ICC-ES Evaluation Report

ESR-3815

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Subject to renewal January 2026

DIVISION: 04 00 00—MASONRY Section: 04 01 20—Maintenance of Unit Masonry	REPORT HOLDER: FORTRESS STABILIZATION SYSTEMS	EVALUATION SUBJECT: FORTRESS CARBON GRID STRAP FIBER-REINFORCED POLYMER COMPOSITE SYSTEM	

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2021, 2018, 2015, 2012 and 2009 *International Building Code®* (IBC)
- 2021, 2018, 2015, 2012 and 2009 *International Residential Code®* (IRC)
- 1997 *Uniform Building Code™* (UBC)

Properties evaluated:

- Structural
- Durability
- Surface burning characteristics

2.0 USES

The Fortress Carbon Grid Strap Fiber-Reinforced Polymer (FRP) Composite System is used to externally strengthen existing unreinforced masonry walls out-of-plane flexural strengths as an alternative to those systems permitted in the IBC and UBC, as described in Section 4.1 of this report. For structures regulated under the IRC, the Fortress Carbon Grid Strap Fiber-Reinforced Polymer (FRP) Composite Strengthening Systems may be used where an engineering design is submitted in accordance with Section R301.1.3 and where approved by the code official in accordance with Section R104.11.

3.0 DESCRIPTION

3.1 General:

The Fortress Carbon Grid Strap Fiber-Reinforced Polymer (FRP) Composite Systems are externally bonded fiber-reinforced polymer (FRP) systems applied to masonry substrates. The Fortress Carbon Grid Strap FRP consists of carbon fiber in an open grid, adhered to the substrate with Fortress 4000 or FSS Xtreme 4070 epoxy paste adhesives to create a FRP composite system.

3.2 Material:

3.2.1 General: All materials must comply with the approved specifications outlined in the Fortress Quality Manual, dated November 8, 2022.

3.2.2 Fortress Carbon Grid Strap Fiber-Reinforced Polymer (FRP) Precured Laminates: The Fortress Carbon Grid Strap FRP precured laminates are composed of three or more uni-directional carbon fiber tows,

precured with an epoxy matrix, bonded together with a transverse fiber producing an open grid. It is supplied in varying widths from 0.5 in. (10 mm) to 50 in. (1,250 mm).

3.2.3 Adhesive Epoxy:

3.2.3.1 Fortress 4000 Adhesive Epoxy: The Fortress 4000 adhesive epoxy is a two-component, ambient cure, epoxy resin system used to adhere Fortress Carbon Grid Strap FRP precured laminates to the substrate. The Fortress 4000 adhesive is packaged in a double-cylinder epoxy cartridge with a static mixing tube available in 300ml x 150ml, 600ml x 300ml tube sets; as well as in 3-gallon (11 L) and 165-gallon (624 L) kits and are mixed at the jobsite prior to application. The mixing ratio is 2:1 by volume (100:35 by weight) for components A and B, respectively.

3.2.3.2 FSS Xtreme 4070 Adhesive Epoxy: The FSS Xtreme 4070 adhesive epoxy is a two-component, ambient cure, epoxy resin paste system used to adhere Fortress Carbon Grid Strap FRP precured laminates to the substrate. The FSS Xtreme 4070 adhesive is packaged in a double cylinder epoxy cartridge with a static mixing tube available in 300ml x 300ml, 600ml x 600ml tube sets; as well as in 2-gallon (7.57 L) and 110 gallon (416 L) kits and are mixed at the jobsite prior to application. The mixing ratio is 1:1 by volume for components A and B, respectively.

3.3 Fortress Carbon Grid Strap Fiber-Reinforced Polymer (FRP) Composite System: In the primary direction, the Fortress Carbon Grid Strap FRP Composite System has a design ultimate tensile strength of 234.7 ksi (1,618 MPa), design tensile modulus of 16,300 ksi (112.3 GPa), and a corresponding design elongation of 1.29 percent. Nominal area of each tow is 0.005 in^2 (3.23 mm^2). The net-fiber area per unit width is 0.0274 $in.^2/in.$ (0.696 mm^2/mm). The Fortress Carbon Grid Strap FRP precured laminates are applied over the substrate continuously in a maximum single layer application.

3.4 Storage Recommendations: Adhesive epoxies and precured laminates should be stored in temperatures between 45ºF and 95ºF (7ºC and 35ºC) with no exposure to moisture. Shelf life must not exceed two years for the epoxies and ten years for the precured laminates.

4.0 DESIGN AND INSTALLATION

4.1 Design:

4.1.1 General: Design of the composite system must be based on required tensile loads at designated masonry strain values. The strength design requirements for masonry must be in accordance with Chapter 21 of the IBC and UBC, as applicable. The owner and registered design professional must be responsible for determining, through analysis, the strengths and demands of the structural elements to be strengthened by the Fortress Carbon Grid Strap FRP Composite System, subject to the approval of the code official.

4.1.2 Composite Design Properties: Structural design properties for the Fortress Carbon Grid Strap FRP Composite System can be found in the Fortress Carbon Grid Strap Design Manual, dated November 10, 2022.

4.1.3 Design Details: Structural design provisions for the composite system, as described in the Design Manual, are based on test results and principles of structural analysis as prescribed in IBC Section 1604.4. Bases of design include strain compatibility, load equilibrium and limit states. All designs must follow procedures as detailed in the IBC and UBC; in the ICC-ES Acceptance Criteria for Concrete and Reinforced and Unreinforced Masonry Strengthening Using Externally Bonded Fiber-Reinforced Polymer (FRP) Composite Systems (AC125), dated November 2021 (editorially revised March 2022); and applicable procedures detailed in the Design Manual, dated November 10, 2022.

4.1.4 Design Strength: The design strengths must be taken as the nominal strength, computed in accordance with Section 4.1.3 of this report, multiplied by the strength reduction factors as prescribed in Chapter 21 of the IBC and Section 2108 of the UBC, **as** applicable.

4.1.5 Load Combination: The load combinations used in design must comply with Section 1605 of the IBC or Section 1612 of the UBC, as applicable.

4.1.6 Walls:

4.1.6.1 Potential Applications: The Fortress Carbon Gird Strap FRP Composite System is applied to unreinforced masonry walls to enhance out-of-plane flexural strengths. The out-of-plane strengthening of masonry wall with Fortress Carbon Gird Strap FRP Composite System is limited to single layer application with a maximum masonry compressive strength of 2,500 psi (17.2 MPa).

4.1.6.2 Structural Design Requirements: Masonry design must comply with the Design Manual and with Chapter 21 of the IBC or UBC, as applicable.

4.1.7 Bond Strength: Where the performance of the FRP composite material depends on bond, as determined by the registered design professional, the bond strength of the Fortress Carbon Grid Strap FRP Composite System to a properly prepared surface must exceed the tensile strength of the masonry substrate and must not be less than $2.5x(f'_m)^{0.5}$. Testing in accordance with ASTM C237, D7234 or D7522 can be used to estimate the bond strength of bond-critical installations. The test must indicate failure in the host substrate. Sufficient bond area must be used to prevent bond failure.

4.2 Installation:

4.2.1 General: The Fortress Carbon Grid Strap FRP precured laminates must be installed on unreinforced masonry walls, as detailed in Section 3 of the Design Manual, dated November 10, 2022. A copy of the Installation Guide must be submitted to the code official for approval of each project that uses the Fortress Carbon Grid Strap FRP Composite System. Installation must be performed by approved applicators trained by the manufacturer in accordance with the published literature. Installation of the system is detailed in Section 3 of the Design Manual.

4.2.2 Saturation: The Fortress Carbon Grid Strap FRP precured laminates are supplied as precured carbon fiber grid and no additional saturation is required.

4.2.3 Application: The Fortress Carbon Grid Strap FRP precured laminates are applied to the substrate using manual methods. Surface preparation, fiber orientation and removal of air bubbles and voids must be done in accordance with the installation instruction detailed in Section 3 of the Design Manual, dated November 10, 2022.

4.2.4 Finishing: The Fortress Carbon Grid Strap FRP precured laminates are fully adhered and covered with the Fortress 4000 or FSS Xtreme 4070 adhesive epoxy which can be coated with paints that may be required for environmental and aesthetic reasons.

4.2.5 Cure Time Prior to Loading: The Fortress Carbon Grid Strap FRP Composite System must be allowed a minimum of 48 hours of cure time (depending on temperatures) prior to application of superimposed loading onto the structural element. Final determination of required cure time must be made by the registered design professional.

4.3 Flame Spread / Smoke Developed: The Fortress Carbon Grid Strap FRP system with maximum thickness of 0.0785 in^2 (50.6 mm^2) yields a Class 1 and Class A flame-spread classification and smoke-developed classification in compliance with the UBC and IBC. The Fortress Carbon Grid Strap FRP Composite System is limited to a maximum one layer.

4.4 Special inspection:

Special inspection during the installation of the system must be in accordance with the ICC-ES Acceptance Criteria for Inspection and Verification of Concrete and Unreinforced Masonry Strengthening Using Fiber-reinforced Polymer (FRP) Composite Systems (AC178), dated October 2017 (editorially revised December 2020). A statement of special inspection must be prepared in accordance with Sections 1704.3 of the 2021, 2018, 2015 and 2012 IBC or Section 1705 of the 2009 IBC. Inspection must also comply with Sections 1704 and 1705 of the 2021, 2018, 2015 and 2012 IBC, Section 1704 through 1707 of the 2009 IBC, or Section 1701 of the UBC, as applicable.

5.0 CONDITIONS OF USE:

The Fortress Carbon Grid Strap FRP Composite System described in this report complies with, or is a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 Design and installation must be in accordance with this report, the manufacturer's installation instructions, the Design Manual dated November 10, 2022, and the IBC, IRC, or UBC, as applicable.

5.2 Copies of the Fortress Carbon Grid Strap FRP Design Manual and Installation Manual must be submitted to the code official for approval with each project using the system.

5.3 Complete construction documents, including plans and calculations verifying compliance with this report, must be submitted to the code official for each project at the time of permit application. The construction documents must be prepared and sealed by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.4 Use of Fortress Carbon Grid Strap FRP Composite System in fire-resistance-rated assemblies is outside the scope of this evaluation report.

5.5 Multi-layer applications and lap splicing of Fortress Carbon Grid Strap FRP Composite System are outside the scope of this evaluation report.

5.6 Use of Fortress Carbon Grid Strap FRP Composite System in full contact with soil or drinking water is outside the scope of this evaluation report.

5.7 Special inspection must be provided in accordance with Section 4.4 of this report.

5.8 Application of Fortress Carbon Grid Strap FRP Composite System to unreinforced masonry walls at a fabricator's facility must be by an approved fabricator complying with Chapter 17 of the IBC or UBC, or at a jobsite with continuous special inspections in accordance with Chapter 17 of the IBC or UBC and Section 4.4 of this report.

5.9 Exterior exposure of Fortress Carbon Grid Strap FRP Composite System with FSS Xtreme 4070 Epoxy has not been evaluated and must not be exposed to direct sunlight.

5.10 Fortress Carbon Grid Strap FRP Composite System is manufactured by Fortress Stabilization Systems in Holland, Michigan, under a quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Concrete and Reinforced and Unreinforced Masonry Strengthening Using Fiber-reinforced Polymer (FRP) Composite Systems (AC125), dated November 2021 (editorially revised March 2022).

7.0 IDENTIFICATION

7.1 The ICC-ES mark of conformity, electronic labeling, or the evaluation report number (ICC-ES ESR-3815) along with the name, registered trademark, or registered logo of the report holder must be included in the product label.

7.2 In addition, the components of the Fortress Carbon Grid Strap Fiber-reinforced Polymer (FRP) Composite System (precured laminates and epoxy) described in this report are identified with a label indicating the name and address of the manufacturer (Fortress Stabilization Systems), product name, and expiration date.

7.3 The report holder's contact information is the following:

FORTRESS STABILIZATION SYSTEMS
184 WEST 64TH STREET
HOLLAND, MICHIGAN 49423
(800) 207-6204
www.fortressstabilization.com
solutions@fortessstabilization.com