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Project name: Trex Transcend Glass Guardrail System for International Residential Code
Creation date: 12/31/19
Last revision:
Revision: 0

I hereby certify that the following pages of this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the states shown on the following pages.

Anthony J Barnes, PE
1/17/20

Anthony J Barnes Digitally signed by Anthony J Barnes
DN: C=US, E=tbarnes@trexcommercial, CN=Anthony J Barnes
Date: 2020.01.17 14:37:17-06'00'

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1 State certifications

State	Professional Engineer license number
Alabama	34664
Arizona	63922
California	84471
Colorado	PE.0049211
Florida	77515
Georgia	PE039214
Idaho	P-17222
Indiana	PE11400345
Iowa	22527
Louisiana	39025
Maryland	45817
Massachusetts	51462
Michigan	6201063081
Minnesota	51612
Mississippi	26806
Missouri	PE2014023010
Nebraska	E-15134
Nevada	023009
New Jersey	24GE05291300
New Mexico	24093
New York	094109
North Carolina	041703
North Dakota	PE-9715
Ohio	79131
Oklahoma	27838
Pennsylvania	PE082756
South Carolina	33939
Tennessee	00117639
Texas	PE 117821
Utah	9163877-2202
Virginia	402054114
Washington	51729
Washington, DC	PE907658
Wisconsin	43059-6
Wyoming	16000

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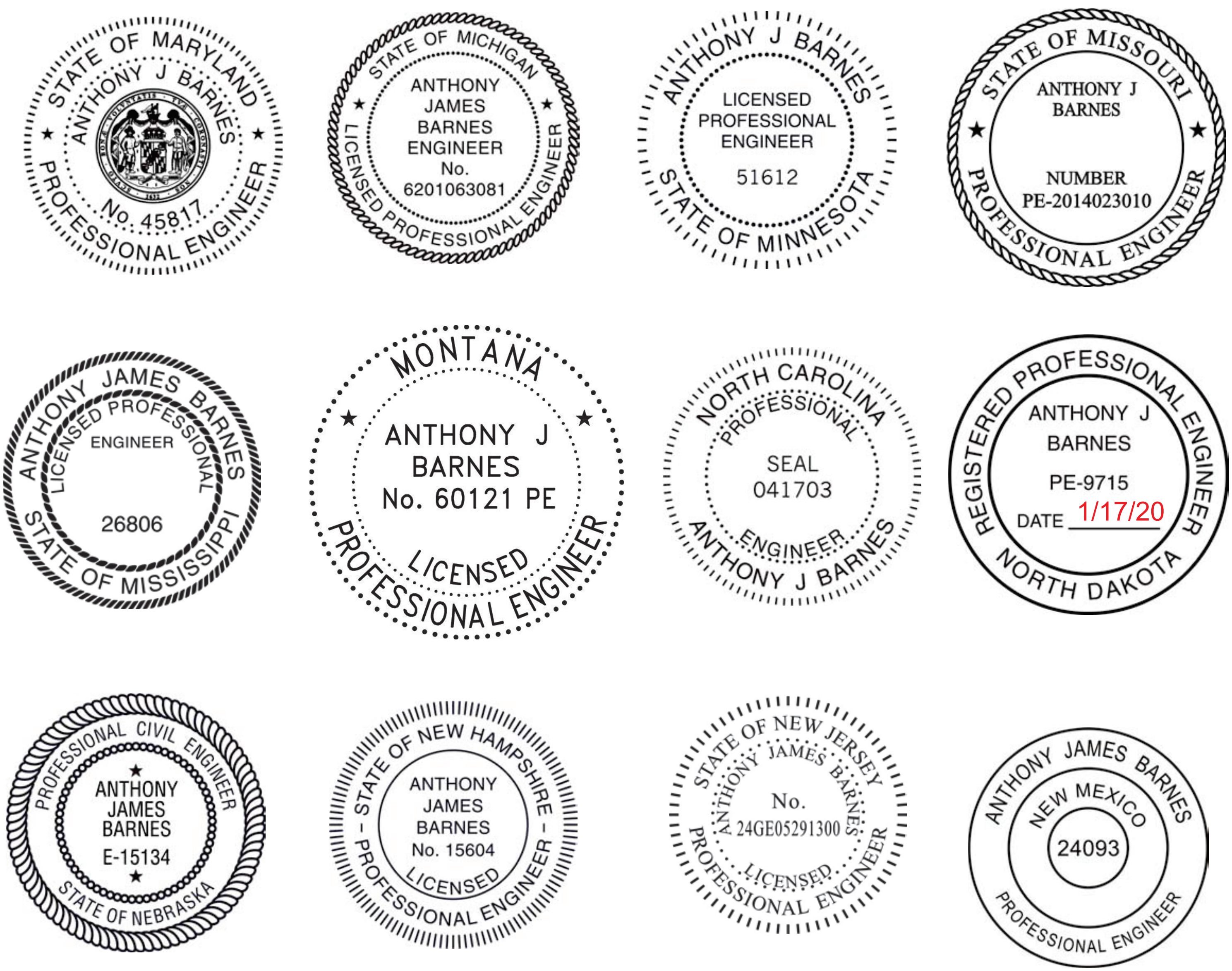

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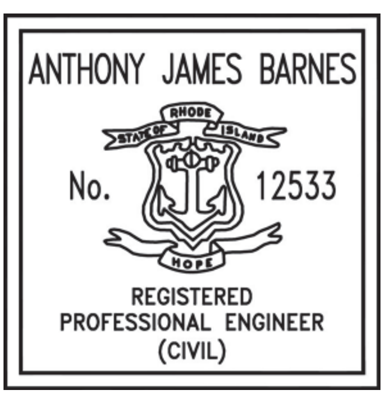

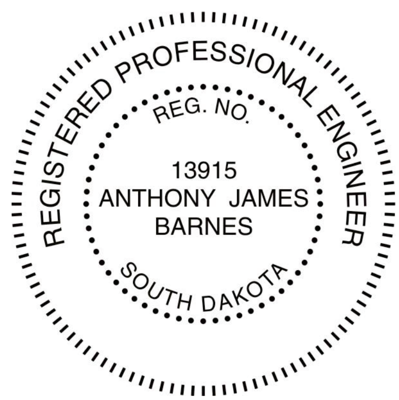

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Revision	Description

Contents

2 Description

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This calculation package illustrates the adequacy of the Trex Transcend glass railing system used in residential applications at post spacings referred to in this report. For all loading conditions not checked in this report, see test report ATI no. I0418.01-119-19 R0 dated 05/09/18-05/29/18.

3 Summary tables

Table 3.1

Allowable glass wind loads (psf)			
Post spacing (ft)	**Rail height (in)**	**Glass type**	**Max wind load (psf)**
6	42	1/4" mono	65
6	36	1/4" mono	90
5	42	1/4" mono	65
5	36	1/4" mono	90
4	42	1/4" mono	65
4	36	1/4" mono	90
* Deflection not considered			
*Allowable stress = 13.5 ksi (93 N/mm2)			
*Based on analysis			

Table 3.2		
Allowable top and bottom extrusion wind loads (psf)		
Post spacing (ft)	**Rail height (in)**	**Max wind load**
6	42	37
6	36	43
5	42	53
5	36	62
4	42	82
4	36	97
*Based on testing		

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Table 3.3

Allowable bracket wind loads (psf)		
Post spacing (ft)	Rail height (in)	Max wind load (psf)
6	42	38
6	36	44
5	42	45
5	36	53
4	42	56
4	36	67
*Based on testing		

Table 3.4

Allowable post wind loads (psf)		
Post spacing (ft)	Rail height (in)	Max wind load (psf)
6	42	19
6	36	26
5	42	23
5	36	31
4	42	29
4	36	39
*Based on analysis		

Post strength controls for all conditions.

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4 System details

4.1 Composite material data

PHYSICAL PROPERTIES

STRENGTH & STABILITY PLATFORM - PVC-BASED FORMULATION

MEASUREMENT	ASTM	UNITS	MATERIAL VALUE
Tensile Modulus, 77° (25°C)	D3039	psi (MPa)	
Extrusion direction			950,000 (6,550)
Cross-extrusion direction			750,000 (5,200)
Tensile Yield Strength, 77° (25°C)	D3039	psi (MPa)	3,000 (21)
Tensile Strength (UTS), 77° (25°C)	D3039	psi (MPa)	
Extrusion direction 5,500 (38)			
Cross-extrusion direction 3,800 (26)			
Tensile Strain at Failure, 77° (25°C)	D3039	%	
Extrusion direction			1.3
Cross-extrusion direction			0.9
Poisson's Ratio	D630	—	0.342 @ 70°F 0.236 @ 160°F
Flexural Modulus, 77° (25°C)	D790	psi (MPa)	830,000 (5,700)
Compressive Modulus, 77° (25°C)	D695	psi (MPa)	571,000 (3,900)
Modulus of Rupture, 77° (25°C)	D790	psi (MPa)	10,000 (69)
Maximum Flexural Strain (Emax)	D790	%	1.7
Impact Strength, Gardner, 77° (25°C) 0.1" sample thickness	D3029	inch •lbs(J)	5.0 (0.56)
Izod Notched Impact, 77° (25°C)	D256	inch •lbs/inch(J/m)	7.0 (28)
Maximum Allowable Dynamic Stress	*	psi (MPa)	16,000 (110)
Extrusion Shrinkage	D3679	%	0.2
Specific Gravity	D792	—	1.4
Hardness, Rockwell "L", 77° (25°C)	D785	—	92
Hardness, Rockwell "M", 77° (25°C)	D785	—	66
Static Coefficient of Friction vs. Neolite std.	F1679-96	—	0.60 wet
Extrusion direction			0.85 dry

FIBREX® ENVIRONMENTAL PROPERTIES

Measurement	ASTM	Units	Material Value
Moisture Absorption	D570-84	%	0.9
Termite Resistance	—	Weight Loss (g)	
C. formosanus			0
R. flavipes			0
Fungal Decay	D1413		None
Moisture Expansion	D1037	inch/inch/%ΔMC*	1.14x10-3

FIBREX® THERMAL PROPERTIES

Measurement	ASTM	Units	Material Value
Heat Deflection Temperature,	D648	°F (°C)	
264psi (1.82 MPa)			173 (78)
66 psi (0.46 MPa)			221 (105)
Coefficient of Thermal Expansion	D696	inch/inch/°F (m/m/°C)	1.6x10-5 (2.9x10-5)
Thermal Conductivity	F433	Btu/hr•ft•°F (W/m•K)	0.1 (0.17)
Specific Heat	—	Btu/lb•°F (J/kg•K)	0.4 (1674)
Flash Ignition Temperature	D1929	°F (°C)	644 (340)
Self Ignition Temperature	D1929	°F (°C)	716 (380)
Flame Spread Index	E84-94		10
Smoke Developed Index	E84-94		580
Average Flame Spread Index	E162-94		22.73
Average Optical Density of Smoke	E662-94		
Flaming mode			472.32
Non-flaming mode			439.24
Average Time of Burn	D635-91	sec.	<5
Average Extent of Burn	D635-91	mm	<5
Final Oxygen Index	D2863	%volume	31.3

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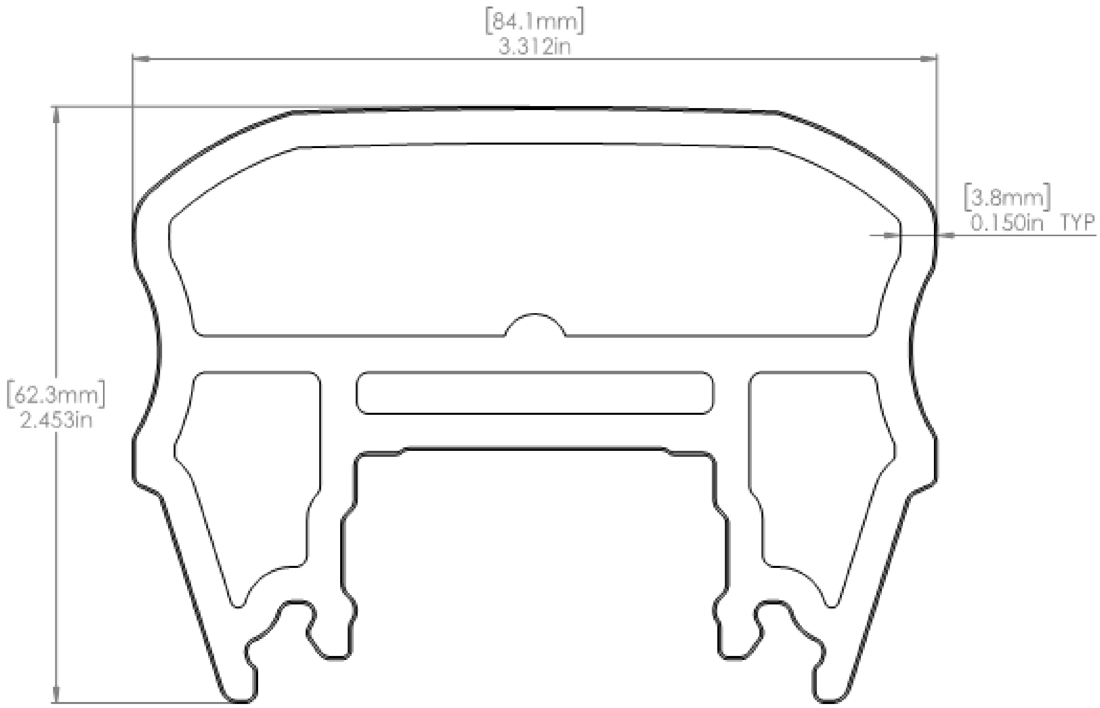
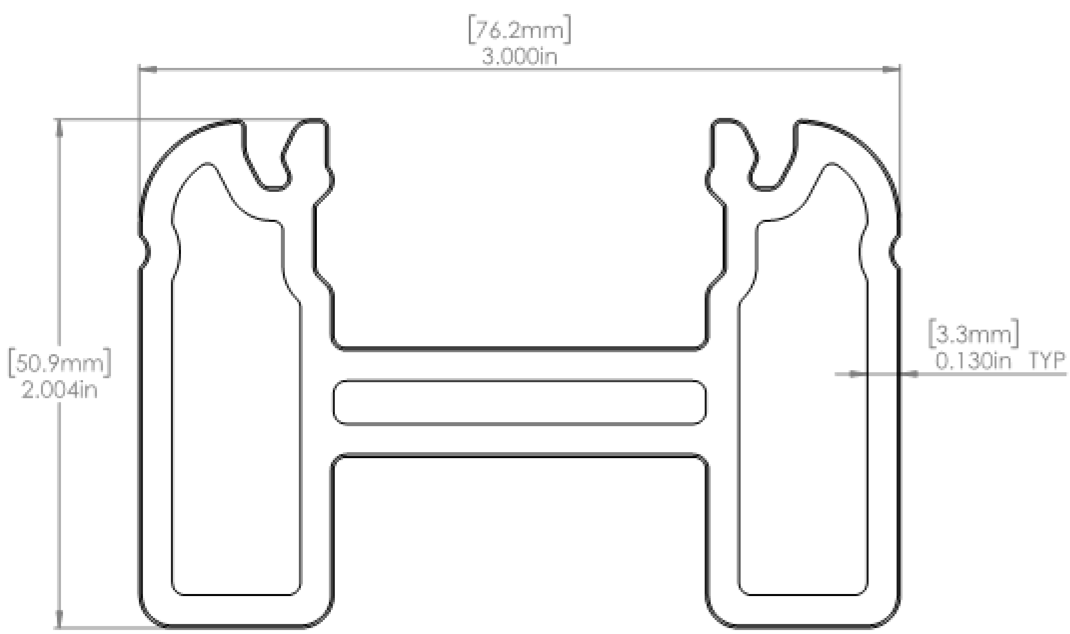
4.2 Top and bottom rail

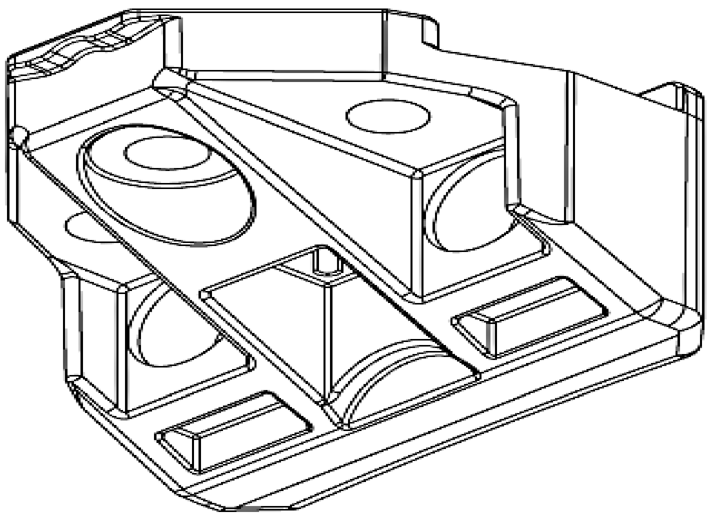




4.3 Posts

Posts are a min SPF #2 (minimum) 4x4 treated wood member.

4.4 Bracket



5 Design criteria

5.1 Building codes/standards/project specifications

1) IRC 2018
2) Aluminum Design Manual 2015
3) ATI report no. I0418.01-119-19 R0 dated 05/09/18-05/29/18
4) NDS 2012

5.2 Design loads

Per table R301.5, a single 200 lb concentrated load shall be applied in any direction at any point along the top of the railing.

→ Live load = 200 lbs applied laterally

Note: by inspection, the lateral load, perpendicular to the plane of the railing controls.

*Per IBC chapter 17 requirements (section 1709.3.1), assemblies must be tested to 2.5 times the design load (= 500 lbs)

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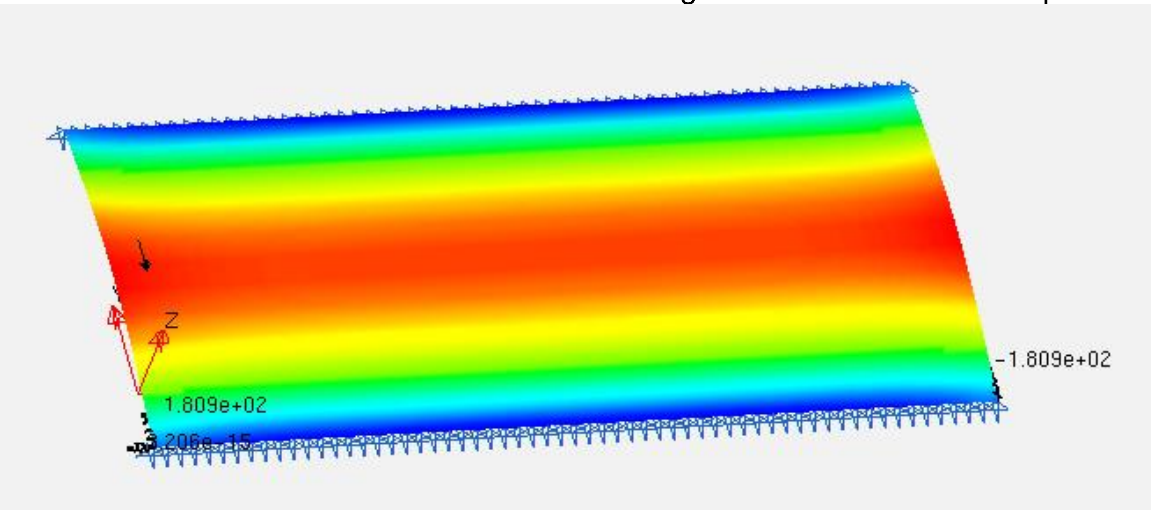
6 Glass analysis

6.1 6' wide by 42" tall panel

6.1.1 ¼" thick monolithic glass

6.1.1.1 Wind load

Max wind for allowable stress and deflection on glass was found to be 65 psf



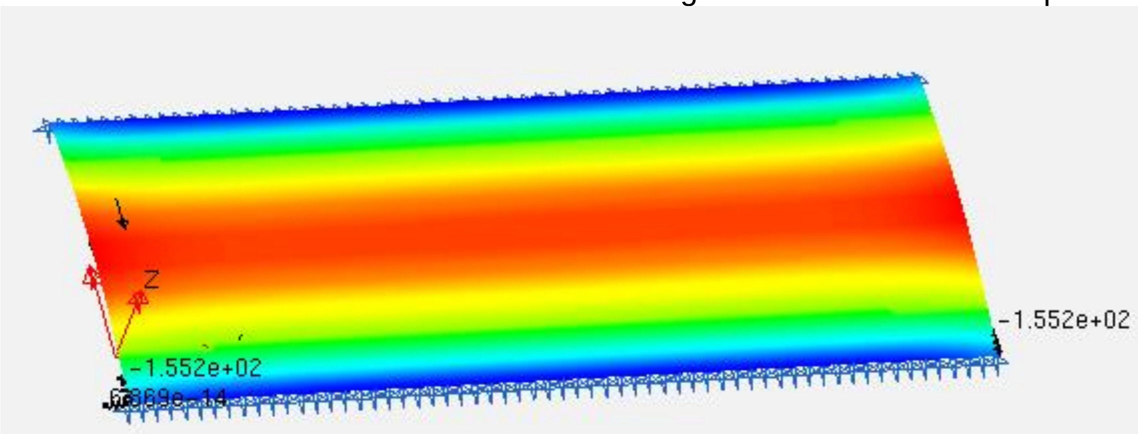
Stress = 13.5 ksi = 13.5 ksi limit, **OK**

6.2 6' wide by 36" tall panel

6.2.1 ¼" thick monolithic glass

6.2.1.1 Wind load

Max wind for allowable stress and deflection on glass was found to be 90 psf



Stress = 13.5 ksi = 13.5 ksi limit, **OK**

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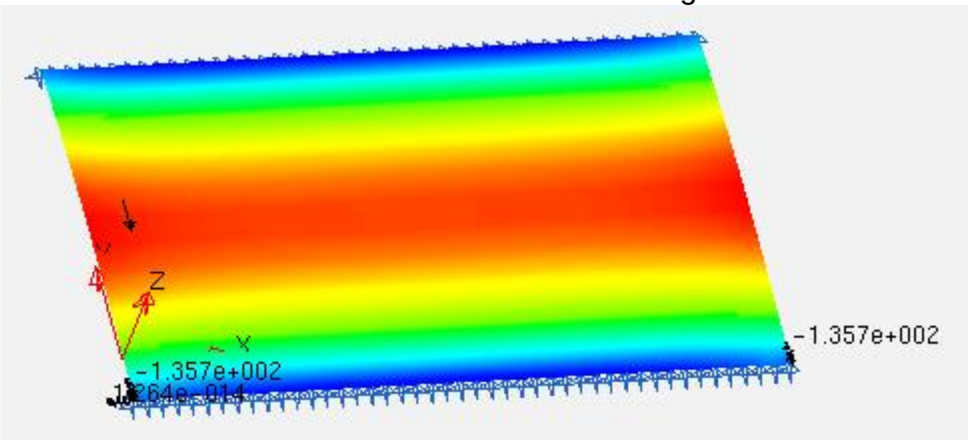
6.3 5' wide by 42" tall panel

6.3.1 ¼" thick monolithic glass

6.3.1.1 Wind load

Max wind for allowable stress and deflection on glass was found to be 65 psf



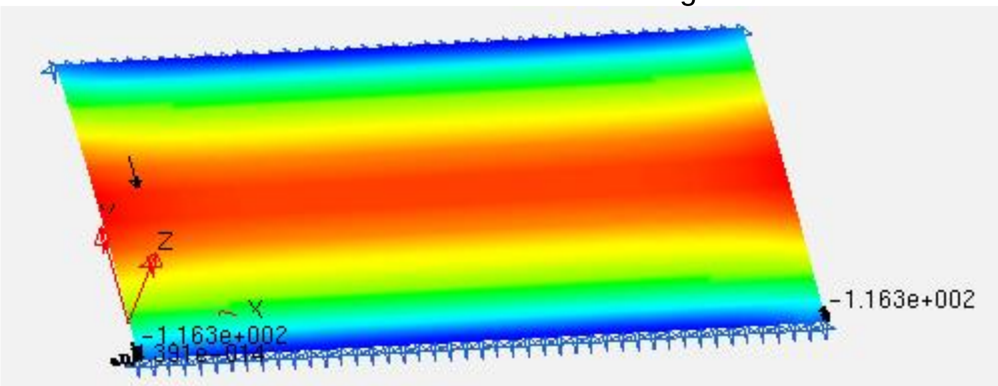
Stress = 13.5 ksi = 13.5 ksi limit, **OK**

6.4 5' wide by 36" tall panel

6.4.1 ¼" thick monolithic glass

6.4.1.1 Wind load

Max wind for allowable stress and deflection on glass was found to be 90 psf



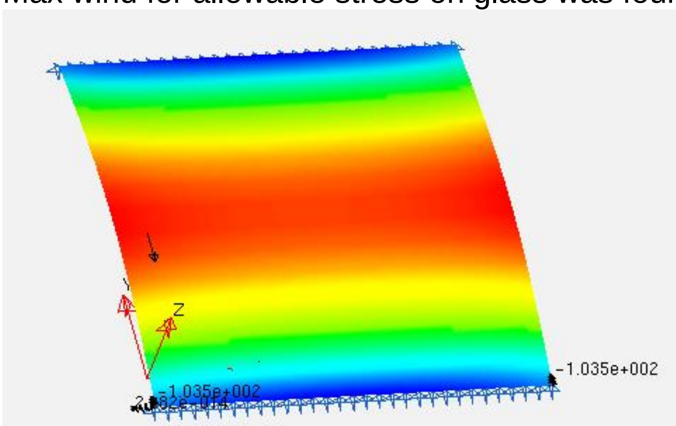
Stress = 13.5 ksi = 13.5 ksi limit, **OK**

6.5 4’ wide by 42” tall

6.5.1 ¼” thick monolithic glass

6.5.1.1 Wind load

Max wind for allowable stress on glass was found to be 65 psf



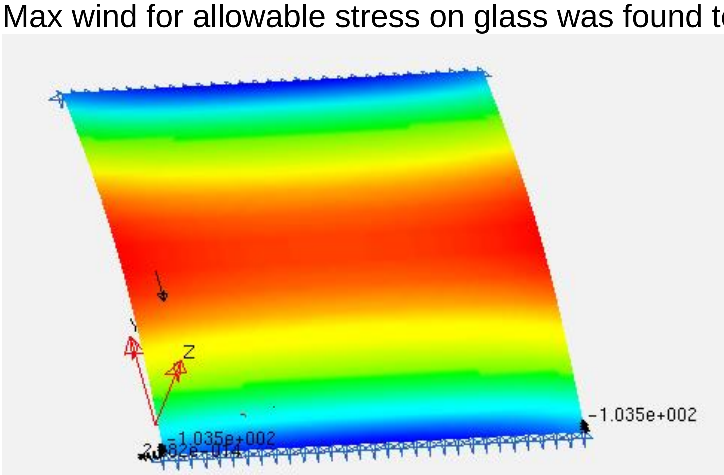
Stress = 13.5 ksi = 13.5 ksi limit, **OK**

6.6 4’ wide by 36” tall

6.6.1 ¼” thick monolithic glass

6.6.1.1 Wind load

Max wind for allowable stress on glass was found to be 90 psf



Stress = 13.5 ksi = 13.5 ksi limit, **OK**

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7 Calculations

7.1 Applied loads for analysis

Considering a 200 lb force applied at the center of the 8' span:

$$M = \frac{PL}{4} = \frac{0.2\ k * 96"}{4} = 4.8\ k - in\ (7.68\ k - in\ LRFD)$$

$$V = \frac{P}{2} = \frac{0.2\ k}{2} = 100\ lbs$$

Considering a 200 lb force at top of post:

$$M = PL = 0.2\ k * 42" = 8.4\ k - in\ (13.44\ k - in\ LRFD)$$

$$V = P = 200\ lbs$$

7.2 Posts

Check 4x4 wood post (#2 SPF or better)

S = 7.15 in^3

Allowable stress per NDS 2012, Fb = 775 psi min.

Bending capacity per 2012 NDS:

$F_b' = F_b C_D C_M C_t C_L C_F C_{fu} C_i C_r$

All values = 1.0 except C_D

$C_D = 1.6$ (short term loading)

$F_b' = 775 \text{ psi} * 1.6$ = 1240 psi

M_n = 1240 psi * 7.15 in^3 = 8.9 k-in > 8.4 k-in applied load as shown in section 5.1

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7.2.1 Allowable post wind loads

$M_n := 8.4 \cdot kip \cdot in$

$spacing := 4 \cdot ft$ Post spacing

$h := 42 \cdot in$ Glass hieght

$$X_{psf} := \frac{M_n}{spacing \cdot (h) \cdot \left(\frac{h}{2}\right)} = 29 \cdot psf$$

$spacing := 5 \cdot ft$

$$X_{psf} := \frac{M_n}{spacing \cdot (h) \cdot \left(\frac{h}{2}\right)} = 23 \cdot psf$$

$spacing := 6 \cdot ft$

$$X_{psf} := \frac{M_n}{spacing \cdot (h) \cdot \left(\frac{h}{2}\right)} = 19 \cdot psf$$

$spacing := 4 \cdot ft$

$h := 36 \cdot in$ Glass hieght

$$X_{psf} := \frac{M_n}{spacing \cdot (h) \cdot \left(\frac{h}{2}\right)} = 39 \cdot psf$$

$spacing := 5 \cdot ft$

$$X_{psf} := \frac{M_n}{spacing \cdot (h) \cdot \left(\frac{h}{2}\right)} = 31 \cdot psf$$

$spacing := 6 \cdot ft$

$$X_{psf} := \frac{M_n}{spacing \cdot (h) \cdot \left(\frac{h}{2}\right)} = 26 \cdot psf$$

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7.2.2 Vertical load

$C_M := 0.75$ Wet service factor

$C_t := 0.9$ Temperature service factor

$C_d := 1.0$ Duration service factor

$E_{min} := 400 \cdot ksi$ Spruce-Pine Fur

$E_{min} := 400 \cdot ksi \cdot C_M \cdot C_t \cdot C_d = 270\,ksi$

$c := 0.8$

$l_e := 42.5 \cdot in$

$d := 4 \cdot in$

$$F_{cE} := \frac{0.822 \cdot E_{min}}{\left(\frac{l_e}{d}\right)^2} = 1.966\,ksi$$

$F_c := 1 \cdot ksi \cdot C_M \cdot C_t \cdot C_d = 0.675\,ksi$

$$C_p := \frac{1 + \left(\frac{F_{cE}}{F_c}\right)}{2 \cdot c} - \sqrt{\left[\frac{1 + \left(\frac{F_{cE}}{F_c}\right)}{2 \cdot c}\right]^2 - \frac{\frac{F_{cE}}{F_c}}{c}} = 0.916$$

$F_c := F_c \cdot C_p = 0.618\,ksi$

$P_{applowable} := F_c \cdot 16in^2 = 9892.356\,lbf$

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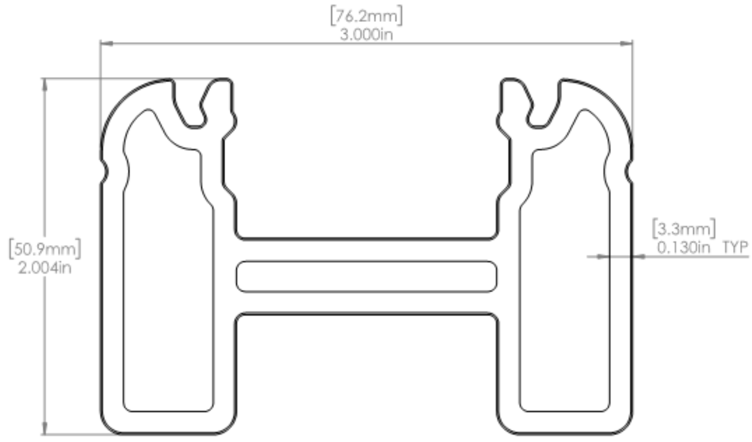
8 Test results

8.1 Universal rail (bottom rail)



Transcend Universal RailSupport Span = 42 IN
Orientation = Upright "I"
Crosshead Speed = 1.09 in/min
Test Date: 05/18/18

SAMPLE NO.	SAMPLE COLOR	WEIGHT PER LINEAL FOOT (lb)	ULTIMATE LOAD (lb)	SLOPE (lbf/in)	MU (in lb)	EL (lb in^2)
1	White	1.05	1097	1145	7679	1506000
2		1.04	1058	1140	7406	1499000
3		1.04	1078	1138	7546	1496000
4		1.05	1066	1136	7462	1493000
5		1.04	1048	1142	7336	1501000
6		1.04	1045	1139	7315	1497000
7		1.05	1068	1141	7476	1500000
8		1.05	1050	1140	7350	1498000
9		1.05	1032	1140	7224	1498000
10		1.05	1085	1134	7595	1491000
11		1.05	1044	1138	7308	1497000
12		1.05	1054	1140	7378	1499000
13		1.04	1048	1137	7336	1495000
14		1.05	1038	1136	7266	1494000
15		1.04	1043	1137	7301	1495000
				Minimum:	1134	7224
				Maximum:	1145	7679
				Average:	1139	7399
				Standard Deviation:	3	129
				Coefficient of Variation:	0%	2%

Conservatively, the minimum ultimate value will be used.
Minimum ultimate load = 1038 lbs
Allowable load = 1038 lbf / 2.5 = 420 lbs

Allowable moment = PL/4 = 420 lbs * 42 in / 4 = 4.4 k-in

8.1.1 Allowable wind load

Universal Rail

$M_a := 4.4 \cdot kip \cdot in$ Allowable moment per test results

Wind equivalent load at 42" tall and 6 ft post spacing

$spacing := 6 \cdot ft$

$h_{glass} := \frac{42.5 \cdot in}{2}$ (half the height since a single extrusion is checked)

$X := \frac{M_a \cdot 8}{spacing^2} = 81 \cdot \frac{lbf}{ft}$

$X_{psf} := \frac{X}{h_{glass}} = 46 \cdot psf$

Wind equivalent load at 36" tall and 6 ft post spacing

$h_{glass} := \frac{36 \cdot in}{2}$ (half the height since a single extrusion is checked)

$X := \frac{M_a \cdot 8}{spacing^2} = 81 \cdot \frac{lbf}{ft}$

$X_{psf} := \frac{X}{h_{glass}} = 54 \cdot psf$

Wind equivalent load at 42" tall and 5 ft post spacing

$spacing := 5 \cdot ft$

$h_{glass} := \frac{42.5 \cdot in}{2}$ (half the height since a single extrusion is checked)

$X := \frac{M_a \cdot 8}{spacing^2} = 117 \cdot \frac{lbf}{ft}$

$X_{psf} := \frac{X}{h_{glass}} = 66 \cdot psf$

Wind equivalent load at 36" tall and 5 ft post spacing

$h_{glass} := \frac{36 \cdot in}{2}$ (half the height since a single extrusion is checked)

$X := \frac{M_a \cdot 8}{spacing^2} = 117 \cdot \frac{lbf}{ft}$

$X_{psf} := \frac{X}{h_{glass}} = 78 \cdot psf$

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Wind equivalent load at 42" tall and 4 ft post spacing

$spacing := 4 \cdot ft$

$h_{glass} := \frac{42.5 \cdot in}{2}$ (half the height since a single extrusion is checked)

$X := \frac{M_a \cdot 8}{spacing^2} = 183 \cdot \frac{lbf}{ft}$

$X_{psf} := \frac{X}{h_{glass}} = 104 \cdot psf$

Wind equivalent load at 36" tall and 4 ft post spacing

$h_{glass} := \frac{36 \cdot in}{2}$ (half the height since a single extrusion is checked)

$X := \frac{M_a \cdot 8}{spacing^2} = 183 \cdot \frac{lbf}{ft}$

$X_{psf} := \frac{X}{h_{glass}} = 122 \cdot psf$

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8.2 Transcend crown rail (top rail)

TEST REPORT FOR TREX COMPANY, INC.
Report No.: I0418.01-119-19 R0
Date: 07/16/19

Transcend Top Rail
Support Span = 42 in
Crosshead Speed = 1.33 in/min
Orientation: Reference Product Drawing in Section 11
Test Date: 05/18/18

SAMPLE NO.	SAMPLE COLOR	WEIGHT PER LINEAL FOOT (lb)	ULTIMATE LOAD (lb)	SLOPE (lbf/in)	MU (in·lb)	EL (lb·in²)
1	White	1.41	901	691	6307	909200
2		1.41	889	687	6223	902800
3		1.38	871	684	6097	899300
4		1.41	901	694	6307	912700
5		1.41	898	690	6286	907400
6		1.41	903	689	6321	905900
7		1.41	914	694	6398	912200
8		1.36	828	663	5796	871500
9		--[1]	860	672	6020	884200
10		1.41	907	691	6349	908600
11		1.41	912	692	6384	910200
12		1.42	918	691	6426	908300
13		1.42	905	694	6335	913000
14		1.41	883	692	6181	910000
15		1.32	770	637	5390	837800
				Minimum:	637	5390
				Maximum:	694	6426
				Average:	684	6188
				Standard Deviation:	16	277
				Coefficient of Variation:	2%	4%

[1]*Weight per lineal foot was not documented for this specimen.*

Conservatively, the minimum ultimate value will be used (other than the 770 lb load which is considered an outlier).
Minimum ultimate load = 828 lbs
Allowable load = 828 lbs / 2.5 = 331 lbs

Allowable moment = PL/4 = 331 lbs * 42 in / 4 = 3.5 k-in

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8.2.1 Allowable wind load

Crown Rail

$M_a := 3.5 \cdot kip \cdot in$ Allowable moment per test results

Wind equivalent load at 42" tall and 6 ft post spacing

$spacing := 6 \cdot ft$

$h_{glass} := \frac{42.5 \cdot in}{2}$ (half the height since a single extrusion is checked)

$$X := \frac{M_a \cdot 8}{spacing^2} = 65 \cdot \frac{lbf}{ft}$$

$$X_{psf} := \frac{X}{h_{glass}} = 37 \cdot psf$$

Wind equivalent load at 36" tall and 6 ft post spacing

$h_{glass} := \frac{36 \cdot in}{2}$ (half the height since a single extrusion is checked)

$$X := \frac{M_a \cdot 8}{spacing^2} = 65 \cdot \frac{lbf}{ft}$$

$$X_{psf} := \frac{X}{h_{glass}} = 43 \cdot psf$$

Wind equivalent load at 42" tall and 5 ft post spacing

$spacing := 5 \cdot ft$

$h_{glass} := \frac{42.5 \cdot in}{2}$ (half the height since a single extrusion is checked)

$$X := \frac{M_a \cdot 8}{spacing^2} = 93 \cdot \frac{lbf}{ft}$$

$$X_{psf} := \frac{X}{h_{glass}} = 53 \cdot psf$$

Wind equivalent load at 36" tall and 5 ft post spacing

$h_{glass} := \frac{36 \cdot in}{2}$ (half the height since a single extrusion is checked)

$$X := \frac{M_a \cdot 8}{spacing^2} = 93 \cdot \frac{lbf}{ft}$$

$$X_{psf} := \frac{X}{h_{glass}} = 62 \cdot psf$$

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Wind equivalent load at 42" tall and 4 ft post spacing

$spacing := 4 \cdot ft$

$h_{glass} := \frac{42.5 \cdot in}{2}$ (half the height since a single extrusion is checked)

$X := \frac{M_a \cdot 8}{spacing^2} = 146 \cdot \frac{lbf}{ft}$

$X_{psf} := \frac{X}{h_{glass}} = 82 \cdot psf$

Wind equivalent load at 36" tall and 4 ft post spacing

$h_{glass} := \frac{36 \cdot in}{2}$ (half the height since a single extrusion is checked)

$X := \frac{M_a \cdot 8}{spacing^2} = 146 \cdot \frac{lbf}{ft}$

$X_{psf} := \frac{X}{h_{glass}} = 97 \cdot psf$

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8.2.2 Vertical load

See test report ATI no. I0418.01-119-19 R0 dated 05/09/18-05/29/18

8.3 Brackets

TEST NO. 4 DESIGN LOAD: 200 LB CONCENTRATED LOAD AT BOTH ENDS OF TOP RAIL (BRACKETS)			
LOAD LEVEL [1]	**TEST LOAD (lb)**	**E.T. (min:sec)**	**RESULT**
1000 lb (2.5 x D.L.) x 2	1003	00:59	Each end withstood load equal to or greater than 500 lb without failure

[1] *Load was imposed on both ends of rail using a spreader beam; therefore, loads were doubled.*

500 lbs / 2.5 = 200 lb allowable shear force at each bracket location.

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8.3.1 Allowable wind load

Bracket

$F_a := 200 \cdot lbf$ Allowable force per test results

Wind equivalent load at 42" tall and 6 ft post spacing

$spacing := \frac{6 \cdot ft}{2}$ (half the width since a single bracket is checked)

$h_{glass} := \frac{42.5 \cdot in}{2}$ (half the height since a single bracket is checked)

$$X := \frac{F_a}{spacing \cdot h_{glass}} = 38 \cdot \frac{lbf}{ft^2}$$

$X_{psf} := X = 38 \cdot psf$

Wind equivalent load at 36" tall and 6 ft post spacing

$h_{glass} := \frac{36 \cdot in}{2}$ (half the height since a single bracket is checked)

$$X := \frac{F_a}{spacing \cdot h_{glass}} = 44 \cdot \frac{lbf}{ft^2}$$

$X_{psf} := X = 44 \cdot psf$

Wind equivalent load at 42" tall and 5 ft post spacing

$spacing := \frac{5 \cdot ft}{2}$ (half the width since a single bracket is checked)

$h_{glass} := \frac{42.5 \cdot in}{2}$ (half the height since a single bracket is checked)

$$X := \frac{F_a}{spacing \cdot h_{glass}} = 45 \cdot \frac{lbf}{ft^2}$$

$X_{psf} := X = 45 \cdot psf$

Wind equivalent load at 36" tall and 5 ft post spacing

$h_{glass} := \frac{36 \cdot in}{2}$ (half the height since a single bracket is checked)

$$X := \frac{F_a}{spacing \cdot h_{glass}} = 53 \cdot \frac{lbf}{ft^2}$$

$X_{psf} := X = 53 \cdot psf$

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Wind equivalent load at 42" tall and 4 ft post spacing

$spacing := \frac{4 \cdot ft}{2}$ (half the width since a single bracket is checked)

$h_{glass} := \frac{42.5 \cdot in}{2}$ (half the height since a single bracket is checked)

$$X := \frac{F_a}{spacing \cdot h_{glass}} = 56 \cdot \frac{lbf}{ft^2}$$

$X_{psf} := X = 56 \cdot psf$

Wind equivalent load at 36" tall and 4 ft post spacing

$h_{glass} := \frac{36 \cdot in}{2}$ (half the height since a single bracket is checked)

$$X := \frac{F_a}{spacing \cdot h_{glass}} = 67 \cdot \frac{lbf}{ft^2}$$

$X_{psf} := X = 67 \cdot psf$

8.3.2 Vertical load

See test report ATI no. I0418.01-119-19 R0 dated 05/09/18-05/29/18

9 Conclusions

For IRC guardrail loading requirements, the 200 lb load applied at the top of the post controls for all components. The max allowable wind load for 6 ft post spacing and 42 in tall railing is 19 psf.

→ Railing meet the requirements of IRC 2018.

10 Appendix A – ESR report

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ESR-3947

Issued 09/2016

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DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES

SECTION: 06 50 00—STRUCTURAL PLASTICS

SECTION: 06 63 00—PLASIC RAILINGS

REPORT HOLDER:

TREX COMPANY, INC.

160 EXETER DRIVE
WINCHESTER, VIRGINIA 22602

EVALUATION SUBJECT:

TREX® TRANSCEND® SERIES RAILING SYSTEM
TREX® SELECT® SERIES RAILING SYSTEM

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DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
Section: 06 50 00—STRUCTURAL PLASTIC
Section: 06 63 00—PLASTIC RAILINGS

REPORT HOLDER:

TREX COMPANY INC.
160 EXETER DRIVE
WINCHESTER, VIRGINIA 22602
(540) 542-6300
www.trex.com

EVALUATION SUBJECT:

TREX® TRANSCEND® SERIES RAILING SYSTEM
TREX® SELECT® SERIES RAILING SYSTEM

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2015, 2012 and 2009 *International Building Code®* (IBC)
- 2015, 2012 and 2009 *International Residential Code®* (IRC)

Property evaluated:

- Structural
- Durability
- Surface-burning Characteristics

2.0 USES

The Trex® Transcend® Series Railing System and Trex® Select® Series Railing System described in this report are limited to exterior use as guards for balconies, porches, and decks in Residential Group R buildings of Type V-B construction and other types of construction in applications where untreated wood is permitted by IBC Section 1406.3 or in buildings constructed in accordance with the IRC.

3.0 DESCRIPTION

3.1 General:

Trex® Transcend® Series Railing System and Trex® Select® Series Railing System are guards consisting of top and bottom rails, balusters, baluster spacers, rail-to-post brackets, foot blocks, with decorative post sleeves, post sleeve caps and post sleeve skirts. The top and bottom rails, post sleeves, and the Transcend and Select balusters are composed of extruded wood-plastic composite core material, with a polyvinyl chloride (PVC) or acrylic cap layer.

3.2 Guards:

3.2.1 Trex® Transcend® Series Railing System: The height of the railing assembly is 36 inches or 42 inches (914.4 mm or 1066.8 mm) above the walking surface. The top rail has overall dimensions of 3.31 inches wide by 2.45 inches tall (84.1 mm by 62.2 mm). The bottom rail has overall dimensions of 3.0 inches wide by 2.0 inches tall (76.2 mm by 50.8 mm). The balusters can be either 1.42 inch (36.1 mm) or 1.125 inch (28.6 mm) square profiles. A baluster spacer, made of PVC with a PVC or acrylic cap layer, is installed onto the top and bottom rails. Each post is covered with a 4.45 inch (113 mm) square composite post sleeve. Rails are attached to posts with nylon composite brackets.

Transcend® Series Railing System components are available in 7 colors: Charcoal Black, Classic White, Fire Pit, Gravel Path, Rope Swing, Tree House, and Vintage Lantern.

3.2.2 Trex® Select® Series Railing System: The height of the railing assembly is 36 inches (914.4 mm) above the walking surface. The top rail has overall dimensions of 2.75 inches wide by 2.0 inches tall (69.9 mm by 50.8 mm). The bottom rail has overall dimensions of 2.0 inches wide by 2.75 inches tall (50.8 mm by 69.9 mm). The balusters are 1.125 inch (28.6 mm) square profiles. Balusters are installed directly into openings machined into the upper and lower rails. Each post is covered with a 4.45 inch (113 mm) square composite post sleeve. Rails are attached to posts with nylon brackets.

Select® Series Railing System is available in white color.

3.3 Durability:

When subjected to weathering, insect attack, and other decaying elements, the material used to manufacture the Trex® Transcend® Railing System and Trex® Select® Railing System are equivalent in durability to code-complying, preservative-treated or naturally durable lumber when used in locations in described in Section 2.0 of this report. Trex® Transcend® Railing System and Trex® Select® Railing System have been evaluated for structural performance when exposed to temperatures from -20°F (-29°C) to 125°F (52°C).

3.4 Surface-burning Characteristics:

When tested in accordance with ASTM E84, Trex® Transcend® Railing System and Trex® Select® Railing System have a flame-spread index of no greater than 200.

4.0 DESIGN AND INSTALLATION

4.1 General:

The Trex® Transcend® Series Railing System and Trex® Select® Series Railing System must be installed in

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accordance with the manufacture's published installation instructions, the approved construction documents and this report. The manufacturer's published installation instructions must be available at all times on the jobsites during installation.

4.2 Design:

The Trex® Transcend® Series Railing System and Trex® Select® Series Railing System are satisfactory to resist loads specified in Section 1607.8.1 of the 2015 and 2012 IBC, Section 1607.7.1 of the 2009 IBC and Table R301.5 of the IRC, when installed at the maximum clear distance between the posts as noted in Table 1. When the railing is supported on one or both ends by the supporting structure, the maximum clear distance between the post and supporting structure or between the structures must comply with the spans noted in Table 1.

4.3 Installation:

4.3.1 Trex® Transcend® Series Railing System: Composite post sleeves are installed over a conventional treated wood 4x4 post, having a minimum specific gravity of 0.55. The attachment of the posts to the deck structure must be adequate and is outside the scope of this report. The top and bottom rail assemblies are attached to the composite post sleeves using mounting brackets. The bracket screws are installed through the composite post sleeve, into the 4x4 wooden post using two #8 x 2-inch-long (50.8 mm) wood screws. Each mounting bracket attaches to the top and bottom rail using two #12 x 1.5-inch-long (38.1 mm) self-drilling flathead screws. Baluster spacers are installed in the top and bottom rails to hold the balusters in place. Foot blocks are installed at mid-span of the bottom rail between the deck surface and the rail using one #10 x 2-inch-long (50.8 mm) screw.

4.3.2 Trex® Select® Series Railing System: Composite post sleeves are installed over a conventional treated wood 4x4 post, having a minimum specific gravity of 0.55. The attachment of the posts to the deck structure must be adequate and is outside the scope of this report. The top and bottom rail assemblies are attached to the composite post sleeves using mounting brackets. The bracket screws are installed through the composite post sleeve, into the 4x4 wooden post using four #8 x 2-inch-long (50.8 mm) wood screws. Each mounting bracket attaches to the top and bottom rail using four #10 x 1-inch-long (25.4 mm) pan-head screws. Balusters are installed directly into the holes in the rail profiles. Foot blocks are installed at mid-span of the bottom rail between the deck surface and the rail using one #10 x 2-inch-long (50.8 mm) screw.

5.0 CONDITIONS OF USE

The Trex® Transcend® Series Railing System and Trex® Select® Series Railing System described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 This Trex® Transcend® Series Railing System and Trex® Select® Series Railing System are limited to exterior use as guards for balconies, porches, and decks in Residential Group R buildings of Type V-B construction and other types of construction in applications where untreated wood is permitted by IBC Section 1406.3, or in building constructed in accordance with the IRC.

5.2 Installation of the Trex® Transcend® Series Railing System and Trex® Select® Series Railing System must comply with this evaluation report, the manufacturer's published installation instructions and the applicable code. When the manufacturer's published installation instructions differ from this evaluation report, this evaluation report governs.

5.3 Only those types of fasteners and fastening methods described in this evaluation report have been evaluated for the installation of Trex® Transcend® Railing System and Trex® Select® Railing System. The compatibility of fasteners with the supporting construction, including chemically treated wood, is outside the scope of this report.

5.4 The Trex® Transcend® Series Railing System and Trex® Select® Series Railing System must be directly fastened to supporting construction having adequate strength and stiffness. Where required by the code official, engineering calculations and construction documents consistent with this report must be submitted for approval. The calculations must verify that the supporting construction complies with the applicable building code requirements and is adequate to resist the loads imparted upon it from the products and systems discussed in this report. The documents must contain details of the attachment to the supporting structure consistent with the requirements of this report. The documents must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.5 The use of Trex® Transcend® Series Railing System and Trex® Select® Series Railing System on stairs has not been evaluated and is outside the scope of this evaluation report.

5.6 Structural posts and attachment of the posts to the supporting structure are outside the scope of this report.

5.7 The Trex® Transcend® Railing System and Trex® Select® Railing System are manufactured in Winchester, Virginia, under a quality-control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Deck Board Span Ratings and Guardrail systems (Guards and Handrails) (AC174), dated January 2012 (Editorially revised December 2014).

7.0 IDENTIFICATION

The Trex® Transcend® Series Railing System and Trex® Select® Series Railing System described in this report are identified by a stamp on each individual piece or on the packaging, bearing the report holder's name (Trex Company, Inc.), the product name (The Trex® Transcend® Series Railing System or Trex® Select® Series Railing System), the allowable span, ICC-ES evaluation report number (ESR-3947).

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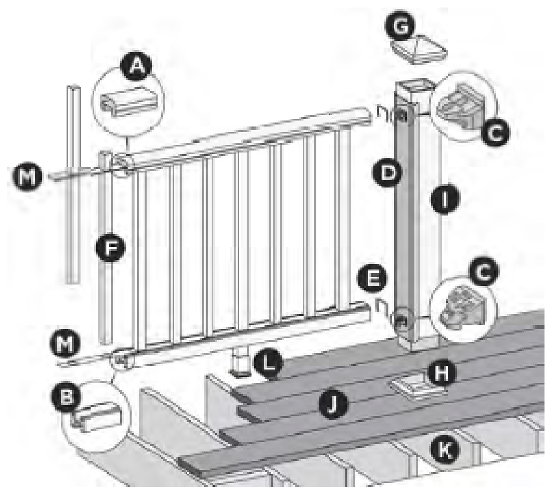
TABLE 1—MAXIMUM GUARDRAIL SYSTEM SPANS[1]

PRODUCT NAME / COMPONENT	APPLICABLE BUILDING CODE[2,3]		MAXIMUM SPAN[4,5] (inches)
	IBC	IRC	
Trex® Transcend® Railing System	Yes	Yes	67.5
Trex® Transcend® Railing System	No[6]	Yes	91.75
Trex® Select® Railing System	No[6]	Yes	68.25

For **SI**: 1 inch = 25.4 mm; 1 foot = 305 mm.
[1]The ability of the supporting construction, including posts, to resist the reactionary loads must be justified to the satisfaction of the code official.
[2]Indicates compliance with the respective building codes.
[3]The minimum height of the top rails is 42 inches in accordance with Section 1015 of the 2015 IBC and Section 1013 of the 2012 and 2009 IBC and 36 inches in accordance with IRC Section R312.
[4]Maximum span is the clear distance measured from edge-of-post to edge-of-post, edge-of-post to edge-of-structure, or edge-of-structure to edge-of-structure.
[5]Maximum allowable span has been adjusted for durability. No further increases are permitted.
[6]Exempt in One- and Two-Family Dwellings.



A. Top Rail
B. Bottom Rail
C. Railing Bracket
D. **Assembly Guide Template
E. **Gaskets
F. Balusters
G. Post Cap
H. Post Skirt
I. Trex® Composite Post Sleeve
J. **Trex® Decking
K. **Code-Approved Wood Joists
L. Trex® Footblock
M. Baluster Spacer

Note: Items marked with ** are outside the scope of this report.

FIGURE 1—TYPICAL TREX® TRANSCEND® SERIES RAILING ASSEMBLY

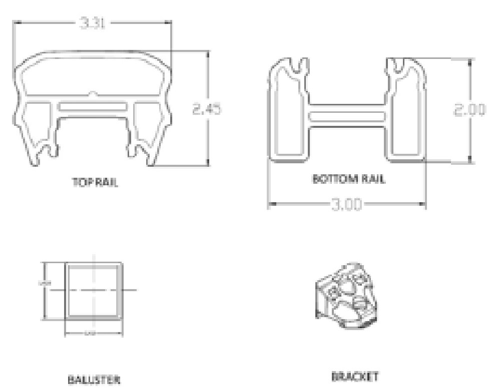


FIGURE 2—TREX® TRANSCEND® SERIES RAILING COMPONENTS

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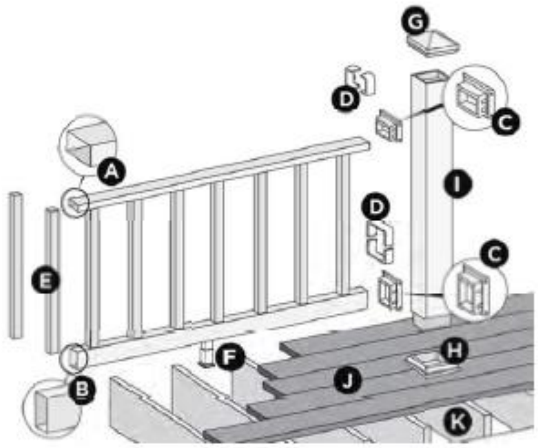

A. Top Rail
B. Bottom Rail
C. Railing Bracket
D. Bracket Covers
E. Balusters
F. Trex® Foot block
G. Post Cap
H. Post Skirt
I. Trex® Composite Post Sleeve
J. **Trex® Decking
K. **Code-Approved Wood Joists

Note: Items marked with ** are outside the scope of this report.

FIGURE 3—TYPICAL TREX® SELECT® SERIES RAILING ASSEMBLY

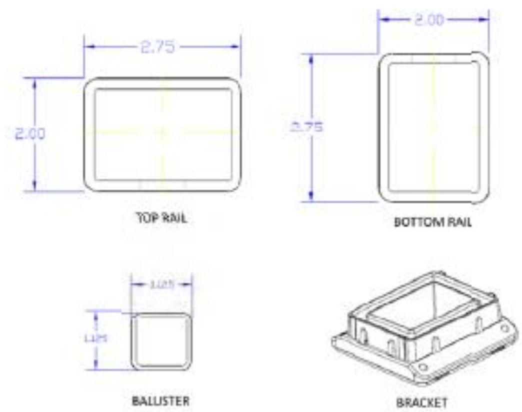

FIGURE 4—TREX® SELECT® SERIES RAILING COMPONENTS

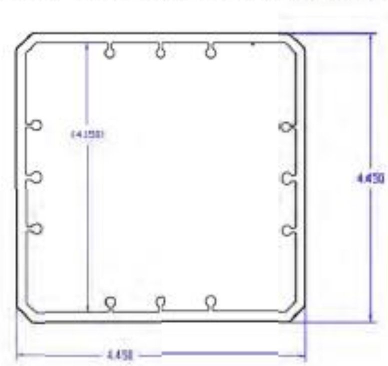

FIGURE 5—TREX® TRANSCEND® AND SELECT® SERIES COMPOSITE POST SLEEVE

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