Technical Advisory
Issues with Code-Compliant Brick Veneer in Residential Construction – 001-2021

TITLE: Issues with Code-Compliant Brick Veneer in Residential Construction

DESIGNATION: RCI-TA-001-2011 (updated 2021)

OBJECTIVE: To provide commentary on issues associated with brick veneer construction that is code-compliant but differs from long-accepted trade practices.

A. BACKGROUND

- Modern residential brick construction includes brick veneer installation on the exterior of wood wall framing covered with engineered wood sheathing, and commonly a weather resistive barrier.
- Water that penetrates the brick veneer migrates down through the drainage cavity to collect at flashing and exit through weep holes located at the base of the wall or at interruptions in the drainage cavity.
- Brick veneer details published by the Brick Industry Association–some dating as far back as July 1950–have provided many years of successful performance when properly constructed.

B. THE PROBLEMS

- Investigations of many brick-veneer-clad buildings have revealed construction details that were found to meet code requirements but were not consistent with long-accepted trade practices.
- The International Residential Code (comprised of parts and pieces of previous building codes) includes provisions that differ from established details that have been found to be more functional.

C. MORTAR-FILLED AIR SPACE

- Code:
  i. 2018 IRC, Section R703.8.4.2 Grout fill: "As an alternative to the airspace required by Table R703.8.4, grout shall be permitted to fill the airspace. Where the airspace is filled with grout, a water-resistive barrier is required over studs or sheathing. Where the airspace is filled, replacing the sheathing and water-resistive barrier with a wire mesh and approved water-resistive barrier or an approved water-resistive barrier-backed reinforcement attached directly to the studs is permitted."
- Positions:
  i. Water vapor can readily migrate through the masonry wall assembly, even with the presence of the code-approved, highly permeable water-resistive barriers described above. Approved water-resistive barriers have typical perm ratings ranging from 9 (#15 asphalt-saturated felt) to approximately 60 (spun-bond polyolefin) and are marketed as vapor- and liquid-water-impermeable. However, investigations have revealed opposing results in certain assemblies.

ii. Liquid water can easily pass through unprotected areas of the wall assembly by capillary continuity when saturated mortar is in direct contact with a high-perm, water-resistive barrier. When this occurs, components and materials within the wall assembly that are susceptible to damage in the presence of high moisture levels are likely to deteriorate and/or exhibit mold growth. When mortar is in direct contact with high-perm water-resistive barriers, moisture migration can occur and has been documented to result in significant damage, as discussed in Derek Hodgin's 2008 *Interface* article (See Section G).

iii. These problems can become exacerbated in hot-humid climates due to the inward direction of moisture/vapor drive during the cooling (summer) months. This is cause by vapor pressure differential. Moisture/vapor moves from an area with higher vapor pressure, such as a hot-humid exterior environment, through the wall assembly towards an area with lower vapor pressure, such as a cool, air-conditioned interior environment unless a true vapor barrier is present to block the vapor transmission. Note that even Class I vapor retarders will allow some passage of vapor. To further intensify the problem, summer rain showers can saturate the brick veneer, and the moisture can migrate through to wet excess mortar accumulations within the cavity that are in contact with the high-perm, water-resistive barrier. Some of the moisture evaporates on the wall surface, while much of the water vapor can be driven towards the cool, conditioned interior. The wall assembly, when built in accordance with the referenced building code requirements, can experience possible damage.

The application and constructability of the alternative design provided by the Code should be limited to geographic areas with low relative humidity and low annual precipitation. These conditions would minimize the effects of deterioration and/or mold growth due to the intimate contact of the grout with a code-approved, highly permeable water-resistive barrier and moisture-sensitive materials.

D. INDUSTRY STANDARDS

- Brick Industry Association

i. BIA Technical Note 28, titled *Brick Veneer/Wood Studs* states: "It is essential to maintain the air space between the brick veneer and the backing to prevent the transmission of moisture and to ensure proper drainage."

ii. The Technical Note further states: "The width of the air space, the distance from the back of the brick to a material on the opposite side of the air space, should not be less than 1 in. (25 mm) wide. A 1-in. (25-mm) air space is customary in residential brick veneer/wood stud walls and has been used successfully for decades. Building codes also require a minimum 1-in. (25-mm) air space but use the terms "nominal" or "specified" to describe the distance. The IRC requires a minimum air space of a nominal 1 in. (25 mm), and the IBC requires a 1-in. (25-mm) minimum air space to be specified." "For commercial structures with brick veneer/wood stud walls, a wider air space of 2 in. (51 mm) is recommended."

a. This technical note does not address the filling of the air space with mortar in the presence of an approved water-resistive barrier, and there is no mention of omitting the water-resistive barrier when a 1-in. (25 mm) air space is provided, as permitted in the 2000 Edition of the International Residence Code.

Relevant technical note text states: "An exterior grade sheathing or insulation material is usually installed on the exterior side of the studs. A water-resistive barrier is required to be placed over the studs or sheathing. These membranes prevent liquid water from passing through them and should keep out any water that finds its way across the air space via anchors, mortar bridging or splashing."

b. The current provisions in the IRC contradict the long-standing (successful) details recommended by the BIA.

iii. BIA Technical Note 7, titled *Water Penetration Resistance – Design and Detailing*, states the following with respect to air spaces behind brick veneer in general:

a. "To the extent possible, the air space must be kept clear of mortar and mortar droppings to achieve adequate drainage. An air space that provides drainage is permitted to contain mortar from construction."

b. "When continuous insulation is present within the air space, provide a minimum dimension of 1 in. (25.4 mm) (nominal or specified per applicable code) between the inside face of the brick and the insulation"

c. "Drainage media may be specified that prevent mortar from entering the air space or that catch mortar droppings at the wall base. These materials are usually made of a plastic mesh or fabric porous enough to

allow passage of water but that will catch or inhibit mortar from collecting at the base of the air space. The effects of mortar collection devices should be considered carefully, as they may require modifications to typical details such as extending the vertical leg of the flashing more than 8 in. (203 mm) above the weep line. Drainage media is permitted to fill the full depth of the air space. While it is not mandatory to include drainage materials, they may help in providing an air space that drains properly. However, the use of drainage media should not preclude good workmanship and an effort to keep mortar and mortar droppings out of the air space to the extent possible."

- Architectural Graphic Standards

  i. The brick veneer cross section from the first edition of the AGS (published in 1932) includes the installation of building paper over the exterior wood wall sheathing and the presence of a 1-inch air space between the brick veneer and the protected wall sheathing.

  ii. The recommended design practices, as early as 1932, incorporate design details that provided protection of the wall assembly and effective drainage provisions.

  iii. The current provisions of the IRC can allow for the construction of possible suspect wall assemblies by the use of details that differ from the time-tested details that have been proven successful for many decades.

E. CONCLUSIONS

- Portions of the current IRC building code reflect details that are substandard, especially for buildings designed and constructed in specific geographic locations in the presence of high humidity and moisture that have resulted in damages. Incorporating commonly used industry minimum design standards that go above and beyond minimum code requirements, such as those recommended by BIA, are often advantageous.
- Structures located in mixed or hot/humid climates are particularly vulnerable to possible damage.
- Current building codes need to be carefully reviewed and revised to reflect the construction details that incorporate the time-tested best practices of the industry.

F. RECOMMENDATIONS

- Designers must consider that all building codes are the minimum requirements. In some cases, achieving acceptable performance and durability requires exceeding the minimum requirements of the building codes. Therefore, designers should consider industry standards in addition to the minimum requirements of the building codes.
- Modify existing IRC building codes to prohibit the filling of wall cavities with mortar.

G. REFERENCES

- International Code Council, Inc., 2018 International Residential Code for One-and Two-Family Dwellings, March 2018.
- International Code Council, Inc., 2018 International Building Code, February 2018.
- Brick Industry Association, Technical Notes on Brick Construction, Water Penetration Resistance Technical Note 7 Series, November 2017.
- Brick Industry Association, *Technical Notes on Brick Construction, Brick Veneer/Wood Studs, Technical Note 28* , November 2012.
- Charles George Ramsey and Harold Reeve Sleeper, *Architectural Graphic Standards for Architects, Engineers, Decorators, Builders and Draftsmen*, 1st edition, 1932.
- Derek A. Hodgin, "Problems with Code-Compliant Brick Veneer in Residential Construction," *Interface*, Sept. 2008, pp. 7-13.