RAS-127

ROOFING APPLICATION STANDARD (RAS) No. 127-20
PROCEDURE FOR DETERMINING THE MOMENT OF RESISTANCE AND MINIMUM CHARACTERISTIC RESISTANCE LOAD TO INSTALL A TILE SYSTEM ON A BUILDING OF A SPECIFIED ROOF SLOPE AND HEIGHT USING ALLOWABLE STRESS DESIGN (ASD) IN ACCORDANCE WITH ASCE 7

Revise the following sections as follows:

1. Scope
This standard covers the procedure for determining the Moment of Resistance (Mr) and Minimum Characteristic Resistance Load (*F'*) to install a tile system on buildings of a specified roof slope and height. Compliance with the requirements and procedures herein specified, where the design wind uplift pressures (P_{asd}) have been determined based on Tables 1-3, ~~or~~ Tables ~~2~~ 4-6, Tables 7-9 or Tables10-12 of this standard, as applicable, do not require additional signed and sealed engineering design calculation. All other calculations must be prepared, signed and sealed by a professional engineer or registered architect. Tables 1-3 ~~is~~ are applicable to a wind speed of 175 mph, risk category II buildings with gable roofs with overhangs, and exposure category C. Tables ~~2~~ 4-6 ~~is~~ are applicable to a wind speed of 175 mph, risk category II buildings with gable roofs with overhangs, and exposure category D. Tables 7-9 are applicable to a wind speed of 175 mph, for risk category II buildings with hip roofs and overhangs, and exposure category C. Tables 10-12 are applicable to a wind speed of 175 mph, for risk category II buildings with hip roofs and overhangs, and exposure category D.

For steep slope roof systems other than tile, Tables 1-3, Tables 4-6, Tables 7-9 or Tables10-12 of this standard, as applicable, do not require additional signed and sealed engineering design calculation when determining the use of a specific product approval. All other calculations must be prepared, signed and sealed by a professional engineer or registered architect.

All calculations must be submitted to the building official at time of permitting.

2. How to determine the Moment Resistance (Mr) (Moment Based Systems)

2.1 Determine the minimum design wind pressures for ~~the field, perimeter and corner areas (P_{asd} 1, P P_{asd} 2 and P_{asd} 3, respectively)~~ each roof pressure zone using the values given in Tables 1-3, or Tables ~~2~~ 4-6, Tables 7-9 or Tables10-12, as applicable, or those obtained by engineering analysis prepared, signed and sealed by a professional engineer or registered architect based on ASCE 7.

2.2 Locate the aerodynamic multiplier (?) in tile Product Approval.

2.3 Determine the restoring moment due to gravity (Mg) per Product Approval.

2.4 Determine the attachment resistance (Mf) per Product Approval.

2.5 Determine the Moment of Resistance (Mr) per following formula:
Mr = (P_{asd} ?) - Mg

2.6 Compare the values for Mr, with the values for Mf, noted in the Product Approval. If the Mf values are greater than or equal to the Mr values, for each area of the roof ~~[i.e., field Pasd(1), perimeter Pasd(2) and corner Pasd(3) areas]~~, then the tile attachment method is acceptable.

.

3. How to determine the Minimum Characteristic Resistance Load (*F'*) (Uplift Based System)

3.1 Determine the minimum design pressures for ~~the field, perimeter and corner areas [Pasd(1), Pasd(2) and Pasd(3), respectively]~~ each roof pressure zone using the values given in Table 1 or Table 2, as applicable, or those obtained by engineering analysis prepared, signed and sealed by a professional engineer or registered architect based on the criteria set forth in ASCE 7.

3.2 Determine the angle (?) of roof slope, from Tables 1-3, ~~or~~ Tables ~~2~~ 4-6, Tables 7-9 or Tables10-12, as applicable.

3.3 Determine the length (l), width (w) and average tile weight (W) of tile, per Product Approval.

3.4 Determine the required uplift resistance (Fr) per following formula:
Fr = [(P_{asd} x l x w) - W] x cos θ

3.5 Compare the values for Fr with the values for *F*' noted in the Product Approval. If the *F*' values are greater than or equal to the Fr values, for each area of ~~roof [i.e., field Pasd(1) perimeter (Pasd(2) and corner Pasd(3) areas]~~, then the tile attachment method is acceptable.

~~TABLE 1 — RISK CATEGORY II EXPOSURE CATEGORY "C"1 MINIMUM DESIGN WIND UPLIFT PRESSURES IN PSF FOR FIELD [Pasd(1)], PERIMETER [Pasd(2)] AND CORNER [Pasd(3)] AREAS OF ROOFS FOR EXPOSURE C BUILDINGS WITH A ROOF MEAN HEIGHT AS SPECIFIED3~~					
~~ROOF SLOPE~~	~~> 2:12 to £ 6:12~~			~~> 6:12 to £12:12~~	
~~Roof mean height~~	~~Pasd(1)~~	~~Pasd(2)~~	~~Pasd(3)2~~	~~Pasd(1)~~	~~Pasd(1) Pasd(2) & Pasd(3)~~
~~£ 20'~~	~~-39.1~~	~~-68.1~~	~~-100.7~~	~~-42.8~~	~~-50.0~~

> 20' to = 25'	-40.9	-71.3	-105.4	-44.8	-52.3
> 25' to = 30'	-42.4	-73.9	-109.3	-46.4	-54.3
> 30' to = 35'	-43.9	-76.6	-113.2	-48.1	-56.2
> 35' to = 40'	-45.1	-78.7	-116.3	-49.4	-57.8

1 Calculated in accordance with ASCE.
2 For Hip Roofs with slope ?5.5:12, Pasd(3) shall be treated as Pasd(2).
3 Pasd = 0.6Pult

TABLE 2 — RISK CATEGORY II EXPOSURE CATEGORY "D"1
MINIMUM DESIGN WIND UPLIFT PRESSURES IN PSF FOR FIELD [Pasd(1)], PERIMETER [Pasd(2)] AND CORNER [Pasd(3)] AREAS OF ROOFS FOR EXPOSURE D BUILDINGS WITH A ROOF MEAN HEIGHT AS SPECIFIED3

ROOF SLOPE	> 2:12 to £ 6:12			> 6:12 to £12:12	
Roof mean height	Pasd(1)	Pasd(2)	Pasd(3)2	Pasd(1)	Pasd(1) Pasd(2) & Pasd(3)
£ 20'	-47.0	-81.9	-121.0	-51.4	-60.1
> 20' to = 25'	-48.8	-85.0	-125.7	-53.4	-62.4
> 25' to = 30'	-50.3	-87.7	-129.6	-55.0	-64.4
> 30' to = 35'	-51.5	-89.9	-132.7	-56.4	-65.9
> 35' to = 40'	-52.7	-91.9	-135.8	- -57.7	-67.9

1 Calculated in accordance with ASCE 7.
2 For Hip Roofs with slope ≤ 5.5:12, P_{asd}(3) shall be treated as P_{asd}(2).
3 $P_{asd} = 0.6P_{ult}$

TABLE 1 — Gable Roofs

MINIMUM ASD DESIGN WIND UPLIFT PRESSURES IN PSF FOR ROOF SLOPE ≥2:12 to ≤4:12 RISK CATEGORY II EXPOSURE CATEGORY "C"

(Overhang)

Roof Mean Height	Roof Pressure Zones		
	1 and 2e	2n, 2r and 3e	3r

≤15’	-74	-108	-128
>15 to ≤20’	-78	-114	-136
>20’ to ≤25’	-82	-120	-142
>25’ to ≤30’	-85	-125	-148
>30 to ≤35’	-88	-129	-153
>35 to ≤40’	-91	-132	-157
>40’ to ≤45’	-93	-136	-162
>45’ to ≤50’	-95	-139	-165
>50’ to ≤55’	-97	-142	-169
>55’ to ≤60’	-98	-144	-171

TABLE 2 — Gable Roofs

MINIMUM ASD DESIGN WIND UPLIFT PRESSURES IN PSF
FOR ROOF SLOPE >4:12 to ≤6:12
RISK CATEGORY II EXPOSURE CATEGORY “C”

~~(Overhang)~~

	Roof Pressure Zones

Roof Mean Height	1 and 2e	2n, 2r and 3e	3r
≤15’	-57	-91	-128
>15 to ≤20’	-60	-96	-136
>20’ to ≤25’	-63	-101	-142
>25’ to ≤30’	-66	-105	-148
>30 to ≤35’	-68	-109	-153
>35 to ≤40’	-70	-111	-157
>40’ to ≤45’	-72	-115	-162
>45’ to ≤50’	-73	-117	-165
>50’ to ≤55’	-75	-120	-169
>55’ to ≤60’	-76	-121	-171

TABLE 3 — Gable Roofs

MINIMUM ASD DESIGN WIND UPLIFT PRESSURES IN PSF
FOR ROOF SLOPE >6:12 to ≤12:12
RISK CATEGORY II EXPOSURE CATEGORY “C”

~~(Overhang)~~

Roof Mean Height	Roof Pressure Zones		
	1, 2e and 2r	2n and 3r	3e
≤15’	-67	-74	-115
>15 to ≤20’	-71	-78	-122
>20’ to ≤25’	-74	-82	-127
>25’ to ≤30’	-78	-85	-132
>30 to ≤35’	-80	-88	-137
>35 to ≤40’	-82	-91	-141
>40’ to ≤45’	-85	-93	-146
>45’ to ≤50’	-86	-95	-147
>50’ to ≤55’	-88	-97	-151
>55’ to ≤60’	-89	-98	-153

-
-

TABLE 4 — Gable Roofs

MINIMUM ASD DESIGN WIND UPLIFT PRESSURES IN PSF
FOR ROOF SLOPE ≥2:12 to ≤4:12
RISK CATEGORY II EXPOSURE CATEGORY "D"

~~(Overhang)~~

Roof Mean Height	Roof Pressure Zones		
	1 and 2e	2n, 2r and 3e	3r
≤15'	-90	-131	-156
>15 to ≤20'	-94	-137	-163
>20' to ≤25'	-98	-142	-169
>25' to ≤30'	-101	-148	-175
>30 to ≤35'	-104	-152	-180
>35 to ≤40'	-106	-155	-184
>40' to ≤45'	-109	-157	-189
>45' to ≤50'	-111	-161	-192
>50' to ≤55'	-113	-164	-195

>55’ to ≤60’	-114	-167	-198

-
-
-

TABLE 5 — Gable Roofs MINIMUM ASD DESIGN WIND UPLIFT PRESSURES IN PSF FOR ROOF SLOPE >4:12 to ≤6:12 RISK CATEGORY II EXPOSURE CATEGORY“D” ~~(Overhang)~~			
Roof Mean Height	Roof Pressure Zones		
	1 and 2e	2n, 2r and 3e	3r
≤15’	-69	-110	-156
>15 to ≤20’	-73	-116	-163
>20’ to ≤25’	-75	-120	-169
>25’ to ≤30’	-78	-124	-175
>30 to ≤35’	-80	-128	-180
>35 to ≤40’	-82	-131	-184
>40’ to ≤45’	-84	-134	-189
>45’ to ≤50’	-85	-136	-192

>50’ to ≤55’	-87	-138	-195
>55’ to ≤60’	-88	-140	-198

TABLE 6 — Gable Roofs

MINIMUM ASD DESIGN WIND UPLIFT PRESSURES IN PSF FOR ROOF SLOPE >6:12 to ≤12:12 RISK CATEGORY II EXPOSURE CATEGORY "D"

~~(Overhang)~~

Roof Mean Height	Roof Pressure Zones		
	1, 2e and 2r	2n and 3r	3e
≤15'	-82	-90	-140
>15 to ≤20'	-86	-94	-146
>20' to ≤25'	-87	-98	-151
>25' to ≤30'	-92	-101	-157
>30 to ≤35'	-94	-103	-161
>35 to ≤40'	-97	-106	-165
>40' to ≤45'	-99	-109	-168
>45' to ≤50'	-101	-111	-172
>50' to ≤55'	-102	-112	-174

>55’ to ≤60’	-104	-114	-177

-
-
-

TABLE 7 — Hip Roofs MINIMUM ASD DESIGN WIND UPLIFT PRESSURES IN PSF FOR ROOF SLOPE ≥2:12 to ≤4:12 RISK CATEGORY II EXPOSURE CATEGORY “C” ~~(Overhang)~~			
Roof Mean Height	Roof Pressure Zones		
	1	2r	2e and 3
≤15’	-67	-88	-94
>15 to ≤20’	-71	-93	-100
>20’ to ≤25’	-75	-97	-104
>25’ to ≤30’	-78	-101	-109
>30 to ≤35’	-80	-105	-113
>35 to ≤40’	-82	-107	-115
>40’ to ≤45’	-85	-110	-119
>45’ to ≤50’	-86	-112	-121

>50’ to ≤55’	-88	-115	-124
>55’ to ≤60’	-89	-117	-125

TABLE 8 — Hip Roofs

MINIMUM ASD DESIGN WIND UPLIFT PRESSURES IN PSF
FOR ROOF SLOPE >4:12 to ≤6:12
RISK CATEGORY II EXPOSURE CATEGORY "C"

~~(Overhang)~~

Roof Mean Height	Roof Pressure Zones		
	1	2r and 2e	3
≤15'	-71	-91	-111
>15 to ≤20'	-75	-97	-118
>20' to ≤25'	-79	-101	-124
>25' to ≤30'	-82	-105	-129
>30 to ≤35'	-84	-109	-133
>35 to ≤40'	-87	-112	-137
>40' to ≤45'	-89	-114	-140
>45' to ≤50'	-91	-117	-143
>50' to ≤55'	-93	-120	-146

>55’ to ≤60’	-94	-122	-149

TABLE 9 — Hip Roofs

MINIMUM ASD DESIGN WIND UPLIFT PRESSURES IN PSF
FOR ROOF SLOPE >6:12 to ≤12:12
RISK CATEGORY II EXPOSURE CATEGORY “C”

~~(Overhang)~~

Roof Mean Height	Roof Pressure Zones			
	1	2r	2e	3
≤15’	-57	-98	-101	-128
>15 to ≤20’	-60	-104	-108	-136
>20’ to ≤25’	-63	-109	-113	-143
>25’ to ≤30’	-66	-113	-117	-149
>30 to ≤35’	-67	-117	-121	-153
>35 to ≤40’	-70	-120	-124	-158
>40’ to ≤45’	-71	-123	-128	-162
>45’ to ≤50’	-73	-126	-130	-165

>50’ to ≤55’	-75	-129	-133	-169
>55’ to ≤60’	-76	-131	-135	-172

TABLE 10 — Hip Roofs

MINIMUM ASD DESIGN WIND UPLIFT PRESSURES IN PSF
FOR ROOF SLOPE ≥2:12 to ≤4:12
RISK CATEGORY II EXPOSURE CATEGORY"D"[1, 2]

~~(Overhang)~~

Roof Mean Height	Roof Pressure Zones		
	1	2r	2e and 3
≤15'	-82	-106	-114
>15 to ≤20'	-86	-111	-120
>20' to ≤25'	-89	-116	-124
>25' to ≤30'	-91	-120	-129
>30 to ≤35'	-94	-123	-132
>35 to ≤40'	-97	-126	-136
>40' to ≤45'	-99	-128	-138
>45' to ≤50'	-101	-131	-141
>50' to ≤55'	-102	-133	-143

>55’ to ≤60’	-104	-135	-146

TABLE 11 — Hip Roofs

MINIMUM ASD DESIGN WIND UPLIFT PRESSURES IN PSF FOR ROOF SLOPE >4:12 to ≤6:12 RISK CATEGORY II EXPOSURE CATEGORY“D”[1, 2]

~~(Overhang)~~

Roof Mean Height	Roof Pressure Zones	
	1	2e, 2r and 3
≤15’	-65	-90
>15 to ≤20’	-68	-94
>20’ to ≤25’	-71	-98
>25’ to ≤30’	-73	-101
>30 to ≤35’	-75	-104
>35 to ≤40’	-77	-106
>40’ to ≤45’	-79	-109

>45’ to ≤50’	-80	-111
>50’ to ≤55’	-82	-112
>55’ to ≤60’	-83	-114

TABLE 12 — Hip Roofs

MINIMUM ASD DESIGN WIND UPLIFT PRESSURES IN PSF FOR ROOF SLOPE >6:12 to ≤12:12 RISK CATEGORY II EXPOSURE CATEGORY“D”[1, 2]

~~(Overhang)~~

Roof Mean Height	Roof Pressure Zones			
	1	2e	2r	3
≤15’	-69	-119	-123	-156
>15 to ≤20’	-73	-124	-129	-163
>20’ to ≤25’	-75	-129	-133	-169
>25’ to ≤30’	-78	-134	-138	-175
>30 to ≤35’	-80	-137	-142	-180
>35 to ≤40’	-82	-141	-145	-184

>40’ to ≤45’	-84	-143	-148	-188
>45’ to ≤50’	-85	-146	-151	-192
>50’ to ≤55’	-87	-149	-154	-195
>55’ to ≤60’	-88	-151	-156	-198

TABLE 13 WHERE TO OBTAIN INFORMATION		
Description	**Symbol**	**Where to find**
Roof Zone Design Pressure	Pasd~~(1) or Pasd(2) or Pasd(3)~~	Tables 1-3, ~~or~~ Tables ~~2~~ 4-6, Tables 7-9 or Tables10-12, as applicable, or by an engineer analysis prepared, signed and sealed by a professional engineer based on ASCE 7
Mean Roof Height	H	Job Site
Roof Slope	?	Job Site
Aerodynamic Multiplier	?	Product Approval
Restoring Moment due to Gravity	Mg	Product Approval
Attachment Resistance	Mf	Product Approval
Required Moment Resistance	Mr	Calculated
Minimum Characteristic Resistance Load	F'	Product Approval
Required Uplift Resistance	Fr	Calculated
Average Tile Weight	W	Product Approval
Tile Dimensions	l = length w = width	Product Approval

~~All calculations must be submitted to the building official at the time of permitting.~~
(S7156)