

ICC-ES Evaluation Report

ESR-2528

Reissued April 2024


This report also contains:

- FBC Supplement

Subject to renewal April 2025

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<p>DIVISION: 07 00 00— THERMAL AND MOISTURE PROTECTION</p> <p>Section: 07 32 16— Concrete Roof Tiles</p>	<p>REPORT HOLDER: SANDSTONE INC., dba STONEWORTH BUILDING PRODUCTS</p>	<p>EVALUATION SUBJECT: STONEWORTH BUILDING PRODUCTS FLAT AND VENETIAN CONCRETE ROOF TILES</p>	
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1.0 EVALUATION SCOPE

1.1 Compliance with the following codes:

- 2021, 2018, 2015, 2012, 2009 and 2006 [International Building Code® \(IBC\)](#)
- 2021, 2018, 2015, 2012, 2009 and 2006 [International Residential Code® \(IRC\)](#)

Properties evaluated:

- Durability
- Fire classification
- Wind uplift resistance

1.2 Evaluation to the following green code:

- 2022 [California Green Building Standards Code \(CALGreen\)](#), Title 24, Part 11

Attributes verified:

See Section 3.1

2.0 USES

The Flat and Venetian concrete roof tiles are used as Class A roof coverings in accordance with the 2021, 2018, 2015, 2012 and 2009 IBC Section 1505.2, Exception 2 (exception to 2006 IBC Section 1505.2) and 2021, 2018, 2015, 2012 and 2009 IRC Section R902.1, Exception 2 (exception to 2006 IRC Section R902.1).

3.0 DESCRIPTION

The Flat and Venetian tiles are manufactured from portland cement, sand, water, coloring agents and admixture, and comply with ASTM C1492. Mineral coloring oxides are mixed with the portland cement to produce color through the entire tile. Both tiles are 16¹/₂ inches (419 mm) long and 13 inches (330 mm) wide, and have longitudinal edges that form interlocking ribs and grooves designed to restrict lateral movement and provide a weather check.

The attributes of the roof tiles have been verified as conforming to the provisions of 2022 CALGreen Section A5.406.1.2 for reduced maintenance. Note that decisions on compliance for those areas rest with the user of this report. The user is advised of the project-specific provisions that may be contingent upon meeting specific conditions, and the verification of those conditions is outside the scope of this report. These codes or standards often provide supplemental information as guidance.

3.1 Flat Tile:

The Flat tiles are approximately 1½ inches (38 mm) high and are classified as Type II tiles in accordance with ASTM C1492. Two nail holes are provided at the top portion of each tile, with protruding head lugs on the underside to provide mechanical attachment over battens. The tiles are installed with a head lap of 3 inches (76 mm) and a side lap of 1.35 inches (34 mm), and have an installed weight of 10½ psf (51 kg/m²). See [Figure 1](#) for tile profile and dimensions with matching ridge, rake and hip units.

3.2 Venetian Tile:

The Venetian tiles are approximately 3 inches (76 mm) high and are classified as Type I tiles in accordance with ASTM C1492. Two nail holes are provided at the top portion of each tile, with protruding head lugs on the underside to provide mechanical attachment over battens. The tiles are installed with a head lap of 3 inches (76 mm) and a side lap of 1.27 inches (32 mm), and have an installed weight of 9½ psf (46 kg/m²). See [Figure 2](#) for tile profile and dimensions with matching ridge, rake and hip units.

4.0 INSTALLATION

4.1 General:

Except as otherwise noted in this report, the tiles must be installed in accordance with the *Concrete and Clay Roof Tile Installation Manual for Moderate Climate Regions*, published by the Tile Roofing Institute, Inc., and the Western States Roofing Contractors Association (herein referred to as the TRI/WSRCA installation manual), dated March 2010. This report and the current TRI/WSRCA installation manual must be available at the jobsite at all times during installation.

4.2 Adhesively Attached Systems:

The Flat and Venetian concrete roof tiles may be installed with roof tile adhesives that are described in a current ICC-ES evaluation report for use in concrete roof tile applications. Installation of tiles using these adhesively attached systems must be in accordance with the adhesive manufacturer's ICC-ES evaluation report.

4.3 Roof Slope Limitations:

Tiles must be installed on roof slopes of between 2½:12 (21 percent) and 21:12 (175 percent).

4.4 Underlayment:

For adhesively attached systems, underlayment must be in accordance with the adhesive manufacturer's ICC-ES evaluation report.

4.5 Fire Classification:

4.5.1 2021, 2018, 2015, 2012 and 2009 IBC and IRC: When installed in accordance with this report, the Flat and Venetia concrete roof tiles are Class A roof coverings in accordance with Exception 2 to IBC Section 1505.2 and Exception 2 to IRC Section R902.1.

4.5.2 2006 IBC and IRC: When installed in accordance with this report, the Flat and Venetian concrete roof tiles are Class A roof coverings in accordance with the exception to IBC Section 1505.2 and IRC Section R902.1.

4.6 Wind Resistance:

4.6.1 2021 IBC and 2018 IBC: For maximum basic design wind speeds of 130 mph (209 km/h) or less and mean roof heights of 60 feet (18.3 m), tiles must be installed in accordance with the perspective parameters of IBC Table 1507.3.7.

4.6.2 2021 IRC and 2018 IRC For ultimate design windspeeds of 130 mph(209 km/h) or less and mean roof heights of 60 feet (18.3 m) for the IBC and mean roof heights of 40 ft (12.2m) for the IRC, tiles must be installed in accordance with the perspective parameters of IBC Table 1507.3.7 or IRC Section R905.3.7.

4.6.3 2015 IBC, 2015 IRC and 2012 IBC: For ultimate design wind speeds (V_{ult}) of 130 mph (209 km/h) or less and mean roof heights of 60 feet (18.3 m) or less under the IBC and mean roof heights of 40 feet (12 192 mm) or less under the IRC, tiles must be installed in accordance with the prescriptive parameters of IBC Table 1507.3.7 or IRC Section R905.3.7, as applicable. For applications beyond these prescriptive parameters, the tiles and fastening systems must be designed in accordance with Appendix A of this report, Design Consideration for High Wind Applications. Under the 2015 IBC and IRC and the 2012 IBC and IRC (ASCE 7-10) [hereinafter referred to as Appendix A].

4.6.4 2012 IRC: For basic wind speeds (3 second gust) of 100 mph (161 km/h) or less and mean roof heights of 40 feet (12 192 mm) or less, tiles must be installed in accordance with the prescriptive parameters of Section R905.3.7 of the IRC. For applications beyond these prescriptive parameters, the tiles and fastening systems must be designed in accordance with Appendix A of this report.

4.6.5 2009 IBC, 2009 IRC, 2006 IBC and 2006 IRC: For maximum basic wind speed of 100 mph (209 km/h) or less and mean roof heights of 60 feet (18.3 m) for the IBC and mean roof heights of 40 ft (12.2m) for the IRC, tiles must be installed in accordance with the perspective parameters of IBC Table 1507.3.7 or IRC Section R905.3.7. For applications beyond these prescriptive parameters, the tiles and the fastening systems must be designed to withstand the aerodynamic wind uplift moment in accordance with the section on Design Considerations for High Wind Applications in Appendix B of the TRI/WSRCA installation manual. The generic required aerodynamic uplift moment, determined in accordance with Tables 5A through 6D of the TRI/WSRCA installation manual, must be multiplied by the tile factor ratio of the tile in [Table 1](#) to obtain the required aerodynamic uplift moment for the specific roof tile being installed. The allowable aerodynamic uplift moment for the roof tile fastening system selected from Table 7A of the TRI/WSRCA installation manual, must be equal to or greater than the required aerodynamic uplift moment for the specific roof tile being installed. See Appendix B of the TRI/WSRCA installation manual, dated March 2010 for additional details.

4.7 Adhesively Attached Systems:

Flat and Venetian Flat and Venetian concrete roof tiles may be installed with a roof tile adhesive that is listed in a current ICC-ES evaluation report for use in concrete roof tile applications. Installation of tiles using the tile adhesive must be in accordance with the adhesive manufacturer's ICC-ES evaluation report.

4.8 Reroofing Applications:

The tiles may be installed over existing roofs, provided the requirements of 2021 IBC Section 1512 [2018 and 2015 IBC Section 1511 (2012, 2009 and 2006 IBC Section 1510)] or 2021, 2018 and 2015 IRC Section R908 (2012, 2009 and 2006 IRC Section R907), as applicable, are met. The roof classification is as noted in Section 4.5.

5.0 CONDITIONS OF USE:

The Flat and Venetian concrete roof tiles 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** The tiles must be manufactured, identified and installed in accordance with this report, the applicable code, and the TRI/WSRCA installation manual, dated March 2010. The instructions within this report govern if there are any conflicts between the installation manual and this report.
- 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 roof tiles are manufactured under a quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the [ICC-ES Acceptance Criteria for Clay and Concrete Roof Tiles \(AC180\)](#), dated February 2012 (editorially revised July 2022).

7.0 IDENTIFICATION

- 7.1** The ICC-ES mark of conformity, electronic labeling, or the evaluation report number (ICC-ES ESR-2528) along with the name, registered trademark, or registered logo of the report holder (Stoneworth Building Products) must be included in the product label.
- 7.2** In addition, each Venetian tile is embossed with the words "Vortex Hydra Italy" or "CFL" or "ALLYNDEB TILE CFL." Additionally, each Flat tile is identified with the embossments "Sandstone" and "Vortex Hydra Italy." Each shipping pallet is identified with the Stoneworth Building Products address; the manufacturing location; the product name (Flat or Venetian) and the installed weight.
- 7.3** The report holder's contact information is the following:

SANDSTONE INC., dba STONEWORTH BUILDING PRODUCTS
4025 BONNER INDUSTRIAL DRIVE
SHAWNEE, KANSAS 66226
(913) 422-0794
www.stoneworthcompany.com

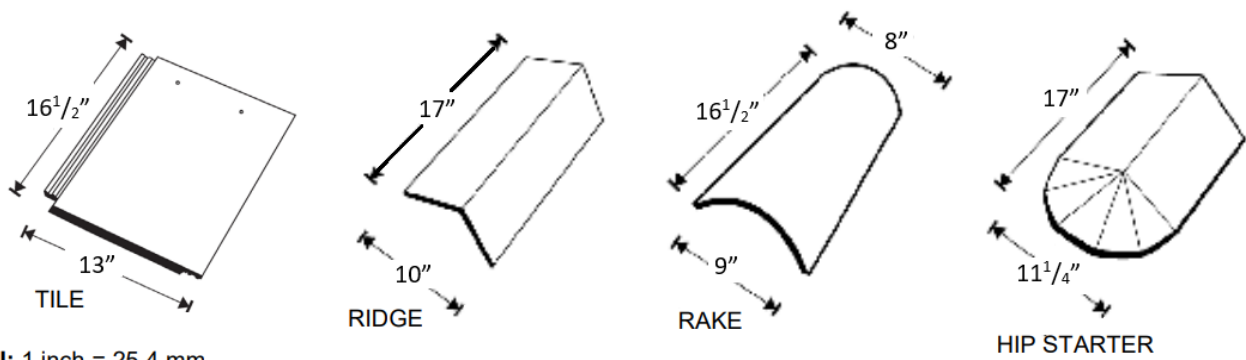


FIGURE 1—FLAT TILE WITH RIDGE, RAKE AND HIP UNITS

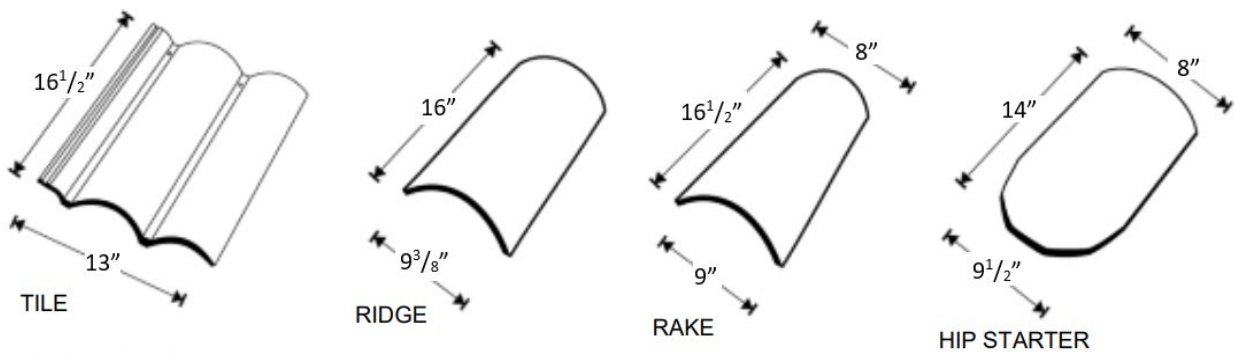


FIGURE 2 – VENETIAN TILE WITH RIDGE, RAKE AND HIP UNITS

TABLE 1 – TILE FACTORS AND TILE FACTOR RATIOS

TILE DESIGNATION	TILE FACTOR (ft ³)	TILE FACTOR RATIO ¹
Flat	1.394	0.991
Venetian	1.404	0.998

¹Tile factor ratio = tile factor / base tile factor of 1.407 ft³. See Section 4.4.2 of this report and Appendix B of the TRI/WSRCA Installation Manual, dated March 2010, for additional details.

APPENDIX A

Design Considerations for High Wind Applications
Under The 2015 IBC and IRC and the 2012 IBC and IRC (ASCE 7-10)

2015 and 2012 IBC: Table 1507.3.7 of the 2015 and 2012 IBC provides prescribed installation requirements for concrete and clay roof tiles applicable to ultimate design wind speeds (V_{ult}) up to 130 miles per hour (58 m/s). For specific regions of the country identified in the 2015 and 2012 IBC as being subjected to ultimate design wind speeds (V_{ult}) in excess of 130 miles per hour (58 m/s), the tiles and fastening systems must be designed in accordance with this Appendix.

2015 IRC: On buildings located in areas where the 2015 IRC ultimate design wind speed does not exceed 130 mph (58 m/s) and having a maximum mean roof height of 40 feet (12.192 mm), tile application must comply with 2015 IRC Section R905.3.7.

2012 IRC: On buildings located in areas where the 2012 IRC basic wind speed does not exceed 100 mph and having a maximum mean roof height of 40 feet (12.192 mm), tile application must comply with 2012 IRC Section R905.3.7. For greater basic wind speeds and/or higher mean roof heights, the tiles and fastening systems must be designed in accordance with this Appendix.

The following design aids are provided to the roof designer for consideration in determining the fastening requirements for roof tiles for wind applications beyond the prescriptive requirements in the IBC or IRC. These tables were developed based on the requirements of 2015 and 2012 IBC Section 1609.5.3 and ASCE 7-10.

Tables 3A through 3D of the Appendix are used to determine the generic required aerodynamic uplift moment for the tile. The generic required aerodynamic uplift moment determined from the tables must be multiplied by the tile factor ratio in Table 1 of this report to obtain the required aerodynamic uplift moment for the specific roof tile being installed. The allowable aerodynamic uplift moment for the roof tile fastening system selected from Table 4 of the Appendix must be equal to or greater than the required aerodynamic uplift moment for the specific roof tile being installed.

Underlayment Notes: For consideration of attachment of underlayments in high wind areas, see 2015 and 2012 IBC Section 1507.3.3.3, 2015 IRC Sections R905.1.1 and R905.3.3 and 2012 IRC Section R905.3.3.3. Attachment of underlayments must comply with the above-mentioned sections.

TABLE 2

Conversion from Nominal Design Wind Speed V_{asd} to Ultimate Design Wind Speed V_{ult} shall be converted as $V_{asd} = V_{ult} * \sqrt{0.6}$ or from the following table:

Design Wind Speed Conversion (mph)									
V_{ult}	110	120	130	140	150	160	170	180	190
V_{asd}	85	93	101	108	116	124	132	139	147

For SI: 1 mile per hour = 0.44 m/s. A linear interpolation is permitted.

DESIGN CONSIDERATIONS FOR HIGH WIND APPLICATIONS
 Under The 2015 IBC and IRC and the 2012 IBC and IRC (ASCE 7-10)

TABLE 3A

Required Aerodynamic Uplift Moment for Tile, Zone 3

Ma (ft-lbf) For Roof Pitches 6:12 and Less

Gable Roof 2¹/₂:12 < θ < 6:12 (12° < θ < 27°)

Hip Roof 5¹/₂:12 < θ < 6:12 (25° < θ < 27°)

Exposure B	Ultimate Design Wind Speed (mph)								
Mean Roof Height	110	120	130	140	150	160	170	180	190
0-15	11.2	13.3	15.6	18.1	20.8	23.7	26.8	30.0	33.4
20	11.2	13.3	15.6	18.1	20.8	23.7	26.8	30.0	33.4
25	11.2	13.3	15.6	18.1	20.8	23.7	26.8	30.0	33.4
30	11.2	13.3	15.6	18.1	20.8	23.7	26.8	30.0	33.4
35	11.7	13.9	16.3	18.9	21.7	24.7	27.9	31.3	34.9
40	12.2	14.5	17.0	19.7	22.6	25.7	29.1	32.6	36.3
45	12.5	14.9	17.4	20.2	23.2	26.4	29.8	33.4	37.2
50	12.9	15.4	18.1	21.0	24.1	27.4	31.0	34.7	38.7
55	13.3	15.8	18.6	21.5	24.7	28.1	31.7	35.6	39.6
60	13.6	16.2	19.0	22.0	25.3	28.8	32.5	36.4	40.6
Exposure C	Ultimate Design Wind Speed (mph)								
Mean Roof Height	110	120	130	140	150	160	170	180	190
0-15	13.6	16.2	19.0	22.0	25.3	28.8	32.5	36.4	40.6
20	14.4	17.1	20.1	23.3	26.8	30.5	34.4	38.6	43.0
25	15.0	17.9	21.0	24.4	28.0	31.8	35.9	40.3	44.9
30	15.7	18.7	21.9	25.4	29.2	33.2	37.5	42.0	46.8
35	16.1	19.2	22.6	26.2	30.1	34.2	38.6	43.3	48.2
40	16.6	19.8	23.2	27.0	30.9	35.2	39.8	44.6	49.7
45	17.0	20.2	23.7	27.5	31.5	35.9	40.5	45.4	50.6
50	17.5	20.8	24.4	28.3	32.4	36.9	41.7	46.7	52.0
55	17.7	21.1	24.8	28.8	33.0	37.6	42.4	47.6	53.0
60	18.1	21.5	25.3	29.3	33.6	38.3	43.2	48.4	54.0
Exposure D	Ultimate Design Wind Speed (mph)								
Mean Roof Height	110	120	130	140	150	160	170	180	190
0-15	16.5	19.6	23.0	26.7	30.7	34.9	39.4	44.1	49.2
20	17.3	20.6	24.1	28.0	32.1	36.6	41.3	46.2	51.6
25	19.9	21.3	25.0	29.0	33.3	37.9	42.8	48.0	53.5
30	18.6	22.1	25.9	30.1	34.5	39.3	44.3	49.7	55.4
35	19.1	22.7	26.6	30.8	35.4	40.3	45.5	51.0	56.8
40	19.5	23.2	27.3	31.6	36.3	41.3	46.6	52.2	58.3
45	20.0	23.8	27.9	32.4	37.2	42.3	47.8	53.5	59.7
50	20.3	24.2	28.4	32.9	37.8	43.0	48.5	54.4	60.6
55	20.7	24.6	28.8	33.4	38.4	43.7	49.3	55.2	61.6
60	20.9	24.9	29.3	34.0	39.0	44.4	50.1	56.1	62.5

Wind Speeds are per ASCE 7-10 for Ultimate Design Wind Speed at 33 ft. above ground. MRH = Mean Roof Height in Feet for Roof Pitches 6:12 and Less Equates to Roof Slopes 12° < θ < 27° for Zone 3.

DESIGN CONSIDERATIONS FOR HIGH WIND APPLICATIONS
 Under The 2015 IBC and IRC and the 2012 IBC and IRC (ASCE 7-10)

TABLE 3B
Required Aerodynamic Uplift Moment for Tile, Zone 3
Ma (ft-lbf) For Roof Pitches 5 1/2:12 and Less
Hip Roof 2 1/2:12 < θ < 5 1/2:12 (12° < θ < 25°)

Exposure B		Ultimate Design Wind Speed (mph)							
Mean Roof Height	110	120	130	140	150	160	170	180	190
0-15	8.4	10.0	11.7	13.6	15.6	17.8	20.1	22.5	25.1
20	8.4	10.0	11.7	13.6	15.6	17.8	20.1	22.5	25.1
25	8.4	10.0	11.7	13.6	15.6	17.8	20.1	22.5	25.1
30	8.4	10.0	11.7	13.6	15.6	17.8	20.1	22.5	25.1
35	8.8	10.4	12.2	14.2	16.3	18.5	20.9	23.5	26.1
40	9.1	10.9	12.7	14.8	17.0	19.3	21.8	24.4	27.2
45	9.4	11.1	13.1	15.2	17.4	19.8	22.4	25.1	27.9
50	9.7	11.6	13.6	15.7	18.1	20.6	23.2	26.0	29.0
55	10.0	11.9	13.9	16.1	18.5	21.2	23.8	26.7	29.7
60	10.2	12.1	14.2	16.5	19.0	21.6	24.4	27.3	30.4
Exposure C		Ultimate Design Wind Speed (mph)							
Mean Roof Height	110	120	130	140	150	160	170	180	190
0-15	10.2	12.1	14.2	16.5	19.0	21.6	24.4	27.3	30.4
20	10.8	12.9	15.1	17.5	20.1	22.9	25.8	28.9	32.2
25	11.3	13.4	15.8	18.3	21.0	23.9	26.9	30.2	33.7
30	11.8	14.0	16.4	19.1	21.9	24.9	28.1	31.5	35.1
35	12.1	14.4	16.9	19.5	22.5	25.6	29.0	32.5	36.2
40	12.5	14.9	17.4	20.2	23.2	26.4	29.8	33.4	37.2
45	12.7	15.1	17.8	20.6	23.7	26.9	30.4	34.1	38.0
50	13.1	15.6	18.3	21.2	24.3	27.7	31.2	35.0	39.0
55	13.3	15.9	18.6	21.6	24.8	28.2	31.8	35.7	39.7
60	13.6	16.1	18.9	22.0	25.2	28.7	32.4	36.2	40.5
Exposure D		Ultimate Design Wind Speed (mph)							
Mean Roof Height	110	120	130	140	150	160	170	180	190
0-15	12.4	14.7	17.3	20.0	23.0	26.2	29.5	33.1	36.9
20	13.0	15.4	18.1	21.0	24.1	27.4	31.0	34.7	38.7
25	13.4	16.0	18.8	21.8	25.0	28.4	32.1	36.0	40.1
30	13.9	16.6	19.4	22.6	25.9	29.5	33.3	37.3	41.5
35	14.3	17.0	19.9	23.1	26.6	30.2	34.1	38.2	42.6
40	14.6	17.4	20.5	23.7	27.2	31.0	35.0	39.2	43.7
45	15.0	17.9	21.0	24.3	27.9	31.7	35.8	40.2	44.8
50	15.2	18.1	21.3	24.7	28.3	32.3	36.4	40.8	45.5
55	15.5	18.4	21.6	25.1	28.8	32.8	37.0	41.5	46.2
60	15.7	18.7	22.0	25.5	29.2	33.3	37.6	42.1	46.9

Wind Speeds are per ASCE 7-10 for Ultimate Design Wind Speed at 33 ft. above ground. Mean Roof Height in Feet for Roof Pitches Less Than 5 1/2:12 Equates to Roof Slopes 12° < θ < 25° for Zone 3.

DESIGN CONSIDERATIONS FOR HIGH WIND APPLICATIONS
 Under The 2015 IBC and IRC and the 2012 IBC and IRC (ASCE 7-10)

TABLE 3C
Required Aerodynamic Uplift Moment for Tile, Zone 3
Ma (ft-lbf) For Roof Pitches Greater Than 6:12
Gable Roof 6:12 < θ < 12:12 (27° < θ < 45°)

Exposure B		Ultimate Design Wind Speed (mph)							
Mean Roof Height	110	120	130	140	150	160	170	180	190
0-15	6.8	8.1	9.6	11.1	12.7	14.5	16.4	18.3	20.4
20	6.8	8.1	9.6	11.1	12.7	14.5	16.4	18.3	20.4
25	6.8	8.1	9.6	11.1	12.7	14.5	16.4	18.3	20.4
30	6.8	8.1	9.6	11.1	12.7	14.5	16.4	18.3	20.4
35	7.1	8.5	10.0	11.6	13.3	15.1	17.1	19.1	21.3
40	7.4	8.8	10.4	12.0	13.8	15.7	17.8	19.9	22.2
45	7.6	9.1	10.7	12.4	14.2	16.1	18.2	20.4	22.8
50	7.9	9.4	11.1	12.8	14.7	16.8	18.9	21.2	23.6
55	8.2	9.7	11.3	13.1	15.1	17.2	19.4	21.7	24.2
60	8.3	9.9	11.6	13.5	15.5	17.6	19.9	22.3	24.8
Exposure C		Ultimate Design Wind Speed (mph)							
Mean Roof Height	110	120	130	140	150	160	170	180	190
0-15	8.3	9.9	11.6	13.5	15.5	17.6	19.9	22.3	24.8
20	8.8	10.5	12.3	14.3	16.4	18.6	21.0	23.6	26.3
25	9.2	10.9	12.8	14.9	17.1	19.5	22.0	24.6	27.4
30	9.6	11.4	13.4	15.5	17.8	20.3	22.9	25.7	28.6
35	9.9	11.8	13.8	16.0	18.4	20.9	23.6	26.4	29.5
40	10.2	12.1	14.2	16.5	18.9	21.5	24.3	27.2	30.3
45	10.3	12.3	14.5	16.8	19.3	21.9	24.8	27.8	30.9
50	10.7	12.7	14.9	17.3	19.8	22.6	25.5	28.5	31.8
55	10.8	12.9	15.2	17.6	20.2	23.0	25.9	29.1	32.4
60	11.1	13.2	15.4	17.9	20.6	23.4	26.4	29.6	33.0
Exposure D		Ultimate Design Wind Speed (mph)							
Mean Roof Height	110	120	130	140	150	160	170	180	190
0-15	10.1	12.0	14.1	16.3	18.7	21.3	24.1	27.0	30.1
20	10.6	12.6	14.8	17.1	19.6	22.3	25.2	28.3	31.5
25	10.9	13.0	15.3	17.7	20.4	23.2	26.2	29.3	32.7
30	11.3	13.5	15.8	18.4	21.1	24.0	27.1	30.4	33.8
35	11.7	13.9	16.3	18.9	21.6	24.6	27.8	31.2	34.7
40	11.9	14.2	16.7	19.3	22.2	25.2	28.5	31.9	35.6
45	12.2	14.5	17.1	19.8	22.7	25.9	29.2	32.7	36.5
50	12.4	14.8	17.3	20.1	23.1	26.3	29.7	33.3	37.1
55	12.6	15.0	17.6	20.4	23.5	26.7	30.1	33.8	37.6
60	12.8	15.2	17.9	20.8	23.8	27.1	30.6	34.3	38.2

Wind Speeds are per ASCE 7-10 for Ultimate Design Wind Speed at 33 ft. above ground. Mean Roof Height in Feet for Roof Pitches Greater Than 6:12 Equates to Roof Slopes 27° < θ < 45° for Zone 3.

DESIGN CONSIDERATIONS FOR HIGH WIND APPLICATIONS
 Under The 2015 IBC and IRC and the 2012 IBC and IRC (ASCE 7-10)

TABLE 3D
Required Aerodynamic Uplift Moment for Tile, Zone 3, Ma (ft-lbf)
for Monoslope Pitches $2\frac{1}{2}:12 < \theta < 6\frac{3}{4}:12$ ($12^\circ < \theta < 30^\circ$)

Exposure B		Ultimate Design Wind Speed (mph)							
Mean Roof Height	110	120	130	140	150	160	170	180	190
0-15	12.1	14.4	17.0	19.7	22.6	25.7	29.0	32.5	36.2
20	12.1	14.4	17.0	19.7	22.6	25.7	29.0	32.5	36.2
25	12.1	14.4	17.0	19.7	22.6	25.7	29.0	32.5	36.2
30	12.1	14.4	17.0	19.7	22.6	25.7	29.0	32.5	36.2
35	12.7	15.1	17.7	20.5	23.5	26.8	30.2	33.9	37.8
40	13.2	15.7	18.4	21.3	24.5	27.9	31.5	35.3	39.3
45	13.5	16.1	18.9	21.9	25.1	28.6	32.3	36.2	40.3
50	14.0	16.7	19.6	22.7	26.1	29.7	33.5	37.6	41.9
55	14.4	17.1	20.1	23.3	26.8	30.4	34.4	38.5	42.9
60	14.7	17.5	20.6	23.9	27.4	31.2	35.2	39.5	44.0
Exposure C		Ultimate Design Wind Speed (mph)							
Mean Roof Height	110	120	130	140	150	160	170	180	190
0-15	14.7	17.5	20.6	23.9	27.4	31.2	35.2	39.5	44.0
20	15.6	18.6	21.8	25.3	29.0	33.0	37.3	41.8	46.6
25	16.3	19.4	22.8	26.4	30.3	34.5	38.9	43.6	48.6
30	17.0	20.2	23.7	27.5	31.6	35.9	40.6	45.5	50.7
35	17.5	20.8	24.5	28.4	32.6	37.0	41.8	46.9	52.2
40	18.0	21.5	25.2	29.2	33.5	38.1	43.1	48.3	53.8
45	18.4	21.9	25.7	29.8	34.2	38.9	43.9	49.2	54.8
50	18.9	22.5	26.4	30.6	35.1	40.0	45.1	50.6	56.4
55	19.2	22.9	26.9	31.2	35.8	40.7	46.0	51.5	57.4
60	19.6	23.3	27.4	31.7	36.4	41.4	46.8	52.5	58.4
Exposure D		Ultimate Design Wind Speed (mph)							
Mean Roof Height	110	120	130	140	150	160	170	180	190
0-15	17.9	21.3	24.9	28.9	33.2	37.8	42.7	47.8	53.3
20	18.7	22.3	26.2	30.3	34.8	39.6	44.7	50.1	55.9
25	19.4	23.1	27.1	31.5	36.1	41.1	46.4	52.0	57.9
30	20.1	23.9	28.1	32.6	37.4	42.5	48.0	53.9	60.0
35	20.6	24.6	28.8	33.4	38.4	43.7	49.3	55.2	61.6
40	21.2	25.2	29.5	34.3	39.3	44.8	50.5	56.6	63.1
45	21.7	25.8	30.3	35.1	40.3	45.9	51.8	58.0	64.7
50	22.0	26.2	30.8	35.7	40.9	46.6	52.6	59.0	65.7
55	22.4	26.6	31.2	36.2	41.6	47.3	53.4	59.9	66.7
60	22.7	27.0	31.7	36.8	42.2	48.1	54.2	60.8	67.8

Wind Speeds are per ASCE 7-10 for Ultimate Design Wind Speed at 33 ft. above ground. Mean Roof Height in Feet for Roof Pitches $6\frac{3}{4}:12$ and Less Equates to Roof Slopes $12^\circ < \theta < 30^\circ$ deg for Zone 3.

DESIGN CONSIDERATIONS FOR HIGH WIND APPLICATIONS
Under The 2015 IBC and IRC and the 2012 IBC and IRC (ASCE 7-10)

TABLE 4
ALLOWABLE AERODYNAMIC UPLIFT MOMENT (ft-lbf)
MECHANICAL FASTENING SYSTEMS

DECK THICKNESS (inches)	ATTACHMENT METHOD	FASTENER TYPE	LOW	MEDIUM	HIGH
15/32	Direct Deck	1-10d smooth or screw shank nail, with clip	25.2	25.2	35.5
		2-10d, smooth or screw shank nail, with clip	38.1	38.1	44.3
		2-10d ring shank nail	39.1	36.1	28.6
		2-10d ring shank nail, with 4-inch head lap	50.3	43.0	33.1
		1-#8 screw	39.1	33.2	28.7
		2-#8 screw	50.2	55.5	51.3
	Batten	1-10d smooth or screw shank nail, with clip	27.5	27.5	29.4
		2-10d smooth or screw shank nail, with clip	37.6	37.6	47.2
		2-10d ring shank nail	34.6	36.4	26.8
		1-#8 screw	25.6	30.1	25.5
2-#8 screw		36.1	41.9	37.1	
19/32	Direct Deck	2-10d ring shank nail	46.4	45.5	41.2

For SI 1 inch = 25.4 mm; 1 ft-lbf = 1.4 N-m

For mean roof heights over 60 feet, engineering calculations must be submitted for permitting.

Notes for Table 4:

- For attachment systems not listed in the table for 19/32-inch-thick (15.1 mm) sheathing use the allowable aerodynamic uplift resistance from the table for 15/32-inch-thick (11.9 mm) sheathing.
- Fasteners shall have a minimum edge distance of 1 1/2 inches (38.1 mm) from the head of the tile and located in the pan of the tile to obtain the values in [Table 3](#).
- Ring shank nails shall be 10d ring shank corrosion-resistant steel nails with the following minimum dimensions: (3-inch long (76.2 mm), 0.283-inch (7.2 mm) flat head diameter, 0.120-inch (3.0 mm) undeformed shank diameter or 0.131-inch (3.3 mm) screw diameter).
- Smooth or screw shank nails shall be 10d corrosion-resistant steel with the following minimum dimension: (3-inch long, (76.2 mm) 0.283-inch (7.2 mm) flat head diameter, 0.120-inch (3.0 mm) undeformed shank diameter or 0.131-inch (3.3 mm) screw diameter).
- Screws are #8 course threaded, 2.5-inch-long (63.5 mm), corrosion-resistant steel wood screws conforming to ANSI/ASME B 18.6.1.
- The fastener hold nearest the overlock shall be used when a single nail or screw is required. The fastener hole nearest the underlock and the fastener hole nearest the overlock shall be used when two nails or screws are required.
- When using eave and field clips, attachment of the tiles is accomplished by a combination of nails and clips. Tiles are nailed to the sheathing or through the battens to the sheathing with one or two 10d corrosion-resistant nails, (Notes 2 and 3 above). Additionally, each tile is secured with a 0.060-inch-thick (1.5 mm) and 0.5-inch-wide (12.7 mm) clip which is secured to the plywood sheathing or eave fascia, as appropriate, with a single nail per clip. The nail shall be placed in the hole closest to the tile for clips having more than one nail hole. The following clip/nail combinations are permitted:
 - Aluminum alloy clip with 1.25-inch (31.8 mm) HD galvanized roofing nail (0.128-inch (3.3 mm) shank diameter).
 - Galvanized steel deck clip with 1.25-inch (31.8 mm) HD galvanized roofing nail (0.128-inch (3.3 mm) shank diameter).
 - Stainless steel clip with 1.25-inch (31.8 mm) HD galvanized roofing nail (0.128-inch (3.3 mm) shank diameter).
- Field clips and eave clips are to be located along the tile where the clip's preformed height and the tile's height above the underlayment are identical.
- Counterbatten values not included.

For attachment systems not listed in table for 15/32-inch-thick (11.9 mm) sheathing, use allowable aerodynamic uplift moment from table for 15/32 – inch-thick (11.9 mm) sheathing.

DIVISION: 07 00 00—THERMAL AND MOISTURE PROTECTION
Section: 07 32 16—Concrete Roof Tiles

REPORT HOLDER:

SANDSTONE INC., dba STONEMORTH BUILDING PRODUCTS

EVALUATION SUBJECT:

STONEMORTH BUILDING PRODUCTS FLAT AND VENETIAN CONCRETE ROOF TILES

1.0 REPORT PURPOSE AND SCOPE**Purpose:**

The purpose of this evaluation report supplement is to indicate that Flat and Venetian concrete roof tiles, described in ICC-ES evaluation report ESR-2528, has also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2023 and 2020 *Florida Building Code—Building*
- 2023 and 2020 *Florida Building Code—Residential*

2.0 CONCLUSIONS

The Flat and Venetian concrete roof tiles, described in Sections 2.0 through 7.0 of ICC-ES evaluation report ESR-2528, complies with the *Florida Building Code—Building* or *Florida Building Code—Residential*. The design requirements must be determined in accordance with the *Florida Building Code—Building* or the *Florida Building Code—Residential*, as applicable. The installation requirements noted in ICC-ES evaluation report ESR-2528 for the 2021 and 2018 *International Building Code*® meet the requirements of the *Florida Building Code—Building* or the *Florida Building Code—Residential*, as applicable, with the following condition:

- The roof tiles must be installed in accordance with Section 1507.3.7 of the *Florida Building Code—Building* where the nominal design wind speed, V_{asd} , is determined in accordance with Section 1609.3.1 of the *Florida Building Code—Building* or *FRSA/TRI Florida High Wind concrete and Clay Roof Tile Installation Manual, Seventh Edition*.
- For maximum basic design wind speeds of 130 mph (209 km/h) or less and mean roof heights of 60 feet (18.3 m) under the *Florida Building Code—Building* and a mean roof height of 40 feet (12 192 mm) or less under the *Florida Building Code—Residential*, tiles must be installed in accordance with the prescriptive parameters of the *Florida Building Code—Building* Section 1507.3.7 or the *Florida Building Code—Residential* Section R905.3.7. For applications beyond these prescriptive parameters under only the 2023 *Florida Building Code—Building* or the *Florida Building Code—Residential*, the tiles and fastening systems must be designed in accordance with Appendix B of this report and the Design Consideration for High Wind Applications Under the *Florida Building Code—Building* and *Florida Building Code—Residential* (ASCE 7-22) [hereinafter referred to as Appendix B].

Use of the Flat and Venetian concrete roof tiles have also been found to be in compliance with the High-Velocity Hurricane Zone provisions of the *Florida Building Code—Building* or the *Florida Building Code—Residential*. In addition to the data noted in Section 6.0 of the evaluation report ESR-2825, data in accordance with Florida Building Test Protocol for High-Velocity Hurricane Zones, TAS 112 was submitted.

For products falling under Florida Rule 61G20-3, 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 evaluation report, reissued April 2023 and revised August 2023.

APPENDIX B

Design Considerations for High Wind Applications

Under the 2023 Florida Building Code— Building and 2023 Florida Building Code—Residential (ASCE 7-22)

2023 Florida Building Code— Building: The *Florida Building Code – Building* provides prescribed installation requirements for concrete and clay roof tiles applicable to ultimate design wind speeds (V_{ult}) up to 130 miles per hour (58 m/s). For specific regions of the country identified in the *Florida Building Code – Building* as being subjected to ultimate design wind speeds (V_{ult}) in excess of 130 miles per hour (58 m/s), the tiles and fastening systems must be designed in accordance with this Appendix.

2023 Florida Building Code—Residential: On buildings located in areas where the *Florida Building Code – Residential* ultimate design wind speed does not exceed 130 mph (58 m/s) and having a maximum mean roof height of 40 feet (12.192 mm), tile application must comply with *Florida Building Code – Residential* Section R905.3.7. For greater basic wind speeds and/or higher mean roof heights, the tiles and fastening systems must be designed in accordance with this Appendix.

The following design aids are provided to the roof designer for consideration in determining the fastening requirements for roof tiles for wind applications beyond the prescriptive requirements in the *Florida Building Code— Building* and *Florida Building Code – Residential*. These tables were developed based on the requirements of Section 1609.6.3 of *Florida Building Code— Building* and *Florida Building Code – Residential* and ASCE 7-22.

Tables 2A through 2F of the Appendix are used to determine the generic required aerodynamic uplift moment for the tile. The generic required aerodynamic uplift moment determined from the tables must be multiplied by the tile factor ratio in Table 1 of ESR-2528 to obtain the required aerodynamic uplift moment for the specific roof tile being installed. The allowable aerodynamic uplift moment for the roof tile fastening system selected from Table 3 of the Appendix must be equal to or greater than the required aerodynamic uplift moment for the specific roof tile being installed.

Underlayment Notes: For consideration of attachment of underlayments in high wind areas, see *Florida Building Code – Building* Section 1507.3.3 and *Florida Building Code – Residential* Sections R905.1.1 and R905.3.3. Attachment of underlayments must comply with the above-mentioned sections.

TABLE 1

Conversion from Nominal Design Wind Speed V_{asd} to Ultimate Design Wind Speed V_{ult} shall be converted as $V_{asd} = V_{ult} * \sqrt{0.6}$ or from the following table:

DESIGN WIND SPEED CONVERSION (mph)									
V_{ult}	110	120	130	140	150	160	170	180	190
V_{asd}	85	93	101	108	116	124	132	139	147

For SI: 1 mile per hour = 0.44 m/s. A linear interpolations permitted.

APPENDIX B (Continued)
DESIGN CONSIDERATIONS FOR HIGH WIND APPLICATIONS
 Under The 2023 Florida Building Code— Building and 2023 *Florida Building Code—Residential* (ASCE 7-22)

TABLE 2A

Required Aerodynamic Uplift Moment for Tile, Zone 3

Ma (ft-lbf) For Roof Pitches 4¹/₂:12 or Less

Hip Roof 2¹/₂: 12 to 4¹/₂:12 (12° < θ < 20°)

Exposure B	Ultimate Design Wind Speed (mph)								
Mean Roof Height	115	120	130	140	150	160	170	180	190
0-30	14.4	15.7	18.4	21.3	24.5	27.9	31.5	35.3	39.3
40	15.2	16.6	19.5	22.6	25.9	29.5	33.3	37.3	41.6
50	16.3	17.7	20.8	24.1	27.7	31.5	35.5	39.8	44.4
60	17.1	18.6	21.8	25.3	29.1	33.1	37.3	41.8	46.6
Exposure C	Ultimate Design Wind Speed (mph)								
Mean Roof Height	115	120	130	140	150	160	170	180	190
0-15	17.5	19.0	22.4	25.9	29.8	33.9	38.2	42.9	47.7
20	18.5	20.2	23.7	27.4	31.5	35.9	40.5	45.4	50.6
30	20.2	22.0	25.8	29.9	34.3	39.0	44.1	49.4	55.1
40	21.4	23.3	27.4	31.7	36.4	41.4	46.8	52.4	58.4
50	22.4	24.4	28.7	33.2	38.2	43.4	49.0	55.0	61.2
60	23.3	25.3	29.7	34.5	39.6	45.0	50.8	57.0	63.5
Exposure D	Ultimate Design Wind Speed (mph)								
Mean Roof Height	115	120	130	140	150	160	170	180	190
0-15	21.2	23.1	27.1	31.4	36.1	41.0	46.3	51.9	57.9
20	22.2	24.2	28.4	32.9	37.8	43.0	48.6	54.5	60.7
30	23.9	26.0	30.5	35.4	40.6	46.2	52.2	58.5	65.2
40	25.1	27.3	32.1	37.2	42.7	48.6	54.9	61.5	68.5
50	26.1	28.5	33.4	38.7	44.5	50.6	57.1	64.0	71.3
60	27.0	29.4	34.5	40.0	45.9	52.2	58.9	66.0	73.6

Wind Speeds are per ASCE 7-22 for Ultimate Design Wind Speed at 33 ft. above ground. MRH = Mean Roof Height in Feet for Roof Pitches 4¹/₂:12 and Less Equates to Roof Slopes 12° < θ < 20° for Zone 3.

APPENDIX B (Continued)
DESIGN CONSIDERATIONS FOR HIGH WIND APPLICATIONS
 Under The 2023 Florida Building Code— Building and 2023 *Florida Building Code—Residential* (ASCE 7-22)

TABLE 2B
Required Aerodynamic Uplift Moment for Tile, Zone 3
Ma (ft-lbf) For Roof Pitches 6:12 and Less
Hip Roof 4¹/₂:12 < θ < 6:12 (20° < θ < 27°)

Exposure B		Ultimate Design Wind Speed (mph)							
Mean Roof Height	115	120	130	140	150	160	170	180	190
0-30	12.0	13.1	15.3	17.8	20.4	23.2	26.2	29.4	32.8
40	12.7	13.8	16.2	18.8	21.6	24.6	27.7	31.1	34.6
50	13.5	14.8	17.3	20.1	23.0	26.2	29.6	33.2	37.0
60	14.2	15.5	18.2	21.1	24.2	27.6	31.1	34.9	38.9
Exposure C		Ultimate Design Wind Speed (mph)							
Mean Roof Height	115	120	130	140	150	160	170	180	190
0-15	14.6	15.9	18.6	21.6	24.8	28.2	31.9	35.7	39.8
20	15.4	16.8	19.7	22.9	26.3	29.9	33.7	37.8	42.1
30	16.8	18.3	21.5	24.9	28.6	32.5	36.7	41.2	45.9
40	17.8	19.4	22.8	26.4	30.3	34.5	39.0	43.7	48.7
50	18.7	21.1	23.9	27.7	31.8	36.2	40.8	45.8	51.0
60	19.4	21.1	24.8	28.7	33.0	37.5	42.3	47.5	52.9
Exposure D		Ultimate Design Wind Speed (mph)							
Mean Roof Height	115	120	130	140	150	160	170	180	190
0-15	17.7	19.2	22.6	26.2	30.1	34.2	38.6	43.3	48.2
20	18.5	20.2	23.7	27.4	31.5	35.9	40.5	45.4	50.6
30	19.9	21.7	25.4	29.5	33.8	38.5	43.5	48.7	54.3
40	20.9	22.8	26.7	31.0	35.6	40.5	45.7	51.3	57.1
50	21.8	23.7	27.8	32.3	37.1	42.2	47.6	53.4	59.5
60	22.5	24.5	28.7	33.3	38.2	43.5	49.1	55.0	61.3

Wind Speeds are per ASCE 7-22 for Ultimate Design Wind Speed at 33 ft. above ground. Mean Roof Height in Feet for Roof Pitches Less Than 6:12 Equates to Roof Slopes 20° < θ < 27° for Zone 3.

APPENDIX B (Continued)
DESIGN CONSIDERATIONS FOR HIGH WIND APPLICATIONS
 Under The 2023 Florida Building Code— Building and 2023 Florida Building Code—Residential (ASCE 7-22)

TABLE 2C
Required Aerodynamic Uplift Moment for Tile, Zone 3
Ma (ft-lbf) For Roof Pitches Greater Than 6:12
Hip Roof 6:12 < θ < 12:12 (27° < θ < 45°)

Exposure B	Ultimate Design Wind Speed (mph)								
Mean Roof Height	115	120	130	140	150	160	170	180	190
0-30	13.6	14.8	17.4	20.2	23.1	26.3	29.7	33.3	37.1
40	14.4	15.7	18.4	21.3	24.5	27.8	31.4	35.2	39.3
50	15.4	16.7	19.6	22.8	26.1	29.7	33.6	37.6	41.9
60	16.1	17.6	20.6	23.9	27.4	31.2	35.3	39.5	44.0
Exposure C	Ultimate Design Wind Speed (mph)								
Mean Roof Height	115	120	130	140	150	160	170	180	190
0-15	16.5	18.0	21.1	24.5	28.1	32.0	36.1	40.5	45.1
20	17.5	19.0	22.4	25.9	29.8	33.9	38.2	42.9	47.7
30	19.0	20.7	24.3	28.2	32.4	36.9	41.6	46.7	52.0
40	20.2	22.0	25.8	30.0	34.4	39.1	44.2	49.5	55.2
50	21.2	23.1	27.1	31.4	36.0	41.0	46.3	51.9	57.8
60	22.0	23.9	28.1	32.5	37.4	42.5	48.0	53.8	57.8
Exposure D	Ultimate Design Wind Speed (mph)								
Mean Roof Height	115	120	130	140	150	160	170	180	190
0-15	20.0	21.8	25.6	29.7	34.1	38.8	43.7	49.0	54.6
20	21.0	22.9	26.8	31.1	35.7	40.6	45.9	51.4	57.3
30	22.5	24.5	28.8	33.4	38.4	43.6	49.3	55.2	61.5
40	23.7	25.8	30.3	35.1	40.3	45.9	51.8	58.1	64.7
50	24.7	26.9	31.5	36.6	42.0	47.8	53.9	59.9	67.4
60	25.5	27.7	32.58	37.7	43.3	49.3	55.6	61.6	69.5

Wind Speeds are per ASCE 7-22 for Ultimate Design Wind Speed at 33 ft. above ground. Mean Roof Height in Feet for Roof Pitches Greater Than 6:12 Equates to Roof Slopes 27° < θ < 45° for Zone 3.

APPENDIX B (Continued)
DESIGN CONSIDERATIONS FOR HIGH WIND APPLICATIONS
 Under The 2023 Florida Building Code— Building and 2023 *Florida Building Code—Residential* (ASCE 7-22)

TABLE 2D

Required Aerodynamic Uplift Moment for Tile, Zone 3

Ma (ft-lbf) For Roof Pitches 4¹/₂:12 or Less

Gable Roof 2¹/₂: 12 to 4¹/₂:12 (12 < θ < 20°)

Exposure B	Ultimate Design Wind Speed (mph)								
Mean Roof Height	115	120	130	140	150	160	170	180	190
0-15	18.4	20.0	23.5	27.3	31.3	35.6	40.2	45.1	50.2
20	18.4	20.0	23.5	27.3	31.3	35.6	40.2	45.1	50.2
30	18.4	20.0	23.5	27.3	31.3	35.6	40.2	45.1	50.2
40	19.5	21.2	24.9	28.8	33.1	37.7	42.5	47.7	53.1
50	20.8	22.6	26.5	30.8	35.3	40.2	45.4	50.9	56.7
60	21.8	23.8	27.9	32.3	37.1	42.2	47.7	53.5	59.6
Exposure C	Ultimate Design Wind Speed (mph)								
Mean Roof Height	115	120	130	140	150	160	170	180	190
0-15	22.4	24.3	28.6	33.1	38.0	43.3	48.8	54.8	61.0
20	23.7	25.8	30.2	35.1	40.3	45.8	51.7	58.0	64.6
30	25.8	28.1	32.9	38.2	43.8	49.9	56.3	63.1	70.3
40	27.3	29.8	34.9	40.5	46.5	52.9	59.8	67.0	74.7
50	28.7	31.2	36.6	42.5	48.8	55.5	62.6	70.2	78.2
60	29.7	32.4	38.0	44.0	50.6	57.5	64.9	72.8	81.1
Exposure D	Ultimate Design Wind Speed (mph)								
Mean Roof Height	115	120	130	140	150	160	170	180	190
0-15	27.1	29.5	34.6	40.1	46.1	52.4	59.2	66.4	73.9
20	28.4	30.9	36.3	42.1	48.3	55.0	62.1	69.6	77.5
30	30.5	33.2	39.0	45.2	51.9	59.0	66.7	74.7	83.3
40	32.1	34.9	41.0	47.5	54.6	62.1	70.1	78.6	87.6
50	33.4	36.4	42.7	49.5	56.8	64.6	73.0	81.8	91.2
60	34.4	37.5	44.0	51.1	58.6	66.7	75.3	84.4	94.0

Wind Speeds are per ASCE 7-22 for Ultimate Design Wind Speed at 33 ft. above ground. MRH = Mean Roof Height in Feet for Roof Pitches 4¹/₂:12 and Less Equates to Roof Slopes 12° < θ < 20° for Zone 3.

APPENDIX B (Continued)
DESIGN CONSIDERATIONS FOR HIGH WIND APPLICATIONS
 Under The 2023 Florida Building Code— Building and 2023 *Florida Building Code—Residential* (ASCE 7-22)

TABLE 2E
Required Aerodynamic Uplift Moment for Tile, Zone 3
Ma (ft-lbf) For Roof Pitches 6:12 and Less
Gable Roof 4¹/₂:12 < θ < 6:12 (20° < θ < 27°)

Exposure B		Ultimate Design Wind Speed (mph)							
Mean Roof Height	115	120	130	140	150	160	170	180	190
0-15	19.4	21.2	24.8	28.8	33.1	37.6	42.5	47.6	53.1
20	19.4	21.2	24.8	28.8	33.1	37.6	42.5	47.6	53.1
30	19.4	21.2	24.8	28.8	33.1	37.6	42.5	47.6	53.1
40	20.6	22.4	26.3	30.5	35.0	39.8	45.0	50.4	56.2
50	21.5	23.4	27.7	31.9	36.6	41.6	47.0	52.7	58.7
60	22.4	24.4	28.6	33.2	38.1	43.4	49.0	54.9	61.2
Exposure C		Ultimate Design Wind Speed (mph)							
Mean Roof Height	115	120	130	140	150	160	170	180	190
0-15	19.4	21.2	24.8	28.8	33.1	37.6	42.5	47.6	53.1
20	20.6	22.4	26.3	30.5	35.0	39.8	45.0	50.4	56.2
30	22.4	24.4	28.6	33.2	38.1	43.4	49.0	54.9	61.2
40	23.8	25.9	30.4	35.2	40.5	46.0	52.0	58.3	64.9
50	24.9	27.1	31.9	36.9	42.4	48.2	54.5	61.1	68.0
60	25.8	28.1	33.0	38.3	44.0	50.0	56.5	63.3	70.5
Exposure D		Ultimate Design Wind Speed (mph)							
Mean Roof Height	115	120	130	140	150	160	170	180	190
0-15	23.6	25.6	30.1	34.9	40.1	45.6	51.5	57.7	64.3
20	24.7	26.9	31.6	36.6	42.0	47.8	54.0	60.5	67.5
30	26.5	28.9	33.9	39.3	45.1	51.3	58.0	65.0	72.4
40	27.9	30.4	35.6	41.3	47.5	54.0	61.0	68.3	76.1
50	29.0	31.6	37.1	43.0	49.4	56.2	63.5	71.1	79.3
60	30.0	32.6	36.3	44.4	51.0	58.0	65.5	73.4	81.8

Wind Speeds are per ASCE 7-22 for Ultimate Design Wind Speed at 33 ft. above ground. Mean Roof Height in Feet for Roof Pitches Less Than 6:12 Equates to Roof Slopes 20° < θ < 27° for Zone 3.

APPENDIX B (Continued)
DESIGN CONSIDERATIONS FOR HIGH WIND APPLICATIONS
 Under The 2023 Florida Building Code— Building and 2023 Florida Building Code—Residential (ASCE 7-22)

TABLE 2F
Required Aerodynamic Uplift Moment for Tile, Zone 3
Ma (ft-lbf) For Roof Pitches Greater Than 6:12
Gable Roof 6:12 < θ < 12:12 (27° < θ < 45°)

Exposure B	Ultimate Design Wind Speed (mph)								
Mean Roof Height	115	120	130	140	150	160	170	180	190
0-15	14.0	15.2	17.9	20.8	23.8	27.1	30.6	34.3	38.2
20	14.0	15.2	17.9	20.8	23.8	27.1	30.6	34.3	38.2
30	14.0	15.2	17.9	20.8	23.8	27.1	30.6	34.3	38.2
40	14.8	16.1	18.9	21.9	25.2	28.7	32.4	36.3	40.4
50	15.8	17.2	20.2	23.4	26.9	30.6	34.5	38.7	43.1
60	16.6	18.1	21.2	24.6	28.3	32.1	36.3	40.7	45.3
Exposure C	Ultimate Design Wind Speed (mph)								
Mean Roof Height	115	120	130	140	150	160	170	180	190
0-15	17.0	18.5	21.7	25.2	28.9	32.9	37.2	41.7	46.4
20	18.0	19.6	23.0	26.7	30.6	34.9	39.4	44.1	49.2
30	19.6	21.3	25.1	29.1	33.4	38.0	42.8	48.0	53.5
40	20.8	22.7	26.6	30.8	35.4	40.3	45.5	51.0	56.8
50	21.8	23.7	27.9	32.3	37.1	42.2	47.4	53.4	59.5
60	22.6	24.6	28.9	33.5	38.5	43.8	49.4	55.4	61.7
Exposure D	Ultimate Design Wind Speed (mph)								
Mean Roof Height	115	120	130	140	150	160	170	180	190
0-15	20.6	22.4	26.3	30.5	35.1	39.9	45.0	50.5	56.3
20	21.6	23.5	27.6	32.0	36.8	41.8	47.2	52.9	59.0
30	23.2	25.3	29.7	34.4	39.5	44.9	50.7	56.9	63.4
40	24.4	26.6	31.2	36.2	41.5	47.3	53.3	59.8	66.6
50	25.4	27.7	32.5	37.7	43.2	49.2	55.5	62.3	69.4
60	26.2	28.5	33.5	38.8	44.6	50.7	57.3	64.2	71.5

Wind Speeds are per ASCE 7-22 for Ultimate Design Wind Speed at 33 ft. above ground. Mean Roof Height in Feet for Roof Pitches Greater Than 6:12 Equates to Roof Slopes 27° < θ < 45° for Zone 3.

APPENDIX B (Continued)
DESIGN CONSIDERATIONS FOR HIGH WIND APPLICATIONS
 Under The 2023 Florida Building Code— Building and 2023 Florida Building Code—Residential (ASCE 7-22)

TABLE 3
ALLOWABLE AERODYNAMIC UPLIFT MOMENT (ft-lbf)
MECHANICAL FASTENING SYSTEMS

DECK THICKNESS (inches)	ATTACHMENT METHOD	FASTENER TYPE	LOW	MEDIUM	HIGH
15/32	Direct Deck	1-10d smooth or screw shank nail, with clip	25.2	25.2	35.5
		2-10d, smooth or screw shank nail, with clip	38.1	38.1	44.3
		2-10d ring shank nail	39.1	36.1	28.6
		1-#8 screw	39.1	33.2	28.7
		2-#8 screw	50.2	55.5	51.3
	Batten	1-10d smooth or screw shank nail, with clip	27.5	27.5	29.4
		2-10d smooth or screw shank nail, with clip	37.6	37.6	47.2
		2-10d ring shank nail	24.6	36.4	26.8
		1-#8 screw	25.6	30.1	25.5
		2-#8 screw	36.1	41.9	37.1
19/32	Direct Deck	2-10d ring shank nail	46.4	45.5	41.2

For SI 1 inch = 25.4 mm; 1 ft-lbf = 1.4 N-m

For mean roof heights over 60 feet, engineering calculations must be submitted for permitting.

Notes for Table 4:

- For attachment systems not listed in the table for 19/32-inch-thick (15.1 mm) sheathing use the allowable aerodynamic uplift resistance from the table for 15/32-inch-thick (11.9 mm) sheathing.
- Fasteners shall have a minimum edge distance of 1 1/2 inches (38.1 mm) from the head of the tile and located in the pan of the tile to obtain the values in Table 3.
- Ring shank nails shall be 10d ring shank corrosion-resistant steel nails with the following minimum dimensions:(3-inch long (76.2 mm), 0.283-inch (7.2 mm) flat head diameter, 0.120-inch (3.0 mm) undeformed shank diameter or 0.131-inch (3.3 mm) screw diameter).
- Smooth or screw shank nails shall be 10d corrosion-resistant steel with the following minimum dimension: (3-inch long, (76.2 mm) 0.283-inch (7.2 mm) flat head diameter, 0.120-inch (3.0 mm) undeformed shank diameter or 0.131-inch (3.3 mm) screw diameter).
- Screws are #8 course threaded, 2.5-inch-long (63.5 mm), corrosion-resistant steel wood screws conforming to ANSI/ASME B 18.6.1.
- The fastener hold nearest the overlock shall be used when a single nail or screw is required. The fastener hole nearest the underlock and the fastener hole nearest the overlock shall be used when two nails or screws are required.
- When using eave and field clips, attachment of the tiles is accomplished by a combination of nails and clips. Tiles are nailed to the sheathing or through the battens to the sheathing with one or two 10d corrosion-resistant nails, (Notes 2 and 3 above). Additionally, each tile is secured with a 0.060-inch-thick (1.5 mm) and 0.5-inch-wide (12.7 mm) clip which is secured to the plywood sheathing or eave fascia, as appropriate, with a single nail per clip. The nail shall be placed in the hole closest to the tile for clips having more than one nail hole. The following clip/nail combinations are permitted:
 - Aluminum alloy clip with 1.25-inch (31.8 mm) HD galvanized roofing nail (0.128-inch (3.3 mm) shank diameter).
 - Galvanized steel deck clip with 1.25-inch (31.8 mm) HD galvanized roofing nail (0.128-inch (3.3 mm) shank diameter).
 - Stainless steel clip with 1.25-inch (31.8 mm) HD galvanized roofing nail (0.128-inch (3.3 mm) shank diameter).
- Field clips and eave clips are to be located along the tile where the clip's preformed height and the tile's height above the underlayment are identical.
- The allowable aerodynamic uplift moments include a generic restoring gravity moment of 6.5 ft-lbf for a direct deck and a restoring gravity moment of 5.5 ft-lbs for a batten installation.
- Counterbatten values not included.

For attachment systems not listed in table for 15/32-inch-thick (11.9 mm) sheathing, use allowable aerodynamic uplift moment from table for 15/32 – inch-thick (11.9 mm) sheathing.