

Glass Balcony Guards: Review

Date:	November 3, 2011
To:	Planning and Growth Management Committee
From:	Chief Building Official and Executive Director, Toronto Building
Wards:	All
Reference Number:	PG11019

SUMMARY

The purpose of this report is to respond to the Planning and Growth Management Committee's direction that the Chief Building Official report on the Toronto Building's review into glass balcony guard safety and provide recommendations for further action by the City in addressing the issue of glass paneled balcony guard safety.

A placeholder report on the agenda of the November 8, 2011 Planning and Growth Management Committee advised that the Chief Building Official and Executive Director, Toronto Building will be submitting this report for the Committee's consideration on November 8, 2011.

This report provides a summary of the City's review of the commonalities and possible causes for the failure of glass paneled balconies in the City. The report background provides information on the evolution of the design of glass balconies, potential causes of failure and the standards which govern glass in building construction.

The report identifies that a response to the issue is necessary on several fronts. Toronto Building is implementing changes to its review of permits where glass panels may be used and is recommending sharing the City's analysis with stakeholders and regulatory authorities and encouraging them to recognize potential issues with the use of glass panels in an urban setting such as Toronto. The Chief Building Official is also recommending that the City request emergency amendments to both the model national and Ontario building codes so that the minimum standards of construction, enforced by the City, minimize the potential for future glass balcony failures.

RECOMMENDATIONS

The Chief Building Official and Executive Director, Toronto Building recommends that City Council direct that:

1. The Chief Building Official and Executive Director, Toronto Building advise the Canadian Commission on Building and Fire Codes and the Ministry of Municipal Affairs and Housing of the results of the City's review of the use of glass panels in balcony guards and request that they consider an emergency amendment to the Ontario Building Code to better address concerns for public safety when glass paneled balconies may break.
2. The Chief Building Official and Executive Director, Toronto Building advise the Toronto Building and Land Development Association (BILD), TARION, Ontario Association of Architects and Professional Engineers Ontario of the results of the City's analysis of glass panel safety in balcony guards and encourage these organizations to update their practices and professional training regarding the use of glass panels in balcony guards.
3. The Chief Building Official and Executive Director, Toronto Building report to the Planning and Growth Management Committee in early 2012 to provide a status update on the actions of the City in addressing glass paneled balcony guards and public safety.

Financial Impact

Adopting the recommendations in this report will have **no** financial impact beyond what has already been approved in the current year's budget.

DECISION HISTORY

At its meeting of October 6, 2011, the Planning and Growth Management Committee considered the (September 22, 2011) Report from the Chief Building Official and Executive Director, Toronto Building, "[Status Update: Glass Balcony Guards](#)". The Committee referred this item to the Chief Building Official and Executive Director, Toronto Building, with the request that she report back to the Planning and Growth Management Committee meeting on November 8, 2011, on the findings of the review into glass balcony guard safety and provide recommendations for action by the City in considering its own practices and to inform discussions with the province, professional designers and the building industry in addressing the issue of glass paneled balcony guard safety.

ISSUE BACKGROUND

In the summer of 2011, there were instances of glass panel failure on a number of high-rise condominium towers in the City. Toronto Building responded under the authority of the Building Code Act to remedy unsafe conditions. The Orders required the submission of an investigation report (for each building) to determine the cause of glass breakage and confirm compliance with the requirements of the building code. The development companies are working cooperatively with Toronto Building to comply with the Orders and protect public safety.

The Chief Building Official reported to the Planning and Growth Management Committee at its meeting of October 6, 2011. The report "Status Update: Glass Balcony Guards" provided an overview of Toronto Building's role in enforcing the Ontario Building Code and information on the initial reports received by the City in identifying possible causes for the failures.

In keeping with the recommendation of the Planning and Growth Management Committee, Toronto Building has reviewed glass panel safety on high-rise condominium towers and investigated the cause of the failures to assist in determining what actions should be taken to protect the public.

As part of this review, Toronto Building retained an independent Professional Engineer to peer review the reports and remedial plans from the developers' Professional Engineers. The City's consultant reviewed six assessment reports on six buildings, met with the developers and their consultants on several occasions and conducted on site reviews.

Toronto Building has received the first draft report from the consultant retained by the City. The information provided in the report at this stage provides necessary information on the design of glass balconies, potential causes of failure and the standards which govern glass in building construction. A second report examining how other jurisdictions other than Ontario regulate glass panels on residential balconies and further advice that could be taken to ensure public safety is underway.

COMMENTS

Technical Review of Glass Balcony, Guard Manufacture and Design

The technical review of the incidents of glass balcony guard failure conducted by the Professional Engineer retained by Toronto Building identified the following findings:

Evolution of Glass Balconies

- Glass panels are increasingly prominent in high-rise residential balcony design in the following ways:
 - "Balcony length is increasing...becoming a continuous element on some faces."
 - Panels are longer, higher and thicker, moving from the top of the slab to the face;
 - Framing around panels is reduced or eliminated.
- Design changes have resulted in the use of larger, thicker panels, which are typically up to three or four times heavier than in earlier designs with an increase in the total volume of glass;
- Glass used in panels in balcony guards is typically tempered glass. Tempering is a thermal process which toughens and increases the strength of the glass and puts stress in the glass so that when the glass is broken it breaks into small pieces with blunt edges;
- The manufacture of glass inherently introduces impurities which result in inclusions from nickel sulphide particles trapped in the glass, that expand, causing some glass panels to fail, overwhelmingly concentrated in the period within two to seven years after manufacture;
- Rates of inclusion which can cause spontaneous breakage are the subject of ongoing debate but the consultants for the developers of the affected projects have generally identified .2 percent or 2/1000 as within expected norms;
- Heat soaking tempered glass after manufacturing and tempering virtually eliminates spontaneous breakage. Heat soaking is not commonly used as the test itself results in breakage of the manufactured glass panel and is an additional step in the process which increases the cost;
- Other test methods, to identify the presence of nickel sulphide impurities (e.g., ultra sound, laser imagery) are not practical or accepted for use in building construction.

Building Code Requirements

The Professional Engineer retained by Toronto Building has reviewed the relevant requirements of the Ontario Building Code, which is not significantly different from the model National Building Code in Part 4 which contains the Structural Design

requirements of the building code. The Engineer's report, however, identifies some lack of clarity and potential conflict between the building code and standards referenced within it. CAN/CGSB 12.1M is the applicable standard for tempered glass referenced in the building code, but it is 21 years old and was written primarily for "glazed exterior/interior passageway doors, storm (combination) doors, patio doors, shower and bathtub doors and their enclosures", rather than balconies. However, it is the standard typically applied and referenced by architects/engineers/designers in the construction of balconies. The consultant notes that "this standard does not require assurance that the glass will not break, only that the glass will break into small pieces of a maximum size."

The Ontario Building Code specifies different loading requirements for panel guards than the referenced CAN/CGSB standard, which seem more applicable to other guard materials (e.g., metal panels or pickets) than glass panels.

The consultant concludes that:

"these issues and inconsistencies may contribute to glass that is potentially not designed or not tested in a manner that provides for safe use in balconies," if the expectation is that "it does not fail and fall from the balcony."

A further factor identified in the Engineer's report is that glass is frequently manufactured outside Canada where an ASTM standard is employed, with the procedure for testing outlined in a further referenced ANSI standard, with some criteria beyond those contained in the referenced CAN standard, arguably more comprehensive than the standard referenced in the Ontario Building Code.

More analysis of the National/Ontario standards relative to international codes and standards and practices will be completed in the second stage of the Engineer's review.

ASSESSMENT OF FAILURES

The City's independent Professional Engineer was tasked with reviewing the submitted reports from the developers' consultants. Toronto Building is now in receipt of a draft report from the Engineer which provides independent comments on the causation of the glass failures. The developers, in consultation with their consultants, are submitting responses to questions with respect to the analysis identified by the independent Engineer, before the City's analysis can be completed. However, the assessment of failures by the Engineer, to date, suggests the following:

Nickel sulphide inclusions have been identified as the most likely cause of failure in the buildings where the highest frequency of failure has occurred, potentially aggravated by other factors, such as loading or deflection, either by causing glass inclusions to rupture at a higher rate, or as a result of glass to metal contact. In the case of the buildings at Regent Park, no connection to nickel sulphide inclusions has been drawn from test results to date, whereas significant rates of glass to metal contact were identified on two of the four towers.

The City's independent Engineer notes consultants for the developers have identified "shortcomings in design protocols for balcony guards, but have suggested different approaches to deal with the shortcomings." The consultant for the Murano and One Bedford buildings recommends "enhanced design practices using load data arrived at through model analogue studies", while the consultant for the TIFF and Regent Park buildings focuses on the size and thickness of panels, that are face mounted to the slab that fall from a height should rupture occur.

The reports from the consultants for the developers, submitted to date in response to the orders issued by Toronto Building, have not identified building code compliance as an issue related to the failures.

On the basis of the information submitted to date, the City's independent Engineer concludes that there is room for improvement in:

- the design of balcony guards incorporating glass;
- the manner in which the Ontario Building Code spells out load and material performance requirements.

STATUS OF REMEDIAL ACTION

Based on the analysis to determine causation of the glass failure in each of the sites, developers are in the process of determining the most appropriate remedial action required for each building. The remedial action proposed for Murano North and South, One Bedford and the TIFF building is redesign and replacement with laminated glass. That approach is suggested to address the falling of ruptured glass with a high degree of certainty that the glass will remain in place until replaced. Laminated glass is permitted by the Ontario Building Code.

The remedial action proposed for the Regent Park buildings is to correct glass-to-metal clearance defects. Toronto Building staff have had preliminary discussions with the developers on their initial remedial plans. The developers, in consultation with their consultants, are still preparing responses to questions Toronto Building has regarding the sufficiency of the proposals. Based on the review, applications for building permits for corrective action are expected to be submitted shortly.

RESPONSE

In addition to determining the reasons for the recent glass panel failures, Toronto Building is pursuing three strategies to reduce the likelihood of future glass failures. These include:

- Review of the levels of service undertaken in the issuance of building permits, and inspections for glass balcony guards;

- Recommendations to the province and the Canadian Commission on Building and Fire Codes for an emergency amendment to the model National Building Code and the Ontario Building Code, and
- Sharing the results of the consultant's review with key stakeholders to encourage the development of best practices, training and communication updates on the issue of glass balcony guard safety.

Building Code Amendments

Within the City of Toronto, Toronto Building enforces the Building Code. It is recommended that City Council direct the Chief Building Official to submit a request for an emergency amendment to the Ontario and model National codes related to balcony loads and balcony glass with the objective of minimizing the risk to public safety in urban settings the failure of glass balcony guards based on the results of its review of these failures.

Other Organizations: Design Practice and Program Revisions

The Chief Building Official has engaged in discussions with stakeholders and regulatory authorities on how their organizations may respond to the issue of glass balcony safety, since experiencing the failures over the past year. It is recommended that the Chief Building Official be directed to continue these discussions and share the results of the City's independent Engineer's review with the Ministry of Municipal Affairs and Housing, Tarion, the Building Industry and Land Development Association, the Ontario Association of Architects and Professional Engineers Ontario.

City Action

Toronto Building is obliged to issue permits where a permit application complies with the building code and all applicable law. Levels of service associated with the review of permit applications are within the discretion of the Chief Building Official. Toronto Building is reviewing current levels of service with respect to the review of permit applications with glass balcony guards and will implement any changes identified to verify compliance with the applicable building code requirements. However, as non-compliance with requirements of the building code has not been identified as a causal factor in the failure of balcony guards to date, this is not expected to address the potential risk of failure of glass balcony guards.

The City is proceeding with a second phase of analysis that will help shape the development of any Code amendments and regulatory approaches to glass balcony safety. The City's consultant is conducting research on how jurisdictions other than Ontario regulate tempered glass panels on residential balconies. It is also undertaking to identify and analyze broader systematic issues related to tempered glass panel balconies that require attention in Ontario's building regulatory framework and construction industry practice. The conclusions from this analysis are not yet complete but will assist in the

City's discussions with the Ministry of Municipal Affairs and Housing and other stakeholders.

This report recommends several immediate actions to address the issue of glass panel balcony safety and minimize the potential for future occurrences of failure. Based on the available information and the analysis completed to date it is difficult to determine where and how glass failure may occur. Toronto Building will respond to any future incidents as they occur on a case-by-case basis, based on our experience to date.

It is recommended that the Chief Building Official and Executive Director, Toronto Building report to the Planning and Growth Management Committee in early 2012 to provide a status update on the actions of the City in addressing glass paneled balcony guards and public safety.

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