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ICC-ES Evaluation Report

ESR-3820

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DIVISION: 03 00 00—CONCRETE

SECTION: 03 16 00—CONCRETE ANCHORS

SECTION: 03 41 00—PRECAST STRUCTURAL CONCRETE

SECTION: 03 47 00—SITE-CAST CONCRETE

REPORT HOLDER:

MAGMATECH LTD

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LONDON NW1 8HK
UNITED KINGDOM**

EVALUATION SUBJECT:

**MAGMATECH YETI-ANCHOR FIBER-REINFORCED WYTHE CONNECTORS FOR
INTEGRALLY INSULATED WALL PANELS**



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Section: 03 16 00—Concrete Anchors
Section: 03 41 00—Precast Structural Concrete
Section: 03 47 00—Site-cast Concrete

REPORT HOLDER:

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1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2015, 2012 and 2009 *International Building Code*® (IBC)

Property evaluated:

- Structural
- Environmental
- Physical and Mechanical

2.0 USES

Yeti-Anchor connectors (40H, 40D, 50H and 50D) are used as panel connections in integrally insulated concrete walls (commonly known as sandwich walls) to resist static and transient tension (40H, 40D, 50H and 50D) and shear loads (40H and 50H) in uncracked, normal-weight concrete having a specified strength, f'_c , of 2,500 psi to 6,000 psi. The connectors are alternatives to cast-in-place steel anchors described in Section 1901.3 of the 2015 IBC, Sections 1908 and 1909 of the 2012 IBC, or Sections 1911 and 1912 of the 2009 IBC.

3.0 DESCRIPTION

3.1 Connectors:

Yeti-Anchor connectors (40H, 40D, 50H and 50D) referred to as “connectors” in this report are fiber-reinforced composite connectors with dove-tail anchors at both ends for anchorage into wet concrete with a plastic stopper in the middle of the connector.

The connectors are illustrated in Figures 1 and 2. The connectors are produced by a pultrusion process from a polymer composite consisting of glass fiber reinforced epoxy vinyl ester. The stopper component is injection-molded from acrylonitrile butadiene styrene (ABS). Yeti-Anchor connectors measure 0.315 inch (8 mm) diameter.

3.2 Concrete:

Normal-weight concrete must conform to Section 1903 of the 2015 and 2012 IBC, or Section 1905 of the 2009 IBC, as applicable, and comply with the compressive strength requirements in Tables 3 and 4.

4.0 DESIGN AND INSTALLATION

4.1 Physical and Material Properties of the Connectors:

Design must be based on the physical and mechanical properties described in Tables 1 and 2.

4.2 Design for Tension and Shear:

Design must be performed using the applicable sections of the applicable codes with the allowable loads as noted in Tables 3 and 4. Allowable loads for Yeti-Anchor connectors subjected to interaction of shear and tension forces must be determined by the following equation:

$$\left(\frac{P_s}{P_t}\right)^{5/3} + \left(\frac{V_s}{V_t}\right)^{5/3} \leq 1$$

where:

P_s = Applied Service Tension Load (lbf or N)

P_t = Service Tension Load (lbf or N)

V_s = Applied Service Shear Load (lbf or N)

V_t = Service Shear Load (lbf or N)

4.3 Displacement of the Connectors:

The displacement due to gravity loads must be limited to 0.1 inch (2.54 mm). When the connector displacement exceeds the limiting value of 0.1 inch (2.54 mm) due to the gravity loads, the free end of the connector must be supported to maintain fixity by other means. The displacement must be calculated as follows (neglecting any contribution from the insulation in the intended application):

$$\Delta g = \frac{Q_g \cdot d_A^3}{12 \cdot E_{AB} \cdot I_A}$$

where:

Δg = Displacement due to gravity load (inch or mm)

Q_g = Gravity load on the connector, typically the weight of the fascia layer of the tributary area for the connector (lbf or kN), $Q_g = t \cdot a \cdot b \cdot y$, where:

t = thickness of the fascia layer (inch or mm);

a = horizontal spacing of the connector (feet or mm);

b = vertical spacing of the connector (feet or mm);

y = density of concrete (lb/ft³ or kN/m³).

$$d_A = d_d + \frac{2h_v}{3} \left[1 - \frac{1}{1 + \frac{h_v}{d_d}} \right]$$

d_A = Connector bending length, a function of insulation thickness and embedment (inch or mm).

d_d = Insulation thickness (inch or mm).

h_v = Embedment length of the connector in concrete.

E_{AB} = 0.95 times the flexural modulus of elasticity as given in table 1 (psi or MPa).

I_A = Moment of inertia of the connector as given in table 1 (in⁴ or mm⁴).

The deflection of the connector may be decreased by reducing the connector spacing, but not less than 8 inches (203 mm) on center each way.

4.4 Installation:

Connector orientations and locations must comply with the plans and specifications approved by the code official.

Yeti-Anchor connectors must be installed in accordance with the instructions provided by MagmaTech Ltd. The instructions are provided with each shipment of the connectors. The minimum embedment, critical edge distance, and critical spacings must comply with Table 2 of this report.

The minimum concrete thickness must comply with the applicable code requirements or Table 2, whichever is greater. Within 20 minutes after the bottom layer of concrete is placed, code-complying rigid insulation board with holes sized to accept the connectors must be placed over the concrete while it is in the plastic state. The connectors, sized to match the insulation board thickness, are inserted through the holes in the insulation board into the bottom layer of concrete, until the prescribed embedment is reached. Concrete consolidation around the connectors must be conducted in accordance with the applicable code and MagmaTech Ltd's published installation instructions. The top layer of concrete is then placed over the insulation board, engaging the connectors and consolidated. Panels must cure in accordance with the applicable code.

4.5 Special Inspection:

Installations must be made under special inspection in accordance with Section 1705.1.1 and Table 1705.3 of the 2015 and 2012 IBC, or Section 1704.15 and Table 1704.4 of the 2009 IBC. The special inspector must be on the jobsite continuously during connector installation to verify connector type, connector dimensions, and cleanliness, embedment depth, concrete type, concrete compressive strength, edge distance(s), connector spacing(s), concrete thickness, concrete consolidation and concrete curing.

5.0 CONDITIONS OF USE

The Yeti-Anchor connectors described in this report complies with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

- 5.1 Connector sizes, dimensions, and installation must comply with the information in this report and MagmaTech Ltd's published installation instructions. In case of a conflict between this report and any other documentation, this report governs.
- 5.2 Allowable tension and shear loads must be used as noted in Table 3 & 4.
- 5.3 Calculations and details demonstrating compliance with this report must be submitted to the code official for approval. The calculations and details must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.
- 5.4 Design and installation of concrete wall panels, except as specifically noted in this report, is outside the scope of this report and must comply with the applicable code.
- 5.5 Connectors may be recognized for interior exposure, exterior exposure or damp environments.
- 5.6 Connectors must not be permitted in contact with preservative-treated and fire-retardant-treated wood.
- 5.7 Special inspection must be provided in accordance with Section 4.5 of this report.
- 5.8 Since ICC-ES acceptance criteria for evaluating data to determine the performance of connectors subjected to fatigue or shock loading is unavailable at this time, the use of these connectors under these conditions is beyond the scope of this statement.
- 5.9 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of fiber-reinforced connectors in cracked concrete is unavailable at this time, the use of these connectors must be limited to installation in uncracked, normal-weight concrete. Cracking occurs when $f_t > f_r$ due to service loads or deformations.
- 5.10 Connectors must not be permitted for use in conjunction with fire-resistant-rated construction, except when connectors resist wind loading only, or for other than wind loading, special consideration is given to fire exposure conditions.
- 5.11 Use of the connectors to resist seismic loads is beyond the scope of this report.
- 5.12 Connectors are manufactured by MagmaTech Ltd, under a quality control program with inspections conducted by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Fiber-reinforced Composite Connectors Anchored in Concrete (AC320), dated October 2015, including creep tests.

7.0 IDENTIFICATION

The connectors must be identified in the field by dimensional characteristics and packaging. The packaging label indicates the MagmaTech Ltd name and address, and the ICC-ES report number (ESR-3820).

TABLE 1—PHYSICAL AND MECHANICAL PROPERTIES

DESCRIPTION	Yeti 40 H AND 40 D		Yeti 50 H AND 40 D	
	Customary Units	SI Units	Customary Units	SI Units
Cross-sectional area	0.078 in ²	50.3 mm ²	0.078 in ²	50.3 mm ²
Moment of inertia	0.000483 in ⁴	201 mm ⁴	0.000483 in ⁴	201 mm ⁴
Embedment Depth (H - horizontal configuration)	1.60 inches	40 mm	2.00 inches	50 mm
Embedment depth (D - diagonal configuration perpendicular to panel)	1.50 inches	38 mm	1.8 inches	47 mm
Embedment Depth (D - Diagonal Configuration)	2.10 inches	54 mm	2.60 inches	67 mm
Bending elastic modulus (flexural modulus)	7,291,448 psi	50,272 MPa	7,291,448 psi	50,272 MPa

TABLE 2—INSTALLATION PARAMETERS

DESCRIPTION	Yeti 40 H ²	Yeti 40 D ³	Yeti 50 H ²	Yeti 50 D ³
Embedment Depth ¹	1.60 inches	2.10 inches	2.00 inches	2.60 inches
Critical Edge Distance	4.00 inches	4.00 inches	4.00 inches	4.00 inches
Critical Spacing	8.00 inches	8.00 inches	8.00 inches	8.00 inches
Minimum Concrete Depth	2.00 inches	2.00 inches	3.00 inches	3.00 inches

For SI: 1 inch = 25.4 mm.

¹ According to Figure 3 of this report.

² Horizontal configuration.

³ Diagonal configuration.

TABLE 3—ALLOWABLE TENSION AND SHEAR VALUES IN NORMAL-WEIGHT CONCRETE 1.6-INCH EMBEDMENT DEPTH¹

	CONCRETE COMPRESSIVE STRENGTH							
	2,500psi (17MPa)	3,000psi ² (21MPa)	3,500psi ² (24MPa)	4,000psi (28MPa)	4,500psi ² (31MPa)	5,000psi ² (34MPa)	5,500psi ² (38MPa)	6,000psi (41MPa)
Yeti 40 H Static Tension (90 degrees to panel)	305 lb (1.4 kN)	351 lb (1.6 kN)	396 lb (1.8 kN)	442 lb (2.0 kN)	463 lb (2.1 kN)	485 lb (2.2 kN)	506 lb (2.2 kN)	527 lb (2.3 kN)
Yeti 40 D Static Tension (45 degrees to panel)	-	-	-	355 lb (1.6 kN)	453 lb (2.0)	552 lb (2.5)	650 lb (2.9)	748 lb (3.3 kN)
Yeti 40 H Static Shear (90 degrees to panel)	232 lb (1.0 kN)	232 lb (1.0 kN)	232 lb (1.0 kN)	232 lb (1.0 kN)	232 lb (1.0 kN)	232 lb (1.0 kN)	232 lb (1.0 kN)	232 lb (1.0 kN)

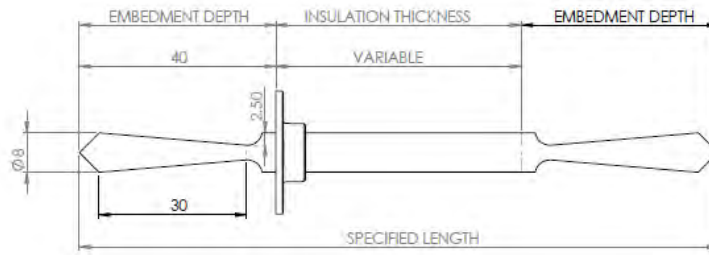
¹ Allowable loads have been determined by applying a factor of safety of 4 to the test results.

TABLE 4—ALLOWABLE TENSION AND SHEAR VALUES IN NORMAL-WEIGHT CONCRETE 2-INCH EMBEDMENT DEPTH¹

	CONCRETE COMPRESSIVE STRENGTH							
	2,500psi (17MPa)	3,000psi (21MPa)	3,500psi (24MPa)	4,000psi (28MPa)	4,500psi (31MPa)	5,000psi (34MPa)	5,500psi (38MPa)	6,000psi (41MPa)
Yeti 50 H Static Tension (90 degrees to panel)	461 lb (2.1 kN)	595 lb (2.6 kN)	730 lb (3.2 kN)	864 lb (3.8 kN)	866 lb (3.9 kN)	869 lb (3.9 kN)	871 lb (3.9 kN)	873 lb (3.9 kN)
Yeti 50 D Static Tension (45 degrees to panel)	-	-	-	600 lb (2.7 kN)	670 lb (3.0 kN)	739 lb (3.3 kN)	809 lb (3.6 kN)	878 lb (3.9 kN)
Yeti 50 H Static Shear (90 degrees to panel)	232 lb (1.0 kN)	232 lb (1.0 kN)	232 lb (1.0 kN)	232 lb (1.0 kN)	232 lb (1.0 kN)	232 lb (1.0 kN)	232 lb (1.0 kN)	232 lb (1.0 kN)

¹ Allowable loads have been determined by applying a factor of safety of 4 to the test results.

YETI 40 H



YETI 40 D

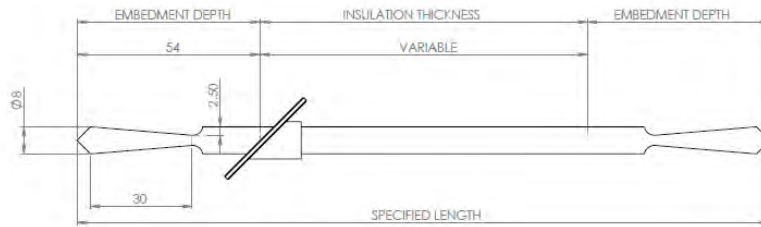
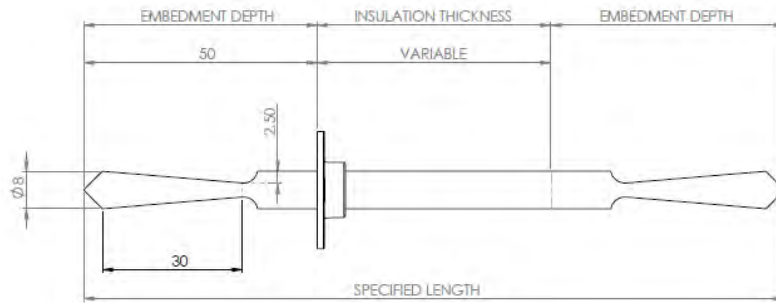


FIGURE 1—YETI 40 HORIZONTAL (H) AND DIAGONAL (D) CONFIGURATIONS

YETI 50 H



YETI 50 D

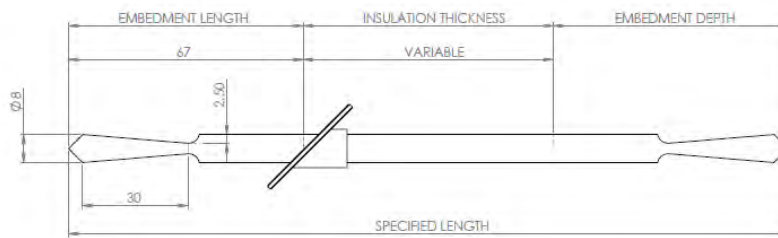


FIGURE 2—YETI 50 HORIZONTAL (H) AND DIAGONAL (D) CONFIGURATIONS

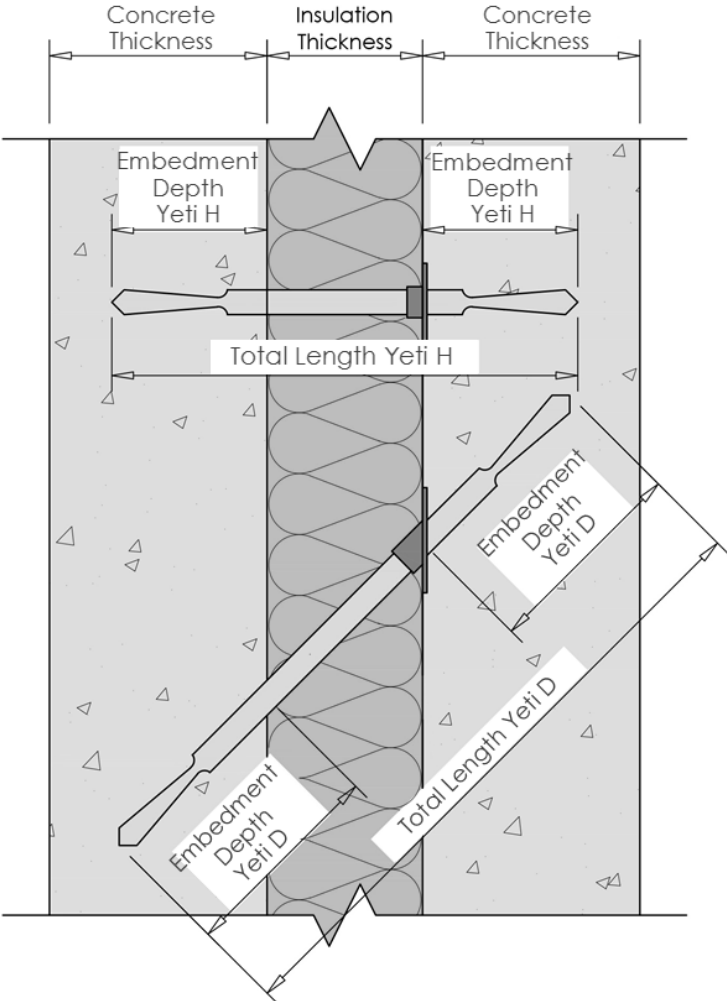


FIGURE 3—EMBEDMENT DETAIL OF YETI H AND YETI D

ICC-ES Evaluation Report

ESR-3820 FBC Supplement

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1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the Magmatech Yeti-Anchor Fiber-Reinforced Wythe Connectors for Integrally Insulated Wall Panels, recognized in ICC-ES master evaluation report ESR-3820, have also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2014 *Florida Building Code—Building*
- 2014 *Florida Building Code—Residential*

2.0 CONCLUSIONS

The Magmatech Yeti-Anchor Fiber-Reinforced Wythe Connectors for Integrally Insulated Wall Panels, described in master evaluation report ESR-3820, comply with the *Florida Building Code—Building* and the *Florida Building Code—Residential*, when designed and installed in accordance with the 2012 *International Building Code*® provisions noted in the master report.

Use of the Magmatech Yeti-Anchor Fiber-Reinforced Wythe Connectors for Integrally Insulated Wall Panels for compliance with the High-Velocity Hurricane Zone Provisions of the *Florida Building Code—Building* and the *Florida Building Code—Residential* has not been evaluated and is outside the scope of this supplement.

For products falling under Florida Rule 9N-3, verification that the report holder's quality-assurance program is audited by a quality-assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official, when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the master report, issued October 2017.