



EBULEN CONSULT

SOLAR PV ROOF-MOUNT RACKING FRAME ENGINEERING CERTIFICATE

ANTAI FLUSH-MOUNT SYSTEM WITH 499 RAIL, L-FOOT & LL305 CLAMPS

Prepared for:

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Ref: E22110958

OVERVIEW

This structural engineering certificate is issued for Antai Solar Roof Flush-mount racking system with 499 rail, L-foot bracket and non-penetrative roof clamp fixing, which have 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
Tin Interface Bracket	ATL-FWNY-05	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
Longline 305 Roof Clamp	ATL-TYN-307/308	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 the 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. 20-0250 by Melbourne Testing Services (MTS) Pty Ltd, dated 22/06/2020
- 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.
- The clamps have been assessed with the Lysaght Longline 305 roof sheeting
- Product details are taken from the drawing set provided by Antai Technology Co., Ltd. as listed in the above component table
- 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, $h/d \leq 0.5$ (Unit: mm)									
Wind Region	Height & Roof Pitch Roof Zone	H<5m		5m<H<10m		10m<H<15m		15m<H<20m	
		$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 15^\circ$	$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 15^\circ$	$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 15^\circ$	$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 15^\circ$
A	Internal Zone	1600	1600	1600	1600	1523	1600	1427	1509
	Intermediate Zone	1324	1381	1324	1381	1180	1296	1044	1159
	Edge Zone	1000	1109	1000	1109	857	950	761	842
	Corner Zone	643	711	643	711	554	612	494	545
B1	Internal Zone	1339	1397	1339	1397	1214	1311	1074	1192
	Intermediate Zone	903	1001	903	1001	775	858	689	762
	Edge Zone	661	730	661	730	569	629	507	560
	Corner Zone	430	474	430	474	372	410	332	365
B2	Internal Zone	1274	1337	1274	1337	1088	1208	964	1068
	Intermediate Zone	811	898	811	898	698	771	620	686
	Edge Zone	595	658	595	658	513	567	457	505
	Corner Zone	388	428	388	428	336	370	300	330
C	Internal Zone	801	887	801	887	689	762	613	677
	Intermediate Zone	519	573	519	573	448	494	400	440
	Edge Zone	384	423	384	423	332	366	296	326
	Corner Zone	252	278	252	278	218*	240*	195*	215*
D	Internal Zone	509	561	509	561	439	484	392	432
	Intermediate Zone	333	367	333	367	288	317	257	283
	Edge Zone	247*	272	247*	272	214*	236*	191*	211*
	Corner Zone	163*	179*	163*	179*	142*	156*	127*	139*

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.
- The Roof pitch angle is given in reference to horizontal. The value of Φ shall be determined and measured by following the figure in Note 3
- The spacing table is based on the fixing condition specified in General Note 7.
- For $0.5 < h/d < 1.0$ cases, the spacing value can be obtained by linear interpolation between $h/d \leq 0.5$ and $h/d \geq 1$ data with the same TC

Interface Spacing Table for Terrain Category 3, $h/d \geq 1$ (Unit: mm)									
Wind Region	Height & Roof Pitch Roof Zone	H<5m		5m<H<10m		10m<H<15m		15m<H<20m	
		$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 15^\circ$	$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 15^\circ$	$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 15^\circ$	$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 15^\circ$
A	Internal Zone	1347	1409	1347	1409	1232	1321	1089	1214
	Intermediate Zone	915	1019	915	1019	786	873	698	775
	Edge Zone	670	743	670	743	577	640	514	569
	Corner Zone	436	482	436	482	376	417	336	372
B1	Internal Zone	941	1048	941	1048	808	898	717	797
	Intermediate Zone	607	673	607	673	523	580	466	516
	Edge Zone	447	495	447	495	387	428	345	382
	Corner Zone	293	324	293	324	254	281	227*	251
B2	Internal Zone	846	940	846	940	727	807	646	717
	Intermediate Zone	547	606	547	606	472	523	421	466
	Edge Zone	404	447	404	447	349	386	312	345
	Corner Zone	265	293	265	293	230*	254	205*	227*
C	Internal Zone	540	599	540	599	466	516	416	460
	Intermediate Zone	353	391	353	391	305	338	273	302
	Edge Zone	262	290	262	290	227*	251	203*	224*
	Corner Zone	173*	191*	173*	191*	150*	166*	134*	148*
D	Internal Zone	346	383	346	383	299	331	267	296
	Intermediate Zone	228*	252	228*	252	197*	218*	176*	195*
	Edge Zone	170*	187*	170*	187*	147*	162*	132*	145*
	Corner Zone	112*	124*	112*	124*	97*	107*	87*	96*

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.
- The Roof pitch angle is given in reference to horizontal. The value of Φ shall be determined and measured by following the figure in Note 3
- The spacing table is based on the fixing condition specified in General Note 7.
- For $0.5 < h/d < 1.0$ cases, the spacing value can be obtained by linear interpolation between $h/d \leq 0.5$ and $h/d \geq 1$ data with the same TC

Interface Spacing Table for Terrain Category 2.5, $h/d \leq 0.5$ (Unit: mm)									
Wind Region	Height & Roof Pitch Roof Zone	H<5m		5m<H<10m		10m<H<15m		15m<H<20m	
		$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 15^\circ$	$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 15^\circ$	$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 15^\circ$	$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 15^\circ$
A	Internal Zone	1566	1600	1464	1548	1381	1453	1332	1389
	Intermediate Zone	1242	1323	1095	1216	974	1080	891	987
	Edge Zone	901	999	798	883	711	787	652	721
	Corner Zone	582	642	517	570	462	510	424	468
B1	Internal Zone	1279	1339	1127	1252	1001	1111	916	1015
	Intermediate Zone	815	902	722	798	644	712	591	652
	Edge Zone	598	660	531	586	475	524	436	481
	Corner Zone	390	430	347	382	311	342	286	315
B2	Internal Zone	1145	1272	1011	1121	899	996	823	911
	Intermediate Zone	733	811	650	718	580	641	533	588
	Edge Zone	539	595	479	528	428	472	394	434
	Corner Zone	352	388	313	345	281	309	259	285
C	Internal Zone	724	801	642	709	573	633	526	581
	Intermediate Zone	470	518	418	461	374	412	344	379
	Edge Zone	348	383	310	341	278	306	256	281
	Corner Zone	229*	252	204*	225*	183*	201*	169*	185*
D	Internal Zone	461	508	410	452	367	404	337	372
	Intermediate Zone	302	332	269	296	241*	265	222*	244*
	Edge Zone	224*	247*	200*	220*	180*	198*	165*	182*
	Corner Zone	148*	163*	132*	145*	119*	131*	109*	120*

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.
- The Roof pitch angle is given in reference to horizontal. The value of Φ shall be determined and measured by following the figure in Note 3
- The spacing table is based on the fixing condition specified in General Note 7.
- For $0.5 < h/d < 1.0$ cases, the spacing value can be obtained by linear interpolation between $h/d \leq 0.5$ and $h/d \geq 1$ data with the same TC

Interface Spacing Table for Terrain Category 2.5, $h/d \geq 1$ (Unit: mm)									
Wind Region	Height & Roof Pitch Roof Zone	H<5m		5m<H<10m		10m<H<15m		15m<H<20m	
		$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 15^\circ$	$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 15^\circ$	$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 15^\circ$	$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 15^\circ$
A	Internal Zone	1290	1348	1143	1275	1015	1131	928	1033
	Intermediate Zone	826	918	731	812	653	724	599	664
	Edge Zone	605	672	538	596	481	533	442	489
	Corner Zone	395	437	351	389	315	348	290	320
B1	Internal Zone	849	944	752	835	671	744	615	682
	Intermediate Zone	549	608	488	540	436	483	401	444
	Edge Zone	405	449	361	399	323	357	297	329
	Corner Zone	266	294	237*	262	213*	235*	196*	216*
B2	Internal Zone	763	848	677	751	604	670	554	614
	Intermediate Zone	495	548	440	487	394	436	362	401
	Edge Zone	366	405	326	361	292	323	269	297
	Corner Zone	241*	266	215*	237*	193*	213*	177*	196*
C	Internal Zone	489	542	435	481	389	431	358	396
	Intermediate Zone	320	354	285	315	256	283	235*	260
	Edge Zone	238*	263	212*	234*	190*	210*	175*	193*
	Corner Zone	157*	173*	140*	155*	126*	139*	116*	128*
D	Internal Zone	314	347	280	309	251	277	231*	255
	Intermediate Zone	207*	228*	184*	204*	165*	183*	152*	168*
	Edge Zone	154*	170*	137*	152*	123*	136*	114*	125*
	Corner Zone	102*	113*	91*	100*	82*	90*	75*	83*

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.
- The Roof pitch angle is given in reference to horizontal. The value of Φ shall be determined and measured by following the figure in Note 3
- The spacing table is based on the fixing condition specified in General Note 7.
- For $0.5 < h/d < 1.0$ cases, the spacing value can be obtained by linear interpolation between $h/d \leq 0.5$ and $h/d \geq 1$ data with the same TC

Interface Spacing Table for Terrain Category 2, $h/d \leq 0.5$ (Unit: mm)									
Wind Region	Height & Roof Pitch Roof Zone	H<5m		5m<H<10m		10m<H≤15m		15m<H≤20m	
		$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 15^\circ$	$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 15^\circ$	$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 15^\circ$	$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 15^\circ$
A	Internal Zone	1483	1569	1344	1402	1285	1341	1205	1307
	Intermediate Zone	1122	1247	910	1009	818	906	769	852
	Edge Zone	817	904	666	736	600	663	565	624
	Corner Zone	529	584	433	478	391	431	369	407
B1	Internal Zone	1155	1283	936	1038	841	931	791	876
	Intermediate Zone	739	817	603	667	544	600	512	566
	Edge Zone	543	600	445	491	402	443	379	418
	Corner Zone	355	391	292	321	264	290	249	274
B2	Internal Zone	1035	1149	841	931	756	837	712	787
	Intermediate Zone	665	735	544	600	491	541	462	510
	Edge Zone	490	540	402	443	363	400	342	377
	Corner Zone	321	353	264	290	239*	263	225*	248
C	Internal Zone	657	726	537	593	485	535	457	504
	Intermediate Zone	428	472	351	387	317	350	299	330
	Edge Zone	317	349	261	287	236*	260	223*	245*
	Corner Zone	209*	230*	172*	189*	156*	171*	147*	162*
D	Internal Zone	419	462	344	379	311	343	294	323
	Intermediate Zone	275	303	227*	249	205*	225*	193*	213*
	Edge Zone	205*	225*	169*	186*	153*	168*	144*	159*
	Corner Zone	135*	149*	112*	123*	101*	111*	95*	105*

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.
- The Roof pitch angle is given in reference to horizontal. The value of Φ shall be determined and measured by following the figure in Note 3
- The spacing table is based on the fixing condition specified in General Note 7.
- For $0.5 < h/d < 1.0$ cases, the spacing value can be obtained by linear interpolation between $h/d \leq 0.5$ and $h/d \geq 1$ data with the same TC

Interface Spacing Table for Terrain Category 2, $h/d \geq 1$ (Unit: mm)									
Wind Region	Height & Roof Pitch Roof Zone	H<5m		5m<H<10m		10m<H≤15m		15m<H≤20m	
		$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 15^\circ$	$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 15^\circ$	$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 15^\circ$	$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 15^\circ$
A	Internal Zone	1171	1294	949	1057	852	948	802	891
	Intermediate Zone	749	832	611	678	551	611	519	575
	Edge Zone	550	610	451	499	407	451	384	425
	Corner Zone	359	398	296	327	267	295	252	279
B1	Internal Zone	770	855	628	697	566	628	533	591
	Intermediate Zone	499	553	409	453	370	409	349	386
	Edge Zone	369	408	303	335	274	303	259	286
	Corner Zone	243*	268	200*	221*	181*	200*	171*	189*
B2	Internal Zone	693	769	566	628	511	566	481	533
	Intermediate Zone	450	499	370	409	334	369	315	348
	Edge Zone	333	369	274	303	248	274	234*	259
	Corner Zone	219*	242*	181*	200*	164*	181*	155*	171*
C	Internal Zone	445	493	365	404	330	365	311	344
	Intermediate Zone	292	322	240*	265	217*	240*	205*	226*
	Edge Zone	217*	240*	179*	197*	162*	179*	153*	169*
	Corner Zone	143*	158*	118*	131*	107*	118*	101*	112*
D	Internal Zone	286	316	235*	260	213*	235*	201*	222*
	Intermediate Zone	189*	208*	155*	172*	141*	155*	133*	147*
	Edge Zone	141*	155*	116*	128*	105*	116*	99*	109*
	Corner Zone	93*	103*	77*	85*	70*	77*	66*	73*

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.
- The Roof pitch angle is given in reference to horizontal. The value of Φ shall be determined and measured by following the figure in Note 3
- The spacing table is based on the fixing condition specified in General Note 7.
- For $0.5 < h/d < 1.0$ cases, the spacing value can be obtained by linear interpolation between $h/d \leq 0.5$ and $h/d \geq 1$ data with the same TC

General Notes

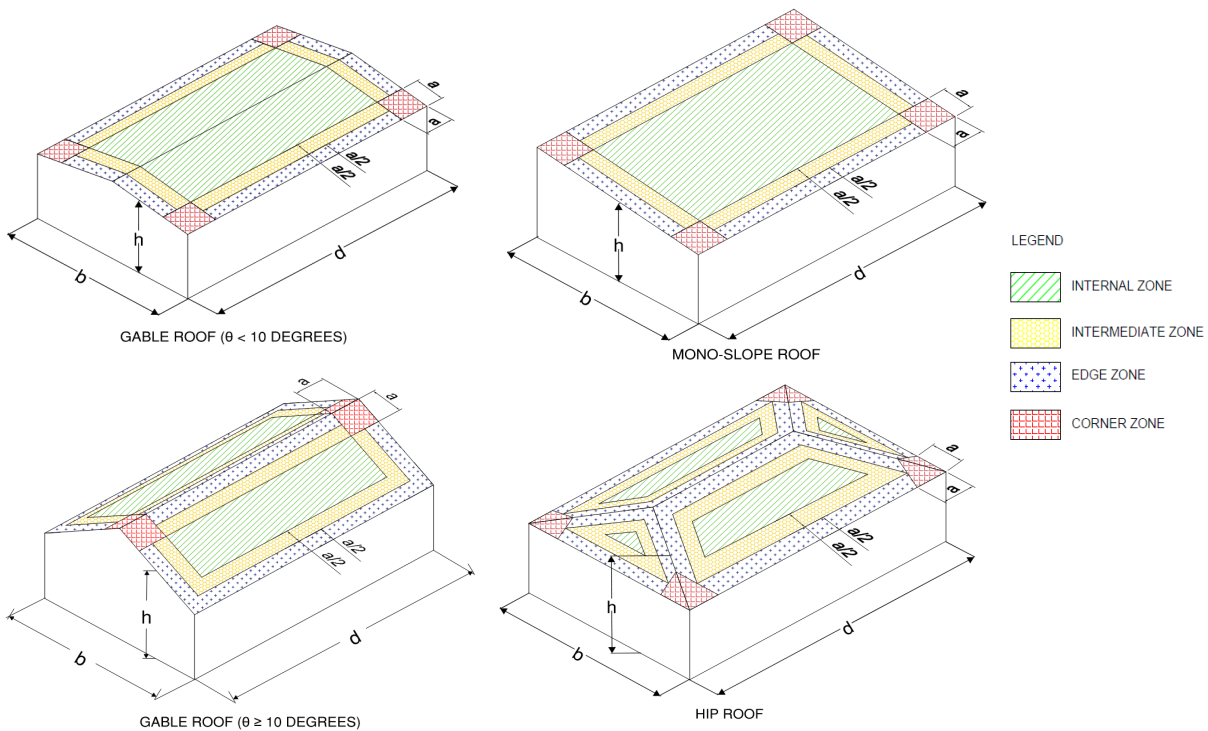
Note 1 Terrain Category 3 (TC 3) denotes terrain with numerous closely spaced obstructions having heights generally from 3m to 10m. The minimum density of obstructions shall be at least the equivalent of 10 house-size obstructions per hectare.

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.
 (Note: As specified by Antai Technology Co., Ltd., this certificate is limited to 4-zone scenario only and it is not applicable for 2-zone scenarios. Refer to AS/NZS 1170.2:2021 section B6.1 for 2 zone scenario)



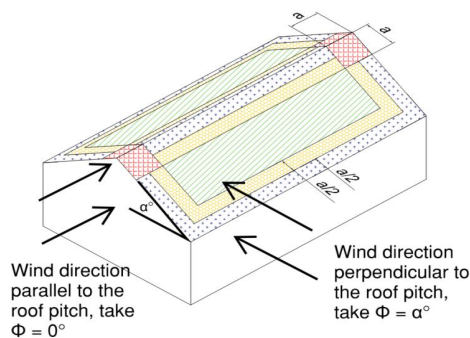
Refer to AS/NZS 1170.2:2021 – Chapter 5.4.4 for more accurate Roof Zone notion and cases.

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

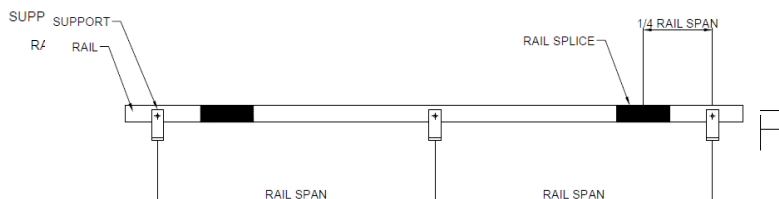
- 1) Determine building height (h), building length (b) and building width (d).
- 2) Determine (h/d) and (h/b)
- 3) If (h/b) or (h/d) ≥ 0.2 , a is the minimum of 0.2b or 0.2d
- 4) If (h/b) and (h/d) < 0.2 , a is equal to 2h

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

Note 3 The pitch angle Φ in the spacing table shall be determined based on the wind direction and the roof pitch angle by following the figure illustration below.



Note 4 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 5 Number of panel clamps required per panel for installation:

		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	4	4	4	6	6
	Corner	4	6	6	6	6	6	6	8	8
Region B1&B2	Internal	4	4	4	4	4	4	4	4	4
	Intermediate	4	4	4	4	4	6	6	6	6
	Edge	6	6	6	6	6	8	8	8	8
Region C	Corner	8	8	8	8	10	10	10	10	NA
	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
Region D	Corner	10	10	NA	NA	NA	NA	NA	NA	NA
	Internal	6	6	6	6	6	8	8	8	8
	Intermediate	8	8	10	8	10	10	10	NA	NA
	Edge	10	10	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 6 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	150%
2300x1200	4 rails	200%
2100x1100	2 rails	109%
2100x1100	3 rails	164%
2100x1100	4 rails	219%
2000x1100	2 rails	115%
2000x1100	3 rails	172%
2000x1100	4 rails	230%
1700x1100	2 rails	135%
1700x1100	3 rails	203%
1700x1100	4 rails	270%

Note: The maximum allowable fixing spacing shall not exceed 1600mm after applying the adjustment factors.

Note 7 The clamps capacities are taken from testing report No.20-0250 by Melbourne Testing Services Pty Ltd, dated 22/06/2020. This test was carried out using Lysaght Longline 305 Non-penetrative roof sheeting clamps. Other roof sheeting products are not covered in this assessment. **The clamps must be mounted over purlins and lapped roof sheeting ribs. No clamp is allowed to be installed on full roof sheeting ribs.**

Note 8 Linear interpolation can be used for determining the spacing values between $h/d > 0.5$ and $h/d < 1$:

Example for $h/d=0.75$:

1. Find fixing spacing **S1** from " $h/d \geq 1$ " table
2. Find fixing spacing **S2** from " $h/d \leq 0.5$ " table
3. **Final Fixing Spacing for $h/d=0.75$:**

$$= S1 + \frac{0.75-0.5}{1-0.5} \times (S2 - S1)$$

Note: Linear interpolation can only be used between tables with the same Terrain Category and Roof Zone.

Note 9 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.