

ICC-ES Evaluation Report

ESR-1190

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This report is subject to re-examination in two years.

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DIVISION: 06—WOOD AND PLASTICS
Section: 06500—Structural Plastics
Section: 06610—Plastic Railings and Guards

REPORT HOLDER:

TREX COMPANY, INC.
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EVALUATION SUBJECT:

**TREX® COMPOSITE LUMBER, TREX BRASILIA™ AND
 TREX CONTOURS™, TREX® HS24, TREX 2x2
 BALUSTER™, TREX 1³/₈ SQUARE BALUSTER, TREX
 RAIL SLEEVE™, TREX® DESIGNER HANDRAIL**

1.0 EVALUATION SCOPE
Compliance with the following codes:

- 2006 *International Building Code*® (IBC)
- 2006 *International Residential Code*® (IRC)
- BOCA® *National Building Code*/1999 (BNBC)
- 1999 *Standard Building Code*® (SBC)
- 1997 *Uniform Building Code*™ (UBC)

Properties evaluated:

- Structural
- Surface-burning characteristics
- Durability

2.0 USES

The Trex® Composite Lumber, Trex Brasilia™ and Trex Contours™, Trex® HS24, Trex 1³/₈ Square Baluster and Trex 2x2 Baluster™ are recognized for use as a flooring, guardrail (guard), or nonstructural trim component for exterior balconies, porches, decks, stair treads and other exterior walking surfaces of Type V-B (IBC), Type V-N (UBC), Type 5B (BNBC), and Type VI (SBC) construction, and in structures constructed in accordance with the IRC.

The Trex® Designer Handrail evaluated in this report is limited to exterior use as a guardrail system for balconies, porches, and decks of Type V-B (IBC) and Type V-N (UBC) construction, and in structures constructed in accordance with the IRC.

3.0 DESCRIPTION
3.1 General:

Trex® is a wood thermoplastic composite lumber (WTCL) made from 50 percent wood fiber and 50 percent polyethylene by weight, and is an alternative to preservative-treated or naturally durable lumber. Trex® is manufactured by a continuous extrusion process, in accordance with the Trex Company quality control manual. Trex is produced in six colors (saddle, woodland brown, madeira, burnished amber, cayenne and winchester grey) and four textures (Trex Origin™, Trex Accents™, Trex Brasilia™ and Trex Contours™).

Trex® must not be used in framing applications, such as components of trusses, or as joists, rafters, studs, beams, columns, or axial loaded posts. Refer to Section 4.1 for additional information on structural capacity.

3.2 Deck Board:

3.2.1 General: Trex® is manufactured in sizes typically used in decking and railing configurations. See Figures 1 and 2 for a typical cross section. The Trex® 5/4 by 6 deck board, 2-inch-by-6-inch [actual dimensions 1.5 inches by 5.5 inches (38 mm by 140 mm)] composite lumber and Trex Brasilia™ and Trex Contours™ are permitted to be used as stair treads provided the maximum span does not exceed that stated in Table 2 of this report.

3.2.2 Durability: When subjected to weathering, insect attack, and other decaying elements, material used to manufacture Trex® is equivalent in durability to preservative-treated or naturally durable lumber when used in locations described in Section 2.0 of this report. Trex® has been evaluated for a temperature range from -20°F (-29°C) to 125°F (52°C).

3.2.3 Surface-burning Characteristics: When tested in accordance with ASTM E 84, Trex® has a flame-spread index of no greater than 200.

3.3 Guardrail System:

3.3.1 General: Trex® members designated as Trex 2x2 Baluster™, Trex 1³/₈ Square Baluster, Trex Rail Sleeve™, and Trex® Designer Handrail are permitted for use in guardrail assemblies constructed in accordance with Tables 4 and 5. The use of these rails as “handrails” is outside the scope of this report. These rails are only permitted for use as guards in accordance with the applicable code. See Figure 3 for typical component cross sections.

3.3.2 Durability: When subjected to weathering, insect attack, and other decaying elements, material used to

manufacture Trex® is equivalent in durability to preservative-treated or naturally durable lumber when used in locations described in Section 2.0 of this report. Trex® has been evaluated for a temperature range from -20°F (-29°C) to 125°F (52°C).

3.3.3 Surface-burning Characteristics: When tested in accordance with ASTM E 84, Trex® has a flame-spread index of no greater than 200.

4.0 DESIGN AND INSTALLATION

4.1 General:

Installation of Trex® must comply with this report and the manufacturer's published installation instructions. The manufacturer's published installation instructions must be available at the jobsite at all times during installation. When the manufacturer's published installation instructions differ from this report, this report governs.

4.2 Deck Boards:

4.2.1 General: Allowable withdrawal and lateral design values for nails and bolts used as fasteners in Trex® material must be determined using the nail and bolt design formula in accordance with the applicable code requirements for solid-sawn lumber. For purposes of fastener calculation only, Trex® must be assumed to have an effective specific gravity of 0.50. There must be no increases made to the load values indicated in the AF&PA NDS when designing fasteners for Trex®. Refer to Table 6 of this report for minimum nail spacing distances. Trex® must be fastened using fasteners with the following diameters:

- Nails having diameters less than or equal to 16d common wire [0.162 inch (4 mm)]
- Screws having diameters less than or equal to No. 12 [0.216 inch (5.5 mm)]
- Bolts having diameters less than or equal to 1/2 inch (12.7 mm)

4.2.2 Structural:

4.2.2.1 Deck Boards: Table 1 lists the allowable stress values for Trex® lumber, Trex® 2x2 Baluster™ and Trex® HS24 lumber. These values must not be adjusted by any of the adjustment factors permitted for wood framing by the AF&PA NDS or applicable code, with the exception that increases for load duration are permitted. The allowable stress values are applicable in uses up to a temperature of 125°F (52°C).

Table 3 lists allowable spans for Trex® used as planking (flatwise bending). This table must be used for determining the maximum allowable span of Trex® used as decking unless the user/designer submits structural calculations to the code official for approval of additional span lengths using the design values indicated in Table 1.

4.2.2.2 Deck Boards Used as Stair Treads: Trex® 2-inch-by-6-inch (51 mm by 152 mm) and Trex® 5/4-inch-by-6-inch (32 mm by 152 mm) composite lumber, when used as a stair tread, is satisfactory to resist the code-prescribed concentrated load of 300 lbf (1.33 kN) when installed at a maximum center-to-center spacing of 12 inches (305 mm), and must have a minimum of three continuous spans over four supports. Trex Brasilia™ and Trex Contours™ composite lumber, when used as a stair tread, is satisfactory to resist the code-prescribed concentrated load of 300 lbf (1.33 kN) when installed at a maximum center-to-center spacing of 9 inches (229 mm), and must have a minimum of two continuous spans over three supports.

4.3 Guardrail System:

4.3.1 General: Fasteners used to construct guardrails must comply with the foot notes of Tables 4 and 5.

4.3.2 Structural: Tables 4 and 5 indicate material and installation requirements for the Trex® Railing Assembly and the Trex® Designer Rail Assembly. When installed in accordance with this report, the system complies with the structural load requirements specified in the applicable building code for lateral load conditions applied to balcony railings and guardrails.

4.3.2.1 Trex® Railing Assembly: The system covered in Table 4 is capable of resisting a uniform load of 50 lbs/ft. (730 N/m) or a concentrated load of 200 pounds (890 N) applied horizontally to the top of the rail. Additionally, the system is capable of withstanding a load of 200 pounds (890 N) applied horizontally over a 1-square-foot (0.093 m²) tributary area of the balusters, and a 200-pound (890 N) concentrated load at the top of the post.

4.3.2.2 Trex® Designer Rail Assembly: The system covered in Table 5 is capable of resisting a uniform load of 50 lbs/ft. (730 N/m) or a concentrated load of 200 pounds (890 N) applied horizontally to the top of the rail. Additionally, the system is capable of withstanding a load of 50 pounds (222 N) applied horizontally over a 1-square-foot (0.093 m²) tributary area of the balusters, and a 200-pound (890 N) concentrated load at the top of the post.

5.0 CONDITIONS OF USE

The Trex® Composite Lumber described in this report complies with, or is a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

- Trex® must not be used as a component of trusses or structural diaphragms, and must not be used in framing applications for joists, rafters, studs, beams, columns, or posts.
- The design and installation of Trex® must be in accordance with this report and the manufacturer's published installation instructions.
- When Trex® is used in guardrail assemblies, information must be submitted to the code official to verify compliance with Tables 4 and 5 of this report. When required by the applicable code or the code official, such documents must be prepared, signed and sealed, and submitted by a registered design professional in accordance with the registration laws of the state in which the project is located.
- The maximum design stresses for Trex®, Trex® HS24 and Trex 2x2 Baluster™ must comply with those listed in Table 1. The maximum spans of decking must comply with Table 3 unless structural calculations, in accordance with Table 1, are provided. Guardrail assemblies must comply with Tables 4 and 5.

The design values listed in Tables 1, 2 and 3 of this report are for loads of normal duration and are applicable to either dry or wet conditions of use. There must not be any allowable design stress increases permitted by the applicable code or the AF&PA NDS, with the exception that increases for load duration, such as due to impact, must be permitted. The design values are applicable in uses up to a temperature not exceeding 125°F (52°C).
- Allowable capacity of fasteners installed in Trex® must comply with Section 4.2.1 of this report.

- 5.6 Trex[®] used as decking must be designed and installed to limit bending deflection under total design load to less than or equal to $L/360$.
- 5.7 Trex[®] must be limited to use with building types where the use of combustible material is permitted. Trex[®] must not be used as a component of heavy timber construction.
- 5.8 The use of Trex[®] as a component of a fire-resistance-rated assembly is outside the scope of this report.
- 5.9 Trex[®] decking must be gapped to permit adequate drainage in accordance with the manufacturer's published installation instructions. Trex[®] must not be attached to any solid surface or watertight flooring systems, such as sheathing, waterproof membranes, concrete, roof decks or patios.
- 5.10 Trex[®] must be fastened directly to the supporting construction. At the request of the code official, calculations must be submitted to confirm that the construction supporting Trex[®] has been designed to resist all of the applicable loads.
- 5.11 The compatibility of the fasteners, metal post mount components and other metal hardware with the supporting construction, including chemically treated wood, is outside the scope of this report.
- 5.12 Deck boards must be installed in a minimum of a two-span condition. Deck boards used as stair treads must be installed in a minimum of a two- or three-span condition as indicated in Table 2.
- 5.13 The allowable design values for Trex[®] greater than 2 inches thick have not been evaluated and are outside the scope of this report.

- 5.14 The use of Trex Rail Sleeve™ or wood post is outside the scope of this report.
- 5.15 The use of Trex[®] as a handrail has not been evaluated and is outside the scope of this report.
- 5.16 Use of deck boards as a walking surface of the means of egress is outside the scope of this report.
- 5.17 Trex[®] is produced in Winchester, Virginia, and Fernley, Nevada, under a quality control program with inspections by PFS (AA-652).

6.0 EVIDENCE SUBMITTED

- 6.1 Data in accordance with the ICC-ES Acceptance Criteria for Thermoplastic Composite Lumber Products (AC109), dated June 2006 (Editorially revised April 2008).
- 6.2 Data in accordance with the ICC-ES Acceptance Criteria for Deck Board Span Ratings and Guardrail Systems (Guards and Handrails) (AC174), dated February 2008 (editorially revised April 2008).

7.0 IDENTIFICATION

The Trex[®] described in this evaluation report must be identified on each piece with the manufacturer's name and address, the product name, the manufacturing location, the name or logo of the inspection agency (PFS) and the evaluation report number (ESR-1190).

Additionally, Trex[®] must have the date of manufacture stamped, labeled or branded into each piece as part of the lot number.

TABLE 1—ALLOWABLE DESIGN STRESS VALUES FOR TREX®

ASTM STANDARD	PROPERTY	ALLOWABLE DESIGN VALUES (psi) ^{1,2,3,4}		
		Trex® (Maximum 2-inch Thickness)	Trex 2x2 Baluster™	Trex HS24
ASTM D 4761	Flexural stress	250	600	375
ASTM D 198	Tension	250	350	250
ASTM D 4761	Modulus of elasticity	1.0 × 10 ⁵	2.0 × 10 ⁵	1.7 × 10 ⁵
ASTM D 198	Compression parallel to grain	550	1,000	550
ASTM D 198	Compression perpendicular to grain	625	1,000	625
ASTM D 143	Shear	200	250	200

For SI: 1 psi = 6.89 kPa, 1 pcf = 16.02 kg/m³, t° C = (t° F - 32)5/9.

¹Trex® used as decking must be designed and installed to limit computed deflection under total design load to less than L/360.

²Design values indicated are applicable for uses where temperatures do not exceed 125°F (52°C).

³Trex® has a density of approximately 60 pcf, and Trex 2x2 Baluster™ has a density of approximately 64 pcf.

⁴The allowable design values for Trex® more than 2 inches (51 mm) thick have not been evaluated and are outside the scope of this report.

TABLE 2—MAXIMUM STAIR TREAD SPANS

DECK BOARDS USED AS STAIR TREADS	MAXIMUM SPAN (in) ^{1,2}
Trex 5/4 × 6 Deck Board	12.0
Trex 2 × 6 Deck Boards	12.0
Trex Brasilia™ and Trex Contours™	9.0

For SI: 1 inch = 25.4 mm; 1 lbf/ft² = 47.9 Pa.

¹Maximum span is measured center-to-center of the supporting construction.

²5/4 × 6 Deck Boards are based on a two-span condition, and 2 × 6 Deck Boards are based on a three-span condition.

TABLE 3—TREX® DECKING SPAN CHART^{1,2,3}

MEMBER SIZE	MAXIMUM UNIFORM LIVE LOADING	
	100 psf	200 psf
	Maximum Member Span Between Supports	
5/4 × 6	16 inches	12 inches
2 × 4, 2 × 6	20 inches	16 inches
HS24 Marine Grade 2 × width	24 inches	16 inches
Trex Brasilia™	16 inches	12 inches
Trex Contours™	16 inches	12 inches

For SI: 1 inch = 25.4 mm, 1 psf = 48 Pa.

¹Tabulated span values are for Trex® members used as planking (flatwise bending). The values are permitted to be used in lieu of application-specific calculations. Other applications or loading conditions require submittal of design calculations, showing compliance with this evaluation report, to the code official for approval.

²Trex® members must be supported by a minimum of three joists and must be fastened at each joist.

³Tabulated spans are based on a deflection limit of L/360.

TABLE 4—TREX® RAIL ASSEMBLIES¹

COMPONENT		INSTALLATION REQUIREMENTS ^{2,3}
Baluster (parts fabricated or milled from other Trex® profiles into baluster shapes are not permitted)		Trex 2x2 Baluster™ spaced a maximum of 5 ¹ / ₈ inches on center
		Trex 1 ³ / ₈ " Square Baluster spaced a maximum of 5 inches on center
Railings	Top plate	Trex® 2x6, 5 ¹ / ₄ x6
	Top rail	Trex® 2x4, 5 ¹ / ₄ x6, 2x6
	Bottom rail	Trex® 2x4, 5 ¹ / ₄ x6, 2x6. Bottom rail must be supported and attached to the deck at a maximum of 18 inches (457 mm) on center. Bottom rail is not required when balusters are attached directly to the deck structural members.
Posts ⁴		Trex Rail Sleeve™ or other approved post material, such as solid-sawn lumber or steel. Maximum post spacing must be 6 feet on center.

For **SI**: 1 inch = 25.4 mm, 1 ft = 0.3 m.

¹Evaluation of framing members supporting the guardrail assembly is outside the scope of this evaluation report.

²Standard guardrail components must be connected as follows:

- a. Post-to-framing connection: Minimum two 1/2-inch-diameter (13 mm) machine bolts, 5¹/₈ inches (130 mm) apart, each post.
- b. Baluster-to-top-rail connection: Minimum two No. 8 by 2¹/₂-inch-long (64 mm) screws, 2 inches (51 mm) apart vertically, through each baluster.
- c. Top-rail-to-top-plate connection: Minimum two No. 8 by 2¹/₂-inch-long (64 mm) screws spaced 12 inches (305 mm) on center.
- d. Top-rail- and top-plate-to-post connection: Minimum two No. 8 by 3-inch-long (76 mm) screws, 2 inches (51 mm) apart, into each post.

³The maximum height of the guardrail assembly must be 42 inches (1067 mm) from the deck boards. The maximum opening under the bottom rail must be 3 inches (76 mm), except for the SBC, where the maximum opening under the bottom rail must be 2 inches (51 mm).

⁴The use of Trex Rail Sleeve™ or wood post is outside the scope of this report.

TABLE 5—TREX® DESIGNER RAIL ASSEMBLIES¹

COMPONENT		INSTALLATION REQUIREMENTS ^{2,3}
Baluster (parts fabricated or milled from other Trex® profiles into baluster shapes are not permitted)		Trex 2x2 Baluster™ spaced a maximum of 5 ¹ / ₄ inches on center.
Railings	Trex® Designer Top Rail	Mount the top of the balusters to the Trex® Designer Top Rail. Top rail must be attached to the posts using the Trex® Railing Bracket. Bottom rail must be supported and attached to the deck at a maximum of 18 inches (457 mm) on center.
	Trex® Designer Bottom Rail	Mount the bottom of the balusters to the Trex® Designer Bottom Rail. Bottom rail must be attached to the posts using the Trex® Railing Bracket. Bottom rail must be supported and attached to the deck at a maximum of 18 inches (457 mm) on center.
Posts ⁴		Trex Rail Sleeve™ or other approved post material, such as solid-sawn lumber or steel. Maximum post spacing must be 6 feet on center.

For **SI**: 1 inch = 25.4 mm, 1 ft = 0.3 m.

¹Evaluation of framing members supporting the guardrail assembly is outside the scope of this evaluation report.

²Designer handrail components must be connected as follows:

- a. Post-to-framing connection: Minimum two 1/2-inch-diameter (13 mm) machine bolts, 5¹/₈ inches (130 mm) apart, each post.
- b. Baluster-to-Designer-top-handrail connection: Minimum one 16-gage finish head nail by 2-inch-long (51 mm) through the side of the top Designer handrail and side of baluster.
- c. Baluster-to-Designer-bottom-handrail connection: Minimum one 16-gage finish head nail by 2-inch-long (51 mm) through the bottom of the designer bottom rail and the bottom of the baluster.
- d. Top-rail-to-post connection: Attach the Trex® Railing Support Bracket to the post using two No. 9 by 1¹/₂-inch-long (38.1 mm) screws provided. Hang the top Designer Handrail on the Trex® Railing Support Bracket and attach using one No. 9 by 1¹/₂-inch-long (38.1 mm) screw provided with the bracket.
- e. Bottom-rail-to-post connection: Attach the Trex® Railing Support Bracket to the post using two No. 9 by 1¹/₂-inch-long (38.1 mm) screws provided. Hang the bottom rail on the Trex® Railing Support Bracket and attach using one No. 9 by 1¹/₂-inch-long (38.1 mm) screw, provided, through the top of the bottom rail down through the bracket.
- f. Support balusters under bottom rail: Attach support balusters under the bottom rail and setting on the deck at a maximum of 18 inches between supports.

³The maximum height of the guardrail assembly must be 42 inches (1067 mm) from the deck boards. The maximum opening under the bottom rail must be 3 inches (76 mm).

⁴The use of Trex Rail Sleeve™ or wood post is outside the scope of this report.

TABLE 6— MINIMUM NAIL SPACING DISTANCES¹

HOLE PREPARATION	EDGE DISTANCE	END DISTANCE		SPACING (PITCH) BETWEEN ROWS OF FASTENERS		SPACING (GAGE) BETWEEN ROWS OF FASTENERS	
		Tension Load Parallel to Grain	Compression Load Parallel to Grain	Parallel to Grain	Perpendicular to Grain	In Line	Staggered
Not prebored	2.5d	15d	10d	15d	10d	5d	2.5d
Prebored	2.5d	10d	5d	10d	5d	3d	2.5d

¹Dimension d equals the diameter of the nail.

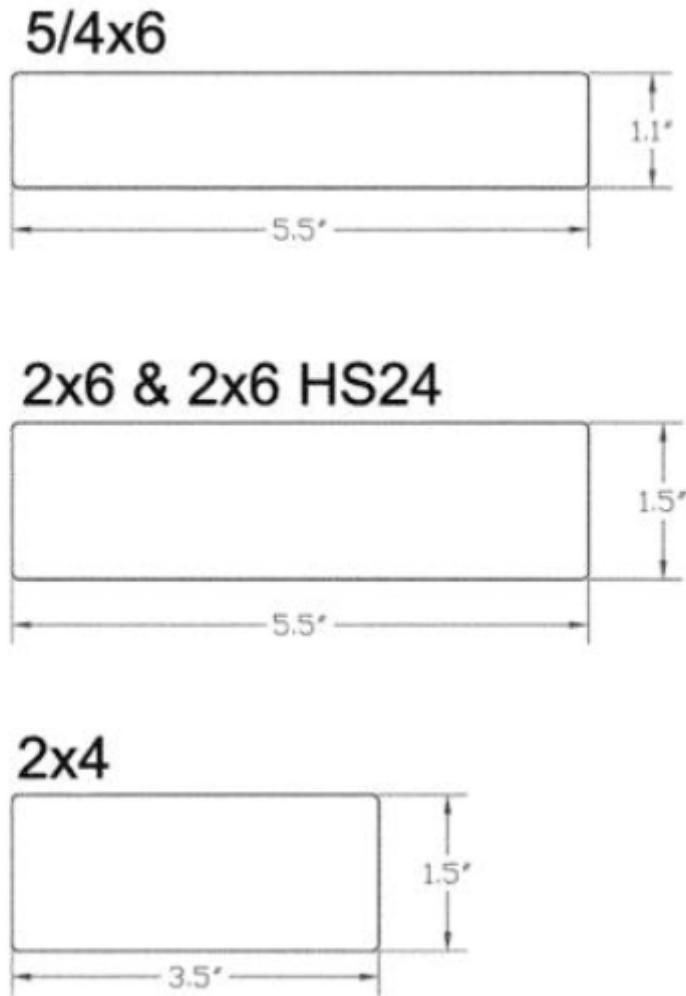
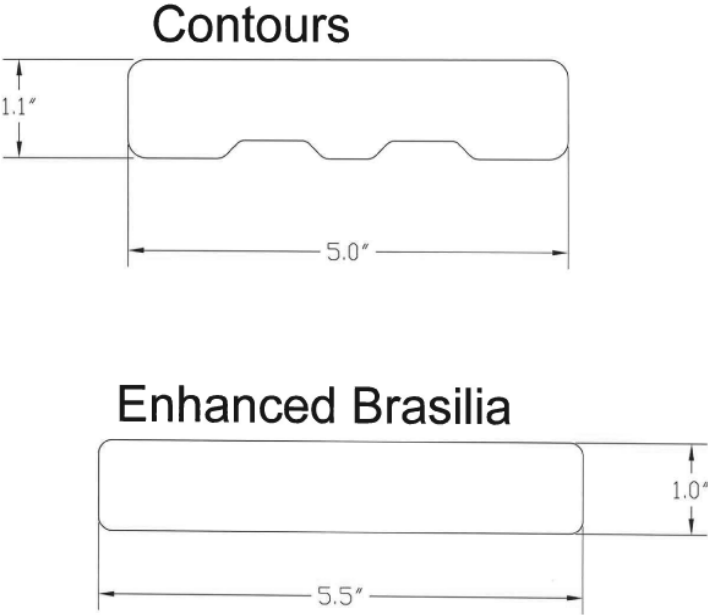


FIGURE 1—TREX DECKING AND DOCKS PROFILES



For SI: 1 inch = 25.4 mm.

FIGURE 1—TREX DECKING AND DOCKS PROFILES (Continued)

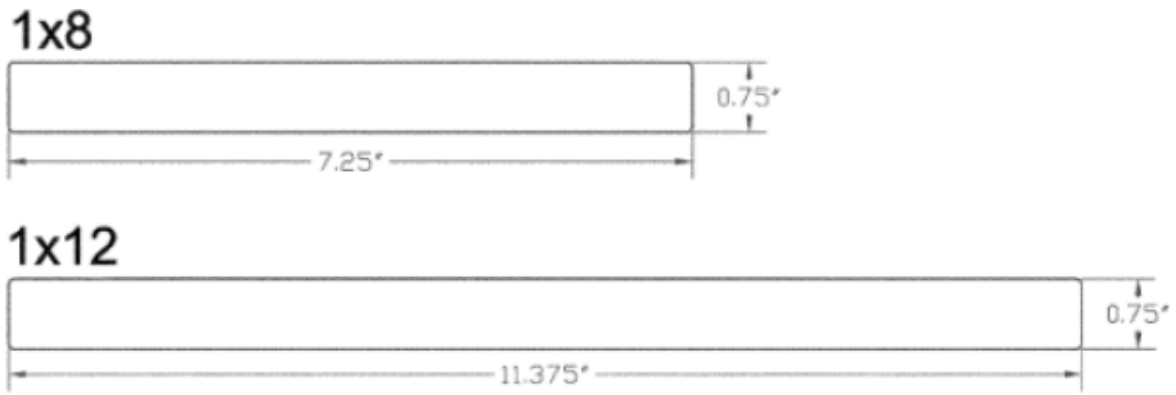


FIGURE 2—TREX FASCIA, RISERS AND TRIM PROFILES

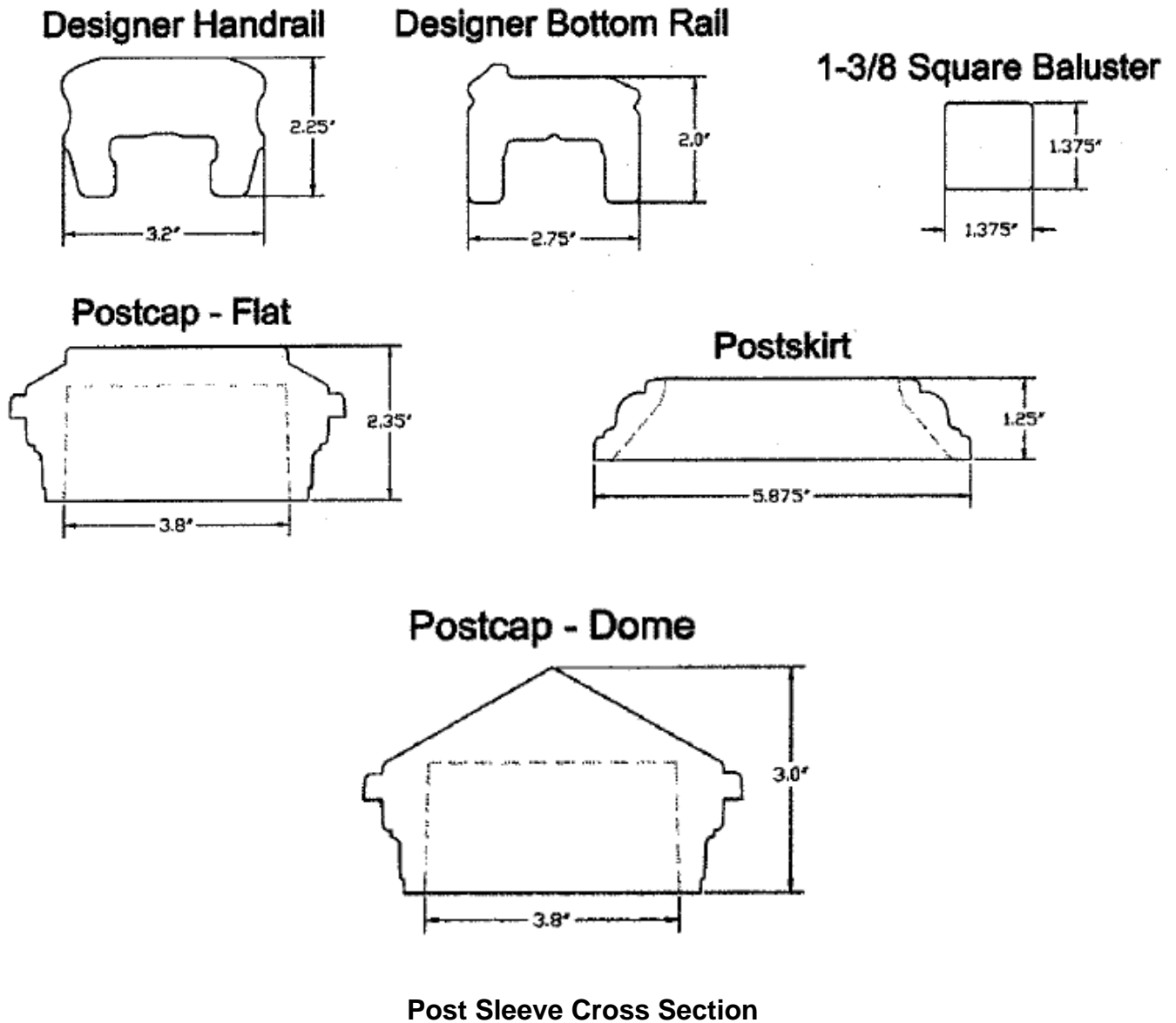
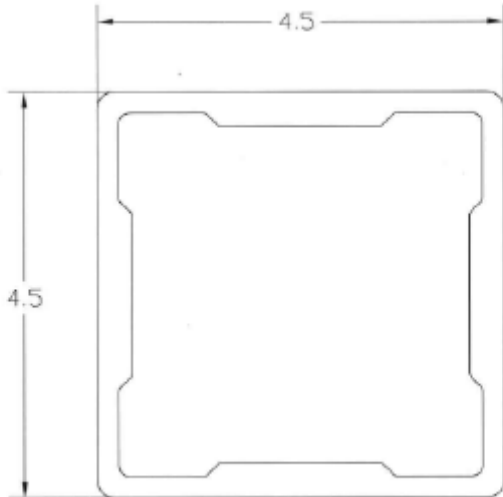


FIGURE 3—TREX RAILING COMPONENT PROFILES



For SI: 1 inch = 25.4 mm.

FIGURE 3—TREX RAILING COMPONENT PROFILES (Continued)