

Glass Guardrail Requirements

Design Requirements Related to Part 3, 4, and 9 of the BC Building Code

November 1, 2022 Bulletin No. 22-05 Revised:

Purpose

This bulletin is to provide a consistent interpretation of the installation of glass guardrails installed in commercial and residential applications as outlined in Part 4 and Section 9.8 of the BC Building Code. The following information will provide clarification for typical installation standard requirements to ensure minimum BC Building Code standards are achieved where glass guard installations are proposed.

Implementation

Effective immediately all glass guards installations that do not incorporate structural top rails shall be reviewed by a registered professional engineer and submit an [Alternative Solution Request](#) to the Building Official to explain how the glass guard complies with the structural redundancy requirement without the top rails (CAN/CGSB-12.20-M, "Structural Design of Glass for Buildings).

All guards shall be designed to withstand loads specified in Section 4.1.5.14. (Loads on Guards and Handrails) of the BC Building Code for Part 3 buildings or 9.8.8.2. for Part 9 buildings (attached Table 9.8.8.2.), including houses. Owners and/or contractors shall be responsible for ensuring documentation is provided at the time of permit plan review, or prior to the installation of the guards. Permit drawings should indicate the guardrail design. Heights and restrictions to openings as outlined in Section 9.8 must also be adhered to.



Verification of Glass Guard Designs

(refer to Background information)

Manufactured Aluminum/wood with glass infill panels:

Provide manufacturer's specifications for review by Building Official showing conformance to Table 9.8.8.2. (see attachment) for BC Building Code - Section 9.8.8, Specified Loads for Guards Forming Part of Sentence 9.8.8.2.(1). Projects under supervision of a registered professional must provide confirmation of installation as outlined within the letters of assurance.

Custom Glass Guard Systems (free-standing with custom top cap)

Where custom guardrail systems with top cap are proposed, submit sealed structural design drawings, Schedule B, Schedule C-B and field reports verifying the system design and installation prior to Occupancy Inspection.

Custom Glass Guard Systems (no top cap)

Where topless glass guardrail systems are proposed, submit an alternate solution application, including Schedule B, Schedule C-B, and field reports **prior** to occupancy inspection.

Residential guard design must include verification to: (including proprietary guard shop drawings)

- 9.8.8.2 Loads on Guards
- 9.8.8.3 Height on Guards
- 9.8.8.5 Openings in Guards
- 9.8.8.6 Design of Guards to Not Facilitate Climbing
- 9.8.8.7 Glass in Guards - including the glass guard complies with the structural redundancy requirement without the top rails. (CAN/CGSB-12.1-“Tempered or Laminated Safety Glass”)

Non-Compliance

Glass guard/handrail assemblies that cannot be shown to meet these standards are to be removed or remediated to meet structural standards under supervision of a structural engineer. On-site installations that vary from the original design/install specification will require a review from a structural engineer and non-occupancy of the deck until installation confirmation is received.

Background Information

Glass Guardrail Systems

The use of glass guardrail systems has been increasing for a number of years and has led to questions on the structural integrity of the glass and rail components as well as impact resistance to objects both horizontally and vertically. Glass is a strong material but is very brittle and must be designed to meet structural loads and have redundancy of fail-safe load transfer. Failure of the glass can result in instantaneous failure resulting in no protection for a fall hazard.

Concerns with structural failures when glass is used as the main structural component:

- No top rail to resist vertical and horizontal impacts.
- Tempered glass fails instantaneously into many blunt pieces.
- Manufacturing of glass can include imperfections in the glass, which can expand and cause the glass to fail.
- Design and installation of framing brackets. Who is designing for the loads and ensuring proper installation in the field?

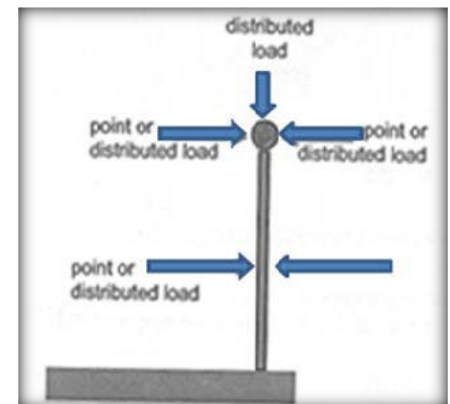
Loads within the BC Building Code are expressed in kN or kN/m (kilo Newton metre) in simple terms this is a quantity very similar to 100 kg (220 lb) of pressure per metre length. If for example it is stated that there is 1.0kN/m, it will be approximate the equivalent of one person weighing 100 kg (220 lb) putting their full weight on 1 m length.

There are two basic loads that are required to be met: (a) loading on the handrail and (b) loading on the infill. The loading on the handrail is called a “uniformly distributed line load”. (Basically, meaning that the load needs to be calculated in a fashion that allows for even distribution of the pressure along the complete length of the element, as opposed to the sum of the load applied to one point).

The load on the infill, be it glass, metal, or other, is tested and calculated in two separate ways: a distributed load and a “point load”.



Typical Residential Guard



Load Diagram

This means the infill of the railing, balustrade, or barrier must be able to withstand an evenly distributed pressure as well as a concentrated pressure on a small point.

B.C. Building Code

Division C - Section 2.3 Alternative Solutions

Alternative solutions must show the intent and objective statements satisfactorily demonstrate that the proposed alternative complies to Code.

A copy of the City's [alternative solution request package](#) can also be found on the Building Inspection Section webpage under *Applications and Forms* or at Development, Engineering, and Sustainability Department counter at 105 Seymour Street.

9.6.1.3. Structural Sufficiency of Glass

- 1) Except as permitted by Sentence (2), glass used in buildings shall be designed in conformance with
 - a) CAN/CGSB-12.20-M89, "Structural Design of Glass for Buildings," or
 - b) ASTM E 1300, "Standard Practice for Determining Load Resistance of Glass in Buildings." (See also Article 4.3.6.1.).

CAN/CSB – 12.20- M89 STRUCTURAL DESIGN OF GLASS FOR BUILDINGS

- This is a limit states design code. The code addresses the brittle nature of glass where used as a structural material by stipulating that support members be designed with a redundant load path. The underlying principle being that if one member fails a cascading or catastrophic failure mechanism does not develop.
- Free standing glass guards must have a top cap which spans over two or more panels and be designed to resist the factored load after failure of alternate panels.
- The deflection of the guard at the point of application of the load, with all panels intact must not exceed 40 mm.

9.8.8.2 Loads on Guards

- 1) Guards shall be designed to resist the specified loads prescribed in Table 9.8.8.2. - Refer to Table attached

9.8.8.7. Glass in Guards

- 1) Glass in guards shall be:
 - a) safety glass of the laminated or tempered type conforming to CAN/CGSB-12.1-M90, "Tempered or Laminated Safety Glass," or
 - b) wired glass conforming to CAN/CGSB-12.11-M, "Wired Safety Glass."

See also Engineers and Geoscientists British Columbia (formerly the Association of Professional Engineers and Geoscientists of BC), regarding designing guards for building projects

<https://www.egbc.ca/News/Articles/Designing-Guards-for-Building-Projects-Guideline-U>

Guard: means a protective barrier around openings in floors or at the open sides of stairs, landings, balconies, mezzanines, galleries, raised walkways, or other locations to prevent accidental falls from one level to another. Such a barrier may or may not have openings through it.

Guardrail Design

Guards must be constructed so as to be strong enough to protect persons from falling under normal use. Many guards installed in dwelling units or on exterior stairs serving one or two dwelling units have demonstrated acceptable performance over time. The loading described in the first row of Table 9.8.8.2. (see attached) is intended to be consistent with the performance provided by these guards.

Have questions? We're here to help. Please contact the Building Inspection Section at 250-828-3554 or building@kamloops.ca for more information.

9.8.8.2. Loads on Guards

(See Note A-9.8.8.2.)

1) Except as provided in Sentences (2) and (4), *guards* shall be designed to resist the specified loads prescribed in Table 9.8.8.2.

Table 9.8.8.2.
Specified Loads for Guards
Forming Part of Sentence 9.8.8.2.(1)

Location of <i>Guard</i>	Minimum Specified Loads		
	Horizontal Load Applied Inward or Outward at any Point at the Minimum Required Height of the <i>Guard</i>	Horizontal Load Applied Outward on Elements Within the <i>Guard</i> , Including Solid Panels and <i>Balusters</i>	Evenly Distributed Vertical Load Applied at the Top of the <i>Guard</i>
<i>Guards</i> within <i>dwelling units</i> and exterior <i>guards</i> serving not more than 2 <i>dwelling units</i>	0.5 kN/m OR concentrated load of 1.0 kN applied at any point ⁽¹⁾	0.5 kN applied over a maximum width of 300 mm and a height of 300 mm ⁽²⁾	1.5 kN/m
<i>Guards</i> serving access ways to equipment platforms and similar areas where the gathering of many people is improbable	Concentrated load of 1.0 kN applied at any point	Concentrated load of 0.5 kN applied over an area of 100 mm by 100 mm located at any point on the element or elements so as to produce the most critical effect	1.5 kN/m
All other <i>guards</i>	0.75 kN/m OR concentrated load of 1.0 kN applied at any point ⁽¹⁾	Concentrated load of 0.5 kN applied over an area of 100 mm by 100 mm located at any point on the element or elements so as to produce the most critical effect	1.5 kN/m

Notes to Table 9.8.8.2.:

- (1) The load that creates the most critical condition shall apply.
- (2) See Sentence (2).

2) For *guards* within *dwelling units* and within houses with a *secondary suite* including their common spaces and for exterior *guards* serving not more than 2 *dwelling units*, where the width and spacing of balusters are such that 3 balusters can be engaged by a load imposed over a 300 mm width, the load shall be imposed so as to engage 3 balusters.

3) None of the loads specified in Table 9.8.8.2. need be considered to act simultaneously.

4) For *guards* within *dwelling units* and within houses with a *secondary suite* including their common spaces and for exterior *guards* serving not more than 2 *dwelling units*, Table 9.8.8.2. need not apply where the *guard* construction used has been demonstrated to provide effective performance.

Conversion Factors: 1.5 kN/m = 1106 lb-ft, 1.0kN= 224 lbs, 0.5kN = 112lbf (pound force)

(Note: None of the loads specified in Table 9.8.8.2. need be considered to act simultaneously)