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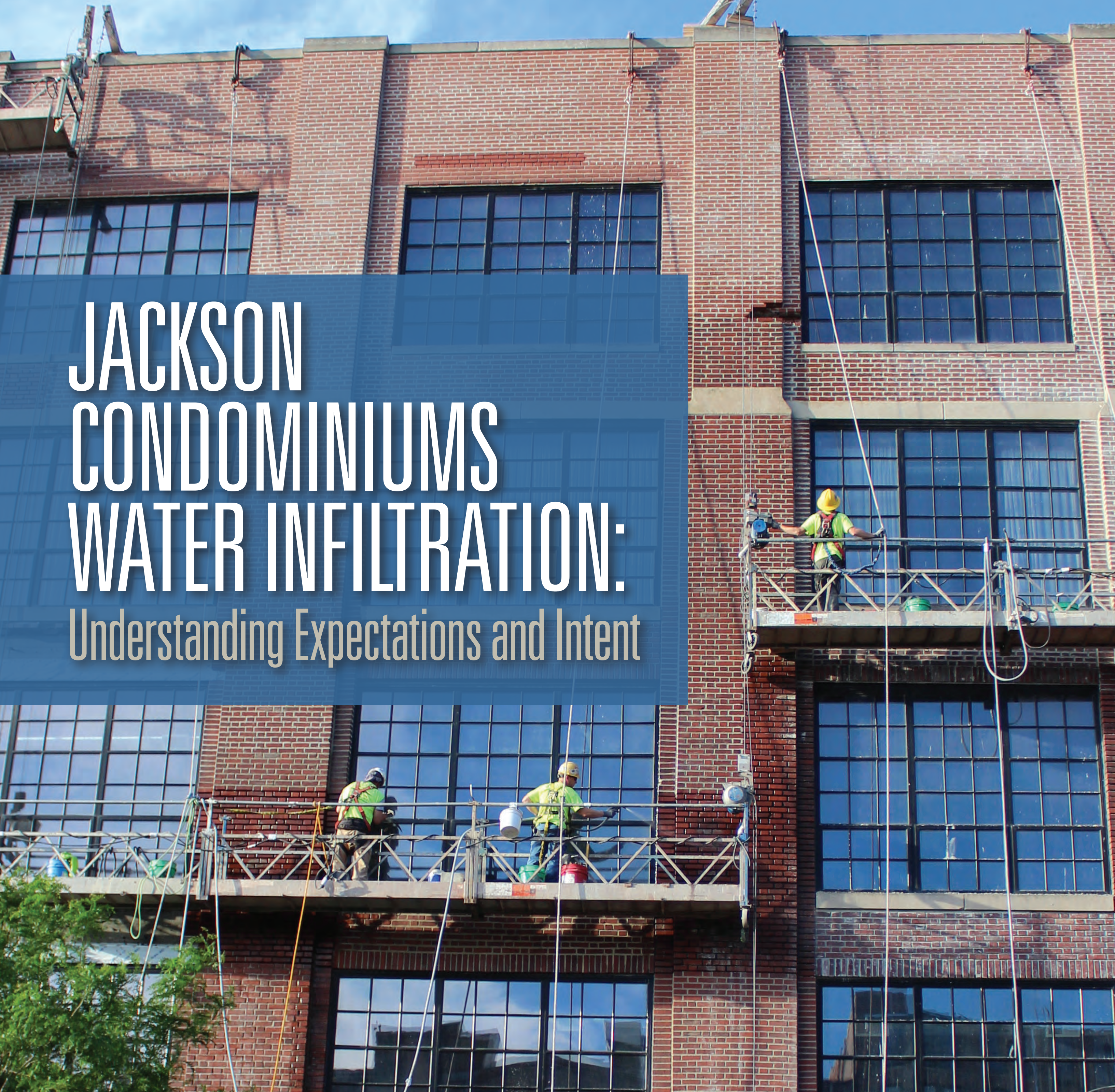
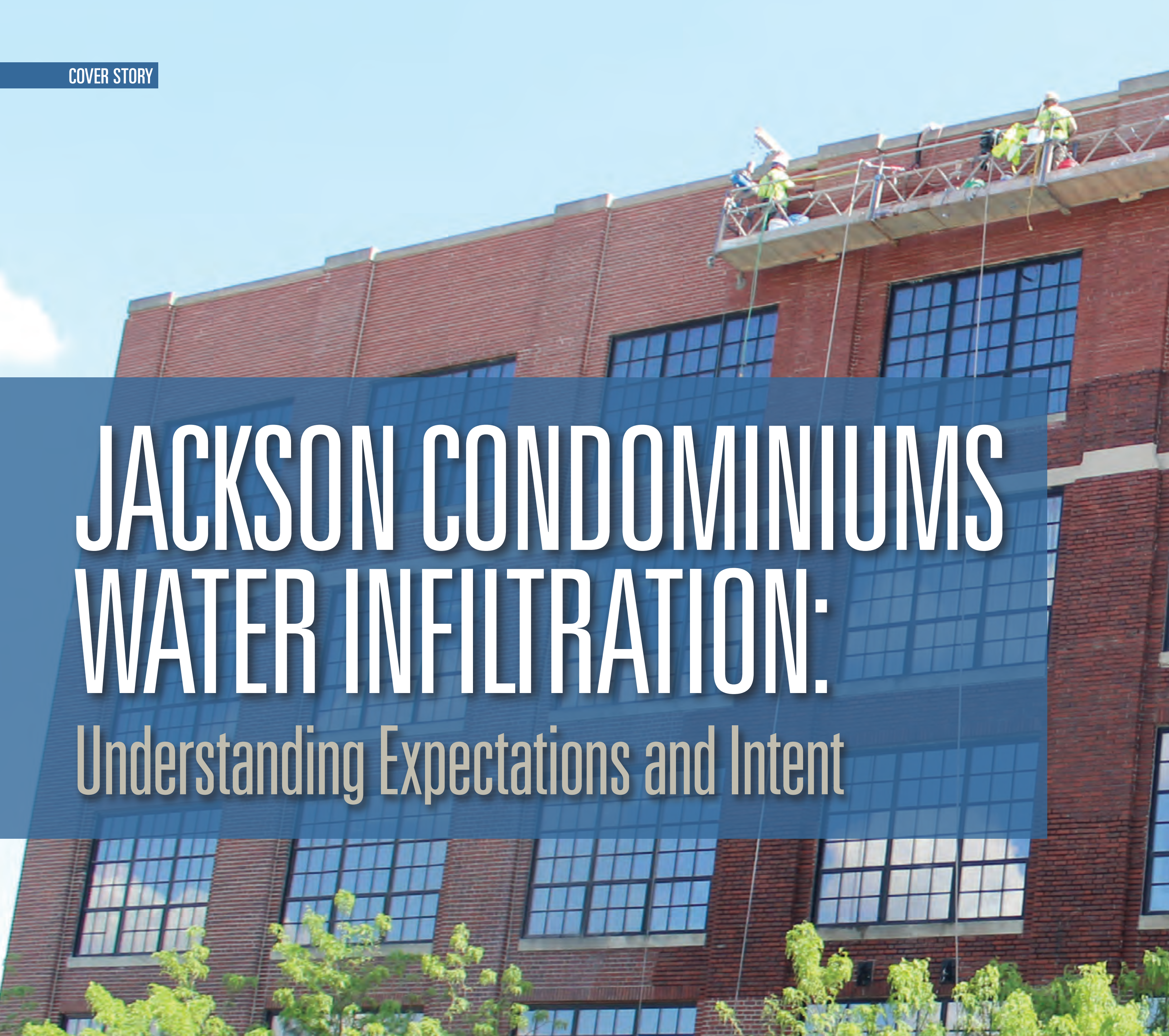


JACKSON CONDOMINIUMS WATER INFILTRATION:

Understanding Expectations and Intent



JACKSON CONDOMINIUMS WATER INFILTRATION:

Understanding Expectations and Intent

BY RACHEL WILL AND FRANK HALSEY

As a specialty restoration contractor and design professional in the preservation industry, the challenging projects have always provided a sense of accomplishment, due the unique problem solving skills that are needed throughout the entire project. The structures with many surprises and concealed conditions, are not usually the easy and peaceful projects, but working together as a team to help the Owner understand the issues and possible solutions, all the while maintaining a budget, can be very rewarding.

The Jackson Condos project, located in the historic "Old Market" district of Omaha, Nebraska, was one of those projects. The 1101 Jackson Street Condominium building was constructed in 1917 as a four-story warehouse and is generally rectangular in plan, measuring approximately one hundred and thirty-two feet in the east-west direction and one hundred and eight feet in the north-south direction. The building is approximately sixty-nine feet above grade on the north facade and slopes down such that an additional floor (garage) is exposed on the south facade. Retail space exists on the first floor and condominium units are on floors two through five. *(Figure 1)* The structural frame consists

FIGURE 1: Overall view of north facade.

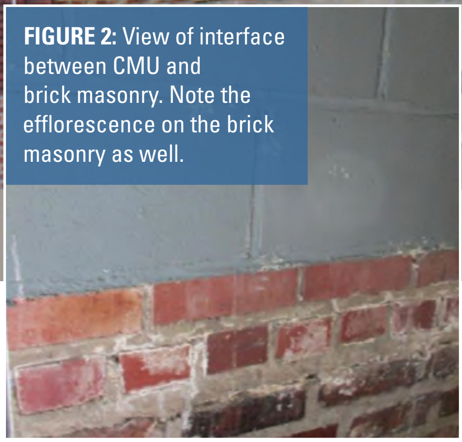


FIGURE 2: View of interface between CMU and brick masonry. Note the efflorescence on the brick masonry as well.

of the original four-story reinforced concrete frame. A steel framed fifth floor was added at some point in the past, as well as a roof framing system consisting of a metal deck supported by regularly spaced steel bar joists.

The exterior walls are multi-wythe header bonded brick masonry and generally three wythes of brick at the lowest four floors and the fifth floor of the south facade and a 12-inch wall comprised of brick and CMU for the fifth floor at the north, east and west facades. *(Figure 2)* The fifth floor was added to the warehouse building sometime in the 1950s, without any consideration for weatherproofing or flashings. The outer wythe of the main facades (along Jackson Street-north and 11th Street-east) consists of face brick and limestone detailing. The outer wythe of the west wall is constructed of face brick and the south wall consists

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of common brick masonry between the exposed concrete slab edges and columns.

At the north, east and south facades non-original prefinished aluminum metal-framed windows are set in punched openings. There are also non-original painted metal balconies on floors two through five at the southernmost bay of the east facade and at the two westernmost bays on the south facade. As part of the adaptive reuse trend, the building was converted to high-end condominiums, with retail space on the ground floor circa 2008. Unfortunately, for the current condominium owners, as happens far too often, the adaptive reuse project failed to address several exterior masonry issues, as well as the way the building had managed water in a less occupied state.

Prior to any current scope of repair work commencing, water infiltration and efflorescence *(Figure 3)* was reported at the exposed brick and concrete masonry units and metal deck ceiling in multiple units on the north, east and south facades. In order to gain a better understanding of the reported leakage and potential causes, WJE conducted an initial limited investigation of the existing masonry and roofing related to the reported ongoing water infiltration in June 2016. As part of that investigation, WJE recommended additional investigation with regard to the existing masonry walls at the fifth floor and roofing, including additional inspection openings and trial repairs with follow up water testing. The follow up investigation was completed in November 2016. The building has a reported history of water infiltration during rain events. Based on the observations from WJE's assessments, there were multiple potential sources for the infiltration, including conditions related to the brick masonry, the windows, and the roofing. *(Figures 4 and 5)*

The exterior walls of the 1101 Jackson building were designed to be 12-inch-thick multi-wythe masonry walls. This type of construction is referred to as a mass wall and was a common construction technique used for load-bearing masonry construction at the time the building was originally constructed. Masonry mass (or barrier) walls are designed to manage water intrusion by deflecting water at the surface and absorbing the water which is not deflected until the rain event ends; at which time, the wall is allowed to dry through evaporation. Water leakage can occur in a mass wall if more water enters the wall than can be absorbed by the wall or if voids exist within mortar and/or the back-up material that allow water to flow instead of being absorbed. Even properly functioning mass walls can become saturated when subjected to enough water (i.e. a long enough rain event). This is in contrast to a brick veneer cavity wall more common in current-day construction. Cavity walls manage water through the use of a concealed drainage plane (the drainage cavity) and a flashing system to collect the water and direct it to the exterior.

The exterior walls of the 1101 Jackson building were designed to be a combination of mass and barrier walls and to manage water by absorbing it into the pores of the masonry and holding it until the rain event ended and drying through evaporation could occur, specifically at the original four floors of the 1900's building. Based on the lack of flashing at the fifth floor window heads and at the interface of the original 1900's wall construction and the added fifth floor,

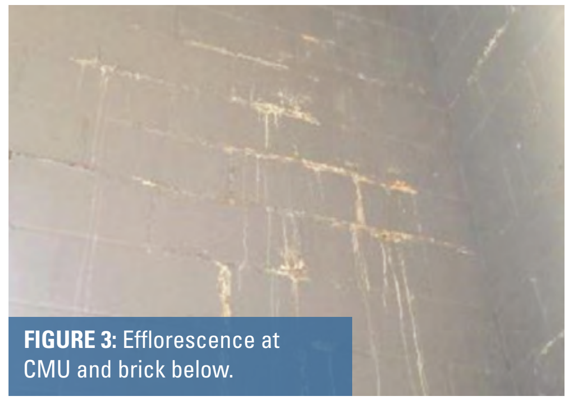

FIGURE 3: Efflorescence at CMU and brick below.

FIGURE 4: Cracks, delaminations, incipient spalls at exposed concrete frame and previous patching at concrete frame. Note the discoloration presumably due to moisture.

FIGURE 5: Cracks and voids at the mortar joints at the original brick masonry of the west facade

it is assumed that the previously added fifth floor also was intended to act as a mass wall rather than similar to the contemporary cavity wall construction. *(Figure 6)*

Based on the reported history of leakage, the existing walls were not performing as would be expected of properly functioning mass walls. Additional investigation of the existing masonry at the interface of the original wall construction and the new fifth floor, above a fifth floor window head and at location of the original wall construction at the location that brick passes in front of the concrete frame was necessary to determine the interface details and to review the conditions contributing the water infiltration. It is likely that the fifth floor was intended to be constructed as a mass wall in that no flashings were installed, yet based on our water testing it was determined that CMU was not grouted and there were significant openings/voids in the collar joint behind the brick masonry and the CMU as well as the joints in the backup.

The open collar joint behind the outer wythe of brick masonry and the CMU causes the wall to function more like a modern cavity wall where water run freely down in the cavity space. *(Figure 7)* This is particularly true where the outer wythe passes in front of the cast-in-place concrete frame. The voids in the as-built wall disrupt the mass and function more as a cavity space, allowing water to flow instead of being held. However, cavity wall systems are designed with the anticipation that water will reach the cavity and are designed and constructed with a flashing system that collects this water and directs it to the exterior. In the as-built walls where the outer wythe is supported on shelf angles, the water can flow down to those shelf angles, collect on them, and run horizontally until it reaches a discontinuity in the shelf angle. There the water can migrate further into the wall. In some locations, these discontinuities align with the jambs of the windows. Thus, water can flow off the steel lintel and onto the metal frame of into the interstitial space between the window frame of the masonry and leak to the interior of the building. Similarly, water can bridge the cavity and run down the face of the spandrel beam, there it can pass behind the steel shelf angle and leak to the interior. *(Figure 8)*

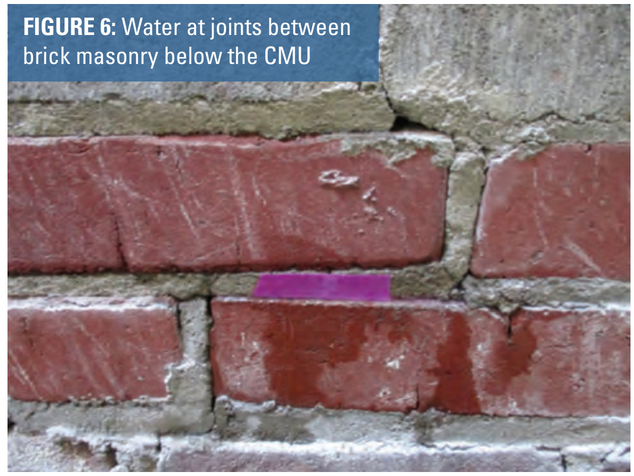

FIGURE 6: Water at joints between brick masonry below the CMU

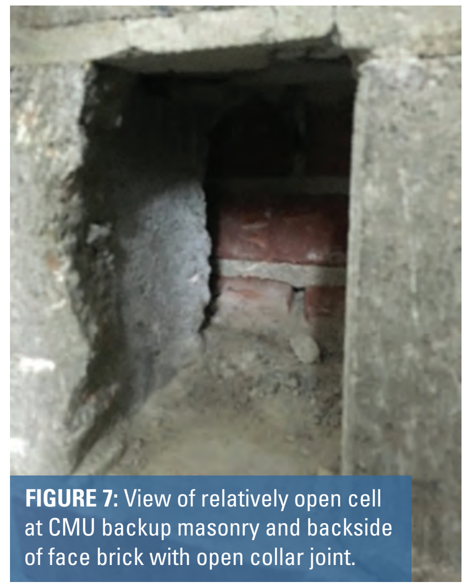

FIGURE 7: View of relatively open cell at CMU backup masonry and backside of face brick with open collar joint.

FIGURE 8: Damaged spandrel beam.

Both in the case of the open collar joints and the compromised CMU wythe, controlling water penetration through the outer-most plane of the wall greatly impacts the water-resistance performance. One of the most significant issues related to the ability of a wall to resist water penetration beyond the face of the wall is the condition of the mortar joints and the bond between the mortar and the adjacent masonry. Repointing is a proven method of improving this performance. For a given wall, the effects of repointing can be measured by performing a test in accordance with ASTM C1601 - Standard Test Method for Field Determination of Water Penetration of Masonry Wall Surface. As the title suggests, this test is designed to measure the volume of water that penetrates the outermost face of the wall. By performing the test on a portion of the wall, repointing that area and retesting, a quantitative comparison of the wall performance before and after the repointing can be

FIGURE 9: Overall view of test area of trial repair location at west wall.

made. *(Figure 9)* This information can assist the project team in assessing the anticipated improvement in the ability of the wall to resist water infiltration to the interior.

FIGURE 10: Fifth floor window head.

Providing flashings at the window heads of the fifth floor and at the interface of the original wall construction and the added fifth floor to collect water that does penetrate the outer wythe and directing out of the wall system, is also important to limit water infiltration into the interior and was included as an alternate repair option. *(Figure 10)* This repair exposed the existing steel lintels so that they could be cleaned of corrosion scale and painted to prolong their service life. Shelf angles that exhibit significant section loss, if any, were removed and replaced as well. The flashing system aided both in controlling water infiltration and limiting the steel shelf angles from future exposure to water.

As discussed above, portions of the outer wythe of masonry walls pass in front of the concrete structure of the building. At these areas, many of the lateral ties provided to hold the outer wythe of masonry (functioning as a veneer) were missing or corroded. The differential movement between the concrete frame and the brickwork and is the result of the brick cantilevering past the face of the column and only being laterally anchored on one side. Supplemental lateral anchorage was recommended and installed. based on the review of the inspection openings at select locations. *(Figure 11)*

FIGURE 11: Helix anchors providing more support.

Following the review of the limited assessment reports prepared by WJE, the Association requested that WJE prepare bid documents, and invite qualified masonry contractors. The repair project generally was concentrated on the exterior masonry and concrete and included the following:

- At all fifth floor window head locations, expose all shelf angles by removing four courses of the existing brick masonry, clean and paint, and install stainless steel sheet metal pan flashing with self-adhered membrane flashing / termination bar.

- At all pier locations, install sheet metal flashing at the base of the fifth floor wall at the pier locations, as indicated on the drawings.
- Remove existing sealant installed at all shelf angle locations at all floors and repoint joint with mortar.
- Repoint 100 percent of mortar joints within the brickwork at the third, fourth and fifth floors at the north and east facades. as designated by the A/E within the brickwork at the first and second floors at the north and east facades. Repoint one hundred percent of all mortar joints within the brickwork at the west and south facades. Note: install backer rod and sealant in joints between brick and concrete framing at the south facade.
- Install sealant in all upward-facing joints between coping and sill units. Follow the mortar removal process described for repointing for upward-facing joints. Install backer rod and sealant into these joints.
- Rebuild sections of the outer wythe of brick masonry at portions of the south and west facades, and at isolated displaced spandrel locations on the north facade.
- Seal all penetrations in the brick masonry, which are related to the existing balconies, conduit, etc., with backer rod and sealant as shown on the drawings.
- Rout and seal cracks at exposed concrete framing.
- Remove delaminated/cracked concrete at areas where the cast-in-place concrete frame is exposed and install a new formed and poured concrete patch.
- Installation of a non-elastomeric architectural coating on the exposed concrete.
- Remove and replace existing sealant at one hundred percent of existing doors, windows, and other opening perimeters. Install new backer rod and sealant at all openings.
- Install weather stripping and weather seals at the interior of all windows.

It should be noted, as part of the initial investigations and the review of the fifth floor construction, WJE had indicated that if the repointing trial repairs were not successful at limiting the water infiltration, the repairs may need to be more invasive. One of the options recommended included removing one hundred percent of the outer wythe of face brick at the fifth floor, pointing the voids in the CMU backup, installing stainless steel pan flashings with self-adhered membrane at the interface of the original mass wall construction at the sills of the fifth floor and the steel lintels at the heads of the fifth floor windows, installation of a liquid applied weather resistive barrier on one hundred percent of the CMU backup stripped into the new through-wall flashings, and reinstallation of the face brick with stainless steel lateral anchorages. *(Figure 12)*

FIGURE 12: Lintel and stainless steel flashing.

FIGURE 13: South elevation concrete repair.

The project bid in early-summer 2017, with a fifty percent completion date for December of that year, and the balance of the work completed during 2018. Like most contractors, Mid-Continental's backlog was mostly full by mid-summer, so it was proposed to complete the entire project in 2018. Due to Association review of bids, Mid-Continental's proposal was accepted.. It was not until several months later, when we first received the standard AIA contract, which had been modified by the Association to include a 10-year warranty against water infiltration, that the Owner's expectations became clear. Management of Owner's expectations was going to be challenging and the team (MCR and WJE), immediately notified the Association that any kind of warranty against water infiltration was not part of the original bid documents, not feasible, and well outside the realm of industry standards for this type of repair work

What followed this initial interaction, was a series of communications and meetings wherein the building construction, existing conditions and the project intent were explained to the President of the Association, a volunteer position, who was also a resident owner, with significant water leaks. He and his wife were both board members and voluntarily assumed responsibility for managing the project, despite minimal knowledge regarding building construction. It became their responsibility to communicate the project intent and objectives to the other unit owners (several of which were not experiencing water infiltration into their units) while lobbying for the mandatory financial assessment to complete the necessary repairs. It should be noted, this is a fully occupied, high-end, condominium building, full of attorneys with leaking homes.

The repairs started in early April 2018 *(Figure 13)* and clouds of dust were experienced inside units almost immediately, despite OSHA required dust collection efforts being utilized during the repointing process. During our efforts to mitigate the dust, it was discovered that the building was acting like a vacuum with negative air pressure actually pulling dust through the solid masonry walls. While investigating this issue, with a mechanical engineer, it was indicated that a typical code required air exchange could be value engineered out of adaptive reuse projects, due to the inclusion of sufficient operable windows in the original adaptive reuse design. If only the operable windows were open, all the time to provide for the sufficient air exchange. These observations, were extrapolated by the team to infer that if dust was being pulled into the interior of units, the same issues would exist with moisture in the walls, even after repointing. To address this issue during construction, temporary modifications were made to the air intakes, and unit owners were encouraged to turn off any intake fans. The more permanent solution to address this issue following the completion of the facade repairs, was far too costly for the Association to entertain and thus would not be implemented to provide a long term repair for dealing with the moisture in the walls being drawn to the interior.

During the project, it was also learned that exterior windows, as well as balconies, are not considered common space and are the responsibility of each individual unit owner, therefore not eligible for normal building assessments to all owners. This became important because some of the windows were avenues for water infiltration.

On August 20, 2018, as the project was approximately fifty percent complete, the Omaha area experienced near record rainfall, with 6.16 inches of wind-driven rain, in less than twenty four hours. Portions of the building, where exterior façade repairs had already been completed, experienced significant water infiltration at the fourth floor window heads, with a similar incident occurring again on December 1, 2018, one week after the project had been fully completed and demobilized. At one point, following one of these incidents, when the frustrated Owner asked how we could guarantee against water infiltration, we responded that they could cover the building in plastic. That comment did not go over well, but it helped to reiterate to the owner the challenges associated with waterproofing a building, with masonry walls and all of the unforeseen conditions, as previously described, that had never intended to be a fully occupied space, much less a residence.

These incidents prompted discussion, and eventually a change order, to address the installation of thru-wall flashing above all the fourth floor window openings. *(Figure 14)* The flashings at these locations were originally included in the bid documents as an alternate due to the findings from the trial repair location, without experiencing leakage during water testing following repointing

FIGURE 14: Fourth floor flashing.

as well as the need to control repair costs. It should be noted the leakage experienced following the completed repointing repairs was only during wind-driven rain events with a significant internal and external pressure differential as well as significant rainfall in a short period of time. Following many discussions with the Association of next steps for dealing with the persistent water leakage at the exterior walls following repointing without having the re-clad the entire fifth floor of the building, the Association and the team, opted for a repair approach which included installing the fourth floor flashing, add alternate as well as installing a clear-penetrating sealer at the brick masonry at the fifth floor. The team discussed the pros and cons with the Association. The team indicated that installation of a sealer is a less durable, but also less expensive repair than the recladding, and would require regular maintenance to promote the efficacy of the sealer along with the other repairs at limiting water infiltration.

Managing water infiltration on mass masonry buildings and Owner's expectations, like the Jackson Condominiums project, is an iterative process that can be challenging and rewarding. While Jackson Condominiums, with its numerous surprises and concealed conditions, was not an easy or typical project in restoration, it provided a fulfilling experience working together as a team with a respected contractor and consultant to find a solution for water leakage while maintaining a budget for the Owner in a building that was never anticipated to have a residency occupancy.

About the Authors

Rachel Will, PE is an Associate Principal and Associate Director of Knowledge Sharing with Wiss, Janney, Elstner Associates, Inc. in the Chicago office. She has over 13 years of experience related to the investigation and repair of existing building facades. She has performed numerous evaluations of historic masonry facades and prepared repair documents along with provided construction period observations for many masonry-clad buildings.

Frank Halsey is the President and Chairman of the Board for Mid-Continental Restoration Company, Inc. headquartered in Fort Scott, KS. Frank has worked in the restoration and waterproofing industry for over 40 years. He is actively involved in industry associations such as the Sealant, Waterproofing and Restoration Institute (SWRI), where he is a Past President, The Association of Preservation Technology (APT), as well as numerous local organizations and charities.