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Glass and Glazing on Our Tall Towers: Is It All It's Cracked Up To Be?

By Brian Hubbs, P.Eng.

Introduction

Glass-clad commercial and residential towers are a popular form of construction; most everyone wants big views and lots of sunlight. Today's fenestration systems (windows) are more advanced, and more efficient, to install than ever before. As a result, entire building façades are being constructed of pre-manufactured glass and aluminum modules as unitized curtain wall or window-wall. These modern glazing systems are high performance and durable when manufactured and installed correctly and require very little maintenance in the first 10 to 20 years in service. The glazing itself is likely to require virtually no maintenance over the initial 20 years.

Unfortunately this is when the party often ends.

High-rise fenestration systems consist of 2 main components:

- the glazing
- the aluminum framing system to hold it in place

The focus of this bulletin is on the glazing component of fenestration systems.

Glazing allows sunlight to enter the building and lets us see the views that we all crave. The glazing needs to perform several other functions including:

- providing necessary insulating value
- preventing overheating and glare on sunny days
- filtering out unwanted street noise
- resisting wind and occupant impact loads

This is achieved by creating an Insulating Glazing Unit (IGU) using 2 to 3 layers of glass, specialized coatings such as silver on different surfaces, and various gasses, such as argon, between the layers of glass. These different layers of glass are then permanently held in place and sealed to prevent gasses from escaping and water from entering. If this seal fails, then damage to specialized coatings and condensation can occur and impair the ability to see out of the building.

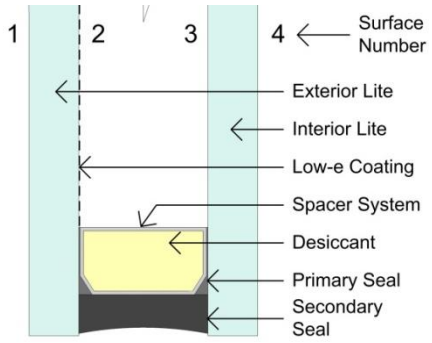

Figure 1: Typical Insulating Glass Unit Construction

When Will Replacement be Required?

On existing buildings, IGUs started being used extensively in buildings during the 70's and 80's. IGUs have expected service lives of 15-40 years before the organic sealants holding

the units together start to fail. This results in water vapour entering the units and can cause fogging and hazing that obstructs vision. Replacement of glazing units is difficult because many of the glass colours and coatings that were common when these buildings were built are no longer available today and matching the visual appearance is an art that requires experience and mock-ups. In addition, re-glazing a modern curtain wall typically needs to be done from the exterior off suspended stages and the cost of replacement can approach the cost of the original glazing system for complicated buildings. Due to the high cost of replacing glazing units on an existing building, it is critical for owners and managers of older buildings to have an understanding of when replacement will be required and if anything can be done to extend the life of the existing glazing units.

Figure 2: Glazing replacement project at a 45 storey high-rise building utilizing a large suspended stage hung from the building

Figure 3: Difficulty in Matching Glass Color – Exterior View

Figure 4: Difficulty in Matching Glass Color – Interior View

New Buildings – How to Guard Against Problems?

On new buildings, there is an almost infinite combination of metallic coatings, glass types, spacer bars, polymers, and sealants that can be used to create an IGU. The glazing industry is evolving rapidly and every year many new products are introduced to the market to improve performance or reduce costs. Unfortunately, many of these new products and combinations of products do not have a long track record of use on buildings. As a result, it is not uncommon to see IGU performance problems.

There are tests required by standards referenced within building codes that IGUs must undergo and certification programs, such as the Insulated Glass Manufacturers Association (IGMA). However, not all manufacturers test all combinations of sealants, coatings and spacers, and even the formulations of these products can change from batch to batch without the manufacturer's knowledge. As a result, it is important to review the glazing

system and IGU make-up to check that it is adequately designed, and that all of the components have been tested to both perform initially and withstand the test of time.

What do I do if there's a Problem?

When investigating IGU problems, a visual review is first conducted to look for fogging, hazing caused by corrosion of coatings, or spacer bar displacement.

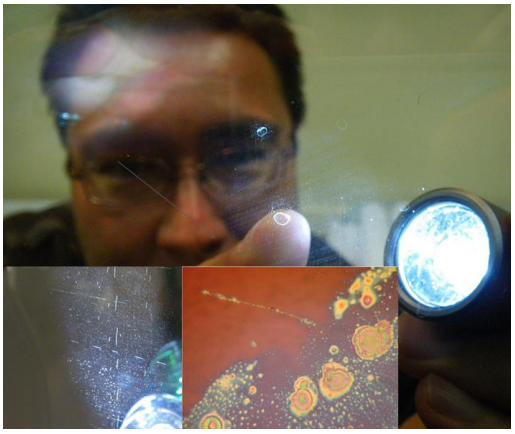

Figure 5: The author examining hazing that could not be cleaned from the glass (corrosion of silver low-e coating inside the IGU).

Figure 6: Volatile fogging between panes of glass occurring during periods of warm weather in direct sunlight.

Figure 7: Spacer bar displacement into glazing unit obstructing view and resulting in fogging.

Figure 8: Severe condensation and frost inside glazing unit during cold weather.

If there is a concern regarding moisture (water vapour) within the IGU, a sampling of units is typically tested using a device called a frost point tester to measure the amount of water inside the glazing unit. Once the amount of water is known, a mathematical model is used to predict the remaining life and the expected replacement costs over the next decade.

Figure 9: Performing a Frost Point test on a suspect unit.

Figure 10: The culprit: unsealed vent tubes. The solution: crimp and seal them.

Most importantly, if there is evidence of excessive water vapour within the IGU, the construction and installation of the IGU must be investigated further to try and develop an economical method of extending the remaining service life of the units that have not yet failed. On older buildings, cleaning weep holes in the aluminum framing members or installing exterior sealants to reduce the amount of water contacting the glazing unit edge seal are methods sometimes used to prolong the service life of an IGU.

On new buildings, incompatible materials can often be separated and glazing installation problems repaired before failure of the unit occurs.

Summary

Insulating glazing units are one of the most valued components on a building from a comfort and enjoyment perspective. They are also one of the largest assets requiring cyclical renewals. Like checking the oil in your car, early diagnosis and action can extend the service life of the entire system if problems are identified early and corrective action taken. Unfortunately, it is more often the case that action is taken after failures have occurred and often this is an exercise in planning for replacement rather than extending service life. Being proactive and checking on the performance of the glazing system every 5 to 10 years is the best way to get the most life possible out of your all glass façade.

About the Author

Brian Hubbs is a Principal and Senior Building Science Specialist with RDH Building Engineering Ltd. in Vancouver, B.C., He has over 20 years of experience as a consulting engineer focused on building enclosure issues across North America. This work has included the design of new building enclosures, as well as forensic investigation, rehabilitation, maintenance, and litigation support on existing buildings. Brian has been involved with IGMA's technical services committee for many years and has undertaken numerous IGU failure and glazing breakage investigations.

For additional information on this and other topics, please visit our website, rdh.com, or contact us at contact@rdh.com.

Additional Resources

- Visit The Wall, for a blog post version of this Technical Bulletin.
- Visit RDH's North American Fenestration Standard in Canada (NAFS) Blog for more posts on windows, doors, and skylights.
- See RDH's work on the One Wall Centre in our Case Study.