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
1 State certifications

<table>
<thead>
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<th>Professional Engineer license number</th>
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<td>Alabama</td>
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2 Description
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

<table>
<thead>
<tr>
<th>Post spacing (ft)</th>
<th>Rail height (in)</th>
<th>Glass type</th>
<th>Max wind load (psf)</th>
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<tbody>
<tr>
<td>6</td>
<td>42</td>
<td>1/4&quot; mono</td>
<td>65</td>
</tr>
<tr>
<td>6</td>
<td>36</td>
<td>1/4&quot; mono</td>
<td>90</td>
</tr>
<tr>
<td>5</td>
<td>42</td>
<td>1/4&quot; mono</td>
<td>65</td>
</tr>
<tr>
<td>5</td>
<td>36</td>
<td>1/4&quot; mono</td>
<td>90</td>
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<tr>
<td>4</td>
<td>42</td>
<td>1/4&quot; mono</td>
<td>65</td>
</tr>
<tr>
<td>4</td>
<td>36</td>
<td>1/4&quot; mono</td>
<td>90</td>
</tr>
</tbody>
</table>

* Deflection not considered
* Allowable stress = 13.5 ksi (93 N/mm2)
* Based on analysis

Table 3.2

<table>
<thead>
<tr>
<th>Post spacing (ft)</th>
<th>Rail height (in)</th>
<th>Max wind load</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>42</td>
<td>37</td>
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<tr>
<td>6</td>
<td>36</td>
<td>43</td>
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<tr>
<td>5</td>
<td>42</td>
<td>53</td>
</tr>
<tr>
<td>5</td>
<td>36</td>
<td>62</td>
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<tr>
<td>4</td>
<td>42</td>
<td>82</td>
</tr>
<tr>
<td>4</td>
<td>36</td>
<td>97</td>
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</tbody>
</table>

* Based on testing
Post strength controls for all conditions.

**Table 3.3**

<table>
<thead>
<tr>
<th>Post spacing (ft)</th>
<th>Rail height (in)</th>
<th>Max wind load (psf)</th>
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</thead>
<tbody>
<tr>
<td>6</td>
<td>42</td>
<td>38</td>
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<tr>
<td>6</td>
<td>36</td>
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<td>5</td>
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<td>5</td>
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<td>4</td>
<td>42</td>
<td>56</td>
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<td>4</td>
<td>36</td>
<td>67</td>
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*Based on testing

**Table 3.4**

<table>
<thead>
<tr>
<th>Post spacing (ft)</th>
<th>Rail height (in)</th>
<th>Max wind load (psf)</th>
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<td>4</td>
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*Based on analysis
4 System details

4.1 Composite material data

### Physical Properties

<table>
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<tr>
<th>Measurement</th>
<th>ASTM Units</th>
<th>Material Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Modulus, 77°F (25°C)</td>
<td>psi (MPa)</td>
<td>950,000 (6,550)</td>
</tr>
<tr>
<td>Extrusion direction</td>
<td></td>
<td>750,000 (5,200)</td>
</tr>
<tr>
<td>Cross-extrusion direction</td>
<td></td>
<td>750,000 (5,200)</td>
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<tr>
<td>Tensile Yield Strength, 77°F (25°C)</td>
<td>psi (MPa)</td>
<td>3,080 (21)</td>
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<tr>
<td>Extrusion direction 5,500 (38)</td>
<td></td>
<td>3,080 (21)</td>
</tr>
<tr>
<td>Cross-extrusion direction 3,800 (26)</td>
<td></td>
<td>3,800 (26)</td>
</tr>
<tr>
<td>Tensile Strain at Failure, 77°F (25°C)</td>
<td>%</td>
<td>1.3</td>
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<tr>
<td>Extrusion direction</td>
<td></td>
<td>0.9</td>
</tr>
<tr>
<td>Cross-extrusion direction</td>
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<td>0.9</td>
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<tr>
<td>Poisson’s Ratio</td>
<td>D330</td>
<td>0.342 @ 70°F</td>
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<tr>
<td>Flexural Modulus, 77°F (25°C)</td>
<td>psi (MPa)</td>
<td>830,000 (5,700)</td>
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<td>Compressive Modulus, 77°F (25°C)</td>
<td>psi (MPa)</td>
<td>571,000 (3,900)</td>
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<tr>
<td>Modulus of Rupture, 77°F (25°C)</td>
<td>psi (MPa)</td>
<td>10,000 (69)</td>
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<td>Maximum Flexural Strain (E max)</td>
<td>%</td>
<td>1.7</td>
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<td>Impact Strength, Gardner, 77°F (25°C)</td>
<td>inch·lb/ft (J/m)</td>
<td>5.0 (0.56)</td>
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<tr>
<td>0.1” sample thickness</td>
<td></td>
<td>5.0 (0.56)</td>
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<tr>
<td>Izod Notched Impact, 77°F (25°C)</td>
<td>inch·lbf/inch (J/m)</td>
<td>1.0 (20)</td>
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<tr>
<td>Maximum Allowable Dynamic Stress</td>
<td>psi (MPa)</td>
<td>16,800 (110)</td>
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<tr>
<td>Extrusion Shrinkage</td>
<td>D3679</td>
<td>%</td>
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<td>Specific Gravity</td>
<td>D792</td>
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<tr>
<td>Hardness, Rockwell “L”, 77°F (25°C)</td>
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<td>Hardness, Rockwell “M”, 77°F (25°C)</td>
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<tr>
<td>Static Coefficient of Friction vs. Neoprene std</td>
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<td>0.50 wet</td>
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<tr>
<td>Extrusion direction</td>
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<td>0.85 dry</td>
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### Fibrex Environmental Properties

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<tr>
<th>Measurement</th>
<th>ASTM Units</th>
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<td>Moisture Absorption</td>
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<td>Termite Resistance</td>
<td>C. formosanus</td>
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<td>R. flavipes</td>
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<td>Fungal Decay</td>
<td>D1613</td>
<td>None</td>
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<td>Moisture Expansion</td>
<td>D1037</td>
<td>inch/inch/%ΔMC*</td>
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<td></td>
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<td>1.1×10^-3</td>
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### Fibrex Thermal Properties

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<td>Heat Deflection Temperature</td>
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<td>173 (78)</td>
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<tr>
<td>264psi (1.82 MPa)</td>
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<td>201 (105)</td>
</tr>
<tr>
<td>44psi (0.30 MPa)</td>
<td></td>
<td>1.6×10^-5 (2.9×10^-5)</td>
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<tr>
<td>Coefficient of Thermal Expansion</td>
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<td>0.1 (0.17)</td>
</tr>
<tr>
<td>Thermal Conductivity</td>
<td>Btu/hr/°F ft²/inch x K</td>
<td>0.6 (0.176)</td>
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<tr>
<td>Flash Ignition Temperature</td>
<td>°F (°C)</td>
<td>644 (340)</td>
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<td>Self Ignition Temperature</td>
<td>°F (°C)</td>
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<td>Flame Spread Index</td>
<td>6B-4</td>
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<td>Smoke Developed Index</td>
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<td>Average Flame Spread Index</td>
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<td>Average Optical Density of Smoke</td>
<td>E462-94</td>
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<td>Flaming mode</td>
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<td>Non-flaming mode</td>
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<td>Average Time of Burn</td>
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</tr>
<tr>
<td>Average Extent of Burn</td>
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<td>&lt;5</td>
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<td>Final Oxygen Index</td>
<td>D2863</td>
<td>%volume</td>
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<td></td>
<td>31.3</td>
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</table>
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)
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

![Graph showing stress distribution](image1)

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

![Graph showing stress distribution](image2)

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

7.1 Applied loads for analysis
Considering a 200 lb force applied at the center of the 8’ span:

\[ M = \frac{PL}{4} = \frac{0.2 \text{ k} \times 96”}{4} = 4.8 \text{ k} - \text{in} \ (7.68 \text{ k} - \text{in LRFD}) \]

\[ V = \frac{P}{2} = \frac{0.2 \text{ k}}{2} = 100 \text{ lbs} \]

Considering a 200 lb force at top of post:

\[ M = PL = 0.2 \text{ k} \times 42” = 8.4 \text{ k} - \text{in} \ (13.44 \text{ k} - \text{in LRFD}) \]

\[ V = P = 200 \text{ lbs} \]
7.2 Posts

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

\[ S = 7.15 \text{ in}^3 \]

Allowable stress per NDS 2012, \( F_b = 775 \text{ psi min.} \)

Bending capacity per 2012 NDS:

\[ F_b' = F_b C_D C_M C_t C_F C_{fu} C_l C_r \]

All values = 1.0 except \( C_D \)

\( C_D = 1.6 \) (short term loading)

\[ F_b' = 775 \text{ psi} \times 1.6 = 1240 \text{ psi} \]

\[ M_n = 1240 \text{ psi} \times 7.15 \text{ in}^3 = 8.9 \text{ k-in} > 8.4 \text{ k-in applied load as shown in section 5.1} \]
7.2.1 Allowable post wind loads

\[ M_n = 8.4 \text{ kip-in} \]

\[ \text{Post spacing} \]

\[ h = 42 \text{ in} \]

\[ \begin{align*}
X_{\text{psf}} &= \frac{M_n}{\text{spacing} \cdot (h - \frac{h}{2})} = 29 \text{ psf} \\
\text{spacing} &= 5 \text{ ft} \\
X_{\text{psf}} &= \frac{M_n}{\text{spacing} \cdot (h - \frac{h}{2})} = 23 \text{ psf} \\
\text{spacing} &= 6 \text{ ft} \\
X_{\text{psf}} &= \frac{M_n}{\text{spacing} \cdot (h - \frac{h}{2})} = 19 \text{ psf} \\
\text{spacing} &= 4 \text{ ft} \\
X_{\text{psf}} &= \frac{M_n}{\text{spacing} \cdot (h - \frac{h}{2})} = 30 \text{ psf} \\
\text{spacing} &= 36 \text{ in} \\
X_{\text{psf}} &= \frac{M_n}{\text{spacing} \cdot (h - \frac{h}{2})} = 31 \text{ psf} \\
\text{spacing} &= 5 \text{ ft} \\
X_{\text{psf}} &= \frac{M_n}{\text{spacing} \cdot (h - \frac{h}{2})} = 31 \text{ psf} \\
\text{spacing} &= 6 \text{ ft} \\
X_{\text{psf}} &= \frac{M_n}{\text{spacing} \cdot (h - \frac{h}{2})} = 26 \text{ psf} \\
\text{spacing} &= 6 \text{ ft} \\
\end{align*} \]
7.2.2 Vertical load

\[ C_M := 0.75 \quad \text{Wet service factor} \]
\[ C_T := 0.9 \quad \text{Temperature service factor} \]
\[ C_D := 1.0 \quad \text{Duration service factor} \]
\[ F_{\text{min}} = 400 \text{ ksi} \quad \text{Spruce-Pine Fur} \]
\[ F_{\text{min}} = 400 \text{ ksi} \cdot C_M \cdot C_T \cdot C_D = 270 \text{ ksi} \]
\[ c := 0.8 \]
\[ l_e := 42.5 \text{ in} \]
\[ d := 4 \text{ in} \]
\[ F_{cE} = \frac{0.822 \cdot F_{\text{min}}}{\left(\frac{l_e}{d}\right)^2} = 1.966 \text{ ksi} \]
\[ F_c := 1 \cdot \text{ksi} \cdot C_M \cdot C_T \cdot C_D = 0.573 \text{ ksi} \]
\[ C_p := \frac{1 + \left(\frac{F_{cE}}{F_c}\right)}{2 \cdot c} = \sqrt{\left[1 + \left(\frac{F_{cE}}{F_c}\right)^2\right] - \frac{F_{cE}}{c}} = 0.916 \]
\[ F_c = F_c \cdot C_p = 0.618 \text{ ksi} \]
\[ P_{\text{allowable}} = F_c \cdot 16\text{ in}^2 = 9892.356 \text{ lbf} \]
8 Test results

8.1 Universal rail (bottom rail)

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**

\[ M_a = 4.4 \text{ kip in} \]  
Allowable moment per test results

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

\[ \frac{h_{glass}}{2} = \frac{42.5 \text{ in}}{2} \]  
(half the height since a single extrusion is checked)

\[ X = \frac{M_a}{\text{spacing}^2} = 8.1 \text{ lbf/ft} \]

\[ X_{psf} = \frac{X}{h_{glass}} = 46 \text{ psf} \]

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

\[ h_{glass} = \frac{36 \text{ in}}{2} \]  
(half the height since a single extrusion is checked)

\[ X = \frac{M_a}{\text{spacing}^2} = 8.1 \text{ lbf/ft} \]

\[ X_{psf} = \frac{X}{h_{glass}} = 54 \text{ psf} \]

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

\[ \text{spacing} = 5 \text{ ft} \]

\[ h_{glass} = \frac{42.5 \text{ in}}{2} \]  
(half the height since a single extrusion is checked)

\[ X = \frac{M_a}{\text{spacing}^2} = 117 \text{ lbf/ft} \]

\[ X_{psf} = \frac{X}{h_{glass}} = 66 \text{ psf} \]

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

\[ h_{glass} = \frac{36 \text{ in}}{2} \]  
(half the height since a single extrusion is checked)

\[ X = \frac{M_a}{\text{spacing}^2} = 117 \text{ lbf/ft} \]

\[ X_{psf} = \frac{X}{h_{glass}} = 78 \text{ psf} \]
Wind equivalent load at 42" tall and 4 ft post spacing

\[
\text{spacing} := 4 \text{-ft} \\
\frac{h_{\text{glass}}}{2} := \frac{42.5 \text{-in}}{2} \quad \text{(half the height since a single extrusion is checked)}
\]

\[
X \ := \ \frac{M_a}{8} \cdot \frac{2}{\text{spacing}} = 183 \text{ lbf/ft}
\]

\[
X_{\text{psf}} = \frac{X}{h_{\text{glass}}} = 104 \text{ psf}
\]

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

\[
\frac{h_{\text{glass}}}{2} := \frac{36 \text{-in}}{2} \quad \text{(half the height since a single extrusion is checked)}
\]

\[
X \ := \ \frac{M_a}{8} \cdot \frac{2}{\text{spacing}} = 183 \text{ lbf/ft}
\]

\[
X_{\text{psf}} = \frac{X}{h_{\text{glass}}} = 122 \text{ psf}
\]
8.2 Transcend crown rail (top rail)

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
8.2.1 Allowable wind load

**Crown Rail**

\[ M_a := 3.5 \text{ kip in} \]

Allowable moment per test results

**Wind equivalent load at 42” tail and 6 ft post spacing**

\[ b_{glass} := \frac{42.5 \text{ in}}{2} \] (half the height since a single extrusion is checked)

\[ X := \frac{M_a}{\text{spacing}^2} = 65. \frac{\text{lbf}}{\text{ft}} \]

\[ X_{psf} = \frac{X}{b_{glass}} = 37. \text{ psf} \]

**Wind equivalent load at 36” tail and 6 ft post spacing**

\[ b_{glass} := \frac{36 \text{ in}}{2} \] (half the height since a single extrusion is checked)

\[ X := \frac{M_a}{\text{spacing}^2} = 65. \frac{\text{lbf}}{\text{ft}} \]

\[ X_{psf} = \frac{X}{b_{glass}} = 43. \text{ psf} \]

**Wind equivalent load at 42” tail and 5 ft post spacing**

\[ b_{glass} := \frac{42.5 \text{ in}}{2} \] (half the height since a single extrusion is checked)

\[ X := \frac{M_a}{\text{spacing}^2} = 93. \frac{\text{lbf}}{\text{ft}} \]

\[ X_{psf} = \frac{X}{b_{glass}} = 52. \text{ psf} \]

**Wind equivalent load at 36” tail and 5 ft post spacing**

\[ b_{glass} := \frac{36 \text{ in}}{2} \] (half the height since a single extrusion is checked)

\[ X := \frac{M_a}{\text{spacing}^2} = 93. \frac{\text{lbf}}{\text{ft}} \]

\[ X_{psf} = \frac{X}{b_{glass}} = 62. \text{ psf} \]
Wind equivalent load at 42” tall and 4 ft post spacing

\[ h_{\text{glass}} = \frac{42.5 \text{-in}}{2} \] (half the height since a single extrusion is checked)

\[ X = \frac{M_a 8}{\text{spacing}^2} = 146 \frac{\text{lb}}{\text{ft}} \]

\[ X_{\text{psf}} = \frac{X}{h_{\text{glass}}} = 82 \text{ psf} \]

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

\[ h_{\text{glass}} = \frac{36 \text{-in}}{2} \] (half the height since a single extrusion is checked)

\[ X = \frac{M_a 8}{\text{spacing}^2} = 146 \frac{\text{lb}}{\text{ft}} \]

\[ X_{\text{psf}} = \frac{X}{h_{\text{glass}}} = 97 \text{ psf} \]
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

<table>
<thead>
<tr>
<th>TEST NO. 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>DESIGN LOAD: 200 LB CONCENTRATED LOAD AT BOTH ENDS OF TOP RAIL (BRACKETS)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LOAD LEVEL</th>
<th>TEST LOAD (lb)</th>
<th>E.T. (min:sec)</th>
<th>RESULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 lb (2.5 x D.L.) x 2</td>
<td>1003</td>
<td>00:59</td>
<td>Each end withstood load equal to or greater than 500 lb without failure</td>
</tr>
</tbody>
</table>

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.
### Allowable wind load

#### Bracket

Allowable force per test results:

\[ F_a = 200 \text{ lbf} \]

Wind equivalent load at 42” tall and 6 ft post spacing:

\[
X = \frac{F_a}{\text{spacing} \times h_{\text{glass}}} = 38 \text{ lbf ft}^2
\]

\[ X_{\text{psf}} = X = 38 \text{ psf} \]

Wind equivalent load at 36” tall and 6 ft post spacing:

\[
X = \frac{F_a}{\text{spacing} \times h_{\text{glass}}} = 44 \text{ lbf ft}^2
\]

\[ X_{\text{psf}} = X = 44 \text{ psf} \]

Wind equivalent load at 42” tall and 5 ft post spacing:

\[
X = \frac{F_a}{\text{spacing} \times h_{\text{glass}}} = 45 \text{ lbf ft}^2
\]

\[ X_{\text{psf}} = X = 45 \text{ psf} \]

Wind equivalent load at 36” tall and 5 ft post spacing:

\[
X = \frac{F_a}{\text{spacing} \times h_{\text{glass}}} = 53 \text{ lbf ft}^2
\]

\[ X_{\text{psf}} = X = 53 \text{ psf} \]
Wind equivalent load at 42” tall and 4 ft post spacing

\[
\text{spacing} = \frac{4 \text{ ft}}{2} \quad \text{(half the width since a single bracket is checked)}
\]

\[
h_{\text{glass}} = \frac{42.5 \text{ in}}{2} \quad \text{(half the height since a single bracket is checked)}
\]

\[
X := \frac{F_a}{\text{spacing} \cdot h_{\text{glass}}} = \frac{56 \text{ lb}}{\text{ft}^2}
\]

\[
X_{\text{psf}} = X = 38 \text{ psf}
\]

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

\[
h_{\text{glass}} = \frac{36 \text{ in}}{2}
\]

\[
X := \frac{F_a}{\text{spacing} \cdot h_{\text{glass}}} = \frac{67 \text{ lb}}{\text{ft}^2}
\]

\[
X_{\text{psf}} = X = 67 \text{ psf}
\]

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.**
Appendix A – ESR report

ICC Evaluation Service

ICC-ES Report

ESR-3947

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

Look for the trusted marks of Conformity!

“2014 Recipient of Prestigious Western States Seismic Policy Council (WSSPC) Award in Excellence”

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DIVISION: 06 30 00—WOOD, PLASTICS AND COMPOSITES  
Section: 06 50 00—STRUCTURAL PLASTIC  
Section: 06 52 00—PLASTIC RAILINGS

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

EVALUATION SUBJECT:
TREX<sup>®</sup> TRANSCEND<sup>®</sup> SERIES RAILING SYSTEM  
TREX<sup>®</sup> SELECT<sup>®</sup> SERIES RAILING SYSTEM

1.0 EVALUATION SCOPE

Compliance with the following codes:
- 2015, 2012 and 2009 International Residential Code® (IRC)

Property evaluated:
- Structural
- Durability
- Surface-burning Characteristics

2.0 USES

The Trex<sup>®</sup> Transcend<sup>®</sup> Series Railing System and Trex<sup>®</sup> Select<sup>®</sup> 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 IRC Section 1406.3 or in buildings constructed in accordance with the IRC.

3.0 DESCRIPTION

3.1 General:

Trex<sup>®</sup> Transcend<sup>®</sup> Series Railing System and Trex<sup>®</sup> Select<sup>®</sup> Series Railing Systems 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<sup>®</sup> Transcend<sup>®</sup> 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 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 spacers, 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<sup>®</sup> 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<sup>®</sup> Select<sup>®</sup> 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 2.76 inches wide by 2.0 inches tall (69.6 mm by 50.8 mm). The bottom rail has overall dimensions of 2.0 inches wide by 2.76 inches tall (52.8 mm by 69.6 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 4.46 inch (113 mm) square composite post sleeve. Rails are attached to posts with nylon brackets.

Select<sup>®</sup> Series Railing System is available in white color.

3.3 Durability:

When subjected to weathering, insect attack, and other decaying elements, the materials used to manufacture the Trex<sup>®</sup> Transcend<sup>®</sup> Railing System and Trex<sup>®</sup> Select<sup>®</sup> Railing System are equivalent in durability to code-complying, preservative-treated or naturally durable lumber when used in locations as described in Section 2.0 of this report. Trex<sup>®</sup> Transcend<sup>®</sup> Railing System and Trex<sup>®</sup> Select<sup>®</sup> Railing System have been evaluated for structural performance when exposed to temperatures from -20°F (-29°C) to 120°F (52°C).

3.4 Surface-burning Characteristics:

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

4.0 DESIGN AND INSTALLATION

4.1 General:

The Trex<sup>®</sup> Transcend<sup>®</sup> Series Railing System and Trex<sup>®</sup> Select<sup>®</sup> Series Railing System must be installed in...
accordance with the manufacturer'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 job site 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 IRC. Section 1007.7.1 of the 2009 IRC 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 4 x 4 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 4 x 4 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 4 x 4 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 4 x 4 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 1400.3, 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 imposed 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-3047).
### TABLE 1—MAXIMUM GUARDRAIL SYSTEM SPANS

<table>
<thead>
<tr>
<th>PRODUCT NAME / COMPONENT</th>
<th>APPLICABLE BUILDING CODE</th>
<th>MAXIMUM SPAN (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trex® Transcend® Railing System</td>
<td>Yes</td>
<td>87.5</td>
</tr>
<tr>
<td>Trex® Transcend® Railing System</td>
<td>No</td>
<td>91.75</td>
</tr>
<tr>
<td>Trex® Select® Railing System</td>
<td>No²</td>
<td>68.25</td>
</tr>
</tbody>
</table>

For Sl: 1 inch = 25.4 mm; 1 foot = 305 mm.

The ability of the supporting construction, including posts, to resist the reactionary loads must be justified to the satisfaction of the code official.

* indicates compliance with the respective building codes.

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.

*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.

*Maximum allowable span has been adjusted for durability. No further increases are permitted.

**Exempt in One- and Two-Family Dwellings.

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**FIGURE 1—TYPICAL TREX® TRANSCEND® SERIES RAILING ASSEMBLY**

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**FIGURE 2—TREX® TRANSCEND® SERIES RAILING COMPONENTS**
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.
11 Appendix B - ATI report no. I0418.01-119-19 R0 dated 05/09/18-05/29/18