DESIGN CERTIFICATE

DESCRIPTION:
This certificate relates to the adequacy of the existing roof at the described location to support the pv-panels and to their fixings.

LOCATION:
Suneden, 21 McInerney Ave, Mitchell Park, SA 5043

DETAILS:
Roof:
The adequacy of the existing roof structure to carry the loads arising from the pv-installation has been assessed based on the capacity of the purlins to support the loads arising from the installation of the pv-panels has been found to be satisfactory.

Fixings:
The portrait format Longi Solar 450W panels are to be mounted on pairs of Clenergy Eco rails, tilt brackets and legs at 15-degree tilt angle to the north roof slopes and secured to using Clenergy clamps every 3rd rib of the RevKlip700 roof sheet:

REFERENCES:

Westside Drawing	55046-E01 (01)	System layout
LSEC calculations	Job No 21076 Rev 0	

STANDARDS:

AS1170.0	Structural design actions - General principles
AS1170.1	Structural design actions – Dead and imposed loads
AS1170.2	Structural design actions - Wind loads

It is certified that the described item(s) have been designed and assessed using the listed Standards, conventional engineering principles and good practice for the location and function detailed above. No physical testing of items has been undertaken.

SCJ Lovell BSc, CEng, MIStructE, NER(Structural), RPEQ 13036
Date: 24 May 2021

Lovell Structural Engineering Consultancy

ABN: 33 473 233 682

PO Box 334

Macclesfield

South Australia 5153

www.lsec.com.au

m. 0420 859 809

Lovell Structural Engineering Consultancy

PO Box 334, Macclesfield, SA 5153
w: LSEC.com.au t: 0420 859 809 ABN: 33 473 233 682

STRUCTURAL CALCULATIONS

Project: **Structural assessment and panel mounting system**

Address: **Suneden, McInerney Av, Mitchell Park SA 5043**

Client: **Westside Energy (SA) Pty Ltd**

Project #: **21076**

Revision	Date	Description
0	24/05/21	Issued for use

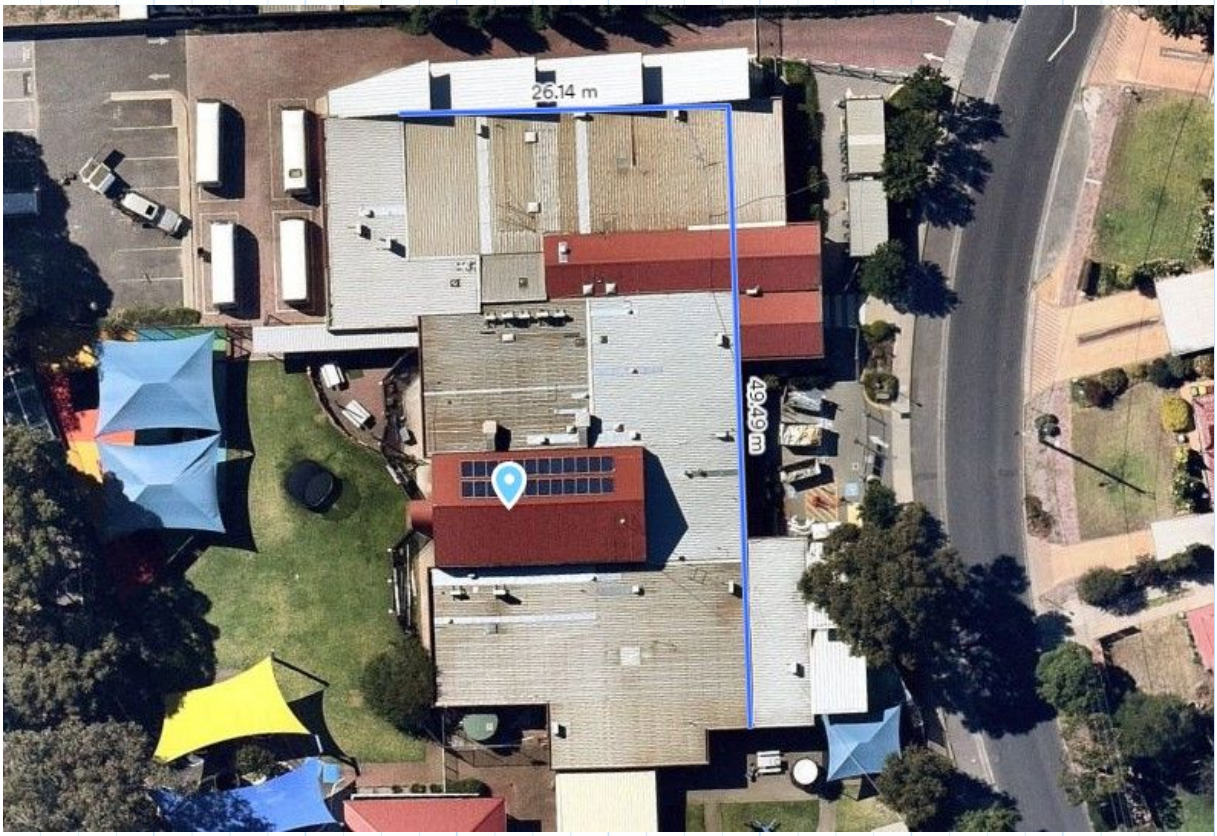
INTRODUCTION

The following structural calculations form part of the certification justifying the fixings for the pv-installation to the roof structure and the roof structure itself at the project location to withstand the applied loads and are to be read in conjunction with the certificate and with the reference drawings.

The calculation have been prepared by SCJ Lovell BSc CEng MIStructE NER RPEQ

DESCRIPTION AND DESIGN PHILOSOPHY

The building measures 26.1 m by 49.5 m with an average roof height of around 4 m.



The roof comprises 2 degree pitch 0.48 BMT revKlip 700 steel sheet on Z15024 purlins at 1200mm spacing and spanning 6 m between rafters.

The pv-panels systems are 15°tilt-up portrait format Longi Solar 450W panels on Eco rails on brackets/tilt legs fixed to clamps attached to the ribs of the roof sheeting with an inter-row spacing of 1200 mm.

It is a pv-panel manufacturer's requirement that the panels are not trafficked by maintenance personnel nor that any materials are stacked on the panels; if it is necessary to undertake any maintenance work then this is conducted by removing panels to create the required access.

The adequacy of the roof will be proven by reviewing the adequacy of the purlins for the actions to which they will be subjected.

The assessment will be in accordance with:

AS1170.0	Structural design actions - General principles
AS1170.1	Structural design actions - Dead and imposed actions
AS1170.2	Structural design actions - Wind actions

REFERENCE DOCUMENTS

Westside Energy drawing
55046-E01 Rev 01 System layout

Clenergy manuals.

Longi LR4-72HPH panel data sheet

PANEL SYSTEM

Panel dimensions Length $p_l := 2094\ mm$

Width $p_w := 1038\ mm$

Inter-row spacing $s_r := 1200\ mm$

Loading from pv-system

Weight of panel $G_{panel} := 23.5\ kg \cdot g = 230\ N$

Weight of frame $G_{frame} := 2.5\ kg \cdot g = 25\ N$

Dead load of pv-system $g_{pv} := \frac{\left(G_{panel} + G_{frame}\right)}{\left(p_l + s_r\right) \cdot p_w} = 75\ Pa$

LOADINGS

Dead loads

Roof sheeting $g_1 := 4.7\ kg \cdot m^{-2}$

Purlins $g_2 := 7.2\ kg \cdot m^{-2}$

Ceiling and services $g_3 := 12.5\ kg \cdot m^{-2}$

Roof dead load $g_{kr} := \left(g_1 + g_2 + g_3\right) \cdot g = 0.239\ kPa$

Imposed load

General load $q_{kr} := \frac{0.25\ kPa \cdot s_r}{p_l + s_r} = 0.091\ kPa$

Wind loads

A wind analysis has been undertaken using CheckWind software

CHECKWIND v5.3.2 AS/NZS 1170 SITE REPORT revo

STRUCTURE:	BUILDING	LATITUDE:	-35.014816	CRITICAL DIRECTION:	West
ORIENTATION:	0°	LONGITUDE:	138.561096	Md:	1.00
WIDTH:	26.10 m	ELEVATION:	35.50 m	TC:	3.00
LENGTH:	49.50 m			Mz,cat:	0.8300
HEIGHT (h):	4.00 m	WIND REGION:	A1	Ms:	1.0
BASE RL:	0.00 m	ULTIMATE ARI:	500 YEARS	Mh:	1.0
		ULTIMATE VR:	45 m/s	Mlee:	1.0
				Mel:	1.0
				Mt:	1.0
				Vdes,θ:	37.35 m/s
				qdes,θ:	0.84 kPa

$$q_{sit} := 0.84\ kPa$$

ROOF

Pitch of roof $\phi := 2\ deg$

Purlin spacing $s_p := 1.200\ m$

Existing Purlins

Z15024 purlins with 1 row of bridging spanning 6 m $R_d := 4.15\ kN \cdot m^{-1}$

Load case 1 - 1.35 (D + pv)

Action on purlin $E_{d.p1} := \frac{1.35 \cdot (g_{kr} + g_{pv})}{\cos(\phi)} \cdot s_p = 0.509\ kN \cdot m^{-1}$

CHECK $\frac{E_{d.p1}}{R_d} = 0.123$ **< 1 :. OK**

Existing purlins OK for additional downward loads from pv panels

Additional dead loads from pv-panels and positive wind loads

Positive external wind load $w_e := 0.2 \cdot q_{sit} = 168\ Pa$

Internal wind suction $w_i := -0.10 \cdot q_{sit} = -0.084\ kPa$

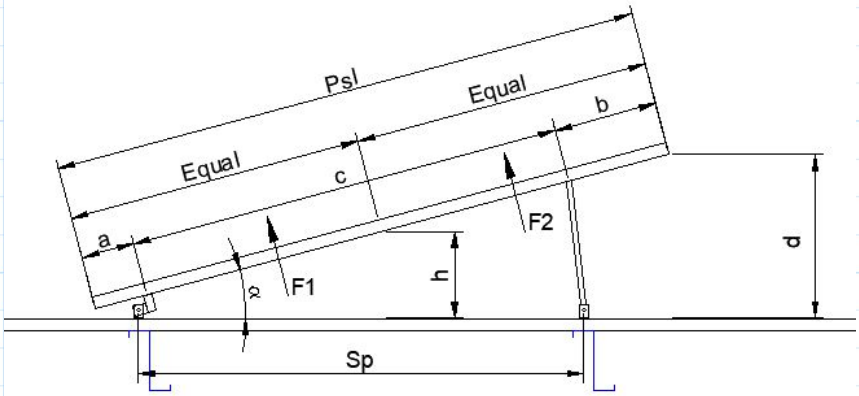
Proposed load on purlin $E_{d.p} := \left(\frac{1.20 \cdot (g_{kr} + g_{pv})}{\cos(\phi)} + w_e - w_i \right) \cdot s_p = 0.755\ kN \cdot m^{-1}$

CHECK $\frac{E_{d.p}}{R_d} = 0.182$ **< 1 :. OK**

Existing purlins OK for positive wind loads

Wind loads on tilt-up systems

Treating the panels as monoslope roofs blocked under to AS1170.2 - D3



Pitch of panel	$\alpha := 15\ deg$
Slope length of panel	$p_{sl} := p_l = 2094\ mm$
Overhang at front	$a := 312\ mm$
Overhang at rear	$b := 312\ mm$
Distance between support rails	$c := p_{sl} - a - b = 1470\ mm$
Height at back of panel	$d := (p_{sl} - a) \cdot \sin(\alpha) + 125\ mm = 0.586\ m$
Mean height	$h := d - \frac{p_{sl} \cdot \sin(\alpha)}{2} = 0.315\ m$
Inwind depth	$d_i := p_{sl} \cdot \cos(\alpha) = 2.023\ m$
Aspect ratio	$\frac{h}{d_i} = 0.156$ < 0.25 but use Table 4(A) values

Wind acting on front of panel

On windward half	$C_{p1} := 0.8$
On leeward half	$C_{p2} := 0.4$

For wind from NW-N-NE

NORTH WEST WIND

RL	Md	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qz
4.00 m	0.95	0.8300	0	-	-	1.0	1.0	35.48 m/s	0.7553 kPa

$q := 0.755\ kPa$

Downward forces $F_1 := q \cdot C_{p1} \cdot p_{sl} \div 2 = 0.632\ kN \cdot m^{-1}$

$F_2 := q \cdot C_{p2} \cdot p_{sl} \div 2 = 0.316\ kN \cdot m^{-1}$

Average UDL on roof $w_e := \frac{F_1 + F_2}{p_l + s_r} = 0.288\ kPa$

Proposed load on purlin $E_{d.p} := \left(\frac{1.20 \cdot (g_{kr} + g_{pv})}{\cos(\phi)} + w_e - w_i \right) \cdot s_p = 0.899\ kN \cdot m^{-1}$

CHECK $\frac{E_{d.p}}{R_d} = 0.217$ **< 1 :. OK**

Existing purlins OK for wind on face of panels

Wind acting on back of panel

On windward half $C_{p2} := -1.5$

On leeward half $C_{p1} := -1.0$

For wind from SE-S-SW

SOUTH WEST WIND

RL	Md	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qz
4.00 m	0.95	0.8300	0	-	-	1.0	1.0	35.48 m/s	0.7553 kPa

$q := 0.755\ kPa$

Uplift forces $F_1 := q \cdot C_{p1} \cdot p_{sl} \div 2 = -0.79\ kN \cdot m^{-1}$

$F_2 := q \cdot C_{p2} \cdot p_{sl} \div 2 = -1.186\ kN \cdot m^{-1}$

Panel load $G_p := (G_{panel} + G_{frame}) \div p_w = 0.246\ kN \cdot m^{-1}$

Taking moments about front leg, force on rear legs

Lever arm to F1 $l_{a1} := \frac{p_{sl}}{4} - a = 211.5\ mm$

Lever arm to F2 $l_{a2} := \frac{3 \cdot p_{sl}}{4} - a = 1258.5\ mm$

Lever arm to self weight $l_{a3} := \frac{p_{sl}}{2} - a = 735\ mm$

Force on rear rail $W_2 := \frac{F_1 \cdot l_{a1} + F_2 \cdot l_{a2} + G_p \cdot l_{a3}}{c} = -1.006\ kN \cdot m^{-1}$

Force on front rail $W_1 := (F_1 + F_2 + G_p) \cdot \cos(\alpha) - W_2 = -0.666\ kN \cdot m^{-1}$

Fixings

The load capacity of clamps is dictated either by the load at which 1st slip of the clamp on the rib takes place or, the load capacity of the roof sheet.

For Clenergy clamps on RevKlip 700 roof sheet 1st slip occurs at $F_{slip} := 1.4\ kN$

For RevKlip 700 roof sheet $E_d := 4.07\ kPa \quad at \quad s_p = 1.2\ m\ span$

Spacing of ribs $s_{rib} := 233.3\ mm$

Point load on rib $F_{rib} := s_{rib} \cdot \frac{2}{3} \cdot E_d \cdot s_p = 0.76\ kN$

Clamp capacity $N_{fix} := -min(F_{slip}, F_{rib}) = -0.76\ kN$

Standard rear rail leg spacing $s_{rr} := min\left(\frac{N_{fix}}{W_2}, 1.90\ m\right) = 0.755\ m$

$$\text{floor}\left(\frac{s_{rr}}{s_{rib}}\right) = 3$$

PROVIDE CLAMPS TO EVERY 3rd RIB

----- STRUCTURE DATA ----------

TYPE: BUILDING
ORIENTATION: 0.0°
ROOF: GABLE
WIDTH: 26.10 m
LENGTH: 49.50 m
ROOF SLOPE (α): 2.0°
HEIGHT (h): 4.00 m
BASE RL: 0.00 m

----- SITE DATA ----------

LOCATION

LATITUDE: -35.014816
LONGITUDE: 138.561096
ELEVATION: 35.50 m

DESIGN

REFERENCE: AS/NZS 1170
IMPORTANCE LEVEL: 2
LIFE: 50 YEARS

WIND

REGION: A1
ULTIMATE ARI: 500 YEARS

REGIONAL WIND SPEED (VR)

• Calculated as per AS/NZS 1170.2 Section 3.2.

ULTIMATE: 45 m/s
ICE: 34 m/s
SERVICEABILITY: 37 m/s

DIRECTION MULTIPLIER (Md)

• Calculated for Region A1 as per AS/NZS 1170.2 Section 3.3.

WIND	Md
N	0.90
NE	0.80
E	0.80
SE	0.80
S	0.85
SW	0.95
W	1.00
NW	0.95

TERRAIN/HEIGHT MULTIPLIER (Mz,cat)

• Calculated using averaging as per AS/NZS 1170.2 Section 4.2.3 and varies with height.

NORTH WIND: Mz,cat = 0.8300 (TC 3.00)

ZONE 1: TC 3 to 580.00 m

NORTH EAST WIND: Mz,cat = 0.8300 (TC 3.00)

ZONE 1: TC 3 to 580.00 m

EAST WIND: Mz,cat = 0.8300 (TC 3.00)

ZONE 1: TC 3 to 580.00 m

SOUTH EAST WIND: Mz,cat = 0.8300 (TC 3.00)

ZONE 1: TC 3 to 580.00 m

SOUTH WIND: Mz,cat = 0.8393 (TC 2.88)

ZONE 1: TC 3 to 464.00 m
ZONE 2: TC 2.5 to 580.00 m

SOUTH WEST WIND: Mz,cat = 0.8300 (TC 3.00)

ZONE 1: TC 3 to 580.00 m

WEST WIND: Mz,cat = 0.8300 (TC 3.00)

ZONE 1: TC 3 to 580.00 m

NORTH WEST WIND: Mz,cat = 0.8300 (TC 3.00)

ZONE 1: TC 3 to 580.00 m

SHIELDING MULTIPLIER (Ms)

• Calculated as per AS/NZS 1170.2 Section 4.3 and varies with height.

NORTH WIND: Ms = 1.0

ID	HEIGHT	ELEVATION	SLOPE	AREA	BREADTH	LATITUDE	LONGITUDE
001	3.00 m	34.50 m	0.0126	321 m²	16.49 m	-35.014152	138.560786
005	3.00 m	35.00 m	0.0092	273 m²	23.89 m	-35.014331	138.561183
006	3.00 m	35.50 m	0.0000	196 m²	2.81 m	-35.014424	138.561333
009	3.00 m	35.00 m	0.0120	179 m²	13.94 m	-35.014475	138.560911
010	3.00 m	35.00 m	0.0082	178 m²	18.51 m	-35.014278	138.560983
017	3.00 m	35.50 m	0.0000	89 m²	5.29 m	-35.014237	138.561418

NORTH EAST WIND: Ms = 1.0

ID	HEIGHT	ELEVATION	SLOPE	AREA	BREADTH	LATITUDE	LONGITUDE
006	3.00 m	35.50 m	0.0000	196 m²	15.17 m	-35.014424	138.561333
012	3.00 m	36.00 m	0.0069	98 m²	12.80 m	-35.014521	138.561799
016	3.00 m	36.00 m	0.0075	90 m²	8.69 m	-35.014585	138.561771
017	3.00 m	35.50 m	0.0000	89 m²	12.26 m	-35.014237	138.561418

EAST WIND: Ms = 1.0

ID	HEIGHT	ELEVATION	SLOPE	AREA	BREADTH	LATITUDE	LONGITUDE
008	3.00 m	36.50 m	0.0163	185 m²	9.93 m	-35.015041	138.561712
012	3.00 m	36.00 m	0.0069	98 m²	3.82 m	-35.014521	138.561799
013	3.00 m	36.00 m	0.0085	93 m²	7.79 m	-35.014675	138.561720
014	3.00 m	36.00 m	0.0087	92 m²	7.79 m	-35.014741	138.561717
015	3.00 m	36.00 m	0.0090	91 m²	9.68 m	-35.014890	138.561701
016	3.00 m	36.00 m	0.0075	90 m²	8.35 m	-35.014585	138.561771
018	3.00 m	36.00 m	0.0093	84 m²	9.68 m	-35.014828	138.561683

SOUTH EAST WIND: Ms = 1.0

ID	HEIGHT	ELEVATION	SLOPE	AREA	BREADTH	LATITUDE	LONGITUDE
008	3.00 m	36.50 m	0.0163	185 m²	12.49 m	-35.015041	138.561712
019	3.00 m	36.50 m	0.0132	60 m²	10.80 m	-35.015426	138.561460

SOUTH WIND: Ms = 1.0

ID	HEIGHT	ELEVATION	SLOPE	AREA	BREADTH	LATITUDE	LONGITUDE
002	3.00 m	36.00 m	0.0070	304 m²	19.24 m	-35.015446	138.561241
003	3.00 m	35.00 m	0.0063	304 m²	15.71 m	-35.015498	138.560824
004	3.00 m	36.00 m	0.0071	282 m²	18.69 m	-35.015449	138.561038
007	3.00 m	35.50 m	0.0000	191 m²	16.43 m	-35.015168	138.560987
022	3.00 m	36.00 m	0.0124	47 m²	6.29 m	-35.015175	138.561154

SOUTH WEST WIND: Ms = 1.0

ID	HEIGHT	ELEVATION	SLOPE	AREA	BREADTH	LATITUDE	LONGITUDE
003	3.00 m	35.00 m	0.0063	304 m²	4.40 m	-35.015498	138.560824
007	3.00 m	35.50 m	0.0000	191 m²	9.34 m	-35.015168	138.560987

WEST WIND: Ms = 1.0

ID	HEIGHT	ELEVATION	SLOPE	AREA	BREADTH	LATITUDE	LONGITUDE
020	3.00 m	35.00 m	0.0147	53 m²	6.57 m	-35.014792	138.560725
021	3.00 m	34.50 m	0.0280	53 m²	6.57 m	-35.014871	138.560710

NORTH WEST WIND: Ms = 1.0

ID	HEIGHT	ELEVATION	SLOPE	AREA	BREADTH	LATITUDE	LONGITUDE
001	3.00 m	34.50 m	0.0126	321 m²	11.28 m	-35.014152	138.560786
009	3.00 m	35.00 m	0.0120	179 m²	13.76 m	-35.014475	138.560911
011	3.00 m	33.50 m	0.0268	110 m²	12.79 m	-35.014382	138.560473

TOPOGRAPHIC MULTIPLIER (Mt)

- Calculated as per AS/NZS 1170.2 Section 4.4 and varies with height.
- Water Surface has been defined @ RL 0.00 m.

WIND	CRITICAL	TOPOGRAPHY	H	Lu	x	Mh	Mt
N	NNE	Escarpment	25.50 m	230.00 m	-2000.00 m	1.0	1.0
NE	NNE	Escarpment	25.50 m	230.00 m	-2000.00 m	1.0	1.0
E	E	Escarpment	24.00 m	200.00 m	2100.00 m	1.0	1.0
SE	SE	Ridge	67.50 m	171.00 m	3000.00 m	1.0	1.0
S	SSE	Ridge	53.50 m	308.67 m	1680.00 m	1.0	1.0
SW	WSW	Flat	8.50 m	410.00 m	-440.00 m	1.0	1.0
W	WSW	Flat	8.50 m	410.00 m	-440.00 m	1.0	1.0
NW	NW	Flat	10.00 m	280.00 m	-420.00 m	1.0	1.0

----- ANALYSIS -----

LOAD CASE 01: Ultimate Wind

NORTH WIND

RL	Md	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qz
4.00 m	0.90	0.8300	0	-	-	1.0	1.0	33.62 m/s	0.6782 kPa
3.60 m	0.90	0.8300	0	-	-	1.0	1.0	33.62 m/s	0.6782 kPa
3.20 m	0.90	0.8300	0	-	-	1.0	1.0	33.62 m/s	0.6782 kPa
2.80 m	0.90	0.8300	6	3.00 m	13.49 m	0.8397	1.0	30.00 m/s	0.5400 kPa
2.40 m	0.90	0.8300	6	3.00 m	13.49 m	0.8397	1.0	30.00 m/s	0.5400 kPa
2.00 m	0.90	0.8300	6	3.00 m	13.49 m	0.8397	1.0	30.00 m/s	0.5400 kPa
1.60 m	0.90	0.8300	6	3.00 m	13.49 m	0.8397	1.0	30.00 m/s	0.5400 kPa
1.20 m	0.90	0.8300	6	3.00 m	13.49 m	0.8397	1.0	30.00 m/s	0.5400 kPa
0.80 m	0.90	0.8300	6	3.00 m	13.49 m	0.8397	1.0	30.00 m/s	0.5400 kPa
0.40 m	0.90	0.8300	6	3.00 m	13.49 m	0.8397	1.0	30.00 m/s	0.5400 kPa
0.00 m	0.90	0.8300	6	3.00 m	13.49 m	0.8397	1.0	30.00 m/s	0.5400 kPa

NORTH EAST WIND

RL	Md	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qz
4.00 m	0.80	0.8300	0	-	-	1.0	1.0	30.00 m/s	0.5400 kPa
3.60 m	0.80	0.8300	0	-	-	1.0	1.0	30.00 m/s	0.5400 kPa
3.20 m	0.80	0.8300	0	-	-	1.0	1.0	30.00 m/s	0.5400 kPa
2.80 m	0.80	0.8300	4	3.00 m	12.23 m	0.8651	1.0	30.00 m/s	0.5400 kPa
2.40 m	0.80	0.8300	4	3.00 m	12.23 m	0.8651	1.0	30.00 m/s	0.5400 kPa
2.00 m	0.80	0.8300	4	3.00 m	12.23 m	0.8651	1.0	30.00 m/s	0.5400 kPa
1.60 m	0.80	0.8300	4	3.00 m	12.23 m	0.8651	1.0	30.00 m/s	0.5400 kPa
1.20 m	0.80	0.8300	4	3.00 m	12.23 m	0.8651	1.0	30.00 m/s	0.5400 kPa
0.80 m	0.80	0.8300	4	3.00 m	12.23 m	0.8651	1.0	30.00 m/s	0.5400 kPa

0.40 m	0.80	0.8300	4	3.00 m	12.23 m	0.8651	1.0	30.00 m/s	0.5400 kPa
0.00 m	0.80	0.8300	4	3.00 m	12.23 m	0.8651	1.0	30.00 m/s	0.5400 kPa

EAST WIND

RL	Md	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qz
4.00 m	0.80	0.8300	0	-	-	1.0	1.0	30.00 m/s	0.5400 kPa
3.60 m	0.80	0.8300	0	-	-	1.0	1.0	30.00 m/s	0.5400 kPa
3.20 m	0.80	0.8300	0	-	-	1.0	1.0	30.00 m/s	0.5400 kPa
2.80 m	0.80	0.8300	7	3.00 m	8.15 m	0.8733	1.0	30.00 m/s	0.5400 kPa
2.40 m	0.80	0.8300	7	3.00 m	8.15 m	0.8733	1.0	30.00 m/s	0.5400 kPa
2.00 m	0.80	0.8300	7	3.00 m	8.15 m	0.8733	1.0	30.00 m/s	0.5400 kPa
1.60 m	0.80	0.8300	7	3.00 m	8.15 m	0.8733	1.0	30.00 m/s	0.5400 kPa
1.20 m	0.80	0.8300	7	3.00 m	8.15 m	0.8733	1.0	30.00 m/s	0.5400 kPa
0.80 m	0.80	0.8300	7	3.00 m	8.15 m	0.8733	1.0	30.00 m/s	0.5400 kPa
0.40 m	0.80	0.8300	7	3.00 m	8.15 m	0.8733	1.0	30.00 m/s	0.5400 kPa
0.00 m	0.80	0.8300	7	3.00 m	8.15 m	0.8733	1.0	30.00 m/s	0.5400 kPa

SOUTH EAST WIND

RL	Md	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qz
4.00 m	0.80	0.8300	0	-	-	1.0	1.0	30.00 m/s	0.5400 kPa
3.60 m	0.80	0.8300	0	-	-	1.0	1.0	30.00 m/s	0.5400 kPa
3.20 m	0.80	0.8300	0	-	-	1.0	1.0	30.00 m/s	0.5400 kPa
2.80 m	0.80	0.8300	2	3.00 m	11.64 m	0.9128	1.0	30.00 m/s	0.5400 kPa
2.40 m	0.80	0.8300	2	3.00 m	11.64 m	0.9128	1.0	30.00 m/s	0.5400 kPa
2.00 m	0.80	0.8300	2	3.00 m	11.64 m	0.9128	1.0	30.00 m/s	0.5400 kPa
1.60 m	0.80	0.8300	2	3.00 m	11.64 m	0.9128	1.0	30.00 m/s	0.5400 kPa
1.20 m	0.80	0.8300	2	3.00 m	11.64 m	0.9128	1.0	30.00 m/s	0.5400 kPa
0.80 m	0.80	0.8300	2	3.00 m	11.64 m	0.9128	1.0	30.00 m/s	0.5400 kPa
0.40 m	0.80	0.8300	2	3.00 m	11.64 m	0.9128	1.0	30.00 m/s	0.5400 kPa
0.00 m	0.80	0.8300	2	3.00 m	11.64 m	0.9128	1.0	30.00 m/s	0.5400 kPa

SOUTH WIND

RL	Md	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qz
4.00 m	0.85	0.8393	0	-	-	1.0	1.0	32.10 m/s	0.6182 kPa
3.60 m	0.85	0.8391	0	-	-	1.0	1.0	32.10 m/s	0.6182 kPa
3.20 m	0.85	0.8390	0	-	-	1.0	1.0	32.09 m/s	0.6179 kPa
2.80 m	0.85	0.8389	5	3.00 m	15.27 m	0.8379	1.0	30.00 m/s	0.5400 kPa
2.40 m	0.85	0.8387	5	3.00 m	15.27 m	0.8379	1.0	30.00 m/s	0.5400 kPa
2.00 m	0.85	0.8386	5	3.00 m	15.27 m	0.8379	1.0	30.00 m/s	0.5400 kPa
1.60 m	0.85	0.8385	5	3.00 m	15.27 m	0.8379	1.0	30.00 m/s	0.5400 kPa
1.20 m	0.85	0.8383	5	3.00 m	15.27 m	0.8379	1.0	30.00 m/s	0.5400 kPa
0.80 m	0.85	0.8382	5	3.00 m	15.27 m	0.8379	1.0	30.00 m/s	0.5400 kPa
0.40 m	0.85	0.8381	5	3.00 m	15.27 m	0.8379	1.0	30.00 m/s	0.5400 kPa
0.00 m	0.85	0.8380	5	3.00 m	15.27 m	0.8379	1.0	30.00 m/s	0.5400 kPa

SOUTH WEST WIND

RL	Md	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qz
4.00 m	0.95	0.8300	0	-	-	1.0	1.0	35.48 m/s	0.7553 kPa
3.60 m	0.95	0.8300	0	-	-	1.0	1.0	35.48 m/s	0.7553 kPa
3.20 m	0.95	0.8300	0	-	-	1.0	1.0	35.48 m/s	0.7553 kPa
2.80 m	0.95	0.8300	2	3.00 m	6.87 m	0.9468	1.0	33.59 m/s	0.6770 kPa
2.40 m	0.95	0.8300	2	3.00 m	6.87 m	0.9468	1.0	33.59 m/s	0.6770 kPa
2.00 m	0.95	0.8300	2	3.00 m	6.87 m	0.9468	1.0	33.59 m/s	0.6770 kPa
1.60 m	0.95	0.8300	2	3.00 m	6.87 m	0.9468	1.0	33.59 m/s	0.6770 kPa
1.20 m	0.95	0.8300	2	3.00 m	6.87 m	0.9468	1.0	33.59 m/s	0.6770 kPa
0.80 m	0.95	0.8300	2	3.00 m	6.87 m	0.9468	1.0	33.59 m/s	0.6770 kPa
0.40 m	0.95	0.8300	2	3.00 m	6.87 m	0.9468	1.0	33.59 m/s	0.6770 kPa
0.00 m	0.95	0.8300	2	3.00 m	6.87 m	0.9468	1.0	33.59 m/s	0.6770 kPa

WEST WIND

RL	Md	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qz
4.00 m	1.00	0.8300	0	-	-	1.0	1.0	37.35 m/s	0.8370 kPa
3.60 m	1.00	0.8300	0	-	-	1.0	1.0	37.35 m/s	0.8370 kPa
3.20 m	1.00	0.8300	0	-	-	1.0	1.0	37.35 m/s	0.8370 kPa
2.80 m	1.00	0.8300	2	3.00 m	6.57 m	0.9502	1.0	35.49 m/s	0.7557 kPa
2.40 m	1.00	0.8300	2	3.00 m	6.57 m	0.9502	1.0	35.49 m/s	0.7557 kPa
2.00 m	1.00	0.8300	2	3.00 m	6.57 m	0.9502	1.0	35.49 m/s	0.7557 kPa
1.60 m	1.00	0.8300	2	3.00 m	6.57 m	0.9502	1.0	35.49 m/s	0.7557 kPa
1.20 m	1.00	0.8300	2	3.00 m	6.57 m	0.9502	1.0	35.49 m/s	0.7557 kPa
0.80 m	1.00	0.8300	2	3.00 m	6.57 m	0.9502	1.0	35.49 m/s	0.7557 kPa
0.40 m	1.00	0.8300	2	3.00 m	6.57 m	0.9502	1.0	35.49 m/s	0.7557 kPa
0.00 m	1.00	0.8300	2	3.00 m	6.57 m	0.9502	1.0	35.49 m/s	0.7557 kPa

NORTH WEST WIND

RL	Md	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qz
4.00 m	0.95	0.8300	0	-	-	1.0	1.0	35.48 m/s	0.7553 kPa
3.60 m	0.95	0.8300	0	-	-	1.0	1.0	35.48 m/s	0.7553 kPa
3.20 m	0.95	0.8300	0	-	-	1.0	1.0	35.48 m/s	0.7553 kPa
2.80 m	0.95	0.8300	3	3.00 m	12.61 m	0.8807	1.0	31.25 m/s	0.5859 kPa
2.40 m	0.95	0.8300	3	3.00 m	12.61 m	0.8807	1.0	31.25 m/s	0.5859 kPa
2.00 m	0.95	0.8300	3	3.00 m	12.61 m	0.8807	1.0	31.25 m/s	0.5859 kPa
1.60 m	0.95	0.8300	3	3.00 m	12.61 m	0.8807	1.0	31.25 m/s	0.5859 kPa
1.20 m	0.95	0.8300	3	3.00 m	12.61 m	0.8807	1.0	31.25 m/s	0.5859 kPa
0.80 m	0.95	0.8300	3	3.00 m	12.61 m	0.8807	1.0	31.25 m/s	0.5859 kPa
0.40 m	0.95	0.8300	3	3.00 m	12.61 m	0.8807	1.0	31.25 m/s	0.5859 kPa
0.00 m	0.95	0.8300	3	3.00 m	12.61 m	0.8807	1.0	31.25 m/s	0.5859 kPa

LOAD CASE 02: Serviceability Wind

NORTH WIND

RL	Md	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qz
4.00 m	0.90	0.8300	0	-	-	1.0	1.0	27.64 m/s	0.4584 kPa
3.60 m	0.90	0.8300	0	-	-	1.0	1.0	27.64 m/s	0.4584 kPa
3.20 m	0.90	0.8300	0	-	-	1.0	1.0	27.64 m/s	0.4584 kPa
2.80 m	0.90	0.8300	6	3.00 m	13.49 m	0.8397	1.0	23.21 m/s	0.3232 kPa
2.40 m	0.90	0.8300	6	3.00 m	13.49 m	0.8397	1.0	23.21 m/s	0.3232 kPa

2.00 m	0.90	0.8300	6	3.00 m	13.49 m	0.8397	1.0	23.21 m/s	0.3232 kPa
1.60 m	0.90	0.8300	6	3.00 m	13.49 m	0.8397	1.0	23.21 m/s	0.3232 kPa
1.20 m	0.90	0.8300	6	3.00 m	13.49 m	0.8397	1.0	23.21 m/s	0.3232 kPa
0.80 m	0.90	0.8300	6	3.00 m	13.49 m	0.8397	1.0	23.21 m/s	0.3232 kPa
0.40 m	0.90	0.8300	6	3.00 m	13.49 m	0.8397	1.0	23.21 m/s	0.3232 kPa
0.00 m	0.90	0.8300	6	3.00 m	13.49 m	0.8397	1.0	23.21 m/s	0.3232 kPa

NORTH EAST WIND

RL	Md	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qz
4.00 m	0.80	0.8300	0	-	-	1.0	1.0	24.57 m/s	0.3622 kPa
3.60 m	0.80	0.8300	0	-	-	1.0	1.0	24.57 m/s	0.3622 kPa
3.20 m	0.80	0.8300	0	-	-	1.0	1.0	24.57 m/s	0.3622 kPa
2.80 m	0.80	0.8300	4	3.00 m	12.23 m	0.8651	1.0	21.25 m/s	0.2709 kPa
2.40 m	0.80	0.8300	4	3.00 m	12.23 m	0.8651	1.0	21.25 m/s	0.2709 kPa
2.00 m	0.80	0.8300	4	3.00 m	12.23 m	0.8651	1.0	21.25 m/s	0.2709 kPa
1.60 m	0.80	0.8300	4	3.00 m	12.23 m	0.8651	1.0	21.25 m/s	0.2709 kPa
1.20 m	0.80	0.8300	4	3.00 m	12.23 m	0.8651	1.0	21.25 m/s	0.2709 kPa
0.80 m	0.80	0.8300	4	3.00 m	12.23 m	0.8651	1.0	21.25 m/s	0.2709 kPa
0.40 m	0.80	0.8300	4	3.00 m	12.23 m	0.8651	1.0	21.25 m/s	0.2709 kPa
0.00 m	0.80	0.8300	4	3.00 m	12.23 m	0.8651	1.0	21.25 m/s	0.2709 kPa

EAST WIND

RL	Md	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qz
4.00 m	0.80	0.8300	0	-	-	1.0	1.0	24.57 m/s	0.3622 kPa
3.60 m	0.80	0.8300	0	-	-	1.0	1.0	24.57 m/s	0.3622 kPa
3.20 m	0.80	0.8300	0	-	-	1.0	1.0	24.57 m/s	0.3622 kPa
2.80 m	0.80	0.8300	7	3.00 m	8.15 m	0.8733	1.0	21.46 m/s	0.2763 kPa
2.40 m	0.80	0.8300	7	3.00 m	8.15 m	0.8733	1.0	21.46 m/s	0.2763 kPa
2.00 m	0.80	0.8300	7	3.00 m	8.15 m	0.8733	1.0	21.46 m/s	0.2763 kPa
1.60 m	0.80	0.8300	7	3.00 m	8.15 m	0.8733	1.0	21.46 m/s	0.2763 kPa
1.20 m	0.80	0.8300	7	3.00 m	8.15 m	0.8733	1.0	21.46 m/s	0.2763 kPa
0.80 m	0.80	0.8300	7	3.00 m	8.15 m	0.8733	1.0	21.46 m/s	0.2763 kPa
0.40 m	0.80	0.8300	7	3.00 m	8.15 m	0.8733	1.0	21.46 m/s	0.2763 kPa
0.00 m	0.80	0.8300	7	3.00 m	8.15 m	0.8733	1.0	21.46 m/s	0.2763 kPa

SOUTH EAST WIND

RL	Md	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qz
4.00 m	0.80	0.8300	0	-	-	1.0	1.0	24.57 m/s	0.3622 kPa
3.60 m	0.80	0.8300	0	-	-	1.0	1.0	24.57 m/s	0.3622 kPa
3.20 m	0.80	0.8300	0	-	-	1.0	1.0	24.57 m/s	0.3622 kPa
2.80 m	0.80	0.8300	2	3.00 m	11.64 m	0.9128	1.0	22.43 m/s	0.3019 kPa
2.40 m	0.80	0.8300	2	3.00 m	11.64 m	0.9128	1.0	22.43 m/s	0.3019 kPa
2.00 m	0.80	0.8300	2	3.00 m	11.64 m	0.9128	1.0	22.43 m/s	0.3019 kPa
1.60 m	0.80	0.8300	2	3.00 m	11.64 m	0.9128	1.0	22.43 m/s	0.3019 kPa
1.20 m	0.80	0.8300	2	3.00 m	11.64 m	0.9128	1.0	22.43 m/s	0.3019 kPa
0.80 m	0.80	0.8300	2	3.00 m	11.64 m	0.9128	1.0	22.43 m/s	0.3019 kPa
0.40 m	0.80	0.8300	2	3.00 m	11.64 m	0.9128	1.0	22.43 m/s	0.3019 kPa
0.00 m	0.80	0.8300	2	3.00 m	11.64 m	0.9128	1.0	22.43 m/s	0.3019 kPa

SOUTH WIND

RL	Md	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qz
4.00 m	0.85	0.8393	0	-	-	1.0	1.0	26.40 m/s	0.4182 kPa
3.60 m	0.85	0.8391	0	-	-	1.0	1.0	26.39 m/s	0.4179 kPa
3.20 m	0.85	0.8390	0	-	-	1.0	1.0	26.39 m/s	0.4179 kPa
2.80 m	0.85	0.8389	5	3.00 m	15.27 m	0.8379	1.0	22.11 m/s	0.2933 kPa
2.40 m	0.85	0.8387	5	3.00 m	15.27 m	0.8379	1.0	22.10 m/s	0.2930 kPa
2.00 m	0.85	0.8386	5	3.00 m	15.27 m	0.8379	1.0	22.10 m/s	0.2930 kPa
1.60 m	0.85	0.8385	5	3.00 m	15.27 m	0.8379	1.0	22.10 m/s	0.2930 kPa
1.20 m	0.85	0.8383	5	3.00 m	15.27 m	0.8379	1.0	22.09 m/s	0.2928 kPa
0.80 m	0.85	0.8382	5	3.00 m	15.27 m	0.8379	1.0	22.09 m/s	0.2928 kPa
0.40 m	0.85	0.8381	5	3.00 m	15.27 m	0.8379	1.0	22.09 m/s	0.2928 kPa
0.00 m	0.85	0.8380	5	3.00 m	15.27 m	0.8379	1.0	22.08 m/s	0.2925 kPa

SOUTH WEST WIND

RL	Md	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qz
4.00 m	0.95	0.8300	0	-	-	1.0	1.0	29.17 m/s	0.5105 kPa
3.60 m	0.95	0.8300	0	-	-	1.0	1.0	29.17 m/s	0.5105 kPa
3.20 m	0.95	0.8300	0	-	-	1.0	1.0	29.17 m/s	0.5105 kPa
2.80 m	0.95	0.8300	2	3.00 m	6.87 m	0.9468	1.0	27.62 m/s	0.4577 kPa
2.40 m	0.95	0.8300	2	3.00 m	6.87 m	0.9468	1.0	27.62 m/s	0.4577 kPa
2.00 m	0.95	0.8300	2	3.00 m	6.87 m	0.9468	1.0	27.62 m/s	0.4577 kPa
1.60 m	0.95	0.8300	2	3.00 m	6.87 m	0.9468	1.0	27.62 m/s	0.4577 kPa
1.20 m	0.95	0.8300	2	3.00 m	6.87 m	0.9468	1.0	27.62 m/s	0.4577 kPa
0.80 m	0.95	0.8300	2	3.00 m	6.87 m	0.9468	1.0	27.62 m/s	0.4577 kPa
0.40 m	0.95	0.8300	2	3.00 m	6.87 m	0.9468	1.0	27.62 m/s	0.4577 kPa
0.00 m	0.95	0.8300	2	3.00 m	6.87 m	0.9468	1.0	27.62 m/s	0.4577 kPa

WEST WIND

RL	Md	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qz
4.00 m	1.00	0.8300	0	-	-	1.0	1.0	30.71 m/s	0.5659 kPa
3.60 m	1.00	0.8300	0	-	-	1.0	1.0	30.71 m/s	0.5659 kPa
3.20 m	1.00	0.8300	0	-	-	1.0	1.0	30.71 m/s	0.5659 kPa
2.80 m	1.00	0.8300	2	3.00 m	6.57 m	0.9502	1.0	29.18 m/s	0.5109 kPa
2.40 m	1.00	0.8300	2	3.00 m	6.57 m	0.9502	1.0	29.18 m/s	0.5109 kPa
2.00 m	1.00	0.8300	2	3.00 m	6.57 m	0.9502	1.0	29.18 m/s	0.5109 kPa
1.60 m	1.00	0.8300	2	3.00 m	6.57 m	0.9502	1.0	29.18 m/s	0.5109 kPa
1.20 m	1.00	0.8300	2	3.00 m	6.57 m	0.9502	1.0	29.18 m/s	0.5109 kPa
0.80 m	1.00	0.8300	2	3.00 m	6.57 m	0.9502	1.0	29.18 m/s	0.5109 kPa
0.40 m	1.00	0.8300	2	3.00 m	6.57 m	0.9502	1.0	29.18 m/s	0.5109 kPa
0.00 m	1.00	0.8300	2	3.00 m	6.57 m	0.9502	1.0	29.18 m/s	0.5109 kPa

NORTH WEST WIND

RL	Md	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qz
4.00 m	0.95	0.8300	0	-	-	1.0	1.0	29.17 m/s	0.5105 kPa
3.60 m	0.95	0.8300	0	-	-	1.0	1.0	29.17 m/s	0.5105 kPa
3.20 m	0.95	0.8300	0	-	-	1.0	1.0	29.17 m/s	0.5105 kPa

2.80 m	0.95	0.8300	3	3.00 m	12.61 m	0.8807	1.0	25.69 m/s	0.3960 kPa
2.40 m	0.95	0.8300	3	3.00 m	12.61 m	0.8807	1.0	25.69 m/s	0.3960 kPa
2.00 m	0.95	0.8300	3	3.00 m	12.61 m	0.8807	1.0	25.69 m/s	0.3960 kPa
1.60 m	0.95	0.8300	3	3.00 m	12.61 m	0.8807	1.0	25.69 m/s	0.3960 kPa
1.20 m	0.95	0.8300	3	3.00 m	12.61 m	0.8807	1.0	25.69 m/s	0.3960 kPa
0.80 m	0.95	0.8300	3	3.00 m	12.61 m	0.8807	1.0	25.69 m/s	0.3960 kPa
0.40 m	0.95	0.8300	3	3.00 m	12.61 m	0.8807	1.0	25.69 m/s	0.3960 kPa
0.00 m	0.95	0.8300	3	3.00 m	12.61 m	0.8807	1.0	25.69 m/s	0.3960 kPa

----- REFERENCES -----

[1] American Association of State Highway and Transportation Officials (AASHTO) 2019, 'LRFD LTS-1 LRFD Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals'.

[2] American Society of Civil Engineers (ASCE) 2014, 'ASCE/SEI 7-10 Minimum Design Loads and Associated Criteria for Buildings and Other Structures'.

[3] American Society of Civil Engineers (ASCE) 2017, 'ASCE/SEI 7-16 Minimum Design Loads and Associated Criteria for Buildings and Other Structures'.

[4] Australasian Wind Engineering Society (AWES) 2012, 'Wind Loadings Handbook for Australia and New Zealand Background to AS/NZS 1170.2 Wind Actions'.

[5] Bureau of Indian Standards 2015, 'IS 875 (Part 3): 2015 Design Loads (Other than Earthquake) for Buildings and Structures - Code of Practice Part 3 Wind Loads (Third Revision)'.

[6] Standards Australia/Standards New Zealand 2007, 'AS/NZS 1170.3:2003 Structural design actions Part 3: Snow and ice actions'.

[7] Standards Australia/Standards New Zealand 2009, 'AS/NZS 1170.1:2002 Structural design actions Part 1: Permanent, imposed and other actions'.

[8] Standards Australia/Standards New Zealand 2011, 'AS/NZS 1170.0:2002 Structural design actions Part 0: General principles'.

[9] Standards Australia/Standards New Zealand 2017, 'AS/NZS 1170.2:2011 Structural design actions Part 2: Wind actions'.

[10] Telecommunications Industry Association 2014, 'TIA-222-G-2 Structural Standard for Antenna Supporting Structures and Antennas'.

[11] Telecommunications Industry Association 2019, 'TIA-222-H-1 Structural Standard for Antenna Supporting Structures and Antennas and Small Wind Turbine Support Structures'.