



Starling Madison Lofquist, Inc.  
*Consulting Structural and Forensic Engineers*

5224 South 39<sup>th</sup> Street, Phoenix, Arizona 85040

tel: (602) 438-2500 fax: (602) 438-2505 www.smleng.com

Roof Tech, Inc.  
333 H Street, Suite 5000  
Chula Vista, CA 91910

July 28, 2016

page 1 of 18

Attn: Mr. Takashi Chiyoda, General Manager

**Subject: Roof Tech RT-[E] Mount – Structural Analysis**

SML Job No.: 471-13

Dear Mr. Chiyoda:

We have analyzed the Roof Tech RT-[E] Mount rail-less photovoltaic (PV) panel roof mount system and determined that, for the configurations and criteria described below, it is in compliance with the applicable sections of the following Reference Documents:

- Codes: ASCE/SEI 7-10 Min. Design Loads for Buildings & Other Structures  
International Building Code 2012 & 2015 Editions  
International Residential Building Code 2012 & 2015 Editions
- Other: Aluminum Design Manual, 2010 & 2015 Editions

The Roof Tech RT-[E] Mount rail-less photovoltaic (PV) panel roof mount system is comprised of a 6000 series aluminum [E] Mount base, panel spacer, middle clamp, end clamp, and optional shim(s), and SS304 bonding plate(s). A stainless steel SS304 8.0 mm bolt, nut, and star conical washer fasten the mounting system together, and the system is attached to the roof wood substrate with SS304 5.0 mm x 60 mm wood screws.

Three wood substrates were tested with the fasteners also passing through two layers of composite asphalt roof shingles. The first tested wood substrate consisted of 7/16" thick sheathing over a 2x4 SPF #2 rafter (2x truss top chord OK by inspection), the second tested wood substrate consisted of 7/16" thick OSB only, and the third tested wood substrate consisted of 15/32" thick plywood only. See Exhibit 'A' – attached. Two wood screws are required at the rafter installations and four wood screws are required at the OSB and plywood only installations.

The testing data provided by Western Technologies report (job) no.: 2163XD260, event no's: G260-2 dated November 12, 2013, G260-3 dated January 3, 2014, and G260-5 June 13, 2014, shows that the critical failure occurs in one of three ways; pullout of the wood screws from the OSB/Plywood only wood substrate, the shear failure of the OSB/Plywood only wood substrate, or the shear failure of the aluminum [E] Mount base at the base flange. Maximum allowable values for these failure conditions were derived using a safety factor of 2.0 on the ultimate loads provided by the testing.

**RT-[E] Mount PV Panel in Landscape Orientation:**

The maximum allowable uplift and shear force for 7/16" thick sheathing over a 2x4 SPF #2 rafter is 597 lb and 561 lb respectively. The maximum allowable uplift, down force and shear force for 7/16" thick OSB only is 177 lb, 258 lb, and 391 lb respectively. The maximum allowable uplift, down force and shear force for 15/32" thick plywood only is 321 lb, 556 lb, and 406 lb respectively.

**RT-[E] Mount PV Panel in Portrait Orientation:**

The maximum allowable uplift and shear force for 7/16" thick sheathing over a 2x4 SPF #2 rafter is 673 lb and 170 lb respectively. The maximum allowable uplift, down force and shear force for 7/16" thick OSB only is 209 lb, 258 lb, and 190 lb respectively. The maximum allowable uplift, down force and shear force for 15/32" thick plywood only is 345 lb, 556 lb, and 178 lb respectively.

The attached tables below show the maximum allowable combined loading criteria of wind speed, roof slope, and snow loads which produce reaction loads below the allowable loads listed above. The effect of seismic loads (for all design categories A-F) have been determined to be less than the effect due to wind loads in all load conditions and combinations. The assumed topography is flat with a  $K_{zt} = 1.0$ . Therefore, the maximum allowable spans for common load cases due to dead, wind and snow loads are the controlling load cases.

Roof Angle (Degrees)	Roof Slope (in/in)
0.0	0:12
4.8	1:12
9.5	2:12
14.0	3:12
18.4	4:12
22.6	5:12
26.6	6:12
33.7	8:12
39.8	10:12
45.0	12:12

Table 1. OSB Only Landscape									
Maximum Design Criteria	Exposure B			Exposure C			Exposure D		
	Wind Speed (mph)	Roof Slope	Ground Snow (psf)	Wind Speed (mph)	Roof Slope	Ground Snow (psf)	Wind Speed (mph)	Roof Slope	Ground Snow (psf)
Zone 1 4 Mounts	150	0:12-8:12	25	130	2:12-6:12	20	120	2:12-6:12	20
	140	0:12-12:12	25	130	4:12-6:12	25	120	4:12-6:12	25
	140	5:12-12:12	30	120	0:12-12:12	25	115	0:12-12:12	25
	130	8:12-12:12	35	120	5:12-12:12	30	110	5:12-12:12	30
	115	8:12-12:12	40	110	8:12-12:12	35	NA	NA	NA
Zone 1 6 Mounts	180	0:12-12:12	40	160	2:12-6:12	35	150	2:12-5:12	35
	180	5:12-12:12	45	160	4:12-6:12	40	140	0:12-12:12	40
	170	4:12-12:12	45	150	0:12-12:12	40	140	5:12-12:12	45
	170	5:12-12:12	50	150	5:12-12:12	45	130	4:12-12:12	45
	160	6:12-12:12	55	140	4:12-12:12	45	130	5:12-12:12	50
	150	8:12-12:12	60	140	5:12-12:12	50	120	6:12-12:12	55
	140	8:12-12:12	65	130	6:12-12:12	55	115	8:12-12:12	60
	120	8:12-12:12	70	120	8:12-12:12	60	110	8:12-12:12	65
Zone 2 4 Mounts	130	8:12-12:12	35	110	8:12-12:12	35	NA	NA	NA
	115	2:12-12:12	25	NA	NA	NA	NA	NA	NA
	115	5:12-12:12	30	NA	NA	NA	NA	NA	NA
	115	8:12-12:12	40	NA	NA	NA	NA	NA	NA
	110	0:12-12:12	25	NA	NA	NA	NA	NA	NA
Zone 2 6 Mounts	160	8:12-12:12	55	130	8:12-12:12	55	120	8:12-12:12	55
	150	8:12-12:12	60	120	8:12-12:12	60	115	8:12-12:12	60
	140	2:12-12:12	40	115	0:12-12:12	40	110	8:12-12:12	65
	140	4:12-12:12	45	115	4:12-12:12	45	NA	NA	NA
	140	5:12-12:12	50	115	5:12-12:12	50	NA	NA	NA
	140	6:12-12:12	55	115	6:12-12:12	55	NA	NA	NA
	140	8:12-12:12	65	115	8:12-12:12	65	NA	NA	NA
	130	0:12-12:12	40	NA	NA	NA	NA	NA	NA
Zone 3 4 Mounts	130	8:12-12:12	35	110	8:12-12:12	35	NA	NA	NA
	115	8:12-12:12	40	NA	NA	NA	NA	NA	NA
Zone 3 6 Mounts	160	8:12-12:12	55	130	8:12-12:12	55	120	8:12-12:12	55
	150	8:12-12:12	60	120	8:12-12:12	60	115	8:12-12:12	60
	140	8:12-12:12	65	115	8:12-12:12	65	110	8:12-12:12	65
	120	8:12-12:12	70	NA	NA	NA	NA	NA	NA
	110	0:12-12:12	40	NA	NA	NA	NA	NA	NA
	110	4:12-12:12	45	NA	NA	NA	NA	NA	NA
	110	5:12-12:12	50	NA	NA	NA	NA	NA	NA
	110	6:12-12:12	65	NA	NA	NA	NA	NA	NA

Table 2. OSB Only Portrait									
Maximum Design Criteria	Exposure B			Exposure C			Exposure D		
	Wind Speed (mph)	Roof Slope	Ground Snow (psf)	Wind Speed (mph)	Roof Slope	Ground Snow (psf)	Wind Speed (mph)	Roof Slope	Ground Snow (psf)
Zone 1 4 Mounts	160	0:12-6:12	15	140	2:12-6:12	15	120	0:12-10:12	10
	150	0:12-12:12	15	130	0:12-12:12	10	120	0:12-6:12	15
	130	6:12-12:12	20	130	0:12-6:12	15	115	0:12-12:12	15
	120	6:12-12:12	25	120	0:12-12:12	15	NA	NA	NA
	NA	NA	NA	110	6:12-12:12	20	NA	NA	NA
Zone 1 6 Mounts	180	0:12-12:12	30	170	2:12-6:12	30	150	0:12-6:12	30
	180	0:12-6:12	35	160	0:12-10:12	25	140	0:12-12:12	30
	170	0:12-12:12	35	160	0:12-6:12	30	140	0:12-6:12	35
	160	5:12-12:12	40	150	0:12-12:12	30	130	0:12-12:12	35
	140	8:12-12:12	45	150	0:12-6:12	35	120	5:12-12:12	40
	130	8:12-12:12	50	140	0:12-12:12	35	115	8:12-12:12	45
	NA	NA	NA	130	5:12-12:12	40	NA	NA	NA
	NA	NA	NA	120	8:12-12:12	45	NA	NA	NA
Zone 2 4 Mounts	140	8:12-12:12	15	115	8:12-12:12	15	NA	NA	NA
	130	8:12-12:12	20	110	8:12-12:12	20	NA	NA	NA
	120	2:12-12:12	15	NA	NA	NA	NA	NA	NA
	120	6:12-12:12	25	NA	NA	NA	NA	NA	NA
	115	0:12-12:12	15	NA	NA	NA	NA	NA	NA
Zone 2 6 Mounts	170	8:12-12:12	35	140	8:12-12:12	35	130	8:12-12:12	35
	160	8:12-12:12	40	130	8:12-12:12	40	120	8:12-12:12	40
	140	0:12-12:12	35	120	0:12-12:12	35	115	8:12-12:12	45
	140	5:12-12:12	40	120	5:12-12:12	40	110	0:12-12:12	35
	140	8:12-12:12	45	120	8:12-12:12	45	110	5:12-12:12	40
	130	8:12-12:12	50	110	8:12-12:12	50	NA	NA	NA
Zone 3 4 Mounts	140	8:12-12:12	15	115	8:12-12:12	15	NA	NA	NA
	130	8:12-12:12	20	110	8:12-12:12	20	NA	NA	NA
	120	8:12-12:12	25	NA	NA	NA	NA	NA	NA
Zone 3 6 Mounts	170	8:12-12:12	35	140	8:12-12:12	35	130	8:12-12:12	35
	160	8:12-12:12	40	130	8:12-12:12	40	120	8:12-12:12	40
	140	8:12-12:12	45	120	8:12-12:12	45	115	8:12-12:12	45
	130	8:12-12:12	50	110	8:12-12:12	50	NA	NA	NA
	115	0:12-12:12	35	NA	NA	NA	NA	NA	NA
	115	5:12-12:12	40	NA	NA	NA	NA	NA	NA

Table 3. Plywood Only Landscape									
Maximum Design Criteria	Exposure B			Exposure C			Exposure D		
	Wind Speed (mph)	Roof Slope	Ground Snow (psf)	Wind Speed (mph)	Roof Slope	Ground Snow (psf)	Wind Speed (mph)	Roof Slope	Ground Snow (psf)
Zone 1 4 Mounts	180	0:12-12:12	50	170	0:12-6:12	50	160	2:12-6:12	50
	180	4:12-12:12	55	170	4:12-6:12	55	160	4:12-6:12	55
	180	6:12-12:12	60	160	0:12-12:12	50	150	0:12-12:12	50
	180	8:12-12:12	65	160	4:12-12:12	55	150	4:12-12:12	55
	170	8:12-12:12	70	160	6:12-12:12	60	150	6:12-12:12	60
	150	8:12-12:12	75	150	8:12-12:12	65	140	8:12-12:12	65
	NA	NA	NA	140	8:12-12:12	70	130	8:12-12:12	70
	NA	NA	NA	130	8:12-12:12	75	120	8:12-12:12	75
Zone 1 6 Mounts	180	0:12-12:12	80	180	0:12-12:12	80	180	0:12-12:12	80
	180	4:12-12:12	85	180	4:12-12:12	85	180	4:12-12:12	85
	180	5:12-12:12	90	180	5:12-12:12	90	180	5:12-12:12	90
Zone 2 4 Mounts	180	8:12-12:12	65	150	8:12-12:12	65	140	8:12-12:12	65
	170	8:12-12:12	70	140	8:12-12:12	70	130	8:12-12:12	70
	150	0:12-12:12	50	130	2:12-4:12	45	120	8:12-12:12	75
	150	4:12-12:12	55	130	8:12-12:12	75	115	0:12-12:12	50
	150	6:12-12:12	60	120	0:12-12:12	50	115	4:12-12:12	55
	150	8:12-12:12	75	120	4:12-12:12	55	115	6:12-12:12	60
	NA	NA	NA	120	6:12-12:12	60	NA	NA	NA
Zone 2 6 Mounts	180	0:12-12:12	80	180	8:12-12:12	90	170	8:12-12:12	90
	180	4:12-12:12	85	150	0:12-12:12	80	140	0:12-12:12	80
	180	5:12-12:12	90	150	4:12-12:12	85	140	4:12-12:12	85
	NA	NA	NA	150	5:12-12:12	90	140	5:12-12:12	90
Zone 3 4 Mounts	180	8:12-12:12	65	150	8:12-12:12	65	140	8:12-12:12	65
	170	8:12-12:12	70	140	8:12-12:12	70	130	8:12-12:12	70
	150	8:12-12:12	75	130	8:12-12:12	75	120	8:12-12:12	75
	120	0:12-12:12	50	NA	NA	NA	NA	NA	NA
	120	4:12-12:12	55	NA	NA	NA	NA	NA	NA
	120	6:12-12:12	60	NA	NA	NA	NA	NA	NA
Zone 3 6 Mounts	180	8:12-12:12	90	180	8:12-12:12	90	170	8:12-12:12	90
	150	2:12-12:12	80	120	0:12-12:12	80	115	2:12-12:12	80
	150	4:12-12:12	85	120	4:12-12:12	85	115	4:12-12:12	85
	150	5:12-12:12	90	120	5:12-12:12	90	115	5:12-12:12	90
	140	0:12-12:12	80	NA	NA	NA	110	0:12-12:12	80

Table 4. Plywood Only Portrait									
Maximum Design Criteria	Exposure B			Exposure C			Exposure D		
	Wind Speed (mph)	Roof Slope	Ground Snow (psf)	Wind Speed (mph)	Roof Slope	Ground Snow (psf)	Wind Speed (mph)	Roof Slope	Ground Snow (psf)
Zone 1 4 Mounts	180	0:12-12:12	35	170	0:12-6:12	35	160	2:12-6:12	35
	170	6:12-12:12	40	160	0:12-12:12	35	150	0:12-12:12	35
	150	8:12-12:12	45	140	6:12-12:12	40	130	6:12-12:12	40
	NA	NA	NA	120	8:12-12:12	45	115	8:12-12:12	45
Zone 1 6 Mounts	180	0:12-12:12	60	180	0:12-12:12	60	180	0:12-12:12	55
	180	8:12-12:12	70	170	8:12-12:12	65	180	0:12-6:12	60
	NA	NA	NA	160	8:12-12:12	70	170	0:12-12:12	60
	NA	NA	NA	NA	NA	NA	160	8:12-12:12	65
	NA	NA	NA	NA	NA	NA	140	8:12-12:12	70
Zone 2 4 Mounts	170	8:12-12:12	40	150	8:12-12:12	35	130	8:12-12:12	40
	150	0:12-12:12	35	140	8:12-12:12	40	115	0:12-12:12	35
	150	6:12-12:12	40	120	0:12-12:12	35	115	6:12-12:12	40
	150	8:12-12:12	45	120	6:12-12:12	40	115	8:12-12:12	45
	NA	NA	NA	120	8:12-12:12	45	NA	NA	NA
Zone 2 6 Mounts	180	0:12-12:12	60	180	8:12-12:12	60	170	8:12-12:12	60
	180	8:12-12:12	70	170	8:12-12:12	65	160	8:12-12:12	65
	NA	NA	NA	160	8:12-12:12	70	140	0:12-12:12	60
	NA	NA	NA	150	0:12-12:12	60	140	8:12-12:12	70
Zone 3 4 Mounts	170	8:12-12:12	40	150	8:12-12:12	35	130	8:12-12:12	40
	150	8:12-12:12	45	140	8:12-12:12	40	115	8:12-12:12	45
	120	0:12-12:12	35	120	8:12-12:12	45	NA	NA	NA
	120	6:12-12:12	40	NA	NA	NA	NA	NA	NA
Zone 3 6 Mounts	180	8:12-12:12	70	180	8:12-12:12	60	170	8:12-12:12	60
	150	2:12-12:12	60	160	8:12-12:12	70	160	8:12-12:12	65
	140	0:12-12:12	60	120	0:12-12:12	60	140	8:12-12:12	70
	NA	NA	NA	NA	NA	NA	115	2:12-12:12	60
	NA	NA	NA	NA	NA	NA	110	0:12-12:12	60

Table 5. Rafter Landscape									
	Exposure B			Exposure C			Exposure D		
Maximum Design Criteria	Wind Speed (mph)	Roof Slope	Ground Snow (psf)	Wind Speed (mph)	Roof Slope	Ground Snow (psf)	Wind Speed (mph)	Roof Slope	Ground Snow (psf)
Zone 1 4 Mounts	180	0:12-12:12	90	180	0:12-12:12	90	180	0:12-12:12	90
	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zone 2 4 Mounts	180	0:12-12:12	90	180	8:12-12:12	90	180	8:12-12:12	90
	NA	NA	NA	170	0:12-12:12	90	160	2:12-12:12	90
	NA	NA	NA	NA	NA	NA	150	0:12-12:12	90
Zone 2 6 Mounts	180	0:12-12:12	90	180	0:12-12:12	90	180	0:12-12:12	90
	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zone 3 4 Mounts	180	8:12-12:12	90	180	8:12-12:12	90	180	8:12-12:12	90
	160	0:12-12:12	90	140	2:12-12:12	90	130	2:12-12:12	90
	NA	NA	NA	130	0:12-12:12	90	120	0:12-12:12	90
Zone 3 6 Mounts	180	0:12-12:12	90	180	8:12-12:12	90	180	8:12-12:12	90
	NA	NA	NA	170	2:12-12:12	90	150	0:12-12:12	90
	NA	NA	NA	160	0:12-12:12	90	NA	NA	NA

Table 6. Rafter Portrait									
	Exposure B			Exposure C			Exposure D		
Maximum Design Criteria	Wind Speed (mph)	Roof Slope	Ground Snow (psf)	Wind Speed (mph)	Roof Slope	Ground Snow (psf)	Wind Speed (mph)	Roof Slope	Ground Snow (psf)
Zone 1 4 Mounts	180	0:12-12:12	60	180	0:12-12:12	60	180	0:12-12:12	60
	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zone 1 6 Mounts	180	0:12-12:12	90	180	0:12-12:12	90	180	0:12-12:12	90
	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zone 2 4 Mounts	180	0:12-12:12	60	180	0:12-12:12	60	180	8:12-12:12	60
	NA	NA	NA	NA	NA	NA	160	0:12-12:12	60
Zone 2 6 Mounts	180	0:12-12:12	90	180	0:12-12:12	90	180	8:12-12:12	90
	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zone 3 4 Mounts	180	8:12-12:12	60	180	8:12-12:12	60	180	8:12-12:12	60
	170	0:12-12:12	60	140	0:12-12:12	60	120	0:12-12:12	60
Zone 3 6 Mounts	180	0:12-12:12	90	180	2:12-12:12	90	180	8:12-12:12	90
	NA	NA	NA	170	0:12-12:12	90	160	0:12-12:12	90

Table Notes for Tables 1 to 6 – Tabulated values are based on the following criteria:

1. Building mean roof height = 30 ft maximum.
2. Risk Category = II.
3. Solar panel maximum area = 18.88 square feet (68 in. x 40 in.).
4. Solar panel dead load = approximately 3.0 psf.
5. ASCE 7-10.
6. OSB shall be 24/16 APA rated sheathing minimum (7/16" thick).
7. Plywood shall be 32/16 APA rated sheathing minimum (15/32" thick).
8. Sheathing shall be free of defects including, but not limited to water damage and delamination.
9. Roof rafters or trusses spaced at 24" on center maximum.
10. PV panels must be supported per the manufacturer's required orientation, location and/or spacing.
11. Through a maximum of 2 layers of composite asphalt roof shingles or maximum 20 gage metal decking provided the metal is predrilled as wood screws are not designed to penetrate the metal decking. Not valid on concrete roof tile.

**'Rail Option':**

The 'Rail Option' consists of the Roof Tech RT-[E] Mount base attached to the roof structure in the same manner as the standard rail-less installation using SS304 5.0 mm x 60 mm wood screws. An appropriately load rated 'L-Foot', by others, shall be attached to the [E] Mount base with a stainless steel SS304 8.0 mm bolt, nut, and star conical washer. An appropriately load rated rail, by others, shall be attached to the 'L-Foot' per the rail manufacturer's installation instructions.

For the 'Rail Option' the lateral loads have been reduced by a ratio of 2.165 inches / 5 inches for OSB/Plywood Only installation options and 2.165 inches / 7 inches for the Rafter installation option, which is the maximum allowable height ratio for the 'Rail Option'. The maximum height for the 'Rail Option' is measured from the bottom of the [E] Mount base to the top of the rail. Due to reduced redundancy for the 'Rail Option' the safety factor for pullout has been increased to 2.5. The rails centerline shall be supported over the middle 2.5 inches of the [E] Mount. See Exhibit 'B' – attached, for the allowable 'Rail Option' PV panel layouts and 'L-Foot' and rail configuration. The maximum rail cantilever shall be limited to the smaller of 40% of the maximum rail span in the 'Rail Option' tables below and the rail manufacturer's specified maximum cantilever. It is the responsibility of the contractor to verify that the 'L-Foot' and rails that are used have a span rating greater than that shown in the 'Rail Option' tables below. Provide thermal expansion splices along the rail at intervals not to exceed 11 feet and refer to the rail manufacturer's thermal expansion splice detailing for proper installation.

For the 'Rail Option' the maximum allowable uplift and shear force for 7/16" thick sheathing over a 2x4 SPF #2 rafter is 477 lb and 139 lb respectively. The maximum allowable uplift, down force and shear force for 7/16" thick OSB only is 167 lb, 258 lb, and 135 lb respectively. The maximum allowable uplift, down force and shear force for 15/32" thick plywood only is 256 lb, 556 lb, and 141 lb respectively.

The attached 'Rail Option' tables below show the maximum [E] Mount spacing in feet that the mounts can safely support for the shown wind speed, wind exposure, roof zone, roof angle, and snow loads which produce reaction loads below the allowable loads listed above.



Table R1. RT-[E] Mount Rail Option for: OSB Only Installations (60 & 72 Cell PV Panels) Maximum Mount Spacing in Feet								
Landscape Orientation - ASCE 7-10								
Snow Load	Exposure Category	Roof Angle	Roof Zone	Basic Wind Speed, V (mph)				
				110	115	120	130	140
0 PSF	B	7 to 27	1	8	8	7	6	5
		Degrees	2	4	4	3	3	2
		28 to 45	1	7	6	6	5	4
		Degrees	2	6	5	5	4	3
	C	7 to 27	1	6	5	5	4	3
		Degrees	2	3	3	2	2	2
1-10 PSF	B	7 to 27	1	6	6	6	6	5
		Degrees	2	4	4	3	3	2
		28 to 45	1	6	6	6	5	4
		Degrees	2	6	5	5	4	3
	C	7 to 27	1	6	5	5	4	3
		Degrees	2	3	3	2	2	2
11-20 PSF	B	7 to 27	1	4	4	4	4	4
		Degrees	2	4	4	3	3	2
		28 to 45	1	5	4	4	4	4
		Degrees	2	5	4	4	4	3
	C	7 to 27	1	4	4	4	4	3
		Degrees	2	3	3	2	2	2
21-30 PSF	B	7 to 27	1	3	3	3	3	3
		Degrees	2	3	3	3	3	2
		28 to 45	1	4	4	4	4	3
		Degrees	2	4	4	4	4	3
	C	7 to 27	1	3	3	3	3	3
		Degrees	2	3	3	2	2	2
31-40 PSF	B	7 to 27	1	2	2	2	2	2
		Degrees	2	2	2	2	2	2
		28 to 45	1	3	3	3	3	3
		Degrees	2	3	3	3	3	3
	C	7 to 27	1	2	2	2	2	2
		Degrees	2	2	2	2	2	2
C	28 to 45	1	3	3	3	3	3	
	Degrees	2	3	3	3	3	2	

Table R2. RT-[E] Mount Rail Option for: OSB Only Installations (60 Cell PV Panels) Maximum Mount Spacing in Feet								
Portrait Orientation - ASCE 7-10								
Snow Load	Exposure Category	Roof Angle	Roof Zone	Basic Wind Speed, V (mph)				
				110	115	120	130	140
0 PSF	B	7 to 27	1	4	4	4	4	3
		Degrees	2	3	2	2	2	0
		28 to 45	1	4	4	3	3	2
		Degrees	2	3	3	3	2	2
	C	7 to 27	1	4	3	3	3	2
		Degrees	2	2	2	0	0	0
28 to 45		1	3	3	2	2	2	
Degrees		2	2	2	2	2	0	
1-10 PSF	B	7 to 27	1	3	3	3	3	3
		Degrees	2	3	2	2	2	0
		28 to 45	1	3	3	3	2	2
		Degrees	2	3	3	3	2	2
	C	7 to 27	1	3	3	3	3	2
		Degrees	2	2	2	0	0	0
28 to 45		1	2	2	2	2	2	
Degrees		2	2	2	2	2	0	
11-20 PSF	B	7 to 27	1	2	2	2	2	2
		Degrees	2	2	2	2	2	0
		28 to 45	1	2	2	2	2	2
		Degrees	2	2	2	2	2	2
	C	7 to 27	1	2	2	2	2	2
		Degrees	2	2	2	0	0	0
28 to 45		1	2	2	2	0	0	
Degrees		2	2	2	2	0	0	
21-30 PSF	B	7 to 27	1	0	0	0	0	0
		Degrees	2	0	0	0	0	0
		28 to 45	1	0	0	0	0	0
		Degrees	2	0	0	0	0	0
	C	7 to 27	1	0	0	0	0	0
		Degrees	2	0	0	0	0	0
28 to 45		1	0	0	0	0	0	
Degrees		2	0	0	0	0	0	
31-40 PSF	B	7 to 27	1	0	0	0	0	0
		Degrees	2	0	0	0	0	0
		28 to 45	1	0	0	0	0	0
		Degrees	2	0	0	0	0	0
	C	7 to 27	1	0	0	0	0	0
		Degrees	2	0	0	0	0	0
28 to 45		1	0	0	0	0	0	
Degrees		2	0	0	0	0	0	

Table R3. RT-[E] Mount Rail Option for: OSB Only Installations (72 Cell PV Panels) Maximum Mount Spacing in Feet								
Portrait Orientation - ASCE 7-10								
Snow Load	Exposure Category	Roof Angle	Roof Zone	Basic Wind Speed, V (mph)				
				110	115	120	130	140
0 PSF	B	7 to 27 Degrees	1	4	4	4	3	3
		2	2	2	2	0	0	
	28 to 45 Degrees	1	3	3	3	3	2	
		2	3	3	2	2	2	
	C	7 to 27 Degrees	1	3	3	3	2	2
		2	0	0	0	0	0	
28 to 45 Degrees	1	2	2	2	2	0		
2	2	2	2	0	0			
1-10 PSF	B	7 to 27 Degrees	1	2	2	2	2	2
		2	2	2	2	0	0	
	28 to 45 Degrees	1	2	2	2	2	2	
		2	2	2	2	2	2	
	C	7 to 27 Degrees	1	2	2	2	2	2
		2	0	0	0	0	0	
28 to 45 Degrees	1	2	2	2	2	0		
2	2	2	2	0	0			
11-20 PSF	B	7 to 27 Degrees	1	0	0	0	0	0
		2	0	0	0	0	0	
	28 to 45 Degrees	1	2	2	0	0	0	
		2	2	2	0	0	0	
	C	7 to 27 Degrees	1	0	0	0	0	0
		2	0	0	0	0	0	
28 to 45 Degrees	1	0	0	0	0	0		
2	0	0	0	0	0			
21-30 PSF	B	7 to 27 Degrees	1	0	0	0	0	0
		2	0	0	0	0	0	
	28 to 45 Degrees	1	0	0	0	0	0	
		2	0	0	0	0	0	
	C	7 to 27 Degrees	1	0	0	0	0	0
		2	0	0	0	0	0	
28 to 45 Degrees	1	0	0	0	0	0		
2	0	0	0	0	0			
31-40 PSF	B	7 to 27 Degrees	1	0	0	0	0	0
		2	0	0	0	0	0	
	28 to 45 Degrees	1	0	0	0	0	0	
		2	0	0	0	0	0	
	C	7 to 27 Degrees	1	0	0	0	0	0
		2	0	0	0	0	0	
28 to 45 Degrees	1	0	0	0	0	0		
2	0	0	0	0	0			

<b>Table R4. RT-[E] Mount Rail Option for:            Plywood Only Installations (60 &amp; 72 Cell PV Panels)            Maximum Mount Spacing in Feet</b>									
<b>Landscape Orientation - ASCE 7-10</b>									
Snow Load	Exposure Category	Roof Angle	Roof Zone	Basic Wind Speed, V (mph)					
				110	115	120	130	140	
0 PSF	B	7 to 27 Degrees	1	8	8	8	8	8	
		28 to 45 Degrees	2	8	7	6	5	5	
	C	7 to 27 Degrees	1	8	8	8	8	7	6
		28 to 45 Degrees	2	8	8	8	7	6	6
		7 to 27 Degrees	1	8	8	8	7	6	6
		28 to 45 Degrees	2	5	5	4	4	3	3
1-10 PSF	B	7 to 27 Degrees	1	8	8	8	8	8	
		28 to 45 Degrees	2	8	7	6	5	5	
	C	7 to 27 Degrees	1	8	8	8	8	7	6
		28 to 45 Degrees	2	8	8	8	7	6	6
		7 to 27 Degrees	1	8	8	8	7	6	6
		28 to 45 Degrees	2	5	5	4	4	3	3
11-20 PSF	B	7 to 27 Degrees	1	6	6	6	6	6	
		28 to 45 Degrees	2	6	6	6	5	5	
	C	7 to 27 Degrees	1	7	7	7	7	7	6
		28 to 45 Degrees	2	7	7	7	7	6	6
		7 to 27 Degrees	1	6	6	6	6	6	6
		28 to 45 Degrees	2	5	5	4	4	3	3
21-30 PSF	B	7 to 27 Degrees	1	6	6	6	6	6	
		28 to 45 Degrees	2	7	7	7	7	6	6
	C	7 to 27 Degrees	1	5	5	5	5	5	5
		28 to 45 Degrees	2	5	5	5	5	5	5
		7 to 27 Degrees	1	5	5	5	5	5	5
		28 to 45 Degrees	2	5	5	4	4	3	3
31-40 PSF	B	7 to 27 Degrees	1	4	4	4	4	4	
		28 to 45 Degrees	2	4	4	4	4	4	4
	C	7 to 27 Degrees	1	4	4	4	4	4	4
		28 to 45 Degrees	2	4	4	4	4	4	4
		7 to 27 Degrees	1	4	4	4	4	4	4
		28 to 45 Degrees	2	4	4	4	4	3	3
31-40 PSF	B	7 to 27 Degrees	1	4	4	4	4	4	
		28 to 45 Degrees	2	4	4	4	4	4	4
	C	7 to 27 Degrees	1	4	4	4	4	4	4
		28 to 45 Degrees	2	4	4	4	4	4	4
		7 to 27 Degrees	1	4	4	4	4	4	4
		28 to 45 Degrees	2	4	4	4	4	4	4

Table R5. RT-[E] Mount Rail Option for: Plywood Only Installations (60 Cell PV Panels) Maximum Mount Spacing in Feet								
Portrait Orientation - ASCE 7-10								
Snow Load	Exposure Category	Roof Angle	Roof Zone	Basic Wind Speed, V (mph)				
				110	115	120	130	140
0 PSF	B	7 to 27 Degrees	1	6	6	6	5	5
		2	4	4	3	3	2	
	28 to 45 Degrees	1	5	5	4	4	4	
		2	5	4	4	3	3	
	C	7 to 27 Degrees	1	5	5	5	4	3
		2	3	3	2	2	2	
28 to 45 Degrees	1	4	4	3	3	3		
2	3	3	3	3	2			
1-10 PSF	B	7 to 27 Degrees	1	3	3	3	3	3
		2	3	3	3	3	2	
	28 to 45 Degrees	1	3	3	3	3	3	
		2	3	3	3	3	3	
	C	7 to 27 Degrees	1	3	3	3	3	3
		2	3	3	2	2	2	
28 to 45 Degrees	1	3	3	3	3	3		
2	3	3	3	3	2			
11-20 PSF	B	7 to 27 Degrees	1	2	2	2	2	2
		2	2	2	2	2	2	
	28 to 45 Degrees	1	2	2	2	2	2	
		2	2	2	2	2	2	
	C	7 to 27 Degrees	1	2	2	2	2	2
		2	2	2	2	2	2	
28 to 45 Degrees	1	2	2	2	2	2		
2	2	2	2	2	2			
21-30 PSF	B	7 to 27 Degrees	1	0	0	0	0	0
		2	0	0	0	0	0	
	28 to 45 Degrees	1	0	0	0	0	0	
		2	0	0	0	0	0	
	C	7 to 27 Degrees	1	0	0	0	0	0
		2	0	0	0	0	0	
28 to 45 Degrees	1	0	0	0	0	0		
2	0	0	0	0	0			
31-40 PSF	B	7 to 27 Degrees	1	0	0	0	0	0
		2	0	0	0	0	0	
	28 to 45 Degrees	1	0	0	0	0	0	
		2	0	0	0	0	0	
	C	7 to 27 Degrees	1	0	0	0	0	0
		2	0	0	0	0	0	
28 to 45 Degrees	1	0	0	0	0	0		
2	0	0	0	0	0			

Table R6. RT-[E] Mount Rail Option for: Plywood Only Installations (72 Cell PV Panels) Maximum Mount Spacing in Feet								
Portrait Orientation - ASCE 7-10								
Snow Load	Exposure Category	Roof Angle	Roof Zone	Basic Wind Speed, V (mph)				
				110	115	120	130	140
0 PSF	B	7 to 27 Degrees	1	6	6	6	5	4
		2	4	3	3	3	2	
	C	28 to 45 Degrees	1	5	5	4	4	3
		2	4	4	4	3	3	
	7 to 27 Degrees	1	5	5	4	4	3	
		2	3	2	2	2	0	
28 to 45 Degrees	1	4	4	3	3	2		
	2	3	3	3	2	2		
1-10 PSF	B	7 to 27 Degrees	1	3	3	3	3	3
		2	3	3	3	3	2	
	C	28 to 45 Degrees	1	3	3	3	3	3
		2	3	3	3	3	3	
	7 to 27 Degrees	1	3	3	3	3	3	
		2	3	2	2	2	0	
28 to 45 Degrees	1	3	3	3	3	2		
	2	3	3	3	2	2		
11-20 PSF	B	7 to 27 Degrees	1	2	2	2	2	2
		2	2	2	2	2	2	
	C	28 to 45 Degrees	1	2	2	2	2	2
		2	2	2	2	2	2	
	7 to 27 Degrees	1	2	2	2	2	2	
		2	2	2	2	2	0	
28 to 45 Degrees	1	2	2	2	2	2		
	2	2	2	2	2	2		
21-30 PSF	B	7 to 27 Degrees	1	0	0	0	0	0
		2	0	0	0	0	0	
	C	28 to 45 Degrees	1	0	0	0	0	0
		2	0	0	0	0	0	
	7 to 27 Degrees	1	0	0	0	0	0	
		2	0	0	0	0	0	
28 to 45 Degrees	1	0	0	0	0	0		
	2	0	0	0	0	0		
31-40 PSF	B	7 to 27 Degrees	1	0	0	0	0	0
		2	0	0	0	0	0	
	C	28 to 45 Degrees	1	0	0	0	0	0
		2	0	0	0	0	0	
	7 to 27 Degrees	1	0	0	0	0	0	
		2	0	0	0	0	0	
28 to 45 Degrees	1	0	0	0	0	0		
	2	0	0	0	0	0		

Table R7. RT-[E] Mount Rail Option for: Rafter Installations (60 & 72 Cell PV Panels) Maximum Mount Spacing in Feet								
Landscape Orientation - ASCE 7-10								
Snow Load	Exposure Category	Roof Angle	Roof Zone	Basic Wind Speed, V (mph)				
				110	115	120	130	140
0 PSF	B	7 to 27 Degrees	1	8	8	8	8	8
		28 to 45 Degrees	2	8	8	8	8	8
	C	7 to 27 Degrees	1	8	8	8	8	8
		28 to 45 Degrees	2	8	8	8	7	6
		7 to 27 Degrees	1	8	8	8	8	8
		28 to 45 Degrees	2	8	8	8	8	8
1-10 PSF	B	7 to 27 Degrees	1	8	8	8	8	8
		28 to 45 Degrees	2	8	8	8	8	8
	C	7 to 27 Degrees	1	8	8	8	8	8
		28 to 45 Degrees	2	8	8	8	7	6
		7 to 27 Degrees	1	8	8	8	8	8
		28 to 45 Degrees	2	8	8	8	8	8
11-20 PSF	B	7 to 27 Degrees	1	8	8	8	8	8
		28 to 45 Degrees	2	8	8	8	8	8
	C	7 to 27 Degrees	1	8	8	8	8	8
		28 to 45 Degrees	2	8	8	8	7	6
		7 to 27 Degrees	1	8	8	8	8	8
		28 to 45 Degrees	2	8	8	8	8	8
21-30 PSF	B	7 to 27 Degrees	1	8	8	8	8	8
		28 to 45 Degrees	2	8	8	8	8	8
	C	7 to 27 Degrees	1	8	8	8	8	8
		28 to 45 Degrees	2	8	8	8	7	6
		7 to 27 Degrees	1	8	8	8	8	8
		28 to 45 Degrees	2	8	8	8	8	8
31-40 PSF	B	7 to 27 Degrees	1	8	8	8	8	8
		28 to 45 Degrees	2	8	8	8	8	8
	C	7 to 27 Degrees	1	8	8	8	8	8
		28 to 45 Degrees	2	8	8	8	7	6
		7 to 27 Degrees	1	8	8	8	8	8
		28 to 45 Degrees	2	8	8	8	8	8

<b>Table R8. RT-[E] Mount Rail Option for: Rafter Installations (60 Cell PV Panels) Maximum Mount Spacing in Feet</b>								
<b>Portrait Orientation - ASCE 7-10</b>								
<b>Snow Load</b>	<b>Exposure Category</b>	<b>Roof Angle</b>	<b>Roof Zone</b>	<b>Basic Wind Speed, V (mph)</b>				
				<b>110</b>	<b>115</b>	<b>120</b>	<b>130</b>	<b>140</b>
<b>0 PSF</b>	<b>B</b>	<b>7 to 27 Degrees</b>	1	8	8	8	8	8
			2	8	7	7	6	5
		<b>28 to 45 Degrees</b>	1	8	8	8	8	7
			2	8	8	8	7	6
	<b>C</b>	<b>7 to 27 Degrees</b>	1	8	8	8	8	6
			2	6	5	5	4	3
<b>1-10 PSF</b>	<b>B</b>	<b>7 to 27 Degrees</b>	1	8	8	8	8	8
			2	8	7	7	6	5
		<b>28 to 45 Degrees</b>	1	8	8	8	8	7
			2	8	8	8	7	6
	<b>C</b>	<b>7 to 27 Degrees</b>	1	8	8	8	8	6
			2	6	5	5	4	3
<b>11-20 PSF</b>	<b>B</b>	<b>7 to 27 Degrees</b>	1	6	6	6	6	6
			2	6	6	6	6	5
		<b>28 to 45 Degrees</b>	1	5	5	5	5	5
			2	5	5	5	5	5
	<b>C</b>	<b>7 to 27 Degrees</b>	1	6	6	6	6	6
			2	6	5	5	4	3
<b>21-30 PSF</b>	<b>B</b>	<b>7 to 27 Degrees</b>	1	5	5	5	5	5
			2	5	5	5	5	5
		<b>28 to 45 Degrees</b>	1	4	4	4	4	4
			2	4	4	4	4	4
	<b>C</b>	<b>7 to 27 Degrees</b>	1	5	5	5	5	5
			2	5	5	5	4	3
<b>31-40 PSF</b>	<b>B</b>	<b>7 to 27 Degrees</b>	1	3	3	3	3	3
			2	3	3	3	3	3
		<b>28 to 45 Degrees</b>	1	3	3	3	3	3
			2	3	3	3	3	3
	<b>C</b>	<b>7 to 27 Degrees</b>	1	3	3	3	3	3
			2	3	3	3	3	3
<b>28 to 45 Degrees</b>	1	3	3	3	3	3		
	2	3	3	3	3	3		



Table R9. RT-[E] Mount Rail Option for: Rafter Installations (72 Cell PV Panels) Maximum Mount Spacing in Feet								
Portrait Orientation - ASCE 7-10								
Snow Load	Exposure Category	Roof Angle	Roof Zone	Basic Wind Speed, V (mph)				
				110	115	120	130	140
0 PSF	B	7 to 27 Degrees	1	8	8	8	8	8
		28 to 45 Degrees	2	7	6	6	5	4
	C	7 to 27 Degrees	1	8	8	8	7	6
		28 to 45 Degrees	2	8	7	7	6	5
		7 to 27 Degrees	1	8	8	8	7	6
		28 to 45 Degrees	2	5	4	4	3	3
1-10 PSF	B	7 to 27 Degrees	1	8	8	8	8	8
		28 to 45 Degrees	2	7	6	6	5	4
	C	7 to 27 Degrees	1	8	8	8	7	6
		28 to 45 Degrees	2	8	7	7	6	5
		7 to 27 Degrees	1	8	8	8	7	6
		28 to 45 Degrees	2	5	4	4	3	3
11-20 PSF	B	7 to 27 Degrees	1	5	5	5	5	5
		28 to 45 Degrees	2	5	5	5	5	4
	C	7 to 27 Degrees	1	5	5	5	5	5
		28 to 45 Degrees	2	5	5	5	5	5
		7 to 27 Degrees	1	5	5	5	5	5
		28 to 45 Degrees	2	5	5	5	5	5
21-30 PSF	B	7 to 27 Degrees	1	4	4	4	4	4
		28 to 45 Degrees	2	4	4	4	4	4
	C	7 to 27 Degrees	1	4	4	4	4	4
		28 to 45 Degrees	2	4	4	4	4	4
		7 to 27 Degrees	1	4	4	4	4	4
		28 to 45 Degrees	2	4	4	4	3	3
31-40 PSF	B	7 to 27 Degrees	1	3	3	3	3	3
		28 to 45 Degrees	2	3	3	3	3	3
	C	7 to 27 Degrees	1	3	3	3	3	3
		28 to 45 Degrees	2	3	3	3	3	3
		7 to 27 Degrees	1	3	3	3	3	3
		28 to 45 Degrees	2	3	3	3	3	3

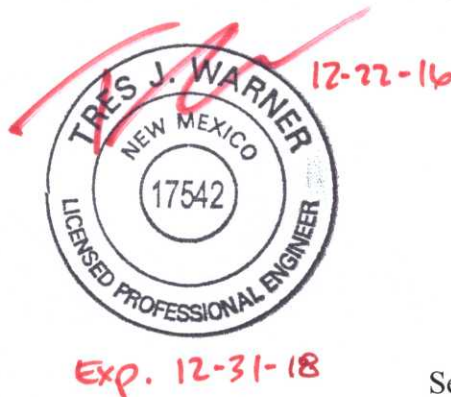
Table Notes for Tables R1 to R9 – Tabulated values are based on the following criteria:

1. Building mean roof height = 30 ft maximum.
2. Risk Category = II.
3. Solar panel maximum width = 40 in for Landscape, 68 in for Portrait 60 Cell & 77.5 in for Portrait 72 Cell.
4. Solar panel & rail dead load = approximately 4.0 psf.
5. ASCE 7-10.
6. OSB shall be 24/16 APA rated sheathing minimum (7/16" thick).
7. Plywood shall be 32/16 APA rated sheathing minimum (15/32" thick).
8. Sheathing shall be free of defects including, but not limited to water damage and delamination.
9. Roof rafters or trusses spaced at 24" on center maximum.
10. PV panels must be supported per the manufacturer's required orientation, location and/or spacing.
11. Through a maximum of 2 layers of composite asphalt roof shingles or maximum 20 gage metal decking provided the metal is predrilled as wood screws are not designed to penetrate the metal decking. Not valid on concrete roof tile.
12. Maximum height from bottom of base mount to top of rail shall not exceed 5" for the OSB & Plywood only installation options and 7" for the rafter installation option. Ref. Exhibit 'B' detail 2.

Our analysis assumes that the connections and associated hardware are installed in a workmanlike manner in accordance with the RT-[E] Mount Installation Manual and generally accepted standards of construction practice. It is the responsibility of the contractor to verify that the strength of the roof framing meets the minimum properties used in the tests and can safely support the maximum imposed loads stated within this document. Starling Madison Lofquist, Inc. and Roof Tech assume no liability beyond what is specifically shown in this letter. Additional information is available at the Roof Tech web site, <http://www.roof-tech.us/>.

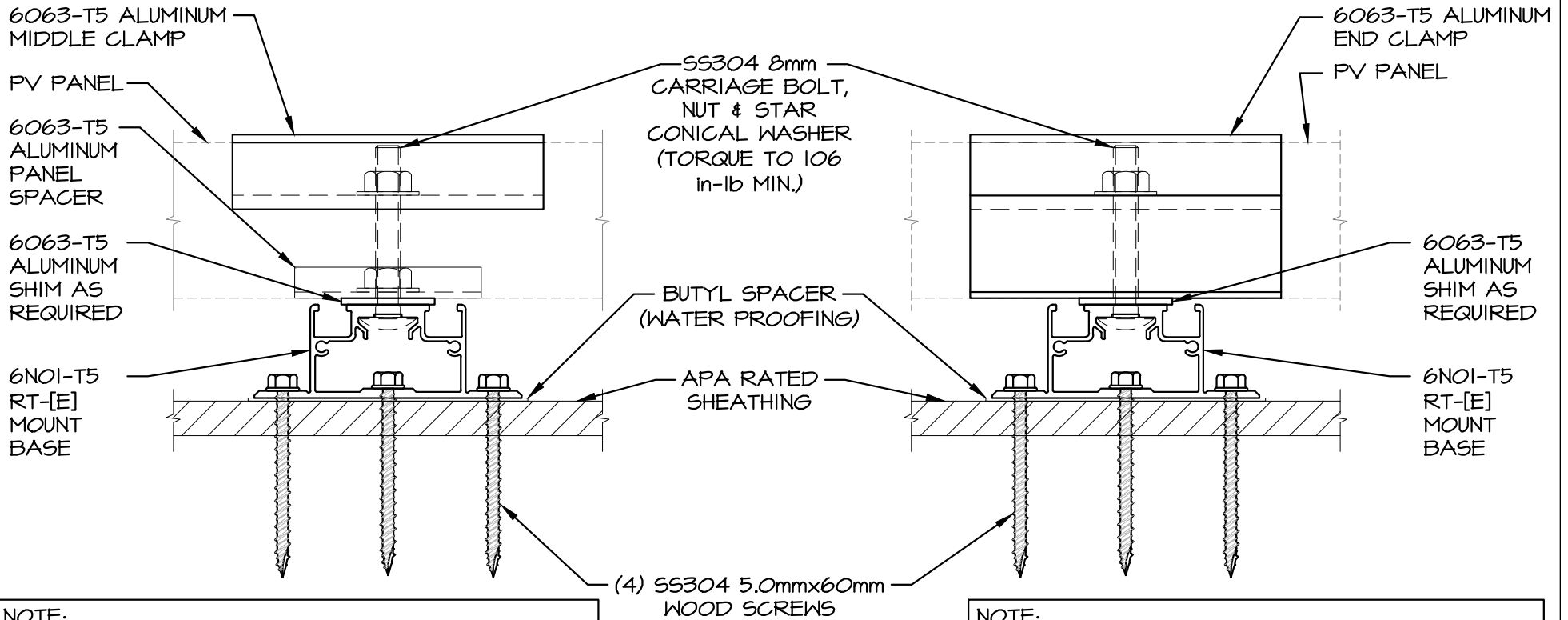
Please feel free to contact me at your convenience if you have any questions.

Respectfully yours,



Tres J. Warner, P.E.  
Design Division Manager

Jesse Light, P.E.  
Senior Structural Engineer



**NOTE:**  
 PROVIDE SS304 BONDING PLATE(S) (NOT SHOWN FOR CLARITY) BETWEEN PANEL SPACER & RT-[E] MOUNT BASE OR SHIM IF USED. WHEN SHIM IS USED PROVIDE ADDITIONAL BONDING PLATE BETWEEN SHIM & RT-[E] MOUNT BASE

**NOTE:**  
 PROVIDE SS304 BONDING PLATE(S) (NOT SHOWN FOR CLARITY) BETWEEN END CAP & RT-[E] MOUNT BASE OR SHIM IF USED. WHEN SHIM IS USED PROVIDE ADDITIONAL BONDING PLATE BETWEEN SHIM & RT-[E] MOUNT BASE

MIDDLE CONNECTION

END CONNECTION

① OSB/PLYWOOD ONLY CONNECTION

SCALE: N.T.S.



Starling Madison Lofquist, Inc.

5224 S. 39th Street  
 Phoenix, Arizona 85040  
 (602) 438-2500  
 fax. (602) 438-2505

Consulting Structural and Forensic Engineers

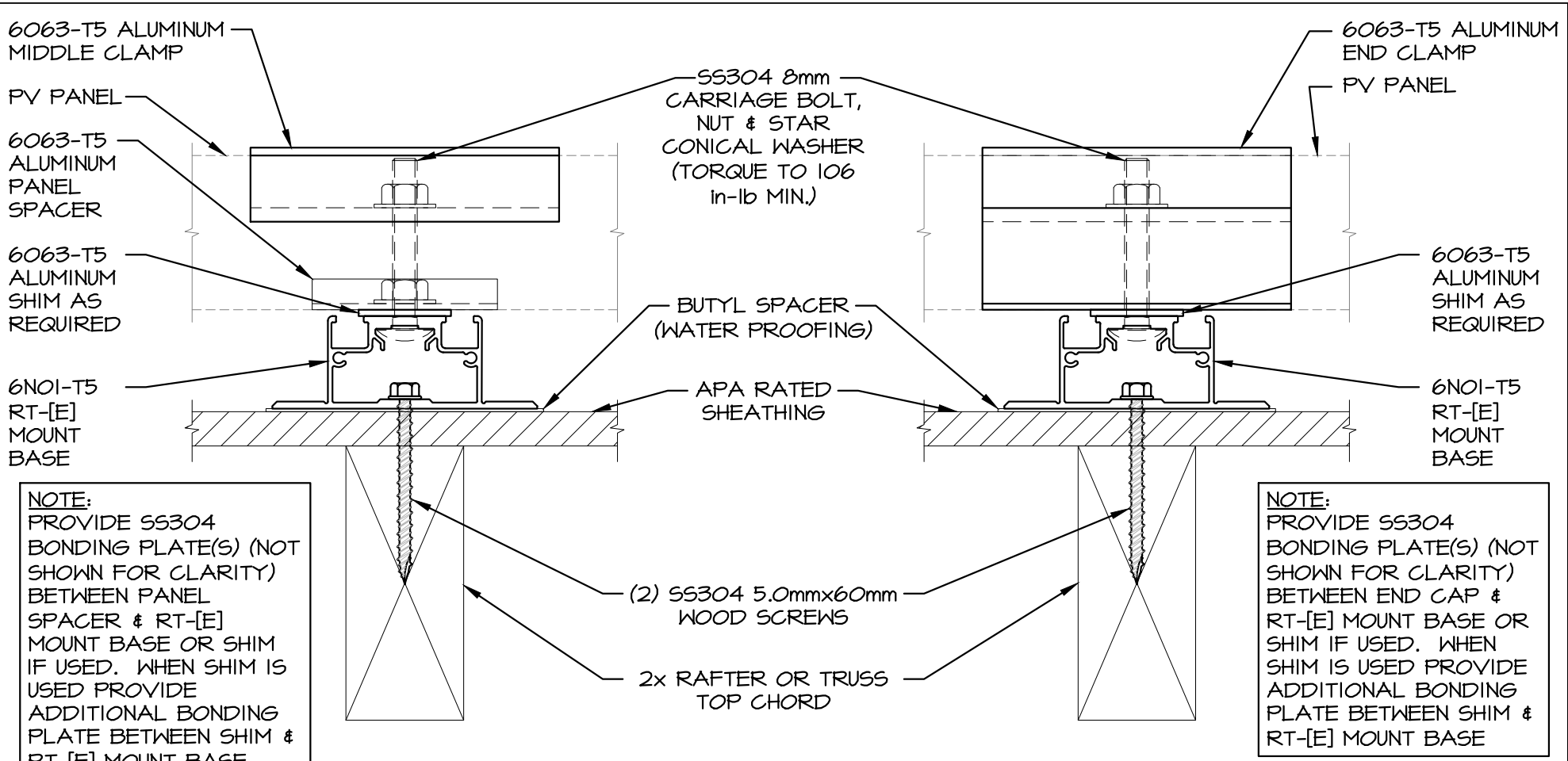
DRAWN BY: T.M.  
 DESIGNED BY: J.L.

DATE: 7-21-15  
 JOB NO: 471-13

ROOF TECH  
 RT-[E] MOUNT  
 STRUCTURAL ANALYSIS

ROOF TECH, INC.  
 333 H STREET, SUITE 5000  
 CHULA VISTA, CA 91910

EXHIBIT A  
 1 OF 4



MIDDLE CONNECTION

END CONNECTION

2
**OSB/PLYWOOD OVER 2x RAFTER/ TRUSS**  
 SCALE: N.T.S.



**Starling Madison Lofquist, Inc.**  
 5224 S. 39th Street  
 Phoenix, Arizona 85040  
 (602) 438-2500  
 fax. (602) 438-2505

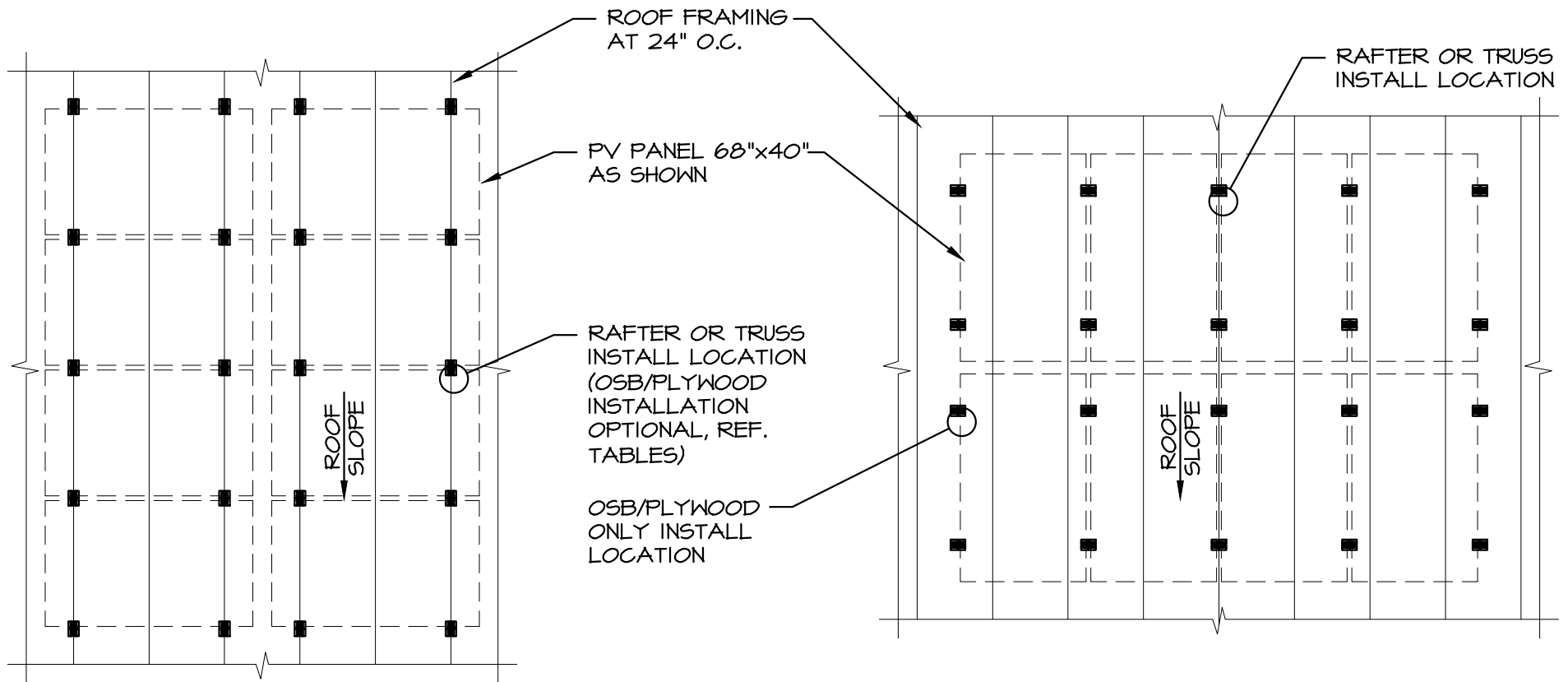
DRAWN BY: T.M.  
 DESIGNED BY: J.L.

DATE: 7-21-15  
 JOB NO: 471-13

ROOF TECH  
 RT-[E] MOUNT  
 STRUCTURAL ANALYSIS

ROOF TECH, INC.  
 333 H STREET, SUITE 5000  
 CHULA VISTA, CA 91910

**EXHIBIT A**  
**2 OF 4**



PV PANEL IN LANDSCAPE ORIENTATION

PV PANEL IN PORTRAIT ORIENTATION

**PARTIAL FRAMING PLAN (4 MOUNTS PER PANEL)**

3

SCALE: N.T.S.



Starling Madison Lofquist, Inc.

5224 S. 39th Street  
 Phoenix, Arizona 85040  
 (602) 438-2500  
 fax. (602) 438-2505

Consulting Structural and Forensic Engineers

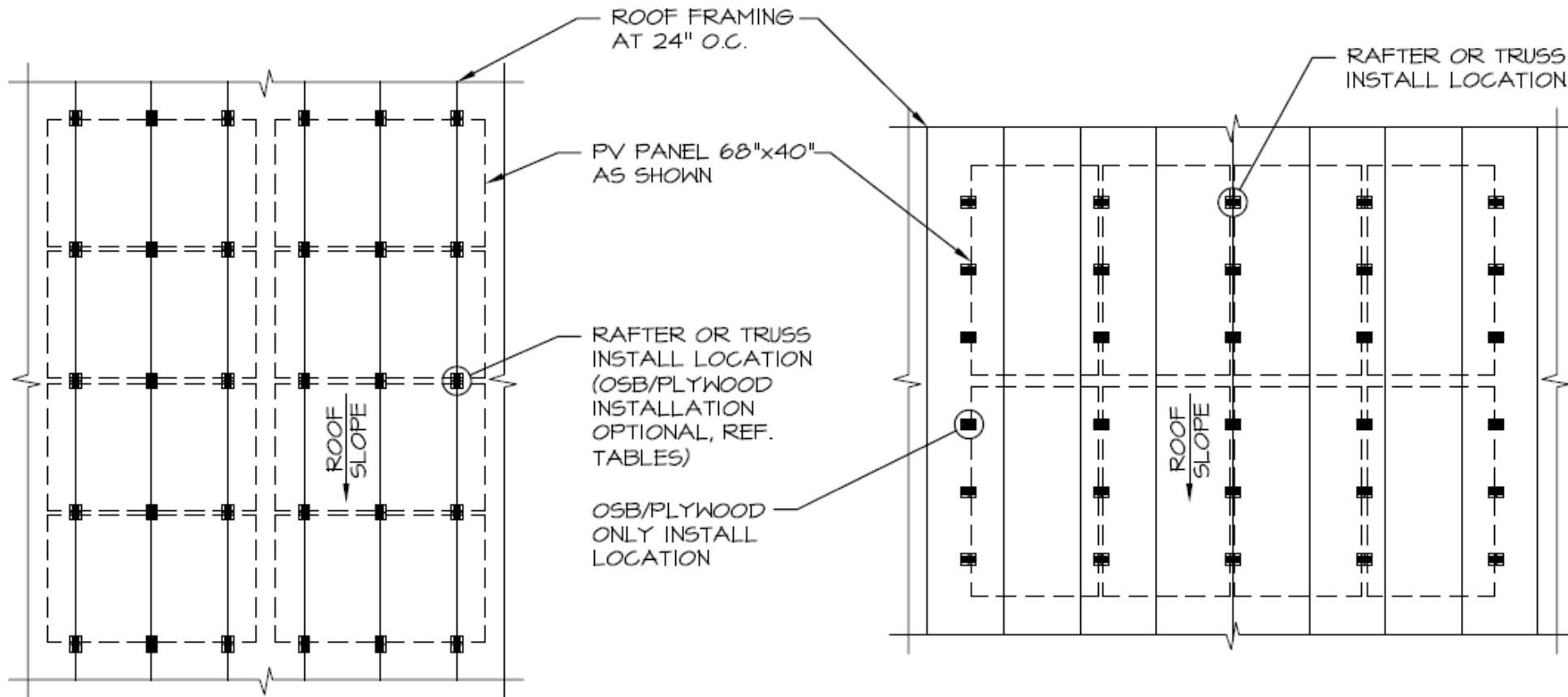
DRAWN BY: T.M.  
 DESIGNED BY: J.L.

DATE: 7-21-15  
 JOB NO: 471-13

ROOF TECH  
 RT-[E] MOUNT  
 STRUCTURAL ANALYSIS

ROOF TECH, INC.  
 333 H STREET, SUITE 5000  
 CHULA VISTA, CA 91910

EXHIBIT A  
 3 OF 4



PV PANEL IN LANDSCAPE ORIENTATION

PV PANEL IN PORTRAIT ORIENTATION

4 PARTIAL FRAMING PLAN (6 MOUNTS PER PANEL)

SCALE: N.T.S.



Starling Madison Lofquist, Inc.  
 5224 S. 39th Street  
 Phoenix, Arizona 85040  
 (602) 438-2500  
 fax. (602) 438-2505

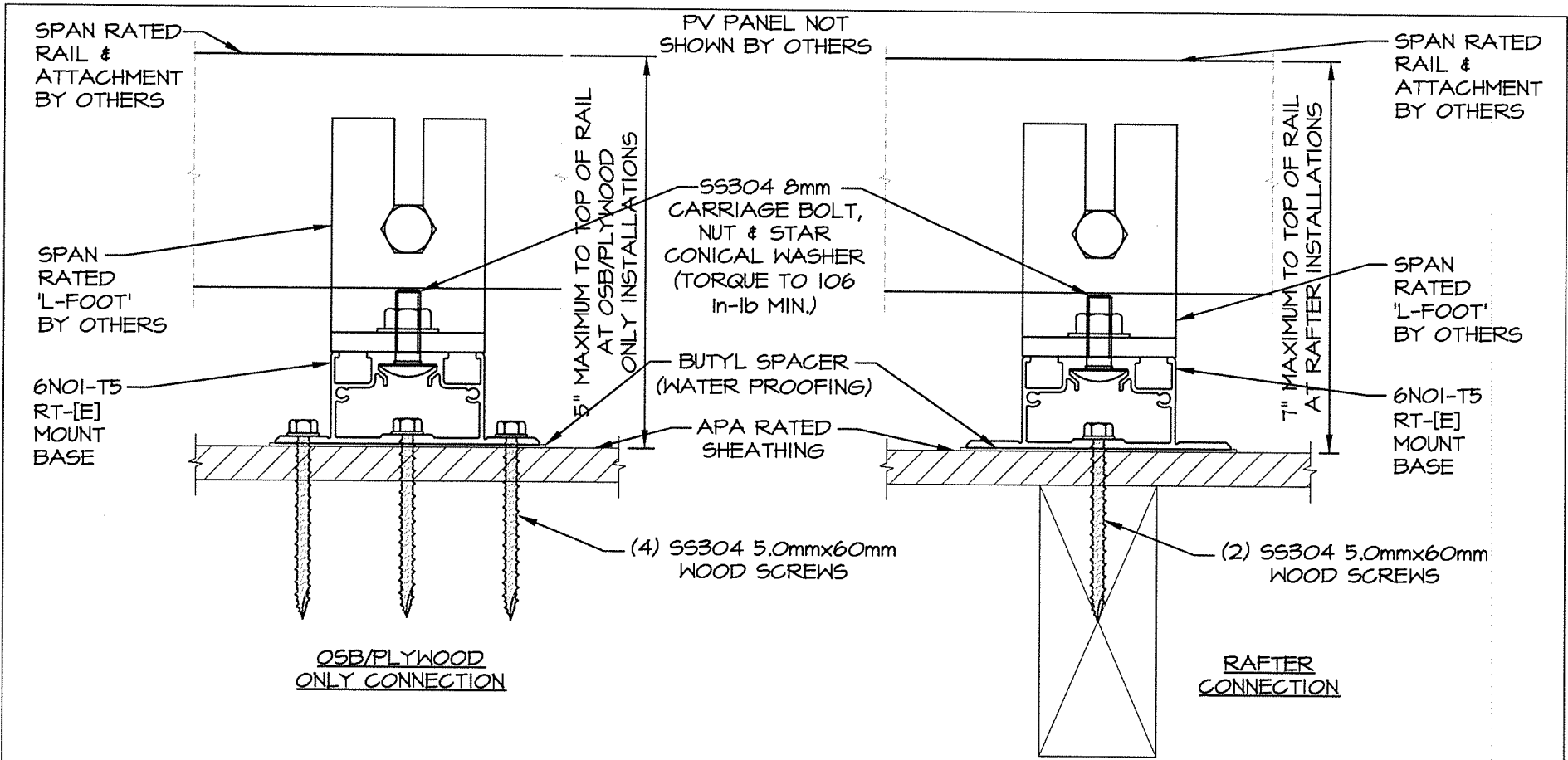
DRAWN BY: T.M.  
 DESIGNED BY: J.L.

DATE: 7-21-15  
 JOB NO: 471-13

ROOF TECH  
 RT-[E] MOUNT  
 STRUCTURAL ANALYSIS

ROOF TECH, INC.  
 333 H STREET, SUITE 5000  
 CHULA VISTA, CA 91910

EXHIBIT A  
 4 OF 4



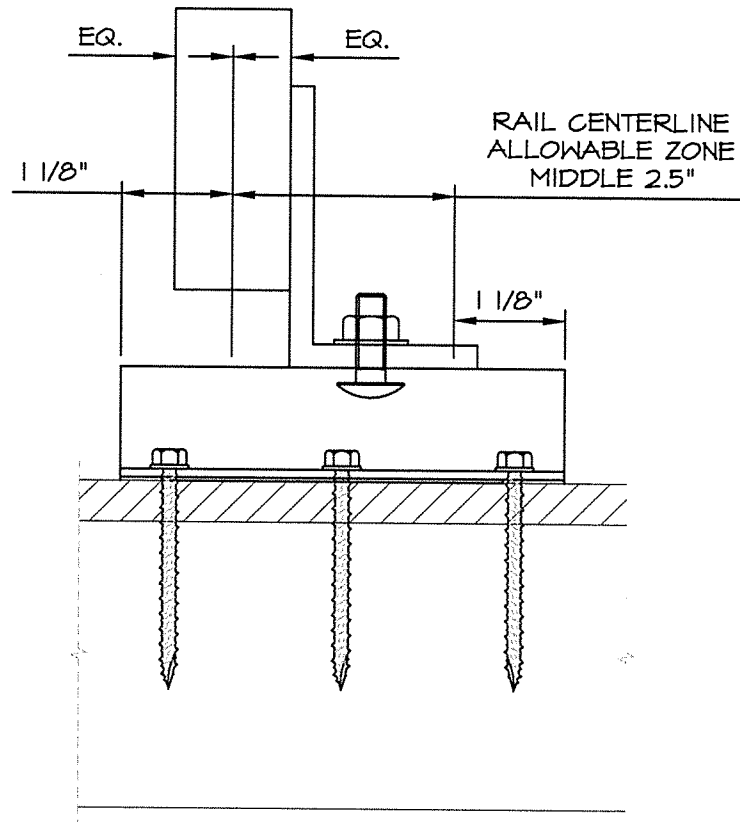
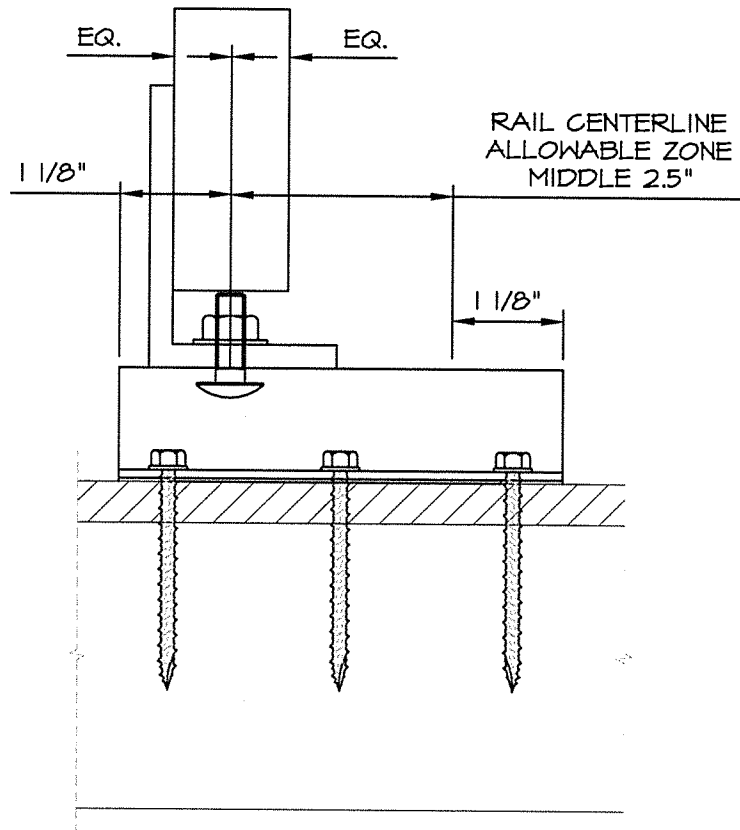
① 'RAIL OPTION' - RAIL AND 'L-FOOT' ORIENTATION  
 SCALE: N.T.S.



Starling Madison Lofquist, Inc.  
 5224 S. 39th Street  
 Phoenix, Arizona 85040  
 (602) 438-2500  
 fax. (602) 438-2505

Consulting Structural and  
 Forensic Engineers

DRAWN BY:	J.L.	DATE:	7-28-16
DESIGNED BY:	J.L.	JOB NO:	471-13
ROOF TECH RT-[E] MOUNT + RAIL STRUCTURAL ANALYSIS		ROOF TECH, INC. 333 H STREET, SUITE 5000 CHULA VISTA, CA 91910	
			EXHIBIT B 1 OF 4



② 'RAIL OPTION' - RAIL AND 'L-FOOT' ORIENTATION

SCALE: N.T.S.



Starling Madison Lofquist, Inc.

5224 S. 39th Street  
 Phoenix, Arizona 85040  
 (602) 438-2500  
 fax. (602) 438-2505

Consulting Structural and  
 Forensic Engineers

DRAWN BY: J.L.  
 DESIGNED BY: J.L.

DATE: 7-28-16  
 JOB NO: 471-13

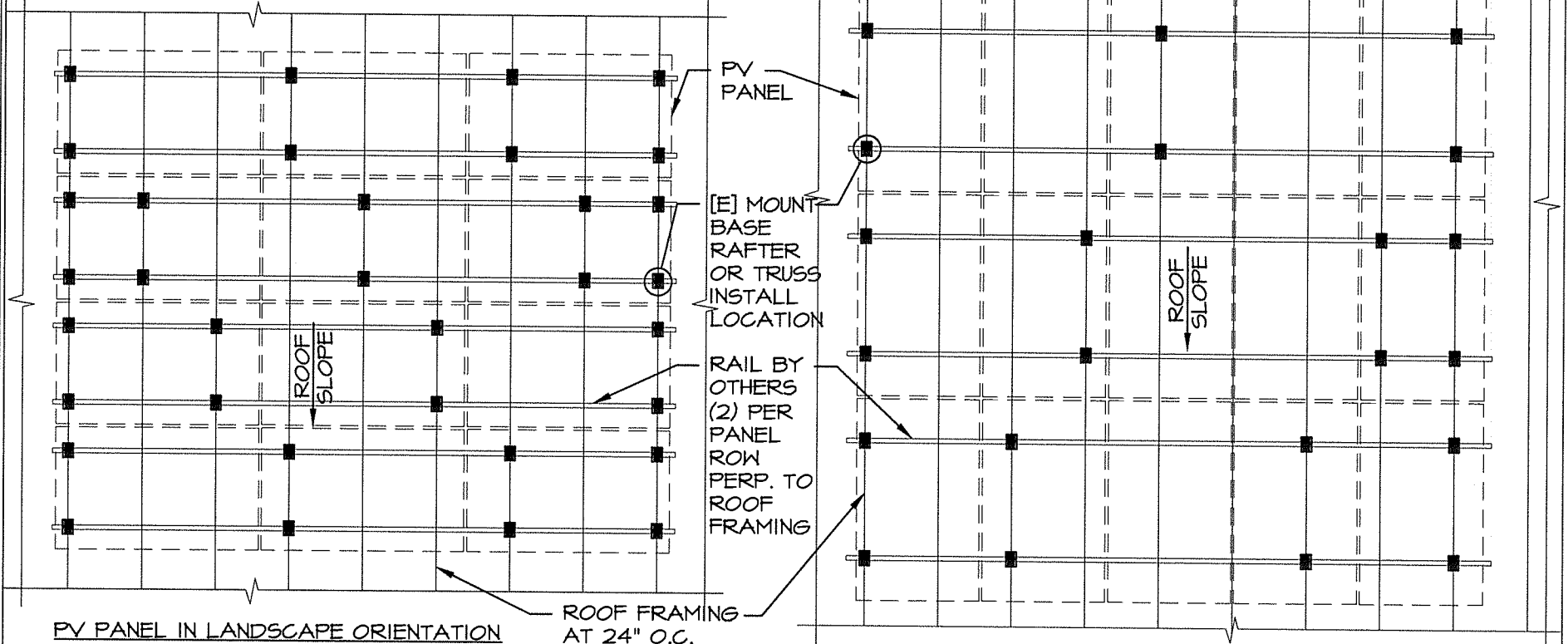
ROOF TECH  
 RT-[E] MOUNT + RAIL  
 STRUCTURAL ANALYSIS

ROOF TECH, INC.  
 333 H STREET, SUITE 5000  
 CHULA VISTA, CA 91910

EXHIBIT B  
 2 OF 4



NOTE: [E] MOUNT BASE TO BE ORIENTED WITH LONG DIRECTION DOWN ROOF SLOPE AS SHOWN. SKIP LOAD ROOF WHERE POSSIBLE TO EVENLY DISTRIBUTE LOAD TO ROOF FRAMING. THERMAL EXPANSION SPLICE RAILS AT 11 FOOT MAXIMUM INTERVALS.



3
PARTIAL FRAMING PLAN  
(RAFTER INSTALLATION)
SCALE: N.T.S.



**Starling Madison Lofquist, Inc.**  
 5224 S. 39th Street  
 Phoenix, Arizona 85040  
 (602) 438-2500  
 fax. (602) 438-2505

Consulting Structural and Forensic Engineers

DRAWN BY: J.L.  
 DESIGNED BY: J.L.

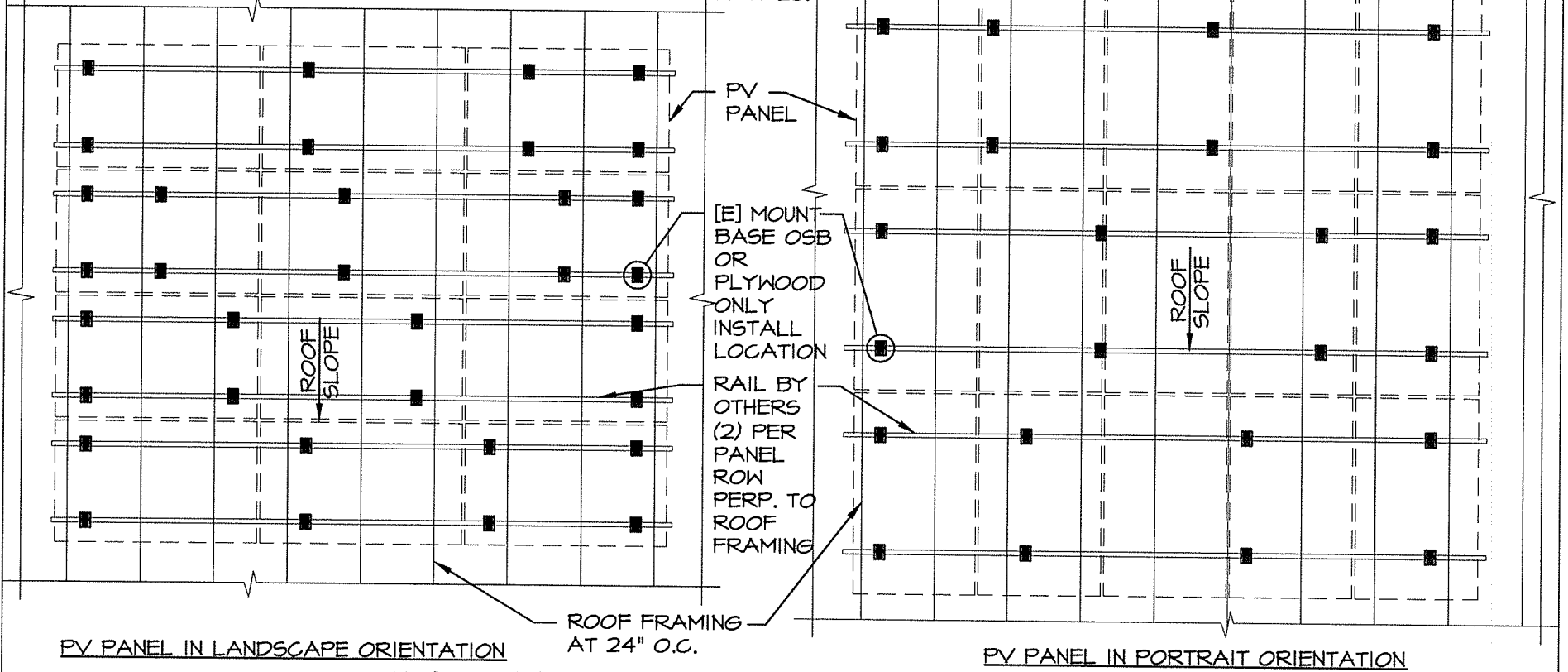
DATE: 7-28-16  
 JOB NO: 471-13

ROOF TECH  
 RT-[E] MOUNT + RAIL  
 STRUCTURAL ANALYSIS


ROOF TECH, INC.  
 333 H STREET, SUITE 5000  
 CHULA VISTA, CA 91910

EXHIBIT B  
 3 OF 4

NOTE: [E] MOUNT BASE TO BE ORIENTED WITH LONG DIRECTION DOWN ROOF SLOPE AS SHOWN. SKIP LOAD ROOF WHERE POSSIBLE TO EVENLY DISTRIBUTE LOAD TO ROOF FRAMING. THERMAL EXPANSION SPLICE RAILS AT 11 FOOT MAXIMUM INTERVALS.

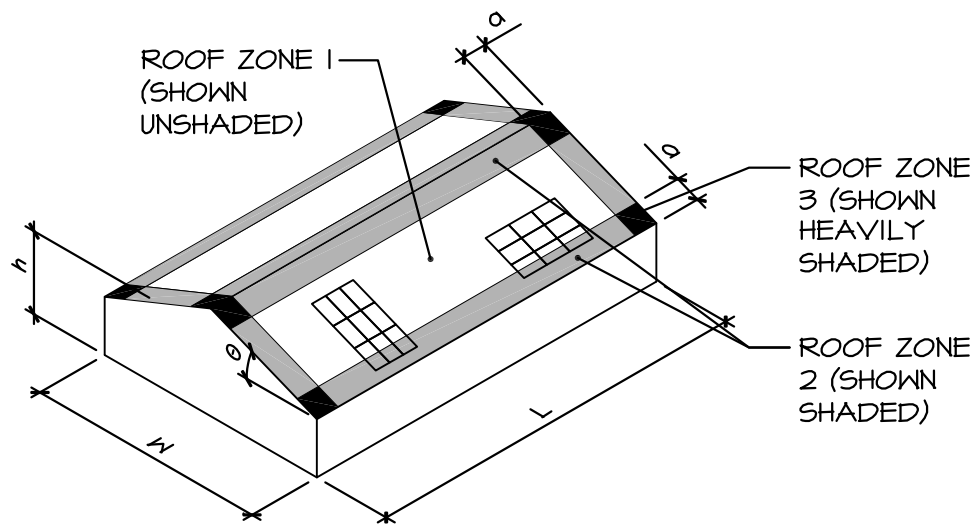


4
**PARTIAL FRAMING PLAN  
(OSB/PLYWOOD ONLY INSTALLATION)**  
 SCALE: N.T.S.

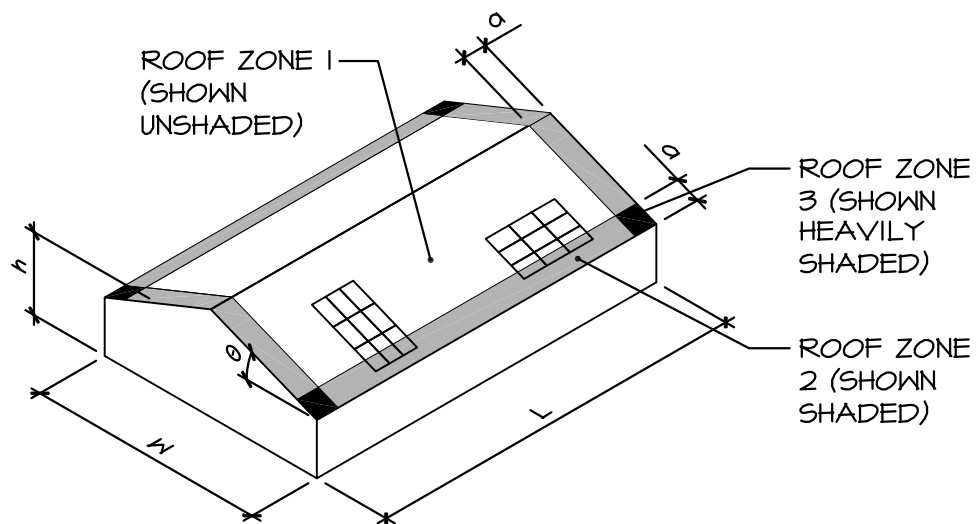

**Starling Madison Lofquist, Inc.**  
 5224 S. 39th Street  
 Phoenix, Arizona 85040  
 (602) 438-2500  
 fax. (602) 438-2505  
*Consulting Structural and Forensic Engineers*

DRAWN BY: J.L.	DATE: 7-28-16
DESIGNED BY: J.L.	JOB NO: 471-13
ROOF TECH RT-[E] MOUNT + RAIL STRUCTURAL ANALYSIS	ROOF TECH, INC. 333 H STREET, SUITE 5000 CHULA VISTA, CA 91910

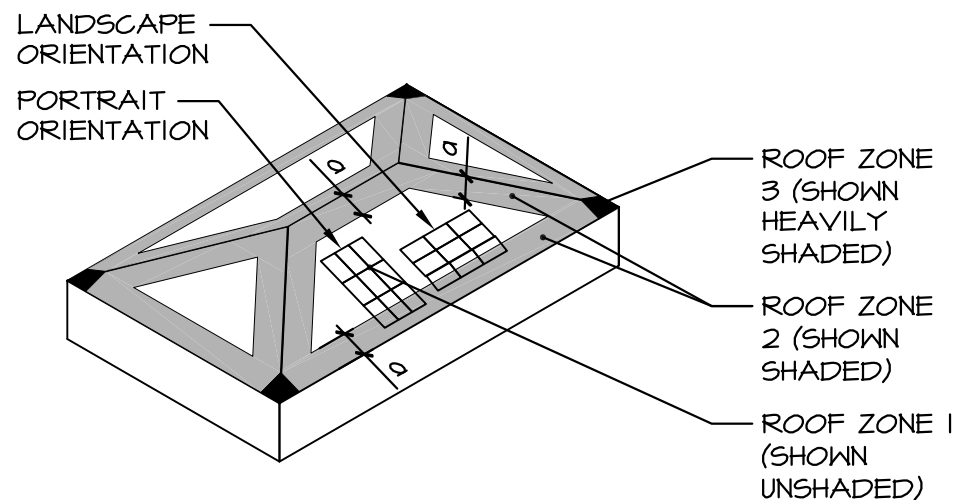
EXHIBIT B  
4 OF 4



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



$$\theta \leq 7^\circ$$



**DEFINITIONS:**

(REF. ASCE 7-10, FIGURES 30.4-1, 30.4-2A, 30.4-2B, 30.4-2C)

$a$  = 10% OF LEAST HORIZONTAL DIMENSION ( $0.1W$ ) OR  $0.4h$ , WHICHEVER IS SMALLER, BUT NOT LESS THAN 3 FT OR 4% OF LEAST HORIZONTAL DIMENSION ( $0.04W$ ).

$W$  = HORIZONTAL WIDTH OF BUILDING.

$L$  = HORIZONTAL LENGTH OF BUILDING.

$h$  = MEAN ROOF HEIGHT, MEASURED VERTICALLY FROM ADJACENT GRADE, EXCEPT THAT EAVE HEIGHT SHALL BE USED FOR  $\theta \leq 10^\circ$ .

$\theta$  = ANGLE OF PLANE OF ROOF FROM HORIZONTAL IN DEGREES.

**FIGURE 1**

WIND ZONE DIAGRAM

SCALE: \_\_\_\_\_ NTS



Starling Madison Lofquist, Inc.

5224 S. 39th Street  
 Phoenix, Arizona 85040  
 (602) 438-2500  
 fax. (602) 438-2505

Consulting Structural and Forensic Engineers