

# ICC-ES Evaluation Report

**ESR-3403**

Reissued November 2024



This report also contains:

- [City of LA Supplement](#)

Subject to renewal November 2025

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<p><b>DIVISION: 03 00 00 — CONCRETE</b></p> <p><b>Section: 03 01 00 — Maintenance of Concrete</b></p> <p><b>Section: 03 01 30 — Maintenance of Cast-in- Place Concrete</b></p> <p><b>DIVISION: 04 00 00 — MASONRY</b></p> <p><b>Section: 04 01 00 — Maintenance of Masonry</b></p> <p><b>Section: 04 01 20 — Maintenance of Unit Masonry</b></p>	<p><b>REPORT HOLDER: SIMPSON STRONG-TIE COMPANY, INC.</b></p> 	<p><b>EVALUATION SUBJECT: SIMPSON STRONG-TIE COMPOSITE STRENGTHENING SYSTEMS (CSSs)</b></p>	
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## 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® \(IRC\)](#)

**Properties evaluated:**

- Structural
- Durability
- Interior finish
- Toxicity
- Fire resistance

## 2.0 USES

The Simpson Strong-Tie Composite Strengthening Systems (CSSs) are used to strengthen normalweight reinforced concrete and masonry structural elements as alternatives to those systems described in the IBC. For structures regulated under the IRC, the Simpson Strong-Tie Composite Strengthening Systems (CSSs) 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](#). The CSS-CUCF and CSS-CUGF systems are also used as an interior finish.

## 3.0 DESCRIPTION

### 3.1 General:

The Composite Strengthening Systems (CSSs) are externally bonded fiber-reinforced polymer (FRP) systems applied to concrete and masonry structural elements. CSSs consist of carbon fabrics or glass fabrics combined with epoxy resin to create the FRP composite systems, or a carbon fiber precured laminate applied with an epoxy paste.

### 3.2 Materials:

**3.2.1 General:** All material must conform to the approved specifications outlined in the Simpson Strong-Tie CSS Quality Control Manual, dated June 18, 2015, Revision 1.

**3.2.2 CSS Fabrics:** The CSS fabrics are composed of carbon or glass fibers. CSS-CUCF11 and CSS-CUCF22 unidirectional carbon fabrics come in either 12-inch x 300-foot (305 mm x 91.4 m) or 24-inch x 150-foot (610 mm x 45.7 m) rolls. CSS-CUCF44 and CSS-CUCF44F unidirectional carbon fabrics come in either 12-inch x 150-foot (305 mm x 45.7 m) or 24-inch x 75-foot (610 mm x 22.9 m) rolls. CSS-CUGF27 unidirectional glass fabric comes in 25-inch or 50-inch x 150-foot (635 mm or 1,270 mm x 100 m) rolls. CSS-CBGF424 bidirectional glass fabric comes in 25-inch or 50-inch x 302-foot (635 mm or 1,270 mm x 92 m) rolls. Material properties vary with fiber type designation.

### 3.2.3 Epoxy Saturants:

**3.2.3.1 CSS-ES Epoxy Saturant:** The CSS-ES epoxy saturant and primer is a two-component, ambient cure, epoxy resin system used to prime substrates and saturate CSS fabrics. It is available in 3-gallon (11.4 L) kits. Component A is packaged with 2 gallons (7.6 L) in a 5-gallon (18.9 L) bucket to allow enough room for mixing full kits of epoxy. Component B is packaged in 1-gallon (3.8 L) containers. Mixing ratio by volume is two-to-one for components A and B, respectively; by weight the ratio is 100 Part A to 38.8 Part B.

**3.2.3.2 CSS-ESLPL Epoxy Saturant:** The CSS-ESLPL is a two-component, long pot-life epoxy resin system used to prime substrates and saturate CSS fabrics. Component A is packaged with 2 gallons (7.6 L) in a 5-gallon (18.9 L) bucket to allow enough room for mixing full kits of epoxy. Component B is packaged in 1-gallon (3.8 L) containers. Mixing ratio by volume is 2.0 Part A to 0.96 Part B; by weight the ratio is 100 Part A to 38.8 Part B.

**3.2.4 CSS-CUCL Precured Laminates:** The CSS-CUCL unidirectional carbon laminates are comprised of carbon fibers, precured in an epoxy resin. CSS precured laminates come in 0.047 inch (1.2 mm), 0.055 inch (1.4 mm) and 0.110 inch (2.8mm) thicknesses and various widths ranging from 0.39 inch to 5.90 inches (10 mm to 150 mm), and a standard length of 492 feet (150 m).

**3.2.5 CSS-EP Epoxy Paste:** The CSS-EP epoxy paste is a two-component, epoxy paste system used to fill and transition irregular substrates and adhere CSS-CUCL precured laminates. CSS-EP is available in 3-gallon (11.4 L) kits. Components A and B are packaged in 1-gallon (3.8 L) containers and entire kits are packaged in one carton. Mixing ratio is two-to-one for components A and B, respectively.

### 3.2.6 CSS Composites:

**3.2.6.1 CSS-CUCF Composites:** In the primary direction (0°), the carbon fiber composites have a minimum ultimate tensile strength of 128,000 psi (880 MPa), a minimum tensile modulus of 14,200 ksi (97 MPa) and a corresponding elongation of 0.9 percent. Cured composites have a thickness of 0.02 inch (0.5 mm) for CSS-CUCF11, 0.04 inch (1 mm) for CSS-CUCF22 and 0.08 inch (2 mm) for CSS-CUCF44 and CSS-CUCF44F, respectively.

**3.2.6.2 CSS-CUGF Composite:** In the primary direction (0°), the glass-fiber composite has a minimum ultimate tensile strength of 56,000 psi (386 MPa), a minimum tensile modulus of 3,300 ksi (22 MPa) and a corresponding elongation of 1.7 percent. Cured composite has the minimum thickness of 0.05-inch (1.3 mm.)

**3.2.6.3 CSS-CBGF Composite:** In both directions ( $\pm 45^\circ$  from the roll length), the glass fiber composite has a minimum ultimate tensile strength of 40,000 psi (275 MPa), a minimum tensile modulus of 2,900 ksi (20 MPa) and a corresponding elongation of 1.4 percent. Cured composite has the minimum thickness of 0.034 inch (0.86 mm.).

**3.2.6.4 CSS-CUCL Laminate Composite:** In the primary direction, the precured laminate has a minimum ultimate tensile strength of 181,000 psi (1,250 MPa), a minimum tensile modulus of 23,600 ksi (163 MPa) and a corresponding elongation of 0.77 percent. The thickness of the precured laminate is 0.047 inch (1.2 mm), 0.055 inch (1.4 mm) and 0.110 inch (2.8mm).

**3.2.7 RPS-207 Finish Coating:** The Simpson Strong-Tie proprietary RPS-207 finish coating is a two-component, polymer-modified cementitious coating. Component A comes in a 1-gallon (3.8 L) container and Component B comes in a 40-pound (18 kg) bag. Pot life is 30 minutes.

**3.2.8 GCP Z-106 HY Finish Coating:** The GCP Applied Technologies Monokote Z-106 HY finish coating is a Portland cement based cementitious fireproofing coating. This product is available in 49 lb (22.2 kg) bags.

**3.2.9 Firebond Concentrate Primer:** The Firebond Concentrate Primer is a bonding agent used to bond GCP Applied Technologies Monokote Z-106 HY to the substrate or installed composite. This primer is available in either 5 gal (19 L) or 55 gal (208.2 L) containers.

**3.2.10 Storage Recommendations:** Epoxies, coating, fabrics and precured laminates should be stored in temperatures between 45°F and 95°F (7°C and 35°C) with no exposure to moisture. Shelf life is one year for coating, two years for epoxies and ten years for fabrics and precured laminates.

## 4.0 DESIGN AND INSTALLATION

### 4.1 Design:

**4.1.1 General:** Design of the Composite Strengthening Systems must be based on required tensile loads at designated concrete strain values. The strength design requirements for concrete and masonry must be in accordance with [Chapters 19 and 21](#) of the IBC and all applicable requirements in Section 4.1 of this evaluation report. The registered design professional must be responsible for determining, through analysis, the strengths and demands of the structural elements to be strengthened with CSS composites, subject to the approval of the code official.

**4.1.2 Composite Design Properties:** Composite structural design properties are found in the CSS Design Manual, dated February 9, 2021.

**4.1.3 Design Details:** Structural design provisions for the composite system are based on test results and principles of structural analysis as set forth in Section [1604.4](#) of the IBC. Bases of design include strain compatibility, load equilibrium and limit states. All designs must follow procedures as detailed in the IBC; 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 August 2014 (editorially revised December 2020); and applicable procedures detailed in the CSS Design Manual.

**4.1.4 Design Strength:** Design strengths must be taken as the nominal strength, computed in accordance with Section 4.1.3 of this report, multiplied by strength reduction factors provided in Section 21.2 of ACI 318-19 (2021 IBC) or [ACI 318-14](#) (2018 and 2015 IBC), Section 9.3 of [ACI 318-11](#) (2012 IBC) or [ACI 318-08](#) (2009 IBC), and modified by AC125, as applicable (for concrete), and Chapter 21 of the IBC (TMS 402) or Chapter 19, as applicable.

**4.1.5 Load Combinations:** The load combinations used in design must comply with Section [1605.2](#) of the IBC, as applicable. Strength reduction factors must comply with Chapter 19 (ACI 318) or Chapter 21 (TMS 402 of the IBC), as applicable.

### 4.1.6 Columns:

**4.1.6.1 Potential Applications:** CSS-CUCF, CSS-CUGF and CSS-CBGF Composite Strengthening Systems are applied to circular or rectangular reinforced concrete columns to enhance their axial, flexural and shear strengths, and ductility.

**4.1.6.2 Structural Design Requirements:** Concrete column design must comply with the CSS Design Manual and with Chapter 19 of the IBC.

### 4.1.7 Beams and Slabs:

**4.1.7.1 Potential Applications:** CSS-CUCF Composite Strengthening Systems are applied to beams to enhance their ductility, flexural and shear strengths. The CSS-CUGF and CSS-CUCL Composite System applied to beams is used to enhance the beam ductility and flexural strength. The CSS-CUCF, CSS-CUGF and CSS-CUCL Composite Strengthening Systems are also applied to slabs to enhance their out of plane flexural strength and their in-plane shear strength.

**4.1.7.2 Structural Design Requirements:** Concrete beam design must comply with the CSS Design Manual and with Chapter 19 of the IBC.

#### 4.1.8 Walls:

**4.1.8.1 Potential Applications:** CSS-CUCF and CSS-CUCL Composite Strengthening Systems are applied to reinforced concrete walls to enhance their out-of-plane flexural strength and in-plane shear strength. CSS-CUGF Composite Strengthening Systems are applied to reinforced masonry walls to enhance their out-of-plane flexural strengths; and to unreinforced masonry walls to enhance their in-plane shear strengths.

**4.1.8.2 Structural Design Requirements:** Concrete design must comply with the CSS Design Manual and Chapter 19 of the IBC, as applicable. Masonry design must comply with the CSS Design Manual and Chapter 21 of the IBC, as applicable.

#### 4.1.9 Wall-to-Floor joints:

**4.1.9.1 Potential Applications:** CBGF Composite Strengthening Systems are applied to concrete wall-to-floor joints to enhance their shear strength.

**4.1.9.2 Structural Design Requirements:** Concrete design must comply with the CSS Design Manual and Chapter 19 of the IBC, as applicable.

#### 4.1.10 Concrete Diaphragms:

**4.1.10.1 Potential Applications:** CUCF Composite Strengthening Systems are applied to reinforced concrete diaphragms to enhance their in-plane shear strength and in-plane flexural strength (chords) for wind loading or seismic (dynamic) loading applications. CUCF Composite Strengthening Systems are also applied to reinforced concrete diaphragms to enhance the axial tension capacity of the collector element for wind loading or seismic (dynamic) loading applications.

**4.1.10.2 Structural Design Requirements:** Concrete design must comply with the CSS Design Manual and Chapter 19 of the IBC, as applicable.

**4.1.11 Bond Strength:** Where the performance of the CSS composite systems defined in this report depends on bond, the bond strength of CSS Composite material to concrete must not be less than 200 psi (1378 kPa). Bond testing must exhibit failure in the concrete substrate. Testing in accordance with [ASTM D7234](#) or [D7522](#) may be used to estimate the bond strength of bond-critical installations.

#### 4.2 Installation:

Simpson Strong-Tie CSS Composite Strengthening Systems installations must be performed by approved applicators specific to this composite system. Installation recommendations are detailed in the approved applicator training program and Section 2.0 of the Quality Control Manual dated June 18, 2015, Revision 1.

**4.2.1 Saturation:** CSS fabrics and saturating epoxy of the CSS Composites are combined in accordance with published literature and applicator training program using a calibrated mechanical saturator or manual saturation methods. CSS precured laminates come to the site in precured form ready to apply to substrate once cut to required length and cleaned.

**4.2.2 Application:** Manual methods must be used to apply saturated CSS Composite fabrics to the substrate prior to epoxy cure. Surface preparation, fiber orientation and removal of bubbles/voids must be done in accordance with published literature and approved applicator training program. For precured laminates, CSS-EP paste must be applied to the laminate with paste thickness of approximately 3 mm (1/8 in.).

**4.2.3 Finishing:** Composite Strengthening Systems are typically painted or coated for aesthetic, fire-resistance or environmental durability considerations.

**4.2.3.1 Health Effects Coating:** The CSS-ES epoxy saturant and CSS-EP are formulated for potable water contact and comply with [ANSI/NSF 61](#) requirements, as referenced by Section 605 of the *International Plumbing Code* (IPC). CSS-ES epoxy saturant must be applied over the CSS composites to a maximum thickness of 10 wet mills (0.025 mm). CSS-EP epoxy paste must be applied over the installed CSS precured laminates to a maximum thickness of 40 wet mills (0.1 mm). All surfaces must be clean, dry, and free of contaminants. Final cure is 72 hours at 70°F (21°C).

**4.2.3.2 Flame Spread / Smoke Developed:** CSS-CUCF and CSS-CUGF composite systems coated with RPS-207 finish coating yields a Class 1 and Class A flame-spread classification and smoke-developed classification in compliance with the IBC. The CSS-CUCF composite is limited to a maximum thickness of 0.8-inch (20 mm) of carbon fabric (maximum 10 layers of CSS-CUCF44, 20 layers of CSS-CUCF22 and 30 layers of CSS-CUCF11). The CSS-CUGF composite is limited to a maximum thickness of 0.3-inch (7.8 mm) of glass fabric (maximum 6 layers of CSS-CUGF27). Coating must be applied minimum 40 mils at a rate of 0.4 lbs/ft<sup>2</sup> (2 kg/m<sup>2</sup>).

### 4.3 Fire-resistance rating:

**4.3.1 Roller or Spray-applied Fire-resistant Material:** The use of RPS-207 finish coating provides up to a four-hour fire-resistance rating in accordance with [ASTM E119](#) when loaded up to 72 percent of ultimate design load for the following structural systems. The two-component coating is applied over the composite system and concrete in accordance with Simpson Strong-Tie installation instructions. The RPS-207 coating must be applied to concrete T-beams with the following properties: 12-inch (305 mm) wide web thickness, 10-inch (254 mm) deep web depth, 6-inch (152 mm) flange thickness, 48-inch (1219 mm) flange width, a 28-day concrete compressive strength between 3,500 psi (24 MPa) and 5,000 psi (34 MPa), reinforced with 2 No. 5 bottom longitudinal reinforcing steel in the web, flange short direction transverse reinforcement is No.3 at 6-inch o/c top and bottom, top longitudinal reinforcement is No. 3 at 6-inch o/c, and stirrup reinforcement No. 3 at 6-inch o/c with minimum 1.75 inch (44 mm) cover depth between reinforcement and concrete surface. The concrete surface to receive fabric must be primed with CSS-ES. CSS-CUCF and CSS-CUGF fabrics must be saturated with CSS-ES. The saturated CSS-CUCF fabric must be applied to the bottom of the web and the saturated CSS-CUGF fabric must be applied to the web at the ends of the T-beam in a U-wrap configuration. RPS-207 coating is applied over the lightly sanded installed fabrics and CSS-ES coated concrete at an application rate of 0.4 lbs/ft<sup>2</sup> (2 kg/m<sup>2</sup>). Other assembly configurations are beyond the scope of this report.

**4.3.2 Spray-applied Fire-resistant Material:** The use of GCP Applied Technologies system provides up to a four-hour fire-resistance rating in accordance with ASTM E119 when loaded up to 72 percent of ultimate design load for the following structural systems. The coating system is applied over the composite system and concrete in accordance with Simpson Strong-Tie installation instructions. The coating system must be applied to concrete T-beams with the following properties: 12-inch (305 mm) wide web thickness, 10-inch (254 mm) deep web depth, 6-inch (152 mm) flange thickness, 48-inch (1219 mm) flange width, a 28-day concrete compressive strength between 3,500 psi (24 MPa) and 5,000 psi (34 MPa), reinforced with 2 No. 5 bottom longitudinal reinforcing steel in the web, flange short direction transverse reinforcement No. 3 at 6-inch o/c top and bottom, top longitudinal reinforcement No. 3 at 6-inch o/c, and stirrup reinforcement No. 3 at 6-inch o/c with minimum 1.75 inch (44 mm) cover depth between reinforcement and concrete surface. The concrete surface to receive fabric must be primed with CSS-ES. CSS-CUCF and CSS-CUGF fabrics must be saturated with CSS-ES. The saturated CSS-CUCF fabric must be applied to the bottom of the web and the saturated CSS-CUGF fabric must be applied to the web at the ends of the T-beam in a U-wrap configuration. The coating system is applied over the lightly sanded installed fabrics and CSS-ES coated concrete by first priming the prepared surfaces with Firebond Concentrate Primer and then spray-applying the GCP Z-106 HY material at a minimum average thickness of ½-inch (13 mm) and a minimum average dry density of 23 lbs/ft<sup>3</sup> (368 kg/m<sup>3</sup>). Other assembly configurations are beyond the scope of this report.

### 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, or Section [1704](#) through [1707](#) of the 2009 IBC

## 5.0 CONDITIONS OF USE

The Simpson Strong-Tie Composite Strengthening Systems (CSSs) 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** Design and installation of the structural systems recognized in this report must be in accordance with this report, the CSS Quality Control Manual dated June 18, 2015, the CSS Design Manual dated February 9, 2021, and the IBC, or IRC, as applicable.
- 5.2** Copies of the Simpson Strong-Tie Composite Strengthening Systems installation instructions and the CSS Design Manual must be submitted to the code official for each project where these products are used.
- 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 Fire-resistance rating of the CSS composite strengthening systems must be in accordance with Section [4.3](#) of this report.
- 5.5 Special Inspection for application of the Composite Strengthening Systems products must be provided in accordance with Section 4.4 of this report.
- 5.6 Application of the Composite Strengthening Systems products to concrete at a fabricator's facility must be by an approved fabricator complying with [Chapter 17](#) of the IBC, or at a jobsite with continuous special inspections in accordance with Chapter 17 of the IBC and Section 4.4 of this report.
- 5.7 Multi-layer applications and lap splices of CSS-CUCL precured laminates are outside the scope of this report. Composite Strengthening Systems (CSSs) must be manufactured by Simpson Strong-Tie Company, Inc. 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 Externally Bonded Fiber-Reinforced Polymer \(FRP\) Composite Systems \(AC125\)](#), dated October 2019 (editorially revised December 2020), including alkali-soil resistance, fuel-resistance and drinking water exposure tests.

## 7.0 IDENTIFICATION

- 7.1 The components of the Simpson Strong-Tie Composite Strengthening Systems (CSSs) (fabric, epoxy saturants, precured laminate and epoxy paste) described in this report are identified with a label indicating the name and address of the manufacturer (Simpson Strong-Tie), the product name, expiration date and the number of the ICC-ES evaluation report (ESR-3403).

The proprietary RPS-207 finish coating is labeled with manufacturer's name (Simpson Strong-Tie) and address, the product name, and expiration date.

- 7.2 The report holder's contact information is the following:

**SIMPSON STRONG-TIE COMPANY, INC.**  
**5956 WEST LAS POSITAS BOULEVARD**  
**PLEASANTON, CALIFORNIA 94588**  
**(800) 925-5099**  
[www.strongtie.com](http://www.strongtie.com)

**DIVISION: 03 00 00—CONCRETE**  
**Section: 03 01 00—Maintenance of Concrete**  
**Section 03 01 30—Maintenance of Cast-in-Place Concrete**

**DIVISION: 04 00 00—MASONRY**  
**Section 04 01 00—Maintenance of Masonry**  
**Section: 04 01 20—Maintenance of Unit Masonry**

**REPORT HOLDER:**

**SIMPSON STRONG-TIE COMPANY, INC.**

**EVALUATION SUBJECT:**

**SIMPSON STRONG-TIE COMPOSITE STRENGTHENING SYSTEMS (CSSs)**

**1.0 REPORT PURPOSE AND SCOPE****Purpose:**

The purpose of this evaluation report supplement is to indicate that the Simpson Strong-Tie Composite Strengthening Systems (CSSs), described in ICC-ES evaluation report [ESR-3403](#), have also been evaluated for compliance with the codes noted below as adopted by the Los Angeles Department of Building and Safety (LADBS).

**Applicable code editions:**

- 2023 *City of Los Angeles Building Code* ([LABC](#))
- 2023 *City of Los Angeles Residential Code* ([LARC](#))

**2.0 CONCLUSIONS**

The Simpson Strong-Tie Composite Strengthening Systems (CSSs), described in Sections 2.0 through 7.0 of the evaluation report [ESR-3403](#), comply with the LABC Chapters 19 and 21 and the LARC, and are subject to the conditions of use described in this supplement.

**3.0 CONDITIONS OF USE**

The Simpson Strong-Tie Composite Strengthening Systems (CSSs), described in this evaluation report supplement must comply with all of the following conditions:

- All applicable sections in the evaluation report [ESR-3403](#).
- The design, installation, conditions of use and identification of the composite strengthening systems are in accordance with the 2021 *International Building Code*® (IBC) provisions noted in the evaluation report [ESR-3403](#).
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16, 17, and 95, as applicable.
- The Simpson Strong-Tie Composite Strengthening Systems must not be used as compressive reinforcement for strengthening concrete or masonry structure.
- The Simpson Strong-Tie Composite Strengthening Systems may be used on exterior side of exterior walls without additional weather protection. However, the site-specific exposure conditions must be evaluated by the registered design professional for each application.
- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.

This supplement expires concurrently with the evaluation report, reissued November 2024.