



EBULEN CONSULT

SOLAR PV ROOF-MOUNT RACKING FRAME ENGINEERING CERTIFICATE

GOOMAX TILE ROOF FLUSH-MOUNT SYSTEM

Prepared for:

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Xiamen, China

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Ref: E22040528

OVERVIEW

This structural engineering certificate is issued for Goomax Tile Roof Flush-mount racking system, which is 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
- AS 4312-2019 - Atmospheric corrosivity zones in Australia and detailed calculation referred to:
 - (1) ISO9224:2012 - Corrosion of metals and alloys Corrosivity of atmospheres - Guiding values for the corrosivity categories
 - (2) ISO9223:2012 - Corrosion of metals and alloys - Corrosivity of atmospheres - Classification, determination and estimation

ASSESSED PV RACKING FRAME COMPONENTS

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

Assessed Components	Component Number	Material
Goomax Rail 1	GM-R56	AL 6005-T5
Goomax Rail 2	GM-R69 (GM-R69-B)	AL 6005-T5
Goomax Rail 3	GM-R01-Light	AL 6005-T5
Rail Splice 1	GM-RS-51-AZ	AL 6005-T5
Rail Splice 2	GM-RS-51-AZ-1	AL 6005-T5
Rail Splice 3	GM-RS-56-AZ (GM-RS-56-AZ-B)	AL 6005-T5
Tile Roof Hook	GM-CTH-01-AZ-02	AL 6005-T5
	GM-CTH-01-P	AL 6005-T5
	GM-CTH-11-AZ	AL 6005-T5
	GM-CTH-10-AZ	AL 6005-T5
Goomax Adjustable Middle Panel Clamp	GM-MC-30(35)-AZ, GM-MC-30(35)-AZ-2 GM-MC-30(40)-AZ	AL 6005-T5

	GM-MC-35(40)-AZ GM-MC-35(40)-AZ-1 GM-MC-35(40)-AZ-2 GM-MC-35/50-D GM-MC-30/35/40/42/45/50-AZ GM-MC-60-TF2-AZ GM-MC-200-TF2-AZ GM-E/MC-30(40)-AZ	
Goomax Adjustable End Panel Clamp	GM-EC-30/35/40/42/45/50-AZ GM-EC-35(40)-AZ GM-EC-30(40)-AZ GM-EC-30(35)-AZ (GM-EC-30(35)-AZ-B) GM-EC-35/50-D GM-EC-60-TF2-AZ GM-EC-200-TF2-AZ	AL 6005-T5
Bolt and Nut	GM-BN-25-AZ	AL 6005-T5, SUS304
Other Required but Non-structural Components	GM-CT-AZ, GM-E-EL-AZ, GM-EK-AZ, GM-SL-XJ-AZ, GM-XJ-AZ, GM-E-EL-12	SUS 304, Plastic

Note: the materials listed in the table refer to the main components and members of the racking frame, other accessories such as nuts, bolts, washers, and sockets are made of SUS 304.

ASSESSMENT CONDITIONS

- Solar PV system design life of 25 years
- Wind region A, B, C, D
- Terrain category 2 & 3
- Ultimate wind recurrence interval of 200 years
- Maximum average roof height of 20m
- Maximum panel tilt angle to roof surface is 30°
- Solar PV panel assessed: 2400mm x 1200mm, 2000mm x 1200mm and 1670mm x 1000mm
- Self-weight of solar PV panel and racking frame is 0.15kPa-0.19kPa
- Solar PV panel is supported by minimum 2 rails
- Penetrative fixing is assumed to be fixed into JD4 seasoned timber
- Tile hook capacities are taken from:
 - Test Report with Test No. XMML22050059, XMML22050060M, XMML22050061_EN, XMML22050062M, XMML22050066, XMML22050067 by BM Shenghe Testing Technology (Xiamen) Co., Ltd., dated 20 May 2022

- Product details are taken from the drawing set provided by Xiamen Goomax Energy 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 aluminum material adopted for the solar racking frame system has been specified as AL6005-T5 by Goomax. The material used in the manufacturing process shall achieve the minimum strength requirements in AS/NZS 1664: 1997 – Aluminum Structures.***
- ***The attached spacing tables must be read in conjunction with foot notes and general notes.***
- ***The non-structural components are only certified structurally using the deem-to-comply method as they do not contribute to the system's structural capacity.***
- ***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 Xiamen Goomax Energy 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 FOR 2M X 1.2M PV PANEL

Interface Spacing Table for Terrain Category 3 (Unit: mm)

Wind Region	Roof Height	H≤10m	10m<H≤15m	15m<H≤20m
A	Internal Zone	1500	1500	1360
	Intermediate Zone	1500	1308	859
	Edge Zone	1244	943	627
	Corner Zone	789	605	408
B	Internal Zone	1500	1500	1204
	Intermediate Zone	1459	1158	765
	Edge Zone	1103	839	560
	Corner Zone	704	540	365*
C	Internal Zone	1450	1224	806
	Intermediate Zone	1020	777	520
	Edge Zone	741	569	384*
	Corner Zone	480	370*	252*
D	Internal Zone	1180	913	608
	Intermediate Zone	765	587	396*
	Edge Zone	560	432*	293*
	Corner Zone	365*	283*	193*

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.
- Roof pitch angle is given in reference to horizontal.
- The spacing table is based on the fixing condition specified in General Note 7.

Interface Spacing Table for Terrain Category 2 (Unit: mm)

Wind Region	Roof Height	H≤10m	10m<H≤15m	15m<H≤20m
A	Internal Zone	1500	1427	990
	Intermediate Zone	1129	899	634
	Edge Zone	818	656	466
	Corner Zone	528	426	305
B	Internal Zone	1485	1262	880
	Intermediate Zone	1002	800	566
	Edge Zone	729	585	417
	Corner Zone	472	381*	273*
C	Internal Zone	1058	843	596
	Intermediate Zone	676	543	388*
	Edge Zone	496	401*	287*
	Corner Zone	324*	263*	189*
D	Internal Zone	793	636	452*
	Intermediate Zone	512	413*	296*
	Edge Zone	378*	306*	220*
	Corner Zone	248*	201*	145*

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.
- Roof pitch angle is given in reference to horizontal.
- The spacing table is based on the fixing condition specified in General Note 7.

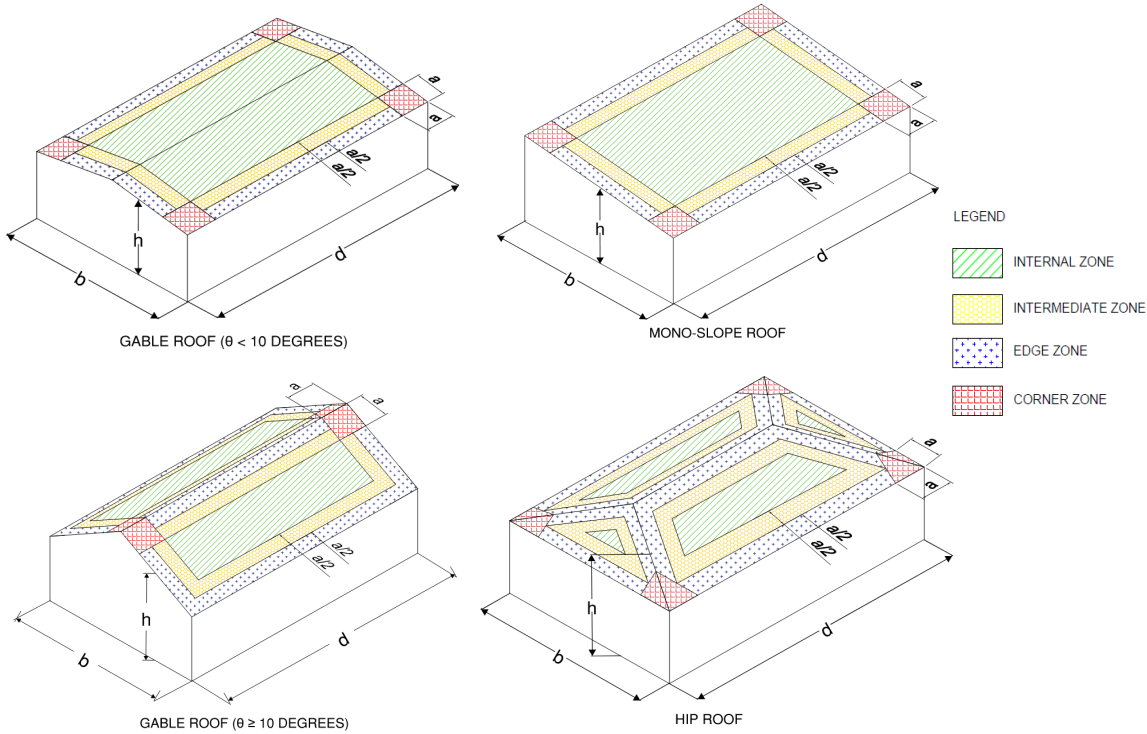
General Notes

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 (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 example (for roof pitch ≤ 10 degrees case) is as shown in the following figure.

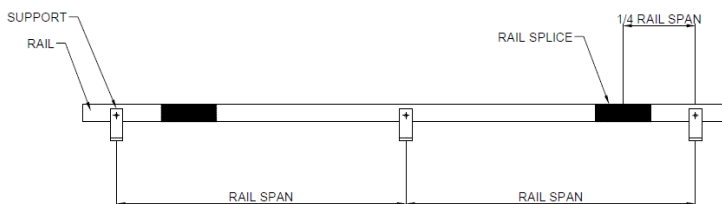


Refer to AS/NZS 1170.2:2021 – Chapter 5.4.4 for more accurate Roof Zone notion and cases.

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 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:

		TC3			TC2		
		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
	Intermediate	4	4	4	4	4	4
	Edge	4	4	4	4	4	4
	Corner	4	4	6	4	6	6
Region B	Internal	4	4	4	4	4	4
	Intermediate	4	4	4	4	4	6
	Edge	4	4	6	4	6	6
	Corner	4	6	NA	6	NA	NA
Region C	Internal	4	4	4	4	4	6
	Intermediate	4	4	6	4	6	NA
	Edge	4	6	NA	6	NA	NA
	Corner	6	8	NA	NA	NA	NA
Region D	Internal	4	4	6	4	6	NA
	Intermediate	6	6	NA	6	NA	NA
	Edge	6	NA	NA	NA	NA	NA
	Corner	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 2000mm 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
2400x1200	2 rails	83%
1670x1000	2 rails	119%
2000x1200	3 rails	150%
2400x1200	3 rails	125%
1670x1000	3 rails	179%

The maximum allowable fixing spacing shall not exceed 1500mm after applying the adjustment factors.

Note 6 The spacing results in previous sections are given based on the corrosivity level C3. Corrosivity adjustment factor for corrosivity category C4 based on the corrosivity category C3 is 95%

Note 7 Fixing spacing in the above tables are based on 14 gauge penetrative fixing pull-out capacity into 35mm embedded into JD4 seasoned timber. The fixing spacing must be adjusted if the roof structure being fixed into does not meet the minimum requirements. The recommended typical penetrative fixings to be adopted are as following:

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

All self-drilling penetrative fixing must be in compliance with AS3566-2002(R2015).

Note 8 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.

APPENDIX B – ASSESSED PV RACKING FRAME PART DRAWINGS

Note:

This certification is a public access version, it does not include part drawings because of Goomax's intellectual properties. Refer to the full version of the certification for part drawings .