



**EBULEN CONSULT**

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

**ANTAI FLUSH-MOUNT SYSTEM WITH 499 RAIL, L-FOOT & SCREW FIXING**

Prepared for:

**Antai Technology Co., Ltd.**

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Xiamen, China

September 27, 2023

Ref: E22110958

## OVERVIEW

This structural engineering certificate is issued for Antai Solar Roof Flush-mount racking system with 499 rail, L-foot bracket 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-499	AL 6005-T6
Rail Splice	ATL-TYN-304/54	AL 6005-T6
	ATL-CG-20	AL 6005-T6
Tin Interface Bracket	ATL-FWNY-05	AL 6005-T6
Tile Hook Bracket	ATL-TYN-HOOK01	SUS 304
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
- 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.
- 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 is taken as per test report No.MT-14/473 by Melbourne Testing Service Pty Ltd., dated 04/07/2014
- 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 - SPACING TABLES FOR TILE HOOK BRACKET

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		
			$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 25^\circ$	$\Phi > 25^\circ$	$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 25^\circ$	$\Phi > 25^\circ$	$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 25^\circ$	$\Phi > 25^\circ$	$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 25^\circ$	$\Phi > 25^\circ$
A	Internal Zone		1613	1710	1861	1613	1710	1861	1481	1567	1700	1404	1467	1587
	Intermediate Zone		1310	1365	1445	1310	1365	1445	1230	1283	1360	1150	1222	1295
	Edge Zone		1102	1200	1273	1102	1200	1273	945	1047	1195	839	928	1071
	Corner Zone		709	783	902	709	783	902	611	674	775	544	600	689
B1	Internal Zone		1325	1381	1466	1325	1381	1466	1245	1298	1375	1183	1236	1310
	Intermediate Zone		995	1103	1221	995	1103	1221	854	945	1091	759	839	967
	Edge Zone		728	805	927	728	805	927	627	693	797	559	617	708
	Corner Zone		474	523	600	474	523	600	410	451	517	366	403	461
B2	Internal Zone		1268	1322	1400	1268	1322	1400	1191	1242	1317	1062	1177	1254
	Intermediate Zone		894	990	1143	894	990	1143	769	850	980	684	755	870
	Edge Zone		656	725	834	656	725	834	566	624	717	504	556	638
	Corner Zone		428	472	541	428	472	541	370	408	467	330	364	417
C	Internal Zone		883	978	1129	883	978	1129	759	840	968	675	746	859
	Intermediate Zone		572	631	725	572	631	725	494	545	625	440	485	557
	Edge Zone		423	466	534	423	466	534	366	403	461	327	360	412
	Corner Zone		278	306	350	278	306	350	241*	265*	303	215*	237*	271*
D	Internal Zone		561	619	711	561	619	711	484	534	612	432	476	545
	Intermediate Zone		367	404	463	367	404	463	317	349	400	284	312	357
	Edge Zone		272*	300	343	272*	300	343	236*	260*	297	211*	232*	265*
	Corner Zone		180*	198*	226*	180*	198*	226*	156*	172*	196*	140*	153*	175*

- 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  $\Phi$  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.

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		
			$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 25^\circ$	$\Phi > 25^\circ$	$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 25^\circ$	$\Phi > 25^\circ$	$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 25^\circ$	$\Phi > 25^\circ$	$\Phi < 10^\circ$	$10^\circ \leq \Phi \leq 25^\circ$	$\Phi > 25^\circ$
A	Internal Zone		1332	1390	1613	1332	1390	1613	1252	1307	1481	1191	1245	1404
	Intermediate Zone		1009	1123	1310	1009	1123	1310	866	962	1230	769	854	1150
	Edge Zone		738	819	1102	738	819	1102	636	705	945	566	627	839
	Corner Zone		480	532	709	480	532	709	415	459	611	370	410	544
B1	Internal Zone		1037	1155	1325	1037	1155	1325	890	989	1245	791	878	1183
	Intermediate Zone		668	741	995	668	741	995	576	639	854	514	569	769
	Edge Zone		493	546	728	493	546	728	426	471	627	380	421	559
	Corner Zone		323	357	474	323	357	474	280	309	410	250*	276	366
B2	Internal Zone		932	1036	1268	932	1036	1268	801	889	1191	712	790	1062
	Intermediate Zone		603	668	894	603	668	894	520	576	769	464	513	684
	Edge Zone		445	493	656	445	493	656	385	426	566	344	380	504
	Corner Zone		292	323	428	292	323	428	253*	280	370	226*	250*	330
C	Internal Zone		595	660	883	595	660	883	514	569	759	458	507	675
	Intermediate Zone		389	430	572	389	430	572	337	372	494	301	332	440
	Edge Zone		289	319	423	289	319	423	250*	276	366	224*	247*	327
	Corner Zone		191*	210*	278	191*	210*	278	165*	182*	241*	148*	163*	215*
D	Internal Zone		381	422	561	381	422	561	330	365	484	295	326	432
	Intermediate Zone		251*	277	367	251*	277	367	217*	240*	317	194*	215*	284
	Edge Zone		187*	206*	272*	187*	206*	272*	162*	179*	236*	145*	160*	211*
	Corner Zone		124*	136*	180*	124*	136*	180*	107*	118*	156*	96*	106*	140*

- 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  $\Phi$  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.

Interface Spacing Table for Terrain Category 2.5, h/d ≤ 0.5 (Unit: mm)														
Wind Region	Height & Roof Pitch Roof Zone		H<5m			5m<H<10m			10m<H≤15m			15m<H≤20m		
			Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°
A	Internal Zone		1522	1612	1750	1431	1505	1631	1366	1423	1527	1318	1373	1455
	Intermediate Zone		1256	1309	1387	1194	1245	1320	1073	1187	1259	981	1087	1214
	Edge Zone		993	1101	1220	879	973	1123	784	867	999	719	794	914
	Corner Zone		641	708	814	569	628	722	509	562	645	468	516	592
B1	Internal Zone		1270	1324	1403	1208	1260	1335	1103	1201	1273	1009	1119	1228
	Intermediate Zone		898	994	1148	795	880	1014	710	784	903	651	719	827
	Edge Zone		658	727	837	585	645	742	523	577	662	480	530	608
	Corner Zone		429	473	543	382	421	483	343	377	432	315	347	397
B2	Internal Zone		1216	1268	1344	1114	1206	1278	991	1098	1219	907	1004	1160
	Intermediate Zone		807	893	1030	716	791	911	639	706	812	587	648	745
	Edge Zone		594	655	753	528	582	668	472	520	597	434	478	548
	Corner Zone		388	427	490	345	381	436	310	341	390	285	314	359
C	Internal Zone		798	882	1017	707	782	900	632	698	802	580	640	735
	Intermediate Zone		518	571	656	461	508	583	412	455	521	379	418	479
	Edge Zone		383	422	484	341	376	431	306	337	386	282	310	355
	Corner Zone		252*	278	317	225*	247*	283	202*	222*	254*	186*	204*	233*
D	Internal Zone		508	560	643	451	498	571	404	445	511	372	409	469
	Intermediate Zone		333	366	419	296	326	373	266*	293	335	245*	269*	308
	Edge Zone		247*	272*	311	221*	243*	277	198*	218*	249*	182*	200*	229*
	Corner Zone		163*	180*	205*	146*	160*	183*	131*	144*	164*	121*	133*	151*

- 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.

Interface Spacing Table for Terrain Category 2.5, h/d ≥ 1 (Unit: mm)														
Wind Region	Height & Roof Pitch Roof Zone		H<5m			5m<H<10m			10m<H≤15m			15m<H≤20m		
			Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°
A	Internal Zone		1277	1334	1522	1215	1269	1431	1119	1210	1366	1023	1139	1318
	Intermediate Zone		910	1012	1256	806	895	1194	719	798	1073	660	732	981
	Edge Zone		667	740	993	592	657	879	530	587	784	487	539	719
	Corner Zone		435	481	641	387	428	569	347	384	509	319	353	468
B1	Internal Zone		935	1040	1270	828	920	1208	739	820	1103	678	752	1009
	Intermediate Zone		605	670	898	537	595	795	481	532	710	442	489	651
	Edge Zone		447	494	658	398	440	585	356	394	523	328	362	480
	Corner Zone		293	324	429	261*	289	382	235*	259*	343	216*	238*	315
B2	Internal Zone		841	935	1216	746	828	1114	666	738	991	611	677	907
	Intermediate Zone		545	604	807	485	537	716	434	480	639	399	441	587
	Edge Zone		404	446	594	359	397	528	322	356	472	296	327	434
	Corner Zone		265*	293	388	237*	261*	345	212*	234*	310	195*	216*	285
C	Internal Zone		539	597	798	479	531	707	429	475	632	394	436	580
	Intermediate Zone		353	390	518	314	347	461	282	311	412	259*	287	379
	Edge Zone		262*	290	383	234*	258*	341	210*	232*	306	193*	213*	282
	Corner Zone		173*	191*	252*	155*	171*	225*	139*	153*	202*	128*	141*	186*
D	Internal Zone		346	382	508	308	341	451	276	305	404	254*	281	372
	Intermediate Zone		228*	252*	333	203*	224*	296	182*	201*	266*	168*	185*	245*
	Edge Zone		170*	187*	247*	152*	167*	221*	136*	150*	198*	125*	138*	182*
	Corner Zone		112*	124*	163*	100*	111*	146*	90*	99*	131*	83*	92*	121*

- 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.

Interface Spacing Table for Terrain Category 2, h/d ≤ 0.5 (Unit: mm)													
Wind Region	Height & Roof Pitch Roof Zone	H<5m			5m<H<10m			10m<H≤15m			15m<H≤20m		
		Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°
A	Internal Zone	1444	1525	1653	1329	1385	1472	1273	1327	1405	1241	1294	1371
	Intermediate Zone	1206	1258	1333	1003	1112	1225	901	998	1153	848	938	1083
	Edge Zone	900	997	1151	734	811	935	661	730	840	623	688	791
	Corner Zone	583	643	739	478	527	604	431	475	545	407	448	514
B1	Internal Zone	1220	1272	1348	1032	1144	1239	927	1026	1186	872	965	1114
	Intermediate Zone	814	901	1039	665	735	845	599	662	761	565	623	716
	Edge Zone	598	661	759	490	541	621	443	488	560	418	460	528
	Corner Zone	391	431	494	322	354	405	291	320	366	274	302	346
B2	Internal Zone	1141	1217	1291	927	1026	1186	833	922	1064	784	867	1000
	Intermediate Zone	733	810	933	599	662	761	541	597	685	509	562	645
	Edge Zone	540	596	684	443	488	560	400	441	505	377	416	476
	Corner Zone	353	389	446	291	320	366	263*	289	331	248*	273	312
C	Internal Zone	724	800	922	592	654	751	534	589	677	503	555	637
	Intermediate Zone	471	520	596	387	426	489	350	385	441	330	363	416
	Edge Zone	349	385	441	287	316	362	260*	286	327	245*	270*	309
	Corner Zone	230*	253*	289	190*	209*	238*	172*	189*	216*	162*	178*	204*
D	Internal Zone	462	509	584	379	418	479	343	378	432	324	356	408
	Intermediate Zone	303	334	382	250*	275	314	226*	249*	284	213*	235*	268*
	Edge Zone	226*	248*	284	186*	205*	234*	168*	185*	211*	159*	175*	200*
	Corner Zone	149*	164*	187*	123*	135*	154*	111*	122*	140*	105*	116*	132*

- 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.

Interface Spacing Table for Terrain Category 2, h/d ≥ 1 (Unit: mm)													
Wind Region	Height & Roof Pitch Roof Zone	H<5m			5m<H<10m			10m<H≤15m			15m<H≤20m		
		Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°
A	Internal Zone	1227	1281	1444	1046	1164	1329	939	1045	1273	883	982	1241
	Intermediate Zone	825	917	1206	674	747	1003	607	673	901	572	634	848
	Edge Zone	606	672	900	497	550	734	449	497	661	423	468	623
	Corner Zone	396	438	583	326	360	478	295	326	431	278	307	407
B1	Internal Zone	848	942	1220	692	768	1032	624	692	927	588	651	872
	Intermediate Zone	550	609	814	451	499	665	407	451	599	384	425	565
	Edge Zone	407	450	598	334	370	490	302	334	443	265	315	418
	Corner Zone	267*	295	391	220*	243*	322	199*	220*	291	168*	208*	274
B2	Internal Zone	763	847	1141	624	692	927	563	623	833	530	587	784
	Intermediate Zone	496	549	733	407	451	599	368	407	541	347	384	509
	Edge Zone	368	406	540	302	334	443	273	302	400	258*	285	377
	Corner Zone	242*	267*	353	199*	220*	291	180*	199*	263*	170*	188*	248*
C	Internal Zone	490	543	724	403	445	592	364	402	534	343	379	503
	Intermediate Zone	322	355	471	265*	292	387	239*	265*	350	226*	250*	330
	Edge Zone	239*	264*	349	197*	218*	287	178*	197*	260*	168*	186*	245*
	Corner Zone	158*	174*	230*	130*	144*	190*	118*	130*	172*	112*	123*	162*
D	Internal Zone	315	348	462	260*	287	379	235*	259*	343	222*	245*	324
	Intermediate Zone	208*	229*	303	171*	189*	250*	155*	171*	226*	147*	162*	213*
	Edge Zone	155*	171*	226*	128*	141*	186*	116*	128*	168*	109*	121*	159*
	Corner Zone	103*	113*	149*	85*	93*	123*	77*	85*	111*	72*	80*	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.



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## APPENDIX B - SPACING TABLES FOR PENETRATIVE SCREW



Interface Spacing Table for Terrain Category 3, h/d ≤ 0.5 (Unit: mm)														
Wind Region	Height & Roof Pitch Roof Zone		H<5m			5m<H<10m			10m<H<15m			15m<H<20m		
			Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°
A	Internal Zone		1613	1710	1861	1613	1710	1861	1481	1567	1700	1387	1467	1587
	Intermediate Zone		1266	1337	1443	1266	1337	1443	1183	1233	1329	1130	1175	1248
	Edge Zone		1111	1156	1221	1111	1156	1221	1046	1089	1151	997	1039	1099
	Corner Zone		931	970	1027	931	970	1027	862	911	966	768	847	920
B1	Internal Zone		1285	1357	1466	1285	1357	1466	1196	1251	1349	1142	1188	1266
	Intermediate Zone		1068	1111	1174	1068	1111	1174	1005	1046	1107	957	998	1056
	Edge Zone		941	981	1038	941	981	1038	884	922	977	789	871	930
	Corner Zone		669	738	846	669	738	846	578	637	730	516	569	651
B2	Internal Zone		1217	1282	1383	1217	1282	1383	1148	1193	1275	1095	1140	1204
	Intermediate Zone		1023	1066	1127	1023	1066	1127	962	1003	1061	917	956	1012
	Edge Zone		901	939	995	901	939	995	799	881	935	712	785	891
	Corner Zone		604	666	764	604	666	764	523	576	659	467	514	588
C	Internal Zone		997	1084	1149	997	1084	1149	858	948	1079	763	843	970
	Intermediate Zone		646	713	819	646	713	819	558	615	706	497	548	629
	Edge Zone		478	526	603	478	526	603	413	455	521	369	406	465
	Corner Zone		314	345	395	314	345	395	272*	299*	342	243*	267*	306*
D	Internal Zone		633	699	803	633	699	803	547	603	692	487	537	616
	Intermediate Zone		414	456	523	414	456	523	358	395	452	320	353	403
	Edge Zone		308*	339	387	308*	339	387	267*	293*	335	238*	262*	300*
	Corner Zone		203*	223*	255*	203*	223*	255*	176*	194*	221*	158*	173*	198*

- 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.

Interface Spacing Table for Terrain Category 3, h/d ≥ 1 (Unit: mm)														
Wind Region	Height & Roof Pitch Roof Zone		H<5m			5m<H<10m			10m<H<15m			15m<H<20m		
			Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°
A	Internal Zone		1294	1370	1613	1294	1370	1613	1202	1263	1481	1148	1196	1387
	Intermediate Zone		1074	1119	1266	1074	1119	1266	1010	1054	1183	963	1005	1130
	Edge Zone		946	988	1111	946	988	1111	889	928	1046	799	884	997
	Corner Zone		678	750	931	678	750	931	586	648	862	523	578	768
B1	Internal Zone		1085	1131	1285	1085	1131	1285	1022	1065	1196	974	1016	1142
	Intermediate Zone		908	948	1068	908	948	1068	814	891	1005	725	803	957
	Edge Zone		696	771	941	696	771	941	602	666	884	537	594	789
	Corner Zone		457	505	669	457	505	669	395	437	578	353*	390	516
B2	Internal Zone		1040	1085	1217	1040	1085	1217	979	1021	1148	932	973	1095
	Intermediate Zone		851	908	1023	851	908	1023	734	813	962	655	725	917
	Edge Zone		629	696	901	629	696	901	543	601	799	485	536	712
	Corner Zone		413	456	604	413	456	604	358*	395	523	320*	353*	467
C	Internal Zone		672	745	997	672	745	997	580	643	858	517	573	763
	Intermediate Zone		439	486	646	439	486	646	380	420	558	340	375	497
	Edge Zone		326	361	478	326	361	478	283*	312	413	253*	279*	369
	Corner Zone		215*	238*	314	215*	238*	314	187*	206*	272*	167*	184*	243*
D	Internal Zone		431	476	633	431	476	633	373	412	547	333	368	487
	Intermediate Zone		283*	313	414	283*	313	414	246*	271*	358	220*	243*	320
	Edge Zone		211*	233*	308*	211*	233*	308*	183*	202*	267*	164*	181*	238*
	Corner Zone		140*	154*	203*	140*	154*	203*	121*	134*	176*	109*	120*	158*

- 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.

Interface Spacing Table for Terrain Category 2.5, h/d <= 0.5 (Unit: mm)														
Wind Region	Height & Roof Pitch Roof Zone		H<5m			5m<H<10m			10m<H<=15m			15m<H<=20m		
			Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°
A	Internal Zone		1522	1612	1750	1423	1505	1631	1337	1412	1527	1276	1347	1455
	Intermediate Zone		1206	1266	1365	1150	1196	1279	1100	1144	1208	1062	1106	1168
	Edge Zone		1067	1111	1174	1016	1058	1119	970	1011	1070	936	975	1033
	Corner Zone		892	930	985	804	885	938	719	793	894	660	728	835
B1	Internal Zone		1218	1284	1386	1163	1209	1298	1112	1157	1221	1074	1118	1181
	Intermediate Zone		1025	1067	1129	976	1017	1076	931	970	1027	898	936	992
	Edge Zone		902	941	996	826	895	948	738	815	905	678	748	858
	Corner Zone		606	668	766	540	595	681	484	533	610	445	490	561
B2	Internal Zone		1170	1216	1309	1116	1161	1227	1066	1110	1173	1029	1072	1133
	Intermediate Zone		982	1023	1082	935	974	1031	891	929	984	829	896	950
	Edge Zone		838	901	954	745	822	908	666	735	843	612	675	774
	Corner Zone		548	604	692	488	537	615	437	481	551	402	443	507
C	Internal Zone		901	996	1101	799	883	1016	713	788	906	655	723	831
	Intermediate Zone		585	645	741	520	574	658	466	513	588	428	472	540
	Edge Zone		433	477	547	386	425	486	346	381	436	318	350	400
	Corner Zone		285*	314	358	254*	279*	319	228*	251*	287*	210*	231*	264*
D	Internal Zone		573	632	726	510	562	645	457	503	577	420	462	530
	Intermediate Zone		376	414	474	335	369	422	300*	330	378	276*	304*	348
	Edge Zone		279*	307*	351	249*	274*	313	224*	246*	281*	206*	226*	259*
	Corner Zone		185*	203*	232*	165*	181*	207*	148*	163*	186*	136*	150*	171*

- 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.

Interface Spacing Table for Terrain Category 2.5, h/d >= 1 (Unit: mm)														
Wind Region	Height & Roof Pitch Roof Zone		H<5m			5m<H<10m			10m<H<=15m			15m<H<=20m		
			Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°
A	Internal Zone		1226	1296	1522	1169	1217	1423	1118	1165	1337	1080	1125	1276
	Intermediate Zone		1031	1075	1206	981	1024	1150	936	977	1100	903	943	1062
	Edge Zone		907	947	1067	836	901	1016	748	829	970	687	761	936
	Corner Zone		614	680	892	547	605	804	490	542	719	451	498	660
B1	Internal Zone		1042	1087	1218	992	1035	1163	947	988	1112	913	954	1074
	Intermediate Zone		854	909	1025	759	840	976	679	752	931	624	690	898
	Edge Zone		631	698	902	561	621	826	503	556	738	463	511	678
	Corner Zone		414	458	606	369*	408	540	331*	366*	484	305*	337*	445
B2	Internal Zone		998	1042	1170	950	992	1116	907	947	1066	862	913	1029
	Intermediate Zone		770	853	982	685	758	935	613	678	891	563	623	829
	Edge Zone		570	630	838	507	561	745	455	503	666	418	462	612
	Corner Zone		375*	414	548	334*	369*	488	300*	331*	437	276*	305*	402
C	Internal Zone		609	674	901	541	599	799	484	536	713	445	493	655
	Intermediate Zone		398	441	585	355	392	520	318	352	466	293*	324	428
	Edge Zone		296*	327	433	264*	292*	386	237*	262*	346	218*	241*	318
	Corner Zone		196*	216*	285*	175*	193*	254*	157*	173*	228*	144*	159*	210*
D	Internal Zone		391	432	573	348	385	510	312	345	457	287*	317	420
	Intermediate Zone		257*	284*	376	230*	253*	335	206*	227*	300*	190*	209*	276*
	Edge Zone		192*	212*	279*	171*	189*	249*	154*	170*	224*	142*	156*	206*
	Corner Zone		127*	140*	185*	113*	125*	165*	102*	112*	148*	94*	103*	136*

- 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.

Interface Spacing Table for Terrain Category 2, h/d ≤ 0.5 (Unit: mm)													
Wind Region	Height & Roof Pitch Roof Zone	H<5m			5m<H<10m			10m<H≤15m			15m<H≤20m		
		Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°
A	Internal Zone	1442	1525	1653	1291	1363	1472	1220	1287	1389	1192	1246	1344
	Intermediate Zone	1161	1207	1295	1071	1115	1178	1027	1069	1131	1002	1043	1104
	Edge Zone	1026	1068	1130	944	984	1042	904	942	998	879	919	974
	Corner Zone	823	894	947	674	744	853	609	671	770	574	633	725
B1	Internal Zone	1174	1220	1315	1083	1127	1191	1038	1081	1143	1013	1055	1116
	Intermediate Zone	985	1026	1086	906	945	1000	846	904	958	797	880	935
	Edge Zone	845	904	958	693	764	876	625	689	790	590	650	745
	Corner Zone	552	608	697	454	500	572	411	452	517	388	427	488
B2	Internal Zone	1126	1171	1243	1038	1081	1143	995	1036	1096	970	1011	1070
	Intermediate Zone	944	983	1041	846	904	958	763	842	918	719	793	895
	Edge Zone	762	841	917	625	689	790	565	622	713	533	587	672
	Corner Zone	499	550	629	411	452	517	371*	409	468	351*	386	441
C	Internal Zone	818	904	1041	669	738	849	603	666	764	569	627	720
	Intermediate Zone	532	587	673	437	482	552	395	435	498	373	410	470
	Edge Zone	394	434	497	325	357	409	294*	323	370	277*	305*	349
	Corner Zone	260*	286*	327	214*	236*	269*	194*	213*	244*	183*	201*	230*
D	Internal Zone	522	575	660	429	472	541	387	427	488	365	402	461
	Intermediate Zone	342	377	431	282*	310	355	255*	281*	321	241*	265*	303*
	Edge Zone	255*	280*	320	210*	231*	264*	190*	209*	239*	180*	197*	225*
	Corner Zone	168*	185*	211*	139*	153*	174*	126*	138*	158*	119*	131*	149*

- 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.

Interface Spacing Table for Terrain Category 2, h/d ≥ 1 (Unit: mm)													
Wind Region	Height & Roof Pitch Roof Zone	H<5m			5m<H<10m			10m<H≤15m			15m<H≤20m		
		Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°	Φ < 10°	10° ≤ Φ ≤ 25°	Φ > 25°
A	Internal Zone	1180	1231	1442	1089	1135	1291	1044	1088	1220	1018	1062	1192
	Intermediate Zone	991	1034	1161	911	951	1071	857	911	1027	808	888	1002
	Edge Zone	856	910	1026	702	777	944	633	701	904	597	681	879
	Corner Zone	559	619	823	460	509	674	416	460	609	393	434	574
B1	Internal Zone	1002	1045	1174	922	962	1083	881	921	1038	830	898	1013
	Intermediate Zone	776	860	985	637	705	906	575	636	846	542	600	797
	Edge Zone	574	635	845	472	522	693	427	472	625	403	445	590
	Corner Zone	378*	417	552	311*	344*	454	282*	311*	411	266*	294*	388
B2	Internal Zone	960	1001	1126	881	921	1038	794	880	995	748	829	970
	Intermediate Zone	701	776	944	575	636	846	520	575	763	490	542	719
	Edge Zone	519	574	762	427	472	625	386	427	565	364*	403	533
	Corner Zone	342*	377*	499	282*	311*	411	255*	281*	371*	241*	266*	351*
C	Internal Zone	554	613	818	455	503	669	411	454	603	388	428	569
	Intermediate Zone	363	401	532	299*	330	437	270*	299*	395	255*	282*	373
	Edge Zone	270*	298*	394	223*	246*	325	202*	222*	294*	190*	210*	277*
	Corner Zone	178*	197*	260*	147*	163*	214*	133*	147*	194*	126*	139*	183*
D	Internal Zone	356	393	522	293*	324	429	265*	293*	387	250*	276*	365
	Intermediate Zone	235*	259*	342	194*	214*	282*	175*	193*	255*	166*	183*	241*
	Edge Zone	175*	193*	255*	144*	159*	210*	131*	144*	190*	124*	136*	180*
	Corner Zone	116*	128*	168*	96*	106*	139*	87*	96*	126*	82*	90*	119*

- 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.

## General Notes

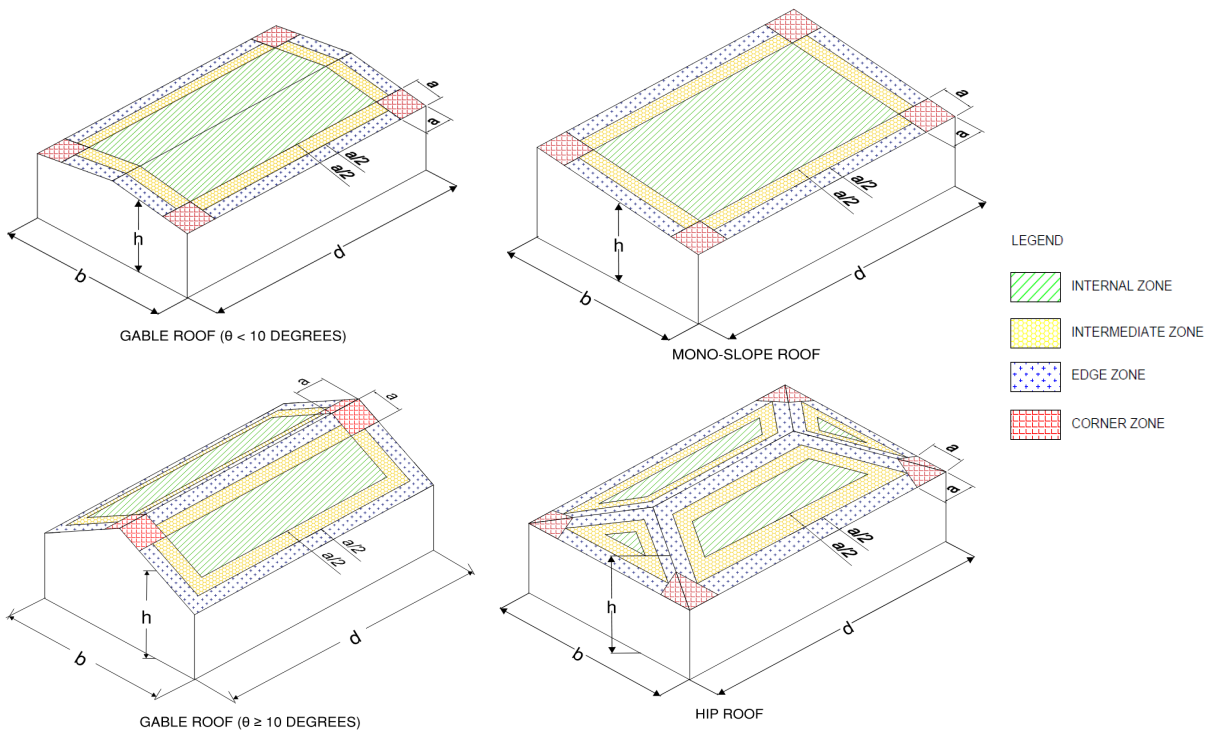
**Note 1** Terrain Category 3 (TC 3) denotes terrain with numerous closely spaced obstructions having heights generally from 3m to 10m. The minimum density of obstructions shall be at least the equivalent of 10 house-size obstructions per hectare.

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)



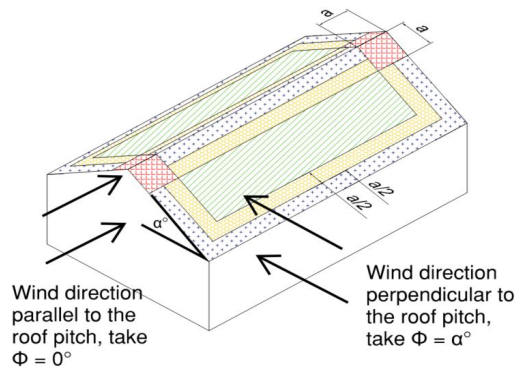
Refer to AS/NZS 1170.2:2021 – Chapter 5.4.4 for more accurate Roof Zone notion and cases.

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

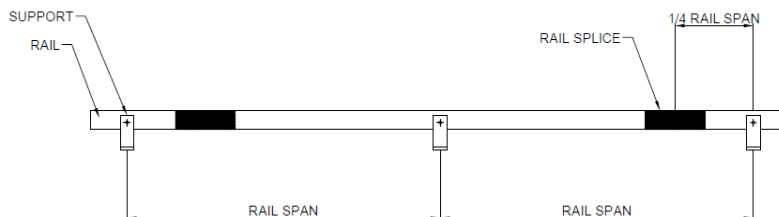
- 1) Determine building height (h), building length (b) and building width (d).
- 2) Determine (h/d) and (h/b)
- 3) If (h/b) or (h/d)  $\geq 0.2$ , a is the minimum of 0.2b or 0.2d
- 4) If (h/b) and (h/d)  $< 0.2$ , a is equal to 2h

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

**Note 3** The pitch angle  $\Phi$  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
	Corner	8	8	8	8	10	10	10	10	NA
Region C	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	10	NA	NA	NA	NA	NA	NA	NA
Region D	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	118%
2300x1200	4 rails	131%
2100x1100	2 rails	104%
2100x1100	3 rails	123%
2100x1100	4 rails	138%
2000x1100	2 rails	105%
2000x1100	3 rails	124%
2000x1100	4 rails	140%
1700x1100	2 rails	113%
1700x1100	3 rails	132%
1700x1100	4 rails	152%

**Note:** The maximum allowable fixing spacing shall not exceed 2000mm after applying the adjustment factors.

**Note 7** 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. Minimum 2 screw fixings are required for each tile hook bracket. 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: 63%
- 2) 1.5mm BMT: 79%
- 3) 2.4mm BMT: 100% for region A and B, 126% for region 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; 154% for Region C&D

**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 example, when installing the racking frame with 2300mm x 1200mm panels and 3 rails fixed to 2.4mm BMT purlins in Region C, it is incorrect that spacing = original spacing x 122% x 126%. For multiple installation conditions change, please seek for the engineer's advice.