

Design for Uplift Using TimberLOK® Screws
to Connect Drag Strut Trusses to Wall Top Plates

TER No. 1306-01

OMG, Inc.
DBA FastenMaster®

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DIVISION: 06 00 00 – WOOD, PLASTICS, AND COMPOSITES
Section: 06 00 90 – Wood and Plastic Fastenings

1. Product(s) Evaluated:

- 1.1. FastenMaster® TimberLOK® Heavy Duty Wood Screw
- 1.2. For the most recent version of this Technical Evaluation Report (TER), visit drjengineering.org. For more detailed state professional engineering and code compliance legal requirements and references, visit drjengineering.org/statelaw. DrJ is fully compliant with all state professional engineering and code compliance laws.
- 1.3. This TER can be used to obtain product approval in any country that is an IAF MLA Signatory (all countries found [here](#)) and covered by an [IAF MLA Evaluation](#) per the [Purpose of the MLA](#) (as an example, see [letter to ANSI](#) from the Standards Council of Canada). Manufacturers can go to jurisdictions in the U.S., Canada and other [IAF MLA Signatory Countries](#) and have their products readily approved by authorities having jurisdiction using [DrJ's ANSI accreditation](#).
- 1.4. Building code regulations require that evaluation reports are provided by an approved agency meeting specific requirements, such as those found in [IBC Section 1703](#). Any agency accredited in accordance with ANSI ISO/IEC 17065 meets this requirement within ANSI's scope of accreditation. For a list of accredited agencies, visit ANSI's [website](#). For more information, see drjcertification.org.

DrJ is a Professional Engineering Approved Source

 **Learn more about DrJ's Accreditation**

- DrJ is an ISO/IEC 17065 accredited product certification body through ANSI Accreditation Services.
- DrJ provides certified evaluations that are signed and sealed by a P.E.
- DrJ's work is backed up by professional liability insurance.
- DrJ is fully compliant with IBC Section 1703.

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- 1.5. Requiring an evaluation report from a specific private company (i.e. ICC-ES, IAPMO, CCMC, DrJ, etc.) can be viewed as discriminatory and is a violation of international, federal, state, provincial and local anti-trust and free trade regulations.
- 1.6. DrJ's code compliance work:
 - 1.6.1. Conforms to code language adopted into law by individual states and any relevant consensus based standard such as an ANSI or ASTM standard.
 - 1.6.2. Complies with accepted engineering practice, all professional engineering laws and by providing an engineer's seal DrJ takes professional responsibility for its specified scope of work.

2. Applicable Codes and Standards:¹

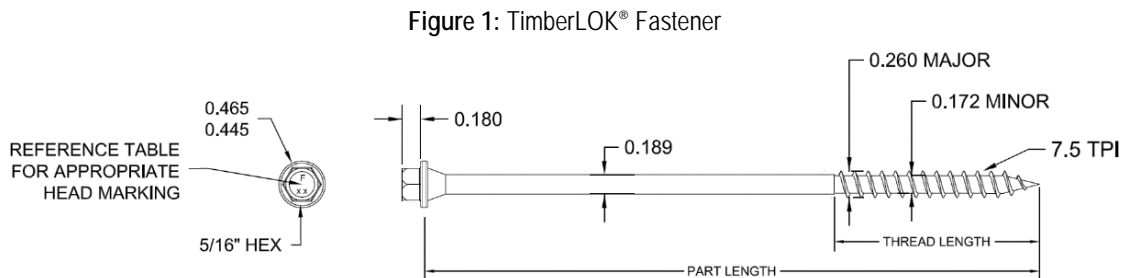
- 2.1. 2012, 2015 and 2018 International Building Code (IBC)
- 2.2. 2012, 2015 and 2018 International Residential Code (IRC)
- 2.3. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- 2.4. ASTM A510 – Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
- 2.5. ASTM D1761 – Standard Test Methods for Mechanical Fasteners in Wood
- 2.6. AWC/TR 12 – General Dowel Equations for Calculating Lateral Connection Values
- 2.7. AWC/NDS – National Design Specification® for Wood Construction

3. Performance Evaluation:

- 3.1. TimberLOK® fasteners were evaluated using their tested allowable design values as an alternate means of attaching wood trusses, drag struts and rafters to the top of the wall below to provide uplift and lateral load resistance. The following conditions were evaluated:
 - 3.1.1. Withdrawal strength of TimberLOK® fasteners for use as an alternative to toe-nail connections, metal hurricane and seismic clips/straps or nails in tension (uplift) loaded applications.
 - 3.1.2. Shear strength of TimberLOK® fasteners for use as an alternative to toe-nail connections, hurricane and seismic clips/straps or nails in shear (lateral) loaded applications either parallel or perpendicular to wood grain.
 - 3.1.3. Head pull through strength of TimberLOK® fasteners for use as an alternative to toe-nail connections, hurricane and seismic clips/straps or nails in tension (uplift) loaded applications.
- 3.2. Connections other than those addressed in [Section 3](#) are outside the scope of this TER.
- 3.3. Any code compliance issues not specifically addressed in this section are outside the scope of this TER.

4. Product Description and Materials:

- 4.1. TimberLOK® fasteners ([Figure 1](#)) are manufactured of 1022 carbon steel or 10B21 wire conforming to ASTM A510.



¹ Unless otherwise noted, all references in this code compliant technical evaluation report (TER) are from the 2018 version of the codes and the standards referenced therein, including, but not limited to, ASCE 7, SDPWS and WFCM. This product also complies with the 2000-2015 versions of the IBC and IRC and the standards referenced therein. As required by law, where this TER is not approved, the building official shall respond in writing, stating the reasons this TER was not approved. For variations in state and local codes, if any see [Section 8](#).

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- 4.2. TimberLOK® fasteners are manufactured using a standard cold-formed process followed by a heat-treating process.
- 4.3. Fasteners are approved for use in interior and exterior conditions and in chemically treated or untreated lumber.
- 4.3.1. The proprietary coating has been tested and found to exceed the protection provided by code-approved hot-dipped galvanized coatings meeting *ASTM A153* ([IBC Section 2304.10.5²](#) and [IRC Section 317.3](#)), which allows for its use in alkaline copper quaternary (ACQ) pressure-treated wood.
- 4.4. Fasteners are approved for use in fire-retardant-treated lumber, provided the conditions set forth by the fire-retardant-treated lumber manufacturer are met, including appropriate strength reductions.
- 4.5. In-plant quality control procedures, under which the TimberLOK® fasteners are manufactured, are audited through an inspection process performed by an approved agency.
- 4.6. The TimberLOK® fasteners evaluated in this report are designated in [Table 1](#).

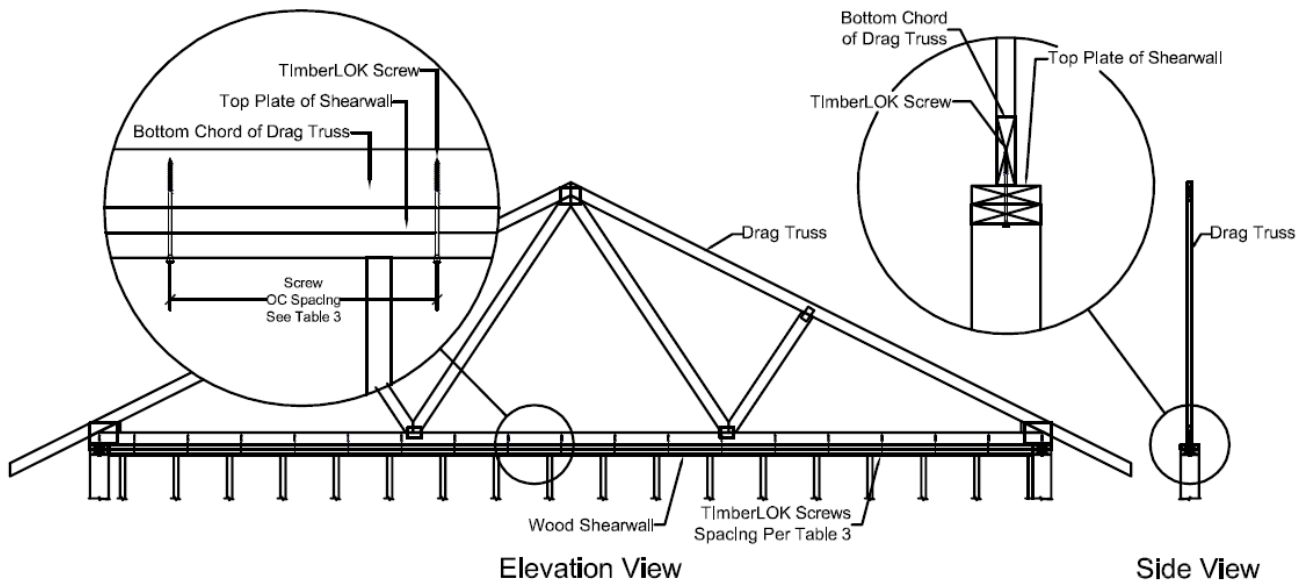
Table 1: Fastener Description				
Product Name	Fastener Designation ³	Head Marking	Overall Length	Thread Length
TimberLOK® 4"	TLOK04	F4.0	4"	2"
TimberLOK® 6"	TLOK06	F6.0	6"	2"

5. Applications:

5.1. Wood-Framed Construction

- 5.1.1. TimberLOK® fasteners are used to attach minimum 1½"-wide drag strut wood truss bottom chords to wood walls that meet the requirements of [IRC Section R602](#) or [IBC Section 2308](#) for wood structural framing members. The fasteners provide resistance to uplift and lateral loads applied parallel and/or perpendicular to the wall or structural framing member. The fasteners also provide a load path for transferring the drag loads into the shear walls below, see [Figure 2](#).

Figure 2: Drag Strut Truss Connection to Shear Walls



² [2012 IBC Section 2304.9.5](#).

³ Fastener designations are found on the product packaging. Individual fasteners may be marked according to [Table 1](#).

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- 5.1.2. Walls shall consist of either a single or double top plate designed in accordance with [IRC Section R602.3.2](#) or [IBC Section 2308.5.3.2](#)⁴.
- 5.1.3. See [Table 2](#) for the design procedure and TimberLOK® allowable design values.
- 5.1.4. See [Section 6](#) for installation requirements.
- 5.1.5. TimberLOK® fasteners are used in buildings requiring wind analysis in accordance with [IRC Section R301.2.1](#) or design in accordance with [IBC Section 1609](#).
- 5.1.6. Use of TimberLOK® fasteners in buildings requiring seismic analysis in accordance with [IRC Section R301.2.2](#) is outside the scope of this TER.
- 5.1.7. Where the application exceeds the limitations set forth herein, design shall be permitted in accordance with accepted engineering procedures, experience and technical judgment.

5.2. Design Concepts and Allowable Design Loads

- 5.2.1. Allowable design loads for uplift and lateral resistance (parallel [F1] and perpendicular [F2] to the plane of the wall or structural member, [Figure 3](#)) are provided in [Table 2](#) for TimberLOK® fasteners. Allowable design loads are listed for selected load durations and specific gravities and are applicable to fasteners installed in accordance with the procedures described in [Section 6](#).

Fastener Designation	Minimum Penetration into Truss/Rafter/Wood Structural Support (in.)	Species Group (Specific Gravity)	Uplift (lbf)			Lateral (lbf)					
						F2 – Perpendicular to Wall			F1 – Parallel to Wall		
			1.0	1.33	1.60	1.0	1.33	1.60	1.0	1.33	1.60
TimberLOK® TLOK04 or TLOK06	2"	So. Pine (0.55)	390	520	620	255	340	410	280	375	450
		Douglas Fir-Larch (0.50)	340	450	540	240	320	385	265	350	425
		Spruce-Pine-Fir/ Hem-Fir (0.42)	260	350	420	210	280	340	230	305	370

1. Wood truss and rafter members shall be a minimum of 2" nominal thickness. Design of truss and rafter members to be 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. Uplift and F2 lateral load values have been adjusted using Hankinson's equation per *NDS*.
 4. For applications involving members with different specific gravities, use the allowable load corresponding to the lowest specific gravity.
 5. Allowable uplift and lateral loads for applications in which the controlling load duration is two months (i.e., 115%) or seven days (i.e., 125%) may be obtained by multiplying the corresponding tabular value in the column marked "1.0" by 1.15 or 1.25, respectively.

⁴ [2012 IBC Section 2308.9.2.1](#).

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5.2.2. Allowable loads (plf) along the wall are listed in [Table 3](#) for the given fastener spacing.

Table 3: Allowable Loads in Pounds per Lineal Foot by Fastening Pattern								
Wood Species	Specific Gravity	On-Center Spacing Between Fasteners (in.)						
		4"	6"	8"	12"	16"	18"	24"
Southern Pine	0.55	1350	900	675	450	340	300	225
Douglas Fir-Larch	0.50	1275	850	640	425	320	285	215
Spruce Pine-Fir/ Hem-Fir	0.42	1110	740	555	370	280	245	185

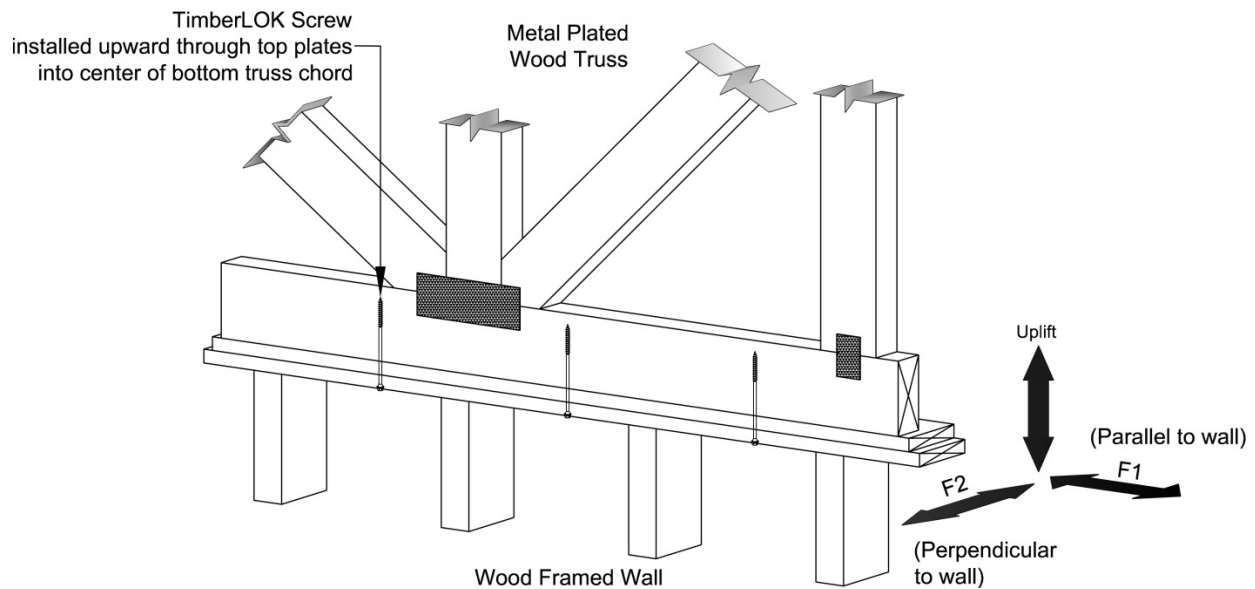
1. Wood truss and rafter members shall be a minimum of 2" nominal thickness. Design of truss and rafter members to be by others.
 2. A load duration factor of 1.6 has been applied to these tables for wind loading per [NDS Table 2.3.2](#). Adjustments to lower this factor may be made at the engineer's discretion. No further increases are allowed.
 3. Table values are based on the lateral loading direction parallel to wall.
 4. Equivalent specific gravity of SCL shall be equal to or greater than the specific gravities provided in this table. Refer to product information from SCL manufacturer.
 5. For applications involving members with different specific gravities, use the allowable load corresponding to the lowest specific gravity.
 6. Interpolation is permitted.

5.2.3. 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.

5.2.3.1. Consult a professional engineer as needed for complex design conditions.

5.2.4. Design example to transfer lateral loads to a shear wall below, see [Figure 3](#):

Figure 3: Uplift & Lateral Load Orientations



5.2.4.1. Drag force – 5000 lbs. (wind)

5.2.4.2. Drag strut truss – 24' long

5.2.4.3. Shear walls are partial – 5' on one end, 7' on other end

5.2.4.4. Load on top chord of drag strut truss is 208.33 plf (5000/24).

5.2.4.5. Resistance is supplied by the two shear walls (5' + 7' = 12').

5.2.4.6. Resistance capacity required is 416.67 plf (5000/12).

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5.2.4.7. Assuming the top plate of the wall is Spruce Pine-Fir, [Table 3](#) indicates that the fasteners must be spaced at 0'-8" o.c. (555 plf allowable load).

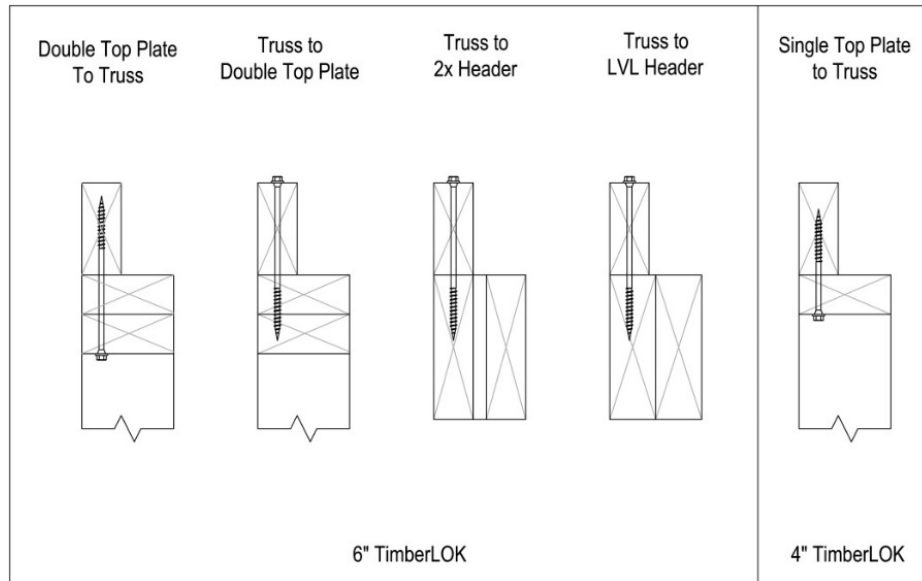
6. Installation:

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. TimberLOK® fasteners:

6.2.1. Select a TimberLOK® fastener from [Table 1](#) with a length sufficient to fully embed the 2" threaded portion of the fastener into the wall top plates or wood structural framing member. See [Figure 4](#) for guidance.

Figure 4: TimberLOK® Fastener Applications for Truss Bottom Chord to Wall Framing



- 6.2.2. Install the required number of fasteners to achieve the required lateral capacity and the uplift loads using the TimberLOK® design capacities for resistance to the uplift and lateral loads from [Table 2](#) and [Table 3](#).
- 6.2.3. When installed from the top down, center the screw on the truss chord and drive vertically until the head of the fastener is flush to the top of the chord. Do not overdrive.
- 6.2.4. When installed upward from the bottom of a single or double top plate, measure $\frac{3}{4}$ " in from the outer edge of the plate(s) so that the screw is centered on the truss chord ($\pm \frac{1}{4}$ ") and drive the fastener vertically until the head of the fastener is flush to the underside of the top plate(s). Do not overdrive.

7. Test and Engineering Substantiating Data:

7.1. FastenMaster® TimberLOK® data for determining:

- 7.1.1. Comparative equivalency for use as an alternative material in accordance with [IRC Section R104.11](#) and [IBC Section 104.11](#).
- 7.1.2. Uplift capacity of TimberLOK® fasteners as evaluated for head pull through and withdrawal of fasteners.
- 7.1.3. TimberLOK® heavy duty wood screw performance when used as a truss hold-down.
- 7.1.4. TimberLOK® heavy duty wood screw performance when loaded laterally.

7.2. Testing to *ASTM D1761* for verifying edge and end distances.

7.3. The product(s) evaluated by this TER fall within the scope of one or more of the model, state or local building codes for building construction. The testing and/or substantiating data used in this TER is limited to buildings, structures, building elements, construction materials and civil engineering related specifically to buildings.

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- 7.4. The provisions of model, state or local building codes for building construction do not intend to prevent the installation of any material or to prohibit any design or method of construction. Alternatives shall use consensus standards, performance-based design methods or other engineering mechanics based means of compliance. This TER assesses compliance with defined standards, accepted engineering analysis, performance-based design methods, etc. in the context of the pertinent building code requirements.
- 7.5. Some information contained herein is the result of testing and/or data analysis by other sources, which DrJ relies on to be accurate, as it undertakes its engineering analysis.
- 7.6. DrJ has reviewed and found the data provided by other professional sources are credible. The information in this TER conforms with DrJ's procedure for acceptance of data from approved sources.
- 7.7. DrJ's responsibility for data provided by approved sources conforms with [IBC Section 1703](#) and any relevant professional engineering law.
- 7.8. Where appropriate, DrJ's analysis is based on design values that have been codified into law through codes and standards (e.g., *IRC*, *WFCM*, *IBC*, *SDPWS*, *NDS*, *ACI*, *AISI*, *PS-20*, *PS-2*, etc.). 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, concrete, etc), DrJ relies upon grade/properties provided by the raw material supplier 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, TimberLOK® fasteners can be used as an acceptable alternative to toe-nail connections, metal hurricane and seismic clips/straps or nails to resist the uplift and lateral loads as provided for in [Table 2](#).
- 8.2. When used and installed in accordance with this TER and the manufacturer's installation instructions, TimberLOK® fasteners can be used as an acceptable alternative to provide resistance to uplift loads due to wind pressure applied from the drag strut truss above lifting up on the top plate of the wall, per [Table 2](#).
- 8.3. When used and installed in accordance with this TER and the manufacturer's installation instructions, TimberLOK® fasteners can be used as an acceptable alternative to provide resistance to lateral loads due to wind pressure applied parallel or perpendicular to the wall, per [Table 2](#).
- 8.4. For joist/rafter and truss to top plate connections, see [TER No. 1105-02: Use of FastenMaster® TimberLOK® Fasteners to Provide Uplift & Lateral Resistance to Trusses & Rafters Attached to the Tops of Walls](#).
- 8.5. [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*.
- 8.6. 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 that are applicable to this evaluation, they are listed here:
 - 8.6.1. No known variations
- 8.7. This TER uses professional engineering law, the building code, ANSI/ASTM consensus standards and generally accepted engineering practice as its criteria for all testing and engineering analysis. DrJ's professional engineering work falls under the jurisdiction of each state Board of Professional Engineers, when signed and sealed.

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9. Conditions of Use:

- 9.1. Where required by 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 code official 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, Registered Design Professional, etc.).
- 9.4. The TimberLOK® fasteners covered in this TER ([Table 1](#)) shall be installed in accordance with this report and the manufacturer's installation instructions.
 - 9.4.1. For conditions not covered in this TER, connections shall be designed in accordance with generally accepted engineering practice.
 - 9.4.2. Manufacturer's installation instructions shall be followed as provided in [Section 6](#) and at fastenmaster.com. In the instance of conflict between the manufacturer's installation instructions and this TER, the more restrictive shall govern.
- 9.5. Manufacturer's installation instructions shall be shipped to the jobsite with the materials or otherwise be available on the jobsite for inspection.
- 9.6. Structural framing members (e.g., wood, masonry, concrete, steel, etc.) connected with TimberLOK® 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.
- 9.7. Loads applied shall not exceed those recommended by the manufacturer or as defined in this TER.
- 9.8. FastenMaster® products are produced by OMG, Inc. at its facility located in Agawam, Massachusetts.
- 9.9. TimberLOK® fasteners are produced under a quality control program subject to periodic inspections in accordance with [IBC Section 1703.5.2](#).
- 9.10. Design
 - 9.10.1. Building Designer Responsibility
 - 9.10.1.1. Unless the AHJ allows otherwise, the Construction Documents shall be prepared by a Building Designer for the Building and shall be in accordance with [IRC Section R106](#) and [IBC Section 107](#).
 - 9.10.1.2. The Construction Documents shall be accurate and reliable and shall provide the location, direction and magnitude of all applied loads and shall be in accordance with [IRC Section R301](#) and [IBC Section 1603](#).
 - 9.10.2. Construction Documents
 - 9.10.2.1. Construction Documents shall be submitted to the Building Official for approval and shall contain the plans, specifications and details needed for the Building Official to approve such documents.
- 9.11. Responsibilities
 - 9.11.1. The information contained herein is a product, material, detail, design and/or application TER evaluated in accordance with the referenced building codes, testing and/or analysis through the use of accepted engineering practice, experience and technical judgment.
 - 9.11.2. DrJ TERs provide an assessment of only those attributes specifically addressed in the Products Evaluated or Code Compliance Process Evaluated sections.
 - 9.11.3. The engineering evaluation was performed on the dates provided in this TER, within DrJ's professional scope of work.
 - 9.11.4. This product is manufactured under a third-party quality control program in accordance with [IRC Section R104.4](#) and [R109.2](#) and [IBC Section 104.4](#) and [110.4](#).
 - 9.11.5. 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, and the TER shall be reviewed for code compliance by the Building Official.

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9.11.6. 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.** FastenMaster® TimberLOK® fasteners described in this TER 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.** The packaging shall include OMG's name and address, fastener size, third-party inspection agency and TER number.
- 10.3.** 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 drjengineering.org.
- 11.2.** For information on the current status of this TER, contact [DrJ Engineering](#).



- [Mission and Professional Responsibilities](#)
- [Product Evaluation Policies](#)
- [Product Approval – Building Code, Administrative Law and P.E. Law](#)