (either dropped or flush), or a combination of these items. Since balconies typically utilize wood beams or joists that penetrate the exterior cladding, they can have a higher potential for water infiltration.

Balcony framing that cantilevers out through the exterior wall poses unique challenges. Moisture-driven dimensional changes of the exposed wood framing require the flashings and sealants to accommodate this movement. Because of this movement potential and the difficulty in flashing these complex interfaces, balcony-framing penetrations through the exterior wall should be avoided. While less complex, deficiencies in flashing installed over balcony and deck ledgers can also result in water infiltration and damage.

**Balcony and Deck Ledger Flashing**

Exterior balconies are common features on mid-rise wood-framed multifamily buildings. Because of the propensity for unsealed openings in the lapped flashing legs and the absence of sufficient slope for drainage, it has been the authors’ experience that water damage to wall components most commonly occurs below the inside corners of the deck or balcony framing or below laps in the ledger flashing (Figure 7).

Flashing laps at inside and outside corners are typically constructed by cutting and lapping the horizontal leg of the flashing. While sealant is often placed between the overlapping legs, these surfaces often separate, resulting in openings in the sealant and water penetration. One potential cause for this separation is the sloped drip and hemmed edge that are often incorporated into the ends of the flashing. These features do not allow the lapped surfaces to mate properly at inside corners. Field adjustments to flatten the mating surfaces during installation, such as with a hammer, are typically unsuccessful. The lack of positive slope away from the building also subjects any openings in the ledger flashing laps to an increased exposure to water. Debris, such as leaf litter and pine needles, can also accumulate along the edges of decking boards in the space between the decking boards and wall and hold water on the ledger flashing, thereby creating greater reliance on the proper sealing of lap joints to prevent water penetration.

Water allowed to penetrate behind the ledger board can become trapped due to the lack of clearance between the backside of the ledger and the WRB. This trapped water can then bypass the WRB at penetrations, such as at the lag screw fastener locations, or can pass into the wall cavity through vapor diffusion.

**Potential Solutions**

- The addition of a roof over the upper-level balcony offers greater protection to susceptible flashing details from rain and snow and can dramatically decrease exposure to the elements and the potential for problems at these areas.
Consider the incorporation of slope in the top (i.e., narrow) edge of the ledger board to promote water drainage away from potentially problematic joints. A similar tapered cut can also be incorporated along the bottom edge of the ledger to provide a drip (Figure 8).

Utilize shop-assembled flashing corners that incorporate soldered seams to provide the most effective, long-term solution. Constructing this flashing in a shop setting will decrease the field installation time and increase the potential for a watertight flashing installation.

Behind the ledger board, consider installing a compatible, self-adhering membrane flashing over the WRB at ledger fastener locations to better seal these penetrations, using a drainage medium behind the ledger board, and placing metal flashing strips behind butt joints within the ledger board.

Balcony Beam Penetrations

Balcony beams are typically supported in beam pockets cut into the wall framing. Therefore, these beams penetrate through the WRB and exterior cladding and must be flashed properly to prevent moisture intrusion into the wall. Because of the potential for moisture-related dimensional changes in the exposed wood and the complex geometry that is typically present at the perimeter of these beams, it has been the authors’ experience that when left up to the contractor in the field to devise this flashing, the potential for problems at this critical interface increases dramatically (Figure 9).

Potential Solutions

- Avoid balcony-beam penetrations when possible, and consider other support options, such as exterior posts, that do not require complex flashing in order to properly perform over the life of the structure.
- Construction of flashing at the beam penetrations should be thoroughly detailed, preferably utilizing prefabricated sheet-metal flashings, and reviewed during preconstruction meetings. Consider performing mock-ups to ensure constructability and proper sequencing of flashing materials.
- Consider covering the entire wood beam with a sheet-metal cap flashing and drip edges to reduce wetting of the beam. Incorporate flanges at the ends of the cap flashing to allow proper lapping of WRB and flashing materials over the cap flashing. Where multi-ply beams are present, the cap flashing also prevents water penetration between plies, which can bypass the flashing at the perimeter of the beam.

SUMMARY

It is not uncommon for the exterior envelope of today’s mid-rise commercial and multifamily/mixed-use wood-framed buildings to experience problems such as masonry cracking and displacement, wood decay, and water penetration into the building and wall construction. The differential movement that occurs between brick veneer and a wood structure (due to moisture and thermal movement of the brick veneer and shrinkage and settlement of the wood framing) should be carefully considered. Additional consideration should be given to horizontal and vertical cladding interfaces, as well as flashing details of decks and balconies. These aforementioned problems can often be avoided through proper design, detailing, and construction. Preconstruction meetings and construction mock-ups can be especially useful to resolve potentially problematic details.

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**Figure 8 – Bevel-cut ledger board used to facilitate water shedding and provide a drip edge.**

**Figure 9 – Deteriorated exterior gypsum sheathing and biological growth due to water penetration and absence of proper flashing at a multi-ply balcony beam.**
REFERENCES


