



July 15, 2021

Solar Warehouse
9628 Valley Boulevard
Rosemead, CA 91770
TEL: (626) 579-3288

Attn.: Solar Warehouse - Engineering Department

Re: Report # 2021-06040HG.7.01 – Solar Warehouse SWH - Ecolite & Standard Rail Certification
Subject: Engineering Certification for the Territory of Puerto Rico

PZSE, Inc. – Structural Engineers has provided engineering and span tables for the SWH - Ecolite & Standard Rails, as presented in PZSE Report # 2021-06040HG.7.01, "Engineering Certification for the Solar Warehouse SWH - Ecolite & Standard Rails for Gable and Hip Roofs". All information, data, and analysis therein are based on, and comply with, the following building codes and typical specifications:

- Building Codes:
1. ASCE/SEI 7-16, Minimum Design Loads for Buildings and Other Structures, by American Society of Civil Engineers
 2. 2018 International Building Code, by International Code Council, Inc.
 3. 2018 International Residential Code, by International Code Council, Inc.
 4. AC428, Acceptance Criteria for Modular Framing Systems Used to Support Photovoltaic (PV) Panels, November 1, 2012 by ICC-ES
 5. Aluminum Design Manual 2015, by The Aluminum Association, Inc.
 6. ANSI/AWC NDS-2018, National Design Specification for Wood Construction, by the American Wood Council

Design Criteria:

Risk Category II
Seismic Design Category = A - E
Exposure Category = B, C & D
Basic Wind Speed (ultimate) per ASCE 7-16 = 100 mph to 200 mph
Ground Snow Load = 0 to 100 (psf)

This letter certifies that the loading criteria and design basis for the SWH - Ecolite & Standard Rails Span Tables are in compliance with the above codes.

If you have any questions on the above, do not hesitate to call.

Prepared by:
PZSE, Inc. – Structural Engineers
Roseville, CA





July 1, 2021

Solar Warehouse
9628 Valley Boulevard
Rosemead, CA 91770
TEL: (626) 579-3288

Attn.: Solar Warehouse - Engineering Department

Re: Report # 2021-06040HG7.01 Engineering Certification for the Solar Warehouse SWH - Ecolite and SWH - Standard Rails for Gable and Hip roofs.

PZSE, Inc. - Structural Engineers have reviewed Solar Warehouse SWH – Ecolite and SWH – Standard Rails. All information, data, and analysis contained within the Solar Warehouse SWH Ecolite and Standard Rail span tables are based on, and comply with the following codes:

1. Minimum Design Loads for Buildings and Other Structures, ASCE/SEI 7-10 & ASCE/SEI 7-16
2. 2012 - 2018 International Building Codes, by the International Code Council, Inc.
3. 2012 - 2018 International Residential Code, by the International Code Council, Inc.
4. AC428, Acceptance Criteria for Modular Framing Systems Used to Support Photovoltaic (PV) Panels, November 1, 2012, by ICC-ES
5. Aluminum Design Manual 2010 & 2015, by The Aluminum Association, Inc.
6. ANSI/AWC NDS-2012 & 2015, National Design Specification for Wood Construction, by the American Wood Council

Following are typical specifications to meet the above code requirements:

Design Criteria:	Ground Snow Load = 0 - 100 (psf) Basic Wind Speed = 100 - 200 (mph) Roof Mean Height = 0 - 30 (ft) Enclosed and Partially Enclosed Gable and Hip Roof Pitch = 0° - 45° (degrees) Exposure Category = B, C & D
Cantilever:	Maximum cantilever length is L/3, where “L” is the span noted in the Span Tables, provided there is at least 1 module length between maximum cantilevers.
Clearance:	2” Minimum clear and 10” Maximum clear from the top of the roof to top of PV panel.

- Splice:** Rails installed with (2) Roof Attachments (1 rail span)*: SWH Splice where required shall be installed within a distance of $L/4$ from either Roof Attachment, where “L” is the rail span.
 Rails installed with (3) or more Roof Attachments (2 or more rail spans)*: SWH Rail Splice where required shall not be installed within a distance of $L/8$ from any Roof Attachment, where “L” is the rail span.
 *SWH Rail Splice may be installed on any portion of the span in instances where the rail is continuous over two roof attachments on both sides of the splice.
- Tolerance(s):** 1.0” tolerance for any specified dimension in this report is allowed for installation.
- Installation Orientation:** Landscape (L) - PV Panel long dimension is parallel to the ridge/eave line of roof, and the PV panel is mounted on the long side.
 Portrait (P) - PV Panel short dimension is parallel to the ridge/eave line of roof, and the PV panel is mounted on the short side.
 Rail Spacing Tables assume maximum panel dimensions are: 80” x 41.5”
- Rail Materials:** The SWH Ecolite Rail Aluminum Alloy: 6005-T5
 The SWH Standard Rail Aluminum Alloy: 6063-T5

Components and Cladding Roof Zones:

Roof Zones – Enclosed and Partially Enclosed Gable Roofs, $\theta \leq 7^\circ$:

The zones shall be determined using figure 30.3-2A of ASCE 7-16 (or figure 30.4-2A of ASCE 7-10). See Figure 1.

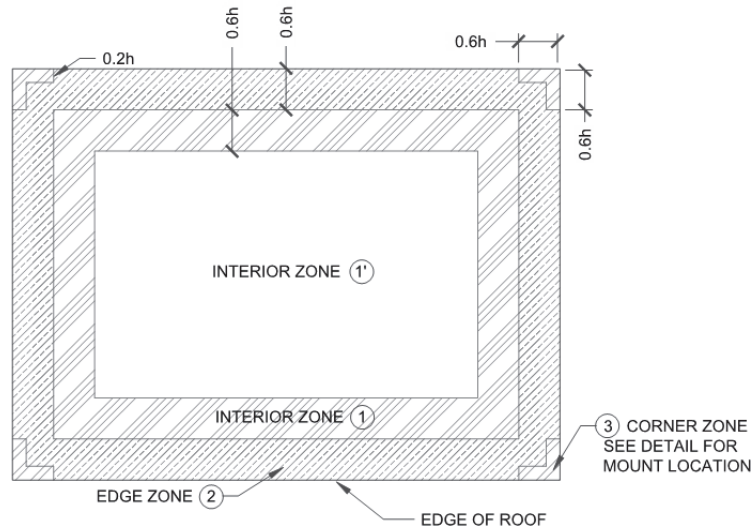


Figure 1: Roof Edge and Corner Zones, Gable Roofs, $\theta \leq 7^\circ$

Roof Zones – Enclosed and Partially Enclosed Gable and Hip Roofs, $7^\circ < \theta \leq 45^\circ$:

The Edge Zone, “a,” shall be determined using figure 30.3-2B to figure 30.3-2D of ASCE 7-16 (or figure 30.4-2A to figure 30.4-2A of ASCE 7-10), for Gable roofs. The Edge Zone, “a,” shall be determined using figure 30.3-2E to figure 30.3-2I of ASCE 7-16 (or figure 30.4-2B – figure 30.4-2C of ASCE 7-10), for Hip roofs.

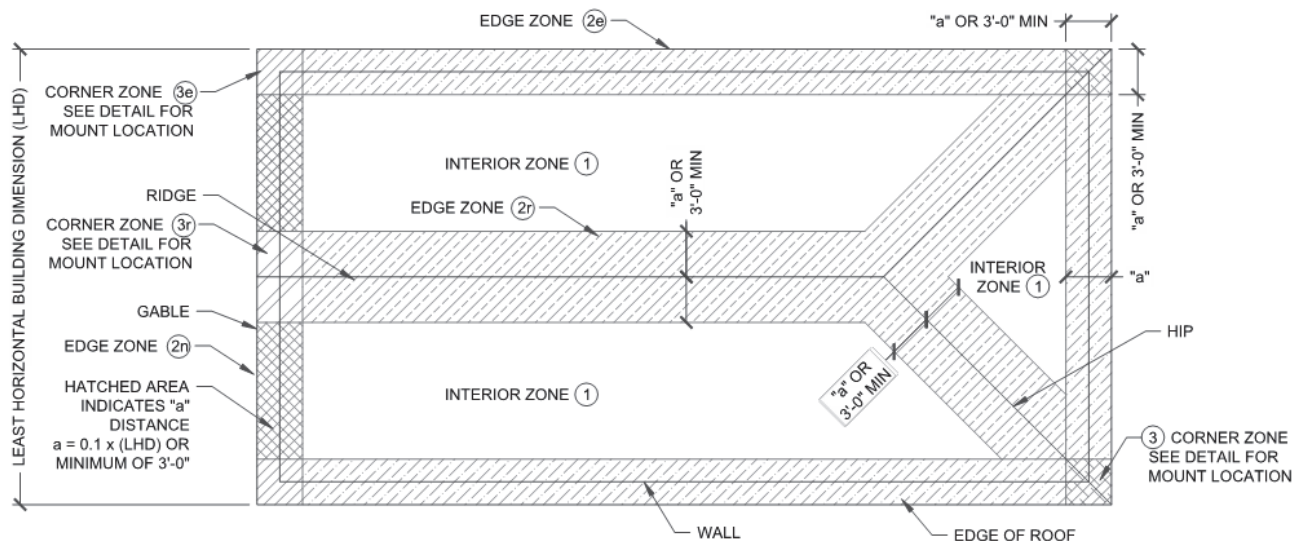


Figure 2: Roof Zones, Gable and Hip Roofs, $7^\circ < \theta \leq 45^\circ$

Notes:

- 1) Tables are determined for Rail only and do not include module attachment or roof capacity check.
- 2) Risk Category II per ASCE 7-10 & ASCE 7-16.
- 3) Topographic factor, k_{zt} is 1.0.
- 4) Average parapet height is 0.0 ft.
- 5) Wind speeds are LRFD values.
- 6) Attachment spacing(s) apply to a seismic design category E or less.



Design Responsibility:

These tables are intended to be used under the responsible charge of a registered design professional where required by the authority having jurisdiction. In all cases, these tables should be used under the direction of a design professional with sufficient structural engineering knowledge and experience to be able to:

- Evaluate whether these tables apply to the project, and
- Understand and determine the appropriate values for all input parameters of these tables.

This letter certifies that the Solar Warehouse SMH Ecolite and Standard Rails, when installed according to the limitations of this letter and the attached span tables, complies with the above codes and loading criteria. This certification excludes evaluation of the building structure to support the loads imposed on the building by the array; including, but not limited to strength and deflection of structural framing members, fastening and/or strength of roofing materials, and/or the effects of snow accumulation on the roof. Structures will require additional knowledge of the building and are outside the scope of the certification of this racking system.

If you have any questions on the above, do not hesitate to call.

Prepared by:
PZSE, Inc. – Structural Engineers
Roseville, CA



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Maximum Rail Spans (Inches)			SWH - Ecolite Rail Flush-Mount on 0 to 30Ft Roof Height -- Portrait Orientation																																				
Ground Snow Load	Exposure Category	Panel Angle	Wind Speed ->	100 mph			110 mph			115 mph			120 mph			130 mph			140 mph			150 mph			160 mph			170 mph			180 mph			190 mph			200 mph		
			Roof 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			
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	27 to 45	Array Interior	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	
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Maximum Rail Spans (Inches)			SWH - Ecolite Rail Flush-Mount on 0 to 30ft Roof Height -- Landscape Orientation																																					
Ground Snow Load	Exposure Category	Panel Angle	Wind Speed ->	100 mph			110 mph			115 mph			120 mph			130 mph			140 mph			150 mph			160 mph			170 mph			180 mph			190 mph			200 mph			
			Roof 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	
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Maximum Rail Spans (Inches)			SWH - Ecolite Rail Flush-Mount on 0 to 30Ft Roof Height -- Landscape Orientation																																				
Ground Snow Load	Exposure Category	Panel Angle	Wind Speed ->	100 mph			110 mph			115 mph			120 mph			130 mph			140 mph			150 mph			160 mph			170 mph			180 mph			190 mph			200 mph		
			Roof 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			
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Maximum Rail Spans (Inches)			SWH - Standard Rail Flush-Mount on 0 to 30Ft Roof Height -- Portrait Orientation																																				
Ground Snow Load	Exposure Category	Panel Angle	Wind Speed ->	100 mph			110 mph			115 mph			120 mph			130 mph			140 mph			150 mph			160 mph			170 mph			180 mph			190 mph			200 mph		
			Roof 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			
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		20 to 27	Array Interior	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
			Array Edge	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
	27 to 45	Array Interior	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	
		Array Edge	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	
	C	0 to 7	Array Interior	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
			Array Edge	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
		7 to 20	Array Interior	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
			Array Edge	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
		20 to 27	Array Interior	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
			Array Edge	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
	27 to 45	Array Interior	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	
		Array Edge	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	
	D	0 to 7	Array Interior	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
			Array Edge	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
		7 to 20	Array Interior	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
			Array Edge	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
		20 to 27	Array Interior	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
			Array Edge	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
	27 to 45	Array Interior	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	
		Array Edge	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	

Maximum Rail Spans (Inches)			SWH - Standard Rail Flush-Mount on 0 to 30ft Roof Height -- Landscape Orientation																																				
Ground Snow Load	Exposure Category	Panel Angle	Wind Speed ->	100 mph			110 mph			115 mph			120 mph			130 mph			140 mph			150 mph			160 mph			170 mph			180 mph			190 mph			200 mph		
			Roof 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
30 psf	B	0 to 7	Array Interior	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	
			Array Edge	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	
		7 to 20	Array Interior	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	
			Array Edge	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	
	C	0 to 7	Array Interior	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	
			Array Edge	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	
		7 to 20	Array Interior	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	
			Array Edge	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	
	D	0 to 7	Array Interior	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	
			Array Edge	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	
		7 to 20	Array Interior	72	72	60	66	66	60	66	66	64	66	66	64	60	60	54	54	54	48	54	54	48	48	48	42	48	48	42	48	48	42	48	48	42	48	48	42
			Array Edge	60	60	54	60	60	48	54	54	48	54	54	48	54	54	42	48	48	42	48	48	42	42	42	36	42	42	36	42	42	36	42	42	30	36	36	30

Maximum Rail Spans (Inches)			SWH - Standard Rail Flush-Mount on 0 to 30ft Roof Height -- Landscape Orientation																																				
Ground Snow Load	Exposure Category	Panel Angle	Wind Speed ->	100 mph			110 mph			115 mph			120 mph			130 mph			140 mph			150 mph			160 mph			170 mph			180 mph			190 mph			200 mph		
			Roof 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			
100 psf	B	0 to 7	Array Interior	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
			Array Edge	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
		7 to 20	Array Interior	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42
			Array Edge	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42
		20 to 27	Array Interior	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42
			Array Edge	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42
	27 to 45	Array Interior	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	
		Array Edge	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	
	C	0 to 7	Array Interior	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
			Array Edge	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
		7 to 20	Array Interior	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42
			Array Edge	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42
		20 to 27	Array Interior	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42
			Array Edge	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42
	27 to 45	Array Interior	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	
		Array Edge	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	
	D	0 to 7	Array Interior	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
			Array Edge	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
7 to 20		Array Interior	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	
		Array Edge	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	
20 to 27		Array Interior	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	
		Array Edge	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	
27 to 45	Array Interior	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48		
	Array Edge	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48		

For Structural Only