



**EBULEN CONSULT**

# **SOLAR PV ROOF-MOUNT RACKING FRAME ENGINEERING CERTIFICATE**

**ANTAI TILT LEG SYSTEM WITH 499 RAIL & KL406 CLAMPS**

Prepared for:

**Antai Technology Co., Ltd.**

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Ref: E22110958

## OVERVIEW

This structural engineering certificate is issued for Antai Solar Roof Tilt Leg racking system with 499 rail and non-penetrative roof clamp fixing, which has been assessed against relevant Australian Standards and regulations. The assessment is carried out based on sound engineering methodologies. Assessment specifications and findings are given in the following sections.

## AUSTRALIAN STANDARDS

- AS/NZS 1170.0:2002 – Structural design actions, Part 0: General principles
- AS/NZS 1170.1:2002 (R2016) – Structural design actions, Part 1: Permanent, imposed and other actions
- AS/NZS 1170.2:2021 – Structural design actions, Part 2: Wind actions
- AS/NZS 1664:1997 – Aluminum Structures

## ASSESSED PV RACKING FRAME PARTS

The following products by Antai Technology Co., Ltd. are assessed against relevant Australian Standards and building regulations based on the specified conditions.

Part Category	Included Parts	Part Material
Rail	ATL-TYN-499	AL 6005-T6
Rail Splice	ATL-TYN-304/54	AL 6005-T6
	ATL-CG-20	AL 6005-T6
Tilt Leg Kit	ATL-TYN-07	AL 6005-T6
	ATL-TYN-57	AL 6005-T6
	ATL-TYN-58	AL 6005-T6
	ATL-TYN-71	AL 6005-T6
	ATL-TYN-329	AL 6005-T6
Inter/End Panel Clamp Kit	ATL-FWNY-09	AL 6005-T6
	ATL-GN-003	AL 6005-T6
	ATL-CG-018	AL 6005-T6
Klip Lock Roof Clamp	ATL-TYN-19/20	AL 6005-T5

## ASSESSMENT CONDITIONS

- Solar PV system design life of 25 years
- Wind region A, B, C, D
- Terrain category 2.0, 2.5, 3.0
- Ultimate wind recurrence interval of 200 years
- Maximum average roof height of 20m
- Solar PV panel assessed: 2300mm x 1200mm, 2100mm x 1100mm, 2000mm x 1100mm, 1700mm x 1100mm
- Self-weight of solar PV panel and racking frame is 0.15kPa-0.18kPa
- Solar PV panel is supported by minimum 2 rails
- The clamps have been assessed with the Lysaght Klip Lok 406 roof sheeting
- The clamps capacities are taken from below testing reports: No.MT-15/317 by Melbourne Testing Services (MTS) Pty Ltd, dated 26/05/2015
- The racking rail capacity is taken as per the test report: No.XMML23090468\_EN by BM Shenghe Testing Technology (Xiamen) Co., Ltd, dated 19/09/2023.
- Product details are taken from the drawing set provided by Antai Technology Co., Ltd. as listed in the above component table
- The pull-out capacity of Antai Tilt Leg kit is taken from Test Report No. XMIN22000964ML03\_EN by SGS-CSTC Standards Technical Service Co., Ltd. Xiamen Branch. Dated at 16/09/2022
- Installation to be carried out strictly in accordance with the manufacturer's installation guidelines

## IMPORTANT NOTES

- ***This certification is issued based on assessments of solar PV racking frame system and its fixing connection to building roof. It has not considered the structural capacity of building structure and solar PV panel due to uncertainty of generic application. The installer must use the data tables as references only.***
- ***The attached spacing tables must be read in conjunction with foot notes and general notes.***
- ***The certificate shall be read as a whole. Any section, text, image, table extracted from this certification is not valid stand-alone.***
- ***This certification shall be reviewed and revalidated by the structural engineer after two years from the date of issue or if any applicable standard is updated.***

## CONCLUSION

The above-mentioned solar PV roof-mount racking frame system by Antai Technology Co., Ltd. is found structurally sound against relevant Australian Standards following the engineering recommendations in this certification. Installation shall be conducted following the manufacturer's guidelines.

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## APPENDIX A – INSTALLATION GUIDELINE

Interface Spacing Table for Terrain Category 3 (Unit: mm)													
Wind Region	Panel Tilt Angle Roof Zone	H<5m			5m<H<10m			10m<H<15m			15m<H<20m		
		Φ < 15°	15° ≤ Φ < 25°	25° ≤ Φ ≤ 45°	Φ < 15°	15° ≤ Φ < 25°	25° ≤ Φ ≤ 45°	Φ < 15°	15° ≤ Φ < 25°	25° ≤ Φ ≤ 45°	Φ < 15°	15° ≤ Φ < 25°	25° ≤ Φ ≤ 45°
A	Internal Zone	1172	730	591	1172	730	591	1002	628	509	887	559	454
	Intermediate Zone	748	473	385	748	473	385	643	409	333	572	365	297
	Edge Zone	549	350	286	549	350	286	474	303	247	422	271	221*
	Corner Zone	358	230*	188*	358	230*	188*	310	200*	163*	277	178*	146*
B1	Internal Zone	769	486	395	769	486	395	661	420	342	588	374	305
	Intermediate Zone	498	318	260	498	318	260	430	275	225*	383	246	201*
	Edge Zone	368	236*	193*	368	236*	193*	318	205*	167*	284	183*	150*
	Corner Zone	242	156*	128*	242	156*	128*	209*	135*	111*	187*	121*	99*
B2	Internal Zone	692	439	357	692	439	357	595	379	309	530	338	276
	Intermediate Zone	449	288	235*	449	288	235*	388	249	203*	346	222*	182*
	Edge Zone	332	214*	175*	332	214*	175*	288	185*	152*	257	166*	136*
	Corner Zone	219*	141*	116*	219*	141*	116*	190*	122*	100*	169*	110*	90*
C	Internal Zone	444	284	232*	444	284	232*	383	246	201*	342	220*	180*
	Intermediate Zone	291	187*	153*	291	187*	153*	252	162*	133*	225*	145*	119*
	Edge Zone	216*	140*	114*	216*	140*	114*	187*	121*	99*	167*	108*	89*
	Corner Zone	143*	92*	76*	143*	92*	76*	124*	80*	66*	111*	72*	59*
D	Internal Zone	285	184*	150*	285	184*	150*	247	159*	130*	221*	142*	117*
	Intermediate Zone	188*	121*	99*	188*	121*	99*	163*	105*	86*	146*	94*	77*
	Edge Zone	140*	91*	74*	140*	91*	74*	121*	79*	64*	109*	70*	58*
	Corner Zone	93*	60*	49*	93*	60*	49*	80*	52*	43*	72*	47*	38*

- NOTES:
- \* denotes the situations where the wind load is more than 5KPa and the installation safety is compromised.
  - Definition of Terrain Category is given in General Note 1.
  - Notion of Roof Zone is given in General Note 2.
  - Panel tilt angle is given in reference to roof surface
  - The spacing table is based on the fixing condition specified in General Note 6.

Interface Spacing Table for Terrain Category 2.5 (Unit: mm)													
Wind Region	Panel Tilt Angle Roof Zone	H<5m			5m<H<10m			10m<H<15m			15m<H<20m		
		Φ < 15°	15° ≤ Φ < 25°	25° ≤ Φ ≤ 45°	Φ < 15°	15° ≤ Φ < 25°	25° ≤ Φ ≤ 45°	Φ < 15°	15° ≤ Φ < 25°	25° ≤ Φ ≤ 45°	Φ < 15°	15° ≤ Φ < 25°	25° ≤ Φ ≤ 45°
A	Internal Zone	1054	660	535	931	585	475	828	523	425	758	480	390
	Intermediate Zone	675	429	349	599	381	311	535	342	279	491	314	256
	Edge Zone	497	318	259	442	283	231*	395	254	207*	363	233*	191*
	Corner Zone	325	209*	171*	289	186*	152*	259	167*	137*	239	154*	126*
B1	Internal Zone	694	440	358	616	392	319	550	351	286	505	322	263
	Intermediate Zone	451	289	236*	401	257	210*	359	231*	188*	330	212*	173*
	Edge Zone	334	215*	175*	297	191*	156*	266	172*	140*	245	158*	129*
	Corner Zone	219*	142*	116*	196*	126*	104*	176*	114*	93*	162*	105*	86*
B2	Internal Zone	625	398	324	555	354	288	496	317	259	455	291	238
	Intermediate Zone	407	261	213*	362	233*	190*	324	209*	171*	298	192*	157*
	Edge Zone	301	194*	159*	269	173*	142*	241	155*	127*	222*	143*	117*
	Corner Zone	199*	128*	105*	177*	114*	94*	159*	103*	84*	146*	95*	78*
C	Internal Zone	402	258	211*	358	230*	188*	320	206*	169*	295	190*	155*
	Intermediate Zone	264	170*	139*	235*	152*	124*	211*	136*	111*	194*	125*	103*
	Edge Zone	196*	127*	104*	175*	113*	93*	157*	102*	83*	145*	94*	77*
	Corner Zone	130*	84*	69*	116*	75*	61*	104*	67*	55*	96*	62*	51*
D	Internal Zone	259	167*	136*	231*	149*	122*	207*	134*	109*	190*	123*	101*
	Intermediate Zone	171*	110*	90*	152*	98*	81*	137*	88*	72*	126*	81*	67*
	Edge Zone	127*	82*	67*	114*	74*	60*	102*	66*	54*	94*	61*	50*
	Corner Zone	84*	55*	45*	75*	49*	40*	68*	44*	36*	62*	40*	33*

- NOTES:
- \* denotes the situations where the wind load is more than 5KPa and the installation safety is compromised.
  - Definition of Terrain Category is given in General Note 1.
  - Notion of Roof Zone is given in General Note 2.
  - Panel tilt angle is given in reference to roof surface
  - The spacing table is based on the fixing condition specified in General Note 6.

Interface Spacing Table for Terrain Category 2 (Unit: mm)																
Wind Region	Roof Zone	Panel Tilt Angle			H<5m			5m<H<10m			10m<H<=15m			15m<H<=20m		
		Φ < 15°	15° ≤ Φ < 25°	25° ≤ Φ ≤ 45°	Φ < 15°	15° ≤ Φ < 25°	25° ≤ Φ ≤ 45°	Φ < 15°	15° ≤ Φ < 25°	25° ≤ Φ ≤ 45°	Φ < 15°	15° ≤ Φ < 25°	25° ≤ Φ ≤ 45°			
A	Internal Zone	953	599	486	775	490	399	697	442	360	656	417	339			
	Intermediate Zone	613	390	318	502	321	262	453	290	237*	427	273	223*			
	Edge Zone	452	289	236*	371	238	195*	335	215*	176*	316	203*	166*			
	Corner Zone	296	191*	156*	244	157*	129*	220*	142*	116*	208*	134*	110*			
B1	Internal Zone	630	401	326	515	329	269	465	298	243	438	281	229*			
	Intermediate Zone	410	263	215*	337	217*	177*	304	196*	160*	287	185*	151*			
	Edge Zone	304	196*	160*	250	161*	132*	226*	146*	119*	213*	138*	113*			
	Corner Zone	200*	129*	106*	165*	107*	87*	149*	97*	79*	141*	91*	75*			
B2	Internal Zone	568	362	295	465	298	243	420	269	220*	395	254	207*			
	Intermediate Zone	370	238	194*	304	196*	160*	275	177*	145*	260	167*	137*			
	Edge Zone	275	177*	145*	226*	146*	119*	205*	132*	108*	193*	125*	102*			
	Corner Zone	181*	117*	96*	149*	97*	79*	135*	88*	72*	128*	83*	68*			
C	Internal Zone	366	235*	192*	301	194*	158*	272	175*	143*	257	165*	135*			
	Intermediate Zone	240	155*	127*	198*	128*	105*	179*	116*	95*	169*	109*	90*			
	Edge Zone	179*	116*	95*	148*	96*	78*	134*	87*	71*	126*	82*	67*			
	Corner Zone	118*	77*	63*	98*	63*	52*	88*	57*	47*	84*	54*	44*			
D	Internal Zone	236*	152*	125*	194*	126*	103*	176*	114*	93*	166*	107*	88*			
	Intermediate Zone	156*	101*	82*	128*	83*	68*	116*	75*	62*	110*	71*	58*			
	Edge Zone	116*	75*	62*	96*	62*	51*	87*	56*	46*	82*	53*	43*			
	Corner Zone	77*	50*	41*	63*	41*	34*	57*	37*	30*	54*	35*	29*			

- NOTES:
- \* denotes the situations where the wind load is more than 5KPa and the installation safety is compromised.
  - Definition of Terrain Category is given in General Note 1.
  - Notion of Roof Zone is given in General Note 2.
  - Panel tilt angle is given in reference to roof surface
  - The spacing table is based on the fixing condition specified in General Note 6.

## General Notes

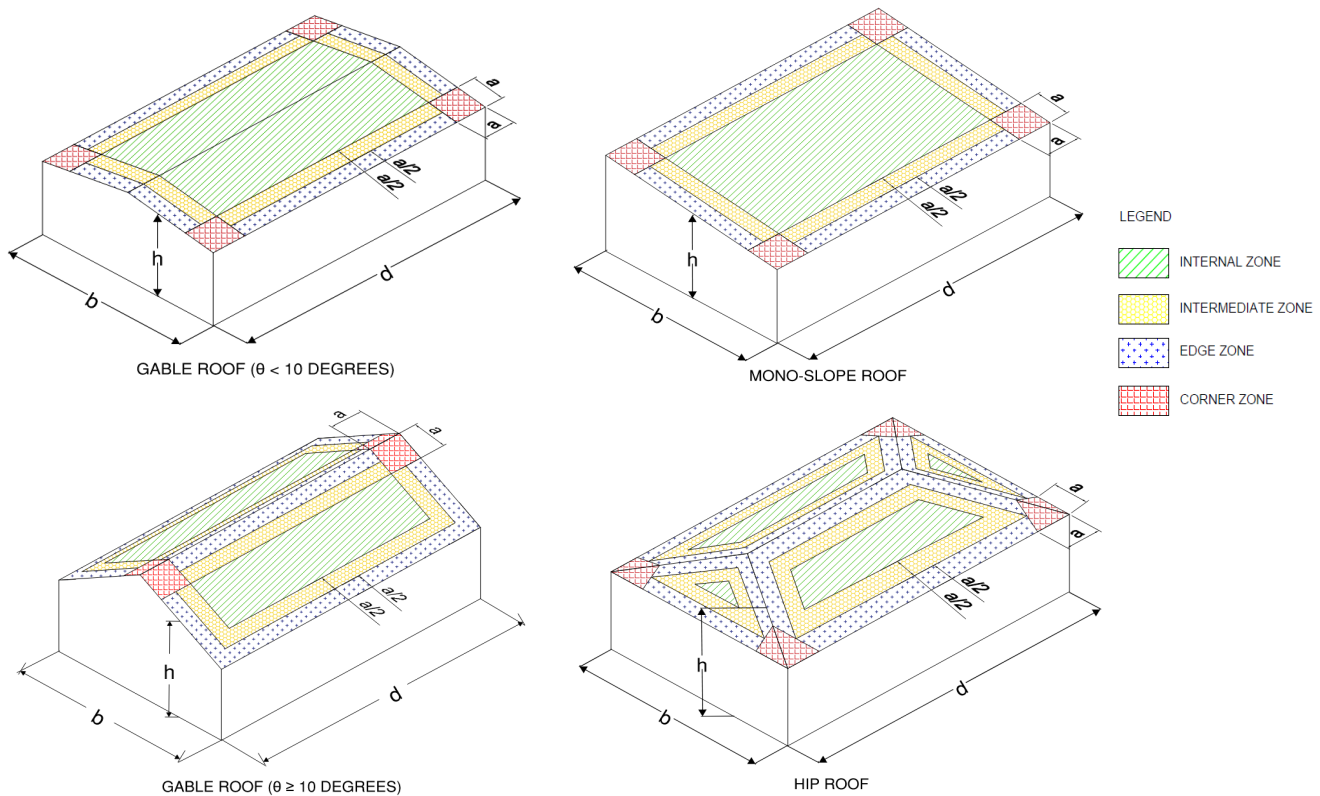
**Note 1** Terrain Category 3 (TC 3) denotes terrain with numerous closely spaced obstructions having heights generally from 3m to 10m. The minimum density of obstructions shall be at least the equivalent of 10 house-size obstructions per hectare.

Terrain Category 2.5 (TC 2.5) denotes terrain with some trees or isolated obstructions, terrain in developing outer urban areas with scattered houses, or large acreage developments with more than two and less than 10 buildings per hectare.

Terrain Category 2 (TC 2) denotes open terrain, including grassland, with well-scattered obstructions having heights generally from 1.5m to 5m, with no more than two obstructions per hectare.

Refer to AS/NZS 1170.2:2021 - 4.2.1 for Terrain Category definitions.

**Note 2** Notion of Roof Zone examples are shown in the following figures.



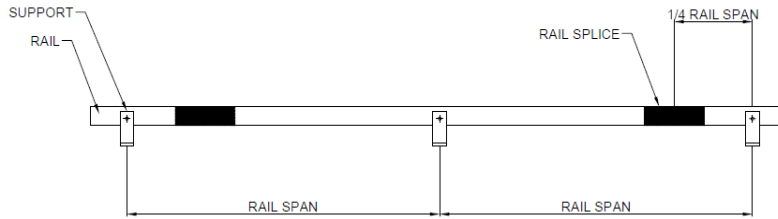
Refer to AS/NZS 1170.2:2021 – Chapter 5.4.4 for more accurate Roof Zone notion and cases.

To determine the zone dimension "a", follow the steps:

- 1) Determine building height (h), building length (b) and building width (d).
- 2) Determine (h/d) and (h/b)
- 3) If (h/b) or (h/d)  $\geq 0.2$ , a is the minimum of 0.2b or 0.2d
- 4) If (h/b) and (h/d)  $< 0.2$ , a is equal to 2h

Note: "h" represents the average roof height. Average roof height = (pitch height - gutter height)/2

**Note 3** To ensure the fixing spacing in above tables are valid, rail splice connectors must not be installed at the support point or at the middle span point between two adjacent supports. It is recommended to install the connector at 1/4 span points from the supports.



**Note 4** Number of panel clamps required per panel for installation when the tilting angle is **less than 15 degrees**:

		TC3			TC2.5			TC2		
		H≤10m	10m<H≤15m	15m<H≤20m	H≤10m	10m<H≤15m	15m<H≤20m	H≤10m	10m<H≤15m	15m<H≤20m
Region A	Internal	4	4	4	4	4	4	4	4	4
	Intermediate	4	4	4	4	4	4	4	4	4
	Edge	4	4	4	4	6	6	6	6	6
	Corner	6	6	6	6	8	8	8	8	8
Region B1&B2	Internal	4	4	4	4	4	4	4	4	4
	Intermediate	4	4	6	6	6	6	6	6	6
	Edge	6	6	6	8	8	8	8	8	8
Region C	Internal	4	6	6	6	6	6	6	8	8
	Intermediate	6	8	8	8	8	10	10	10	10
	Edge	8	10	10	10	NA	NA	NA	NA	NA
	Corner	NA	NA	NA	NA	NA	NA	NA	NA	NA
Region D	Internal	6	8	8	8	8	8	10	10	10
	Intermediate	10	NA	NA	NA	NA	NA	NA	NA	NA
	Edge	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Corner	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

1. NA denotes the situations where an excessive amount of panel clamps are required and the installation is no longer practical.
2. A site-specific engineering assessment must be carried out to determine the number of panel clamps required for situations not covered in this table.

Number of panel clamps required per panel for installation with tilting angle **up to 45 degrees**:

		TC3			TC2.5			TC2		
		H≤10m	10m<H≤15m	15m<H≤20m	H≤10m	10m<H≤15m	15m<H≤20m	H≤10m	10m<H≤15m	15m<H≤20m
Region A	Internal	4	4	4	4	4	6	6	6	6
	Intermediate	6	6	6	6	6	8	8	8	8
	Edge	6	8	8	8	8	10	10	10	10
	Corner	10	NA	NA	NA	NA	NA	NA	NA	NA
Region B1&B2	Internal	6	6	6	6	8	8	8	8	10
	Intermediate	8	10	10	10	10	NA	NA	NA	NA
	Edge	10	NA	NA	NA	NA	NA	NA	NA	NA
Region C	Internal	8	10	10	10	10	NA	NA	NA	NA
	Intermediate	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Edge	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Corner	NA	NA	NA	NA	NA	NA	NA	NA	NA
Region D	Internal	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Intermediate	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Edge	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Corner	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

1. NA denotes the situations where an excessive amount of panel clamps are required and the installation is no longer practical.
2. A site-specific engineering assessment must be carried out to determine the number of panel clamps required for situations not covered in this table.



**Note 5** The provided installation spacing tables are based on maximum PV panel size of 2300mm x 1200mm with 2 rails per panel array. For other panel sizes and more rails, refer the below table for adjustment factors based on the given spacing tables.

Maximum Panel Size	Number of Rails	Spacing Adjustment Factor
2300x1200	3 rails	120%
2300x1200	4 rails	160%
2100x1100	2 rails	109%
2100x1100	3 rails	131%
2100x1100	4 rails	175%
2000x1100	2 rails	115%
2000x1100	3 rails	138%
2000x1100	4 rails	176%
1700x1100	2 rails	130%
1700x1100	3 rails	162%
1700x1100	4 rails	214%

**Note:** The maximum allowable fixing spacing shall not exceed 1400mm after applying the adjustment factors.

**Note 6** The clamps capacities are taken from testing report No.MT-15/317 by Melbourne Testing Services Pty Ltd, dated 26/05/2015. This test was carried out using Lysaght KlipLok 406 Non-penetrative roof sheeting clamps. Other roof sheeting products are not covered in this assessment. **The clamps must be mounted over purlins and on full roof sheeting ribs. No clamp is allowed to be installed on lapped roof sheeting ribs.**

**Note 7** All above-mentioned adjustment factors from different notes shall not be applied together to determine the final installation spacing. Factors from each note shall be applied independently. For multiple installation conditions change, please seek for the engineer's advice.