



CERTIFICATION



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Technical Evaluation Report

TER 1703-06

Use of FastenMaster® FrameFAST®
Fasteners to Provide Top Plate Roll
Resistance to Trusses & Rafters
Attached to the Tops of Walls

OMG, Inc. DBA FastenMaster®

Product:

**FrameFAST® Structural Wood
Screw
(FrameFAST® fasteners)**

Issue Date:

August 25, 2017

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June 27, 2019

Subject to Renewal:

July 1, 2020

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DIVISION: 06 00 00 - WOOD, PLASTICS AND COMPOSITES

SECTION: 06 00 90 - Wood and Plastic Fastenings

1 PRODUCT EVALUATED¹

- 1.1 FrameFAST® Structural Wood Screw
(FrameFAST® fasteners)

2 APPLICABLE CODES AND STANDARDS^{2,3}

2.1 Codes

- 2.1.1 *IBC—12, 15, 18: International Building Code®*
- 2.1.2 *IRC—12, 15, 18: International Residential Code®*

2.2 Standards and Referenced Documents

- 2.2.1 *ANSI/AWC NDS: National Design Specification (NDS) for Wood Construction*
- 2.2.2 *ANSI/AWC SDPWS: Special Design Provisions for Wind and Seismic*
- 2.2.3 *ASTM A153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*
- 2.2.4 *ASTM D1761: Standard Test Methods for Mechanical Fasteners in Wood*
- 2.2.5 *ICC 600: Standard for Residential Construction in High-wind Regions*

¹ Building codes require data from valid research reports be obtained from approved sources. An approved agency, which is an approved source, is defined as "an established and recognized agency that is regularly engaged in...furnishing product certification where such agency has been approved..." Being approved, defined as "acceptable to the building official," is accomplished via accreditation using ISO/IEC 17065 evaluation procedures meeting code requirements of independence, adequate equipment, and experienced personnel. DrJ is an ISO/IEC 17065 ANSI-Accredited Product Certification Body - Accreditation #1131.

Through ANSI accreditation, DrJ certification can be used to obtain product approval in any country that is an IAF MLA Signatory and covered by an IAF MLA Evaluation per the Purpose of the MLA - "certified once, accepted everywhere." Manufacturers can go to jurisdictions in any IAF MLA Signatory Country and have their products readily approved by authorities having jurisdiction using DrJ's ANSI accreditation.

For more information on any of these topics or our mission, product evaluation policies, product approval process, and engineering law, see drjcertification.org.

² Unless otherwise noted, all references in this TER are from the 2018 version of the codes and the standards referenced therein (e.g., *ASCE 7*, *NDS*, *ASTM*). This material, design, or method of construction also complies with the 2000-2015 versions of the referenced codes and the standards referenced therein. As required by code, where this TER is not approved, the building official shall respond in writing stating the reasons this TER was not approved. For any variations in state and local codes, see Section 8.

³ All terms defined in the applicable building codes are italicized.

3 PERFORMANCE EVALUATION

- 3.1 FrameFAST® fasteners used in truss to top plate connections were evaluated to specifically assess the effect of “Top Plate Roll” (TPR).
 - 3.1.1 TPR is defined as the turning or “rolling” of the top plate of a wall assembly in relation to the truss assembly above and/or off the wall assembly below.
 - 3.1.2 TPR is caused by eccentric load path connections (i.e., the connections of the truss to top plate and the top plate to stud are not directly lined up vertically).
 - 3.1.3 This condition is shown in Figure 1.

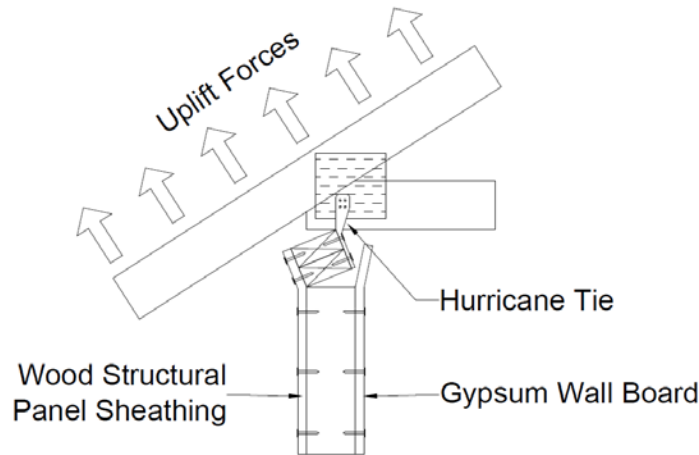


FIGURE 1. ILLUSTRATION OF TOP PLATE ROLL

- 3.2 The TPR condition is assessed with respect to existing building code requirements.
- 3.3 For general FrameFAST® truss to top plate connection design information, see [TER No. 1503-03](#).
- 3.4 Any code compliance issues not specifically addressed in this section are outside the scope of this TER.
- 3.5 Any engineering evaluation conducted for this TER was performed on the dates provided in this TER and within DrJ’s professional scope of work.

4 PRODUCT DESCRIPTION AND MATERIALS

- 4.1 The product evaluated in this TER is shown in Figure 2.

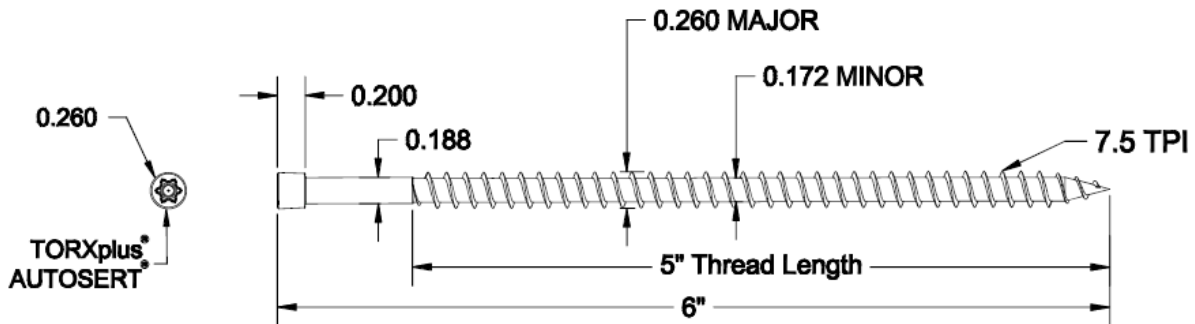


FIGURE 2. FRAMEFAST® FASTENER SPECIFICATION (FMFF006)

- 4.2 FrameFAST® fasteners are manufactured with modified 10B21 carbon steel wire conforming to the manufacturers specifications and are coated with a proprietary finish.
- 4.3 FrameFAST® fasteners are manufactured using a standard cold-formed process followed by a heat-treating process.
- 4.4 FrameFAST® fasteners are approved for use in interior and exterior conditions and in pressure-treated wood.
- 4.5 In-plant quality control procedures, under which the FrameFAST® fasteners are manufactured, are audited through an inspection process performed by an approved agency.
- 4.6 The fasteners evaluated in this TER are set forth in Table 1.

TABLE 1. FASTENER DIMENSIONS AND STRENGTH DETAILS

Fastener Name	Designation	Head (in)		Fastener Length ¹ (in)	Shank Diameter ² (in)	Thread Length ¹ (in)	Thread Diameter (in)		Nominal Bending Yield, ² f _{yb} (psi)	Allowable Fastener Strength ² (lbf)	
		Diameter	Thickness				Minor	Major		Tensile	Shear
FrameFAST®	FMFF006	0.260	0.200	6	0.188	5	0.172	0.260	166,600	155,900	120,360

SI: 1 in = 25.4 mm, 1 lb = 4.45 N, 1 psi = 0.00689 MPa

- 1. Fastener length is measured from the topside of the head to the tip. Thread length includes tapered tip (Figure 2).
- 2. Bending yield, tension, and shear values determined at minor root diameter.

5 APPLICATIONS

5.1 General Code Requirements

- 5.1.1 Neither the *IBC* nor the *IRC* contain requirements that specifically address the potential for TPR due to an eccentric load path.
- 5.1.2 There are no code-defined deflection requirements for deformations caused by uplift.
- 5.1.3 The design for uplift is an allowable stress design (ASD) load consideration. Uplift loads must be resisted by the fastening system used.

5.2 IRC Requirements

- 5.2.1 Table 2 defines the connection, per *IRC* Table R602.3(1).⁴

TABLE 2. EXCERPT FROM *IRC* TABLE R602.3(1) FASTENER SCHEDULE FOR STRUCTURAL MEMBERS⁵

Item	Description of Building Elements	Number and Types of Fastener	Spacing of Fasteners
6	Rafter or roof truss to plate	3-16d box nails (3½" x 0.135"); or 3-10d common nails (3" x 0.148"); or 4-10d box (3" x 0.128"); or 4-3" x 0.131" nails	2 toe nails on one side and 1 toe nail on opposite side of each rafter or truss

SI: 1 in = 25.4 mm

⁴ 2015 *IRC* Table R602.3(1) Fastening schedule includes this requirement at row #6 and adds 4-10d box (3" x 0.128") or 4-3" x 0.131" nails.

⁵ 2015 *IRC* Table R602.3(1) Fastening schedule includes this requirement at row #6 and adds 4-10d box (3" x 0.128") or 4-3" x 0.131" nails.

- 5.2.2 IRC Section R802.11 discusses the roof to wall uplift resistance in terms of resistance to load with no deflection criteria.

Where the uplift force does not exceed 200 pounds, rafters and trusses spaced not more than 24 inches (610 mm) on center shall be permitted to be attached to their supporting wall assemblies in accordance with Table R602.3(1).

- 5.2.3 IRC Section R802.11.1.1⁶ addresses truss to top plate connections for trusses.

R802.11.1.1 Truss uplift resistance. Trusses shall be attached to supporting wall assemblies by connections capable of resisting uplift forces as specified on the truss design drawings. Uplift forces shall be permitted to be determined as specified by Table R802.11, if applicable, or as determined by accepted engineering practice.

- 5.2.4 IRC Section R802.11.1.2⁷ then addresses the connection for rafters.

R802.11.1.2 Rafter uplift resistance. Individual rafters shall be attached to supporting wall assemblies by connections capable of resisting uplift forces as determined by Table R802.11 or as determined by accepted engineering practice. Connections for beams used in a roof system shall be designed in accordance with accepted engineering practice

5.3 IBC Requirements

- 5.3.1 IBC Section 1604.8.1 and 1604.9 contain the following requirements:

1604.8.1 General. Anchorage of the roof to walls and columns, and of walls and columns to foundations, shall be provided to resist the uplift and sliding forces that result from the application of the prescribed loads.

1604.9 Wind and Seismic Detailing. Lateral force-resisting systems shall meet seismic detailing requirements and limitations prescribed in this code and ASCE 7 Chapters 11, 12, 13, 15, 17 and 18 as applicable, even where wind load effects are greater than seismic load effects.

- 5.3.2 There are a number of other requirements addressing specific conditions, all of which only address the resistance to applied load. There is no mention of deformation requirements.

5.4 There are two standards referenced by the IBC and IRC that contain provisions that could prescriptively address the potential for TPR.

- 5.4.1 ICC 600 Section 304.1 states:

... Connectors resisting uplift of the roof framing shall be fastened to the top plate on the same side of the wall as the top plate to wall uplift connection.

- 5.4.2 SDPWS Section 4.4.1.5 states that, when using wood structural panels for top plate to stud uplift resistance:

Roof or upper level uplift connectors shall be on the same side of the wall as the sheathing unless other methods are used to prevent twisting of the top plate due to eccentric loading.

5.5 FastenMaster® commissioned testing conducted at the Structural Building Components Research Institute (SBCRI) to assess the occurrence of TPR.

- 5.5.1 Test assembly construction (Figure 3)

5.5.1.1 Double 2x4 top plates and trusses constructed from SPF #2.

5.5.1.2 ½" gypsum wallboard installed to interior side of wall using #6 x 1¼" drywall screws. Fasteners along the top edge of the drywall were installed into the lower top plate at 7" o.c.

5.5.1.3 Wood structural panel (WSP) sheathing was installed on the exterior wall in accordance with the code.

⁶ 2012 IRC Section R802.11.1.2

⁷ 2012 IRC Section R802.11.1.3.

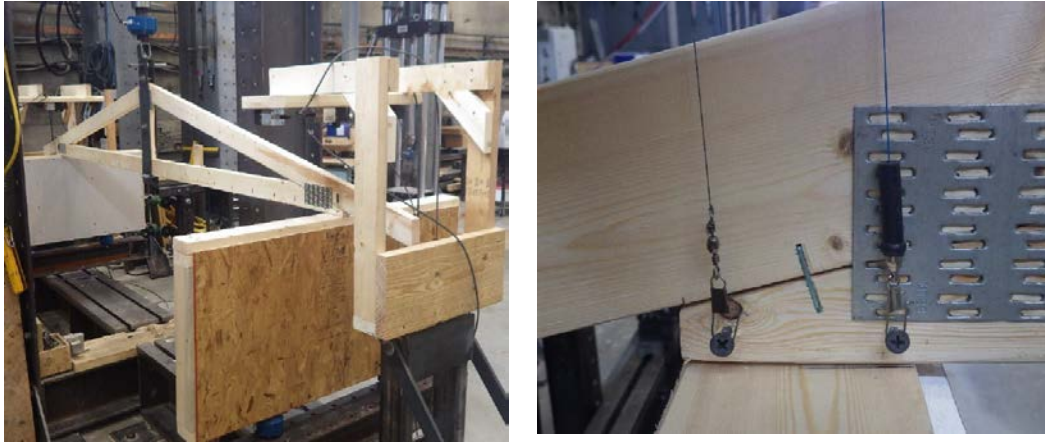


FIGURE 3. WALL CONSTRUCTION TEST SETUP

5.5.1.4 FrameFAST® fasteners were installed at a 22.5° angle from vertical, beginning ½" from the inside edge of the lower top plate and driven up through both plates and into the truss.

5.5.2 The published allowable design loads are shown in Table 3.

TABLE 3. FRAMEFAST® FASTENERS ALLOWABLE LOADS FOR UPLIFT & LATERAL RESISTANCE FOR SELECTED LOAD DURATIONS & WOOD-SPECIFIC GRAVITIES

Fastener Designation	Minimum Penetration into Truss/Rafter/Wood Structural Support (in) ¹	Species Group (Specific Gravity) ^{2,3}	Uplift (lbf) ⁴			F1 Parallel to Wall (lbf)			F2 Perpendicular to Wall (lbf)		
			1.0	1.33	1.6	1.0	1.33	1.6	1.0	1.33	1.6
6" FMFF006	2½	So. Pine (0.55)	430	575	690	175	235	285	305	405	485
		Douglas Fir-Larch (0.50)	410	545	655	190	250	300	285	375	455
		Spruce-Pine-Fir (0.42)	370	495	595	205	275	330	250	335	400

SI: 1 in = 25.4 mm, 1 lb = 4.45 N

1. Wood truss and rafter members shall be a minimum of 2" nominal thickness. Design of truss and rafter members by others.
2. Equivalent specific gravity of structural composite lumber (SCL) shall be equal to or greater than the specific gravities provided in this table. Refer to product information from SCL manufacturer.
3. For applications involving members with different specific gravities, use the allowable load corresponding to the lowest specific gravity.
4. Use reduction factor of 0.80 when connecting each ply of multiply trusses to the top plate.

5.5.1 Where it is anticipated that loads will be applied to a single fastener simultaneously in more than one direction, additional evaluation is required to account for the combined effect of these loads using accepted engineering practice.

5.5.1.1 Consult a professional engineer, as needed, for complex design conditions.

5.6 Where the application exceeds the limitations set forth herein, design shall be permitted in accordance with accepted engineering procedures, experience, and technical judgment.

6 INSTALLATION

6.1 Installation shall comply with the manufacturer's installation instructions and this TER. In the event of a conflict between the manufacturer's installation instructions and this TER, the more restrictive shall govern.

6.2 Installation Procedure

- 6.2.1 Select a FrameFAST® fastener with a length sufficient to fully embed 2½" of the fastener length into the truss or rafter. See Figure 4 for guidance.

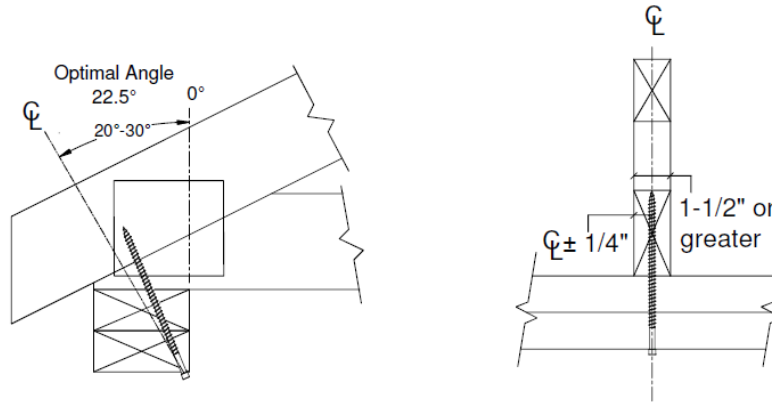


FIGURE 4. INSTALLATION OF FRAMEFAST® FASTENERS ON WOOD TRUSS OR RAFTER TO DOUBLE TOP PLATE

- 6.2.2 Install one (1) FrameFAST® fastener upward through the wall top plates or wood structural framing member at the bottom corner of the top plates and into the center of the wood truss or rafter. The fastener should be installed at a 20°-30° angle and should penetrate the wood truss or rafter within ¼" of the centerline. See Figure 4.
- 6.2.2.1 If the wood truss or rafter is located directly over a top plate splice, offset the fastener ¼" to one side of the splice and insert the fastener upward through the wall top plates or wood structural framing member at the bottom corner of the top plates and into the center of the truss or rafter. The fastener should be installed at a 20°-30° angle.
- 6.3 Use a ½" low RPM/high torque drill to drive the fastener head flush with the surface of the wall framing or wood structural framing member.

7 TEST ENGINEERING SUBSTANTIATING DATA

- 7.1 FrameFAST® fastener testing conducted by SBCRI, under contract with Qualtim, Inc., 2017 for the following conditions:
- 7.1.1 Uplift capacity of FrameFAST® fasteners as evaluated for head pull through and withdrawal of fasteners.
 - 7.1.2 FrameFAST® fastener performance when used as a truss hold-down.
- 7.2 FrameFAST® fastener testing conducted by SBCRI, under contract with Qualtim, Inc., 2015 for the following conditions:
- 7.2.1 Uplift capacity of FrameFAST® fasteners as evaluated for head pull through and withdrawal of fasteners.
 - 7.2.2 FrameFAST® fastener performance when used as a truss hold-down.
 - 7.2.3 FrameFAST® fastener performance when loaded laterally.
- 7.3 Some information contained herein is the result of testing and/or data analysis by other sources which conform to [IBC Section 1703](#) and relevant [professional engineering law](#). DrJ relies on accurate data from these sources to perform engineering analysis. DrJ has reviewed and found the data provided by other professional sources to be credible.

- 7.4 Where appropriate, DrJ's analysis is based on design values that have been codified into law through codes and standards (e.g., *IBC*, *IRC*, *NDS*®, and *SDPWS*). This includes review of code provisions and any related test data that aids in comparative analysis or provides support for equivalency to an intended end-use application. Where the accuracy of design values provided herein is reliant upon the published properties of commodity materials (e.g., lumber, steel, and concrete), DrJ relies upon the grade mark, stamp, and/or design values provided by raw material suppliers to be accurate and conforming to the mechanical properties defined in the relevant material standard.

8 FINDINGS

- 8.1 When used and installed in accordance with this TER and the manufacturer's installation instructions, the product(s) listed in Section 1.1 are approved for the following:
- 8.1.1 Toenail connections, metal hurricane and seismic clips/straps, or nails to resist the uplift loads and lateral loads as provided for in Table 3.
 - 8.1.2 Provide resistance to uplift loads due to wind negative pressure applied from the truss above lifting up on the top plate of the wall, per Table 3.
- 8.2 TPR is not a significant concern for FrameFAST® fasteners at allowable design load levels.
- 8.3 *IBC* Section 104.11 (*IRC* Section R104.11 and *IFC* Section 104.9 are similar) states:
- 104.11 Alternative materials, design and methods of construction and equipment.** The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been *approved*. An alternative material, design or method of construction shall be *approved* where the *building official* finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code...Where the alternative material, design or method of construction is not *approved*, the *building official* shall respond in writing, stating the reasons the alternative was not *approved*.
- 8.4 This product has been evaluated in the context of the codes listed in Section 2 and is compliant with all known state and local building codes. Where there are known variations in state or local codes applicable to this evaluation, they are listed here.
- 8.4.1 No known variations

9 CONDITIONS OF USE

- 9.1 Where required by the *building official*, also known as the authority having jurisdiction (AHJ) in which the project is to be constructed, this TER and the installation instructions shall be submitted at the time of *permit* application.
- 9.2 Any generally accepted engineering calculations needed to show compliance with this TER shall be submitted to the AHJ for review and approval.
- 9.3 Design loads shall be determined in accordance with the building code adopted by the *jurisdiction* in which the project is to be constructed and/or by the Building Designer (e.g., *owner* or *registered design professional*).
- 9.4 Structural framing members connected with FrameFAST® fasteners shall be designed in accordance with the requirements of their specific design standards/specifications as referenced in the building code adopted by the jurisdiction in which the project is to be constructed.
- 9.5 Loads applied shall not exceed those recommended by the manufacturer or as defined in this TER.
- 9.6 At a minimum, this product shall be installed per Section 6 of this TER.
- 9.6.1 For conditions not covered in this TER, connections shall be designed in accordance with accepted engineering practice.
 - 9.6.2 Manufacturer's installation instructions shall be shipped to the jobsite with the materials or otherwise be available on the jobsite for inspection.

- 9.7 This product is manufactured under a third-party quality control program in accordance with IBC Section 104.4 and 110.4 and IRC Section R104.4 and R109.2.
- 9.8 The actual design, suitability, and use of this TER, for any particular building, is the responsibility of the owner or the owner's authorized agent. Therefore, the TER shall be reviewed for code compliance by the building official for acceptance.
- 9.9 The use of this TER is dependent on the manufacturer's in-plant QC, the ISO/IEC 17020 third-party quality assurance program and procedures, proper installation per the manufacturer's instructions, the building official's inspection, and any other code requirements that may apply to demonstrate and verify compliance with the applicable building code.

10 IDENTIFICATION

- 10.1 The product(s) listed in Section 1.1 are identified by a label on the board or packaging material bearing the manufacturer's name, product name, TER number, and other information to confirm code compliance.
- 10.2 Additional technical information can be found at fastenmaster.com.

11 REVIEW SCHEDULE

- 11.1 This TER is subject to periodic review and revision. For the most recent version of this TER, visit drjcertification.org.
- 11.2 For information on the current status of this TER, contact [DrJ Certification](#).