Hanging Out: Risk Management for Exterior Facades

By David McKenna and Mark LeMay

Day in and day out, building Owners and managers must deal with a wide range of building-related issues to keep their tenants happy and safe. Most of these are short-term, immediate needs, such as tripped circuit breakers or minor repairs to HVAC equipment, while others are planned maintenance items, such as filter replacement and window washing. Moreover, as building systems age, budgets must be adjusted to allocate funds for replacement and/or upgrading. While roofs and HVAC systems seem to garner the most attention when it comes to maintenance and repair, one critical building component tends to get overlooked on a consistent basis: building facades. However, failure of façade elements can be much more catastrophic than failure of many other building systems. Therefore, it's vital that the risk associated with the possibility of building façade failure is adequately managed.

Realizing the risk involved, several large cities have enacted ordinances requiring a "critical examination" of facades on buildings taller than six stories or 60 feet. According to these ordinances, "up-close inspections" must be performed every five years on a representative sample of the façade by a qualified person (registered design professional), with written reports filed with the city. Unfortunately, the vast majority of municipalities, institutions of higher education, hospital districts, and other high-rise venues have no such ordinance. This means that their ability to address—or even prepare for—that sustained gust of wind or storm system that can peel a façade and drop it on an unsuspecting environment does not exist. Given this, it's important that Owners are aware of exactly what these risks entail and know how to manage them.

Facade Fundamentals

Building facades are dual-purpose: they provide the visual aesthetics for a building, but more importantly, they work to repel the exterior elements to maintain a watertight enclosure. Facades on older buildings may consist of load-bearing elements, such as brick masonry, natural stone, or terra cotta. Cement stucco may be used as an exterior finish over brick or rubble stone. Typically, these structures do not have an air space behind the exterior finish, nor a waterproofing plane within the wall system, nor control joints filled with flexible sealants. Embedded cast iron or steel members may be used to support and/or anchor projecting facade elements, such as cornices, and over-window, door, and other openings.

On newer structures, it is common to find facades comprised of many of the same materials as older buildings, but applied as an exterior veneer (i.e., non-load-bearing). Veneer systems must be tied securely to a back-up wall system, such as cast-in-place concrete, concrete masonry units (CMU), and wood or metal studs. Common anchors include corrugated metal ties, ladder or truss-type wire systems, and adjustable loop-type anchors. The anchors must be spaced properly in order to perform as intended. Cavity wall systems utilize a moisture barrier, flashings and weep holes to help direct any moisture that enters the wall system back out to the exterior. Vertical and horizontal control joints filled with flexible sealants allow the façade to accommodate differential movements. Steel angles are used to support the veneer system over façade openings, and, in some cases, at floor levels on taller structures to provide intermediate support.

In old and new structures alike, workmanship can factor into the performance of exterior facades. Voids in mortar joints, improperly installed veneer anchors, joint reinforcing installed too close to the outside edge of the joint, and inadequate control joints exemplify common deficiencies found in the construction of building envelope systems.

Despite the age or type of construction, the primary function of the façade system is to repel wind, rain, heat and cold, thereby separating the exterior environment from the interior

environment. While the penetration of wind, heat, and cold may adversely affect the comfort of building occupants, moisture intrusion into exterior walls and facades creates potential dangers that must be understood and reckoned with. Leaks into a building are never a welcome occurrence, but it is the hidden effects of moisture intrusion that can create major headaches for Owners. Moisture intrusion can lead to several damaging effects:

- The deterioration of wood and gypsum-based building materials
- The development of mold on wood or gypsum-based materials
- The corrosion of metal anchorage, support and structural elements
- Freeze/thaw damage

Moisture intrusion into exterior facades does not always manifest itself as leaks into interior spaces, so it can often be overlooked. But failing to identify and rectify areas of moisture intrusion increases the risk of a potentially catastrophic failure, especially in multi-story buildings, and where facades abut pedestrian and vehicular pathways. In many instances, the failure or detachment of a façade element occurs without warning, despite the fact that observable evidence may have existed.

Risk Management

So how does one go about managing the risks associated with exterior facades? The following is a simple knowledge-based process that should be applicable to any singular structure or group of buildings:

1. **Commissioning:** On new construction projects, this process includes a review of the construction documents prior to installation as well as monitoring of construction activities to assure what is being built conforms to the documents. Proper performance of the structural, anchorage, and waterproofing components of the building envelope will help to minimize the potential for failure.
2. **Know what you have:** Retain copies of the original construction documents (drawings and specifications), along with any subsequent addition, alteration, or repair documents. The drawings, especially the exterior wall sections and details, will show the different components that comprise the exterior walls. In most cases, the specifications will name the materials specified for use in constructing the building.
3. **Documentation and recordkeeping:** Create a database of information for your building(s). You may already have something established for your HVAC system that can be expanded to include the building façade. Track maintenance and repairs, including what work was performed, when, and by whom. Include drawings, specifications, scopes of work, costs, etc. Several companies offer building maintenance and repair software, or utilize a database program to customize your own recordkeeping.
4. **Periodic inspections:** Begin with visual inspections. Binoculars and spotting scopes are tools commonly used to inspect exterior facades. However, with older or more complex facades, periodic "up-close" examinations may be warranted. Cracks or missing mortar in joints, rust stains, spalled or broken brick or stone, split, and detached or missing joint sealants all are indications that moisture intrusion could be occurring. If deficiencies are observed, additional investigations may be necessary, and this can include infrared thermography, detection of metal ties, selective demolition, and/or material testing. Document the deficiencies, and prioritize the need for repair in conjunction with the potential risk of a failure. Use the information proactively to plan for maintenance, not only for next year, but for the next five years. Doing so should help to reduce the need for more costly (reactive) repairs.

Facade Failures

In some rare instances, however, due-diligent monitoring efforts may not be able to detect some potentially dangerous conditions. Such was the case on the night of January 15, 2012, on the campus of Texas A&M University-Commerce when a 12-foot x 12-foot section of brick veneer detached from the 13th floor penthouse level of a building constructed

Figure 1: Detached section of brick at the 13th-floor penthouse

in 1968 and fell onto the parking lot below (Figure 1). High winds, which were estimated at upwards of 65-70 mph, triggered the collapse. Observations of the failed section of brick revealed the *complete absence* of brick ties in the upper portion of the wall (Figure 2). Identifying construction defects such as this would be akin to finding the proverbial "needle in the haystack."

Figure 2: Detached section of brick at the 13th-floor penthouse

Fortunately, there were no injuries from this event, although there was a small amount of damage to vehicles. Investigations conducted on various sections of the façade also uncovered severe corrosion of brick ties, along with significant corrosion of the steel shelf angles at each floor level (Figure 3).

Engineering recommendations were quickly reviewed and implemented by University Administration. Over the next six months, work crews removed and salvaged thousands

Figure 3: Corroded shelf angle

of brick units, replaced corroded shelf angles, installed new stainless steel brick ties, flashing systems, mortar joints, and weep holes, to restore the structural and waterproof integrity of the exterior skin of the building.

While the Texas A&M incident involved a building from the '60s, more modern buildings constructed in the '70s and '80s are not immune to façade deficiencies. For example, suspended brick soffits on buildings at a major university and at a county college both in North Texas have required repairs due to cracked and spalling brick units (Figure 4). Cast in four-foot long units with reinforcing rods grouted in the holes of the brick, the units are hung from steel relief angles. However, moisture intrusion through the brick veneer

Figure 4: Cracked brick soffit units

coupled with improper flashing of the relief angle resulted in corrosion of the grouted reinforcing steel. The expanding volume of the corroding steel cracked the brick units, and eventually caused portions of the brick to become detached. The fact that this section of the façade was located over pedestrian walkways made the situation quite critical.

As a result of the unexpected failure at Texas A&M-Commerce, the University requested that other buildings on campus built in, or around, the same time be assessed by their engineering consultant. These investigations uncovered two other buildings where distress in the brick veneer was observed. Repairs were initiated immediately to prevent another sudden failure.

Future Framework

The comprehensive report generated by the building assessment process has been incorporated into the University's risk management program of documentation, record-keeping and periodic inspections for all buildings on the Texas A&M-Commerce campus. Going forward, this due-diligent effort should provide a suitable framework for the management of risks associated with the exterior facades of the buildings on campus.

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