

structural practices

The Deception of WYSIWYG in Façade Inspections

What Structural Engineers Need to Know About Masonry Façade Inspections

By Pamela Jergenson, CCS, CCCA

Warning: Believing WYSIWYG in masonry façades may be a costly and a dangerous mistake for you and your client. "What You See Is What You Get" or WYSIWYG was a computer software term coined in the 1980s. The software function was to show on the monitor exactly what the printer would produce on paper. In masonry façade inspections, WYSIWYG does not exist. No inspection software or technology today gives a completely accurate picture or answers every question.

The older frontier of existing buildings presents technological challenges in both maintenance and renovation. Technology can enhance the inspection process – for example, a building's condition can be documented electronically and photographed digitally – but technology cannot always tell us when something is awry. A masonry façade inspection *must go beyond what is seen* to embrace the real image of a façade's condition. Along with technology,

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we must perform our own visual observations and value judgments to determine if the building is performing correctly or requires repair and maintenance.

Façade Ordinances

In the last 20 years, accounts of building façades falling down have impelled the writing and adopting of façade inspection ordinances in various cities. Saddled with the responsibility of life safety for the sidewalk pedestrian, cities like Boston, New York, Detroit, Columbus, Chicago, and Milwaukee now enforce a façade ordinance tailored to the existing building demographics. As other large cities age and as unfortunate incidents occur, façade ordinances will continue to be adopted and move across the country like pioneers traveling to the west.

If only technology for existing masonry façades could produce equipment like X-ray vision goggles, we would not be in the predicament of unfortunate incidents and façade ordinances. Until then, the close visual inspection and destructive test openings required by façade ordinances will give us a more complete picture of a masonry façade, and the true condition of the exterior system performance. Knowing the status quo of the masonry façade connection to the structure is indispensable to making an assessment of both the life safety of pedestrians and property damage concerns around an existing building.

"...a more complete picture of a masonry façade..."

Yet visual inspection and test openings are only a small element in truly understanding if the exterior wall system is functioning and not posing any threat to life safety. Remember this: Masonry fools our eye and mind with the appearance of being solid, long lasting, and impervious to age. What is seen on the surface of masonry does not always tell the whole true tale of the exterior wall system performance. What you see is *not* what you get, and masonry façades can be closer akin to an optical illusion. There can be much more to the story behind the façade.

Anatomy of a Façade Investigation

A comprehensive façade investigation has five essential parts:

1. Develop the scope: Development includes understanding how much of the façade is to be closely inspected and how to access these areas. Local façade ordinances must be considered and an initial site visit completed.

2. Prepare for the investigation: Considerable legwork needs to be accomplished. Gathering building history, interviewing site personnel, reviewing past repair and maintenance documents, and understanding any adverse weather or events that impacted the façade are all essential.
3. Perform the actual inspection: Documentation of close visual inspection, non-destructive testing, and exploratory openings sum up the inspection. However, do not limit the inspection to the exterior; visual observation and possibly destructive test openings of the interior may enhance or expand the investigation. Inspection results can often alter the original scope.
4. Contract for additional investigation: The building is an entire composition of many systems. Therefore, structural, mechanical, or even roofing components may be contributing to façade issues. Call on subconsultants for further expertise if needed.
5. Write the report: The local façade ordinance will dictate the report content and format of the façade investigation. Beyond a façade ordinance, the owner may require a full written report with photographs, elevation drawings, and a plan view.

Personnel Qualifications

To perform a façade investigation, a person needs working knowledge of the following:

- Façade materials
- Exterior wall systems and details
- Construction materials and failure

Along with that, local façade ordinances may require a registered professional engineer to perform, stamp, and sign the report or forms submitted to the local authorities. In areas where no façade ordinance exists, a registered professional is still recommended.

Façade inspection

Before close visual inspection and destructive test openings, there are two key steps to realizing and developing the scope of a façade investigation. First, an initial site visit and collecting background information help fill out the building portrait prior to setting a swing stage on a building. Scrutinizing all elevations during an initial site visit begins the stream of clues that help plan the strategy for further information gathering. Clues are found everywhere in the initial site visit: in the transitions from roof system to wall system, from one exterior material to another, and from exterior wall to exterior opening. The initial site visit is critical – it begins the formulation of the scope of the façade investigation.

“...the stream of clues that help plan the strategy for further information gathering.”

After the initial site visit, the collection of background information adds more detail to the building portrait for the investigative work to begin. Resources for background information can be either limitless or limited, depending upon the building owner’s records, the site personnel, and the historical significance of the structure.

Original building drawings are a goldmine of information, but at times are as rare as hens’ teeth. In the best scenario, a prudent building owner will have records of past building additions, repair work orders, photographs, and other documentation that sheds light on the building structure and the changes over the years. A hidden asset of information is site personnel, especially if they have a long history with the building. They can relate undocumented accounts that can become critical to seeing the entire building aura.

“A hidden asset of information is site personnel...”

Having historical significance greatly benefits the sleuthing of many building narratives and details. Typically the owner of a historical property has salvaged and chronicled as many building records as possible. The background information gathered fine-tunes the slant of the investigation.

From this point, the shape and detail of the masonry façade investigation needed by that particular building is customized. Crack mapping, non-destructive testing, and destructive test openings are examples of the variety of tools used to determine the masonry façade performance. However, although many bits of information have been collected and perhaps an elaborate façade investigation plan developed, you must look beyond performance. Do not lose the primary objective in this scheme: finding and resolving life safety concerns of the masonry façade.

Case Study

The following case study shows the optical illusion of WYSIWYG in action. The façade inspection involved a three-story masonry building over 80 years old. This building is a classic example of how a masonry façade optical illusion was revealed and shattered by a thorough investigation with exploratory openings and background information.

In Summer 2003, a limited masonry restoration project began on this building. At the start of the project, two loose stones were found in the upper stone band. This band is also known as the “water table.” The work was temporarily stopped, a façade investigation formulated and conducted, and a final report presented to the owner, all within a two-month period. The following is a recount of the findings.

From grade the parapet of this masonry building appeared to be satisfactory (Figure 1). However, upon close visual inspection mortar was found to be missing in spot locations (Figure 2). Based on this early information, the quick remedy of tuck pointing seemed fitting and any life safety issues readily dismissed.

Later in the masonry façade investigation, an exploratory opening at the parapet revealed the inner masonry



Figure 1: View from grade of the three-story building parapet



Figure 2: Close visual inspection of the same parapet shown in Figure No. 1



Figure 3: Damp inner wythe mortar material from test opening at same location



Figure 4: Corroded, perforated and failed metal strap ties in test opening

wythe was damp (Figure 3). If heavy wind-driven rains had occurred the night before, damp masonry could be expected. A continually damp inner masonry wythe is an excellent host for corrosion of any metal, specifically masonry veneer ties.

However, the recent weather patterns were consistent drought conditions, so the wythe should have been dry. As the masonry façade investigation continued, the evidence of serious façade issues was mounting. Corroded, perforated, and failed metal strap ties were found at several parapet exploratory openings (Figure 4). The parapet was now suspect for life safety concerns.

“...the evidence of serious façade issues was mounting.”

The final tip-off to life safety concerns with the parapet lay with the background information. Minimal maintenance and reactive repairs were part of the building's history. The building had already experienced deterioration on all exterior walls, and restoration of some upper masonry areas had been performed in past years. The exterior wall maintenance had consisted of spot tuck pointing and some areas of solid tuck pointing. Current site personnel said that the tuck pointing had occurred many years prior to their employ, so this indicated that the façade problems had been on-going.

A bulging wall above a low roof area was rebuilt six years earlier. After some brick fell from a chimney, complete restoration of the chimney from top to bottom was done in 2001. Then, when two loose stones were found from the water table in 2003, the plot thickened for the life safety concerns of this building.

By combining the background information and the results of the close-up visual inspection and exploratory openings, the parapet of the masonry building was determined to be a life safety concern. A three-tiered set of recommendations was presented to the building owner.

- The first-tier recommendation addressed the life safety issues immediately by rebuilding the highest deteriorated parapet near building entrances.

Top Five “Red Flags” to Look For

1. Efflorescence on masonry
2. Out-of-plane masonry
3. Stained masonry
4. Exfoliated lintels
5. Minimal past maintenance or repair

- The second-tier recommendation addressed the potential property damage issues above lower roof areas.
- The third-tier recommendation addressed the lesser-deteriorated parapet areas.

As a case study this three-story masonry building initially deceived us by appearance. Placing together all of the pieces of the investigation puzzle, background information, and exploratory openings dispelled the illusion. These realizations – what you see is not what you get, and the necessity for full detective work – were imperative in this seemingly simple case study.

The prudent conclusion? A complete masonry façade investigation reveals the true picture for life safety at any existing building.

Conclusion

Masonry façades visually lull us to believe they are imperishable. No technological tool today can see through a masonry façade and determine what are precisely the conditions of the masonry connection to the structure. Behind the optical illusion of masonry, an entirely different story is told. Getting beyond WYSIWYG means a comprehensive masonry façade investigation. Digging deep into the building background and using investigative tools, like exploratory openings, are crucial to determining masonry façade life safety issues. Search for all of the clues – visual, physical, written, and verbal – to solve the mystery behind the masonry façade. ■

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Façade Inspection Definitions

Crack mapping: Graphically representing the location and size of cracks, or other deficiencies, on exterior elevations.

Efflorescence: a deposit of soluble salts, usually white in color, appearing on the surface of masonry and concrete construction.

Exfoliation: a disintegrating condition that occurs when successive layers peel off of a surface.

Exploratory openings: a destructive method of testing in which a portion of the wall is removed to reveal the inner detail and condition. Example: Removal of several sq. ft. of exterior brick to assess the condition of the through-wall flashing.

Façade: The whole exterior side of a building; the building face.

Life safety: The concept of hazards or imminent danger that threatens human life. Example: A building is considered to have life safety issues if it is in such disrepair that portions of the facade may fall to the ground.

Lintel: a piece of steel, wood or stone placed horizontally across the top of a window or door opening to support the walls immediately above the opening.

Non-destructive testing: a method of testing which does not adversely affect the structure or component being tested. Examples: visual inspection, infrared photography ultrasonics, and even x-ray.

Out-of-plane: a condition in which a section of masonry has shifted so that it is no longer in flat alignment with the original vertical or horizontal surface.

Parapet: a low protective wall or railing along the edge of a roof, balcony or terrace.

Wythe: each continuous vertical section or thickness of brick masonry; the course or thickness of brick separating flues.

Definitions for efflorescence, exfoliation, façade, lintel, parapet and wythe taken from *The Construction Dictionary*, Third Printing – April 1980 Revision. Publisher: The National Association of Women in Construction.