DSA IR 24-1

GLASS PANEL RAILINGS: 2025 CBC

Disciplines: Structural, Fire and Life Safety

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Division of the State Architect (DSA) documents referenced within this publication are available on the DSA Forms or DSA Publications webpage.

PURPOSE

This Interpretation of Regulations (IR) clarifies requirements for glass panel railings used on construction projects under DSA jurisdiction.

SCOPE

This IR is applicable to the design and construction of glass panel railings. Glass panel railing refers to a railing assembly consisting of glass panels cantilevered from a base with or without a continuous top rail. This IR defines three compliance options for glass panel railings as follows: the design method per Section 2 below, the test method per Section 3 below, and evaluation report validation per Section 4 below.

BACKGROUND

California Building Code (CBC) Section 2407 addresses glass used in handrails and guards including material properties and other requirements. CBC Section 1607A.9 defines live load requirements for handrails and guards. When used in exterior applications, glass panel railings are also subject to wind loads prescribed by CBC Section 1609A and American Society of Civil Engineers (ASCE) Standard 7: Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE 7).

1. GENERAL

Glass panel railings shall be designed and constructed in accordance with CBC Section 2407. The design must demonstrate that the top rail remains in place in the event of failure of an individual glass panel. A continuous top rail may be omitted if the system complies with the Exception of CBC Section 2407.1.2.

1.1 Material

Glass in railing panels shall be an approved safety glazing material complying with CBC Sections 2406.1.1 and 2407.1.

1.2 Design Loads

Glass panel railing systems shall be designed for all applicable loads combined in accordance with CBC Section 1605A.

1.2.1 The required vertical and horizontal live loads for glass panel railings are prescribed in CBC Section 1607A.9.1 including concentrated and distributed loads.

1.2.2 For exterior installations, the design shall account for wind and snow (where applicable) loads as required by CBC Sections 1608A and 1609A and ASCE 7.

1.2.3 Regardless of the compliance method used to justify the system, glass elements of the handrail assembly shall comply with the stress limits required by CBC Section 2407.1.1.

1.3 Deflection Criteria

Glass panel railing must comply with the deflection limits of CBC Sections 2403.3 and 2403.4.

1.3.1 The deflection of cantilever elements resulting from the horizontal loads per Section 1.2 above shall not exceed the following limits when combined in accordance with the allowable stress design load combinations:

1.3.1.1 Length (L) no more than 13’-6”: L/90.

1.3.1.2 Length (L) greater than 13’-6”: L/120 + 1/8-inch.

1.3.2 The deflection of simple span elements resulting from the horizontal loads per Section 1.2 above shall not exceed the following limits when combined in accordance with the allowable stress design load combinations:

1.3.2.1 Length (L) no more than 13’-6”: L/175.

1.3.2.2 Length (L) greater than 13’-6”: L/240 + 1/4-inch.

1.3.3 To avoid creating a pinching hazard, the out-of-plane deflection limit for interior glazing adjacent to a walking surface, with two adjacent unsupported glass edges, shall comply with CBC Section 2403.4.

1.3.3.1 Clips or other devices may be installed between the adjacent glazing panel edges as an alternative means of complying with CBC Section 2403.4 provided load testing demonstrates that the clip or other device will limit the out-of-plane differential deflection to the thickness of the panel.

1.3.3.2 A horizontal test force of 50 pounds per linear foot shall be applied to one panel at the height producing the maximum deflection, up to 42 inches above the walking surface.

1.4 Location

Glass panel railings shall not be used in locations where they are exposed to vehicle impact, in accordance with CBC Section 2407.1.3.

1.5 Full Height Glass Walls

Full height glass walls designed to comply with the safety glazing requirements of CBC Section 2406 need not also comply with the requirements for handrails and guards.

2. DESIGN METHOD

Glass panel railings may be approved based on a rational analysis utilizing mechanics of materials and accepted engineering principles. Mechanical properties of the glass upon which the design is based (e.g., modulus of rupture, modulus of elasticity, etc.) shall be specified on the construction documents.

2.1 National Council of Structural Engineers Association (NCSEA) Guide

Compliance with the latest edition of the Engineering Structural Glass Design Guide published by NCSEA is an acceptable means of substantiating the structural adequacy of a railing system.

2.1.1 The load resisting capacity of glass shall comply with ASTM E1300: Determining Load Resistance of Glass in Buildings.

2.1.2 Applied loads and load combinations are as required by the CBC and ASCE 7.

2.1.3 The allowable stress shall be adjusted (i.e., reduced) by a load duration factor. Load combinations shall be substantiated for the most severe load duration factor of the loads being combined, neglecting the factor for self-weight (which need only be applied to the self-weight load considered independently). Load duration factors shall be determined for time durations no less than the following:

2.1.3.1 Wind load: 3 seconds.

2.1.3.2 Live load (including rail loads required by CBC Section 1607A.9): 12 hours.

2.1.3.3 Snow loads: 1 month.

2.1.3.4 Applied dead loads: 15 years.

2.1.3.5 Self-weight: 50 years.

2.1.4 The allowable stress shall be adjusted (i.e., reduced) by a probability of breakage factor corresponding to a probability of 1 in 1,000.

2.2 Alternative Design Method

Alternative design methods will be considered and accepted when approved in accordance with CBC Section 104.2.3 and California Administrative Code (CAC) Section 4-304. Approval of an alternative design method is described in *Procedure (PR) 18-01: Request for Alternate Design, Materials and Methods of Construction* and requires submission of form *DSA 1-AMM: Request for Alternate Design, Materials and Methods of Construction*.

3. TEST METHOD

Glass panel railings may be approved based on testing that demonstrates compliance with the performance requirements of ASTM E2358: Standard Specification for Performance of Glazing in Permanent Railing Systems, Guards, and Balustrades and this section. Tests may be conducted in the field or in the laboratory. Mock-ups tested as evidence of structural adequacy shall be exact duplicates of each unique railing configuration with variation limited to that permitted by ASTM E2358 Section 8.

3.1 Test Protocol

Tests shall be performed in accordance with ASTM E2353: Standard Test Methods for Performance of Glazing in Permanent Railing Systems, Guards, and Balustrades by a DSA-accepted testing laboratory.

3.1.1 Tests must be observed and results recorded in a report signed by a California registered civil or structural engineer. The test program must be defined on the construction documents per Section 3.3 below.

3.1.2 The In-Fill Load Test shall be performed per ASTM E2353 Section 12.2.4. In lieu of that given in ASTM E2358, the test load shall be four (4) times the horizontal force required by CBC Section 1607A.9.1.2 as follows: 4.0 x 50 pounds (lbf) = 200 lbf.

3.1.3 The Uniform Load Test shall be performed per ASTM E2353 Section 12.2.5.

3.1.3.1 In lieu of that given in ASTM E2358, when the load path includes a glass element, the test load shall be four (4) times the force required by CBC Section 1607A.9.1.1 as follows: 4.0 x 50 pounds per linear foot (plf) = 200 plf.

3.1.3.2 If the system's load path does not include any glass elements, the test load may be taken as two and one-half (2.5) times the design force as follows: 2.5 x 50 plf = 125 plf.

3.1.4 The Concentrated Load Test shall be performed per ASTM E2353 Section 12.2.6.

3.1.4.1 In lieu of that given in ASTM E2358, when the load path includes a glass element, the test load shall be four (4) times the force required by CBC Section 1607A.9.1 as follows: 4.0 x 200 lbf = 800 lbf.

3.1.4.2 If the system's load path does not include any glass elements, the test load may be taken as two and one-half (2.5) times the design force as follows: 2.5 x 200 lbf = 500 lbf.

3.1.5 Exterior systems shall also be tested for the critical wind and snow loads. Test loads shall be equal to four (4.0) times the maximum forces determined based on allowable stress

design load combinations per Section 1.2.2 above. Test loads shall be applied in a manner and extent consistent with the design loads as prescribed by the code.

3.1.6 The Shot Bag Impact Test shall be performed per ASTM E2353 Sections 12.4 and 13.3. The test load shall be as given in ASTM E2358.

3.1.7 When required by ASTM E2358 Table 1, the Pendulum Impact Test shall be performed per ASTM E2353 Sections 12.5 and 13.4. The test load shall be as given in ASTM E2358.

3.2 Acceptance Criteria

Specimens tested in accordance with Section 3.1 above shall demonstrate compliance with the performance requirements of ASTM E2358 and the following:

3.2.1 No damage is observed in the glass or non-glass elements, including cracking, yielding, fracturing, fastener loosening, etc.

3.2.2 No permanent or residual deformation is observed in the system. The top rail shall recover to its original position upon release of the test load.

3.2.3 Deflections measured when the test load equals one (1.0) times the design load per Section 1.2 above comply with the criteria defined in Section 1.3 above.

3.3 Construction Documents

The construction drawings shall clearly identify the quantity and types of glass panel railings to be tested. In accordance with ASTM E2353 Section 9, at least three specimens shall be tested for each unique railing configuration.

3.3.1 Drawings shall identify the location(s) and extent of glass panel railings to be replicated in the mock-up(s) constructed for testing purposes.

3.3.2 Drawings shall define the magnitude, location, and direction of test loads to be applied in accordance with Section 3.1 above.

3.3.3 Testing requirements for glass panel railings shall also be stated on the form *DSA 103: List of Required Structural Tests and Special Inspections*.

4. EVALUATION REPORT VALIDATION

Glass panel railing systems may be approved based on an evaluation report complying with *IR A-5: Product and Material Acceptance Based on a Valid Evaluation Report.* An acceptable evaluation report will state that the product complies with International Code Council Evaluation Service (ICC-ES) Acceptance Criteria AC439: Acceptance Criteria for Glass Railing and Balustrade System. In addition to the evaluation report, structural calculations must demonstrate compliance with the deflection criteria in Section 1.3 above.

REFERENCES

2025 California Code of Regulations (CCR) Title 24
Part 1: California Administrative Code (CAC), Section 4-304.
Part 2: California Building Code (CBC), Sections 104.2.3, 1605A, 1607A.9, 1608A, 1609A, 2403.3, 2406.1, 2407, and 2407.1.