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Experimental Test to Determine Cable Tension Necessary to Resist Sphere Pass-Through Requirement of National Building Code Of Canada 2015

The 2015 National Building Code of Canada (NBC 2015) requires that openings through any residential guard shall be of a size that will prevent the passage of a spherical object having a diameter of 100 mm (3.937 in.) (NBC 2015 9.8.8.5. Openings In Guards). However, the code does not state the maximum allowable load to be applied to the 100 mm (3.937 in.) sphere. While the absence of that load specification is not critical to solid railing members, it may be important for wire rope cable infill since it is flexible. Therefore, in the absence of a specific load requirement, a rational load requirement has been developed based on the following:

The NBC 2015 (NBC 2015 Section 9.8.8.2. Loads on Guards) does address a requirement for secondary elements of a guard by stating that the elements within the guard must withstand a load of 0.5 kN (112.4 lb.) applied over a 300 mm (11.81 in.) x 300 mm (11.81 in.) area, applied horizontally and perpendicular to the guard plane. Applying that pressure over the projected area of a 100 mm (3.937 in.) diameter sphere, the resulting load on the sphere is calculated as follows:

$$F = 0.5 \text{ kN} / (300 \text{ mm} \times 300 \text{ mm}) \times \frac{\pi \times (100 \text{ mm})^2}{4} = 0.0436 \text{ kN} (9.81 \text{ lb.})$$

To allow for dynamic/impact loading, a conservative safety factor of 2.0 is applied:

$$F_{\text{MAX}} = 0.0436 \text{ kN} (9.81 \text{ lb.}) \times 2.0 = 0.0873 \text{ kN} (19.62 \text{ lb.})$$

Therefore, in the absence of a load required by code, it is recommended that 0.0873 kN (19.62 lb.) be used as the standard force applied to a 100 mm (3.937 in.) diameter sphere, for which cable railing infill must not allow to pass in order to be NBC 2015 compliant.

The elements within the guard case to be tested are:

3.18 mm (0.125 in.) diameter, 1x19 construction, 316 stainless steel cables

1219.2 mm (48.0 in.) unsupported cable span

76.2 mm (3.0 in.) cable spacing, center to center

This represents the thinnest cable in our Vista line, hence the largest space between cables, given our standard center to center cable spacing of 76.2 mm (3.0 in.). A 1219.2 mm (48.0 in.) cable unsupported span was chosen to be convenient for both design and installation of the railing system.

Railing Assembly and Test Arrangement

A 2438 mm (96 in.) Vista Cable Railing System was assembled with 11 - 3.175 mm (0.125 in.) stainless steel cables in 1.0 kN (225 lb.) tension.

Top and bottom rails were fastened using (4) #10 x 1" pan head screws. See Fig. 1. A calibrated Revere 3000 lb. load cell (Serial # M 850441) was anchored to one end of the assembly, and one of the cables is attached to its opposite end, allowing direct measurement of the tension in that cable.

See Fig. 2.

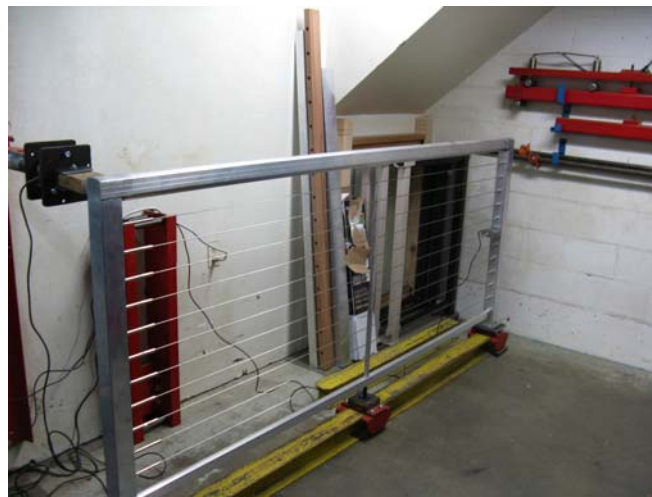


Fig. 1



Fig. 2

Railing Mock-Up and Test Arrangement and Results

A fixture to support and guide a 100 mm (3.937 in.) diameter steel sphere was built. See Fig. 3. The steel sphere was centered between the two cables perpendicular to the plane containing the cables centerlines. The sphere push-through test was performed with a calibrated compression load cell (Serial # 168460). Push-through force was measured to be 25.0 lb. (0.1112 kN). See Fig. 4.



Fig. 3



Fig. 4



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Recommendations / Conclusions

Based on the test result, it is recommended that Vista cable railing infill be installed in accordance with the following guidelines:

76.2 mm (3.0 in.) cable space, center to center, and
1219.2 mm (48.0 in.) maximum unsupported cable span, and
1.0 kN (225 lbs.) cable tension force.

In this assembly, a 0.1112 kN (25.0 lb.) push-through force is required for a 100 mm (3.937 in.) diameter steel sphere centered between two cables to pass through in a direction perpendicular to the plane containing the cables centerlines. This load exceeds by over 27 percent the load requirement determined using table 9.8.8.2. Specified Load for Guards of the 2015 National Building Code of Canada (NBC) with an applied safety factor of 2.0 in consideration of the dynamic / impact nature of the load.

Therefore, Vista Cable Railing Systems when assembled in accordance with the guidelines provided, will meet the load requirements of the NBC 2015 Section 9.8.8.2. (1) Loads On Guards in applicable residential applications.

Regards,

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