

Design Criteria for Span Tables:

Values in the maximum allowable rail span tables provided herein are subject to the following general criteria and additional criteria shown on individual span tables sheets. Values in span tables are based on the same engineering methodology and calculation algorithms used for U-Builder and are provided here for reference.

Building Assumptions

- Building Risk Category: II
- Mean Roof Height: 30 ft
- Roof Pitch: 0°-45°
- Site Elevation: 0 ft

Wind Design Assumptions

- Wind loads used are based on ASCE 7-16 Sec 29.4.4 with Provisions from SEAOC PV2-2017
- Exposure Category B, C, or D
- Basic Wind Speed = 90 – 180 mph
- Level terrain. Topographic factor, $k_{zt} = 1.0$
- $\gamma_E = 1.0$ for 'Interior' spans, $\gamma_E = 1.5$ for 'Exposed' spans (ASCE 7-16, Fig. 29.4-7)

Snow Design Assumptions

- Ground Snow Load = 0-100 psf
- Exposure Factor coefficients of Partially Exposed condition
- Thermal Factor = 1.0
- Results based on uniform snow load

Seismic Design Assumptions

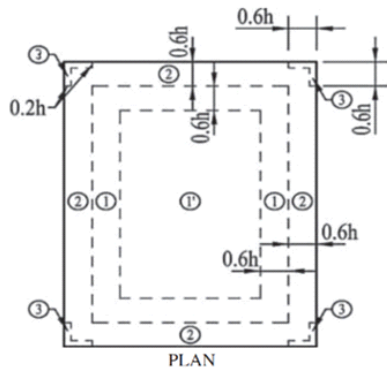
- 0.2-s Spectral Response Acceleration, $SS \leq 3$
- $S_s = 1.25$ and 3 per criteria shown on individual span tables sheets.
- $S_1 = 0.5$
- Seismic site class D

Array Assumptions

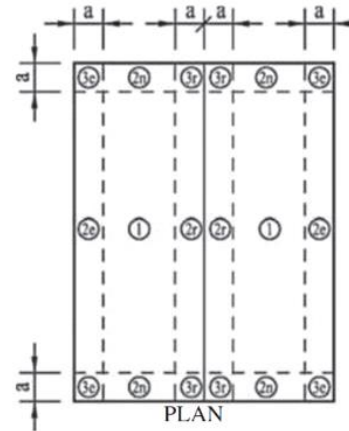
- Module orientation and Rail direction per criteria shown on individual span tables sheets.
- Maximum module dimensions of 40.1" x 67" (~19 sq.ft, 47.65 lbs) and 41" x 80" (~23 sq.ft, 58.6 lbs) per criteria shown on individual span tables sheets.
- Minimum distance between modules and roof edge is at least twice the module height above roof surface.
- Modules are parallel to roof surface and maximum height above roof surface is 5" to 10" depending on attachment type.
- Gaps between module rows and columns is 0.25" in to 1" depending on clamp type.
- The most restrictive of all roof zone spans shall be used when any part of the module is attributed to that span.
- 'Exposed' spans as defined in ASCE 7-16 sec. 29.4.4 shall be used when any part of an exposed module or panel as is attributed to that span.

Span Tables

Zone should be considered as per ASCE 7-16, Fig. 30.3-2A to 30.3-2D



Gable Roofs $\theta \leq 7^\circ$

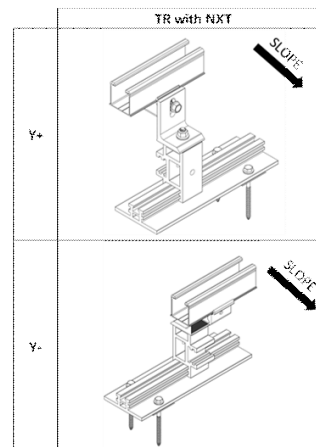


Gable Roofs $7^\circ < \theta \leq 45^\circ$

Grouping of ASCE 7-16 Roof Zones (Gable and Flat)

- **Roof Tilt 0° - 7°**
 - Roof Zone 1 = 1
 - Roof Zone 2 = 2
 - Roof Zone 3 = 3
- **Roof Tilt 7° - 27°**
 - Roof Zone 1 = 1, 2e
 - Roof Zone 2 = 2n, 2r, 3e
 - Roof Zone 3 = 3r
- **Roof Tilt 27° - 45°**
 - Roof Zone 1 = 1, 2e, 2r
 - Roof Zone 2 = 2n, 3r
 - Roof Zone 3 = 3e

Rails can be installed in these possible orientations.





ASCE 7-16
Design Standard

II
Risk Category

30 ft
Roof Height

Ss = 1.25
Seismic

19 sq.ft
Module Area

PORTRAIT
Orientation

CROSS-SLOPE
Rail Direction

NXT
Rail Type

NXT COMBO
Clamp

Tile Replacement
Attachment

SPAN TABLES

Maximum Allowable Rail Spans for Rooftop Solar Panels Parallel to the Roof Surface (inches)

Ground Snow Load (psf)	Wind Exposure Category	Roof Tilt Angle (deg)	Panel Exposure	Basic Wind Speed (mph)																																								
				Roof Wind Zone																																								
				90			95			100			105			110			115			120			130			140			150			160			170			180				
				1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3					
0	B	0-7	Interior	86	86	86	86	86	83	86	86	79	86	86	76	86	83	73	86	80	71	86	77	68	82	72	61	77	68	47	73	64	39	69	52	34	66	43	30	58	38	27		
			Exposed	86	83	73	86	79	70	86	76	67	83	73	63	80	70	54	77	68	46	74	65	41	69	52	35	65	42	30	54	36	26	44	32	22	38	28	30	34	25	27		
		7-20	Interior	86	86	85	86	86	81	86	83	77	86	80	74	86	76	71	82	74	68	80	71	66	75	66	51	70	54	40	67	42	35	61	37	30	51	32	27	44	29	24		
			Exposed	85	76	71	82	73	67	78	70	64	75	67	53	73	62	44	70	53	40	68	45	36	62	37	31	50	32	26	42	27	23	37	24	30	32	21	26	29	28	24		
		20-27	Interior	86	86	86	86	86	86	86	86	86	86	85	86	86	81	86	82	78	86	79	75	86	76	72	84	71	67	79	67	57	75	58	43	71	46	36	68	39	30	65	35	26
			Exposed	86	82	78	86	78	74	86	75	71	84	72	68	81	69	65	78	67	55	78	62	46	71	46	36	67	38	30	61	33	25	52	29	21	44	26	18	39	23	24		
	27-45	Interior	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	
		Exposed	87	87	81	87	85	77	87	81	74	84	78	71	80	75	69	77	72	66	74	70	61	69	65	46	65	52	37	50	42	31	41	36	27	36	23	32	28	20				
	C	0-7	Interior	86	86	75	86	82	72	86	78	69	86	75	66	82	72	60	79	70	52	76	67	45	71	58	37	67	46	32	60	39	28	49	34	24	41	30	21	37	27	29		
			Exposed	82	72	60	78	69	50	75	66	42	72	61	38	69	52	35	67	45	31	64	41	29	50	34	24	40	29	21	35	26	27	31	22	24	27	30	21	24	26	19		
		7-20	Interior	86	79	73	84	75	69	81	72	66	77	69	60	75	66	50	72	60	42	70	51	39	65	40	33	55	34	28	46	29	24	39	26	21	35	23	28	31	30	25		
			Exposed	74	66	50	74	57	41	69	47	37	66	41	34	61	37	30	54	34	28	48	31	25	40	26	22	34	22	28	29	24	26	26	21	23	23	19	30	20	17			
20-27		Interior	86	85	80	86	81	76	86	77	73	86	74	70	84	71	67	81	68	64	78	66	53	73	52	40	69	41	32	65	36	27	56	31	23	48	27	19	41	24	25			
		Exposed	83	71	67	80	68	60	77	65	49	74	55	41	71	46	36	69	41	32	66	39	28	57	31	23	47	27	19	40	23	24	35	31	21	31	27	19	27	24	17			
27-45	Interior	87	87	84	87	87	80	87	84	76	86	80	73	83	77	70	79	74	68	76	72	66	71	67	52	67	58	41	57	46	34	44	39	29	38	34	25	34	25	31	22			
	Exposed	82	77	70	79	74	67	75	70	64	72	68	54	69	65	46	67	57	40	63	49	36	45	39	29	38	34	24	33	29	21	29	26	23	23	22	30	20						
D	0-7	Interior	86	80	70	86	76	67	83	73	63	80	70	53	76	67	45	74	65	40	71	58	37	67	45	31	57	38	27	46	33	23	39	29	31	35	25	27	31	22	24			
		Exposed	76	67	45	73	64	39	70	54	35	67	46	32	65	41	29	56	37	26	49	34	24	40	29	31	34	25	27	29	21	23	26	28	20	23	25	18	30	22	16			
	7-20	Interior	82	73	68	78	70	64	75	67	52	72	62	44	70	51	39	67	44	36	65	39	33	54	33	28	44	29	24	38	25	31	33	22	27	29	29	24	26	26	21			
		Exposed	70	51	39	67	42	35	63	38	31	55	34	28	49	31	26	43	28	23	39	26	21	33	22	27	29	28	23	25	25	20	22	21	18	29	19	16	26	17	14			
	20-27	Interior	86	79	74	86	75	71	84	72	68	81	69	65	78	66	54	75	61	45	73	52	39	68	40	32	65	34	26	54	30	22	45	26	18	39	23	24	35	31	21			
		Exposed	78	66	53	75	58	43	72	48	37	69	41	33	67	37	29	64	34	25	57	31	23	46	26	18	38	23	23	33	30	20	29	26	18	26	23	16	23	14				
27-45	Interior	87	85	78	87	81	74	83	78	71	80	75	68	77	72	66	74	69	59	71	67	51	66	56	40	54	44	33	42	37	28	37	33	24	32	29	20	29	26	27				
	Exposed	77	72	66	73	69	57	70	66	47	67	59	41	63	50	36	53	43	32	45	39	29	37	33	24	32	28	20	27	25	25	24	22	22	21	29	19	28	26	16				
10	B	0-7	Interior	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72			
			Exposed	72	72	72	72	72	70	72	72	67	72	63	72	70	54	72	68	46	72	65	41	69	52	35	65	42	30	54	36	26	44	32	22	38	28	30	34	25	27			
		7-20	Interior	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	
			Exposed	72	72	71	72	72	67	72	70	64	72	62	44	70	53	40	68	45	36	62	37	31	50	32	26	42	27	23	37	24	30	32	21	26	29	28	24					
		20-27	Interior	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83		
			Exposed	83	82	78	83	78	74	83	75	71	83	72	68	81	69	65	78	67	55	76	62	46	71	46	36	67	38	30	61	33	25	52	29	21	44	26	18	39	23	24		
	27-45	Interior	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86			
		Exposed	86	86	81	86	85	77	86	81	74	84	78	71	80	75	69	77	72	66	74	70	61	69	65	46	65	52	37	50	42	31	41	36	27	36	23	32	28	20				
	C	0-7	Interior	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72			
			Exposed	72	72	60	72	69	50	72	66	42	72	61	38	69	52	35	67	45	31	64	41	29	50	34	24	40	29	21	35	26	27	31	22	24	27	30	21	24	26	19		
		7-20	Interior	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72		
			Exposed	72	66	50	71	57	41	69	47	37	66	41	34	61	37	30	54	34	28	48	31	25	40	26	22	34	22	28	29	24	26	26	21	23	23	19	30	20	17			
20-27		Interior	83	83	80	83	81	76	83	77	73	83	74	70	83	71	67	81	68	64	78	66	53	73	52	40	69	41	32	65	36	27	56	31	23	48	27	19	41	24	25			
		Exposed	83	71	67	80	68	60	77	65	49	74	55	41	71	46	36	69	41	32	66	39	28	57	31	23	47	27	19	40	23	24	35	31	21	31	27	19	27	24	17			
27-45	Interior	86	86	84	86	86	80	86	84	76	86	80	73	83	77	70	79	74</																										



ASCE 7-16
Design Standard

II
Risk Category

30 ft
Roof Height

Ss = 1.25
Seismic

23 sq.ft
Module Area

LANDSCAPE
Orientation

CROSS-SLOPE
Rail Direction

NXT
Rail Type

NXT COMBO
Clamp

Tile Replacement
Attachment

SPAN TABLES

Maximum Allowable Rail Spans for Rooftop Solar Panels Parallel to the Roof Surface (inches)

Ground Snow Load (psf)	Wind Exposure Category	Roof Tilt Angle (deg)	Panel Exposure	Basic Wind Speed (mph)																																							
				90			95			100			105			110			115			120			130			140			150			160			170			180			
				Roof Wind Zone																																							
0	B	0-7	Interior	101	101	101	101	101	101	101	101	96	101	101	91	101	101	87	101	96	83	101	92	80	100	85	74	92	80	69	86	75	65	81	71	56	77	67	50	73	62	44	
			Exposed	101	101	87	101	95	82	101	91	78	101	86	74	96	83	71	92	79	68	88	76	66	82	71	57	76	66	49	71	60	42	67	52	37	63	46	49	56	41	44	
		7-20	Interior	101	101	101	101	101	98	101	101	93	101	97	88	101	92	83	101	87	79	97	83	76	89	77	70	83	71	65	78	66	57	74	60	50	71	53	44	67	47	39	
			Exposed	101	92	83	101	86	78	94	82	74	89	78	71	86	74	68	83	71	65	80	68	60	75	61	50	70	52	43	66	45	37	60	40	49	53	44	47	47	39		
		20-27	Interior	102	102	102	102	102	102	102	102	102	102	100	102	102	102	94	102	96	89	102	91	85	102	84	78	94	78	72	88	73	67	84	68	59	79	64	50	76	57	43	
			Exposed	102	100	94	102	94	88	102	89	83	102	85	79	98	81	75	94	77	71	90	74	68	84	68	60	79	63	49	74	55	41	71	48	34	67	42	29	64	37	39	
	27-45	Interior	102	102	102	102	102	102	102	102	102	102	102	102	102	102	99	102	99	102	102	99	102	101	90	102	93	83	93	86	77	86	80	72	81	75	68	76	71	63	71	67	54
		Exposed	102	102	98	102	102	93	102	99	88	102	94	84	98	89	80	93	85	77	88	82	74	81	76	68	75	71	61	70	66	52	65	60	44	59	53	38	52	47	33		
	C	0-7	Interior	101	101	90	101	99	85	101	94	81	101	89	77	99	85	74	95	82	71	91	79	68	84	73	61	78	68	52	74	64	45	69	56	40	66	49	53	60	44	47	
			Exposed	99	85	73	94	81	70	89	77	67	85	74	63	81	71	57	78	68	52	75	65	47	70	57	40	65	49	52	58	42	45	50	37	39	44	49	36	39	43	34	
		7-20	Interior	101	95	86	101	89	81	99	85	77	92	80	73	88	77	70	85	73	67	82	70	64	77	65	54	72	56	46	68	49	40	65	42	35	57	37	47	51	50	42	
			Exposed	88	76	70	84	72	66	81	69	61	77	65	55	74	61	50	72	55	46	69	51	42	65	43	36	56	37	46	49	48	40	42	42	35	56	37	47	50	39	27	
		20-27	Interior	102	102	98	102	98	91	102	93	86	102	88	82	102	84	78	97	80	74	93	77	71	86	71	65	81	66	53	77	59	44	73	51	37	69	45	32	66	40	42	
			Exposed	102	83	77	96	79	73	91	75	69	87	71	66	84	68	59	81	65	53	78	61	47	73	52	38	69	44	31	65	38	40	57	51	35	50	45	31	45	40	27	
	27-45	Interior	102	102	102	102	102	96	102	102	91	102	97	87	102	92	83	97	88	79	92	85	76	84	78	70	78	73	66	72	68	56	68	64	48	63	57	41	56	50	36		
		Exposed	102	92	83	95	87	78	90	83	75	85	79	71	81	76	68	77	72	65	74	70	59	68	65	48	62	56	40	54	48	34	47	42	45	42	37	38	37	50	33		
	D	0-7	Interior	101	96	82	101	91	78	101	86	74	96	62	71	91	79	68	87	76	65	84	73	61	78	68	51	73	62	44	68	54	38	64	47	50	57	41	44	50	37	40	
			Exposed	91	79	68	86	75	65	82	71	58	79	68	53	75	66	48	72	61	43	70	56	40	65	48	51	56	41	44	48	53	38	42	47	38	37	41	29	50	37	26	
		7-20	Interior	101	87	79	94	82	74	89	77	71	86	74	67	82	70	64	79	67	59	76	65	54	71	55	45	67	47	39	62	41	51	54	36	45	48	47	39	43	42	35	
			Exposed	82	70	64	78	67	57	75	62	51	72	56	46	69	51	42	67	46	38	65	43	35	55	36	45	47	47	39	41	40	34	54	35	29	47	34	26	42	28	23	
		20-27	Interior	102	95	88	102	89	83	102	85	79	98	80	75	93	77	71	89	73	68	86	70	65	80	65	52	76	57	43	71	49	36	68	43	30	64	38	39	57	51	35	
			Exposed	93	77	71	88	73	67	85	69	61	81	66	54	78	61	47	75	56	42	73	51	37	68	43	30	63	37	39	55	49	34	48	43	29	42	38	26	57	34	23	
	27-45	Interior	102	102	93	102	99	88	102	93	84	97	89	80	92	85	76	88	81	73	84	78	70	77	72	65	71	67	54	66	62	46	60	54	39	53	48	33	47	42	45		
		Exposed	92	85	76	87	80	72	82	76	69	78	73	66	74	70	60	71	67	53	68	64	48	61	54	39	52	47	33	45	41	42	40	53	36	35	47	31	47	42	27		
10	B	0-7	Interior	90	90	90	90	90	90	90	90	90	90	90	90	90	83	90	90	83	90	80	90	85	74	90	80	69	86	75	65	81	71	56	77	67	50	73	62	44			
			Exposed	90	90	87	90	90	82	90	90	78	90	86	74	90	83	71	90	79	68	88	76	66	82	71	57	76	66	49	71	60	42	67	52	37	63	46	49	56	41	44	
		7-20	Interior	91	91	91	91	91	91	91	91	91	91	88	91	91	83	91	87	79	91	83	76	89	77	70	83	71	65	78	66	57	74	60	50	71	53	44	67	47	39		
			Exposed	91	91	83	91	86	78	91	82	74	89	78	71	86	74	68	83	71	65	80	68	60	75	61	50	70	52	43	66	45	37	60	40	49	53	44	47	47	39		
		20-27	Interior	99	99	99	99	99	99	99	99	99	99	99	99	99	99	94	99	96	89	99	91	85	99	84	78	94	78	72	88	73	67	84	68	59	79	64	50	76	57	43	
			Exposed	99	99	94	99	94	88	99	89	83	99	85	79	98	81	75	94	77	71	90	74	68	84	68	60	79	63	49	74	55	41	71	48	34	67	42	29	64	37	39	
	27-45	Interior	101	101	101	101	101	101	101	101	101	101	101	101	101	101	99	101	99	101	101	99	101	94	101	93	83	93	86	77	86	80	72	81	75	68	76	71	63	71	67	54	
		Exposed	101	101	98	101	101	93	101	99	88	101	94	84	98	89	80	93	85	77	88	82	74	81	76	68	75	71	61	70	66	52	65	60	44	59	53	38	52	47	33		
	C	0-7	Interior	90	90	90	90	90	85	90	90	81	90	89	77	90	85	74	90	82	71	90	79	68	84	73	61	78	68	52	74	64	45	69	56	40	66	49	53	60	44	47	
			Exposed	90	85	73	90	81	70	89	77	67	85	74	63	81	71	57	78	68	52	75	65	47	70	57	40	65	49	52	58	42	45	50	37	39	44	49	36	39	43	34	
		7-20	Interior	91	91	86	91	89	81	91	85	77	91	80	73	88	77	70	85	73	67	82	70	64	77	65	54	72	56	46	68	49	40	65	42	35	57	37	47	51	50	42	
			Exposed	88	76	70	84	72	66	81	69	61	77	65	55	74	61	50	72	55	46	69	51	42	65	43	36	56	37	46	49	48	40	42	42	35	56	37	47	50	39	27	
20-27		Interior	99	99	98	99	98	91	99	93	86	99	88	82	99	84	78	97	80	74	93	77	71	86	71	65	81	66	53	77	59	44	73	51	37	69	45	32	66	40	42		
		Exposed	99	83	77	96	79	73	91	75	69	87	71	66	84	68	59	81	65	53	78	61	47	73	52	38	69	44	31	65	38	40	57	51	35	50	45	31	45	40	27		
27-45	Interior	101	101	101	101	101	96	101	101	91	101	97	87	101	92	83	97	88	79	92	85	76	84	78	70																		



ASCE 7-16
Design Standard

II
Risk Category

30 ft
Roof Height

Ss = 3.00
Seismic

19 sq.ft
Module Area

PORTRAIT
Orientation

CROSS-SLOPE
Rail Direction

NXT
Rail Type

NXT COMBO
Clamp

Tile Replacement
Attachment

SPAN TABLES

Maximum Allowable Rail Spans for Rooftop Solar Panels Parallel to the Roof Surface (inches)

Ground Snow Load (psf)	Wind Exposure Category	Roof Tilt Angle (deg)	Panel Exposure	Basic Wind Speed (mph)																																								
				Roof Wind Zone																																								
				90			95			100			105			110			115			120			130			140			150			160			170			180				
0	B	0-7	Interior	86	86	86	86	86	83	86	86	79	86	86	76	86	83	73	86	80	71	86	77	68	82	72	61	77	68	47	73	64	39	69	52	34	66	43	30	58	38	27		
			Exposed	86	83	73	86	79	70	86	76	67	83	73	63	80	70	54	77	68	46	74	65	41	69	52	35	65	42	30	54	36	26	44	32	22	38	28	30	34	25	27		
		7-20	Interior	86	86	85	86	86	81	86	83	77	86	80	74	86	76	71	82	74	68	80	71	66	75	66	51	70	54	40	67	42	35	61	37	30	51	32	27	44	29	24		
			Exposed	85	76	71	82	73	67	78	70	64	75	67	53	73	62	44	70	53	40	68	45	36	62	37	31	50	32	26	42	27	23	37	24	30	32	21	26	29	28	24		
		20-27	Interior	86	86	86	86	86	86	86	86	86	86	85	86	86	81	86	82	78	86	79	75	86	76	72	84	71	67	79	67	57	75	58	43	71	46	36	68	39	30	65	35	26
			Exposed	86	82	78	86	78	74	86	75	71	84	72	68	81	69	65	78	67	55	78	62	46	71	46	36	67	38	30	61	33	25	52	29	21	44	26	18	39	23	24		
	27-45	Interior	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	
		Exposed	87	87	81	87	85	77	87	81	74	84	78	71	80	75	69	77	72	66	74	70	61	69	65	46	65	52	37	50	42	31	41	36	27	36	23	32	28	20				
	C	0-7	Interior	86	86	75	86	82	72	86	78	69	86	75	66	82	72	60	79	70	52	76	67	45	71	58	37	67	46	32	60	39	28	49	34	24	41	30	21	37	27	29		
			Exposed	82	72	60	78	69	50	75	66	42	72	61	38	69	52	35	67	45	31	64	41	29	50	34	24	40	29	21	35	26	27	31	22	24	27	30	21	24	26	19		
		7-20	Interior	86	79	73	84	75	69	81	72	66	77	69	60	75	66	50	72	60	42	70	51	39	65	40	33	55	34	28	46	29	24	39	26	21	35	23	28	31	30	25		
			Exposed	74	66	50	72	57	41	69	47	37	66	41	34	61	37	30	54	34	28	48	31	25	40	26	22	34	22	28	29	24	26	26	21	23	23	19	30	20	17			
		20-27	Interior	86	85	80	86	81	76	86	77	73	86	74	70	84	71	67	81	68	64	78	66	53	73	52	40	69	41	32	65	36	27	56	31	23	48	27	19	41	24	25		
			Exposed	83	71	67	80	68	60	77	65	49	74	55	41	71	46	36	69	41	32	66	39	28	57	31	23	47	27	19	40	23	24	35	31	21	31	27	19	27	24	17		
	27-45	Interior	87	87	84	87	87	80	87	84	76	86	80	73	83	77	70	79	74	68	76	72	66	71	67	52	67	58	41	57	46	34	44	39	29	38	34	25	34	25	31	22		
		Exposed	82	77	70	79	74	67	75	70	64	72	68	54	69	65	46	67	57	40	63	49	36	45	39	29	38	34	24	33	29	21	29	26	23	23	22	30	20					
	D	0-7	Interior	86	80	70	86	76	67	83	73	63	80	70	53	76	67	45	74	65	40	71	58	37	67	45	31	57	38	27	46	33	23	39	29	31	35	25	27	31	22	24		
			Exposed	76	67	45	73	64	39	70	54	35	67	46	32	65	41	29	56	37	26	49	34	24	40	29	31	34	25	27	29	21	23	26	28	20	23	25	18	30	22	16		
		7-20	Interior	82	73	68	78	70	64	75	67	52	72	62	44	70	51	39	67	44	36	65	39	33	54	33	28	44	29	24	38	25	31	33	22	27	29	29	24	26	26	21		
			Exposed	70	51	39	67	42	35	63	38	31	55	34	28	49	31	26	43	28	23	39	26	21	33	22	27	29	28	23	25	25	20	22	21	18	29	19	16	26	17	14		
		20-27	Interior	86	79	74	86	75	71	84	72	68	81	69	65	78	66	54	75	61	45	73	52	39	68	40	32	65	34	26	54	30	22	45	26	18	39	23	24	35	31	21		
			Exposed	78	66	53	75	58	43	72	48	37	69	41	33	67	37	29	64	34	25	57	31	23	46	26	18	38	23	33	30	20	29	26	18	26	23	16	23	20	14			
	27-45	Interior	87	85	78	87	81	74	83	78	71	80	75	68	77	72	66	74	69	59	71	67	51	66	56	40	54	44	33	42	37	28	37	33	24	32	29	20	29	26	27			
		Exposed	77	72	66	73	69	57	70	66	47	67	59	41	63	50	36	53	43	32	45	39	29	37	33	24	32	28	20	27	25	25	24	22	22	21	29	19	28	26	16			
10	B	0-7	Interior	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72			
			Exposed	72	72	72	72	72	70	72	72	67	72	63	72	70	54	72	68	46	72	65	41	69	52	35	65	42	30	54	36	26	44	32	22	38	28	30	34	25	27			
		7-20	Interior	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	
			Exposed	72	72	71	72	72	67	72	70	64	72	62	44	70	53	40	68	45	36	62	37	31	50	32	26	42	27	23	37	24	30	32	21	26	29	24	28	24				
		20-27	Interior	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83		
			Exposed	83	82	78	83	78	74	83	75	71	83	72	68	81	69	65	78	67	55	76	62	46	71	46	36	67	38	30	61	33	25	52	29	21	44	26	18	39	23	24		
	27-45	Interior	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86		
		Exposed	86	86	81	86	85	77	86	81	74	84	78	71	80	75	69	77	72	66	74	70	61	69	65	46	65	52	37	50	42	31	41	36	27	36	23	32	28	20				
	C	0-7	Interior	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72			
			Exposed	72	72	60	72	69	50	72	66	42	72	61	38	69	52	35	67	45	31	64	41	29	50	34	24	40	29	21	35	26	27	31	22	24	27	30	21	24	26	19		
		7-20	Interior	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72		
			Exposed	72	66	50	71	57	41	69	47	37	66	41	34	61	37	30	54	34	28	48	31	25	40	26	22	34	22	28	29	24	26	26	21	23	23	19	30	20	17			
20-27		Interior	83	83	80	83	81	76	83	77	73	83	74	70	83	71	67	81	68	64	78	66	53	73	52	40	69	41	32	65	36	27	56	31	23	48	27	19	41	24	25			
		Exposed	83	71	67	80	68	60	77	65	49	74	55	41	71	46	36	69	41	32	66	39	28	57	31	23	47	27	19	40	23	24	35	31	21	31	27	19	27	24	17			
27-45	Interior	86	86	84	86	86	80	86	84	76	86	80	73	83	77	70	79	74	68	76	72	66	71	67	52	67	58	41	57	46	34	44	39	29	38	34	25	34	25	31	22			
	Exposed	82	77	70	79	74	67																																					



ASCE 7-16
Design Standard

II
Risk Category

30 ft
Roof Height

Ss = 3.00
Seismic

19 sq.ft
Module Area

LANDSCAPE
Orientation

CROSS-SLOPE
Rail Direction

NXT
Rail Type

NXT COMBO
Clamp

Tile Replacement
Attachment

SPAN TABLES

Maximum Allowable Rail Spans for Rooftop Solar Panels Parallel to the Roof Surface (inches)

Ground Snow Load (psf)	Wind Exposure Category	Roof Tilt Angle (deg)	Panel Exposure	Basic Wind Speed (mph)																																									
				90			95			100			105			110			115			120			130			140			150			160			170			180					
				Roof Wind Zone																																									
				1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3						
0	B	0-7	Interior	102	102	102	102	102	102	102	102	97	102	102	92	102	102	88	102	97	84	102	93	80	101	86	74	93	80	69	87	76	65	82	71	58	77	67	51	73	64	45			
			Exposed	102	102	87	102	96	83	102	91	79	102	87	75	97	83	72	93	80	69	89	77	66	82	72	58	77	67	50	72	61	43	68	53	38	64	47	50	57	42	45			
		7-20	Interior	102	102	102	102	102	102	102	102	94	102	98	89	102	93	84	102	88	80	99	84	77	89	78	71	84	72	66	79	67	58	75	62	51	71	54	45	68	48	40			
			Exposed	102	93	84	102	87	79	96	82	75	90	78	72	87	75	68	83	71	65	80	69	61	75	62	52	71	53	44	67	46	38	62	40	51	54	36	45	48	48	40			
		20-27	Interior	103	103	103	103	103	103	103	103	103	103	103	103	101	103	102	95	103	97	90	103	92	86	103	85	79	95	79	73	89	73	68	84	69	60	85	65	51	76	58	44		
			Exposed	103	102	95	103	96	89	103	90	84	103	86	80	99	82	76	95	78	72	91	75	69	85	69	62	80	64	50	75	56	41	71	49	35	68	43	30	65	38	40			
	27-45	Interior	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	102	91	103	94	84	95	87	78	87	81	73	81	76	69	76	72	65	72	68	56			
		Exposed	103	103	100	103	103	94	103	100	89	103	95	85	99	90	81	94	86	77	89	83	74	82	76	69	76	71	64	71	67	53	66	61	45	60	54	39	53	48	34				
	C	0-7	Interior	102	102	91	102	100	86	102	95	81	102	90	78	100	86	74	96	83	71	92	79	68	85	74	63	79	69	54	74	65	46	70	57	41	66	50	36	61	45	48			
			Exposed	100	86	74	95	82	70	90	78	67	86	74	64	82	71	58	79	69	53	76	66	48	70	58	41	66	50	35	59	43	46	51	38	40	45	50	36	40	44	32			
		7-20	Interior	102	96	87	102	90	82	101	86	78	93	81	74	89	77	71	86	74	68	83	71	65	77	65	55	73	57	47	69	50	41	65	43	36	58	38	48	52	51	43			
			Exposed	89	77	70	85	73	62	81	69	63	78	66	57	75	62	51	72	57	47	70	52	43	65	44	36	57	38	47	50	49	41	43	43	36	38	38	32	51	34	28			
		20-27	Interior	103	103	99	103	99	93	103	94	87	103	89	83	103	85	79	98	81	75	94	77	72	87	71	66	82	66	55	77	60	45	73	52	38	70	46	33	67	41	28			
			Exposed	103	84	78	97	80	74	92	76	70	88	72	67	85	69	61	81	66	54	79	62	48	74	53	39	69	45	32	65	39	41	58	34	36	52	46	32	46	41	28			
	27-45	Interior	103	103	103	103	103	97	103	103	92	103	98	88	103	93	84	98	89	80	93	85	77	85	79	71	78	74	66	73	69	57	68	65	49	64	58	42	57	51	37				
		Exposed	103	93	84	96	88	79	91	84	75	86	80	72	82	76	69	78	73	66	75	60	61	69	65	49	63	57	41	55	49	35	48	43	30	42	38	39	38	51	34				
	D	0-7	Interior	102	97	83	102	92	79	102	87	75	97	83	72	92	80	69	88	76	66	85	73	62	79	68	53	73	63	45	69	55	39	65	48	51	58	42	45	52	38	40			
			Exposed	92	79	69	87	76	65	83	72	59	79	69	54	76	66	49	73	63	44	70	57	41	65	49	35	57	42	45	49	36	39	43	48	34	38	42	36	51	37	27			
		7-20	Interior	102	88	80	96	83	75	90	78	71	86	74	68	83	71	65	80	68	60	77	65	55	72	56	46	68	48	40	64	42	35	56	36	46	49	49	40	43	43	36			
			Exposed	83	71	65	79	67	58	76	64	53	73	57	47	70	52	43	68	48	39	65	43	36	52	37	46	48	40	42	41	34	36	36	36	36	36	36	36	36	24				
		20-27	Interior	103	96	89	103	90	84	103	86	79	99	81	75	94	78	72	90	74	69	87	71	66	81	66	53	76	58	44	72	50	36	68	44	31	65	39	40	59	34	36			
			Exposed	94	77	72	89	73	68	85	70	64	82	67	55	79	63	48	76	57	43	73	52	38	69	44	31	65	38	40	56	50	34	49	44	30	43	39	27	38	34	24			
	27-45	Interior	103	103	94	103	100	89	103	94	85	99	90	81	93	86	77	89	82	74	85	79	71	78	73	66	72	68	55	67	63	47	61	55	40	54	49	34	48	43	30				
		Exposed	93	86	77	88	81	73	83	77	70	79	74	66	75	70	61	71	68	54	68	65	49	62	56	40	53	48	34	46	41	44	40	36	37	36	48	32	48	43	28				
10	B	0-7	Interior	91	91	91	91	91	91	91	91	91	91	91	91	91	88	91	91	84	91	91	80	91	86	74	91	80	69	87	76	65	82	71	58	77	67	51	73	64	45				
			Exposed	91	91	87	91	91	83	91	91	79	91	87	75	91	83	72	91	80	69	89	77	66	82	72	58	77	67	50	72	61	43	68	53	38	64	47	50	57	42	45			
		7-20	Interior	91	91	91	91	91	91	91	91	91	91	91	91	91	91	89	91	91	84	91	88	80	91	84	77	89	78	71	84	72	66	79	67	58	75	62	51	71	54	45	68	48	40
			Exposed	91	91	84	91	87	79	91	82	75	90	78	72	87	75	68	83	71	65	80	69	61	75	62	52	71	53	44	67	46	38	62	40	51	54	36	45	48	48	40			
		20-27	Interior	100	100	100	100	100	100	100	100	100	100	100	100	100	100	95	100	97	90	100	92	86	100	85	79	95	79	73	89	73	68	84	69	60	85	65	51	76	58	44			
			Exposed	100	100	95	100	96	89	100	90	84	100	86	80	99	82	76	95	78	72	91	75	69	85	69	62	80	64	50	75	56	41	71	49	35	68	43	30	65	38	40			
	27-45	Interior	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102			
		Exposed	102	102	100	102	102	94	102	100	89	102	95	85	99	90	81	94	86	77	89	83	74	82	76	69	76	71	64	71	67	53	66	61	45	60	54	39	53	48	34				
	C	0-7	Interior	91	91	91	91	91	86	91	91	81	91	90	78	91	86	74	91	83	71	91	79	68	85	74	63	79	69	54	74	65	46	70	57	41	66	50	36	61	45	48			
			Exposed	91	86	74	91	82	70	90	78	67	86	74	64	82	71	58	79	69	53	76	66	48	70	58	41	66	50	35	59	43	46	51	38	40	45	50	36	40	44	32			
		7-20	Interior	91	91	87	91	90	82	91	86	78	91	81	74	89	77	71	86	74	68	83	71	65	77	65	55	73	57	47	69	50	41	65	43	36	58	38	48	52	51	43			
			Exposed	89	77	70	85	73	62	81	69	63	78	66	57	75	62	51	72	57	47	70	52	43	65	44	36	57	38	47	50	49	41	43	43	36	38	38	32	51	34	28			
		20-27	Interior	100	100	99	100	99	93	100	94	87	100	89	83	100	85	79	98	81	75	94	77	72	87	71	66	82	66	55	77	60	45	73	52	38	70	46	33	67	41	28			
			Exposed	100	84	78	97	80	74	92	76	70	88	72	67	85	69	61	81	66	54	79	62</																						



ASCE 7-16
Design Standard

II
Risk Category

30 ft
Roof Height

Ss = 3.00
Seismic

23 sq.ft
Module Area

LANDSCAPE
Orientation

CROSS-SLOPE
Rail Direction

NXT
Rail Type

NXT COMBO
Clamp

Tile Replacement
Attachment

SPAN TABLES

Maximum Allowable Rail Spans for Rooftop Solar Panels Parallel to the Roof Surface (inches)

Ground Snow Load (psf)	Wind Exposure Category	Roof Tilt Angle (deg)	Panel Exposure	Basic Wind Speed (mph)																																									
				90			95			100			105			110			115			120			130			140			150			160			170			180					
				Roof Wind Zone																																									
0	B	0-7	Interior	101	101	101	101	101	101	101	101	96	101	101	91	101	101	87	101	96	83	101	92	80	100	85	74	92	80	69	86	75	65	81	71	56	77	67	50	73	62	44			
			Exposed	101	101	87	101	95	82	101	91	78	101	86	74	96	83	71	92	79	68	88	76	66	82	71	57	76	66	49	71	60	42	67	52	37	63	46	49	56	41	44			
		7-20	Interior	101	101	101	101	101	98	101	101	93	101	97	88	101	92	83	101	87	79	97	83	76	89	77	70	83	71	65	78	66	57	74	60	50	71	53	44	67	47	39			
			Exposed	101	92	83	101	86	78	94	82	74	89	78	71	86	74	68	83	71	65	80	68	60	75	61	50	70	52	43	66	45	37	60	40	49	53	44	47	47	39				
		20-27	Interior	102	102	102	102	102	102	102	102	102	102	100	102	102	102	99	102	94	102	96	89	102	91	85	102	84	78	94	78	72	88	73	67	84	68	59	79	64	50	76	57	43	
			Exposed	102	100	94	102	94	88	102	89	83	102	85	79	99	81	75	94	77	71	90	74	68	84	68	60	79	63	49	74	55	41	71	48	34	67	42	29	64	37	39			
	27-45	Interior	102	102	102	102	102	102	102	102	102	102	102	102	102	102	99	102	99	102	99	102	99	102	101	90	102	93	83	93	86	77	86	80	72	81	75	68	76	71	63	71	67	54	
		Exposed	102	102	98	102	102	93	102	99	88	102	94	84	98	89	80	93	85	77	88	82	74	81	76	68	75	71	61	70	66	52	65	60	44	59	53	38	52	47	33				
	C	0-7	Interior	101	101	90	101	99	85	101	94	81	101	89	77	99	85	74	95	82	71	91	79	68	84	73	61	78	68	52	74	64	45	69	56	40	66	49	53	60	44	47			
			Exposed	99	85	73	94	81	70	89	77	67	85	74	63	81	71	57	78	68	52	75	65	47	70	57	40	65	49	52	58	42	45	50	37	39	44	49	36	39	43	34			
		7-20	Interior	101	95	86	101	89	81	99	85	77	92	80	73	88	77	70	85	73	67	82	70	64	77	65	54	72	56	46	68	49	40	65	42	35	57	37	47	51	50	42			
			Exposed	88	76	70	84	72	66	81	69	61	77	65	55	74	67	50	72	55	46	69	51	42	65	43	36	56	37	46	49	48	40	42	42	35	56	37	44	50	39	27			
		20-27	Interior	102	102	98	102	98	91	102	93	86	102	88	82	102	84	78	97	80	74	93	77	71	86	71	65	81	66	53	77	59	44	73	51	37	69	45	32	66	40	42			
			Exposed	102	83	77	96	79	73	91	75	69	87	71	66	84	68	59	81	65	53	78	61	47	73	52	38	69	44	31	65	38	40	57	51	35	50	45	31	45	40	27			
	27-45	Interior	102	102	102	102	102	96	102	102	91	102	97	87	102	92	83	97	88	79	92	85	76	84	78	70	78	73	66	72	68	56	68	64	48	63	57	41	56	50	36				
		Exposed	102	92	83	95	87	78	90	83	75	85	79	71	81	76	68	77	72	65	74	70	59	68	65	48	62	56	40	54	48	34	47	42	45	42	37	38	37	50	33				
	D	0-7	Interior	101	96	82	101	91	78	101	86	74	96	62	71	91	79	68	87	76	65	84	73	61	78	68	51	73	62	44	68	54	38	64	47	50	57	41	44	50	37	40			
			Exposed	91	79	68	86	75	65	82	71	58	79	68	53	75	66	48	72	61	43	70	56	40	65	48	51	56	41	44	48	53	38	42	47	38	37	41	29	50	37	26			
		7-20	Interior	101	87	79	94	82	74	89	77	71	86	74	67	82	70	64	79	67	59	76	65	54	71	55	45	67	47	39	62	41	51	54	36	45	48	47	39	43	42	35			
			Exposed	82	70	64	78	67	57	75	62	51	72	56	46	69	51	42	67	46	38	65	43	35	55	36	45	47	47	39	41	40	34	54	35	29	47	34	26	42	28	23			
		20-27	Interior	102	95	88	102	89	83	102	85	79	98	80	75	93	77	71	89	73	68	86	70	65	80	65	52	76	57	43	71	49	36	68	43	30	64	38	39	57	51	35			
			Exposed	93	77	71	88	73	67	85	69	61	86	54	78	61	47	75	56	42	73	51	37	68	43	30	63	37	39	55	49	34	48	43	29	42	38	26	57	34	23				
	27-45	Interior	102	102	93	102	99	88	102	93	84	97	89	80	92	85	76	88	81	73	84	78	70	77	72	65	71	67	54	66	62	46	60	54	39	53	48	33	47	42	45				
		Exposed	92	85	76	87	80	72	82	76	69	78	73	66	74	70	60	71	67	53	68	64	48	61	54	39	52	47	33	45	41	42	40	53	36	35	47	31	47	42	27				
10	B	0-7	Interior	90	90	90	90	90	90	90	90	90	90	90	90	87	90	90	83	90	80	90	85	74	90	80	69	86	75	65	81	71	56	77	67	50	73	62	44						
			Exposed	90	90	87	90	90	82	90	90	78	90	86	74	90	83	71	90	79	68	88	76	66	82	71	57	76	66	49	71	60	42	67	52	37	63	46	49	56	41	44			
		7-20	Interior	91	91	91	91	91	91	91	91	91	91	88	91	91	83	91	87	79	91	83	76	89	77	70	83	71	65	78	66	57	74	60	50	71	53	44	67	47	39				
			Exposed	91	91	83	91	86	78	91	82	74	89	78	71	86	74	68	83	71	65	80	68	60	75	61	50	70	52	43	66	45	37	60	40	49	53	44	47	47	39				
		20-27	Interior	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99		
			Exposed	99	99	94	99	94	88	99	89	83	99	85	79	98	81	75	94	77	71	90	74	68	84	68	60	79	63	49	74	55	41	71	48	34	67	42	29	64	37	39			
	27-45	Interior	101	101	101	101	101	101	101	101	101	101	101	101	101	101	99	101	101	99	101	99	101	101	99	101	94	101	93	83	93	86	77	86	80	72	81	75	68	76	71	63	71	67	54
		Exposed	101	101	98	101	101	93	101	99	88	101	94	84	98	89	80	93	85	77	88	82	74	81	76	68	75	71	61	70	66	52	65	60	44	59	53	38	52	47	33				
	C	0-7	Interior	90	90	90	90	90	85	90	90	81	90	89	77	90	85	74	90	82	71	90	79	68	84	73	61	78	68	52	74	64	45	69	56	40	66	49	53	60	44	47			
			Exposed	90	85	73	90	81	70	89	77	67	85	74	63	81	71	57	78	68	52	75	65	47	70	57	40	65	49	52	58	42	45	50	37	39	44	49	36	39	43	34			
		7-20	Interior	91	91	86	91	89	81	91	85	77	91	80	73	88	77	70	85	73	67	82	70	64	77	65	54	72	56	46	68	49	40	65	42	35	57	37	47	51	50	42			
			Exposed	88	76	70	84	72	66	81	69	61	77	65	55	74	67	50	72	55	46	69	51	42	65	43	36	56	37	46	49	48	40	42	42	35	56	37	44	50	39	27			
20-27		Interior	99	99	98	99	98	91	99	93	86	99	88	82	99	84	78	97	80	74	93	77	71	86	71	65	81	66	53	77	59	44	73	51	37	69	45	32	66	40	42				
		Exposed	99	83	77	96	79	73	91	75	69	87	71	66	84	68	59	81	65	53	78	61	47	73	52	38	69	44	31	65	38	40	57	51	35	50	45	31	45	40	27				
27-45	Interior	101	101	101	101	101	96	101	101	91	101	97	87	101																															

