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:

COMPOSITE TECHNOLOGIES, LLC dba THERMOMASS

EVALUATION SUBJECT:

THERMOMASS® MC AND MS FIBER REINFORCED COMPOSITE WYTHE CONNECTORS FOR INTEGRALLY INSULATED WALL PANELS
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Section: 03 16 00—Concrete Anchors
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1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2013 Abu Dhabi International Building Code (ADIBC)†
- 1997 Uniform Building Code™ (UBC)

†The ADIBC is based on the 2009 IBC. 2009 IBC code sections referenced in this report are the same sections in the ADIBC.

Properties evaluated:

- Structural
- Environmental
- Physical and mechanical

2.0 USES

The MC and MS connectors are used in integrally insulated concrete walls (commonly known as sandwich walls) to resist static and transient tension and shear loads in uncracked, normal-weight concrete. 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, Sections 19 11 and 1912 of the 2009 IBC, and Section 1923 of the UBC.

3.0 DESCRIPTION

3.1 Connectors:

MC and MS connectors are fiber-reinforced composite connectors with dove-tail anchors at both ends for anchorage into wet concrete with a plastic overmold in the middle of the connector. The connectors are illustrated in Figure 1. The connectors are produced by a pultrusion process from a polymer composite consisting of epoxy vinylester resin reinforced with glass fibers. The overmold is injection-molded from polystyrene plastic.

The MC and MS connectors measure 0.224 inch (5.7 mm) thick and 0.393 inch (10 mm) wide.

3.2 Concrete:

Normal-weight concrete must conform to Section 1903 of the IBC or UBC and Section 1905 of the 2009 IBC or UBC, as applicable and comply with the compressive strength requirements in Table 2.

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 and using the allowable loads as noted in Table 2. Allowable loads for MC or MS connectors subjected to combined shear and tension forces must be determined by the following equation:

\[(P_s/P_t) + (V_s/V_t) \leq 1\]

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 Connector:

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):

\[\Delta_g = \frac{Q_g \cdot dA^3}{12E_{Ad} \cdot I_A}\]

where:

- \(\Delta_g\) = 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).
- \(d\) = Thickness of the fascia layer (feet or m);
5.0 CONDITIONS OF USE

The Thermomass MC and MS connectors described in this report comply 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 this report and Thermomass published installation instructions. In case of a conflict between this report and other documentation, this report governs.

5.2 Allowable tension and shear loads must be as noted in the Table 2.

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 the concrete wall panels, except as specifically noted in this report, is outside the scope of the 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 an 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 report.

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 \( f_r > f_c \), due to service loads or deformations.

5.10 Connectors must not be permitted for use in conjunction with fire-resistance-rated construction. Exceptions are:

- Connectors resist wind loading only.
- For other wind loading, special consideration is given to fire exposure conditions.

5.11 Seismic or wind load under the IBC: Use of the connectors to resist seismic loads is beyond the scope of this report. When using the basic load combinations in accordance with IBC Section 1605.3.1.1, allowable loads are not permitted to be increased for wind loading. When using the alternative basic load combinations in IBC Section 1605.3.2 that include wind loads, the allowable shear and tension loads for connectors may be increased.

5.12 Seismic or wind load under the UBC: When using the basic load combinations in accordance with UBC Section 1612.3.1, allowable loads are not permitted to be increased for wind or seismic loading. When using the alternative basic load combinations in UBC Section 1612.3.2 that include wind or seismic loads, the allowable shear and tension loads for connectors are permitted to be increased by 33 \( \frac{1}{3} \) percent.

5.13 Connectors are manufactured by Composite Technologies, LLC dba Thermomass, 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 Polymer Composite or Unreinforced
Polymer Connectors Anchored in Concrete (AC320), dated October 2015, including seismic tests, creep tests, and extreme temperature tests.

7.0 IDENTIFICATION

7.1 The connectors must be identified in the field by dimensional characteristics and packaging. The packaging label indicates the Composite Technologies, LLC dba Thermomass name and address, and the ICC-ES report Number (ESR-1746). Each connector is stamped with the lot number.

7.2 The report holder’s contact information is the following:

COMPOSITE TECHNOLOGIES, LLC dba THERMOMASS
1000 TECHNOLOGY DRIVE
POST OFFICE BOX 950
BOONE, IOWA 50036
(515) 433-6075
www.thermomass.com
vsehhappa@thermomass.com
bnesset@thermomass.com

<table>
<thead>
<tr>
<th>TABLE 1—PHYSICAL AND MECHANICAL PROPERTIES</th>
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<tbody>
<tr>
<td>DESCRIPTION</td>
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<tr>
<td></td>
</tr>
<tr>
<td>Cross-sectional area</td>
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<tr>
<td>Average moment of inertia</td>
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<td>Embedment depth</td>
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<tr>
<td>Bending elastic modulus (flexural modulus)</td>
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<tr>
<th>TABLE 2—ALLOWABLE TENSION AND SHEAR VALUES IN NORMAL-WEIGHT CONCRETE¹ (in pounds)</th>
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<tbody>
<tr>
<td>DESCRIPTION</td>
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<tr>
<td></td>
</tr>
<tr>
<td>Static tension</td>
</tr>
<tr>
<td>Static shear, parallel to strong axis</td>
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<tr>
<td>Static shear, parallel to weak axis</td>
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<tr>
<td>Seismic tension³</td>
</tr>
<tr>
<td>Seismic shear, parallel to strong axis³</td>
</tr>
<tr>
<td>Seismic shear, parallel to weak axis³</td>
</tr>
<tr>
<td>High-temperature tension (at 150°F)</td>
</tr>
<tr>
<td>Low-temperature tension (at −40°F)</td>
</tr>
</tbody>
</table>

For SI: 1 psi = 6.9 kPa, 1 pound = 4.45 N, t°C = 5/9(t° − 32).

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

²Concrete must achieve this compressive strength before anchors are loaded [minimum of 24 MPa is required under ADIBC Appendix L, Section 5.1.1].

³For use under the UBC only.

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<tr>
<th>TABLE 3—INSTALLATION PARAMETERS</th>
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<tbody>
<tr>
<td>DESCRIPTION</td>
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<tr>
<td>Embedment</td>
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<tr>
<td>Critical edge distance</td>
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<tr>
<td>Critical spacing</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm.
MC CONNECTOR PROFILE
(ALL DIMENSIONS IN MM)

For customary units 25.4 mm = 1 inch.

MS CONNECTOR PROFILE
(ALL DIMENSIONS IN MM)

FIGURE 1