Listing and Technical Evaluation Report™

A Duly Authenticated Report from an Approved Agency

Report No: 1711-02

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Magnitude10 brace

Trade Secret Report Holder:

Quake Bracing, LLC

Phone: 510-225-1112 Website: www.quakebracing.com Email: info@quakebracing.com

CSI Designations:

DIVISION: 05 00 00 - METALS

Section: 05 12 23 - Structural Steel for Buildings

DIVISION: 13 00 00 SPECIAL CONSTRUCTION

Section: 13 48 00 - Sound, Vibration and Seismic Control

Section: 13 48 63 - Fabricated Seismic Control Components

1 Innovative Product Evaluated[1]

1.1 Magnitude10 brace:

1.1.1 Size A

1.1.2 Size AX

1.1.3 Size F

1.1.4 Size FX

1.2 See **Section 2** for product descriptions.

2 Product Description and Materials

2.1 The Magnitude10 brace is an assembly of materials intended for use as lateral force resisting elements to resist lateral forces in buildings.

2.2 The Magnitude10 brace is made up of wide flange or other steel columns (see Item #12 in **Figure 2**) that includes a sacrificial structural fuse (see **Figure 3**) connection between the top of the column and a connection to the building framing.

2.2.1 The minimum column sizes for the Size A Magnitude10 brace is:

2.2.1.1 W8 x 35, W10 x 30, or HP8 x 36 (see **Section 2.2.5**).

2.2.2 The minimum column sizes for the Size AX Magnitude10 brace is:

2.2.2.1 W8 x 67 or HP10 x 57 (see **Section 2.2.5**).

2.2.3 The minimum column sizes for the Size F Magnitude10 brace is:

2.2.3.1 W12 x 65 or HP12 x 74 (see **Section 2.2.5**).

2.2.4 The minimum column size for the Size FX Magnitude10 brace is:

2.2.4.1 W12 x 136, W14 x 109, or W16 x 89 (see **Section 2.2.5**).

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2.2.5 Larger steel sections may be specified by the Engineer of Record (EOR), subject to compatibility with remaining manufactured components (see **Section 6.4.2.4**).

2.2.6 Wide flange steel columns shall be of Type HSLA Grade 50 (F_y = 50-ksi) steel conforming to ASTM A992.

2.2.7 Bearing pile (HP) steel columns shall be of Type HSLA Grade 50 (F_y = 50-ksi) steel conforming to ASTM A572.

2.2.8 Structural Fuse Plates shall be of Type HSLA Grade 50 (F_y = 50-ksi) steel conforming to ASTM A572.

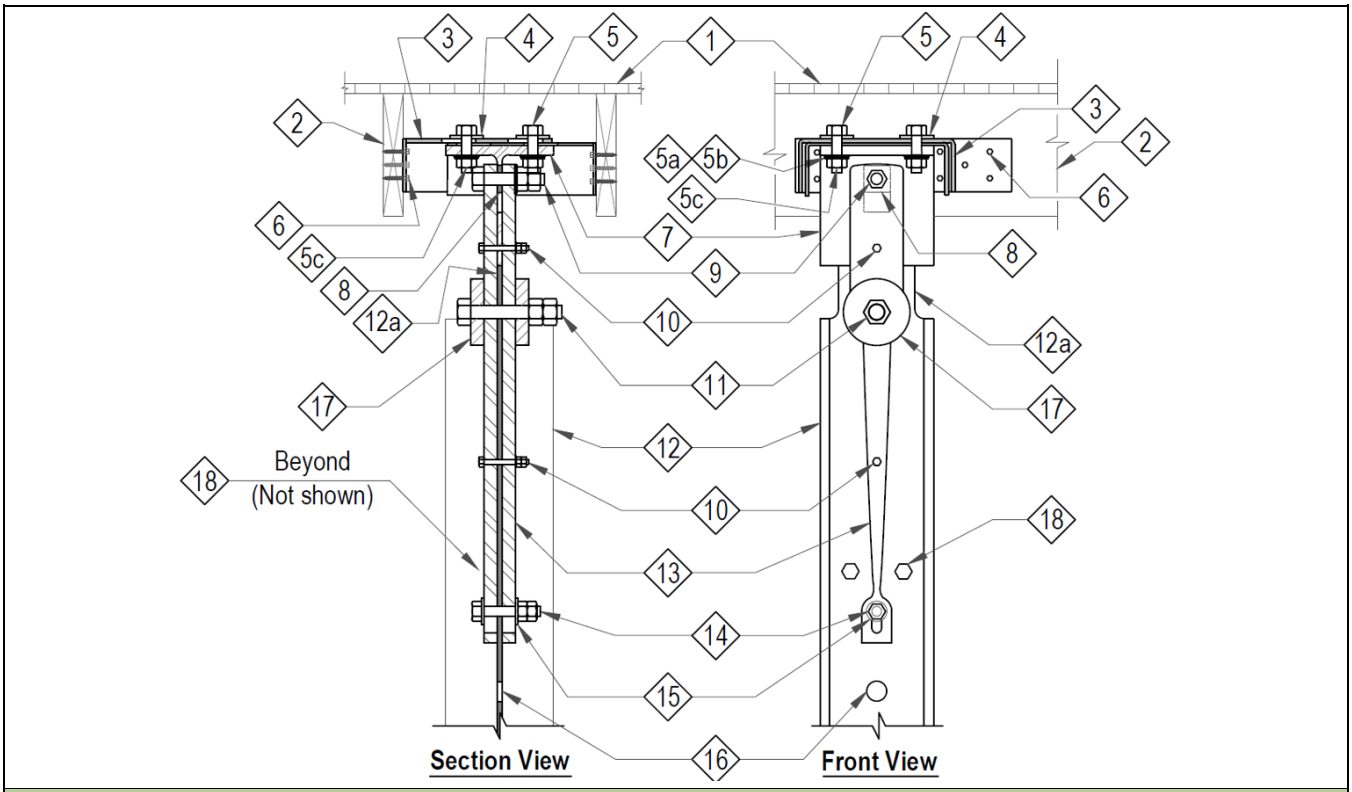
2.3 The innovative product evaluated in this report is shown in **Figure 1**.



Figure 1. Installed Magnitude10 brace

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2.4 A parts list of the Magnitude10 brace is presented in **Figure 2**.



Detail of Magnitude10 brace and Connections to Floor Framing			
Item #	Description	Item #	Description
1	Floor Sheathing	9	Ceiling Bolt Through Bushing and Fuse Plates with Double Nuts
2	Floor Joists	10	Shear Bolt(s) with Double Nuts; Number, Size, and Location Varies with Magnitude10 brace
3	Steel Connector Channels	11	Top Bolt in Column Through Fuse Plates, Bearing Plates, and Column Web with Double Nuts
4	Square Washers	12	Column
5	Connection Bolts at Loading Tee	12a	Column Web Extension (Column Web and Web Extension Shown Shaded in Section View)
5a	Direct Tension Indicating Washer	13	Fuse Plates Both Sides of Column
5b	Hardened Washer	14	Bottom Bolt Through Column Web and Slotted Holes in Fuse Plates with Double Nuts
5c	Hardened Nut	15	Standard Round Washers Against Fuse Plates at Both Ends of Bolt
6	Structural Screws from Connector Channels to Joist	16	Hole Provided in Web for Utilities
7	Loading Tee	17	Bearing Plate on Both Sides
8	Square or Rectangular Bushing (Concealed Between Fuse Plates)	18	Guide Bolts and Spacers

Figure 2. Magnitude10 brace Assembly

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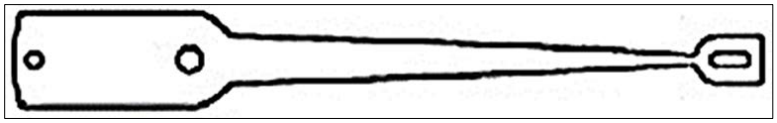


Figure 3. Diagram of Structural Fuse Used in Magnitude10 brace

2.5 The base of the column (Item #12 in **Figure 2**) is embedded in reinforced concrete or provided with a welded base plate to create a moment resisting connection in accordance with the detailed installation drawings.

2.6 Magnitude10 braces are intended to provide resistance to lateral loads equivalent to conventional lateral resisting systems.

2.7 A complete Magnitude10 brace system includes the following:

2.7.1 *Column:*

2.7.1.1 Designed to resist lateral loads and limit deflection to an acceptable level (see Item #12 in **Figure 2**).

2.7.1.2 Steel columns will be dependent on project specific fabrication drawings provided by Quake Bracing, LLC and may be sourced locally, provided that the steel column complies with the material specifications detailed in **Section 2.2.6** and **Section 2.2.7**.

2.7.2 *Structural Fuses:*

2.7.2.1 Designed to resist lateral loads while allowing certain deflections within a specified range (see Item #13 in **Figure 2**).

2.7.3 *Shear Bolts(s):*

2.7.3.1 Provide increased stiffness to the system prior to a given load level (see Item #10 in **Figure 2**). These bolts are optional subject to **Section 6.3.1.2**. Shear bolts may be fastened with double nuts locked together or with a single nut with the end of the bolt threads peened to prevent the nut from unscrewing.

2.7.4 *Connectors for Attaching Magnitude10 brace to Structural Framing:*

2.7.4.1 *Steel Connector Channels:*

2.7.4.1.1 Connects the Magnitude10 brace assembly between joists in the floor system of the building above the Magnitude10 brace (see Item #3 in **Figure 2**).

2.7.4.2 *Steel Connector Plate:*

2.7.4.2.1 Connects the Magnitude10 brace to the underside of a wood beam or collector, or other member as designed by the RDP.

2.7.4.3 *Loading Tee:*

2.7.4.3.1 Transfers load from the Structural Fuses to the Connector Channels (see Item #7 in **Figure 2**) to floor system.

2.7.5 Hardware and accessories shall be as follows (all items listed below are provided with Magnitude10 brace as needed for the connection type listed in **Section 2.7.4**):

2.7.5.1 *Structural Screws:*

2.7.5.1.1 Structural wood screws for attaching the steel channel to the floor joists or the steel connector plate and loading tee to a wood beam or collector shall be self-drilling structural wood screws used in accordance with a current code evaluation report (see Item #6 in **Figure 2**).

2.7.5.2 *Bolts:*

2.7.5.2.1 High-strength ASTM F3125, Grade A325 bolts and SAE J429, Grade 2 and Grade 5 cap screws are used to make connections between the steel members (see Items #5, #9, #10, #11, #14, and #18 in **Figure 2**). See **Table 1** for additional details.

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Table 1. Bolt Sizes for the Magnitude10 brace[1,2]

Part Number from Figure 2	Magnitude10 brace Size A & AX	Magnitude10 brace Size F & FX
#5 – Connection Bolts at Loading Tee	1/2" ASTM F3125, Grade 325	
#9 – Ceiling Bolt (Grade 5)	5/8"	3/4"
#10 – Shear Bolts (Grade 2)	(2) 1/4"	(3) 5/16"
#11 – Top Bolt (Grade 5)	3/4"	1 1/2"
#14 – Bottom Bolt (Grade 5)	1/2"	3/4"
#18 – Guide Bolt (Grade 5)	1/2"	3/4"

2.7.5.3 *Washers:*

2.7.5.3.1 Hardened washers are in accordance with ASTM F436 (see Item #5b in **Figure 2**); standard round washers per ASTM F844 (see Items #15 and #18 in **Figure 2**).

2.7.5.4 *Square Washers:*

2.7.5.4.1 5/16" square washers are cut from steel plate (see Item #4 in **Figure 2**).

2.7.5.5 *Direct Tension Indicating (DTI) Washers:*

2.7.5.5.1 DTI washers shall be in accordance with ASTM F959 (see Item #5a in **Figure 2**).

2.7.5.6 *Nuts:*

2.7.5.6.1 High-strength nuts shall be in accordance with ASTM A563 DH or ASTM A194-2H (see Item #5c in **Figure 2**).

2.7.5.6.2 Standard nuts shall be in accordance with ASTM A563A or SAE J995, Grade 2 (see Items #9, #10, #11, #14, and #18 in **Figure 2**).

2.7.5.6.3 Where double nuts are used, they may be standard hex-nuts, jam-nuts, or a combination of both. When standard hex-nuts are used as the outer nut, the bolt threads need only project through one-half the thickness of the nut. Double nuts shall be tightened against each other to resist loosening of the connection.

2.7.5.7 *Guide Bolt and Spacers:*

2.7.5.7.1 Each Guide Bolt and Spacer includes a bolt, double nut, two washers, and two custom tubular spacers (see Item #18 in **Figure 2**).

2.7.6 Magnitude10 braces may be shipped preassembled with Items #7 through #18 (see **Figure 2**). Items #3 through #6 in **Figure 2** are provided with Magnitude10 braces to be assembled on site according to the manufacturer installation instructions.

2.7.6.1 The steel column (Item #12 in **Figure 2**) can be procured separately as detailed in **Section 2.7.1.2**.

2.7.6.2 Individual components specific to the Magnitude10 brace, or a *"Structural Fuse Kit"*, may be provided by Quake Bracing, LLC.

2.8 As needed, review material properties for design in **Section 6** and the regulatory evaluation in **Section 8**.

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3 Definitions[2]

3.1 New Materials[3] are defined as building materials, equipment, appliances, systems, or methods of construction, not provided for by prescriptive and/or legislatively adopted regulations, known as alternative materials.[4] The design strength and permissible stresses shall be established by tests[5] and/or engineering analysis.[6]

3.2 Duly authenticated reports[7] and research reports[8] are test reports and related engineering evaluations that are written by an approved agency[9] and/or an approved source.[10]

3.2.1 This report utilizes intellectual property and/or trade secrets to create public domain material properties for commercial end-use.

3.2.1.1 This report protects confidential Intellectual Property and trade secrets under the regulation, 18.US.Code.90, also known as Defend Trade Secrets Act of 2016 (DTSA).[11]

3.3 An approved agency is *"approved"* when it is ANAB ISO/IEC 17065 accredited. DrJ Engineering, LLC (DrJ) is accredited and listed in the ANAB directory.

3.4 An approved source is *"approved"* when a professional engineer (i.e., Registered Design Professional, hereinafter RDP) is properly licensed to transact engineering commerce. The regulatory authority governing approved sources is the state legislature via its professional engineering regulations.[12]

3.5 Testing and/or inspections conducted for this duly authenticated report were performed by an ISO/IEC 17025 accredited testing laboratory, an ISO/IEC 17020 accredited inspection body, and/or a licensed RDP.

3.5.1 The Center for Building Innovation (CBI) is ANAB[13] ISO/IEC 17025 and ISO/IEC 17020 accredited.

3.6 The regulatory authority shall enforce[14] the specific provisions of each legislatively adopted regulation. If there is a non-conformance, the specific regulatory section and language of the non-conformance shall be provided in writing[15] stating the nonconformance and the path to its cure.

3.7 The regulatory authority shall accept duly authenticated reports from an approved agency and/or an approved source with respect to the quality and manner of use of new materials or assemblies as provided for in regulations regarding the use of alternative materials, designs, or methods of construction.[16]

3.8 ANAB is an International Accreditation Forum (IAF) Multilateral Recognition Arrangement (MLA) signatory. Therefore, recognition of certificates and validation statements issued by conformity assessment bodies accredited by all other signatories of the IAF MLA with the appropriate scope shall be approved.[17] Thus, all ANAB ISO/IEC 17065 duly authenticated reports are approval equivalent,[18] and can be used in any country that is an MLA signatory found at this link: https://iaf.nu/en/recognised-abs/

3.9 Approval equity is a fundamental commercial and legal principle.[19]

4 Applicable Local, State, and Federal Approvals; Standards; Regulations[20]

4.1 *Local, State, and Federal*

4.1.1 Approved in all local jurisdictions pursuant to ISO/IEC 17065 duly authenticated report use, which includes, but is not limited to, the following featured local jurisdictions: Austin, Baltimore, Broward County, Chicago, Clark County, Dade County, Dallas, Detroit, Denver, DuPage County, Fort Worth, Houston, Kansas City, King County, Knoxville, Las Vegas, Los Angeles City, Los Angeles County, Miami, Nashville, New York City, Omaha, Philadelphia, Phoenix, Portland, San Antonio, San Diego, San Jose, San Francisco, Seattle, Sioux Falls, South Holland, St. Louis County, Texas Department of Insurance, and Wichita.[21]

4.1.2 Approved in all state jurisdictions pursuant to ISO/IEC 17065 duly authenticated report use, which includes, but is not limited to, the following featured states: California, Florida, New Jersey, Oregon, New York, Texas, Washington, and Wisconsin.[22]

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4.1.3 Approved by the Code of Federal Regulations Manufactured Home Construction: Pursuant to Title 24, Subtitle B, Chapter XX, Part 3282.14[23] and Part 3280[24] pursuant to the use of ISO/IEC 17065 duly authenticated reports.

4.1.4 Approved means complying with the requirements of local, state, or federal legislation.

4.2 *Regulations*

4.2.1 *IBC – 18, 21, 24: International Building Code®*

4.2.2 *IRC – 18, 21, 24: International Residential Code®*

4.2.3 *CBC — 22, 25: California Building Code[25] (Title 24, Part 2)*

4.2.4 *CRC — 22, 25: California Residential Code[25] (Title 24, Part 2.5)*

4.3 *Standards*

4.3.1 *ASCE 31: Seismic Evaluation of Existing Buildings*

4.3.2 *ASCE 41: Seismic Rehabilitation of Existing Buildings*

4.3.3 *ASCE/SEI 7: Minimum Design Loads and Associated Criteria for Buildings and Other Structures*

4.3.4 *ASTM A194: Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both*

4.3.5 *ASTM A563: Standard Specification for Carbon and Alloy Steel Nuts*

4.3.6 *ASTM A572: Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel*

4.3.7 *ASTM A992: Standard Specification for Structural Steel Shapes*

4.3.8 *ASTM D7989: Standard Practice for Demonstrating Equivalent In-Plane Lateral Seismic Performance to Wood-Frame Shear Walls Sheathed with Wood Structural Panels*

4.3.9 *ASTM E2126: Standard Test Methods for Cyclic (Reversed) Load Test for Shear Resistance of Vertical Elements of the Lateral Force Resisting Systems for Buildings*

4.3.10 *ASTM F436: Standard Specification for Hardened Steel Washers Inch and Metric Dimensions*

4.3.11 *ASTM F844: Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use*

4.3.12 *ASTM F959: Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series*

4.3.13 *ASTM F3125 – Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120-ksi (830 MPa) and 150-ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions*

4.3.14 *FEMA P-807: Seismic Evaluation and Retrofit of Multi-Unit Wood-Frame Buildings With Weak First Stories*

4.3.15 *FEMA P-1100-2B: Vulnerability-Based Seismic Assessment and Retrofit of One-and Two-Family Dwellings*

4.3.16 *SAE J429: Mechanical and Material Requirements for Externally Threaded Fasteners*

4.3.17 *SAE J995: Mechanical and Material Requirements for Steel Nuts*

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4.4 Structural performance for shear wall assemblies used as lateral force resisting systems in Seismic Design Categories A through F have been tested and evaluated in accordance with the following standards:

4.4.1 *ASCE/SEI 7: Minimum Design Loads and Associated Criteria for Buildings and Other Structures*

4.4.2 *ASTM D7989: Standard Practice for Demonstrating Equivalent In-Plane Lateral Seismic Performance to Wood-Frame Shear Walls Sheathed with Wood Structural Panels*

4.4.2.1 ASTM D7989 is accepted engineering practice used to establish Seismic Design Coefficients (SDC).

4.4.2.2 Tested data generated by ISO/IEC 17025 approved agencies and/or professional engineers, which use ASTM D7989 as their basis, are defined as intellectual property and/or trade secrets.

4.4.2.3 All professional engineering evaluations are defined as an independent design review (i.e., listings, certified reports, duly authenticated reports from approved agencies, and/or research reports, are prepared independently by approved agencies and/or approved sources, when signed and sealed by licensed professional engineer pursuant to registration law.

4.4.3 *ASTM E564: Standard Practice for Static Load Test for Shear Resistance of Framed Walls for Buildings*

4.4.4 *ASTM E2126: Standard Test Methods for Cyclic (Reversed) Load Test for Shear Resistance of Vertical Elements of the Lateral Force Resisting Systems for Buildings*

5 Listed[26]

5.1 Equipment, materials, products, or services included in a List published by a nationally recognized testing laboratory (e.g., CBI), an approved agency (e.g., CBI and DrJ), and/or an approved source (e.g., DrJ), or other organization(s) concerned with product evaluation (e.g., DrJ), that maintains periodic inspection (e.g., CBI) of production of listed equipment or materials, and whose listing states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner.

6 Tabulated Properties Generated from Nationally Recognized Standards

6.1 Magnitude10 braces have been tested in accordance with ASTM E2126, Method C. Seismic design parameters and allowable loads are determined using the test data analysis methods in accordance with ASTM D7989.

6.2 The testing was conducted to measure the load capacities and drift characteristics of the Magnitude10 brace as a lateral-force-resisting element with performance equivalent to wood structural panel shear walls.

6.3 Magnitude10 braces may be used in new or existing construction.

6.3.1 In existing construction, Magnitude10 braces were evaluated for use as a replacement or supplementation for the existing lateral load resisting system of construction containing soft story irregularities.

6.3.1.1 In accordance with ASCE 7, Section 12.3.2, soft story irregularity is defined to exist where there is a story in which the lateral stiffness is less than seventy percent (70%) of that in the story above or less than eighty percent (80%) of the average stiffness of the three stories above.

6.3.1.2 For voluntary installations, the RDP may specify removal of some or all of the shear bolts from the Magnitude10 brace (Item #10 in **Figure 2**) after installation, when their design determines that the initial energy absorption is more critical than limiting the deflection during low seismic events.

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6.4 *Structural Applications*

6.4.1 The allowable lateral load capacity and seismic design coefficients for Magnitude10 braces are as described in **Table 2**.

Table 2. Allowable Lateral Load Capacity and Seismic Design Coefficients for Magnitude10 braces[1,2]

Product Size	Maximum Ceiling Height[3]	Allowable Lateral Load Capacity (lbf)[4]	Response Modification Coefficient R[5]	Overstrength Factor Ω_0[6,7]	Deflection Amplification Factor C_d[8]	Structural System Limitations and Building Height Limit (ft)				
						Seismic Design Category				
						B	C	D	E	F
A	8' 5¼"	2,400	6.5	3.0	4	NL[9]	NL	65	65	65
AX	8' 5¼"	3,400								
F	8' 5¼"	8,275								
FX	8' 5¼"	11,750								

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

1. Magnitude10 brace shall be installed in accordance with Section 9 of this report.
2. All seismic design parameters follow the equivalency as defined in Section 8 of this report.
3. *"Ceiling height"* is measured from the top of the foundation grade beam, pedestal, or column base plate, to the bottom of the framing members of the floor being braced with Magnitude10 brace. See Figure 4 and Figure 5 for details showing how the ceiling height is measured.
4. A story height of 9 feet was used to determine the drift limit.
5. Response modification coefficient, R, for use throughout ASCE 7. *Note:* R reduces forces to a strength level, not an allowable stress level.
6. The tabulated value of the overstrength factor, Ω_0, is permitted to be reduced by subtracting one-half (0.5) for structures with flexible diaphragms.
7. Collectors and their connections and bearing and anchorage of the steel column, shall be designed in accordance with the special load combinations of ASCE 7, Section 12.4.3.
8. Deflection amplification factor, C_d, for use with ASCE 7 Section 12.8.6, ASCE 7 Section 12.8.7, and ASCE 7 Section 12.9.2.
9. NL = Not Limited. Heights are measured from the base of the structure as defined in ASCE 7 Section 11.2.

6.4.2 If an alternative steel column section is specified in accordance with **Section 2.2.5**, the selected section shall be designed to resist the specified lateral loads and limit deflection to an allowable level.

6.4.2.1 The lateral loads shall be applied to the column at the location of the top pin connecting the fuse member to the column or an equivalent force system shall be determined to account for the moment generated by the span between the top of the column and the point of connection to the floor framing.

6.4.2.2 Required column strength shall be determined considering a lateral load equal to the value given in **Table 2** as the Allowable Lateral Load Capacity for the Magnitude10 brace size used, multiplied by the Overstrength Factor given in **Table 2**. The Overstrength Factor may be reduced by 0.5 for structures with flexible diaphragms, in accordance with note *"b"* in ASCE 7, Table 12.2-1. The lateral load shall be considered to act on the column as described in **Section 6.4.2.1**.

6.4.2.3 The design story drift shall be calculated using the strength level seismic forces specified in ASCE 7, Section 12.8 without reduction for allowable stress design. The allowable lateral load in **Table 2** can be converted to a design strength level by dividing by 0.7.

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6.4.2.4 Alternate column sections shall have a minimum design web thickness (t_w), and minimum clear distance between fillets at flanges (T) as listed below:

6.4.2.4.1 Size A: t_w = 0.300", T = $5^3/_4$"

6.4.2.4.2 Size AX: t_w = 0.565", T = $5^3/_4$"

6.4.2.4.3 Size F: t_w = 0.390", T = $9^1/_8$"

6.4.2.4.4 Size FX: t_w = 0.525", T = $9^1/_8$"

6.4.2.5 *For Magnitude10 brace Size A:*

6.4.2.5.1 The deflection contribution of Magnitude10 brace components, other than the steel column, shall be taken as 0.277" at the design lateral capacity of 3,430 lbs. (2,400 lbs./0.7). This deflection may be reduced by the ratio of the lateral seismic force to the design lateral capacity. The deflection of the Magnitude10 brace components shall be added to the calculated elastic deflection of the steel column at the strength level seismic forces to determine the total elastic deflection of the Magnitude10 brace. The design story drift shall be determined in accordance with ASCE 7, Section 12.8.6, using the deflection amplification factor listed in **Table 2**.

6.4.2.6 *For Magnitude10 brace Size AX:*

6.4.2.6.1 The deflection contribution of the Magnitude10 brace components, other than the steel column, shall be taken as 0.422" at the design lateral capacity of 4,857 lbs. (3,400 lbs./0.7). This deflection may be reduced by the ratio of the lateral seismic force to the design lateral capacity. The deflection of Magnitude10 brace components shall be added to the calculated elastic deflection of the steel column at the strength level seismic forces to determine the total elastic deflection of the Magnitude10 brace. The design story drift shall be determined in accordance with ASCE 7, Section 12.8.6 using the deflection amplification factor listed in **Table 2**.

6.4.2.7 *For Magnitude10 brace Size F:*

6.4.2.7.1 The deflection contribution of the Magnitude10 brace components, other than the steel column, shall be taken as 0.292" at the design lateral capacity of 11,821 lbs. (8,275 lbs./0.7). This deflection may be reduced by the ratio of the lateral seismic force to the design lateral capacity. The deflection of the Magnitude10 brace components shall be added to the calculated elastic deflection of the steel column at the strength level seismic forces to determine the total elastic deflection of Magnitude10 brace. The design story drift shall be determined in accordance with ASCE 7, Section 12.8.6 using the deflection amplification factor listed in **Table 2**.

6.4.2.8 *For Magnitude10 brace Size FX:*

6.4.2.8.1 The deflection contribution of the Magnitude10 brace components, other than the steel column, shall be taken as 0.430" at the design lateral capacity of 16,786 lbs. (11,750 lbs./0.7). This deflection may be reduced by the ratio of the lateral seismic force to the design lateral capacity. The deflection of the Magnitude10 brace components shall be added to the calculated elastic deflection of the steel column at the strength level seismic forces to determine the total elastic deflection of the Magnitude10 brace. The design story drift shall be determined in accordance with ASCE 7, Section 12.8.6 using the deflection amplification factor listed in **Table 2**.

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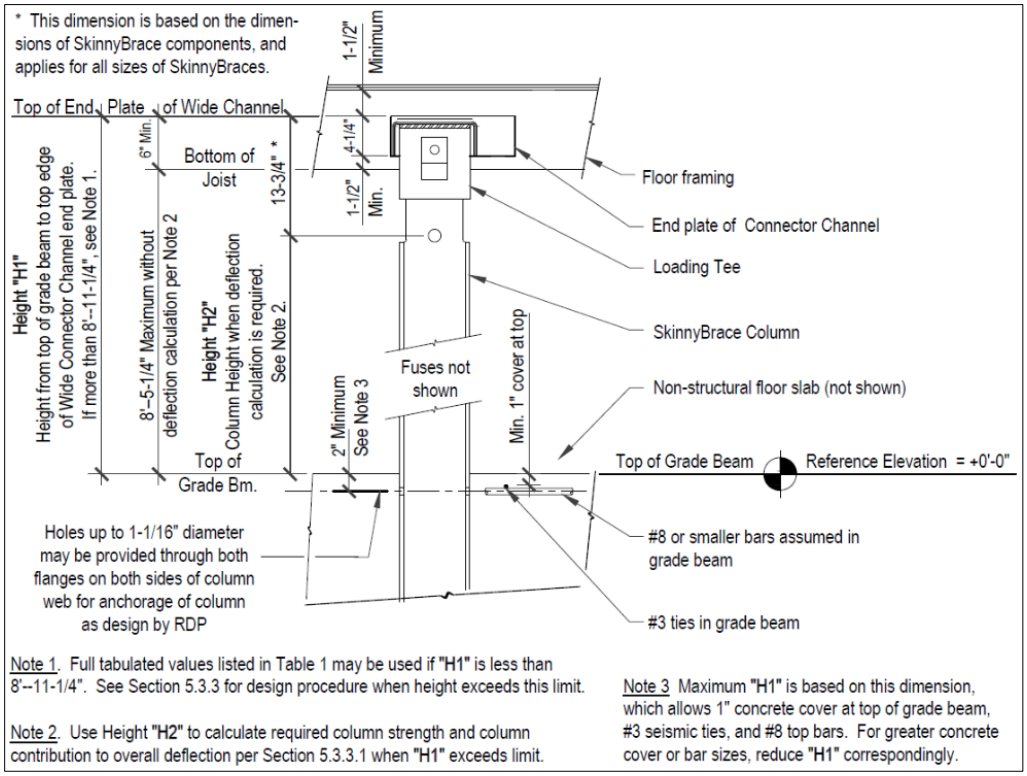


Figure 4. Height Determination for Connection to Joists

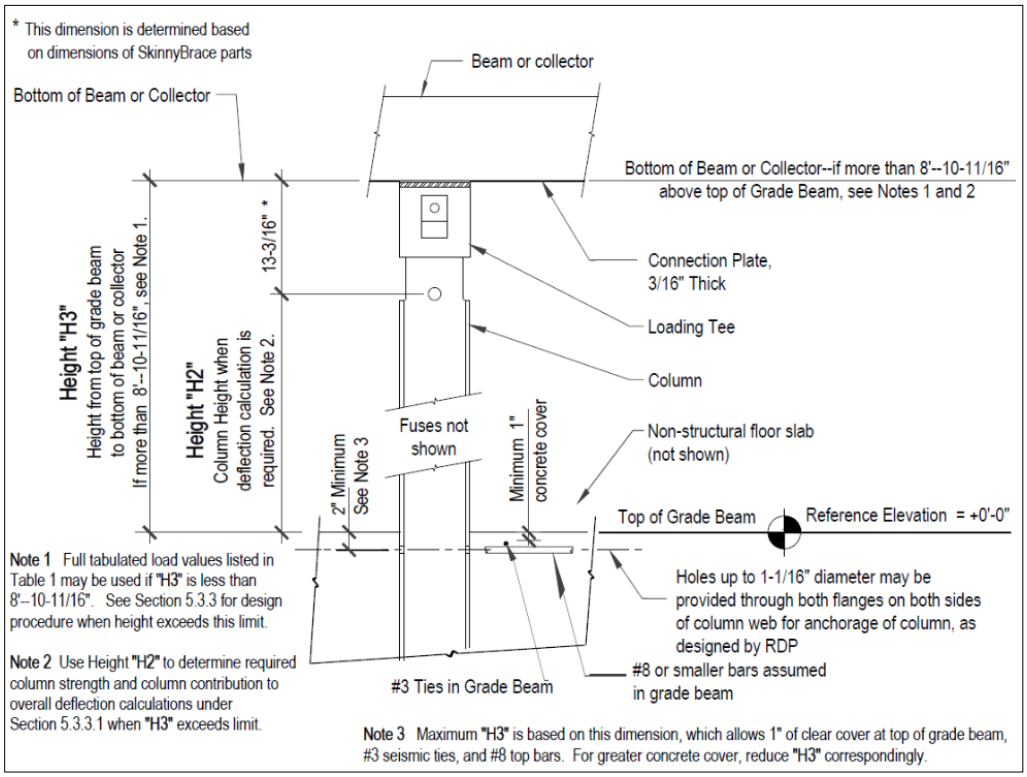


Figure 5. Height Measurements at Connection to Beam Collector

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6.5 If the Magnitude10 brace installation is not mandated by state or local regulations or where the Authority Having Jurisdiction allows, the RDP is permitted to specify the size of the steel column onto which the *"Structural Fuse Kit"* will be installed.

6.5.1 Nominal depth of the column shall be at least 8" for the A and AX models.

6.5.2 Nominal depth of the column shall be at least 12" for the F and FX models.

6.5.3 Corresponding allowable loads will be developed by the RDP.

6.6 Alternative techniques shall be permitted in accordance with accepted engineering practice and experience. These provisions for the use of alternative materials, designs, and methods of construction are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed herein. This includes, but is not limited to, the following areas of engineering: mechanics of materials, structures, building science, and fire science.

7 Certified Performance[27]

7.1 All construction methods shall conform to accepted engineering practices to ensure durable, livable, and safe construction and shall demonstrate acceptable workmanship reflecting journeyman quality of work of the various trades.[28]

7.2 The strength and rigidity of the component parts and/or the integrated structure shall be determined by engineering analysis or by suitable load tests to simulate the actual loads and conditions of application that occur.[29]

8 Regulatory Evaluation and Accepted Engineering Practice

8.1 The Magnitude10 brace complies with the following legislatively adopted regulations and/or accepted engineering practice for the following reasons:

8.1.1 Magnitude10 brace was evaluated to determine the following:

8.1.1.1 Structural performance for shear wall assemblies used as lateral force resisting systems in Seismic Design Categories A through F, have been tested and evaluated in accordance with the following standards:

8.1.1.1.1 ASCE/SEI 7: Minimum Design Loads and Associated Criteria for Buildings and Other Structures

8.1.1.1.2 ASTM D7989: Standard Practice for Demonstrating Equivalent In-Plane Lateral Seismic Performance to Wood-Frame Shear Walls Sheathed with Wood Structural Panels

8.1.1.1.3 ASTM E2126: Standard Test Methods for Cyclic (Reversed) Load Test for Shear Resistance of Vertical Elements of the Lateral Force Resisting Systems for Buildings

8.1.1.2 Lateral force resisting systems for use in both wind and seismic applications follow the performance-based provisions of IBC Section 2306.1, IBC Section 2306.3, and/or SDPWS Section 4.3 for light-frame wood wall assemblies.

8.1.1.2.1 **Table 2** provides Seismic Design Coefficients (SDC) that conform to the requirements in ASCE 7, Section 12.2.1, Section 12.2.1.1, and Table 12.2-1 for design of wall assemblies in buildings that require seismic design.

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8.1.1.3 Proprietary *"shear wall"* assemblies tested in accordance with ASTM D7989, as permitted by FEMA P 1100-2b, Sheet S1, Section M, for use in prescriptive seismic retrofits of one and two-family dwellings.

8.1.1.3.1 The basis for equivalency testing is outlined in Section 12.2.1.1 of ASCE 7:

> 12.2.1.1 Alternative Structural Systems. Use of seismic force-resisting systems not contained in Table 12.2-1 shall be permitted contingent on submittal to and approval by the Authority Having Jurisdiction and independent structural design review of an accompanying set of design criteria and substantiating analytical and test data. The design criteria shall specify any limitations on system use, including Seismic Design Category and height; required procedures for designing the system's components and connections; required detailing; and the values of the response modification coefficient, R; overstrength factor, Ω_0; and deflection amplification factor, C_d.

8.1.1.3.2 The seismic evaluation performed as part of this report is based on testing executed in accordance with ASTM D7989 and ASTM E2126 to establish SDC that conforms to the requirements of ASCE 7, Section 12.2.1.1.

8.2 The Magnitude10 brace has been evaluated for lateral load only. Use for resisting gravity loads is outside the scope of this report and is not approved.

8.3 Any building code, regulation and/or accepted engineering evaluations (e.g., research reports, duly authenticated reports, etc.) that are conducted for this Listing were performed by DrJ, which is an ISO/IEC 17065 accredited certification body and a professional engineering company operated by RDP or approved sources. DrJ is qualified[30] to practice product and regulatory compliance services within its scope of accreditation and engineering expertise,[31] respectively.

8.4 Engineering evaluations are conducted with DrJ's ANAB accredited ICS code scope of expertise, which is also its areas of professional engineering competence.

9 Installation

9.1 Installation shall comply with the approved construction documents, the manufacturer installation instructions, this report, and the applicable building code.

9.2 In the event of a conflict between the manufacturer installation instructions and this report, contact the manufacturer for counsel on the proper installation method.

9.3 *Typical Installation Procedure*

9.3.1 Install the Connector Channels between framing members. For installation to the bottom of a beam or collector, install the Connector Plate to the underside of the structural member.

9.3.2 Excavate a trench for the Magnitude10 brace footing.

9.3.3 Install the Magnitude10 brace to the Connector Channels or Connector Plate.

9.3.4 Assemble the reinforcement *"cage"* around the base of the Magnitude10 brace column.

9.3.5 Place concrete in the footing trench to match the surface of the existing concrete slab.

9.4 All Magnitude10 brace installations in new or existing construction shall be accompanied by a complete set of detailed design drawings sealed by the RDP, setting forth the components to be used for the installation and the requirements for installation.

9.4.1 When used in existing construction, consideration shall be given to the condition of the existing building and the ability to retrofit the building with the Magnitude10 brace system to provide the alternate lateral load resisting system.

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9.5 Sizing of the Magnitude10 brace system components shall be such that the resistance provided exceeds the loading requirements of the building code in force in the jurisdiction where the Magnitude10 brace is being installed.

9.6 The Magnitude10 brace system shall also be designed to limit deflections and story drift to no more than those allowed in accordance with the adopted building code.

9.7 Collectors and their connections, and bearing and anchorage of the steel column, shall be designed in accordance with the special load combinations of ASCE 7, Section 12.4.3.

9.8 Where connection to framing cannot be accomplished using the Connector Channels or Connection Plates provided by the manufacturer, the building designer shall design an alternative connection from the Loading Tee to the existing structure. The alternative connection shall provide for special load combinations of ASCE 7, Section 12.4.3.

10 Substantiating Data

10.1 Testing has been performed under the supervision of a professional engineer and/or under the requirements of ISO/IEC 17025 as follows:

10.1.1 Seismic test data analysis in accordance with ASTM D7989

10.1.2 Cyclical shear resistance testing in accordance with ASTM E2126

10.2 Yield Link Connection Providing Ductility and Hysteretic Energy Dissipation with Easily Replaceable Elements to Reduce Earthquake Damage and Recovery Time, SEAOC Convention Proceedings, 2016

10.3 Information contained herein may include the result of testing and/or data analysis by sources that are approved agencies, approved sources, and/or an RDP. Accuracy of external test data and resulting analysis is relied upon.

10.4 Where applicable, testing and/or engineering analysis are based upon provisions that have been codified into law through state or local adoption of regulations and standards. The developers of these regulations and standards are responsible for the reliability of published content. DrJ's engineering practice may use a regulation-adopted provision as the control. A regulation-endorsed control versus a simulation of the conditions of application to occur establishes a new material as being equivalent to the regulatory provision in terms of quality, strength, effectiveness, fire resistance, durability, and safety.

10.5 The accuracy of the provisions provided herein may be reliant upon the published properties of raw materials, which are defined by the grade mark, grade stamp, mill certificate, or duly authenticated reports from approved agencies and/or approved sources provided by the supplier. These are presumed to be minimum properties and relied upon to be accurate. The reliability of DrJ's engineering practice, as contained in this duly authenticated report, may be dependent upon published design properties by others.

10.6 *Testing and Engineering Analysis*

10.6.1 The strength, rigidity, and/or general performance of component parts and/or the integrated structure are determined by suitable tests that simulate the actual conditions of application that occur and/or by accepted engineering practice and experience.[32]

10.7 Where additional condition of use and/or regulatory compliance information is required, please search for Magnitude10 brace on the DrJ Certification website.

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11 Findings

11.1 As outlined in **Section 6**, Magnitude10 brace has performance characteristics that were tested and/or meet applicable regulations. In addition, they are suitable for use pursuant to its specified purpose.

11.2 When used and installed in accordance with this duly authenticated report and the manufacturer installation instructions, Magnitude10 brace shall be approved for the following applications:

11.2.1 The Quake Bracing, LLC Magnitude10 brace system is approved to replace or supplement lateral resisting systems (e.g., wood structural panel shear walls).

11.2.1.1 Approval of Magnitude10 brace is based on the testing listed in **Section 10**, which has been submitted in accordance with IBC Section 1703.4.

11.3 Unless exempt by state statute, when the Magnitude10 brace is to be used as a structural and/or building envelope component in the design of a specific building, the design shall be performed by an RDP.

11.4 Any application specific issues not addressed herein can be engineered by an RDP. Assistance with engineering is available from Quake Bracing, LLC.

11.5 IBC Section 104.2.3[33] (IRC Section R104.2.2[34] and IFC Section 104.2.3[35] are similar) in pertinent part state:

> 104.2.3 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 is not specifically prohibited by this code and has been approved.

11.6 **Approved:**[36] Building regulations require that the building official shall accept duly authenticated reports.[37]

11.6.1 An approved agency is *"approved"* when it is ANAB ISO/IEC 17065 accredited.

11.6.2 An approved source is *"approved"* when an RDP is properly licensed to transact engineering commerce.

11.6.3 Federal law, Title 18 US Code Section 242, requires that, where the alternative product, material, service, design, assembly, and/or method of construction is not approved, the building official shall respond in writing, stating the reasons why the alternative was not approved. Denial without written reason deprives a protected right to free and fair competition in the marketplace.

11.7 DrJ is a licensed engineering company, employs licensed RDPs and is an ANAB Accredited Product Certification Body – Accreditation #1131.

11.8 Through the IAF Multilateral Arrangement (MLA), this duly authenticated report can be used to obtain product approval in any jurisdiction or country because all ANAB ISO/IEC 17065 duly authenticated reports are equivalent.[38]

12 Conditions of Use

12.1 As defined in **Section 6**, where material and/or engineering mechanics properties are created for load resisting design purposes, the resistance to the applied load shall not exceed the ability of the defined properties to resist those loads using the principles of accepted engineering practice.

12.2 As listed herein, the Magnitude10 brace shall not be used to carry vertical loads.

12.3 Special inspection of each installed Magnitude10 brace shall be conducted by a qualified third-party inspector as required by the manufacturer installation requirements and the jurisdiction where the Magnitude10 brace is installed.

12.4 Any generally accepted engineering calculations needed to show compliance with this report shall be submitted to the code official for review and approval.

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12.5 When required by adopted legislation and enforced by the building official, also known as the Authority Having Jurisdiction (AHJ) in which the project is to be constructed:

12.5.1 Any calculations incorporated into the construction documents shall conform to accepted engineering practice and, when prepared by an approved source, shall be approved when signed and sealed.

12.5.2 This report and the installation instructions shall be submitted at the time of permit application.

12.5.3 At a minimum, this innovative product shall be installed per **Section 9**.

12.5.4 The review of this report by the AHJ shall comply with IBC Section 104.2.3.2 and IBC Section 105.3.1.

12.5.5 This innovative product has an internal quality control program and a third party quality assurance program in accordance with IBC Section 104.7.2, IBC Section 110.4, IBC Section 1703, IRC Section R104.7.2, and IRC Section R109.2.

12.5.6 The application of thishese] innovative product in the context of this report is dependent upon the accuracy of the construction documents, implementation of installation instructions, inspection as required by IBC Section 110.3, IRC Section R109.2, and any other regulatory requirements that may apply.

12.6 The approval of this report by the AHJ shall comply with IBC Section 1707.1, where legislation states in part, *"the building official shall make, or cause to be made, the necessary tests and investigations; or the building official shall accept duly authenticated reports from approved agencies in respect to the quality and manner of use of new materials or assemblies as provided for in Section 104.2.3"*, all of IBC Section 104, and IBC Section 105.3.

12.7 Design loads shall be determined in accordance with the regulations adopted by the jurisdiction in which the project is to be constructed and/or by the building designer (i.e., owner or RDP).

12.8 The actual design, suitability, and use of this report for any particular building, is the responsibility of the owner or the authorized agent of the owner.

13 Identification

13.1 The Magnitude10 brace, as listed in **Section 1.1**, is identified by a label on the board or packaging material bearing the manufacturer name, product name, this report number, and other information to confirm code compliance.

13.2 Additional technical information can be found at www.quakebracing.com/installation-instructions.

14 Review Schedule

14.1 This report is subject to periodic review and revision. For the latest version, visit www.drjcertification.org.

14.2 For information on the status of this report, please contact DrJ Certification.

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Issue Date: September 14, 2021
Supplement Revision Date: July 23, 2026
Subject to Renewal: October 1, 2027

CBC and CRC Supplement to Report Number 1711-02

REPORT HOLDER: Quake Bracing, LLC

1 Evaluation Subject

1.1 Magnitude10 brace:

1.1.1 Size A

1.1.2 Size AX

1.1.3 Size F

1.1.4 Size FX

2 Purpose and Scope

2.1 Purpose

2.1.1 The purpose of this Report Supplement is to show Magnitude10 brace, recognized in Report Number 1711-02 has also been evaluated for compliance with the codes listed below.

2.2 *Applicable Code Editions*

2.2.1 *CBC — 22, 25: California Building Code (Title 24, Part 2)*

2.2.2 *CRC — 22, 25: California Residential Code (Title 24, Part 2.5)*

3 Conclusions

3.1 The Magnitude10 brace, described in Report Number 1711-02, complies with the CBC and CRC and is subject to the conditions of use described in this supplement.

3.2 Where there are variations between the IBC and IRC and the CBC and CRC applicable to this report, they are listed here:

3.2.1 CBC Section 104.11 replaces IBC Section 104.2.3 and IBC Section 104.2.3.2.

3.2.2 CBC Section 104.7 replaces IBC Section 104.7.2.

3.2.3 CBC Section 1703.4 replaces IBC Section 1703.4.

3.2.4 CBC Section 1707.1 replaces IBC Section 1707.1.

3.2.5 CRC Section R104.4 replaces IRC Section R104.7.2.

3.2.6 CRC Section R104.11 replaces IRC Section R104.2.2.

4 Conditions of Use

4.1 Magnitude10 brace, described in Report Number 1711-02, must comply with all of the following conditions:

4.1.1 All applicable sections in Report Number 1711-02.

4.1.2 The design, installation, and inspections are in accordance with additional requirements of CBC and CRC, as applicable.

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Notes

1 For more information, visit drjcertification.org or call us at 608-310-6748.

2 Capitalized terms and responsibilities are defined pursuant to the applicable building code, applicable reference standards, the latest edition of TPI 1, the NDS, AISI S202, US professional engineering law, Canadian building code, Canada professional engineering law, Qualtim External Appendix A: Definitions/Commentary, Qualtim External Appendix B: Project/Deliverables, Qualtim External Appendix C: Intellectual Property and Trade Secrets, definitions created within Design Drawings and/or definitions within Reference Sheets. Beyond this, terms not defined shall have ordinarily accepted meanings as the context implies. Words used in the present tense include the future; words stated in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural, the singular.

3 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1702

4 Alternative Materials, Design and Methods of Construction and Equipment: The provisions of any regulation code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by a regulation. Please review https://www.justice.gov/atr/mission and https://up.codes/viewer/mississippi/ibc-2024/chapter/1/scope-and-administration#104.2.3

5 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1706.2:~:text=the%20design%20strengths%20and%20permissible%20stresses%20shall%20be%20established%20by%20tests

6 The design strengths and permissible stresses of any structural material shall conform to the specifications and methods of design of accepted engineering practice. https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1706.1:~:text=Conformance%20to%20Standards-,The%20design%20strengths%20and%20permissible%20stresses,-of%20any%20structural

7 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1707.1:~:text=the%20building%20official%20shall%20make%2C%20or%20cause%20to%20be%20made%2C%20the%20necessary%20tests%20and%20investigations%3B%20or%20the%20building%20official%20shall%20accept%20duly%20authenticated%20reports%20from%20approved%20agencies%20in%20respect%20to%20the%20quality%20and%20manner%20of%20use%20of%20new%20materials%20or%20assemblies%20as%20provided%20for%20in%20Section%20104.2.3.

8 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1703.4.2

9 https://up.codes/viewer/mississippi/ibc-2024/chapter/2/definitions#approved_agency

10 https://up.codes/viewer/mississippi/ibc-2024/chapter/2/definitions#approved_source

11 https://www.law.cornell.edu/uscode/text/18/1832 (b) Any organization that commits any offense described in subsection (a) shall be fined not more than the greater of $5,000,000 or 3 times the value of the stolen trade secret to the organization, including expenses for research and design and other costs of reproducing the trade secret that the organization has thereby avoided. The federal government and each state have a public records act. To follow DTSA and comply state public records and trade secret legislation requires approval through ANAB ISO/IEC 17065 accredited certification bodies or approved sources. For more information, please review this website: Intellectual Property and Trade Secrets.

12 https://www.nspe.org/resources/issues-and-advocacy/professional-policies-and-position-statements/regulation-professional AND https://apassociation.org/list-of-engineering-boards-in-each-state-archive/

13 https://www.cbitest.com/accreditation/

14 https://up.codes/viewer/mississippi/ibc-2024/chapter/1/scope-and-administration#104.1:~:text=directed%20to%20enforce%20the%20provisions%20of%20this%20code

15 https://up.codes/viewer/mississippi/ibc-2024/chapter/1/scope-and-administration#104.2.3 AND https://up.codes/viewer/mississippi/ibc-2024/chapter/1/scope-and-administration#105.3.1

16 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1707.1

17 https://iaf.nu/en/about-iaf-mla/#:~:text=Once%20an%20accreditation%20body%20is%20a%20signatory%20of%20the%20IAF%20MLA%2C%20it%20is%20required%20to%20recognise%20certificates%20and%20validation%20and%20verification%20statements%20issued%20by%20conformity%20assessment%20bodies%20accredited%20by%20all%20other%20signatories%20of%20the%20IAF%20MLA%2C%20with%20the%20appropriate%20scope

18 True for all ANAB accredited product evaluation agencies and all International Trade Agreements.

19 https://www.justice.gov/crt/deprivation-rights-under-color-law AND https://www.justice.gov/atr/mission

20 Unless otherwise noted, the links referenced herein use un-amended versions of the 2024 International Code Council (ICC) 2024 International Code Council (ICC) model codes as foundation references. Mississippi versions of the IBC 2024 and the IRC 2024 are un-amended. This material, product, design, service and/or method of construction also complies with the 2000-2012 versions of the referenced codes and the standards referenced therein. As pertinent to this technical and code compliance evaluation, CBI and/or DrJ staff have reviewed any state or local regulatory amendments to assure this report is in compliance.

21 See Adoptions by Publisher for the latest adoption of a non-amended or amended model code by the local jurisdiction. https://up.codes/codes/general

22 See Adoptions by Publisher for the latest adoption of a non-amended or amended model code by state. https://up.codes/codes/general

23 https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3282/subpart-A/section-3282.14

24 https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280

25 All references to the CBC and CRC are the same as the 2024 IBC and 2024 IRC unless otherwise noted in the California Supplement at the end of this report.

26 https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280#p-3280.2(Listed%20or%20certified); https://up.codes/viewer/mississippi/ibc-2024/chapter/2/definitions#listed AND https://up.codes/viewer/mississippi/ibc-2024/chapter/2/definitions#labeled

27 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1703.4

28 https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280#:~:text=All%20construction%20methods%20shall%20be%20in%20conformance%20with%20accepted%20engineering%20practices%20to%20insure%20durable%2C%20livable%2C%20and%20safe%20housing%20and%20shall%20demonstrate%20acceptable%20workmanship%20reflecting%20journeyman%20quality%20of%20work%20of%20the%20various%20trades

29 https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280#:~:text=The%20strength%20and%20rigidity%20of%20the%20component%20parts%20and/or%20the%20integrated%20structure%20shall%20be%20determined%20by%20engineering%20analysis%20or%20by%20suitable%20load%20tests%20to%20simulate%20the%20actual%20loads%20and%20conditions%20of%20application%20that%20occur

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[30] Qualification is performed by a legislatively defined Accreditation Body. ANSI National Accreditation Board (ANAB) is the largest independent accreditation body in North America and provides services in more than 75 countries. DrJ is an ANAB accredited product certification body.

[31] https://anabpd.ansi.org/Accreditation/product-certification/AllDirectoryDetails?prgID=1&orgID=2125&statusID=4#:~:text=Bill%20Payment%20Date-,Accredited%20Scopes,-13%20ENVIRONMENT.%20HEALTH

[32] See Code of Federal Regulations (CFR) Title 24 Subtitle B Chapter XX Part 3280 for definition: https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280

[33] 2021 IBC Section 104.11

[34] 2021 IRC Section R104.11

[35] 2018: https://up.codes/viewer/wyoming/ifc-2018/chapter/1/scope-and-administration#104.9 AND 2021: https://up.codes/viewer/wyoming/ibc-2021/chapter/1/scope-and-administration#104.11

[36] Approved is an adjective that modifies the noun after it. For example, Approved Agency means that the Agency is accepted officially as being suitable in a particular situation. This example conforms to IBC/IRC/IFC Section 201.4 (https://up.codes/viewer/mississippi/ibc-2024/chapter/2/definitions#201.4) where the building code authorizes sentences to have an ordinarily accepted meaning such as the context implies.

[37] https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1707.1

[38] Multilateral approval is true for all ANAB accredited product evaluation agencies and all International Trade Agreements.

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