

ICC-ES Evaluation Report

ESR-4251

Issued October 2019

This report is subject to renewal October 2020.

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A Subsidiary of the International Code Council®

DIVISION: 07 00 00—THERMAL AND MOISTURE PROTECTION

Section: 07 32 13—Clay Roof Tiles

REPORT HOLDER:

IRONSTONE STRONG LTD.

EVALUATION SUBJECT:

IRONSTONE TILE ROOF COVERING SYSTEM

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2018, 2015 and 2012 *International Building Code*® (IBC)
- 2018, 2015 and 2012 *International Residential Code*® (IRC)

For evaluation for compliance with codes adopted by California Office of Statewide Health Planning and Development (OSHPD) and Division of the State Architect (DSA), see [ESR-4251 CBC and CRC Supplement](#).

Properties evaluated:

- Weather resistance
- Fire classification
- Wind uplift resistance
- Structural

2.0 USES

The Ironstone Tile Roof Covering System described in this report is used as a Class A roof covering system when installed in accordance with Section 4.4 of this report.

3.0 DESCRIPTION

3.1 General:

The Ironstone Tile Roof Covering System consists of porcelain roof tiles and a patented proprietary galvanized steel batten and stainless steel hanger system (fastening system). The porcelain (vitrified clay) roof tiles are classified as Type III, Grade 3, in accordance with ASTM C1167.

Accessory tiles such as trim tiles, tile liner (HDPE interlayment), trim spacers and trim saddle are supplied by the report holder.

3.2 Components:

3.2.1 Porcelain Roof Tiles: The porcelain roof tiles are nominally 12 inches long by 12 inches wide (305 mm long by 305 mm wide), have a nominal thickness of 0.36 inches

(9.14 mm) and weigh approximately 4.0 lbs (18.1 kg) each. The tiles have an installed weight of approximately 4.94 pounds per square foot (24.12 kg/m²) when installed with a minimum 1.7-inch (43.2 mm) headlap. Trim tiles are identical to the porcelain tiles except they are 6 inches (152 mm) wide. Accessory tiles, such as hip and ridge tiles and trim tiles, are made of the same materials as the porcelain roof tiles. See Figure 1 for more details.

3.2.2 Batten and Hanger System (Fastening System):

The batten and hanger system consists of 2-inch-wide by 47¹/₂-inch-long (50.8 mm by 1206.5 mm) by 0.02-inch-thick (0.50 mm) ASTM A653 galvanized steel battens and 5.0 inches (127 mm) long, 0.083 inch (2.1 mm) diameter ASTM A240, Type 304 stainless steel hangers. Each hanger has a hook that has an outside diameter bend of 0.585-inch (14.86 mm) and a 0.44-inch (11.18 mm) return. Each batten has slots for hangers located at 3-inch (76.2 mm) intervals. Hangers can be placed at 3-inch (76.2 mm) or 6-inch (152.4 mm) intervals. (See Figure 2).

Fasteners used to secure the galvanized steel batten to the roof deck must be No. 12 gage [0.109-inch diameter (2.77 mm)] corrosion-resistant steel ring shank roofing nails located at every hanger location. Nails must have sufficient length to penetrate the sheathing ³/₄ inch (19 mm) or through the sheathing, whichever is less.

Trim tiles are fastened to the hip and ridge of the roof using the trim saddle. The trim saddle is screwed directly to the trim spacer and roof-deck using four No. 8, 1⁵/₈-inch pan head, stainless steel wood screws supplied by the report holder.

3.2.3 Underlayment: Underlayment must be a minimum of two layers of Type I (No. 15) asphalt-saturated organic felt, or one layer of Type II (No. 30) asphalt-saturated organic felt, complying with ASTM D226, or GAF VersaShield® Fire-Resistant Roof Deck Protection recognized in ICC-ES ([ESR-2053](#)). For roof slopes between 4:12 (33.3 percent) and 5:12 (41.7 percent), a self-adhering underlayment, complying with ASTM D1970 or currently recognized in an ICC-ES evaluation report as complying with the ICC-ES Acceptance Criteria for Self-adhered Underlayments for Use as Ice Barriers (AC48), is required.

4.0 INSTALLATION

4.1 General:

In case of a conflict between the report holder's installation manual and this report, this report governs. This evaluation report and the report holder's installation instructions must be available at the jobsite at all times during installation.

The roof covering system must be installed on roofs with solid sheathing and a minimum roof slope of 4:12 (33.3 percent). Solid sheathing must be minimum $1^{5}/_{32}$ -inch (11.9 mm) exterior-grade plywood, $1^{5}/_{32}$ -inch (11.9 mm) oriented strand board (OSB) or nominally 1-inch-thick (25.4 mm) lumber complying with the applicable code. The sheathing must be structurally adequate and fastened to resist the wind loads as specified by IBC Section 1609 or IRC R301.2, for components and cladding.

Flashing must be in accordance with IBC Sections 1503.2 and 1507.3.9 or IRC Section R903.2 and R905.3.8, as applicable.

4.2 Underlayment:

Underlayment, as described in Section 3.2.3, must be installed over the entire surface of the solid sheathing. For roof slopes between 4:12 (33.3 percent) and 5:12 (41.7 percent), a self-adhering underlayment, as described in Section 3.2.3, is required.

In areas where the average daily temperature in January is 25°F (-4°C) or less, or where there is a possibility of ice forming along the eaves and causing a backup of water, an underlayment cemented together, or a self-adhering underlayment complying with ASTM D1970 or currently recognized in an ICC-ES evaluation report as complying with the ICC-ES Acceptance Criteria for Self-adhered Roof Underlayments for Use as Ice Barriers (AC48), must extend from the eave's edge to a point 24 inches (610 mm) inside the exterior wall line of the building.

4.3 Ironstone Tile Roof Covering System:

The roof covering system may be installed with a straight edge or staggered architectural appearance within the limitations described in this report. For a straight edge architectural appearance hangers must be aligned in the down positions. For a staggered architectural appearance hangers must be aligned in the up position with tiles pressed down a maximum of 1 inch (25.4 mm) when installed. See Figure 3.

Battens must be installed with a minimum spacing of $9^{1}/_{2}$ inches (241 mm) plus or minus $1^{1}/_{2}$ inch (12.7 mm) between each row. Hangers must be installed at a maximum spacing of 6 inches (152.4 mm) on center. Battens must be secured to the roof deck at every hanger location with No. 12 gage [0.109-inch diameter (2.77 mm)] corrosion-resistant steel ring shank roofing nails located at every hanger location. Nails must have sufficient length to penetrate the sheathing $3^{1}/_{4}$ inch (19 mm) or through the sheathing, whichever is less.

The Ironstone HDPE Tile Liner (interlayment), supplied with the roof covering system in rolls measuring 12 inches (304.8 mm) wide and 373 feet (113.7 m) long, must be installed over each batten with the shiny side of the liner facing down. The liner must be fastened in place, no more than 1 inch (25.4 mm) from the top edge of the liner at a minimum on center spacing of 5 feet (1.52 m) and a maximum on center spacing of 6 feet (1.83 m), with minimum No. 12 gage [0.109-inch diameter (2.77 mm)] corrosion-resistant steel ring shank roofing nails. A minimum 12 inches (304.8 mm) of overlap must be provided at vertical and horizontal lap.

Ironstone porcelain tiles must be tightly butted together in hangers positioned on top of the tile liner. Each tile must be attached with a minimum of two hangers.

4.4 Fire Classification:

The Ironstone Tile Roof Covering System has a Class A roof classification in accordance with ASTM E108 (UL790) when

installed as follows with a maximum exposure of 10 inches (254 mm):

- Deck: Closely fitted, minimum $1^{5}/_{32}$ -inch thick (11.9 mm) exterior grade plywood, minimum $1^{5}/_{32}$ -inch-thick (11.9 mm) oriented strand board (OSB) or nominally 1-inch-thick (25.4 mm) lumber complying with the applicable code.
- Minimum roof slope: 4:12 (33.3 percent).
- Underlayment: One layer of GAF VersaShield® Fire-Resistant Roof Deck Protection ([ESR-2053](#)).
- Interlayment: Ironstone HDPE Tile Liner installed in accordance with Section 4.3.
- Maximum tile exposure of 10 inches (254 mm).

4.5 Wind Uplift Resistance:

The Ironstone roof covering system has an allowable overturning moment (M_a) of 48 ft-lbf (65.1 N-m) with a coefficient of lift (C_L) of 0.562. The roof covering system has maximum allowable design wind speeds at corresponding maximum roof heights as shown in Table 1 through 3.

4.6 Reroofing:

Prior to application of the Ironstone Tile Roof Covering System, the existing roof covering and underlayment must be completely removed. Any damaged sheathing must be replaced. The installation of the Ironstone Tile Roof Covering System, including underlayment, interlayment and fastening system, must then proceed as described in Section 4.0. An existing self-adhered ice barrier membrane may remain in place if covered with a new ice barrier membrane in accordance with the applicable code. The roof classification is as noted in Section 4.4.

5.0 CONDITIONS OF USE

The Ironstone Tile Roof Covering 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 The Ironstone Tile Roof Covering System is manufactured, identified, and installed in accordance with this report and the report holder's published installation instructions. In the event of conflict between this report and the report holder's published installation instructions, this report governs.
- 5.2 The roof sheathing and roof framing system must be designed for the appropriate loads determined in accordance with the applicable code, subject to the approval of the code official.
- 5.3 The Ironstone batten and hanger system described in Section 3.2.2 is limited to use with Ironstone porcelain roof tiles.
- 5.4 The Ironstone Tile Roof Covering System is produced in Lawrenceburg Kentucky, under a quality-control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

- 6.1 Data in accordance with the ICC-ES Acceptance Criteria for Clay and Concrete Roof Tiles (AC180), dated February 2012 (editorially revised March 2018).
- 6.2 Data in accordance with Section 3.3 of the ICC-ES Acceptance Criteria for Concrete and Clay Roof Tile Fasteners (AC65), dated June 1991 (editorially revised July 2015).
- 6.3 Reports of test in accordance with SBCCI SSTD 11 Test Standard for Determining Wind Resistance of Concrete or Clay Roof Tiles.

7.0 IDENTIFICATION

7.1 Each pallet or package of the Ironstone Tile Roof Covering System is identified with the report holder's name (Ironstone Strong Ltd.), the report holder's address, the component name, the installed weight and the evaluation report number (ESR-4251).

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

IRONSTONE STRONG LTD.
1250 NORTHEAST LOOP 410
SUITE 800
SAN ANTONIO, TEXAS 78209
(210) 878-0080
www.ironstonestrong.com

TABLE 1—2018 IBC and 2018 IRC WIND SPEED & MAXIMUM MEAN ROOF HEIGHT¹

MAXIMUM ALLOWABLE MEAN ROOF HEIGHTS FOR GABLE ROOFS (Slope 4:12 to 6.1:12)										
ATTACHMENT	EXPOSURE CATEGORY	Maximum Basic Design Wind Speed (mph)								
		≤ 100	110	120	130	140	150	160	170	180
Ironstone battens with hangers installed 9½ inches o.c. using No. 12 ga. 1½ inch ring shank galvanized roofing nails placed 6 inches o.c. along batten.	B	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	42 ft	NA	NA
	C	60 ft	60 ft	60 ft	60 ft	35 ft	18 ft	NA	NA	NA
	D	60 ft	60 ft	60 ft	32 ft	NA	NA	NA	NA	NA
MAXIMUM ALLOWABLE MEAN ROOF HEIGHTS FOR GABLE ROOFS (Slope 6.1:12 to 12:12)										
ATTACHMENT	EXPOSURE CATEGORY	Maximum Basic Design Wind Speed (mph)								
		≤ 100	110	120	130	140	150	160	170	180
Ironstone battens with hangers installed 9½ inches o.c. using No. 12 ga. 1½ inch ring shank galvanized roofing nails placed 6 inches o.c. along batten.	B	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	38 ft	NA
	C	60 ft	60 ft	60 ft	60 ft	54 ft	28 ft	15 ft	NA	NA
	D	60 ft	60 ft	60 ft	55 ft	23 ft	NA	NA	NA	NA
MAXIMUM ALLOWABLE MEAN ROOF HEIGHT FOR HIP ROOFS (Slope 4:12 to 6.1:12)										
ATTACHMENT	EXPOSURE CATEGORY	Maximum Basic Design Wind Speed (mph)								
		≤ 100	110	120	130	140	150	160	170	180
Ironstone battens with hangers installed 9½ inches o.c. using No. 12 ga. 1½ inch ring shank galvanized roofing nails placed 6 inches o.c. along batten.	B	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	44 ft
	C	60 ft	60 ft	60 ft	60 ft	60 ft	59 ft	32 ft	18 ft	NA
	D	60 ft	60 ft	60 ft	60 ft	57 ft	26 ft	NA	NA	NA
MAXIMUM ALLOWABLE MEAN ROOF HEIGHT FOR HIP ROOFS (Slope 6.1:12 to 12:12)										
ATTACHMENT	EXPOSURE CATEGORY	Maximum Basic Design Wind Speed (mph)								
		≤ 100	110	120	130	140	150	160	170	180
Ironstone battens with hangers installed 9½ inches o.c. using No. 12 ga. 1½ inch ring shank galvanized roofing nails placed 6 inches o.c. along batten.	B	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	42 ft	NA	NA
	C	60 ft	60 ft	60 ft	60 ft	35 ft	18 ft	NA	NA	NA
	D	60 ft	60 ft	60 ft	32 ft	NA	NA	NA	NA	NA

For SI: 1 ft = 25.4 mm, 1 mph = 0.44m/s NA = Not applicable

¹Mean roof heights were determined from allowable overturning moment for Ironstone Tile Roof Covering System (see Section 4.5) determined in accordance with SBCCI SSTD 11 and wind loads calculated in accordance with ASCE 7-16 and 2018 IBC Section 1609.5.3.

TABLE 2—2015 and 2012 IBC and 2015 IRC WIND SPEED & MAXIMUM MEAN ROOF HEIGHT¹

MAXIMUM ALLOWABLE MEAN ROOF HEIGHTS FOR GABLE ROOFS (Slope 4:12 to 6.1:12)										
ATTACHMENT	EXPOSURE CATEGORY	Ultimate Design Wind Speed (mph)								
		≤ 100	110	120	130	140	150	160	170	180
Ironstone battens with hangers installed 9½ inches o.c. using No. 12 ga. 1½ inch ring shank galvanized roofing nails placed 6 inches o.c. along batten.	B	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	57 ft	38 ft
	C	60 ft	60 ft	60 ft	60 ft	60 ft	50 ft	26 ft	NA	NA
	D	60 ft	60 ft	60 ft	60 ft	46 ft	21 ft	NA	NA	NA
MAXIMUM ALLOWABLE MEAN ROOF HEIGHTS FOR GABLE ROOFS (Slope 6.1:12 to 12:12)										
ATTACHMENT	EXPOSURE CATEGORY	Ultimate Design Wind Speed (mph)								
		≤ 100	110	120	130	140	150	160	170	180
Ironstone battens with hangers installed 9½ inches o.c. using No. 12 ga. 1½ inch ring shank galvanized roofing nails placed 6 inches o.c. along batten.	B	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft
	C	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft
	D	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	44 ft
MAXIMUM ALLOWABLE MEAN ROOF HEIGHT FOR HIP ROOFS (Slope 4:12 to 5.6:12)										
ATTACHMENT	EXPOSURE CATEGORY	Maximum Basic Design Wind Speed (mph)								
		≤ 100	110	120	130	140	150	160	170	180
Ironstone battens with hangers installed 9½ inches o.c. using No. 12 ga. 1½ inch ring shank galvanized roofing nails placed 6 inches o.c. along batten.	B	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft
	C	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	57 ft	35 ft
	D	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	51 ft	24 ft

For SI: 1 ft = 25.4 mm, 1 mph = 0.44m/s NA = Not applicable

¹Mean roof heights were determined from allowable overturning moment for Ironstone Tile Roof Covering System (see Section 4.5) determined in accordance with SBCCI SSTD 11 and wind loads calculated in accordance with ASCE 7-10 and 2015 and 2012 IBC Section 1609.5.3.

TABLE 3—2012 IRC WIND SPEED & MAXIMUM MEAN ROOF HEIGHT¹

MAXIMUM ALLOWABLE MEAN ROOF HEIGHTS FOR GABLE ROOFS (Slope 4:12 to 6.1:12)										
ATTACHMENT	EXPOSURE CATEGORY	Maximum Basic Wind Speed (mph)								
		≤ 85	90	100	110	120	130	140	150	160
Ironstone battens with hangers installed 9½ inches o.c. using No. 12 ga. 1½ inch ring shank galvanized roofing nails placed 6 inches o.c. along batten.	B	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	44 ft	NA	NA
	C	60 ft	60 ft	60 ft	60 ft	43 ft	20 ft	NA	NA	NA
	D	60 ft	60 ft	60 ft	48 ft	17 ft	NA	NA	NA	NA
MAXIMUM ALLOWABLE MEAN ROOF HEIGHTS FOR GABLE ROOFS (Slope 6.1:12 to 12:12)										
ATTACHMENT	EXPOSURE CATEGORY	Maximum Basic Wind Speed (mph)								
		≤ 85	90	100	110	120	130	140	150	160
Ironstone battens with hangers installed 9½ inches o.c. using No. 12 ga. 1½ inch ring shank galvanized roofing nails placed 6 inches o.c. along batten.	B	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft
	C	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	54 ft	29 ft
	D	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	51 ft	23 ft	NA
MAXIMUM ALLOWABLE MEAN ROOF HEIGHT FOR HIP ROOFS (Slope 4:12 to 5.6:12)										
ATTACHMENT	EXPOSURE CATEGORY	Maximum Basic Wind Speed (mph)								
		≤ 85	90	100	110	120	130	140	150	160
Ironstone battens with hangers installed 9½ inches o.c. using No. 12 ga. 1½ inch ring shank galvanized roofing nails placed 6 inches o.c. along batten.	B	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	46 ft
	C	60 ft	60 ft	60 ft	60 ft	60 ft	60 ft	39 ft	20 ft	NA
	D	60 ft	60 ft	60 ft	60 ft	60 ft	37 ft	15 ft	NA	NA

For SI: 1 ft = 25.4 mm, 1 mph = 0.44m/s NA = Not applicable

¹Mean roof heights were determined from allowable overturning moment for Ironstone Tile Roof Covering System (see Section 4.5) determined in accordance with SBCCI SSTD 11 and wind loads calculated in accordance with ASCE 7-05 and 2012 IBC Section 1609.5.3.



FIGURE 1—IRONSTONE ROOF COVERING SYSTEM AND ACCESSORIES

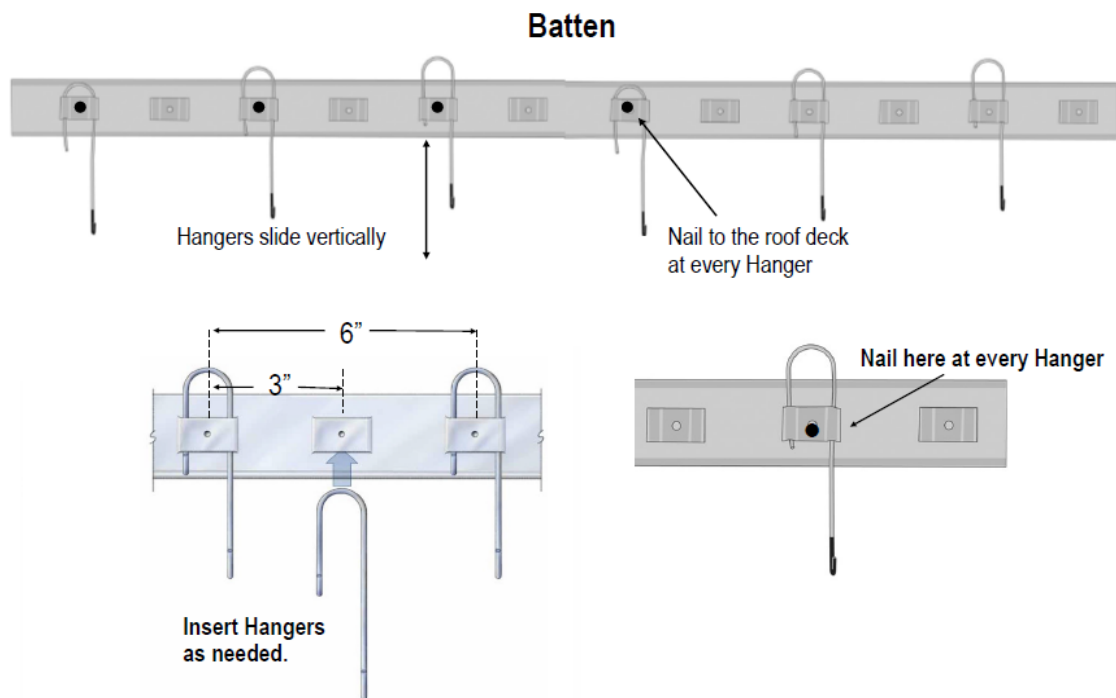


FIGURE 2—IRONSTONE BATTEN AND HANGER SYSTEM (FASTENING SYSTEM)

For Straight Edge



Hangers DOWN

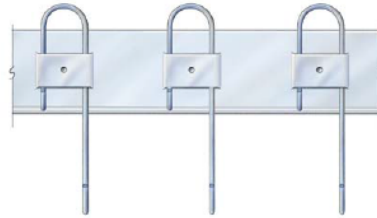


For straight-edge: Tap the Batten on the top of hooks to get the Hangers aligned in the **DOWN** position. Once nailed to the roof deck, all Hangers will remain the same length.

For Staggered Edge



Hangers UP



For staggered-edge: Tap the batten on the hook side to get all of the Hangers aligned in the **UP** position. Once the Batten is nailed to the roof, a staggered pattern is achieved by pressing some tiles down (max. 1") when installed.

FIGURE 3—IRONSTONE PORCELAIN TILE

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IRONSTONE STRONG LTD.

EVALUATION SUBJECT:

IRONSTONE TILE ROOF COVERING SYSTEM

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that Ironstone Tile Roof Covering System, recognized in ICC-ES evaluation report ESR-4251, has also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2016 *California Building Code* (CBC)

For evaluation of applicable chapters adopted by the California Office of the Statewide Health Planning and Development (OSHPD) and Division of the State Architects (DSA), see Sections 2.1.1 and 2.1.2 below.
- 2016 *California Residential Code* (CRC)

2.0 CONCLUSIONS

2.1 CBC:

The Ironstone Tile Roof Covering System described in the evaluation report ESR-4251 may be used where a Class A roof covering complying with CBC Section 1505.1.1, a Class B roof covering complying with CBC Section 1505.1.2, or a Class C roof covering complying with CBC Section 1505.1.3 is required, provided installation is in accordance with the 2015 *International Building Code*® (IBC) provisions noted in the evaluation report and the additional requirements of CBC Sections 1507.3.10 and 1513, as applicable. Specific to CBC Section 1513.4, the clay roof tiles must be installed in accordance with Section 4.0 of ESR-4251 where the nose of each tile is securely fastened with two hangers per tile.

The tile roof covering system may be used in the construction of new buildings located in a Fire Hazard Severity Zone within State Responsibility Areas or any Wildland–Urban Interface Fire Area, provided installation is also in accordance with the 2015 *International Building Code*® (IBC) provisions noted in the evaluation report and the additional requirements of CBC Sections 701A.3 and 705A.

2.1.1 OSHPD:

The Ironstone Tile Roof Covering System, described in Sections 2.0 through 7.0 of the evaluation report ESR-4251, complies with CBC Chapter 15 [OSHPD 2] and CBC amended Chapter 15 [OSHPD 1 and 4]

2.1.2 DSA:

The Ironstone Tile Roof Covering System, described in Sections 2.0 through 7.0 of the evaluation report ESR-4251, complies with CBC amended Chapter 15 [DSA-SS and DSA-SS/CC].

2.2 CRC:

The Ironstone Tile Roof Covering System described in the evaluation report ESR-4251 may be used where a Class A roof covering complying with CRC Section R902.1.1, a Class B roof covering complying with CRC Section R902.1.2, or a Class C roof covering complying with CRC Section R902.1.3 is required, provided installation is in accordance with the 2015 *International Residential Code*® (IRC) provisions noted in the evaluation report .

The tile roof covering system may be used in the construction of new buildings located in any Wildland–Urban Interface Fire Area, provided installation is also in accordance with the 2015 *International Residential Code*® (IRC) provisions noted in the evaluation report and the additional requirements of Sections R337.1.3.1 and R337.5 of the CRC.

The products recognized in this supplement have not been evaluated for compliance with the *International Wildland–Urban Interface Code*®.

This supplement expires concurrently with the evaluation report, issued October 2019.