BRICK FAÇADE EVOLUTION IN COMMERCIAL CONSTRUCTION IN WASHINGTON, DC, FROM 1950 ONWARD

BY PETER SALLEE

Façades: solid and void, cladding and fenestration—the basic elements. Simple. Concise. Yet when one starts to examine the various materials and assemblages that can be incorporated into creating building façades, the results are endless.

Cladding: dimensional stone, veneer stone, brick, concrete masonry units, terracotta, tile, metal panels, smooth panels, textured panels, corrugated panels, insulation-core panels, pre-cast concrete, tilt-up concrete, wood siding, aluminum siding, and vinyl siding (we'll skip that asbestos siding).

Fenestration: windows, curtainwall, plate glass, insulated glass units, vision glass, spandrel glass, laminated glass, tempered glass, aluminum frames, steel frames, wood frames, vinyl frames, thermally broken frames, fixed windows, operable windows, sliders, awnings, and casements.

So how to narrow the focus? I am an architect practicing in the Washington, DC, metropolitan area. I started in the field back in 1981, some 35 years ago, as a green intern (young and inexperienced, not environmentally correct). I have worked for small and large architectural firms and for myself—exclusively on commercial projects. Along with designing new buildings, I have spent a good part of my time designing renovations and additions to existing buildings, giving me insight into what was designed and how it was constructed over the decades (the fun being trying to figure out the mindset of the architect and the techniques of the craftsmen). Commercial projects in my geographical area are mostly office and multifamily use mid-rise, concrete-framed structures. Mid-rise here is 10 to 17 stories, depending on the jurisdictional zoning regulations (we call them "high-rise," but that is only self-inflating).

In Washington, DC, the Zoning Act of 1938 established use, location, and height and bulk limitations and incorporated the building height limits enacted by the U.S. Congress in 1910. (The Height of Buildings Act of 1910 limited the heights of new buildings within the federal city to 130 feet or the width of the right-of-way of the street the building fronted—whichever was less.) These height limitations spurred the development of reinforced concrete flat-plate construction to allow for shorter floor-to-floor heights than could be accomplished with steel-framed structures, so that the maximum number of stories could be designed and constructed. There have been and continue to be very creative uses of the zoning regulations to garner the maximum density such as measuring the building height from the highest point along the street frontage on a sloping site.

Much has been researched and written about façades—what is most efficient, most economical, most environmentally sensitive, best-performing, and all that other good stuff. So, through a combination of rereading old blueprints (and I do mean old, somewhat musty-smelling, white-on-blue prints) and referencing the quality technical standards from the *Whole Building Design Guide* of the National Institute of Building Sciences and The Brick Industry Association's (BIA's) *Technical Notes on Brick Construction* (both original and revised/updated), I will recap and offer analytical opinion on the development of brick masonry in the façades of commercial buildings in and around Washington, DC, throughout the years.

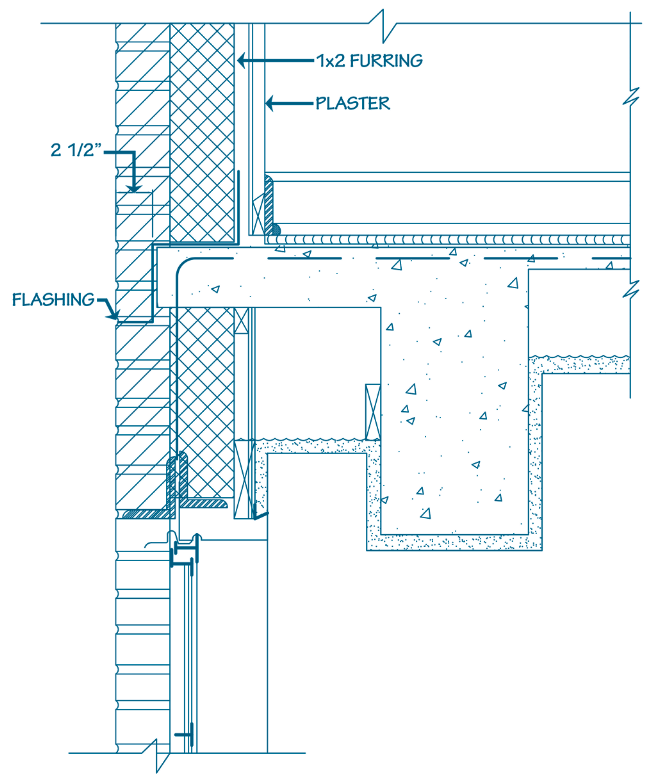


Figure 1 – Detail of 1950 rental apartment construction.

1950: RENTAL APARTMENT BUILDING

- ~750 units
- 8 stories (~85-ft. height) at frontage (additional four stories exposed at rear)
- Floor-to-floor height: 9 ft., 2 in.
- 139,500 sq. ft.

See *Figure 1*. The exterior masonry wall consists of a composite brick/block masonry unit wall of 8-in. combined masonry thickness and a mortar-filled cavity (a mortared collar joint) between, with two wythes. Inward, the wall has 1 x 2 wood furring strips, foil-backed sheetrock (as a lathing layer), and interior finish multi-application plaster. The typical floor slab is a one-directional concrete coffer with concrete beams (paralleling the exterior and the corridors) framing to concrete columns. The concrete slab, of 4-in. thickness, projects outward of the perimeter concrete beam to within 2½ in. of the exterior face-of-brick. This projection allows the brick wythe partial bearing. The slab front is concealed by cut bricks or "soaps." Through-wall metal flashing is installed at the slab edge, from interior back face to outer drip edge. The brick-to-block cross anchorage is provided by brick bonding, with the installation of "stretcher" bricks at seven courses on-center vertically. At window heads, double steel angle lintels are suspended from vertical rebar that is bent and cast into the concrete slab. Through-wall metal flashing is provided at the angles.

There was no insulation, no waterproofing, no vapor barrier, and no thermal expansion provisions—just the basics, typical of the era, and using only the mass of the wall; the brick + mortar + block provided everything needed. This was thought to allow sufficient leakage of air at the steel casement windows to minimize issues with moisture intrusion and mold development. The building is both heated and cooled mechanically by a central plant. Installing the through-wall metal flashing in the masonry mortar without providing a pathway by which water could exit (a secondary backup approach) was always an interesting practice.

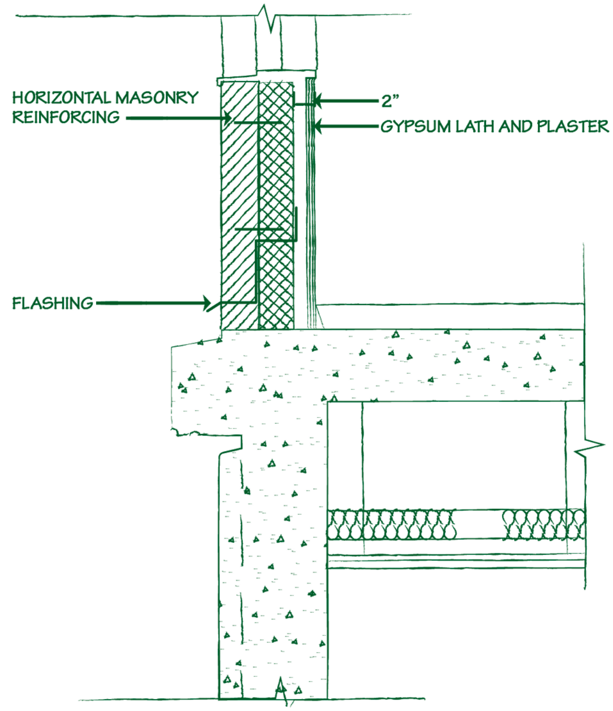


Figure 3 – Detail of 1966 rental apartment building.

1960: SPECULATIVE RENTAL OFFICE BUILDING

- 12 stories (~125-ft. height)
- Floor-to-floor height: 10 ft., 2 in.
- 70,000 sq. ft.

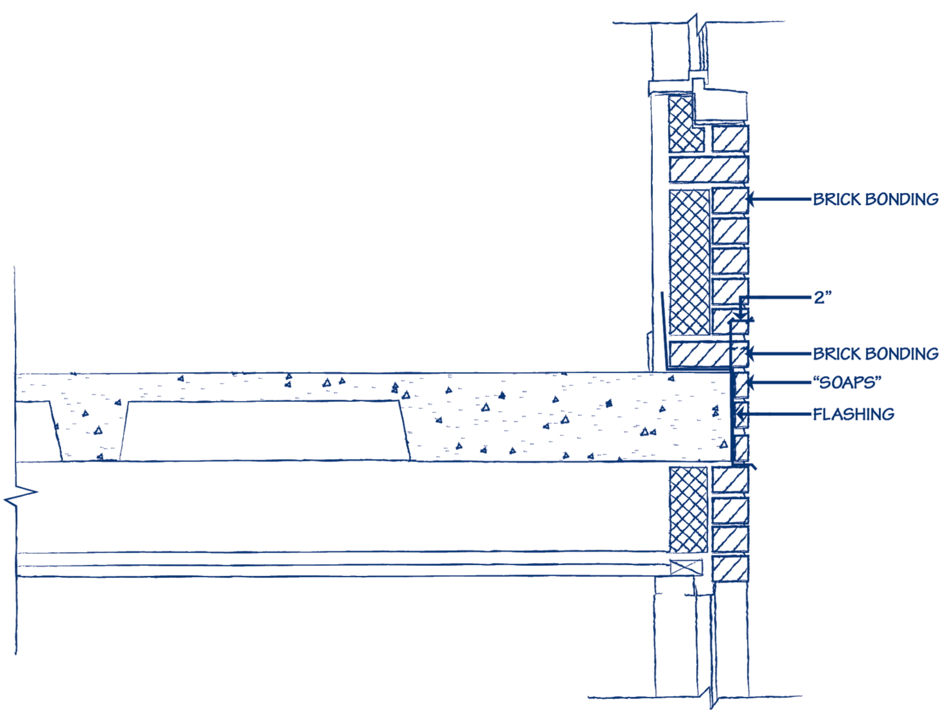


Figure 2 – Detail of 1960 speculative rental office building.

See *Figure 2*. The exterior masonry wall consists of a composite brick/block masonry unit wall of combined 8-in. masonry thickness and a mortared collar joint between, with two wythes. Inward, the wall has wood furring strips and plaster/lath finish. The typical floor slab is a one-directional concrete coffer of 8½-in. thickness with concrete beams and columns. The concrete slab projects outward, acting as a shallow beam, to within 2 in. of the exterior face-of-brick. This beam projection allows the brick wythe partial bearing. The slab front is concealed by cut bricks or "soaps." Through-wall metal flashing is installed at the slab edge, from interior back face to outer drip edge. The brick-to-block cross-anchorage is provided by brick bonding, with the installation of "stretcher" bricks at the slab top and at six courses on-center vertically. Loose steel angle lintels are provided at window heads with through-wall flashing. No mechanical anchorage of the brick/block wall is provided. However, dovetail slots are embedded into the concrete columns for connections at each column bay and corners of the building.

Again, we see no insulation, waterproofing, or vapor barriers beyond the physical mass of the masonry. Thermal expansion had just begun to become a concern; the concrete column-to-masonry wall slot anchorage provided connections while allowing up-and-down movement of the wall different from that of the structure.

1966: RENTAL APARTMENT BUILDING

- ~800 units
- 16 stories (~155-ft. height)
- Floor-to-floor height: 9 ft. 4 in.

See *Figure 3*. The exterior masonry wall consists of a composite brick/block masonry unit wall of combined 8-in. thickness and a mortared collar joint between, with two wythes. Inward, the wall has wood furring strips and plaster/lath finish. The structure is an 8-in.-thick reinforced concrete flat-slab with concrete columns.

The outer slab edge in this building has two conditions. The first is similar to the prototype of earlier construction, with the slab edge being 2½ in. inward of the face-of-building with soap bricks. The second is a projected, exposed-concrete slab tapered top and bottom sides with radius folds for an architectural expression. Horizontal metal masonry reinforcing is installed at 16 in. on center, vertically. Steel shelf angles are provided at the slab edge above full-height windows and sliding glass doors. Through-wall metal flashing is installed at the slabs and steel shelf angles.

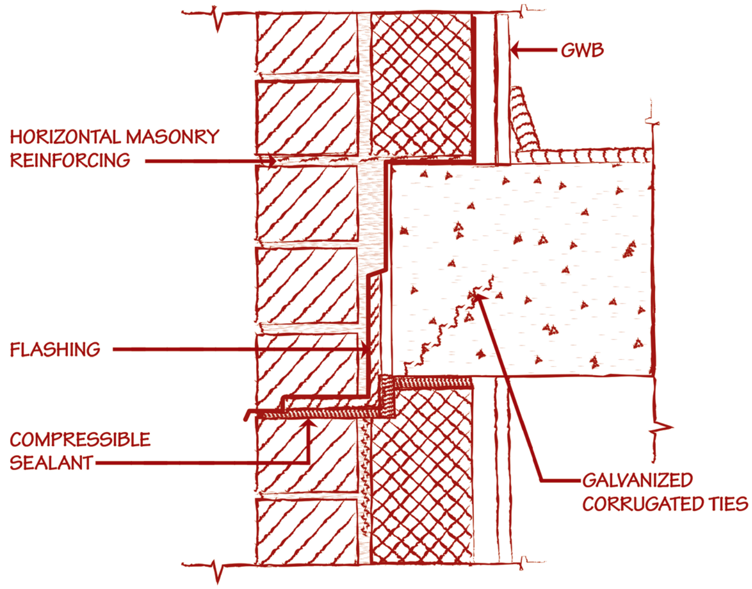


Figure 4 – Detail of 1971 rental apartment building.

Still, we see no insulation, waterproofing, or vapor barriers beyond the physical mass of the masonry. Thermal expansion has not been addressed, except for the limiting of masonry wall height between exposed slab-bearing and window-lintel angles at the many windows and sliding glass doors typical of the true "Modern" architectural design mantra.

We do, however, see the introduction of prefabricated horizontal masonry reinforcing instead of brick bonding with ladder or truss form reinforcing pieces.

1971 RENTAL APARTMENT BUILDING

- ~300 units
- 17 stories (~155-ft. height)
- Floor-to-floor height: 8 ft., 9 in.

See *Figure 4*. The exterior masonry wall consists of a composite brick/block masonry

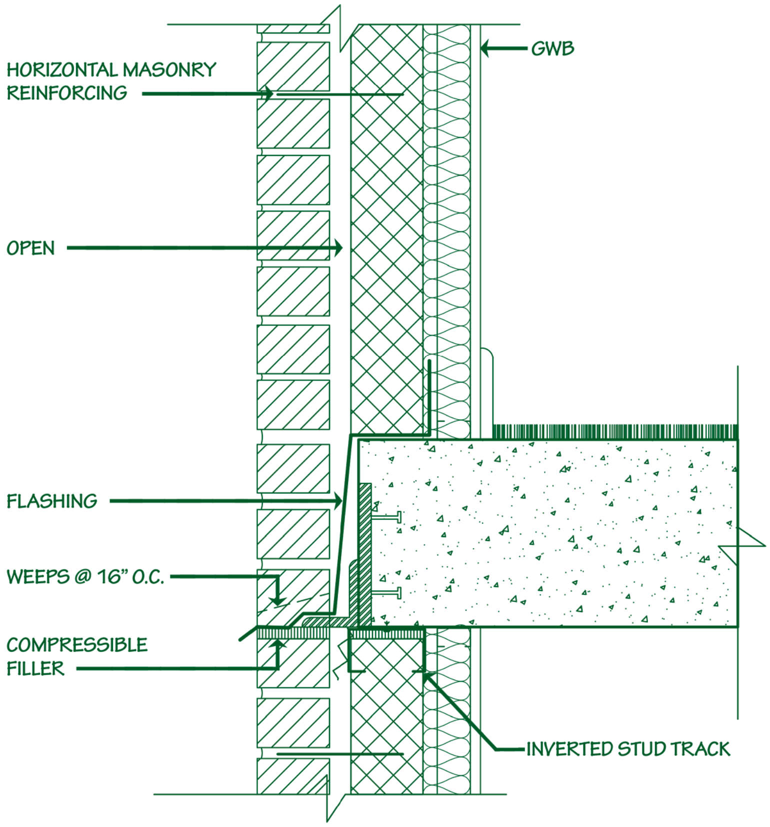


Figure 5 – Detail of 1988 rental apartment building.

unit wall of combined 8-in. thickness and a mortared collar joint between, with two wythes. Inwardly, the wall has 1 x 3 wood furring strips at 24 in. on-center, and ½-in. gypsum wallboard finish. The structure is an 8-in.-thick reinforced concrete flat-slab with concrete columns. The outer slab edge was originally designed at 2½ in. inward of the face-of-building with soap bricks. However, during construction, continuous 6 x 3½ x ⅝-in. steel shelf angles at the slab edge were installed at approximately every third floor with compressible filler and sealant at the underside to the top face of the brick in lieu of a mortar bed. Compressible filler was also installed at the underside of the slab/top of block at corresponding floor levels. Through-wall spandrel flashing was installed at the steel shelf angles. Horizontal metal masonry "ladder" reinforcing was installed at 16 in. on center, vertically. Galvanized corrugated masonry ties were also cast into the slab bottom edge at 48 in. on-center horizontally.

And still, we see no insulation, waterproofing, or vapor barriers beyond the physical mass of the masonry wall. Thermal expansion has just begun to be addressed. This is especially interesting, as masonry-relieving joints were added into the project during the construction (quite unusual, to say the least).

1988: RENTAL APARTMENT BUILDING

- 100 units
- 11 stories (~124-ft. height)
- Floor-to-floor height: 9 ft.

See *Figure 5*. The exterior masonry wall consists of a brick/concrete masonry unit (CMU) cavity wall of 8-in. thickness and an open cavity between, with two wythes. Inward, the wall has 2½-in. metal studs with batt insulation, and ½-in. gypsum wallboard finish. The structure is an 8-in.-thick reinforced concrete flat slab with concrete columns. The outer slab edge is 5 in. inward of the face of building. Continuous steel support angles, 4 x 4 x ¼ in., are welded to a steel plate/studs embedded in the cast-in-place structural concrete slab edge. An inverted metal stud track was installed at the underside of the slab to align with the CMU wythe with compressible filler at the CMU top coarse. Horizontal metal masonry "ladder" reinforcing is installed at 16 in. on center, vertically. Loose steel angle lintels with through-wall flashing are installed at window and sliding glass door openings. Vertical masonry control jointing is provided at fenestration jambs at approximately 20 ft. on-center.

So, we now see concerns regarding thermal resistance and environmental comfort being addressed. The open cavity was thought to be providing excellent thermal resistance, as well as water infiltration protection. *BIA Tech Note 21* (revised),

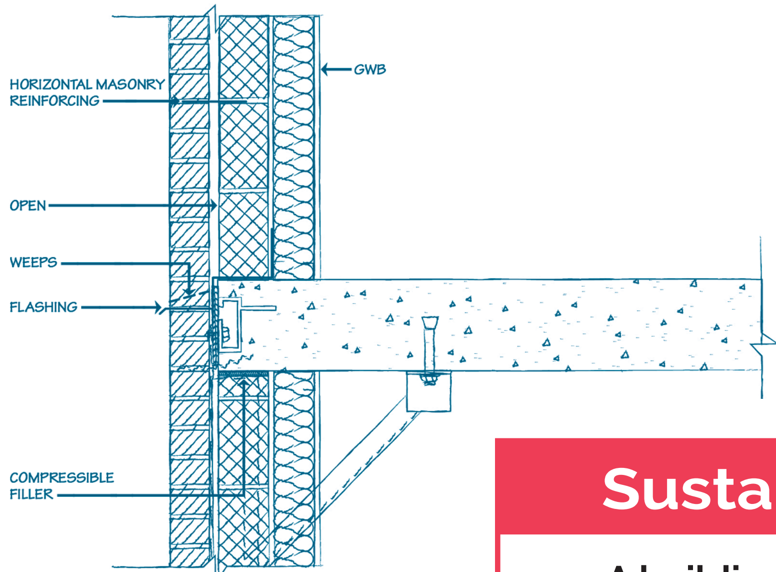


Figure 6 – Detail of 1999 office building.

Even a brick wants to be something.

— Louis Kahn

reissued in May 1987, states that masonry cavity walls are used because they provide "superior rain penetration resistance, excellent thermal capabilities, good sound transmission resistance, and high fire resistance." Further, we see fully addressed expansion and contraction of the façade materials horizontally and vertically.

1999: CORPORATE OFFICE BUILDING

- 9 stories (~118-ft. height)
- Floor-to-floor height: 12 ft.
- 320,000 sq. ft.

See *Figure 6*. The exterior masonry wall consists of a brick/CMU cavity wall of 9-in. thickness and an open cavity between, with two wythes. Inward, the wall has 3½-in. metal studs with batt insulation, and ½-in. gypsum wallboard finish. The structure varies, with lower floors constructed of reinforced concrete flat-slab with concrete columns and the upper floors constructed of steel deck/concrete slab floors supported on steel joists and beams with steel columns. The outer slab edge is 5 in. inward of the face of building. Suspended steel support angles create a datum plane at the head of windows, continuous through the abutting masonry walls. Through-wall flashing with tube weeps occurs at these angles and at the slab edges. There are compressible fill/sealant joints at these angle undersides and the slab edge underside/CMU joint. Horizontal metal masonry "truss" reinforcing is installed at 16 in. on center, vertically. Vertical masonry control jointing is provided

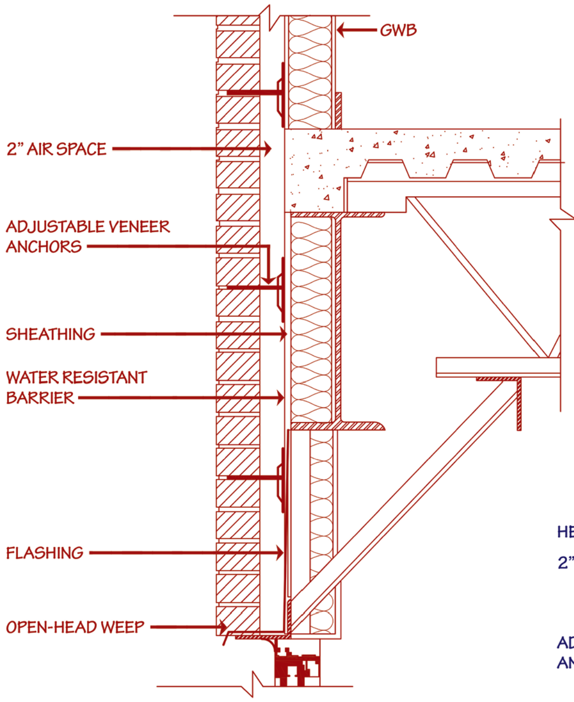


Figure 7 – Detail of theoretical 2005 office building.

at fenestration jambs at approximately 20 ft. on-center.

Here we now see increased inward thermal insulation and a greater thermal-break cavity space, but mass is still the greatest thermal barrier. Expansion and contraction of the façade materials—horizontally and vertically—is controlled. However, moisture and vapor resistance has not yet moved into the current century. This was one of the last Washington, DC, buildings of this size constructed in the brick/block methodology.

CIRCA 2005: THEORETICAL OFFICE BUILDING

- 10 stories (~120-ft. height)
- Floor-to-floor height: 12 ft.

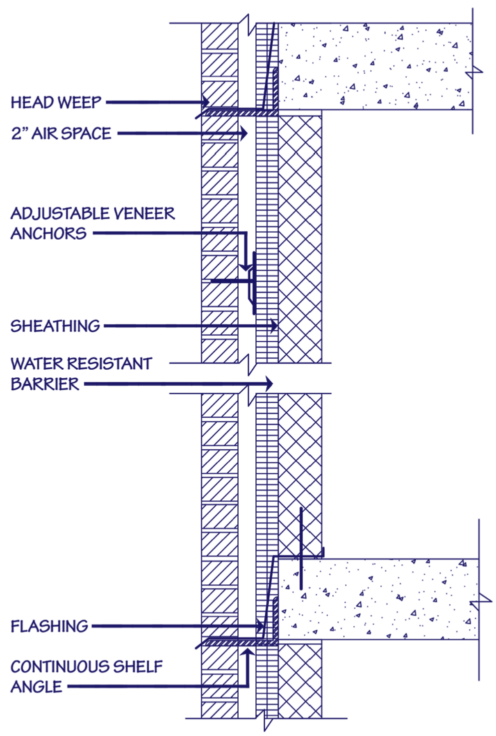


Figure 8 – Detail of theoretical 2015 office building.

See *Figure 7*. The typical brick veneer and steel stud exterior wall building with concrete or concrete/steel deck composite floors has the slab edge inward of the face of the building by 5⅝ in. This allows for a standard 3⅝-in.-thick brick wythe and a 2-in. open air space. This would be labelled a veneer drainage wall system. The interior section of the wall would be comprised of 3½-in. (or larger) galvanized metal studs with thermal batt insulation spanning slab-to-slab. The outward face of the metal studs would be clad with sheathing (exterior grade gypsum wall board, oriented strand board, or glass fiber mat) plus a water-resistant barrier (No. 15 asphalt felts, high-density polyethylene, or housewraps). Suspended steel shelf angles support both the brick wythe and also windows below. Through-brick flashing with full open-head weeps at 24 in. on-center horizontally was recommended. The brick wythe was anchored back to the steel studs with adjustable veneer anchors at no more than 18 in. on-center vertically and 32 in. on-center horizontally.

This design has moved the concept of brick veneer exterior walls forward drastically. The exterior veneer is still a water barrier, but we are accepting that some moisture will enter or develop in the cavity and need to be released. The inner wall is now water-protected on the exterior face. There is still a thermal bridge issue at the composite slab edge on which the insulated stud wall rests and to which it is connected.

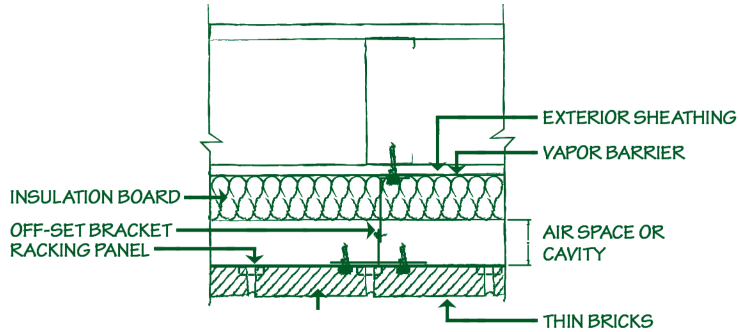


Figure 9 – The metal mounting bracket system creates an air space between the brick tiles and the outward face of the barrier wall.

CIRCA 2015: THEORETICAL OFFICE BUILDING

- 10 stories (~120-ft. height)
- Floor-to-floor height: 12 ft.

See *Figure 8*. The latest idea in façades is to have a pressure-moderated rainscreen wall. As explained in *BIA Tech Note 27*, August 1994, the equalization of the pressure in the air space behind the masonry wythe is the main difference in the type of cavity drainage wall design. While the exterior brick wythe acts as the primary water-resistance layer and functions as part of the thermal resistance, it is not to be considered the sole barrier. The typical full-wythe brick rainscreen would consist of an open 2-in. air space behind the brick and a layer of rigid insulation (~2 in. thick, to be calculated). The insulation passes across the backup wall and the slab edge. The inward section of the wall assembly will span slab-top to slab-bottom above, and can be either 4-in. CMU or 3½-in. (or larger) galvanized metal studs with outward sheathing. Vertical movement is resolved with either compressible fill joints at the CMU head or a galvanized metal slip-track head for the stud wall. The exterior of the CMU or sheathing would have a vapor (and air) retarder material—either sheet, rolled, or sprayed. There would be continuous supporting steel angles at the slab edge. Through-brick flashing with full open-head weeps at 24 in. on-center horizontally is recommended. The brick wythe anchors back to the steel studs or CMU with adjustable veneer anchors at no more than 18 in. on-center vertically and 32 in. on-center horizontally.

This design concept has maintained the successful elements of the previous brick veneer/steel stud assemblage but has resolved the thermal bridging issue at the floor slab edge by passing the insulation layer in the air space.

Another new design is the use of a thin

brick "tile" and support racking or modular panel system. The major elements are manufactured by a single company. Thin bricks are mechanically or adhesively attached to the racking panel, which is manufactured with grooves or tabs for mounting ease. The racking panel can be direct-contact mounted to the exterior substrate or offset outward using a metal mounting bracket system that creates an air space between the back of the brick tiles and the outward face of the barrier wall (*Figure 9*). The thermal insulation is placed within this air space. The thermal insulation can be combined with a drainage board or mat. The inward section of the wall assembly spans slab top to slab bottom above, and can be either 4-in. CMU or 3½-in. (or larger) galvanized metal studs with outward sheathing. The exterior of the CMU or sheathing would have a vapor (and air) retarder material—either sheet, rolled, or sprayed. Support angles or slab edge bearing for the brick tiles are not required. Through-wall flashing would be installed at window and door head conditions and at the lower terminations.

This idea is gaining acceptance; there is an ease of installation, but it may slowly push the skilled mason into extinction. It follows the ideas of metal panel rainscreen design and installation.

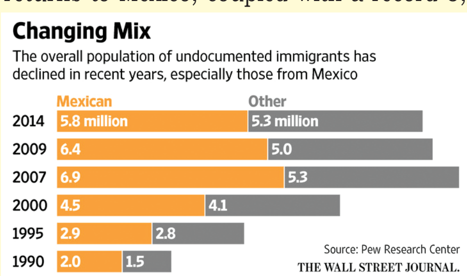
Human innovation has developed uncountable ways to construct. Each, at its time, was thought to be the best way, and each was then developed and improved upon—sometime resulting in the demise of the original innovation. What will come next? If we only knew.

Peter Sallee

Peter Sallee is a registered architect in Maryland and Washington, DC. He obtained his undergraduate degree from Clemson University and his Master of Architecture from the University of Maryland. He began working for Abel & Weinstein, advancing to become vice-president. After Weinstein's retirement, Sallee became a founding member of the firm of Lee Sallee & Company. In 2011, Sallee joined KCCT, a DC firm specializing in government clientele, as a senior architectural manager.

Small Business Lament: Too Few Mexicans in U.S.?

Annual inflows of undocumented immigrants from Mexico have slowed to about 100,000 a year since 2009, from about 350,000 a year in the mid 2000s and more than half a million in the late 1990s and early 2000s, estimates the Pew Research Center. At the same time, voluntary returns to Mexico, coupled with a record 3,000,000 deportations by the Obama administration since 2009, have shrunk the number of undocumented Mexican immigrants in the U.S. to 5.8 million in 2014 from 6.9 million in 2007, according to Pew.



As hiring accelerates and the labor market tightens due to U.S. recovery, employers who need low-skilled workers are increasingly struggling to fill vacancies. One big reason: Mexican workers, who form the labor backbone of industries such as construction, agriculture, and hospitality, are in short supply. At the same time, Congress has failed to reach a compromise policy on immigration to address employer needs for a steady, legal workforce, and President Donald Trump campaigned on a promise to deport immigrants who are here illegally and to build a wall to prevent new ones from sneaking in.

A recent article in the *Wall Street Journal* quoted Nelson Braddy Jr. of King of Texas Roofing Co, who noted his company has turned down $20 million in projects in the last two years because it doesn't have enough workers. "Without Mexican labor, our industry is at a standstill," Braddy claimed.

About six in ten undocumented immigrants hold construction, service, and production jobs, twice the share of U.S.-born workers, according to Pew. A survey in 2015 by the Associated General Contractors of America (AGC) found that 86% of construction firms were struggling to fill openings for carpenters, electricians, and other trades.

— Wall Street Journal

TEST METHODS PROPOSED FOR LIQUID-APPLIED POLYMERIC ROOF MEMBRANES

A set of proposed ASTM International test methods will help support the growing number of roofing projects that use liquid-applied polymers. The proposed standard (WK40123, *Test Methods for Sampling and Testing Liquid Applied Polymeric Roofing and Waterproofing Membranes That Are Directly Exposed to Weather*) will help manufacturers, testing labs, and the construction industry as they sample, test, and compare products. It is being developed by ASTM's Committee on Roofing and Waterproofing (D08).

The proposed standard includes ways to test liquid-applied polymeric materials that are cured to form roofing and waterproofing membranes and are directly exposed to all kinds of weather. By their nature, these materials are seamless. They are also useful when working with complex surfaces and custom-fit projects.

ASTM member Philip Moser and technical contact notes that these membranes have been traditionally used for waterproofing of elevated parking decks, but that their use for applications like roofing is quickly rising.

Moser, a senior project manager specializing in building technology at Simpson, Gumpertz, and Heger, says, "Delivery to the exact point of application in relatively small containers makes these products particularly attractive for small rooftop terraces, congested urban areas, and roofs that are not accessible by crane, where delivery of larger containers would create logistical problems."

The test methods would be used by manufacturers and testing labs as well as the people who write specifications that indicate which test methods should be used to evaluate physical properties.

The committee's next meeting is June 11-14 in Ontario.

— ASTM Standardization News