

**CHAPTER 5
ROOF ASSEMBLIES**

501.2 APPLICATION

The installation of roof assemblies shall include the provisions of Chapter 9 – Roof Assemblies of the *International Residential Code* and or Chapter 15 – Roof Assemblies and Rooftop Structures of the *International Building Code* with the modifications provided in this Chapter 5 – Roof Assemblies.

TABLE 501.3.1.1

Design Uplift Pressure (psf)							
Gable or Hip Roof	Roof Zones	Basic Design Wind Speed, V (mph)					
		100	110	120	130	140	150
0:12 to 1-½:12 (0° to 7°)	1	18.0	21.8	25.9	30.4	35.3	40.5
	2	30.2	36.5	43.5	51.0	59.2	67.9
	3	45.4	55.0	65.4	76.8	89.0	102.2
1-½:12 to 6:12 (7° to 27°)	1	16.5	19.9	23.7	27.8	32.3	37.0
	2	28.7	34.7	41.3	48.4	56.2	64.5
	3	42.2	51.3	61.0	71.6	83.1	95.4
6:12 to 12:12 (27° to 45°)	1	18.0	21.8	25.9	30.4	35.3	40.3
	2	21.0	25.5	30.3	35.6	41.2	47.3
	3	21.0	25.5	30.3	35.6	41.2	47.3

Notes for Table 501.3.1.1:

1. Exposure B
2. Mean roof height of 30 feet.
3. Importance factor of 1.0

TABLE 502.4.5

Flashing Fastener Spacing			
Basic Design Wind Speed	90 mph to 110 mph	Greater than 110 mph to 140 mph	Greater than 140 mph to 150 mph
Maximum Spacing (inches)	6	4	4

503 MATERIALS

503.1 ROOF SHEATHING

Roof sheathing shall be solid sheathing designed to resist the loads required by Chapter 16 and provide a structural membrane for attachment of the roof covering installed in accordance with this standard.

503.2 FASTENER CORROSION RESISTANCE

Fasteners shall be corrosion resistant meeting ASTM A 641, Class I complying with 304.3 or an equal corrosion resistance by coating, electro galvanization, mechanical galvanization, hot dipped galvanization, stainless steel, nonferrous metal and alloys or other suitable corrosion-resistant material.

Exceptions:

1. Fasteners used to secure roof sheathing.
2. Fasteners for concrete and clay roof tiles shall comply with Table 504.3.5, Note 8.

504 REQUIREMENTS FOR ROOF COVERINGS

504.1 SCOPE

Roof coverings shall be applied in accordance with Section R905 REQUIREMENTS FOR ROOF COVERINGS of the *International Residential Code* or Section 1507 REQUIREMENTS FOR ROOF COVERINGS of the *International Building Code*, the applicable provisions of this section and the manufacturer's installation instruction.

504.2 ASPHALT SHINGLES

Asphalt shingles shall comply with Section R905.2 Asphalt shingles of the *International Residential Code* or Section 1507.2 Asphalt shingles of the *International Building Code* and this section.

**Table 504.2.2
Minimum Attachment for Asphalt Shingles**

Maximum Basic Design Wind Speed (Figure 104A)	Classification in accordance to ASTM D 3161	Classification in accordance to ASTM D 7158
100	Class D	Class G
110	Class F	Class G
120	Class F	Class G
150	---	Class H

504.3.4 Attachment: Clay and concrete tile shall be attached in accordance with this section and the manufacturer's instructions. Clay and concrete roof tiles shall be secured to resist the appropriate required aerodynamic uplift moment, M_a , in Tables 504.3.4.1 design wind speed in accordance with this section or Section 1609.7.3 of the *International Building Code*. The allowable aerodynamic uplift moment determined by Table 504.3.5 plus any gravity moment due to the dead weight of the roof tile shall be equal to or greater than the required aerodynamic uplift moment determined by Section Table 504.3.4.1 or Section 1609.7.3 of the *International Building Code*.

**TABLE 504.3.4.1
REQUIRED AERODYNAMIC UPLIFT MOMENT, M_A (FT-LBF)
EXPOSURE B**

Importance Factor = 1.00									
Gable Roof 1-1/2:12 < θ < 6:12 (7° < θ < 27°)									
Hip Roof 5-1/2:12 < θ < 6:12 (25° < θ < 27°)									
Height (ft)	Basic Design Wind Speed, V (mph)								
	100	105	110	120	125	130	140	145	150
Gable Roof 1-1/2:12 < θ < 6:12 (7° < θ < 27°)									
Hip Roof 5-1/2:12 < θ < 6:12 (25° < θ < 27°)									
0-30	15.4	17.0	18.7	22.2	24.1	26.1	30.3	32.5	34.7
40	16.8	18.5	20.3	24.1	26.2	28.3	32.9	35.3	37.7
Hip Roof 1-1/2:12 < θ < 5-1/2:12 (7° < θ < 25°)									
0-30	11.6	12.8	14.0	16.7	18.1	19.6	22.7	24.4	26.1
40	12.6	13.9	15.2	18.1	19.6	21.3	24.6	26.4	28.3
Gable Roof 6:12 < θ < 12:12 (27° < θ < 45°)									
0-30	9.4	10.4	11.4	13.6	14.7	15.9	18.5	19.8	21.2
40	10.2	11.3	12.4	14.8	16.0	17.3	20.1	21.5	23.1
Monoslope Roof 2:12 < θ < 7:12 (10° < θ < 30°)									
0-30	16.7	18.4	20.2	24.1	26.1	28.3	32.8	35.2	37.6
40	18.2	20.0	22.0	26.2	28.4	30.7	35.6	38.2	40.9
EXPOSURE C									
Importance Factor = 1.00									
Gable Roof 1-1/2:12 < θ < 6:12 (7° < θ < 27°)									
Hip Roof 5-1/2:12 < θ < 6:12 (25° < θ < 27°)									

Height (ft)	Basic Design Wind Speed, V (mph)								
	100	105	110	120	125	130	140	145	150
Gable Roof 1-½:12 < θ < 6:12 (7° < θ < 27°)									
Hip Roof 5-½:12 < θ < 6:12 (25° < θ < 27°)									
0-15	18.7	20.6	22.6	26.9	29.2	31.6	36.7	39.3	42.1
20	19.9	21.9	24.1	28.6	31.1	33.6	39.0	41.8	44.7
25	20.8	23.0	25.2	30.0	32.6	35.2	40.8	43.8	46.9
30	21.7	23.9	26.2	31.2	33.8	36.6	42.4	45.5	48.7
40	23.0	25.4	27.8	33.1	35.9	38.9	45.1	48.4	51.8
Hip Roof 1-1/2:12 < θ < 5 ½:12 (7° < θ < 25°)									
0-15	14.0	15.5	17.0	20.2	21.9	23.7	27.5	29.5	31.6
20	14.9	16.4	18.0	21.5	23.3	25.2	29.2	31.3	33.5
25	15.6	17.2	18.9	22.5	24.4	26.4	30.6	32.9	35.2
30	16.2	17.9	19.6	23.4	25.4	27.4	31.8	34.1	36.5
40	17.3	19.0	20.9	24.8	27.0	29.2	33.8	36.3	38.8
Gable Roof 6:12 < θ < 12:12 (27° < θ < 45°)									
0-15	11.4	12.6	13.8	16.5	17.9	19.3	22.4	24.0	25.7
20	12.1	13.4	14.7	17.5	19.0	20.5	23.8	25.5	27.3
25	12.7	14.0	15.4	18.3	19.9	21.5	25.0	26.8	28.6
30	13.2	14.6	16.0	19.1	20.7	22.4	25.9	27.8	29.8
40	14.1	15.5	17.0	20.2	22.0	23.8	27.6	29.6	31.6
Monoslope Roof 2:12 < θ < 7:12 (10° < θ < 30°)									
0-15	20.3	22.3	24.5	29.2	31.7	34.3	39.7	42.6	45.6
20	21.5	23.7	26.1	31.0	33.7	36.4	42.2	45.3	48.5
25	22.6	24.9	27.3	32.5	35.3	38.1	44.2	47.5	50.8
30	23.5	25.9	28.4	33.8	36.6	39.6	46.0	49.3	52.8
40	24.9	27.5	30.2	35.9	38.9	42.1	48.8	52.4	56.1

Notes for Table 504.3.4.1:

1. Roof tiles shall comply with the following dimensions:
 - (1) The total length of the roof tile shall be between 1.0 foot and 1.75 feet.
 - (2) The exposed width of the roof tile shall be between 0.67 feet and 1.25 feet.
 - (3) The maximum thickness of the tail of the roof tile shall not exceed 1.3 inches.
2. The required aerodynamic uplift moments in these tables are based on a roof tile that has a Tile Factor of 1.407 ft³. The required aerodynamic uplift moment for roof tiles with a Tile Factor other than 1.407 ft³ shall be determined by using the following procedure. These tables are conservative for roof tiles with a Tile Factor less than 1.407 ft³.
 - (1) Calculate the Tile Factor for the desired roof tile.
Tile Factor = b (L) (L_a)
b = exposed width of the roof tile (ft)
L = total length of roof tile (ft)
L_a = moment between point of rotation and the theoretical location of the resultant of the wind uplift force. For the standard roof tiles the moment arm = 0.76 L (See *International Building Code* – Section 1609.7.3)
 - (2) Based on exposure, roof style, roof pitch, importance, basic wind speed, and mean roof height select the appropriate required aerodynamic uplift moment from the tables for the desired roof tile.
 - (3) Multiply the selected required aerodynamic uplift moment by the ratio of the tile factor for the desired roof tile and 1.407 ft³.
 - (4) Select an attachment system that is equal to or greater than the calculated required aerodynamic uplift moment in step 3.
3. The Table 504.3.4.2 provides a combination of exposed widths and total lengths that generate a Tile Factor of 1.407 ft³. Roof tile with length and exposed width equal to or less than those listed Table 504.3.4.2 have a Tile Factor that is equal to or less than 1.407 ft³. The required aerodynamic uplift moments for these roof tiles are equal to or less than the required aerodynamic uplift moments in Table 504.3.4.1.

**TABLE 504.3.5
ALLOWABLE AERODYNAMIC UPLIFT MOMENTS MECHANICAL FASTENING SYSTEMS**

Direct Deck Installation		
Roof Tile Profile	¹⁵/₃₂" Sheathing (plywood or code approved equivalent)	Allowable Aerodynamic Uplift Resistance (ft-lbf)
Flat/Low	2-10d ring shank nails (18-22 rings per inch)	39.1
Medium		36.1
High		28.6
Flat/Low	1-#8 screw	39.1
Medium		33.3
High		28.7
Flat/Low	2-#8 screws	50.1
Medium		55.5
High		51.3
Flat/Low	1-10d smooth or screw shank nail	13.5
Medium		12.9
High		11.3
Flat/Low	2-10d smooth or screw shank nails	20.2
Medium		19.1
High		13.1
Flat/Low	1-10d smooth or screw shank nail with clip	25.2
Medium		25.2
High		35.5
Flat/Low	2-10d smooth or screw shank nails	38.1
Medium		38.1
High		44.3
Batten Installation		
Roof Tile Profile	¹⁵/₃₂" Sheathing (plywood or code approved equivalent)	Allowable Aerodynamic Uplift Resistance (ft-lbf)
Flat/Low	2-10d ring shank nails (18-22 rings per inch)	24.6
Medium		36.4
High		26.8
Flat/Low	1-#8 screw	25.6
Medium		30.1
High		25.5
Flat/Low	2-#8 screws	36.1
Medium		41.9
High		37.1
Flat/Low	1-10d smooth or screw shank nail	10.1
Medium		8.7
High		8.2
Flat/Low	2-10d smooth or screw shank nails	12.8
Medium		11.9
High		12.7
Flat/Low	1-10d smooth or screw shank nail with clip	27.5
Medium		27.5
High		29.4
Flat/Low	2-10d smooth or screw shank nails	37.6
Medium		37.6
High		47.2
Direct Deck Installation		
Roof Tile Profile	¹⁹/₃₂" Sheathing (plywood or code approved equivalent)	Allowable Aerodynamic Uplift Resistance (ft-lbf)
Flat/Low	2-10d ring shank nails (18-22 rings per inch)	46.4
Medium		45.5
High		41.2
Flat/Low	1-10d smooth or screw shank nail	16.0
Medium		15.2
High		13.0
Flat/Low	2-10d smooth or screw shank nails	25.0
Medium		23.4
High		15.4

Notes for Table 504.3.5:

1. Fasteners shall have a minimum edge distance of 1-½ inches from the head of the tile and located in the pan of the tile to obtain the values in Table 504.3.5. Consult the tile manufacturer for additional limitations or restrictions.
 2. Ring shank nails shall be 10d ring shank corrosion resistant steel nails ~~(with the following minimum dimensions: 3 inches long, 0.283 inch flat head diameter, 0.124 inch undeformed shank diameter, and 0.131 inch ring diameter).~~ with the following minimum dimensions: 3 inches long, 0.283 inch flat head diameter, 0.120 inch undeformed shank diameter, and 0.131 inch ring diameter).
 3. Smooth or screw shank nails shall be 10d corrosion resistant steel ~~(with the following minimum dimensions: 3 inches long, 0.28 inch flat head diameter, 0.128 inch screw 0.120 inch undeformed shank diameter or 0.131 inch smooth shank screw diameter).~~ with the following minimum dimensions: 3 inches long, 0.283 inch flat head diameter, 0.120 inch undeformed shank diameter or 0.131 inch smooth shank screw diameter).
 4. Screws are #8 coarse threaded, minimum 2-½ inches long corrosion resistant steel wood screws conforming to ANSI/ASME B 18.6.1.
 5. The fastener hole 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.
 6. 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 (Note 2 and 3 above) as required by Tables 504.3.5. Additionally, each tile is secured with a 0.060 inch thick and 0.5 inch wide 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:
 1. Aluminum alloy clip with 1.25 inches HD galvanized roofing nail (0.128 inch shank diameter).
 2. Galvanized steel deck clip with 1.25 inches HD galvanized roofing nail (0.128 inch shank diameter).
 3. Stainless steel clip with 1.25 inches HD galvanized roofing nail (0.128 inch shank diameter).
 7. 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.
 8. The nail and screw shall meet ASTM A 641, Class I or an equal corrosion resistance by coating, electro galvanization, mechanical galvanization, hot dipped galvanization, stainless steel, nonferrous metal and alloys or other suitable corrosion-resistant material.
 9. For attachment systems not listed in the table for ¹⁹/₃₂ inch sheathing use the allowable aerodynamic uplift resistance from the table for ¹⁵/₃₂ inch sheathing.
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504.7.7.1.2 Screws: Screws to attach the battens to the framing shall be No. 8 by 2-½ inches long corrosion resistant wood screws. Wood screws shall be corrosion resistant screws conforming to ANSI/ASME B 18.6.1. The corrosion resistance shall ~~meet ASTM A 641, Class 1 or an equal corrosion resistance by coating, electro galvanization, mechanical galvanization, stainless steel, nonferrous metal or other suitable corrosion resistant material~~ comply with Section 304.3.

504.8.7.1.2 Screws: Screws to attach the battens to the framing shall be No. 8 by 2-½ inches long corrosion resistant wood screws. Wood screws shall be corrosion resistant screws conforming to ANSI/ASME B 18.6.1. The corrosion resistance shall ~~meet ASTM A 641, Class 1 or an equal corrosion resistance by coating, electro galvanization, mechanical galvanization, stainless steel, nonferrous metal or other suitable corrosion resistant material~~ comply with Section 304.3.
