EBULEN CONSULT

SOLAR PV ROOF-MOUNT RACKING FRAME ENGINEERING CERTIFICATE

ANTAI TILT LEG SYSTEM WITH 355B RAIL & KL700 CLAMPS

Prepared for:

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Ref: E22110958

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OVERVIEW

This structural engineering certificate is issued for Antai Solar Roof Tilt Leg racking system with 355B 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-355B	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-25/26	AL 6005-T5

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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 capacities are taken from below testing reports: No.MT-15/317 by Melbourne Testing Services (MTS) Pty Ltd, dated 26/05/2015
- 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.

Certified by:

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APPENDIX A – INSTALLATION GUIDELINE

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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	1233	768	622	1233	768	622	1054	661	536	934	588	478
	Intermediate Zone	787	498	405	787	498	405	677	430	350	602	384	313
	Edge Zone	578	369	300	578	369	300	498	319	260	444	285	232*
	Corner Zone	377	242*	198*	377	242*	198*	326	210*	172*	291	188*	154*
B1	Internal Zone	809	512	416	809	512	416	695	442	360	618	394	321
	Intermediate Zone	524	335	273	524	335	273	452	290	237*	403	259	211*
	Edge Zone	387	249*	203*	387	249*	203*	335	215*	176*	299	193*	158*
	Corner Zone	254	164*	134*	254	164*	134*	220*	142*	117*	197*	127*	104*
B2	Internal Zone	728	462	376	728	462	376	626	399	325	557	356	290
	Intermediate Zone	472	303	247*	472	303	247*	408	262	214*	364	234*	191*
	Edge Zone	350	225*	184*	350	225*	184*	303	195*	159*	270	174*	143*
	Corner Zone	230*	149*	122*	230*	149*	122*	199*	129*	106*	178*	115*	94*
C	Internal Zone	467	299	244*	467	299	244*	403	259	212*	360	231*	189*
	Intermediate Zone	306	197*	161*	306	197*	161*	265	171*	140*	237*	153*	125*
	Edge Zone	227*	147*	120*	227*	147*	120*	197*	127*	104*	176*	114*	93*
	Corner Zone	150*	97*	80*	150*	97*	80*	130*	84*	69*	117*	76*	62*
D	Internal Zone	300	193*	158*	300	193*	158*	260	168*	137*	232*	150*	123*
	Intermediate Zone	198*	128*	105*	198*	128*	105*	171*	111*	91*	153*	99*	81*
	Edge Zone	147*	95*	78*	147*	95*	78*	128*	83*	68*	114*	74*	61*
	Corner Zone	98*	63*	52*	98*	63*	52*	85*	55*	45*	76*	49*	40*

NOTES:
1. * denotes the situations where the wind load is more than 5KPa and the installation safety is compromised.
2. Definition of Terrain Category is given in General Note 1.
3. Notion of Roof Zone is given in General Note 2.
4. Panel tilt angle is given in reference to roof surface
5. 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	1109	694	562	979	616	500	871	550	447	798	505	411
	Intermediate Zone	711	451	367	630	401	327	563	359	293	517	330	270
	Edge Zone	523	334	273	465	298	243*	416	267	218*	382	246*	201*
	Corner Zone	342	220*	180*	304	196*	160*	273	176*	144*	251	162*	133*
B1	Internal Zone	730	463	377	648	412	336	578	369	301	531	339	277
	Intermediate Zone	474	304	248*	422	271	221*	378	243*	198*	347	223*	183*
	Edge Zone	351	226*	185*	313	201*	165*	280	181*	148*	258	166*	136*
	Corner Zone	231*	149*	122*	206*	133*	109*	185*	119*	98*	170*	110*	90*
B2	Internal Zone	658	418	341	584	372	303	522	333	272	479	307	250
	Intermediate Zone	428	275	224*	381	245*	200*	341	219*	179*	314	202*	165*
	Edge Zone	317	204*	167*	283	182*	149*	253	163*	134*	233*	151*	123*
	Corner Zone	209*	135*	111*	186*	120*	99*	167*	108*	89*	154*	100*	82*
C	Internal Zone	423	271	222*	376	242*	198*	337	217*	177*	310	200*	163*
	Intermediate Zone	278	179*	146*	247*	160*	131*	222*	143*	117*	204*	132*	108*
	Edge Zone	206*	133*	109*	184*	119*	98*	165*	107*	88*	152*	99*	81*
	Corner Zone	136*	88*	72*	122*	79*	65*	109*	71*	58*	101*	65*	53*
D	Internal Zone	272	175*	144*	243*	157*	128*	218*	141*	115*	200*	129*	106*
	Intermediate Zone	179*	116*	95*	160*	104*	85*	144*	93*	76*	132*	86*	70*
	Edge Zone	134*	87*	71*	119*	77*	63*	107*	69*	57*	99*	64*	52*
	Corner Zone	89*	57*	47*	79*	51*	42*	71*	46*	38*	65*	42*	35*

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

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Interface Spacing Table for Terrain Category 2 (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	1003	630	511	815	516	419	733	465	379	690	439	357
	Intermediate Zone	645	411	335	528	337	275	476	305	249*	449	288	235*
	Edge Zone	475	304	249*	390	251	205*	352	227*	185*	332	214*	175*
	Corner Zone	311	201*	164*	256	165*	135*	232*	150*	123*	219*	141*	116*
B1	Internal Zone	663	422	343	542	346	283	489	313	255	461	295	241*
	Intermediate Zone	431	277	226*	354	228*	186*	320	206*	169*	302	195*	159*
	Edge Zone	320	206*	168*	263	170*	139*	238*	154*	126*	225*	145*	119*
	Corner Zone	211*	136*	111*	174*	112*	92*	157*	102*	83*	148*	96*	79*
B2	Internal Zone	597	381	310	489	313	255	441	283	231*	416	267	218*
	Intermediate Zone	390	250	204*	320	206*	169*	289	187*	153*	273	176*	144*
	Edge Zone	289	186*	152*	238*	154*	126*	215*	139*	114*	203*	131*	108*
	Corner Zone	191*	123*	101*	157*	102*	83*	142*	92*	75*	134*	87*	71*
C	Internal Zone	385	247*	202*	316	204*	167*	286	184*	151*	270	174*	142*
	Intermediate Zone	253	163*	134*	208*	135*	110*	189*	122*	100*	178*	115*	94*
	Edge Zone	188*	122*	100*	155*	101*	82*	141*	91*	75*	133*	86*	70*
	Corner Zone	125*	81*	66*	103*	67*	55*	93*	60*	49*	88*	57*	47*
D	Internal Zone	248*	160*	131*	204*	132*	108*	185*	120*	98*	175*	113*	92*
	Intermediate Zone	164*	106*	87*	135*	87*	72*	122*	79*	65*	115*	75*	61*
	Edge Zone	122*	79*	65*	101*	65*	53*	91*	59*	48*	86*	56*	46*
	Corner Zone	81*	52*	43*	67*	43*	35*	60*	39*	32*	57*	37*	30*

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

General Notes

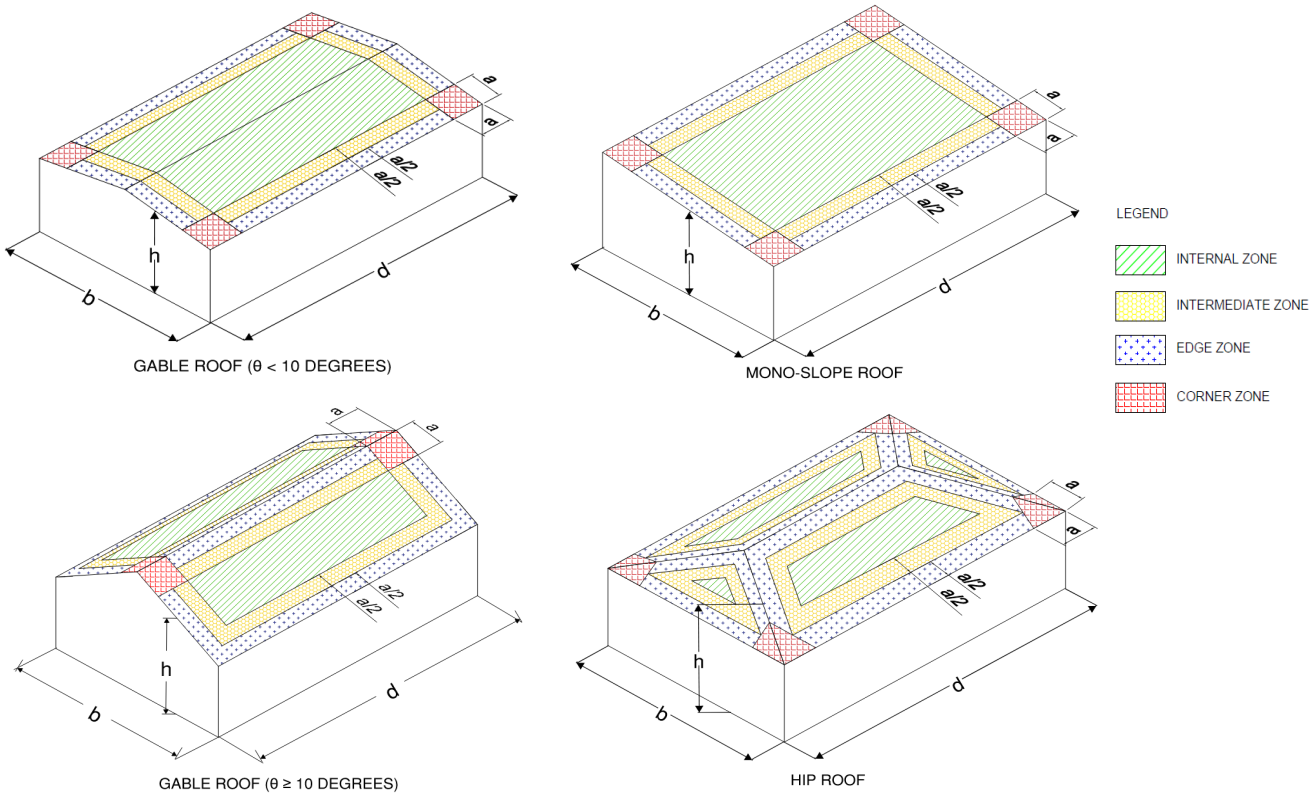
Note 1 Terrain Category 3 (TC 3) denotes terrain with numerous closely spaced obstructions having heights generally from 3m to 10m. The minimum density of obstructions shall be at least the equivalent of 10 house-size obstructions per hectare.

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.



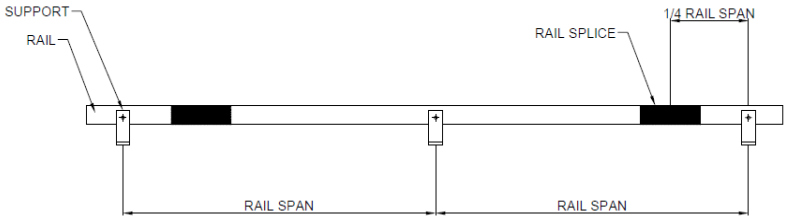
Refer to AS/NZS 1170.2:2021 – Chapter 5.4.4 for more accurate Roof Zone notion and cases.

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) ≥ 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
	Corner	8	8	10	10	NA	NA	10	NA	NA
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
	Corner	NA	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	108%
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 700 Non-penetrative roof sheeting clamps. Other roof sheeting products are not covered in this assessment. **The clamps must be mounted over purlins.**

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.