



Use of Laminated Glass in Glass Railing Systems

Introduction

Glass railing systems are used in a variety of residential and commercial settings for safety and the beauty glass adds to a structure. Laminated glass offers a variety of design options: the interlayer can be clear, tinted, or custom printed. The glass can be clear, tinted or decorative; flat or curved, fully supported on 1, 2, 3, or 4 edges or minimally supported with bolts and/or clamps. Laminated glass offers a benefit over monolithic glass used in railings; namely, if breakage occurs, glass particles will adhere to the laminate interlayer increasing the likelihood of glass retention in the system.

Glass Selection

A variety of glass and interlayer products can be incorporated into laminated glass railing systems. Laminated products constructed with heat strengthened and tempered glass shall be specified in accordance with ASTM Specifications C1036 - *Standard Specification for Flat Glass*, C1048 - *Standard Specification for Heat Treated Flat Glass; Kind HS, Kind FT Coated and Uncoated Glass* and C1172 - *Standard Specification for Laminated Architectural Flat Glass*. Products requiring the fabrication of holes and/or notches shall adhere to the guidelines contained in ASTM C1048.

Building Code Requirements

Chapter 24 of the International Building Code (IBC) addresses glass used in handrails and guards. It states that glass used as a handrail assembly or guard section is to be a minimum thickness of ¼ inch (6 mm) monolithic tempered glass, laminated tempered glass, or laminated heat strengthened glass. Glazing in railing in-fill panels is required to conform to Category II impact requirements of the Consumer Product Safety Commission (CPSC) 16 CFR 1201 or Class A of ANSI Z97.1. In addition, the panels and their support systems must be able to meet load requirements. A safety factor of 4 is applied to the glass.

Two additional provisions were added to the 2009 IBC. The first is an exception to the requirement of a minimum of three glass balusters supporting each handrail or guard section. The code requires an attached handrail or guard, *except* where the glass balusters are laminated with two or more glass plies of equal thickness and the same glass type when approved by the building official. Since states and local municipalities may be enforcing older or modified versions of the IBC, it is important to confirm requirements related to glass railing systems with the building department.

The second provision addresses glass installed in exterior railing in-fill panels or balusters in wind-borne debris regions. It says the glass is to be laminated glass complying with safety glazing impact requirements. When the top rail is supported by glass, large or small impact testing is required. The top rail is required to remain in place after impact.

Glass Railing Standards

Glass railing system testing is done according to ASTM E 2353-06 *Standard Test Methods for Performance of Glass in Permanent Glass Railing Systems, Guards & Balustrades*. The standard evaluates static strength, impact resistance, and post-break retention. Railing systems are specified according to ASTM E 2358-04, *Standard Specification for the Performance of Glass in Permanent Glass Railing Systems, Guards, and Balustrades*. These systems include glazing infill, as well as structural glass railing types. The four levels of performance are shown below.

Performance Level	Structural ^A	Safety Impact ^B	Enhanced impact ^C
1	Concentrated load: 890 N (200 lbf) Uniform Load: 290 N/m (20 lb/ft) Infill Horizontal Load: 220 N (50 lbf)	Pass 230 J 150 ft-lb	Not required
2	Concentrated load: 890 N (200 lbf) Uniform Load: 730 N/m (50 lb/ft) Infill Horizontal Load: 220 N (50 lbf)	Pass 542 J 400 ft-lb	Not required
3	Concentrated load: 1330 N (300 lbf) Uniform Load: 730 N/m (50 lb/ft) Infill Horizontal Load: 220 N (50 lbf)	Pass 542 J 400 ft-lb	Pass
4	Concentrated load: 1620 N (365 lbf) Uniform Load: 880 N/m (60 lb/ft) Infill Horizontal Load: 220 N (50 lbf)	Pass 542 J 400 ft-lb	Pass

^ATests performed as outlined in ASTM E 935.

^BTests performed as described in ANSI Z97.1.

^CTests performed as described in ASTM E 2025.

Glass Railing Applications

Laminated glass railing systems provide safety in many sports venues around the world. The metal top cap and handrail have been eliminated in some of these systems to afford spectators an unobstructed view onto the playing field.



Glass railings in shopping malls and airports create an open feeling on the inside of a large public space. In the case of multi-story shopping malls, shoppers have a clear view of stores on other levels. In airports, glass railings may be situated next to moving walkways. In both cases, public safety is a primary concern.

Laminated glass railing systems can also be installed in exterior applications, such as balconies in apartments, hotels, and condominiums. Laminated glass provides improved resistance to glass fallout in the event of breakage. If the laminate edge is not covered, additional consideration should be given to the interlayer type and glazing system design.



*Citizens Bank Park—Philadelphia, PA
Photo courtesy of DuPont*

Compatibility of Materials

When the system is wet glazed, it is important to verify compatibility of the caulk grout, or sealant used in contact with the laminate interlayer, especially in exterior applications where moisture and expansion rates can impact the system. Bolted or clamped systems require careful attention to minimize stress that can occur around the holes or clamps.

For additional information on laminated glazing materials consult the *GANA Laminated Glazing Reference Manual* and the GANA website: www.glasswebsite.com.

The Glass Association of North America (GANA) has produced this Glass Informational Bulletin solely to provide information regarding the use of laminated glass in glass railing systems. This bulletin makes no attempt to provide all information or considerations in the use of laminated glass. The user of this Bulletin has the responsibility to ensure their awareness of the use of laminated glass in glass railing systems. GANA disclaims any responsibility for any specific results related to the use of this Bulletin, for any errors or omissions contained in the Bulletin, and for any liability for loss or damage of any kind arising out of the use of this Bulletin.

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