STRUCTURAL CALCULATIONS
ALUMINUM GUARDRAIL

WORKPOINT engineering (WPe)

- ■ NO EXCEPTIONS
- ☐ EXCEPTIONS NOTED
- ☐ REVISE AND RESUBMIT
- ☐ REJECTED

LIMITED REVIEW OF ITEMS NOT DESIGNED BY WPe.

WPe's REVIEW IS SOLELY FOR GENERAL CONFORMANCE WITH THE CONTRACT DOCUMENTS TO THE EXTENT OF REVIEW FOR LOADS IMPOSED ON STRUCTURAL ITEMS DESIGNED BY WPe AND PERFORMANCE CRITERIA ESTABLISHED IN THE CONTRACT DOCUMENTS. WPe REVIEW DOES NOT RELIEVE THE CONTRACTOR FROM COMPLYING WITH CONTRACT DOCUMENTS, PERFORMANCE CRITERIA, SPECIFICATIONS AND ANY OTHER APPLICABLE BUILDING CODES AND LAWS, TO WHICH THE CONTRACTOR REMAINS SOLELY RESPONSIBLE.

BY: BMJ DATE: 3/17/2025

PROJECT:

Gabriel Park Project
4144 SW Candy Street
Portland, OR 97219

for

RailPro
14110 NW 3rd Court
Vancouver, Washington 98685

James G. Pierson, Inc. — STRUCTURAL ENGINEERS — Since 1945

STRUCTURAL REGISTERED PROFESSIONAL ENGINEER
18346PE
OREGON
March 19, 1996
PEDER R. GOLBERG
2-6-25
EXPIRES: 6-30-25

James G. Pierson, Inc.
Consulting Structural Engineers
2850 SW Cedar Hills Blvd #2241 BEAVERTON, OR. 97005
(503) 226-1286 FAX 226-3130

February 6, 2025

Gabriel Park Project –Picket Guardrails

GENERAL DESIGN LOADS:

Project is designed in accord with requirements of the 2022 Oregon Structural Specialty Code. For this location the following residential design parameters apply:

Dead Load = 10 psf
Live Load = 60 psf
Snow Load = 25 psf
Wind: 98 MPH, Exp B
Guardrail Load: 200 lb and 50 plf– any direction at 42" AFF
Pickets and Bottom Rail = 50 lbs over 1 sq ft.

Design Summary:

The following calculations are for the proposed aluminum guardrail replacement systems located at the Gabriel Park complex in Portland, OR. The proposed railing system is a picket railing system, Series 1500s top rail and W/P Bottom Rail. These rails (wall to wall) and rails/post are qualified by Intertek test reports, provided as part of this calculation package. The posts and connections were tested as a system to resist bending, deflection, and shear for typical railing loads. This calculation package demonstrates adequacies of the proposed connections and demonstrates adequate connection to the structure. The deck structure is now existing and was designed by others.

The techniques and principles of structural analysis used for these calculations conform to generally accepted standards of the engineering community. These design calculations have been prepared based upon shop drawings provided by Railpro Railing Solutions.

ALUMINUM PROPERTIES

Extruded 6005-T5, 6005A-T61 – Used for extrusion, horizontal and vertical rails

;$Ft_{u6005T5}$ = 38 ksi
;$Ft_{y6005T5}$ = 35 ksi
;$F'_{cy6005T5}$ = 35 ksi
;$F_{shear6005T5}$ = 0.6 * $Ft_{y6005T5}$ = **21.00** ksi; (ADM Table A.3.1)
;E_{6005}= 10100 ksi

;$F_{b16005T5}$ = $F'_{cy6005T5}$ / 1.65 = **21200** psi; (ASD) or
;$F_{b26005T5}$ = $Ft_{u6005T5}$ / (1 * 1.95) = **19500** psi;(ASD)
;$F_{b6005T5}$ = min($F_{b16005T5}$,$F_{b26005T5}$) = **19500** psi

Plate 6061-T6– Used for covers, caps, and baseplates

;Ft_{u6061} = 42 ksi
;Ft_{y6061} = 35 ksi
;F'_{cy6061} = 35 ksi
;$F_{shear6061}$ = 0.6 * Ft_{y6061} = **21.00** ksi; (ADM Table A.3.1)
;E_{6061} = 10100 ksi

;F_{b16061} = F'_{cy6061} / 1.65 = **21200** psi; (ASD) or
;F_{b26061} = Ft_{u6061} / (1 * 1.95) = **21500** psi ;(ASD)
;F_{b6061_Plate} = min(F_{b16061},F_{b26061}) = **21200** psi

Extruded 6061-T6 – Used for extrusions, horizontal and vertical rails

;Ft_{u6061} = 38 ksi
;Ft_{y6061} = 35 ksi
;F'_{cy6061} = 35 ksi
;$F_{shear6061}$ = 0.6 * Ft_{y6061} = **21.00** ksi; (ADM Table A.3.1)
;E_{6061} = 10100 ksi

;F_{b16061} = F'_{cy6061} / 1.65 = **21200** psi; (ASD) or
;F_{b26061} = Ft_{u6061} / (1 * 1.95) = **19500** psi ;(ASD)
;F_{b6061} = min(F_{b16061},F_{b26061}) = **19500** psi

Extruded 6063-T5 – Used for extrusions, horizontal and vertical rails

;$Ft_{u6063T5}$ = 22 ksi
;$Ft_{y6063T5}$ = 16 ksi
;$F'_{cy6063T5}$ = 16 ksi
;$F_{shear6063T5}$ = 0.6 * $Ft_{y6063T5}$ = **9.60** ksi; (ADM Table A.3.1) ;$F_{shear6063T5}$ = 13 ksi
;E_{6063T5} = 10100 ksi

;$F_{b16063T5}$ = $F'_{cy6063T5}$ / 1.65 = **9700** psi; (ASD) or
;$F_{b26063T5}$ = $Ft_{u6063T5}$ / (1 * 1.95) = **11300** psi; (ASD)
;$F_{b6063T5}$ = min($F_{b16063T5}$,$F_{b26063T5}$)= **9700** psi

Extruded 6063-T6 – Used for extrusions, horizontal and vertical rails

;$Ft_{u6063T6}$ = 30 ksi
;$Ft_{y6063T6}$ = 25 ksi
;$F'_{cy6063T6}$ = 25 ksi
;$F_{shear6063T6}$ = 0.6 * Ft_{y6063} = **15.00** ksi; (ADM Table A.3.1)
;E_{6063T6} = 10100 ksi

;$F_{b16063T6}$ = $F'_{cy6063T6}$ / 1.65 = **15200** psi; (ASD) or
;$F_{b26063T6}$ = $Ft_{u6063T6}$ / (1 * 1.95) = **15400** psi; (ASD)
;$F_{b6063T6}$ = min($F_{b16063T6}$,$F_{b26063T6}$) = **2181800**

FASCIA ATTACHMENT

Max ; L = 5.5 ft; tributary load

;d = 4.5 in + (6 in) /2 = **7.500** in;

;H_{362} = 36 in;

;H = H_{36} + d = **43.500** in;

;M_1 = 200 lbs * (H) = **8700.000** lb_in ;(ASD)

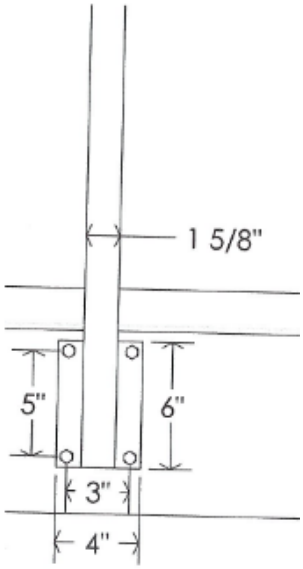
;M_2 = 50 plf * L*(H) = **11962.500** lb_in

;M_{max} = max (M_1, M_2) = **11962.500** lb_in;

V_1= 200 lbs; (ASD)

;V_2 = L * 50 plf = **275.000** lbs

;V_{max} = max (V_1, V_2) = **275.000** lb;



Front View

Anchor Forces

Bending moment from guardrail load resolves into force couple at bolts with spacing ;s =5 in;. Tension controls

;T = M_{max} / s = **2392.500** lb; at top two bolts or

;T_{lag} = T / 2 = **1196.250** lb ;per lag

Per NDS Table 12.2A, 3/8” lags into HF G 0.43

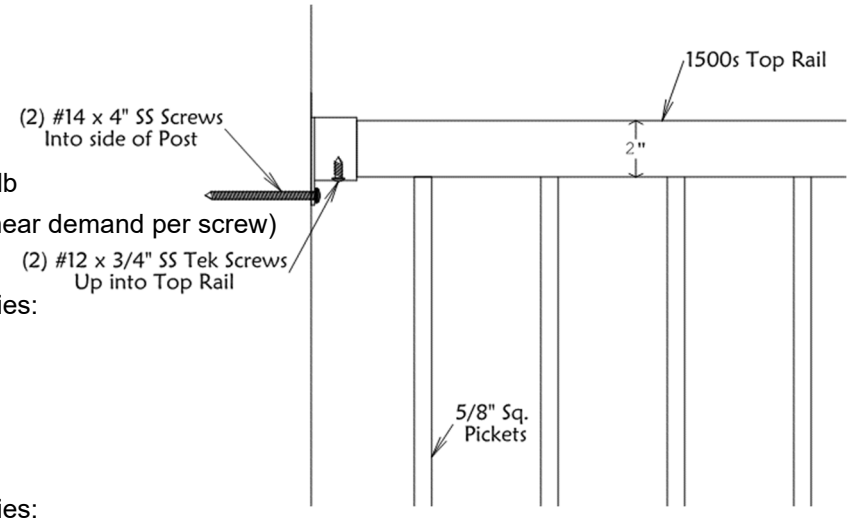
;W = 243 lb / in * 1.6 = **390** lb/in; embedment (includes duration factor)

;TE = T_{lag} / W = **3.1** in; embedment required

Use (4) 3/8” x 5” fully threaded lags per post

Wall Mount Connections

Max ;L = 6 ft; ;



;V_1= 200 lbs; (ASD) ;

;V_2 = 50 plf * L/2 = **150.000** lb;

;V_{max} = max (V_1, V_2) = **200.000** lb

;V_u = V_{max} /2 = **100.000** lbs ; (shear demand per screw)

1500S Top Rail Section Properties:

;I_x = 0.2505 in^4;

;I_y = 0.3497 in^4;

Deflection in top rail

1500S Top Rail Section Properties:

;I_x = 0.2505 in^4;

;I_y = 0.3497 in^4;

P = 50 plf * L = **300.000** lb;

;x = L /2 ;

;E =**10000.000** ksi;;I = min (I_x, I_y) = **0.251** in^4;

;delta = P * x^2 / (48 * E * I) * (3 * L - 4 * x) = **0.233** in; deflection (AISC Table 3-23 #16)

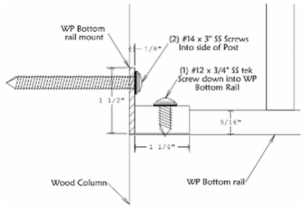
Midspan deflection in rail creates rotation where rails where are connected to the structure:

M = 50plf * L / 2 * delta = **34.922** lb_in;

AT = M / 1.5 in = **23.281** lb; withdrawal demand, per screw, at top rail connection to blocking

Per NDS 2018 Table 12M, t_s 14ga (approximated to allow for reduction in capacity due to Aluminum plate instead of the steel plate assumed by the NDS), assume DF, G 0.5

#14 screw diameter ;d_{14} = 0.242 in; ;Z_{14} = 162 lb; ;w_{14} = 154 lb/in ; per inch embedment;



;Z = Z_{14} = **162.000** lb; ;w = w_{14} = **154.000** lb/in; ;d = d_{14} = **0.242** in;

;l = **4 in**; (min length of design screw)

;p_{minall} = 8*d = **1.936** in; (minimum allowable penetration for full shear capacity)

;p_{prov} = l * 2/3 = **2.667** in; (screw penetration provided by design screw length ;l = **4.000** in;)

Shear

;**"Adequate penetration provided for shear"**

Tension

;w_{all} = w * 1.6 = **246.400** lb/in; embedment

;D = AT / w_{all} = **0.094**in; embedment required

; **"Adequate embedment for tension"**

Required minimum screw length for shear and tension is ;**0.142** in;

CONCLUSION: For maximum rail span ;L = **6.000** ft; testing has shown adequacy of railing for loads. Calculated deflection in rail due to loading requires adequate penetration of screws into wood grain at structure, and when #14 screws are used, required minimum screw length is ;l_{req} = **0.142** in;.

Use (2) #14 x3" min SS screws at top and bottom wall mount connections.

07/07/2023

Duncan Priestly
Railcraft International
13272 Comber Way
Surrey, BC, Canada, V3W 5V9

RE: Intertek Report number: 100294140COQ-004

Dear Mr. Priestly,

This letter is in regard to the Intertek report referenced above and attached hereto labeled as R1 through R22. After review of the test report results within the intent of IBC 1709, I conclude that the results show compliance with Section 1607.9.1 Handrails and Guards of the 2021 International Building Code for the samples shown and recommend that the report be accepted by the building official. Pursuant to Oregon Statute 672.020 my seal and signature are applied below.

Respectfully,

EXP: 06/30/2025

Bruce J. Keeler, P.E.*
Principal
LTS Drafting & Engineering, LLC.

*P.E. licensed in: AZ, CO, FL, GA, ID, IA, LA, MD, MI, MN, MS, MT, NE, NV, NM, NY, NC, ND, OH, OK, OR, PA, TX, TN, UT, WA, WV, WI, WY

C: file

8670 Concord Center Drive, Englewood, Colorado 80112 phone: 303.858.9858 fax: 303.858.8373

TEST REPORT

REPORT NUMBER: 100294140COQ-004
ORIGINAL ISSUE DATE: January 17, 2011

EVALUATION CENTER

INTERTEK TESTING SERVICES NA LTD.
1500 BRIGANTINE DRIVE
COQUITLAM, BC V3K 7C1

RENDERED TO

RAILCRAFT INTERNATIONAL INC.
13272 COMBER WAY
SURREY, BC V3W 5V9

PRODUCT EVALUATED: Aluminum Welded Picket and Glass Railing Systems
EVALUATION PROPERTY: Load Requirements

Report of Railcraft International Inc. Aluminum Welded Picket and Glass Railing Systems for compliance with the applicable requirements of Section 1607.7.1 *Handrails and Guards* of the 2009 International Building Code (IBC)

1 Table of Contents

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2 Introduction

Intertek Testing Services NA Ltd. (Intertek) has conducted a test program for Railcraft International Inc. on various railing systems. The evaluation was carried out to determine whether the railing systems would resist the loads specified in Section 1607.7.1 *Handrails and Guards* of the 2009 International Building Code (IBC). This evaluation was conducted in the month of January 2011.

3 Test Samples

3.1. SAMPLE SELECTION

The client submitted twelve (12) aluminum railing systems to the Evaluation Center on January 11, 2010. Samples were not independently selected for testing.

3.2. SAMPLE AND ASSEMBLY DESCRIPTION

The different samples were identified as the following:

Table 1. Railing Configurations

Railing	Post	Post Spacing	Mounting Plate	Rails	Picket/Panel Insert
Welded Picket - Fascia Mount	1-5/8" x 1-5/8"	84-1/4"	4" x 6" x 3/8"	42" high	5/8" x 5/8"
Welded Picket - Top Mount	1-5/8" x 1-5/8"	84-1/4"	4" x 4" x 3/8"	42" high	5/8" x 5/8"
Glass Panel - Fascia Mount	1-5/8" x 1-5/8"	66-3/8"	4" x 6" x 3/8"	42" high	1/4" Glass
Glass Panel - Top Mount	1-5/8" x 1-5/8"	66-3/8"	4" x 4" x 3/8"	42" high	1/4" Glass

Note: Post to sub-structure fastener evaluation is beyond the scope of this report. 3/8 in. Grade 5 bolts were used to install the specimen for testing.

4 Testing and Evaluation Methods

The test specimen was loaded at a rate to achieve the specified loads between 10 seconds and 5 minutes. The specified test loads were held for one minute before the load was released. As per the 2009 IBC, the following tests were conducted:

4.1. 2009 IBC: SECTION 1607.7.1 HANDRAILS AND GUARDS

1) Handrails and guards shall be designed to resist a load of 50 pounds per linear foot (plf) (0.73 kN/m) applied in any direction at the top.

2) Handrails and guards shall be able to resist a single concentrated load of 200 pounds (0.89 kN), applied in any direction at any point along the top.

3) Intermediate rails, balusters and panel fillers shall be designed to withstand a horizontally applied normal load of 50 pounds (0.22 kN) on an area equal to 1 square foot (0.093 m²).

Notes:

1. A live load factor of 2.5 is applicable to the above loads.

4.2. IN-FILL LOAD TEST

For the welded picket systems, a load of 125 lbs was applied using a 1 square foot block normal to the in-fill. For the glass systems, a load of 200 lbs was applied to the glass panel using a 1 square foot block normal to the in-fill. After release of the load, the system was evaluated for failure, any evidence of disengagements of any component and/or visible cracking from any component.

4.3. UNIFORM LOAD TEST

The guardrail system was subjected to a maximum equivalent uniform load of 125 plf applied horizontally to the top rail. The load was applied using quarter point loading. After release of the load, the system was evaluated for failure, any evidence of disengagements and/or visible cracking from any component.

4.4. CONCENTRATED LOAD TEST

The top rail of the guardrail system was subjected to a horizontal concentrated load of 500 lbs adjacent to the rail post connection to verify the connection capacity.

5 Testing and Evaluation Results

5.1. RESULTS AND OBSERVATIONS

The product test results are shown in Table 1 below and a full set of test data is located in Appendix A.

Table 1. Test Results

System Description	Test	Compliance
Aluminum Welded Picket Railing System – Fascia Mount	In-fill load	Pass
	Uniform Load	Pass
	Concentrated Load Adjacent to Post	Pass
Aluminum Welded Picket Railing System – Top Mount	In-fill load	Pass
	Uniform Load	Pass
	Concentrated Load Adjacent to Post	Pass
Aluminum Glass Panel Railing System – Fascia Mount	In-fill load	Pass
	Uniform Load	Pass
	Concentrated Load Adjacent to Post	Pass
Aluminum Glass Panel Railing System – Top Mount	In-fill load	Pass
	Uniform Load	Pass
	Concentrated Load Adjacent to Post	Pass

6 Conclusion

The Railcraft International Inc. aluminum railing systems identified in this test report have complied with the requirements of Section 1607.7.1 *Handrails and Guards* of the 2009 International Building Code. The product test results are presented in Section 5 of this report.

INTERTEK TESTING SERVICES NA LTD.

Reported by: _____
Chris Chang, EIT
Test Engineer – Construction Products

Reviewed by: _____
Riccardo DeSantis
Lab Supervisor / Test Technician – Building Products

APPENDIX A: Test Data (12 pages)

Intertek

Test:	**IBC Loads on Guards** Test #1		Project: G100294140
Date:	14-Jan-11		Eng/Tech: Chris Chang
Client:	Railcraft International Inc.		Reviewer: Riccardo DeSantis
Product:	**Aluminum Welded Picket Railing System**		
Installation:	**Fascia Mount**		
Post Spacing:	7.02 ft	2.14 m	
Height of Guard:	42 in	1070 mm	
Opening in Guard:	3.875 in	98 mm	
Method:	2009 International Building Code (IBC) Section 1607.7.1 Handrails and Guards Section 1713 Test Safe Load		
Safety Factor:	2.5		
Equipment:	Artech 5K load cell (Intertek ID# SN138768, cal due August 20, 2011) Vaisala Indicator (Intertek ID# V2920010, cal due November 2, 2011)		
Time/Temp/RH:	7:45 AM / 18.3°C / 54.3%		

Test	Design Load (Inward/ Outward) (lbf)	Factored Load	Calculated Moment (lbf-ft)	Equivalent Quarter-Point Load (lbf)	Required Proof Load (lbf)	Pass/Fail
Individual Elements / Components (1ft²)	50	125	-	-	125	**PASS**
Horizontal Uniform Load (per ft)	50	125	770	439	878	**PASS**
Top of Post Horizontal Concentrated Load	200	500	-	-	500	**PASS**

Intertek

Test:	**IBC Loads on Guards** Test #2		Project: G100294140
Date:	14-Jan-11		Eng/Tech: Chris Chang
Client:	Railcraft International Inc.		Reviewer: Riccardo DeSantis
Product:	**Aluminum Welded Picket Railing System**		
Installation:	**Fascia Mount**		
Post Spacing:	7.02 ft	2.14 m	
Height of Guard:	42 in	1070 mm	
Opening in Guard:	3.875 in	98 mm	
Method:	2009 International Building Code (IBC) Section 1607.7.1 Handrails and Guards Section 1713 Test Safe Load		
Safety Factor:	2.5		
Equipment:	Artech 5K load cell (Intertek ID# SN138768, cal due August 20, 2011) Vaisala Indicator (Intertek ID# V2920010, cal due November 2, 2011)		
Time/Temp/RH:	10:00 AM / 19.2°C / 53.9%		

Test	Design Load (Inward/ Outward) (lbf)	Factored Load	Calculated Moment (lbf-ft)	Equivalent Quarter-Point Load (lbf)	Required Proof Load (lbf)	Pass/Fail
Individual Elements / Components (1ft²)	50	125	-	-	125	**PASS**
Horizontal Uniform Load (per ft)	50	125	770	439	878	**PASS**
Top of Post Horizontal Concentrated Load	200	500	-	-	500	**PASS**

Intertek

Test:	**IBC Loads on Guards** Test #3		Project: G100294140
Date:	14-Jan-11		Eng/Tech: Chris Chang
Client:	Railcraft International Inc.		Reviewer: Riccardo DeSantis
Product:	**Aluminum Welded Picket Railing System**		
Installation:	**Fascia Mount**		
Post Spacing:	7.02 ft	2.14 m	
Height of Guard:	42 in	1070 mm	
Opening in Guard:	3.875 in	98 mm	
Method:	2009 International Building Code (IBC) Section 1607.7.1 Handrails and Guards Section 1713 Test Safe Load		
Safety Factor:	2.5		
Equipment:	Artech 5K load cell (Intertek ID# SN138768, cal due August 20, 2011) Vaisala Indicator (Intertek ID# V2920010, cal due November 2, 2011)		
Time/Temp/RH:	10:48 AM / 19.2°C / 53.9%		

Test	Design Load (Inward/ Outward) (lbf)	Factored Load	Calculated Moment (lbf-ft)	Equivalent Quarter-Point Load (lbf)	Required Proof Load (lbf)	Pass/Fail
Individual Elements / Components (1ft²)	50	125	-	-	125	**PASS**
Horizontal Uniform Load (per ft)	50	125	770	439	878	**PASS**
Top of Post Horizontal Concentrated Load	200	500	-	-	500	**PASS**

Intertek

Test:	**IBC Loads on Guards** Test #1		Project: G100294140
Date:	13-Jan-11		Eng/Tech: Chris Chang
Client:	Railcraft International Inc.		Aldin Chang
Product:	**Aluminum Welded Picket Railing System**		Reviewer: Riccardo DeSantis
Installation:	**Top Mount**		
Post Spacing:	7.02 ft	2.14 m	
Height of Guard:	42 in	1070 mm	
Opening in Guard:	3.875 in	98 mm	
Method:	2009 International Building Code (IBC) Section 1607.7.1 Handrails and Guards Section 1713 Test Safe Load		
Safety Factor:	2.5		
Equipment:	Artech 5K load cell (Intertek ID# SN138768, cal due August 20, 2011) Vaisala Indicator (Intertek ID# V2920010, cal due November 2, 2011)		
Time/Temp/RH:	12:35 PM / 16.7°C / 46.4%		

Test	Design Load (Inward/ Outward) (lbf)	Factored Load	Calculated Moment (lbf-ft)	Equivalent Quarter-Point Load (lbf)	Required Proof Load (lbf)	Pass/Fail
Individual Elements / Components (1ft²)	50	125	-	-	125	**PASS**
Horizontal Uniform Load (per ft)	50	125	770	439	878	**PASS**
Top of Post Horizontal Concentrated Load	200	500	-	-	500	**PASS**

Intertek

Test:	**IBC Loads on Guards** Test #2		Project: G100294140
Date:	13-Jan-11		Eng/Tech: Chris Chang
Client:	Railcraft International Inc.		Aldin Chang
Product:	**Aluminum Welded Picket Railing System**		Reviewer: Riccardo DeSantis
Installation:	**Top Mount**		
Post Spacing:	7.02 ft	2.14 m	
Height of Guard:	42 in	1070 mm	
Opening in Guard:	3.875 in	98 mm	
Method:	2009 International Building Code (IBC) Section 1607.7.1 Handrails and Guards Section 1713 Test Safe Load		
Safety Factor:	2.5		
Equipment:	Artech 5K load cell (Intertek ID# SN138768, cal due August 20, 2011) Vaisala Indicator (Intertek ID# V2920010, cal due November 2, 2011)		
Time/Temp/RH:	1:00 PM / 16.6°C / 48.5%		

Test	Design Load (Inward/ Outward) (lbf)	Factored Load	Calculated Moment (lbf-ft)	Equivalent Quarter-Point Load (lbf)	Required Proof Load (lbf)	Pass/Fail
Individual Elements / Components (1ft²)	50	125	-	-	125	**PASS**
Horizontal Uniform Load (per ft)	50	125	770	439	878	**PASS**
Top of Post Horizontal Concentrated Load	200	500	-	-	500	**PASS**

Intertek

Test:	**IBC Loads on Guards** Test #3	Project:	G100294140
Date:	13-Jan-11	Eng/Tech:	Chris Chang
Client:	Railcraft International Inc.		Aldin Chang
Product:	**Aluminum Welded Picket Railing System**	Reviewer:	Riccardo DeSantis
Installation:	**Top Mount**		
Post Spacing:	7.02 ft 2.14 m		
Height of Guard:	42 in 1070 mm		
Opening in Guard:	3.875 in 98 mm		
Method:	2009 International Building Code (IBC) Section 1607.7.1 Handrails and Guards Section 1713 Test Safe Load		
Safety Factor:	2.5		
Equipment:	Artech 5K load cell (Intertek ID# SN138768, cal due August 20, 2011) Vaisala Indicator (Intertek ID# V2920010, cal due November 2, 2011)		
Time/Temp/RH:	1:15 PM / 16.4°C / 48.6%		

Test	Design Load (Inward/ Outward) (lbf)	Factored Load	Calculated Moment (lbf-ft)	Equivalent Quarter-Point Load (lbf)	Required Proof Load (lbf)	Pass/Fail
Individual Elements / Components (1ft²)	50	125	-	-	125	**PASS**
Horizontal Uniform Load (per ft)	50	125	770	439	878	**PASS**
Top of Post Horizontal Concentrated Load	200	500	-	-	500	**PASS**

Intertek

Test:	**IBC Loads on Guards** Test #1		Project: G100294140
Date:	14-Jan-11		Eng/Tech: Chris Chang
Client:	Railcraft International Inc.		Reviewer: Riccardo DeSantis
Product:	**Aluminum Glass Panel Railing System**		
Installation:	**Fascia Mount**		
Post Spacing:	5.53 ft	1.69 m	
Height of Guard:	42 in	1070 mm	
Opening in Guard:	1.625 in	41 mm	
Method:	2009 International Building Code (IBC)		
	Section 1607.7.1 Handrails and Guards		
	Section 1713 Test Safe Load		
Safety Factor:	2.5		
	4.0 In-fill Glass Panel		
Equipment:	Artech 5K load cell (Intertek ID# SN138768, cal due August 20, 2011)		
	Vaisala Indicator (Intertek ID# V2920010, cal due November 2, 2011)		
Time/Temp/RH:	12:20 PM / 19.0°C / 51.2%		

Test	Design Load (Inward/ Outward) (lbf)	Factored Load	Calculated Moment (lbf-ft)	Equivalent Quarter-Point Load (lbf)	Required Proof Load (lbf)	Pass/Fail
Individual Elements / Components (1ft²)	50	200	-	-	200	**PASS**
Horizontal Uniform Load (per ft)	50	125	478	346	691	**PASS**
Top of Post Horizontal Concentrated Load	200	500	-	-	500	**PASS**

Intertek

Test:	**IBC Loads on Guards** Test #2		Project: G100294140
Date:	14-Jan-11		Eng/Tech: Chris Chang
Client:	Railcraft International Inc.		Reviewer: Riccardo DeSantis
Product:	**Aluminum Glass Panel Railing System**		
Installation:	**Fascia Mount**		
Post Spacing:	5.53 ft	1.69 m	
Height of Guard:	42 in	1070 mm	
Opening in Guard:	1.625 in	41 mm	
Method:	2009 International Building Code (IBC) Section 1607.7.1 Handrails and Guards Section 1713 Test Safe Load		
Safety Factor:	2.5 4.0 In-fill Glass Panel		
Equipment:	Artech 5K load cell (Intertek ID# SN138768, cal due August 20, 2011) Vaisala Indicator (Intertek ID# V2920010, cal due November 2, 2011)		
Time/Temp/RH:	1:15 PM / 19.2°C / 53.6%		

Test	Design Load (Inward/ Outward) (lbf)	Factored Load	Calculated Moment (lbf-ft)	Equivalent Quarter-Point Load (lbf)	Required Proof Load (lbf)	Pass/Fail
Individual Elements / Components (1ft²)	50	200	-	-	200	**PASS**
Horizontal Uniform Load (per ft)	50	125	478	346	691	**PASS**
Top of Post Horizontal Concentrated Load	200	500	-	-	500	**PASS**

Intertek

Test:	**IBC Loads on Guards** Test #3		Project: G100294140
Date:	14-Jan-11		Eng/Tech: Chris Chang
Client:	Railcraft International Inc.		Reviewer: Riccardo DeSantis
Product:	**Aluminum Glass Panel Railing System**		
Installation:	**Fascia Mount**		
Post Spacing:	5.53 ft	1.69 m	
Height of Guard:	42 in	1070 mm	
Opening in Guard:	1.625 in	41 mm	
Method:	2009 International Building Code (IBC)		
	Section 1607.7.1 Handrails and Guards		
	Section 1713 Test Safe Load		
Safety Factor:	2.5		
	4.0 In-fill Glass Panel		
Equipment:	Artech 5K load cell (Intertek ID# SN138768, cal due August 20, 2011)		
	Vaisala Indicator (Intertek ID# V2920010, cal due November 2, 2011)		
Time/Temp/RH:	1:48 PM / 19.1°C / 53.9%		

Test	Design Load (Inward/ Outward) (lbf)	Factored Load	Calculated Moment (lbf-ft)	Equivalent Quarter-Point Load (lbf)	Required Proof Load (lbf)	Pass/Fail
Individual Elements / Components (1ft²)	50	200	-	-	200	**PASS**
Horizontal Uniform Load (per ft)	50	125	478	346	691	**PASS**
Top of Post Horizontal Concentrated Load	200	500	-	-	500	**PASS**

Intertek

Test:	**IBC Loads on Guards** Test #1	Project:	G100294140
Date:	13-Jan-11	Eng/Tech:	Chris Chang
Client:	Railcraft International Inc.		Aldin Chang
Product:	**Aluminum Glass Panel Railing System**	Reviewer:	Riccardo DeSantis
Installation:	**Top Mount**		
Post Spacing:	5.53 ft 1.69 m		
Height of Guard:	42 in 1070 mm		
Opening in Guard:	1.625 in 41 mm		
Method:	2009 International Building Code (IBC) Section 1607.7.1 Handrails and Guards Section 1713 Test Safe Load		
Safety Factor:	2.5 4.0 In-fill Glass Panel		
Equipment:	Artech 5K load cell (Intertek ID# SN138768, cal due August 20, 2011) Vaisala Indicator (Intertek ID# V2920010, cal due November 2, 2011)		
Time/Temp/RH:	9:00 AM / 14.0°C / 54.8%		

Test	Design Load (Inward/ Outward) (lbf)	Factored Load	Calculated Moment (lbf-ft)	Equivalent Quarter-Point Load (lbf)	Required Proof Load (lbf)	Pass/Fail
Individual Elements / Components (1ft²)	50	200	-	-	200	**PASS**
Horizontal Uniform Load (per ft)	50	125	478	346	691	**PASS**
Top of Post Horizontal Concentrated Load	200	500	-	-	500	**PASS**

Intertek

Test:	**IBC Loads on Guards** Test #2	Project:	G100294140
Date:	13-Jan-11	Eng/Tech:	Chris Chang
Client:	Railcraft International Inc.		Aldin Chang
Product:	**Aluminum Glass Panel Railing System**	Reviewer:	Riccardo DeSantis
Installation:	**Top Mount**		
Post Spacing:	5.53 ft 1.69 m		
Height of Guard:	42 in 1070 mm		
Opening in Guard:	1.625 in 41 mm		
Method:	2009 International Building Code (IBC)		
	Section 1607.7.1 Handrails and Guards		
	Section 1713 Test Safe Load		
Safety Factor:	2.5		
	4.0 In-fill Glass Panel		
Equipment:	Artech 5K load cell (Intertek ID# SN138768, cal due August 20, 2011)		
	Vaisala Indicator (Intertek ID# V2920010, cal due November 2, 2011)		
Time/Temp/RH:	10:15 AM / 13.8°C / 54.0%		

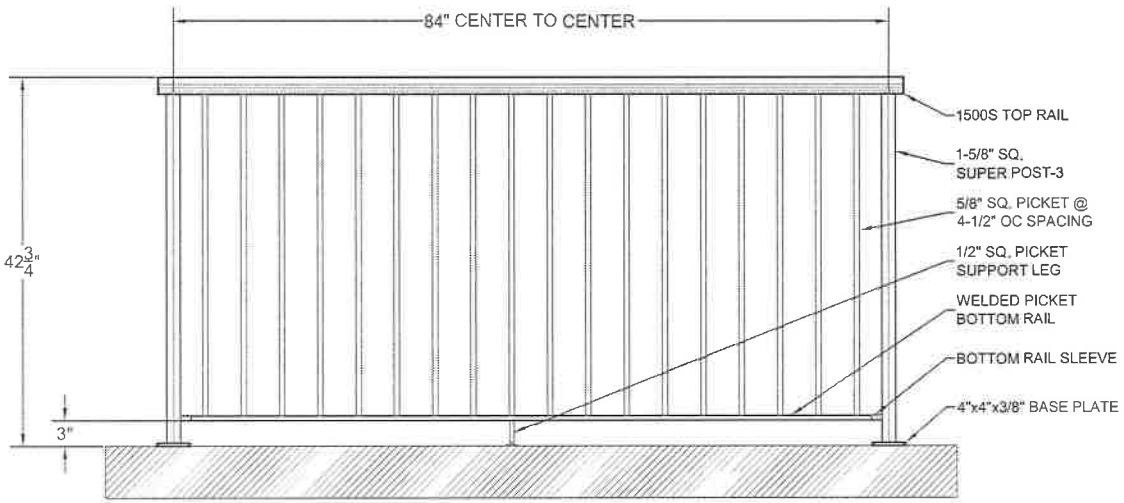
Test	Design Load (Inward/ Outward) (lbf)	Factored Load	Calculated Moment (lbf-ft)	Equivalent Quarter-Point Load (lbf)	Required Proof Load (lbf)	Pass/Fail
Individual Elements / Components (1ft²)	50	200	-	-	200	**PASS**
Horizontal Uniform Load (per ft)	50	125	478	346	691	**PASS**
Top of Post Horizontal Concentrated Load	200	500	-	-	500	**PASS**

Intertek

Test:	**IBC Loads on Guards** Test #3	Project:	G100294140
Date:	13-Jan-11	Eng/Tech:	Chris Chang
Client:	Railcraft International Inc.		Aldin Chang
Product:	**Aluminum Glass Panel Railing System**	Reviewer:	Riccardo DeSantis
Installation:	**Top Mount**		
Post Spacing:	5.53 ft 1.69 m		
Height of Guard:	42 in 1070 mm		
Opening in Guard:	1.625 in 41 mm		
Method:	2009 International Building Code (IBC)		
	Section 1607.7.1 Handrails and Guards		
	Section 1713 Test Safe Load		
Safety Factor:	2.5		
	4.0 In-fill Glass Panel		
Equipment:	Artech 5K load cell (Intertek ID# SN138768, cal due August 20, 2011)		
	Vaisala Indicator (Intertek ID# V2920010, cal due November 2, 2011)		
Time/Temp/RH:	11:05 AM / 15.0°C / 51.5%		

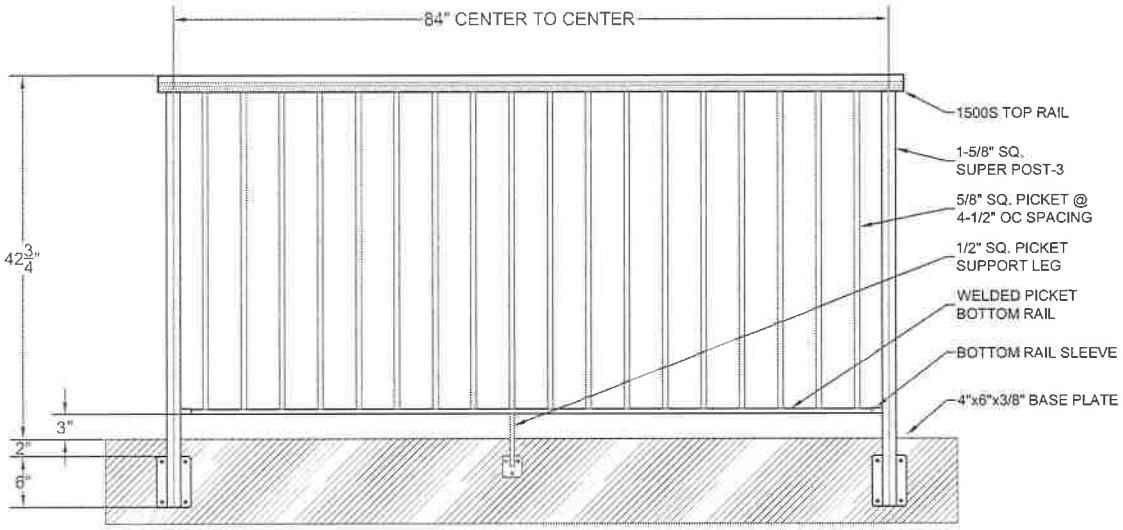
Test	Design Load (Inward/ Outward) (lbf)	Factored Load	Calculated Moment (lbf-ft)	Equivalent Quarter-Point Load (lbf)	Required Proof Load (lbf)	Pass/Fail
Individual Elements / Components (1ft²)	50	200	-	-	200	**PASS**
Horizontal Uniform Load (per ft)	50	125	478	346	691	**PASS**
Top of Post Horizontal Concentrated Load	200	500	-	-	500	**PASS**

APPENDIX B: Drawings (2 pages)



SURFACE MOUNT PICKET RAIL

(OPTION 1 - WELDED BASE PLATES, OPTION 2 - SCREWED BASE PLATES, OPTION 3- WELDED & SCREWED BASE PLATES)



FASCIA MOUNT PICKET RAIL

ENGINEERING STAMP AND DATE:

DESIGN NOTE:

DESIGN:
1. STRUCTURAL DESIGN HAS BEEN PERFORMED IN ACCORDANCE WITH THE 2006 BC BUILDING CODE & AMENDMENTS.
2. IN ACCORDANCE WITH ARTICLE 4.1.5.15.DESIGN LOADS ARE AS FOLLOWS:
   a. HORIZONTAL LOADS APPLIED AT TOP OF GUARD EITHER INWARD OR OUTWARD:
      i. UNIFORM FORCE OF .73 kN/m, OR
      ii. CONCENTRATED FORCE OF 1.0 kN(WHICHEVER GOVERNS)
   b. HORIZONTAL LOAD APPLIED TO INDIVIDUAL ELEMENTS WITHIN THE GUARDS; 0.5kN APPLIED OVER AN AREA OF 100mm x 100mm AT ANY POINT.
   c. VERTICLE LOAD APPLIED TO TOP OF GUARD: 1.5 kN/m
   d. DESIGN LOADS NEED NOT TO BE APPLIED CONCURRENTLY.
3. SUPPORTING STRUCTURE MUST BE STRUCTURALLY ADEQUATE TO WITHSTAND GUARD LOADS.
4. DESIGN OF ALUMINUM COMPONENTS: TO CAN/S-157.

MATERIALS:
1. ALUMINUM ALLOY AND TEMPER
   POSTS - 6005A-T61
   RAILS - 6063-T5
   RASCPLATTR - 6005A-T61
2. WELDED COEFFICIENT $\lambda = 1.0 \Phi = 1.12$
3. JOINTS SHALL BE WIRE FED MIG WELDED WITH ALLOY TYPE ER-4043.
4. BUILD UP AREA TO BE GRINDED AND BUFFED SMOOTH ON TOP AND OUTER PERIMETER EDGES.
5. ALL WELDS TO BE COMPLETED BY CSA CERTIFIED (A) UNLIMITED WELDER.
6. UNLESS OTHERWISE NOTED, ANCHORAGE TO WALLS SHALL CONSIST OF A MINIMUM OF TWO(2) DRILLED OR 7/8"x 4-1/2" TPP STAINLESS STEEL ANCHORS.
7. BOLTS AND CONNECTORS AS PER MANUFACTURERS SPECIFICATIONS.
8. GLAZING: TO CAN/CGSB-12.1-M90, MINIMUM THICKNESS: 8mm TEMPERED)
9. ASSUMED CONCRETE COMPRESSIVE STRENGTH: 20MPa

COATINGS:
1. FINISHED POWDER COAT COLOR IS: TBA.
2. POWDER COAT MEET AAMA 2604-05 VOLUNTARY SPECIFICATION, PERFORMANCE REQUIREMENTS AND TEST PROCEDURES FOR HIGH PERFORMANCE ORGANIC COATINGS ON ALUMINUM EXTRUSIONS AND PANELS.

GENERAL NOTES:
1. CONTRACTOR TO FIELD VERIFY ALL DIMENSIONS AND QUANTITIES PRIOR TO FABRICATION.
2. CONTRACTOR TO VERIFY FINISH COLOUR WITH OWNER PRIOR TO FABRICATION.
3. CONFIRM ALL DIMENSIONS WITH FIELD MEASUREMENT ONCE CONCRETE IS POURED.
4. FOR ALL ANCHORS ENSURE THAT THE MANUFACTURER'S MINIMUM EDGE AND SPACING DISTANCES ARE OBSERVED.
5. ENSURE COMPLIANCE WITH MAXIMUM OPENING SIZE AND CLIMBABILITY REQUIREMENTS OF THE ONTARIO BUILDING CODE.
6. RAILCRAFT INTERNATIONAL INC. IS NOT RESPONSIBLE FOR WATERTIGHTNESS AT CONNECTIONS TO PARAPETS, WALL, COLUMNS, FLOORS AND/OR ROOFS AND FOR THE STRUCTURAL ADEQUACY OF THE BUILDING COMPONENTS PROVIDING SUPPORT FOR GUARDRAILS AND HANDRAILS INCLUDING BACKING FOR SPECIFIED CONNECTIONS.

POWDER COATED TOUGH™

CWB CERTIFIED

08 NOVEMBER 2010

RAILCRAFT ALUMINUM RAILING SYSTEMS

1 2

PROJECT NAME: INTERTEK TESTING

0

REVISION	DATE

TITLE: RAILING ELEVATION

1500S WELDED PICKET RAILING SYSTEM

PROJECT NUMBER:

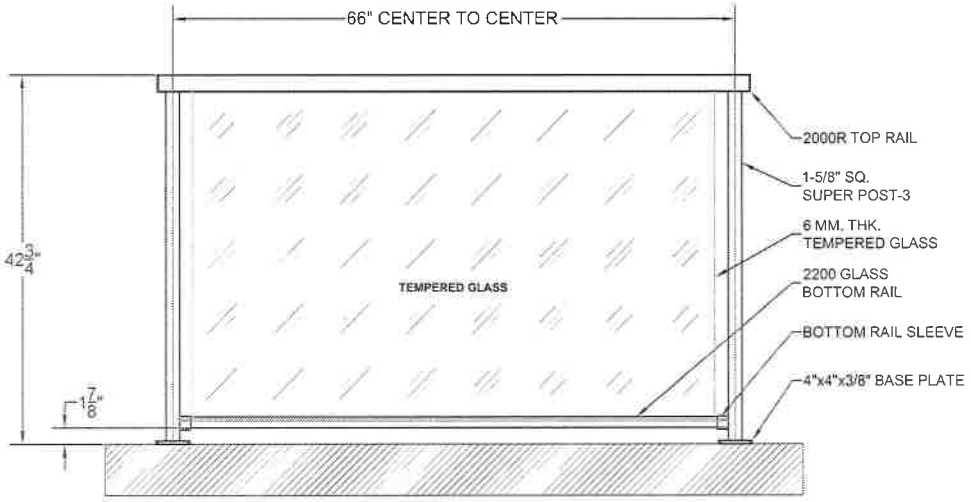
SCALE: 1-3/4" = 1'-0" | DATE: 24 NOVEMBER 2010

DESIGNED BY: | DRAWN BY: ROGER | CHECKED BY: DON SMITH

Toll Free: 1-800-563-7255
Fax: (604) 543-4147
Toll Free: 1-800-211-4841
Web: www.railcraft.com
Email: railing@railcraft.com

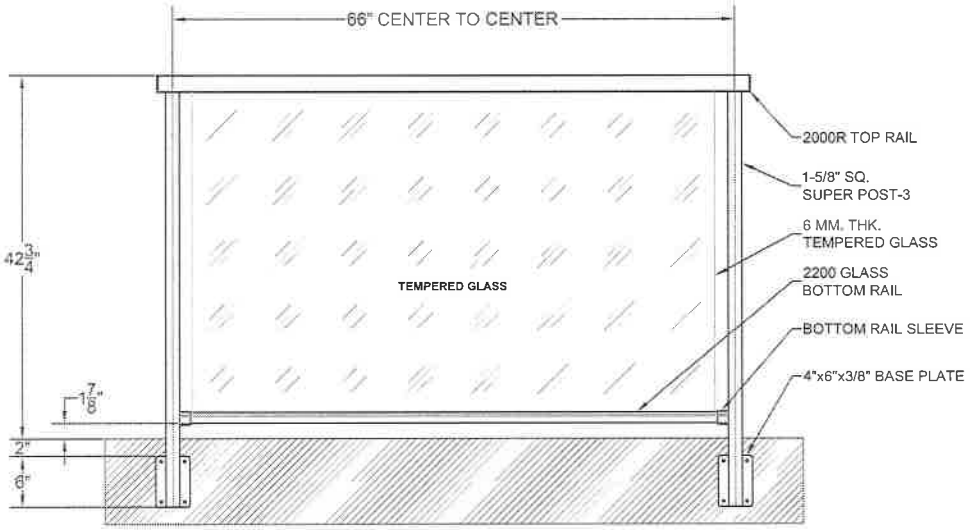
13272 COMBER WAY
SURREY, B.C.
CANADA V3W 3X9

RAILCRAFT INTERNATIONAL INC.



SURFACE MOUNT GLASS RAIL

(OPTION 1 - WELDED BASE PLATES, OPTION 2 - SCREWED BASE PLATES, OPTION 3- WELDED & SCREWED BASE PLATES)



FASCIA MOUNT GLASS RAIL

ENGINEERING STAMP AND DATE:

DESIGN NOTE:

DESIGN:
1. STRUCTURAL DESIGN HAS BEEN PERFORMED IN ACCORDANCE WITH THE 2006 BC BUILDING CODE & AMENDMENTS.
2. IN ACCORDANCE WITH ARTICLE 4.1.5.16 DESIGN LOADS ARE AS FOLLOWS:
   a. HORIZONTAL LOADS APPLIED AT TOP OF GUARD EITHER INWARD OR OUTWARD:
      i. UNIFORM FORCE OF 0.75 kN/m, OR
      ii. CONCENTRATED FORCE OF 1.0 kN (WHICHEVER GOVERNS).
   b. HORIZONTAL LOAD APPLIED TO INDIVIDUAL ELEMENTS WITHIN THE GUARDS; 0.5kN APPLIED OVER AN AREA OF 100mm x 100mm AT ANY POINT.
   c. VERTICLE LOAD APPLIED TO TOP OF GUARD; 1.5 kN/m.
   d. DESIGN LOADS NEED NOT TO BE APPLIED CONCURRENTLY.
3. SUPPORTING STRUCTURE MUST BE STRUCTURALLY ADEQUATE TO WITHSTAND GUARD LOADS.
4. DESIGN OF ALUMINUM COMPONENTS TO CAN/S157.

MATERIALS:
1. ALUMINUM ALLOY AND TEMPER
   POSTS - 6063A-T61
   RAILS - 6063-T5
   BASEPLATES - 6005A-T61
2. WELDED COEFFICIENT k = 1.0 k = 1.12
3. JOINTS SHALL BE WIRE FED MIG WELDED WITH ALLOY TYPE ER-4043.
4. BUILD UP AREA TO BE GRINDED AND BUFFED SMOOTH ON TOP AND OUTER PERIMETER EDGES.
5. ALL WELDS TO BE COMPLETED BY CSA CERTIFIED ALUMINUM WELDER.
6. UNLESS OTHERWISE NOTED ANCHORAGE TO WALLS SHALL CONSIST OF A MINIMUM OF TWO(2) FRIULSIDER 3/8x1-1/2" TPP STAINLESS STEEL ANCHORS.
7. BOLTS AND CONNECTORS AS PER MANUFACTURER'S SPECIFICATIONS.
8. GLAZING: TO CAN/CGSB-12.1-M90 MINIMUM THICKNESS: 6mm(TEMPERED).
9. ASSUMED CONCRETE COMPRESSIVE STRENGTH : 30MPa.

COATINGS:
1. FINISHED POWDER COAT COLOR IS TBA.
2. POWDER COAT MEET AAMA 2604-05 VOLUNTARY SPECIFICATION PERFORMANCE REQUIREMENTS AND TEST PROCEDURES FOR HIGH PERFORMANCE ORGANIC COATINGS ON ALUMINUM EXTRUSIONS AND PANELS.

GENERAL NOTES:
1. CONTRACTOR TO FIELD VERIFY ALL DIMENSIONS AND QUANTITIES PRIOR TO FABRICATION.
2. CONTRACTOR TO VERIFY FINISH COLOUR WITH OWNER PRIOR TO FABRICATION.
3. CONFIRMED DIMENSIONS WITH FIELD MEASUREMENT ONCE CONCRETE IS POURED.
4. FOR ALL ANCHORS ENSURE THAT THE MANUFACTURER'S MINIMUM EDGE AND SPACING DISTANCES ARE OBSERVED.
5. ENSURE COMPLIANCE WITH MAXIMUM OPENING SIZE AND CLIMBABILITY REQUIREMENTS OF THE ONTARIO BUILDING CODE.
6. RAILCRAFT INTERNATIONAL INC. IS NOT RESPONSIBLE FOR WATERTIGHTNESS AT CONNECTIONS TO PARAPETS, WALL, COLUMNS, FLOORS AND/OR ROOFS AND FOR THE STRUCTURAL ADEQUACY OF THE BUILDING COMPONENTS PROVIDING SUPPORT FOR GUARDRAILS AND HANDRAILS INCLUDING BACKING FOR SPECIFIED CONNECTIONS.

POWDER COATED TOUGH™

CWB CERTIFIED

08 NOVEMBER 2010

RAILCRAFT ALUMINUM RAILING SYSTEMS

2 / 2

PROJECT NAME: INTERNATIONAL TERMINALS

DATE:

REVISION:

0

TITLE: RAILING ELEVATION
2000R GLASS RAILING SYSTEM

PROJECT MANAGER:

SCALE: 1-3/4" = 1"

DESIGNED BY:

DRAWN BY: RC/DEH

DATE: 08 NOVEMBER 2010

CHECKED BY: DCH/SMITH

RAILCRAFT CANADA LTD.
12272 COMBER WAY
SURREY B.C.
V3V 0A9

INTERNATIONAL INC.

R22