Building Façade Inspection

Part 2: Procedures

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Structural engineers with varied experience in the areas of design, forensics, water and damp proofing, and construction are the best qualified professionals to conduct façade inspections. They have knowledge of how materials behave when subjected to imposed loads and movements. Determining the root cause of a deficiency can be very challenging, though not impossible if you understand how façades and building superstructures are constructed, how they behave when subjected to movement and load, and the possible failure mechanisms involved. Part One (STRUCTURE®, September 2010) discussed some of the important considerations that motivate building façade inspections; this article describes the actual inspection and documentation process.

Detailed Façade inspection including sounding for delamination being conducted from a telescoping boom lift.

Inspection Process

Façade inspections are typically conducted by a qualified professional accompanied by qualified inspectors in general compliance with ASTM E 2270, *Standard Practice for Periodic Inspection of Building Façades for Unsafe Conditions*, supplemented by a design and construction cost estimate of proposed remedial repairs. The qualified professional, as the name implies, is a duly licensed architect or engineer. It is important that the professional be both knowledgeable and experienced with the design and construction of building façades, understand how façades behave when subjected to environmental changes and building movements, and be familiar with the failure mechanisms involved.

The inspection begins with a kick-off meeting that includes the building user and maintenance personnel to obtain historical information regarding the building envelope including re-roofing, previous repairs, additions, and known deficient conditions. A quick guided tour of the facility should be conducted to familiarize the inspectors with the layout of the building, and to allow building representatives and inspectors to view any known problem areas. It is important that building security personnel be informed about the inspection process, as the nature of the work may appear suspicious. Inspectors should be granted access to review any available construction documents, typically limited to plans and sometimes specifications. Drawings are reproduced to aid in the inspection and reporting process. Wall sections are also copied and studied to determine the makeup of the exterior walls. Knowledge of how the façades are constructed is important in determining the cause of any deficiencies discovered during the inspection. When previous façade inspection reports exist, they may identify areas where both visible and concealed damage is likely and assist in prioritizing inspection areas.

The degree of inspection is categorized into two levels. *General Inspection* is visual observation at a distance greater than 6 feet from the façade, with and without magnification. *Detailed Inspection* consists of hands-on observation, including pushing, pulling, probing, and sounding, as well as the removal of loose, unsound, or fractured material to examine the underlying cause of the degradation. Initial general and detailed inspection is focused in areas of known and likely deficiencies, both from the interior and exterior of the building, as these may be indicative of trends in the façade degradation.

Mortar joints that are too small can cause spalls when terra cotta coping expands.

Detailed inspection of roofing and parapets comes next. Degraded roofing and parapets can be a source of moisture intrusion into the exterior walls, which can cause rust and deterioration of reinforcing and supports; also, moisture trapped within the veneer can freeze or cause the material to expand, resulting in cracks and spalls of the veneer. Parapets experience the full effect of environmental conditions on both faces. Differential temperature and moisture content changes between the parapet and the walls of the building below cause differential expansion and contraction. Modern brick detailing requires standard-width expansion joints in masonry walls every 25 feet and within 10 feet of building corners. Since parapets experience greater amounts of differential movement, a joint spacing of 15 feet is recommended at parapets.

Most buildings constructed more than 30 or 40 years ago lack any type of expansion joints in the façade. This phenomenon is further exacerbated by concrete frames or concrete masonry units (CMU) that shrink, steel frames that expand and contract with temperature changes, through-wall flashing at the base of parapets that can weaken the parapet, and multi-wythe parapet construction where the exterior wythe is a continuation of a taller wall below that expands and contracts more than the inner wythe supported on the roof. All

Failure of relief angles above causes limestone curtainwall to buckle under the panel weight from above.

of these competing movements and associated stresses lead to diagonal cracks, horizontal cracks, and bulging of parapets, particularly at the corners of the building.

The façade is then generally inspected by thoroughly and methodically scanning the exterior, both horizontally and vertically, with tripod-mounted binoculars. Deficiencies are documented with the aid of a camera with a telephoto lens. The purpose is to identify, quantify, and photograph anything within the façade that looks out of place, such as missing components, stains, cracks, spalls, bulges, previous repairs, deteriorated sealants, and any other physical damage. Items documented will be noted on building elevations along with a unique deficiency and photograph number to aid with report development.

Based on the findings of the general inspection, previously identified deficiencies, and repair history, representative areas are selected for detailed inspection. The minimum extent is defined in the Annex to ASTM E 2270 according to the age and type of façade material, and may be supplemented by local codes and/or owner requirements. Based on the building heights and access, detailed inspection can be conducted via adjacent roofs, ladder, swing stage, telescoping boom lift, and industrial rope access. At large holes in the façade, mirrors and/or a remote camera can be utilized, when appropriate, to observe and record the substrate condition. Where a remote camera or mirror cannot be used, holes can be drilled in mortar and sealant joints, with the owner's permission, and a borescope inserted to observe and record the substrate. These holes should then be plugged with sealant.

Reporting

Based on the data collected, the professional in conjunction with the inspectors will analyze each and every deficiency noted and determine the root cause and severity. This analysis is usually conducted during the inspection and documented later. Severity levels for deficiencies are classified as follows:

- *Unsafe condition* poses an imminent threat to persons or property and should immediately be brought to the attention of the owner, and local jurisdiction as required, including potential repair and remedial options.
- *Requires repair/stabilization* identifies a situation that could become unsafe if not addressed prior to the next scheduled inspection.
- *Ordinary maintenance* defines something that should be addressed during the next scheduled maintenance.

Corrosion of the reinforcing steel has cuased the concrete cover to spall.

Detailed façade inspection utilizing borescope examination of veneer supports.

To assist the owner with budgeting future maintenance of the building façade, a detailed estimate broken down by severity classification is prepared for inclusion in the final report. The estimate should contain all costs including contractor's labor, material, equipment, overhead, and general conditions, as well as fees for architecture and engineering services, owner's administration, and contingency.

Reporting should convey the history and condition of the façade in terms that the layperson can understand, to assist the building owner in planning for remedial repairs and future inspections. The original building construction, additions, alterations, renovations, and repairs should be described including roofing, parapet construction, façade system and support, waterproofing, primary structural system, and foundations. Methods of inspection, classification of deficiencies (including written and photographic documentation), and the probable cause of the deficiency should be described, along with recommended remedial options and repairs and associated cost estimates.

Conclusion

Façade inspection is as much of an art as a science, and forces structural engineers to think outside the box. No matter how unique and challenging a deficiency seems to be, experience and persistence will lead to the root cause. With roughly only 15,000 buildings subject to façade ordinances in nine cities across the nation, there are a lot of other possible time bombs out there requiring inspection and remedial action. Hopefully, other municipalities will adopt ASTM E 2270 before the harmful effects of not doing so are experienced.▪

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