Hayat Engineering Inc.

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Name of Project:	BlueWater Park Apartments	Project #: HE204-22A
Project Address:	101 Kathleen Street Whitby Ontario	Date/Time of Visit: Dec 13, 2022 11:30 am
Contractor	Link Aluminum Railing and Guardrails Bowie Contracting Ltd.	Building Permit No. MU-22-108895
Site Representative	Zakir Patel	Date Permit issued: November 25, 2022
Distribution	Link Aluminum Railing and Guardrails	
Weather	Sunny	
Materials	Painted aluminum guard rail with 2"x2" aluminum vertical posts and tempered glass infill panel. 5 ¼"x5"x ⅜" Posts Shoes anchored into concrete slab with 2-½" dia stainless steel anchor bolts.	
Location	Suite 201 Balcony Guardrail north Elevation	
Type Report	Guardrail Load Testing	

References: 1.0 Ontario Building Code 2012, Clause 4.1.5.14, Table 4.1.3.2.A. Standard(s)
2.0 Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings (ASTM E935n-13 e1)

1.0 Introduction

On December 13, 2022 Hayat Engineering was requested to perform horizontal load tests on one balcony guardrail unit at the above-mentioned location according to the above-mentioned references and Standard.

2.0 Procedure and Building code

2.1 Ontario Building Code 2012, Clause 4.1.5.14, Live Loads on Guards

(1) The minimum specified horizontal load applied inward or outward at the top of every required guard shall be,

(a) 3.0 kN/m for means of egress in grandstands, stadia, bleachers and arenas,

(b) a concentrated load of 1.0 kN applied at any point for access ways to equipment platforms, contiguous stairs and similar areas where the gathering of many people is improbable, and

(c) 0.75 kN/m or a concentrated load of 1.0 kN applied at any point, whichever governs for locations other than those described in Clauses (a) and (b).

(2) Individual elements within the guard, including solid panels and pickets, shall be designed for a load of 0.5 kN applied over an area of 100 mm by 100 mm located at any point in the element or elements so as to produce the most critical effect.

(3) The loads required in Sentence (2) need not be considered to act simultaneously with the loads provided for in Sentences (1) and (4).

(4) The minimum specified load applied vertically at the top of every required guard shall be 1.5 kN/m and need not be considered to act simultaneously with the horizontal load provided for in Sentence (1).

2.2 Ontario Building Code 2012, Clause 4.1.7, Specified Wind Load

2.3 Ontario Building Code 2012, Table 4.1.3.2.A, Load Combinations for Ultimate Limit States: Column 1, Case 2 (1.5 L+0.4W) and Case 4: (1.4**W**+0.5**L)**

Suite 201 Balcony Guardrail;

Horizontal Load Test:

*The section of the railing was pre-loaded to 50% of full load of **225** pounds then the load was released to zero before starting the first load of 225 pounds according to ASTM E 935.*

Intermediate Post

A horizontal load of 225 was applied to the top the intermediate post at L-L section as shown in *Photograph No. 11. The load was then increased to 1.5 times without failure. Permanent deformation was measured. The loads were applied outward and inward.*

Handrail

A horizontal load of 225 was applied to the mid-section of the handrail at L-R section as shown in *Photograph No. 12. The load was then increased to 1.5 times without failure. Permanent deformation was measured. The loads were applied outward.*

Tempered Glass Panel / Infill

A horizontal point load of 115 pounds was applied to the panel on the L-R section as shown in Photograph No. 12. The load was then increased to 1.5 times without failure.

3.0 Results and Conclusions

The balcony guard systems therefore meet with O.B.C. 2012, Clause 4. 1. 5. 14 of live load and Table 4.1.3.2.A, column 1, Case 2 and 4 of live load and wind load combinations for ultimate limit states.

Client	Link Aluminum Railings and Guardrails											Date			December 13, 2022	
Project	101 Kathlene Street Whitby Ontario											Project No				
Supplier	Link Aluminium Railing and Guardrails															
Location	Unit 201 - Balcony											Date Tested			December 13, 2022	

Guardrail Member	Type of Load	Section	Sectional Span or Height (mm)	Load Required		Gauge Reading (Psi)	Actual Load Applied (Lbs)	Actual Load Applied (KN)	Allowable Maximum Initial Displacement (mm)	Displacement			Elapsed Time (min)	Allowable Residual Displacement (mm)	Actual Residual Displacement (mm)	
				Concentrated Load (Lbs)	Distributed Load					Initial Reading (mm)	Final Reading (mm))	Actual Displacement (mm)				
At Top of Intermediate Post	Horizontal Load Outward	L-L	Height=1075	0		0	0	0	92	432	432	0	5	13	0	**Pass**- No structural or mechanical connection failure was observed during the test.
		L-L		115		115	115	0.51		432	445	13				
		L-L		225		225	225	1		432	457	25				
		L-L		280		280	280	1.24		432	462	30				
		L-L		338		338	338	1.5		432	468	36				
				0		0	0	0		432	432	0				
	Horizontal Load Inward	L-L	Height =1075	0		0	0	0	92	1108	1108	0	5	13	0	**Pass**- No structural or mechanical connection failure was observed during the test.
		L-L		115		115	115	0.51		1108	1099	9				
		L-L		225		225	225	1		1108	1091	17				
		L-L		280		280	280	1.24		1108	1082	26				
		L-L		338		338	338	1.5		1108	1073	35				
				0		0	0	0		1108	1108	0				
Handrail Mid-Span	Horizontal Load Outward	L-R	Span=1112	0		0	0	0	57	368	368	0	5	10.9	1	**Pass**- No structural or mechanical connection failure was observed during the test.
		L-R		115		115	115	0.51		368	386	18				
		L-R		225		225	225	1		368	398	30				
		L-R		280		280	280	1.24		368	407	39				
		L-R		338		338	338	1.5		368	414	46				
				0		0	0	0		368	369	1				
Intermediate Picket/Infill	Horizontal Load Outward	L-R	Span=1112	0		0	0	0	32	405	405	0	5	6	0	**Pass**- No structural or mechanical connection failure was observed during the test.
		L-R		58		58	59	0.26		405	411	6				
		L-R		113		112.5	113	0.5		405	417	12				
		L-R		145		145	145	0.64		405	420	15				
		L-R		169		169	169	0.75		405	423	18				
		L-R		0		0	0	0		405	405	0				

We trust that this report will meet your requirements. If there are any questions or further consultation is required, please feel free to contact the undersigned.

Noel James, P. Eng.
Senior Engineer
Building Engineering Group

Asif Ihsan, P. Eng.
Manager, Building Engineering Group
Building Engineering Group

Suite 201 Balcony Guardrail

Photograph No. 1
Typical Guardrails

Photograph No. 2
Typical Post Shoe

Photograph No. 3
Intermediate post Horizontal outward load (Top)

Photograph No. 4
Intermediate Post Outward Load Deflection

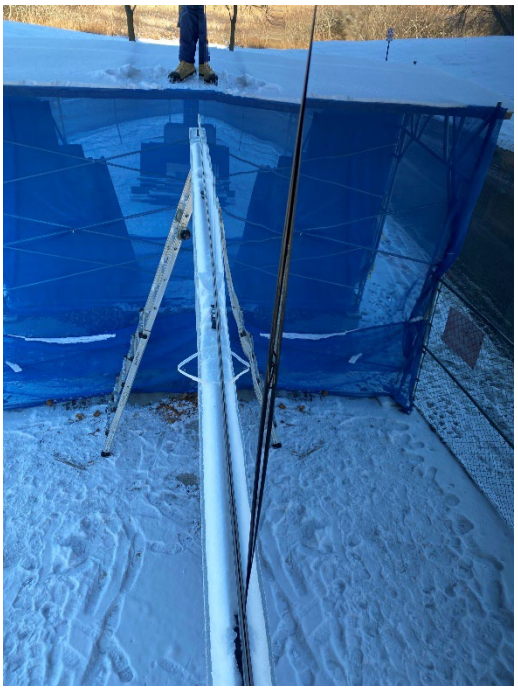
Photograph No. 5
Intermediate Post Inward Load Application (Top)

Photograph No. 6
Intermediate Post Inward Load deflection (Top)

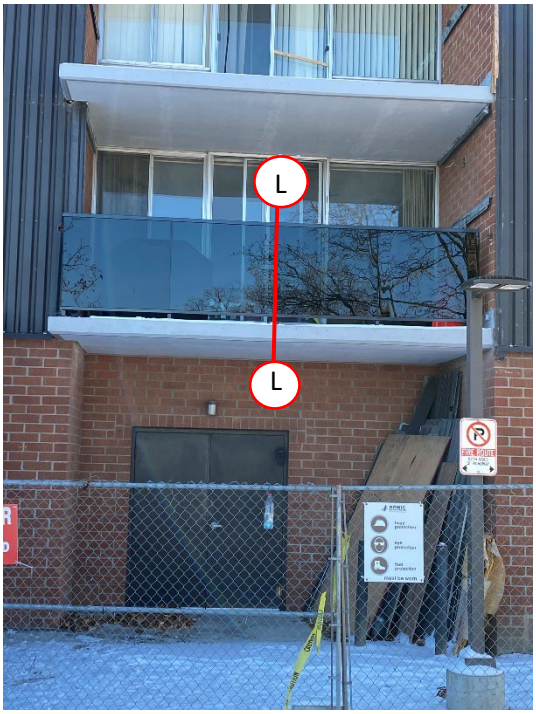
Photograph No. 7
Handrail Mid-section Outward Load

Photograph No. 8
Handrail Mid-Section Outward Load Deflection

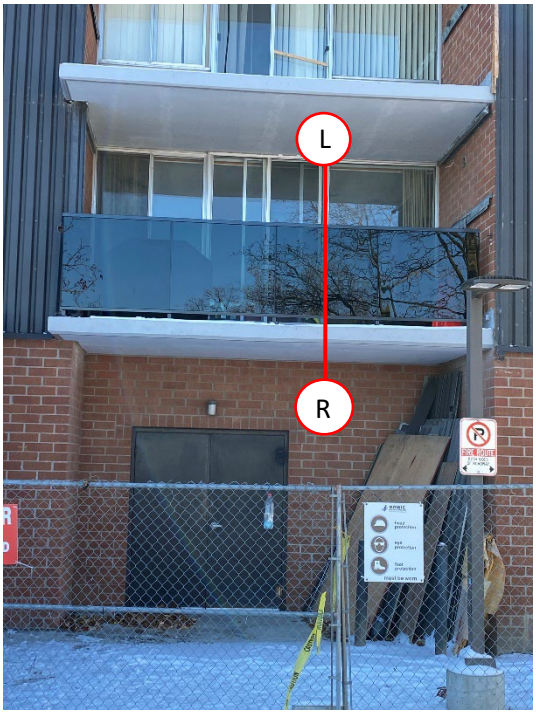
Photograph No. 9
Tempered Glass Mid-Section Outward Load Application



Photograph No. 10
Tempered Glass Mid-Section Outward Load Deflection



Photograph No. 11
Location of Inward and Outward Load application on top of Intermediate Post



Photograph No. 12
Location Of Outward Load Application On Handrail Mid-Section and application of Outward Load on Glass Panel.