

Gamcorp (Melbourne) Pty Ltd A.C.N 141 076 904 A.B.N 73 015 060 240
www.gamcorp.com.au Email: melbourne@gamcorp.com.au
Suite 4, 346 Ferntree Gully Rd, Notting Hill VIC 3149. Tel: 03 9543 2211 Fax: 03 9543 4046

Our Ref: 6165-Powerwave-Rev1/KZ
15 December 2018

FUJIAN FENAN ALUMINIUM CO., LTD
Room No.2704, No.3 Building
Xinglin Bay Business Operations Center
Xiamen City Fujian 361022
China

PV Array Frame Engineering Certification

RE: AS/NZ 1170.2 Certification for Powerwave by FOEN Tile & Tin Roof Flush-Mount PV Array System with B52 Rails

Gamcorp (Melbourne) Pty Ltd, being Structural Engineers within the meaning of Australian Building Regulations, have carried out a structural design check of FOEN Tile and Tin Roof Flush-Mounted PV array system installation within Australia. The design check is based on the information and test reports provided by FUJIAN FENAN ALUMINIUM CO., LTD.

This certificate is only valid for the FOEN Tile and Tin Roof Flush-Mounted PV array system. The roof structure or the building structure shall be assessed separately and accordingly.

This certificate is only valid when fixing into minimum 1.9BMT steel or JD4 seasoned timber. If the fixing condition is different from this conditions, interface spacing shall be reviewed and validated.

This certificate is only valid when the roof zone definition falls into D6 of AS1170.2-2011(R2016).

This certificate is only valid as a whole. Any information extracted from this certificate is not valid if standing alone.

We find the FOEN Tile and Tin Roof Flush-Mounted PV array system for Australian use to be structurally sufficient based on the following conditions:

- Wind loads to AS/NZ1170.2:2011(R2016) Wind actions
- Wind region **A, B, C, D**
- Wind terrain category **2 & 3**
- Wind average recurrence interval of **200 years**
- Maximum building height **20m**
- The maximum assessed PV panels dimensions are **1670mm x 1000mm** and **2000mm x 1000mm**
- Weight of the PV panel and array frame to be 15 kg/m²
- Rails to be **B52 Rails**
- The spacings are determined based on fixings into minimum JD4 seasoned timber and 1.9mm thick steel purlins

Gamcorp (Melbourne) Pty Ltd A.C.N 141 076 904 A.B.N 73 015 060 240
www.gamcorp.com.au Email: melbourne@gamcorp.com.au
Suite 4, 346 Ferntree Gully Rd, Notting Hill VIC 3149. Tel: 03 9543 2211 Fax: 03 9543 4046

- No PV panels to be installed within 2xs from edges and ridge. "s" is the maximum gap between the underside of the PV panels and the roof surface when installed on the roof ($50\text{mm} \leq s \leq 300\text{mm}$)
- Installation of PV panels to be done in accordance with the PV panels installation manual
- The certification **excludes** assessment of roof structure and PV panels

Refer to attached summary table for interface spacing

NOTES:

- **The recommended spacing nominated in this certification is based on the capacity of the array frame, not the roof structure and PV panels. It is the responsibility of the installer to adopt the most critical spacing.**
- **If any of the above conditions cannot be met, the structural engineer must be notified immediately.**
- **Standard Tile Interface is considered reaching its serviceability limit when residual displacement reaches 30% loaded displacement.**
- **The capacity of roof tile hook was obtained from test report no. R20181113-01 dated 13.11.2018 and provided by FUJIAN FENAN ALUMINIUM CO., LTD**
- **The spacing shown in the interface tables shall be adjusted based on the assessment and requirement of the roof structures.**
- **For PV panels with length of 2000mm, reduce the spacing in the tables by 21%.**
- **This certificate is valid till 15.12.2020 unless noted otherwise.**

Construction is to be carried out strictly in accordance with the manufacturers instructions. This work was designed by **Kevin Zhang** in accordance with the provisions of Australian Building Regulations and in accordance with sound, widely accepted engineering principles. This certificate is only valid till 15/12/2020. Gamcorp should be contacted for future validation.

Yours faithfully,
Gamcorp (Melbourne) Pty Ltd

A handwritten signature in black ink, appearing to read 'Jianzeng Geng'.

Jianzeng Geng
Principal Engineer
MIEAust CPEng NER 3108316
NT Registration: 239858ES
QLD Registration: 18455
VIC Registration: EC 39483
TAS Registration: CC7263

Structural Design Documentation

**Certification for Powerwave by FOEN Tile & Tin Roof Flush-Mount
PV Array System
According to AS/NZS 1170.2:2011 (R2016)
with B52 Rail
within Australia
Terrain Category 2 & 3**

For: FUJIAN FENAN ALUMINIUM CO., LTD
Room No.2704, No.3 Building
Xinglin Bay Business Operations Center
Xiamen City Fujian 361022
China

Job Number: 6165
Date: 15 December 2018



COPYRIGHT: The concepts and information contained in this document are the property of Gamcorp (Melbourne) Pty Ltd. Use or copying of this document in whole or in part without the written permission of Gamcorp constitutes an infringement of copyright.

LIMITATION: This report has been prepared on behalf of and for the exclusive use of Gamcorp (Melbourne) Pty Ltd's Client, and is subject to and issued in connection with the provisions of the agreement between Gamcorp (Melbourne) Pty Ltd and its Client. Gamcorp (Melbourne) Pty Ltd accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report by any third party.



Relationships built on trust

Suite 4, 346 Ferntree Gully Road
Notting Hill VIC 3168
Tel: 03 9543 2211
Fax: 03 9543 4046
melbourne@gamcorp.com.au
www.gamcorp.com.au

ISO 9001:2008 Registered Firm
Certificate No: AU1222

Job No: 6165
Client: FUJIAN FENAN ALUMINIUM CO., LTD
Project: Certification for Powerwave by FOEN Tile & Tin Roof Flush-Mount PV Array System
Address: within Australia

Australian Standards

AS/NZS 1170.0:2002 – Structural design actions, Part 0: General principles
AS/NZS 1170.1:2002 – Structural design actions, Part 1: Permanent, imposed
and other actions
AS/NZS 1170.2:2011 (R2016) – Structural design actions, Part 2: Wind actions

AS/NZS 1252:1996 – High Strength Structural Bolting
AS/NZS 1664:1997 – Aluminium Structures
AS 4100:1998(R2016) – Steel Structures
AS/NZS 4600:2005 – Cold-Formed Steel Structures

Wind Terrain Category: WTC 2 & 3

Designed: KZ

Date: Dec-18

Relationships built on trust
 Client: **FUJIAN FENAN ALUMINIUM CO., LTD**
 Project: **Powerwave by FOEN Tile & Tin Roof Flush-Mount PV Array System**
 Address: **within Australia**
 Designed: **KZ**

Job: **6165**
 Date: **Dec-18**

Checked: **AA**

Powerwave by FOEN Flush Array Frame System Spacing Table for tiled roof

Type of Rail: B52 Rail
 Type of Interface: Roof Tile Hook
 Solar Panel Dimension: 1.67m x 1m
 Terrain category: 2

Roof Angle (Φ) - $\Phi < 5^\circ$

Wind Region	Building Height - H (m)							
	H \leq 5		5<H \leq 10		10<H \leq 15		15<H \leq 20	
	D.W & U.W	Central	D.W & U.W	Central	D.W & U.W	Central	D.W & U.W	Central
A	875	1095	710	880	635	790	600	740
B	780	970	635	785	565	700	535	660
C	515	640	420	520	380	465	360	440
D	400	490	325	400	295	360	280	340

Roof Angle (Φ) - $5^\circ \leq \Phi \leq 30$

Wind Region	Building Height - H (m)							
	H \leq 5		5<H \leq 10		10<H \leq 15		15<H \leq 20	
	D.W & U.W	Central	D.W & U.W	Central	D.W & U.W	Central	D.W & U.W	Central
A	875	1315	710	1055	635	940	600	880
B	780	1160	635	935	565	835	535	785
C	515	755	420	615	380	550	360	520
D	400	580	325	475	295	425	280	400



Relationships built on trust
 Client: **FUJIAN FENAN ALUMINIUM CO., LTD**
 Project: **Powerwave by FOEN Tile & Tin Roof Flush-Mount PV Array System**
 Address: **within Australia**
 Designed: **KZ**

Job: **6165**
 Date: **Dec-18**
 Checked: **AA**

Powerwave by FOEN Flush Array Frame System Spacing Table for tiled roof

Type of Rail: B52 Rail
 Type of Interface: L-Feet
 Solar Panel Dimension: 1.67m x 1m
 Terrain category: 2

Roof Angle (Φ) - $\Phi < 5^\circ$

Wind Region	Building Height - H (m)							
	H ≤ 5		5 < H ≤ 10		10 < H ≤ 15		15 < H ≤ 20	
	D.W & U.W	Central	D.W & U.W	Central	D.W & U.W	Central	D.W & U.W	Central
A	1485	1575	1380	1490	1270	1430	1200	1400
B	1045	1280	855	1050	775	945	730	895
C	555	680	460	560	415	505	390	480
D	340	415	280	340	255	310	240	295

Roof Angle (Φ) - $5^\circ \leq \Phi \leq 30^\circ$

Wind Region	Building Height - H (m)							
	H ≤ 5		5 < H ≤ 10		10 < H ≤ 15		15 < H ≤ 20	
	D.W & U.W	Central	D.W & U.W	Central	D.W & U.W	Central	D.W & U.W	Central
A	1485	1650	1380	1560	1270	1515	1200	1485
B	1045	1510	855	1235	775	1115	730	1050
C	555	800	460	660	415	595	390	560
D	340	485	280	400	255	365	240	345

Client: **FUJIAN FENAN ALUMINIUM CO., LTD**
 Project: **Powerwave by FOEN Tile & Tin Roof Flush-Mount PV Array System**
 Address: **within Australia**
 Designed: **KZ**

Job: **6165**
 Date: **Dec-18**

Checked: **AA**

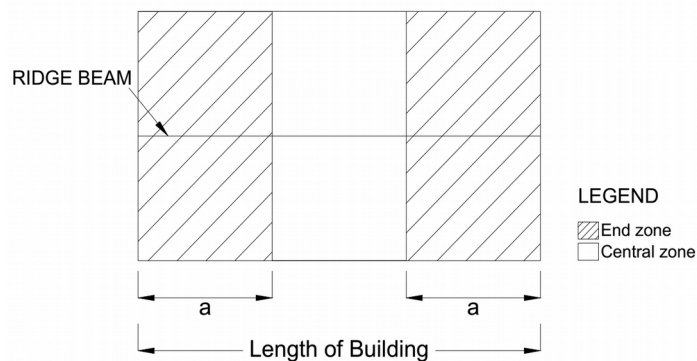
General Notes

Note 1 Following components are satisfied to use according to AS/NZS 1170.2-2011(R2016)

Components	Description
Rail	B52 Rail As Per Fujian Schematic Drawings
Splice	B52 Rail Connector As Per Fujian Schematic Drawing
Tile Roof Hook	As Per Fujian Schematic Drawings
L-Feet	As Per Fujian Schematic Drawings

Note 2 Terrain category 2 (TC2) refers to open terrain, including grassland, with well-scattered obstructions having heights generally from 1.5 m to 5 m, with no more than two obstruction per obstructions per hectare.

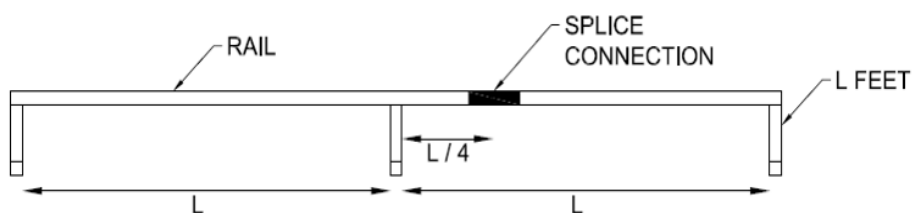
Note 3 For the definition of Downwind, Upwind end and central, refer figure D9 from AS/NZS 1170.2-2011(R2016).



Note 4 Screw embedment is minimum 35 mm into timber.

Metal Purlins/Battens	Fasteners to use
1.5 mm	M6-11 TPI RoofZips OR 14g-10 TPI Tek screws
1.9 mm	M6-11 TPI RoofZips OR 14g-10 TPI Tek screws
2.4 mm and Above	14g-10 TPI Tek screws
Timber Purlins/Battens	Fasteners to use
Pine and Hardwood (35mm embedment and above)	M6 (14g) with 10 TPI

Note 6 The optimised location of rail splice connection is at quarter length of the spacing of the interface. No Splice connection should be placed at the centre of spacing or over the interface.



Note 7 For PV panels with length of 2000mm, reduce the spacing in the tables by 21%.



Relationships built on trust

Client: **FUJIAN FENAN ALUMINIUM CO., LTD**
 Project: **Powerwave by FOEN Tile & Tin Roof Flush-Mount PV Array System**
 Address: **within Australia**
 Designed: **KZ**

Job: **6165**
 Date: **Dec-18**
 Checked: **AA**

Powerwave byFOEN Flush Array Frame System Spacing Table for tiled roof

Type of Rail: B52 Rail
 Type of Interface: Roof Tile Hook
 Solar Panel Dimension: 1.67m x 1m
 Terrain category: **3**

Roof Angle (Φ) - $\Phi < 5^\circ$

Wind Region	Building Height - H (m)							
	H≤5		5<H≤10		10<H≤15		15<H≤20	
	D.W & U.W	Central	D.W & U.W	Central	D.W & U.W	Central	D.W & U.W	Central
A	1085	1365	1085	1365	925	1160	815	1015
B	955	1200	955	1200	820	1025	725	900
C	635	785	635	785	545	670	480	595
D	485	600	485	600	420	515	375	460

Roof Angle (Φ) - $5^\circ \leq \Phi \leq 30$

Wind Region	Building Height - H (m)							
	H≤5		5<H≤10		10<H≤15		15<H≤20	
	D.W & U.W	Central	D.W & U.W	Central	D.W & U.W	Central	D.W & U.W	Central
A	1085	1650	1085	1650	925	1390	815	1220
B	955	1445	955	1445	820	1225	725	1075
C	635	935	635	935	545	800	480	705
D	485	710	485	710	420	610	375	540



Relationships built on trust

Client: **FUJIAN FENAN ALUMINIUM CO., LTD**
 Project: **Powerwave by FOEN Tile & Tin Roof Flush-Mount PV Array System**
 Address: **within Australia**
 Designed: **KZ**

Job: **6165**
 Date: **Dec-18**
 Checked: **AA**

Powerwave byFOEN Flush Array Frame System Spacing Table for tin roof

Type of Rail: B52 Rail
 Type of Interface: L-Feet
 Solar Panel Dimension: 1.67m x 1m
 Terrain category: **3**

Roof Angle (Φ) - $\Phi < 5^\circ$

Wind Region	Building Height - H (m)							
	H \leq 5		5<H \leq 10		10<H \leq 15		15<H \leq 20	
	D.W & U.W	Central	D.W & U.W	Central	D.W & U.W	Central	D.W & U.W	Central
A	1570	1665	1570	1665	1510	1595	1450	1545
B	1270	1565	1270	1565	1095	1345	975	1195
C	675	830	675	830	585	715	520	640
D	410	505	410	505	355	435	320	390

Roof Angle (Φ) - $5^\circ \leq \Phi \leq 30$

Wind Region	Building Height - H (m)							
	H \leq 5		5<H \leq 10		10<H \leq 15		15<H \leq 20	
	D.W & U.W	Central	D.W & U.W	Central	D.W & U.W	Central	D.W & U.W	Central
A	1570	1745	1570	1745	1510	1675	1450	1615
B	1270	1690	1270	1690	1095	1590	975	1410
C	675	975	675	975	585	840	520	750
D	410	590	410	590	355	510	320	455

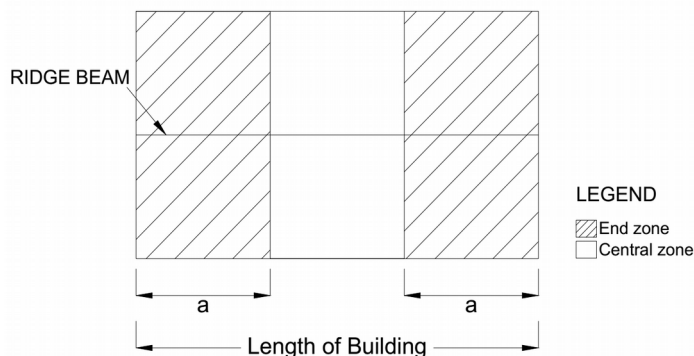
General Notes

Note 1 Following components are satisfied to use according to AS/NZS 1170.2-2011(R2016)

Components	Description
Rail	B52 Rail As Per Fujian Schematic Drawings
Splice	B52 Rail Connector As Per Fujian Schematic Drawing
Tile Roof Hook	As Per Fujian Schematic Drawings
L-Feet	As Per Fujian Schematic Drawings

Note 2 Terrain category 3(TC3) refers to numerous closely spaced obstructions having heights generally from 3 m to 10 m. For example suburban housing or light industrial estates. Refer clause 4.2.1 of AS/NZS 1170.2-2011(R2016) for definition of Terrain category 3.

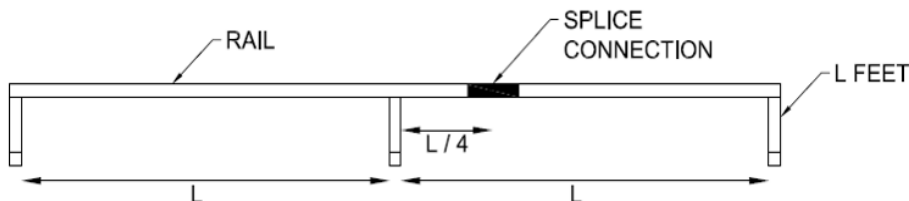
Note 3 For the definition of Downwind, Upwind end and central, refer figure D9 from AS/NZS 1170.2-2011(R2016).



Note 4 Screw embedment is minimum 35 mm into timber.

Metal Purlins/Battens	Fasteners to use
1.5 mm	M6-11 TPI RoofZips OR 14g-10 TPI Tek screws
1.9 mm	M6-11 TPI RoofZips OR 14g-10 TPI Tek screws
2.4 mm and Above	14g-10 TPI Tek screws
Timber Purlins/Battens	Fasteners to use
Pine and Hardwood (35mm embedment and above)	M6 (14g) with 10 TPI

Note 6 The optimised location of rail splice connection is at quarter length of the spacing of the interface. No Splice connection should be placed at the centre of spacing or over the interface.



Note 7 For PV panels with length of 2000mm, reduce the spacing in the tables by 21%.