CONSIDERING THE IMPORTANCE OF PERIODIC FAÇADE INSPECTIONS FOR TALL BUILDINGS

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CONTEXT

For tall buildings, façades comprise the majority of the building envelope, the critical component for structures providing separation between the conditioned and unconditioned environment. Building façades continue to evolve aesthetically, in complexity, but also in efficiency. However, building façades deteriorate due to environmental exposure, lack of maintenance, design and construction errors, or a combination of such factors [1]. Deterioration can result in potential unsafe conditions, and if unaddressed, can jeopardize public safety and surrounding properties. Understanding that these conditions can develop throughout the service life of buildings, prompts the need for periodic inspection and assessment of building exterior façades to identify such hazardous conditions.

Building façade deterioration is not specific to any one region, but a widespread phenomenon. Even with the growing knowledge around performance of building façades and their deterioration, a significantly low percentage of cities throughout North America have enacted façade ordinances.

NOTABLE PAST FAÇADE FAILURES

Incidents of façade failures resulting in falling debris pose an endemic problem in the built-up areas of Canada and the United States, with too many failures resulting in tragedy. Table 1 provides a few examples of façade failures over the last decade.

JURISDICTIONAL REQUIREMENTS

Past incidents of façade failure throughout North America have resulted in multiple jurisdictions enacting legislation related to building façade inspection and maintenance. In Canada, Calgary, Alberta, and the Province of Quebec have active façade ordinances. For the United States, cities include Boston, Chicago, Cincinnati, Cleveland, Columbus, Detroit, Milwaukee, New York City, Philadelphia, Pittsburgh, San Francisco, and St. Louis [2].

Comparison of façade ordinances reveals the following common building façade inspection requirements:

- Building height: Five stories or greater (and/or buildings with appurtenances in excess of 60 feet)
- Building age: 10 years or older
- Review periods/intervals: Five-year intervals

A wider variance was observed in other requirements such as:

- Minimum inspections methods
- Minimum access methods
- Inspector qualifications: Registered architect or professional structural engineer
- Hazardous condition repair deadlines
- Penalties and fines for violations

Interest and consensus surrounding potential unsafe conditions caused by building façade deterioration led to development of the ASTM E2270 – Standard Practice for Periodic Inspection of Building Facades for Unsafe Conditions. The intent of

Table 1 – Examples of Notable Past Building Façade Failures in North America

Date	City	Failed Façade Component	Description
July, 2009	Montreal, Quebec, Canada	Precast concrete panel	A precast concrete panel fell from the 18th floor killing a woman in the restaurant directly below, as well as seriously injuring her partner [3].
August, 2011	Chicago, Illinois, United States	Metal cladding panel	A metal cladding panel fell from the first floor of a downtown high-rise building leaving a pedestrian in serious to critical condition. The metal panel was estimated to measure approximately 15-feet tall, by three-feet wide, and more that one-inch thick [4].
December, 2019	New York City, New York, United States	Terra Cotta	Failed terracotta fell from above the 15th floor of a downtown Manhattan high-rise building which struck and killed a pedestrian below [5].
July, 2020	Calgary, Alberta, Canada	Concrete roofing tiles, stucco, sheathing, etc.	An architectural feature roof, clad mainly with concrete roofing tiles and stucco, collapsed, and fell from the 7th floor penthouse resulting in property damage. No injuries were reported.

ASTM E2270 is to establish minimum requirements for conducting such periodic building façade inspections and provide basic guidelines or standard practices applicable in all jurisdictions internationally [1].

Research provides minimal information related to building façade ordinances or any direct inspection and maintenance legislation for other municipal jurisdictions in Canada. Additionally, provinces do not provide legislation related to building façade inspection and maintenance in their Public Health Acts or building codes (excluding Quebec). A 2013 report by The Elliot Lake Commission of Inquiry outlining Property Maintenance and Repair Policies, Regulations, Legislation and By-Laws highlights in general the lack of written policy throughout Ontario municipalities requiring inspection or visual assessment of buildings for unsafe conditions [6]. It is noted that policies typically do not address how enforcement is carried out or what is required to trigger building inspections, but rather that practice of enforcement is mostly complaint-driven [6].

Active façade ordinances in the United States appear to define minimum requirements similar to those described in ASTM E2270, with several cities referencing the standard directly. However, variability still exists due to the jurisdictional nature of the legislation. For instance, New York City (NYC) permits only qualified exterior wall inspectors (QEWIs) to complete building façade inspections. QEWIs must be registered design professionals with at least seven years of relevant experience with façades over six stories, and pass both written and oral exams as required by the NYC Department of Building's Facades Unit [2]. Contrary, Detroit, Michigan and Calgary, Alberta provide minimal to no qualification criteria for inspectors. In Calgary, visual assessments must "be performed by a person with sufficient education, training, skill and experience [relating to roofs and/or walls] such that the person's visual assessment may reasonably be relied upon [7, p. 3]."

AVAILABLE FAÇADE INSPECTION TECHNOLOGIES

ASTM E2270 defines that a combination of two categories, both general and detailed inspection, are required [1]. These façade inspection categories are defined as:

(1) General inspection, which includes "visual observation of façade components from distances equal to or greater than six feet (1.8 metres) with or without the use of magnification or remote optical devices" [1, p. 3] (e.g., binoculars or drones); and

(2) Detailed inspection which requires "visual observation and tactile evaluation of façade components, including probing and NDT [non-destructive testing] to observe concealed conditions of wall construction" [1, p. 3].

General inspection or visual review from ground level can be effective for review of low-rise buildings and some mid-rise buildings but may provide limited ability to detect hazards during review of high-

Table 2 – Summary of Available NDT and DT Technologies

NDT Technologies

- Remotely piloted aircraft systems (RPAS) (i.e., drones)
- LIDAR / laser scanning
- Infrared thermography
- Ultrasonic testing equipment or smoke testing for air leakage
- Hammer sounding

DT Technologies

- Borescope (i.e. probing)
- Exploratory openings

rise building façades [8]. Close-up or tactile visual review can be performed via swingstage, rope access techniques, accessing adjacent balconies, etc. [8].

Incorporation of NDT technologies can augment the effectiveness of the overall visual inspection and may detect or identify isolated façade areas requiring more detailed or intrusive review. When intrusive review is required, use of destructive testing (DT) technologies may capture conditions of hidden cladding components (such as anchor connections, reinforcement, etc.). Some examples of available NDT and DT technologies are listed in Table 2 below.

Depending on the jurisdiction, selecting appropriate assessment methods and supplemental technologies is often left to the individual (or company) performing the façade inspection. In general, accessing the building façade and use of NDT and/or DT technologies are the main contributors to overall costs of exterior façade inspections. Downward pressure on fees by building owners may contribute to building façade inspections meeting only the minimum requirements of a jurisdictional façade ordinance (e.g., strictly visual assessment from ground and roofs). Building owners should be informed of the limitations of visual inspection or assessment as hidden façade conditions with potentially unsafe conditions cannot be captured.

ATTAINING A REASONABLE LEVEL OF CONFIDENCE

A representative sample area must be defined when performing façade inspections to acquire data that is statistically significant and provides a reasonable level of confidence. Existing façade conditions can vary widely between buildings and even jurisdictionally. There is no absolute value for representative sample sizes that apply to all buildings; therefore, a representative sample must be determined based on past knowledge of façade inspections, reference to available standards or best practices (such as ASTM E2270), and the building façade service history (if available).

Review of available building architectural and structural drawings, and past façade performance and service history may distinguish between original construction and subsequent repairs. Document review may isolate façade areas that require more detailed inspection or provide grounds to expand the sample area based on indicated facade performance problems.

CONCLUSIONS

Cladding failure is an endemic problem that continues to jeopardize public safety and result in damage to property. Building façade deterioration is not unique to only a few jurisdictions but a widespread phenomenon. Data suggests municipalities are typically the governing bodies to enact such regulations, but provinces may also produce and enforce legislation (e.g., Province of Quebec, Canada). Due to the jurisdictional nature of the legislation, variability of defined minimum façade inspection requirements is common.

Enacting legislation to enforce periodic building façade inspection may offer an approach to ensure preventative identification and maintenance of potentially unsafe building façade conditions are performed; however, legislation does not guarantee public safety from hazardous conditions. The quality and reliability of building façade inspections are dependent on both the owner and inspector (i.e., fee/level of inspection/inspector qualifications). Downward pressure from building owners on fees will remain and may result in only minimum legislative requirements being met.

Reference to internationally accepted standards, such as ASTM E2270, can assist when determining an appropriate level of façade inspection, representative sample area, and use of available NDT and DT technologies. Remaining cognizant of standard practices and industry consensus for appropriate minimum requirements will assist efforts to educate building owners and continue to refine how building façade inspections for unsafe conditions are conducted.

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