



**EBULEN CONSULT**

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

**ANTAI TILT LEG SYSTEM WITH 355B RAIL & SCREW FIXING**

Prepared for:

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Ref: E22110958

## OVERVIEW

This structural engineering certificate is issued for Antai Solar Roof Tilt Leg racking system with 355B rail and penetrative screw 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
- AS/NZS 4600:2018 – Cold-Formed Steel Structures
- AS1720.1:2010 – Timber structures – Design methods
- AS3600:2018 – Concrete 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

## 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
- Screw fixing pull-out has been checked with insert into minimum 35mm JD4 timber structure and steel structure with thicknesses of 1.2mm, 1.5mm, 1.9mm and 2.4mm
- 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

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		
		$\Phi < 15^\circ$	$15^\circ \leq \Phi < 25^\circ$	$25^\circ \leq \Phi \leq 45^\circ$	$\Phi < 15^\circ$	$15^\circ \leq \Phi < 25^\circ$	$25^\circ \leq \Phi \leq 45^\circ$	$\Phi < 15^\circ$	$15^\circ \leq \Phi < 25^\circ$	$25^\circ \leq \Phi \leq 45^\circ$	$\Phi < 15^\circ$	$15^\circ \leq \Phi < 25^\circ$	$25^\circ \leq \Phi \leq 45^\circ$
A	Internal Zone	1451	960	777	1451	960	777	1317	826	670	1167	735	597
	Intermediate Zone	983	623	507	983	623	507	846	538	438	752	480	391
	Edge Zone	722	461	376	722	461	376	623	399	325	555	356	291*
	Corner Zone	471	303*	248*	471	303*	248*	408	262*	215*	364	235*	192*
B1	Internal Zone	1011	640	520	1011	640	520	869	552	450	773	493	401
	Intermediate Zone	655	418	341	655	418	341	565	362	296*	504	324	264*
	Edge Zone	484	311*	254*	484	311*	254*	419	269*	220*	374	241*	197*
	Corner Zone	318	205*	168*	318	205*	168*	276*	178*	146*	246*	159*	130*
B2	Internal Zone	909	577	470	909	577	470	783	499	406	697	445	363
	Intermediate Zone	591	378	309*	591	378	309*	510	328	268*	455	293*	239*
	Edge Zone	437	281*	230*	437	281*	230*	378	244*	199*	338	218*	178*
	Corner Zone	288*	186*	152*	288*	186*	152*	249*	161*	132*	223*	144*	118*
C	Internal Zone	584	374	305*	584	374	305*	504	324	264*	450	289*	236*
	Intermediate Zone	382	246*	202*	382	246*	202*	331	214*	175*	296*	191*	156*
	Edge Zone	284*	184*	150*	284*	184*	150*	246*	159*	130*	220*	143*	117*
	Corner Zone	188*	122*	100*	188*	122*	100*	163*	106*	86*	146*	95*	77*
D	Internal Zone	375	242*	198*	375	242*	198*	325	209*	171*	290*	187*	153*
	Intermediate Zone	247*	160*	131*	247*	160*	131*	214*	139*	114*	192*	124*	102*
	Edge Zone	184*	119*	98*	184*	119*	98*	160*	104*	85*	143*	93*	76*
	Corner Zone	122*	79*	65*	122*	79*	65*	106*	69*	56*	95*	61*	50*

- 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		
		$\Phi < 15^\circ$	$15^\circ \leq \Phi < 25^\circ$	$25^\circ \leq \Phi \leq 45^\circ$	$\Phi < 15^\circ$	$15^\circ \leq \Phi < 25^\circ$	$25^\circ \leq \Phi \leq 45^\circ$	$\Phi < 15^\circ$	$15^\circ \leq \Phi < 25^\circ$	$25^\circ \leq \Phi \leq 45^\circ$	$\Phi < 15^\circ$	$15^\circ \leq \Phi < 25^\circ$	$25^\circ \leq \Phi \leq 45^\circ$
A	Internal Zone	1374	867	703	1224	769	625	1089	688	559	997	631	513
	Intermediate Zone	888	564	459	788	502	409	704	449	366	646	413	337
	Edge Zone	653	418	341	581	372	304*	520	334	273*	478	307*	251*
	Corner Zone	427	275*	225*	381	245*	201*	341	220*	180*	314	203*	166*
B1	Internal Zone	913	579	471	809	515	420	723	461	376	664	424	346
	Intermediate Zone	593	380	310*	527	338	276*	472	303*	248*	434	279*	228*
	Edge Zone	439	282*	231*	391	252*	206*	350	226*	185*	322	208*	170*
	Corner Zone	289*	186*	153*	257*	166*	136*	231*	149*	122*	213*	138*	113*
B2	Internal Zone	822	523	426	729	465	379	652	417	340	599	383	313
	Intermediate Zone	535	343	280*	476	306*	250*	426	274*	224*	392	253*	207*
	Edge Zone	397	255*	209*	353	228*	186*	317	204*	167*	292*	188*	154*
	Corner Zone	261*	169*	138*	233*	151*	123*	209*	135*	111*	193*	125*	102*
C	Internal Zone	529	339	277*	470	302*	247*	421	271*	222*	388	250*	204*
	Intermediate Zone	347	224*	183*	309*	200*	163*	277*	179*	147*	255*	165*	135*
	Edge Zone	258*	167*	137*	230*	149*	122*	207*	134*	110*	190*	123*	101*
	Corner Zone	171*	111*	91*	152*	99*	81*	137*	89*	73*	126*	82*	67*
D	Internal Zone	340	219*	180*	303*	196*	160*	272*	176*	144*	250*	162*	133*
	Intermediate Zone	224*	145*	119*	200*	130*	106*	180*	116*	95*	166*	107*	88*
	Edge Zone	167*	108*	89*	149*	97*	79*	134*	87*	71*	124*	80*	66*
	Corner Zone	111*	72*	59*	99*	64*	53*	89*	58*	47*	82*	53*	44*

- 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	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	1254	788	639	1019	645	524	917	582	473	863	548	446
	Intermediate Zone	806	513	418	660	422	344	595	381	311*	561	360	294*
	Edge Zone	594	381	311*	488	313	256*	441	283*	232*	416	267*	219*
	Corner Zone	389	251*	205*	320	207*	169*	290*	187*	153*	274*	177*	145*
B1	Internal Zone	829	527	429	678	433	353	611	391	319	576	369	301*
	Intermediate Zone	539	346	283*	443	285*	233*	400	258*	211*	378	243*	199*
	Edge Zone	400	257*	211*	329	212*	174*	298*	192*	157*	281*	181*	149*
	Corner Zone	263*	170*	139*	217*	140*	115*	196*	127*	104*	186*	120*	98*
B2	Internal Zone	747	476	388	611	391	319	552	354	289*	520	334	273*
	Intermediate Zone	487	313	256*	400	258*	211*	362	233*	191*	341	220*	180*
	Edge Zone	361	233*	191*	298*	192*	157*	269*	174*	142*	254*	164*	134*
	Corner Zone	238*	154*	126*	196*	127*	104*	178*	115*	94*	168*	109*	89*
C	Internal Zone	481	309*	253*	396	255*	208*	358	231*	189*	337	218*	178*
	Intermediate Zone	316	204*	167*	261*	168*	138*	236*	153*	125*	223*	144*	118*
	Edge Zone	235*	152*	125*	194*	126*	103*	176*	114*	93*	166*	108*	88*
	Corner Zone	156*	101*	83*	129*	83*	68*	116*	76*	62*	110*	71*	58*
D	Internal Zone	310*	200*	164*	256*	165*	135*	231*	150*	123*	218*	141*	116*
	Intermediate Zone	205*	133*	109*	169*	109*	90*	153*	99*	81*	144*	94*	77*
	Edge Zone	153*	99*	81*	126*	82*	67*	114*	74*	61*	108*	70*	57*
	Corner Zone	101*	66*	54*	84*	54*	44*	76*	49*	40*	72*	46*	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.

**General Notes**

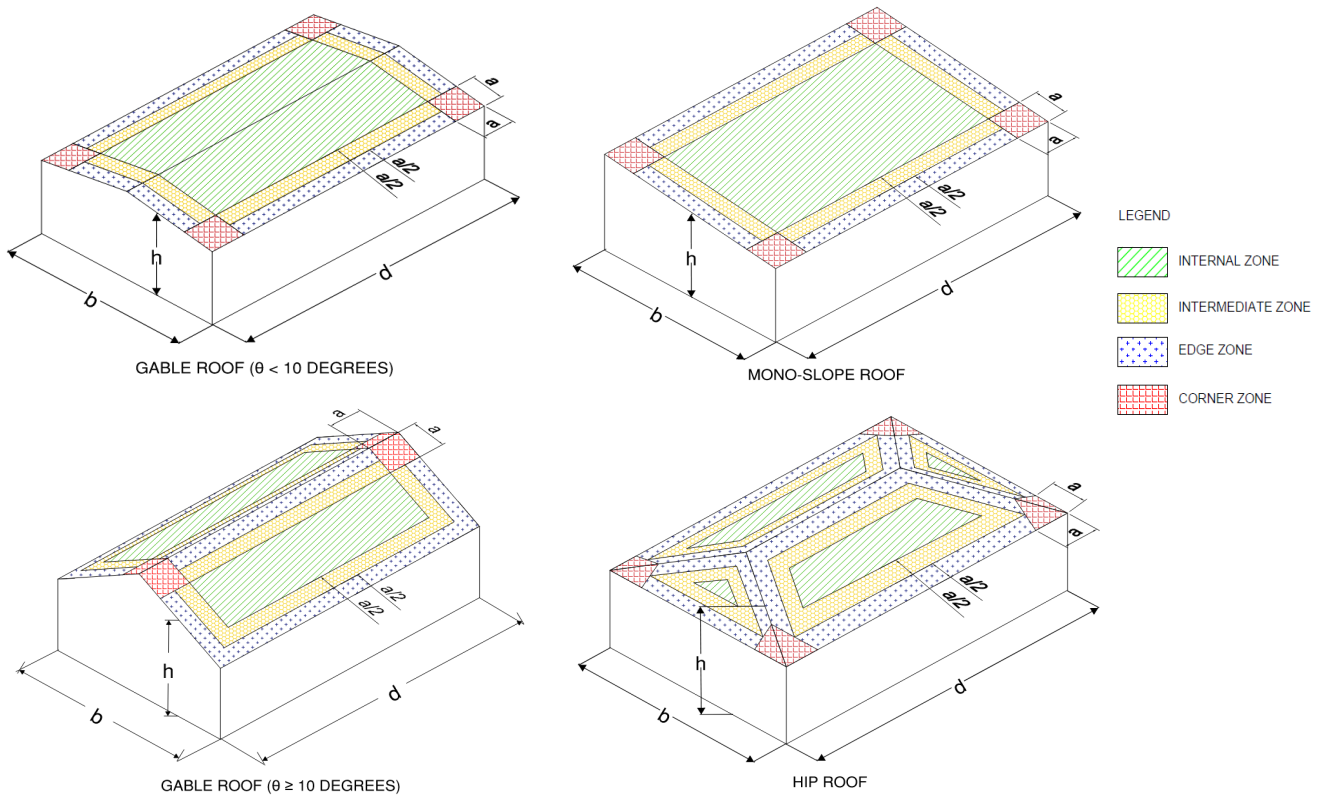
**Note 1** Terrain Category 3 (TC 3) denotes terrain with numerous closely spaced obstructions having heights generally from 3m to 10m. The minimum density of obstructions shall be at least the equivalent of 10 house-size obstructions per hectare.

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.



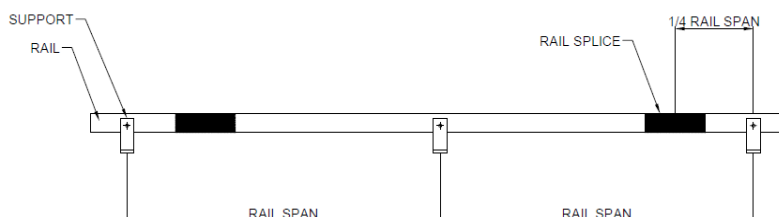
Refer to AS/NZS 1170.2:2021 – Chapter 5.4.4 for more accurate Roof Zone notion and cases.

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	108%
1700x1100	3 rails	162%
1700x1100	4 rails	214%

**Note:** The maximum allowable fixing spacing shall not exceed 1800mm after applying the adjustment factors.

**Note 6** Fixing spacing in the above tables are based on 1 x 14 gauge penetrative screw fixing pull-out capacity into 1.9BMT steel and 35mm embedded into JD4 seasoned timber. The fixing spacing must be adjusted if the roof structure being fixed into a different substructure. The recommended typical penetrative fixings to be adopted are as following:

Steel purlin/batten	-	14g-10TPI Self-drilling Tek Metal Screw (Buildex recommended)
Timber purlin/batten	-	14g-10TPI Self-drilling T17s Timber Screw (Buildex recommended)

Larger diameter new screws (14 gauge typical) shall be used for solar installation to replace the old roof screws (12 gauge typical). All self-drilling penetrative fixing must be in compliance with AS3566-2002 (R2015).

For fixing into steel roof structure with different thicknesses, refer below for adjustment factors based on the given spacing tables.

1) 1.2mm BMT:	62%
2) 1.5mm BMT:	77%
3) 2.4mm BMT:	100% for region A, B, C and D.

When installing on concrete roof, adopt concrete chemical or mechanical anchor as per the anchor manufacturer's specifications. The recommended concrete fixing anchors are as below:

Chemical anchor	-	M8/M10 G5.8 galvanised anchor stud with Chemset Reo502 PLUS or approved equivalent; Minimum embedment depth 70mm
Mechanical anchor	-	M8/M10 DynaBolt PLUS DP08065SS or DP10075GH or approved equivalent; Minimum embedment depth 35mm/45mm

For fixing into concrete roofs, refer below for adjustment factors based on the given spacing tables. 100% for Region A, B, C and D;

**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 example, when installing the racking frame with 2300mm x 1200mm panels and 3 rails fixed to 1.5mm BMT purlins in Region C, it is incorrect that spacing = original spacing x 120% x 77%. For multiple installation conditions change, please seek for the engineer's advice.