



Civil & Structural Engineering Design Services Pty. Ltd.

Client: EXTREME MARQUEES PTY. LTD.

Project: Design check – 8m & 10m Pinnacle Range Square Pagoda Tents for **80km/hr** Wind Speed.

Reference: Extreme Marquees Pty Ltd Technical Data

Report by: KZ
Checked by: EAB
Date: 21/11/2016

JOB NO: E-11-264962-4



Table of Contents

1	Introduction	3
2	Design Restrictions and Limitations.....	4
3	Specifications.....	5
3.1	General.....	5
3.2	Aluminium Properties.....	8
3.3	Buckling Constants.....	8
3.4	Section Properties.....	9
4	Design Loads	9
4.1	Ultimate	9
4.2	Load Combinations.....	9
4.2.1	Serviceability	9
4.2.2	Ultimate.....	10
5	Wind Analysis	10
5.1	Parameters.....	10
5.2	Pressure Coefficients (C_{fig}).....	10
5.2.1	Pressure summary.....	14
5.3	Wind Load Diagrams.....	15
5.3.1	Wind (case 1)	15
5.3.2	Wind (case 2)	15
5.3.3	Max Bending Moment due to critical load combination in major axis.....	16
5.3.4	Max Bending Moment in minor axis due to critical load combination.....	16
5.3.5	Max Shear in due to critical load combination.....	17
5.3.6	Max Axial force in upright support and roof beam due to critical load combination.....	17
5.3.7	Max reactions.....	18
5.3.8	Summary Table:	18
6	Checking Members Based on AS1664.1 ALUMINIUM LSD	19
6.1	Rafter	19
6.2	Upright Supports	23
6.3	Eave	27
7	Checking Members Based on AS4100-1998 Steel Structures.....	31
7.1	Centre Pole	31
8	Summary.....	33
8.1	Conclusions.....	33
9	Appendix A – Base Anchorage Requirements	34
10	Appendix B – Hold Down Method Details.....	35



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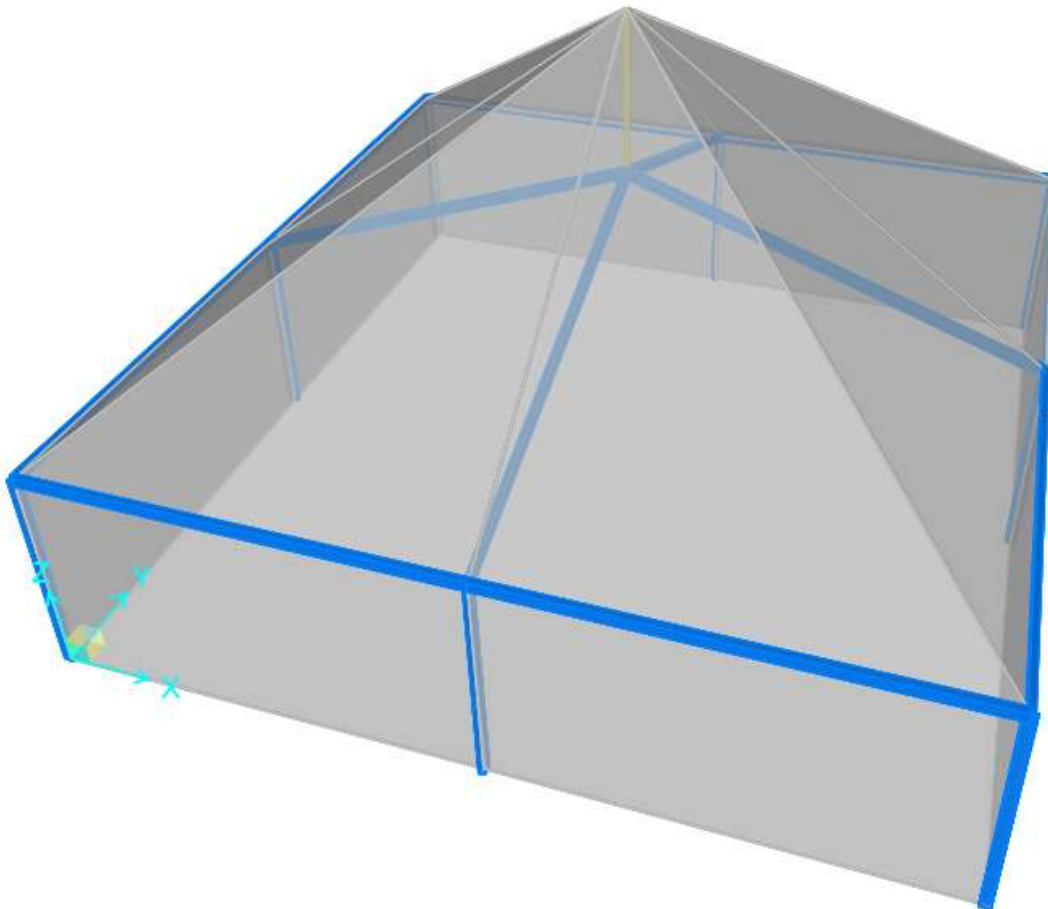
1 Introduction

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The following structural drawings and calculations are for the transportable tents supplied by Extreme Marquees.

The frame consists principally of extruded '6061-T6' aluminium components with hot dipped galvanized steel ridge and knee connection inserts and base plate.

The report examines the effect of 3s gust wind of 80 km/hr on 10m × 10m Pinnacle Range Pagoda Tent as the worst-case scenario. The relevant Australian Standards AS1170.0:2002 General principles, AS1170.1:2002 Permanent, imposed and other actions and AS1170.2:2011 Wind actions are used. The design check is in accordance with AS/NZS 1664.1:1997 Aluminum limit state design & AS 4100:1998 Steel Structures.





2 Design Restrictions and Limitations

- 2.1 The erected structure is for temporary use only.
- 2.2 It should be noted that if high gust wind speeds are anticipated or forecast in the locality of the tent, the temporary erected structure should be dismantled.
- 2.3 For forecast winds in excess of **(refer to summary)** – all fabric shall be removed from the frames, and the structure should be completely dismantled.
(Please note that the locality squall or gust wind speed is affected by factors such as terrain exposure and site elevations.)
- 2.4 The structure may only be erected in regions with wind classifications no greater than the limits specified on the attached wind analysis.
- 2.5 The wind classifications are based upon Terrain Category 2. Considerations have also been made to the regional wind terrain category, topographical location and site shielding from adjacent structures. Please note that in many instances topographical factors such as a location on the crest of a hill or on top of an escarpment may yield a higher wind speed classification than that derived for a higher wind terrain category in a level topographical region. For this reason, particular regard shall be paid to the topographical location of the structure. For localities which do not conform to the standard prescribed descriptions for wind classes as defined above, a qualified Structural Engineer may be employed to determine an appropriate wind class for that the particular site.
- 2.6 The structures in no circumstances shall ever be erected in tropical or severe tropical cyclonic condition as defined on the Map of Australia in AS 1170.2-2011, Figure 3.1.
- 2.7 The tent structure has not been designed to withstand snow and ice loadings such as when erected in alpine regions.
- 2.8 For the projects, where the site conditions approach the design limits, extra consideration should be given to pullout tests of the stakes and professional assessment of the appropriate wind classification for the site.
- 2.9 The tents are stabilized as using rigid connections as shown on the drawings.
- 2.10 It is important to use 76.1x3.2 CHS Steel made (grade 250) for the Centre Pole.**



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3 Specifications

3.1 General

Tent category	
Material	Aluminum 6061-T6 Steel Grade 250 mPa

Size	Model
10m x 10m	Pinnacle Range



Pinnacle Range

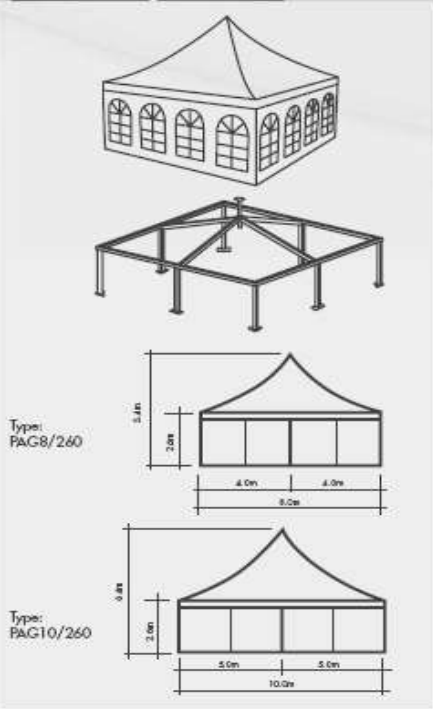
8m / 10m

Product Photos



Item	Specification
Clear-Span Width	8m / 10m
Eave Height	2.6m
Ridge Height	5.4m / 6.4m
Max Allowed Windspeed	80km/hr 0.3kn/m ²
Eave Connection	Hot-dip galvanized steel insert
Framework Material	Hard pressed extruded aluminium 6061/T6 (13HW)
Cover Material	PVC, flame retardant to DIN 4102 B1 M2. 750-900g/m ²

Technical Diagrams



Types: PA/G-8/260
PA/G-10/260

Product Info

The Pinnacle is the choice when impressions matter. Designed specifically for classy special events, the Pinnacle is versatile and stylish but built with substance. Quality 6061 T6 aluminium combined with a myriad of accessories across 4 sizes makes the Pinnacle a strong & flexible marquee choice.

Accessories:

- PVC window sidewalls
- Anchoring
- Rain gutter
- Lining & curtains
- Glass door units
- Hard walling system
- Glass walling system
- Transparent PVC cover & sidewall
- Flooring System
- Weight plate

Profiles

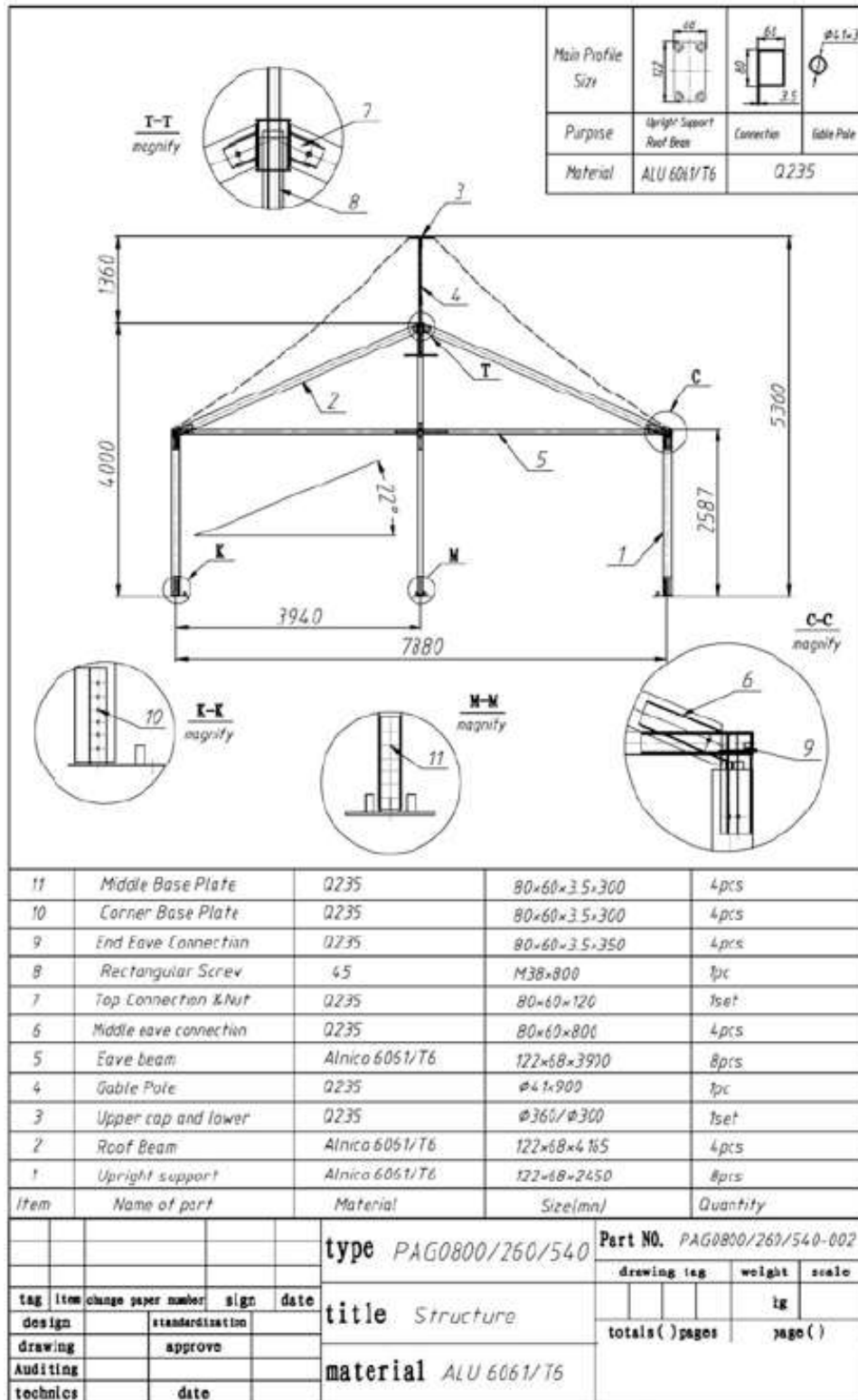
Framework Main profile dimensions and use



www.extrememarquees.com.au
call 1300 850 832

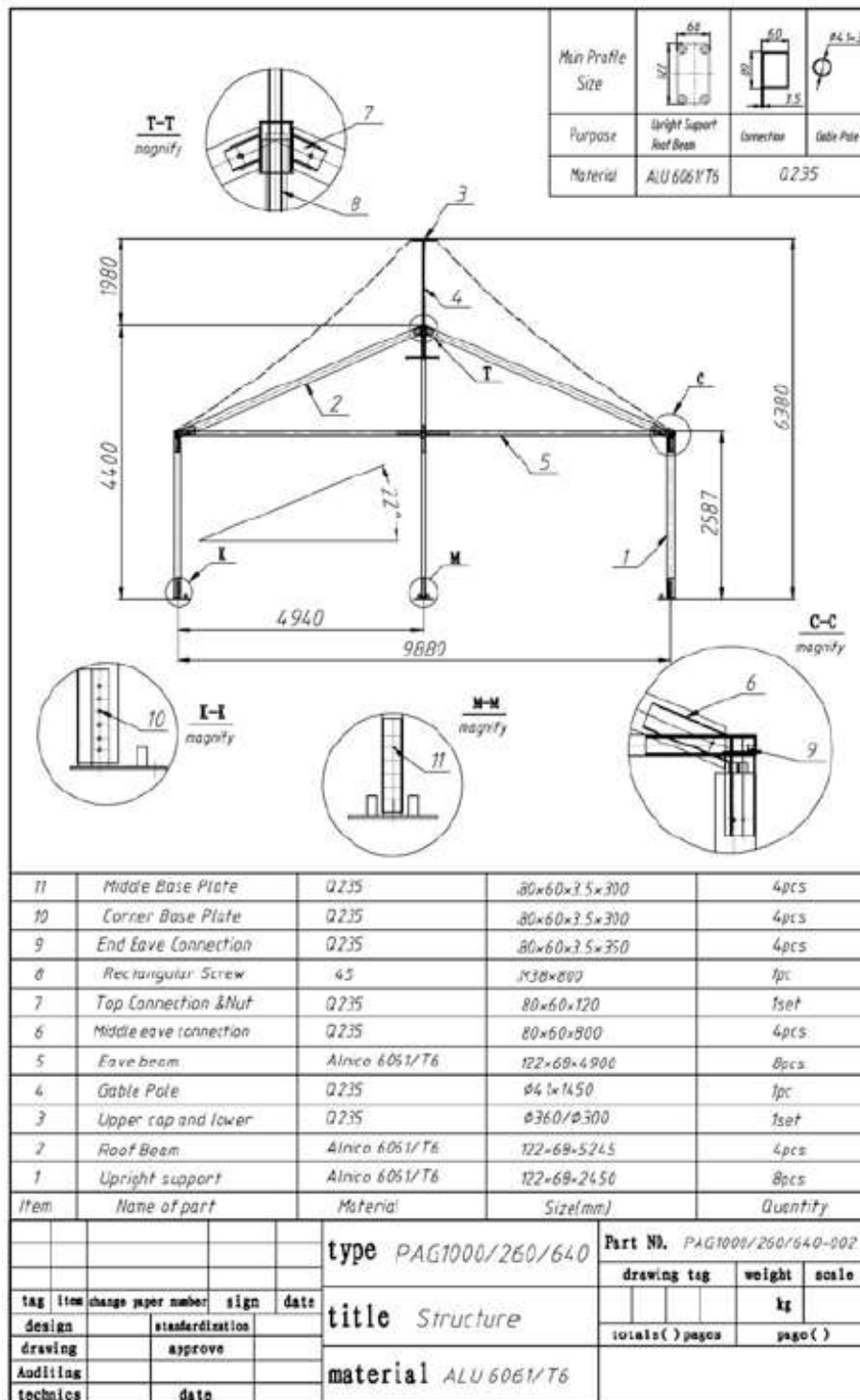


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3.2 Aluminium Properties

Aluminium Properties		
Compressive yield strength	Fcy	241 MPa
Tensile yeild strength	Fty	241 MPa
Tensile ultimate strength	Ftu	262 MPa
Shear yield strength	Fsy	138 MPa
Bearing yeild strength	Fby	386 MPa
Bearing ultimate strength	Fbu	552 MPa
Yield stress (min{Fcy:Fty})	Fy	241 MPa
Elastic modulus	E	70000 MPa
Shear modulus	G	26250 MPa
Value of coefficients	kt	1.00
	kc	1.00
Capacity factor (general yield)	ϕ_y	0.95
Capacity factor (ultimate)	ϕ_u	0.85
Capacity factor (bending)	ϕ_b	0.85
Capacity factor (elastic shear buckling)	ϕ_v	0.8
Capacity factor (inelastic shear buckling)	ϕ_{vp}	0.9

3.3 Buckling Constants

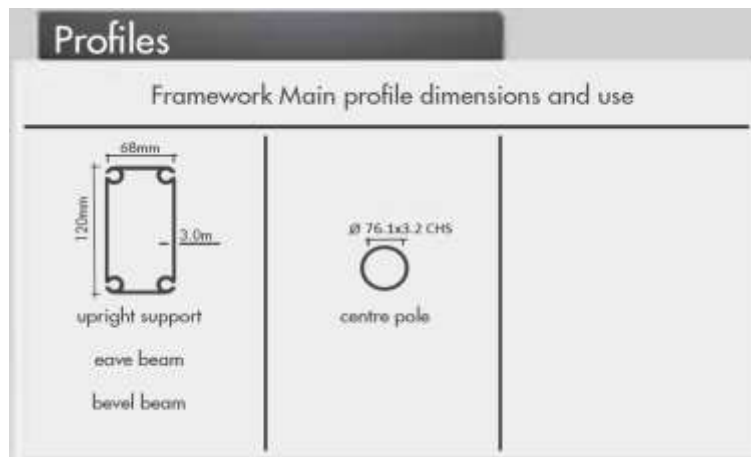
Type of member and stresses	Intercept, MPa	Slope, MPa	Intersection
Compression in columns and beam flanges	BC= 242.87	Dc= 1.43	Cc= 69.61
Compression in flat plates	Bp= 310.11	Dp= 2.06	Cp= 61.60
Compressive bending stress in solid rectangular bars	Bbr= 459.89	Dbr= 4.57	Cbr= 67.16
Compressive bending stress in round tubes	Btb= 250.32	Dtb= 14.18	Ctb= 183.52
Shear stress in flat plates	Bs= 178.29	Ds= 0.90	Cs= 81.24



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3.4 Section Properties

MEMBER(S)	Section	b	d	t	y _c	A _g	Z _x	Z _y	S _x	S _y	I _x	I _y	J	r _x	r _y
		mm	mm	mm	mm	mm ²	mm ³	mm ³	mm ³	mm ³	mm ⁴	mm ⁴	mm ⁴	mm	mm
Rafter	120x68x3	68	120	3	60.0	1092.0	35622.6	25888.4	43362.0	29166.0	2137356.0	880204.0	1906682.1	44.2	28.4
Upright Support	120x68x3	68	120	3	60.0	1092.0	35622.6	25888.4	43362.0	29166.0	2137356.0	880204.0	1906682.1	44.2	28.4
Peak Pole (Steel 250)	76.1x3.2CHS	76.1	-	3.2	38.0	733.0	12825.2	12825.2	17000.0	17000.0	488000.0	488000.0	976000.0	25.8	25.8
Eave	120x68x3	68	120	3	60.0	1092.0	35622.6	25888.4	43362.0	29166.0	2137356.0	880204.0	1906682.1	44.2	28.4



4 Design Loads

4.1 Ultimate

		Distributed load (kPa)	Design load factor (-)	Factored imposed load (kPa)
Live	Q	-	1.5	-
Self weight	G	self weight	1.35, 1.2, 0.9	1.2 self weight, 0.9 self weight
3s 80km/hr gust	W	0.245 C _{fig}	1.0	0.245 C _{fig}

4.2 Load Combinations

4.2.1 Serviceability

Gravity = $1.0 \times G$

Wind = $1.0 \times G + 1.0 \times W$



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4.2.2 Ultimate

$$\begin{aligned}\text{Downward} &= 1.35 \times G \\ &= 1.2 \times G + W_u \\ &= 1.2 \times G + W_u + W_{Is}\end{aligned}$$

$$\begin{aligned}\text{Upward} &= 0.9 \times G + W_u \\ &= 0.9 \times G + W_u + W_{IP}\end{aligned}$$

5 Wind Analysis

Wind towards surface (+ve), away from surface (-ve)

5.1 Parameters

Terrain category = 2

Site wind speed ($V_{sit,\beta}$) = $V_R M_d (M_{z,cat} M_s M_t)$

$V_R = 22.22 \text{ m/s (80 km/hr)}$

(regional 3 s gust wind speed)

$M_d = 1$

$M_s = 1$

$M_t = 1$

$M_{z,cat} = 0.91$

(Table 4.1(B) AS1170.2)

$V_{sit,\beta} = 20.22 \text{ m/s}$

Height of structure (h) = 4.5 m

(mid of peak and eave)

Width of structure (w) = 10 m

Length of structure (l) = 10 m

Pressure (P) = $0.5 \rho_{air} (V_{sit,\beta})^2 C_{fig} C_{dyn}$
= 0.245 C_{fig} kPa

5.2 Pressure Coefficients (C_{fig})

Name	Symbol	Value	Unit	Notes	Ref.
Input					
Importance level		2			Table 3.1 - Table 3.2 (AS1170.0)
Annual probability of exceedance		Temporary			Table 3.3
Regional gust wind speed		80	Km/hr		Table 3.1
Regional gust wind speed	V_R	22.22	m/s		Table 3.2 (AS1170.2)
Wind Direction Multiplier	M_d	1			Table 4.1
Terrain Category Multiplier	$M_{Z,Cat}$	0.91			4.3 (AS1170.2)
Shield Multiplier	M_s	1			4.4 (AS1170.2)
Topographic Multiplier	M_t	1			



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Site Wind Speed	$V_{Site,\beta}$	20.22	m/s	$V_{Site,\beta} = V_R * M_d * M_z, cat * M_{S, Mt}$	
Pitch	α	35	Deg		
Pitch	α	0.611	rad		
Width	B	10	m		
Width Span	S_w	5	m		
Length	D	10	m		
Height	Z	4.5	m		
Bay Span		5	m		
Purlin Spacing		-	m		
Number of Intermediate Purlin		-			
	h/d	0.45			
	h/b	0.45			
Wind Pressure					
ρ_{air}	ρ	1.2	Kg/m ³		
dynamic response factor	C_{dyn}	1			
Wind Pressure	$\rho * C_{fig}$	0.245	Kg/m ²	$\rho = 0.5 \rho_{air} * (V_{des,\beta})^2 * C_{fig} * C_{dyn}$	2.4 (AS1170.2)
WIND DIRECTION 1 & 2 Internal Pressure					
Opening Assumption	With Dominant Opening ($C_{pi} = n C_{pe}$)				
Internal Pressure Coefficient (Without Dominant) MIN		-0.1			Table 5.1 A
Internal Pressure Coefficient (Without Dominant) MAX		0.2			
Internal Pressure Coefficient (With Dominant) MIN		-0.1			Table 5.1B
Internal Pressure Coefficient (With Dominant) MAX		0.2			
N		0.7		$C_{pi} = N * C_{pe}$	
Combination Factor	$K_{C,i}$	1			
Internal Pressure Coefficient	$C_{p,i}$	0.70			



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MIN

Internal Pressure Coefficient

$C_{p,i}$ 0.70

MAX

External Pressure

1. Windward Wall

External Pressure Coefficient

$C_{p,e}$ 0.6

Table 5.2 A

Area Reduction Factor

K_a 1

Table 5.4

combination factor applied to internal pressures

$K_{C,e}$ 0.8

local pressure factor

K_l 1

porous cladding reduction factor

K_p 1

aerodynamic shape factor

$C_{fig,e}$ 0.48

Wind Wall Pressure

P 0.12 kPa

Edge Column Force

F 0.29 kN/m

Intermediate Column Force

F 0.59 kN/m

2. Leeward Wall

External Pressure Coefficient

$C_{p,e}$ -0.5

Table 5.2 B

Area Reduction Factor

K_a 1

Table 5.4

combination factor applied to internal pressures

$K_{C,e}$ 0.8

local pressure factor

K_l 1

porous cladding reduction factor

K_p 1

aerodynamic shape factor

$C_{fig,e}$ -0.4

Lee Wall Pressure

P -0.10 kPa

Edge Column Force

F -0.25 kN/m

Intermediate Column Force

F -0.49 kN/m

Table 5.2 C

3. Side Wall

Area Reduction Factor

K_a 1

Table 5.4

combination factor applied to internal pressures

$K_{C,e}$ 0.8

local pressure factor

K_l 1

porous cladding reduction factor

K_p 1

External Pressure Coefficient

$C_{p,e}$ -0.65

0 to 1h



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External Pressure Coefficient	$C_{P,e}$	-0.5		1h to 2h
External Pressure Coefficient	$C_{P,e}$	-0.3		2h to 3h
External Pressure Coefficient	$C_{P,e}$	-0.2		>3h
aerodynamic shape factor	$C_{fig,e}$	-0.52		0 to 1h
aerodynamic shape factor	$C_{fig,e}$	-0.4		1h to 2h
aerodynamic shape factor	$C_{fig,e}$	-0.24		2h to 3h
aerodynamic shape factor	$C_{fig,e}$	-0.16		>3h
Side Wall Pressure	P	-0.13	kPa	0 to 1h
Side Wall Pressure	P	-0.10	kPa	1h to 2h
Side Wall Pressure	P	-0.06	kPa	2h to 3h
Side Wall Pressure	P	-0.04	kPa	>3h

4. Roof Up Wind Slope

Area Reduction Factor	K_a	1		
combination factor applied to internal pressures	$K_{C,e}$	0.8		
local pressure factor	K_l	1		
porous cladding reduction factor	K_p	1		
External Pressure Coefficient MIN	$C_{P,e}$	-0.16		
External Pressure Coefficient MAX	$C_{P,e}$	0.42		
aerodynamic shape factor MIN	$C_{fig,e}$	-0.13		
aerodynamic shape factor MAX	$C_{fig,e}$	0.34		
Pressure MIN	P	-0.03	kPa	
Pressure MAX	P	0.08	kPa	
Edge Rafter Force MIN	F	-0.08	kN/m	
Edge Rafter Force Max	F	0.21	kN/m	
Intermediate Rafter Force MIN	F	-0.16	kN/m	
Intermediate Rafter Force MAX	F	0.41	kN/m	

5. Roof Down Wind Slope

Area Reduction Factor	K_a	1		
combination factor applied to internal pressures	$K_{C,e}$	0.8		
local pressure factor	K_l	1		
porous cladding reduction factor	K_p	1		
External Pressure Coefficient	$C_{P,e}$	-0.6		
aerodynamic shape factor	$C_{fig,e}$	-0.48		

$\alpha > 10^\circ$

Table 5.3 B

Table 5.3C

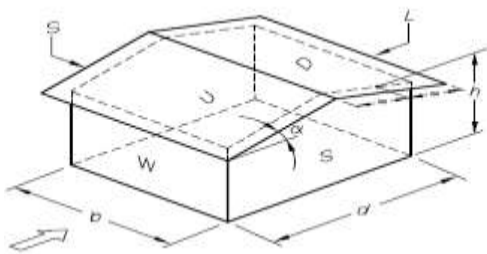


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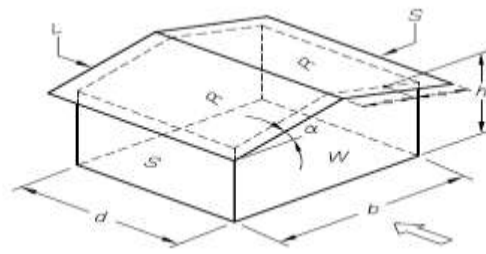
Pressure MIN	P	-0.12	kPa
Pressure MAX	P	-0.12	kPa
Edge Rafter Force MIN	F	-0.29	kN/m
Edge Rafter Force MAX	F	-0.29	kN/m
Intermediate Rafter Force MIN	F	-0.59	kN/m
Intermediate Rafter Force MAX	F	-0.59	kN/m

5.2.1 Pressure summary

WIND EXTERNAL PRESSURE			Direction1 & 2	
Windward (kPa)			0.12	
Leeward (kPa)			-0.10	
Sidewall (m)	Length	(m)	(m)	(Kpa)
	0 - 1h	0	4.5	-0.13
	1h - 2h	4.5	9	-0.10
	2h - 3h	9	13.5	-0.06
	>3h	13.5	-	-0.04
Roof			Min (Kpa)	Max (Kpa)
	Upwind Slope		-0.03	0.08
	Downwind Slope		-0.12	-0.12
Wind Internal Pressure (kPa)			Min (kPa)	Max (kPa)
			Proportion of Cpe	Proportion of Cpe



Direction 1



Direction 2

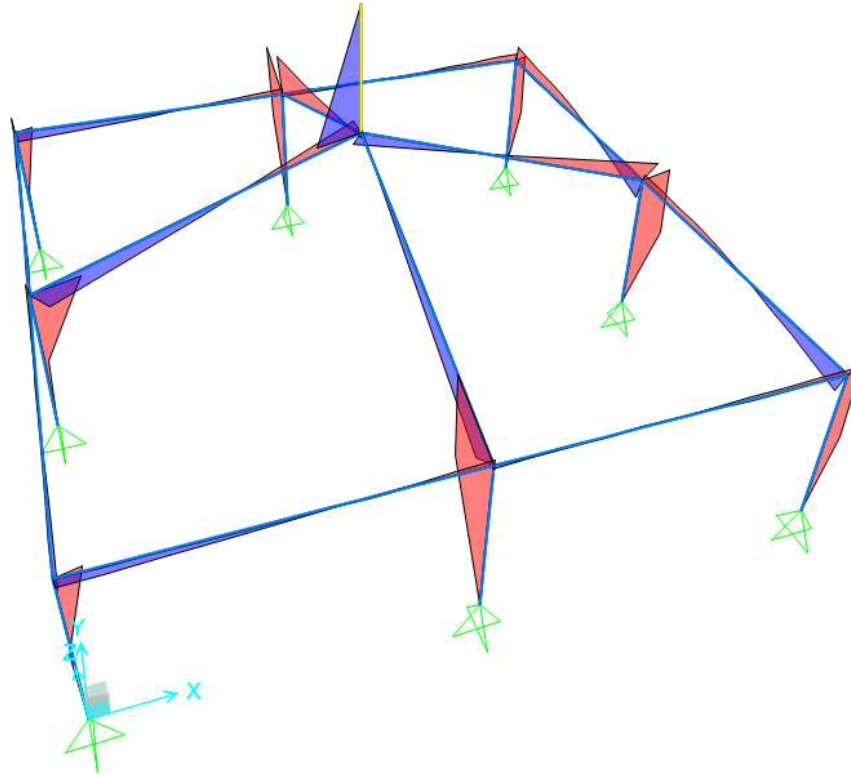
AS1170.2



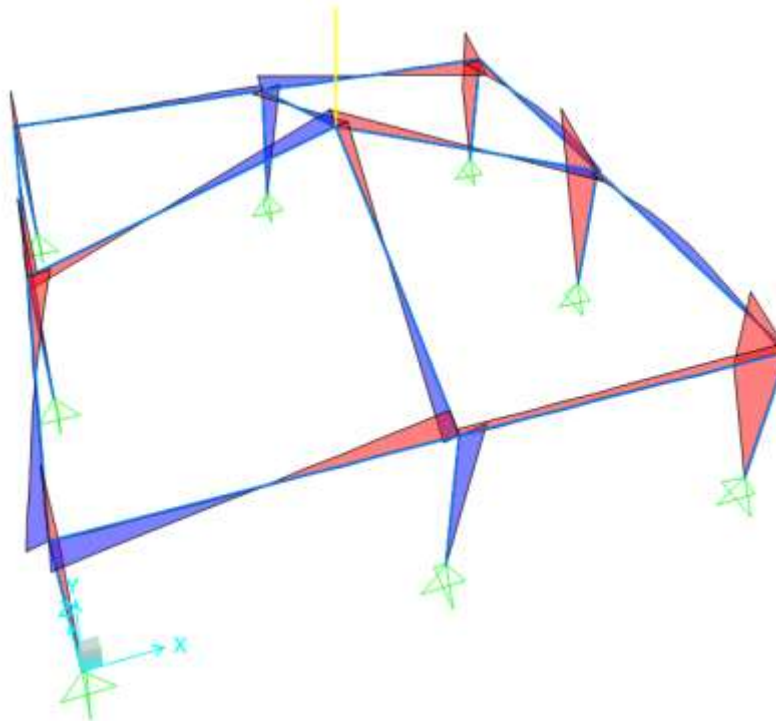


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5.3.3 Max Bending Moment due to critical load combination in major axis



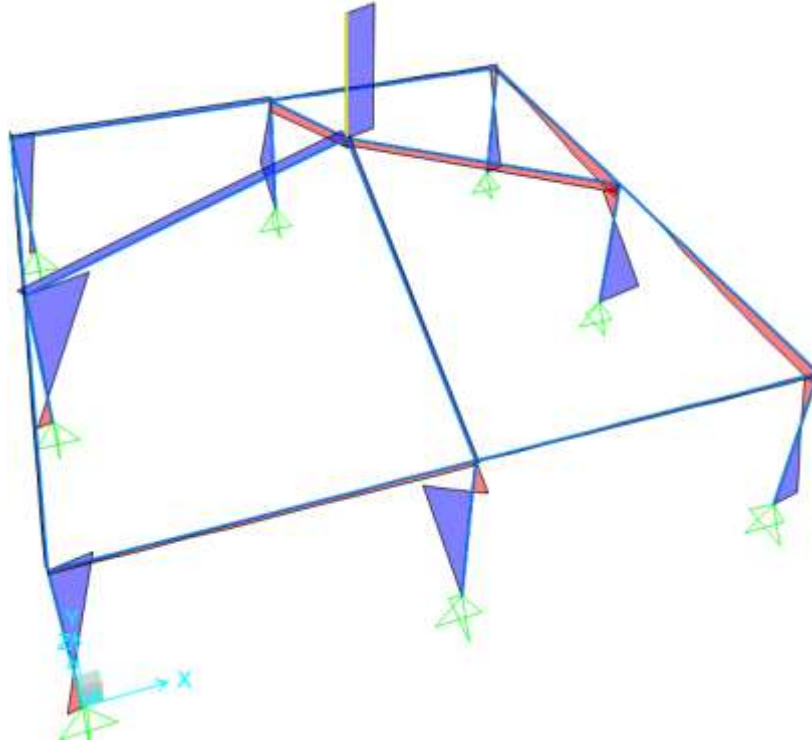
5.3.4 Max Bending Moment in minor axis due to critical load combination



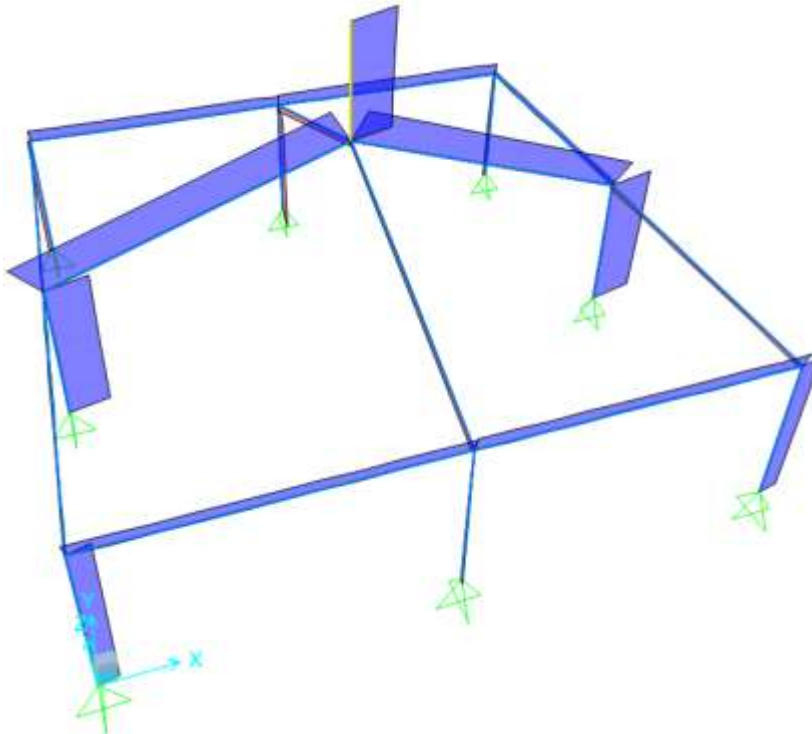


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5.3.5 Max Shear in due to critical load combination



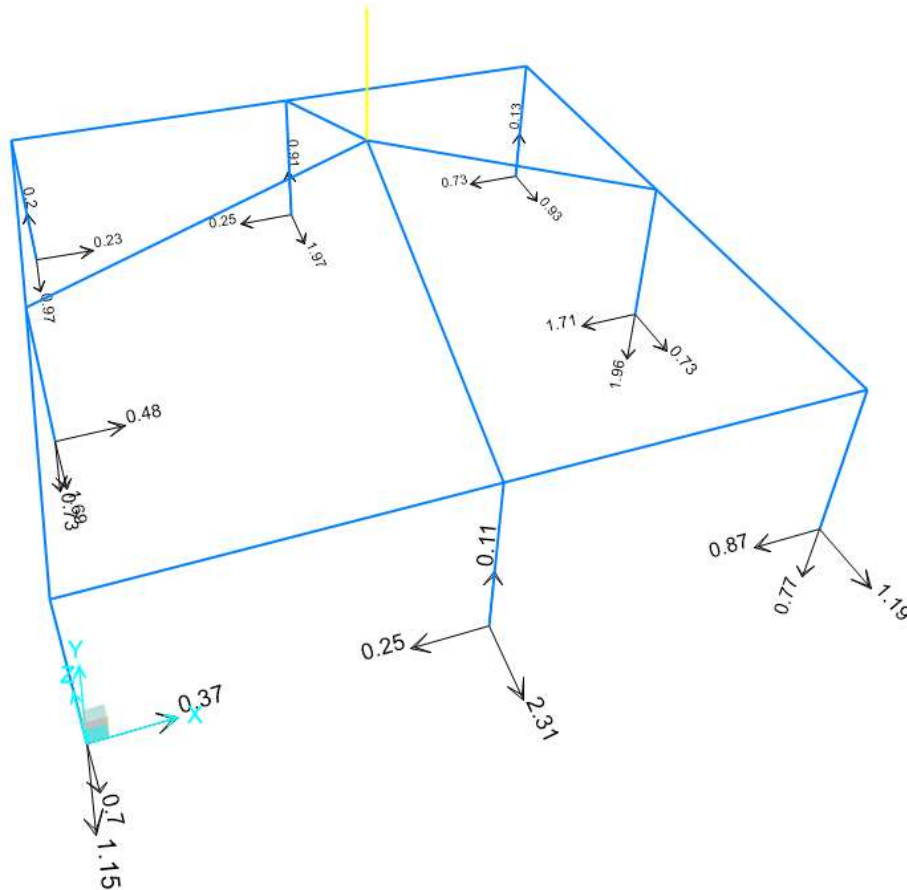
5.3.6 Max Axial force in upright support and roof beam due to critical load combination





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5.3.7 Max reactions



Max Reaction (Bearing) $N^* = 1.2 \text{ kN}$

Max Reaction (Uplift) $N^* = 2 \text{ kN}$

5.3.8 Summary Table:

MEMBER(S)	Section	b	d	t	Vx	Vy	P (Axial) Negative -> Compression Positive -> Tension	Mx	My
		mm	mm	mm	kN	kN	kN	kN.m	kN.m
Rafter	120x68x3	68	120	3	-1.15	0.218	0.288	-3.3341	0.5195
Upright Support	120x68x3	68	120	3	0.19	0.809	0.827	-3.6046	-2.1023
Centre Pole	76.1x3.2CHS	76.1	-	3.2	0	0	0	0	0
Eave	120x68x3	68	120	3	-0.29	-0.648	0.461	-1.311	-1.147



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6 Checking Members Based on AS1664.1 ALUMINIUM LSD

6.1 Rafter

NAME	SYMBOL	VALUE	UNIT	NOTES	REF
120x68x3	Rafter				
Alloy and temper	6061-T6				AS1664.1
Tension	F_{tu}	= 262	MPa	Ultimate	T3.3(A)
	F_{ty}	= 241	MPa	Yield	
Compression	F_{cy}	= 241	MPa		
Shear	F_{su}	= 165	MPa	Ultimate	
	F_{sy}	= 138	MPa	Yield	
Bearing	F_{bu}	= 551	MPa	Ultimate	
	F_{by}	= 386	MPa	Yield	
Modulus of elasticity	E	= 70000	MPa	Compressive	
	k_t	= 1.0			T3.4(B)
	k_c	= 1.0			
FEM ANALYSIS RESULTS					
Axial force	P	= 0	kN	compression	
	P	= 0.288	kN	Tension	
In plane moment	M_x	= 3.3341	kNm		
Out of plane moment	M_y	= 0.5195	kNm		
DESIGN STRESSES					
Gross cross section area	A_g	= 1092	mm ²		
In-plane elastic section modulus	Z_x	= 35622.6	mm ³		
Out-of-plane elastic section mod.	Z_y	= 25888.35	mm ³		
Stress from axial force	f_a	= P/A_g			
		= 0.00	MPa	compression	
		= 0.26	MPa	Tension	
Stress from in-plane bending	f_{bx}	= M_x/Z_x			
		= 93.60	MPa	compression	
Stress from out-of-plane bending	f_{by}	= M_y/Z_y			
		= 20.07	MPa	compression	
Tension					
3.4.3 Tension in rectangular tubes					



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	ϕF_L	=	228.95	MPa		
		O				
		R				
	ϕF_L	=	222.70	MPa		
COMPRESSION						
3.4.8 Compression in columns, axial, gross section						
1. General						... 3.4.8.1
Unsupported length of member	L	=	5310	mm		
Effective length factor	k	=	1			
Radius of gyration about buckling axis (Y)	r_y	=	28.39	mm		
Radius of gyration about buckling axis (X)	r_x	=	44.24	mm		
Slenderness ratio	kLb/r_y	=	187.03			
Slenderness ratio	kL/r_x	=	120.02			
Slenderness parameter	λ	=	3.493			
	D_c^*	=	90.3			
	S_1^*	=	0.33			
	S_2^*	=	1.23			
	ϕ_{cc}	=	0.950			
Factored limit state stress	ϕF_L	=	18.76	MPa		
2. Sections not subject to torsional or torsional-flexural buckling						... 3.4.8.2
Largest slenderness ratio for flexural buckling	kL/r	=	187.03			
3.4.10 Uniform compression in components of columns, gross section - flat plates						
1. Uniform compression in components of columns, gross section - flat plates with both edges supported						... 3.4.10.1 T3.3(D)
	k_1	=	0.35			
Max. distance between toes of fillets of supporting elements for plate	b'	=	62			
	t	=	3	mm		
Slenderness	b/t	=	20.666667			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	32.87			
Factored limit state stress	ϕF_L	=	205.58	MPa		



Most adverse compressive limit state stress	F_a	=	18.76	MPa		
Most adverse tensile limit state stress	F_a	=	222.70	MPa		
Most adverse compressive & Tensile capacity factor	f_a/F_a	=	0.00		PASS	
BENDING - IN-PLANE						
3.4.15 Compression in beams, extreme fibre, gross section rectangular tubes, box sections						
Unbraced length for bending	L_b	=	5310	mm		
Second moment of area (weak axis)	I_y	=	8.80E+05	mm ⁴		
Torsion modulus	J	=	1.91E+06	mm ³		
Elastic section modulus	Z	=	35622.6	mm ³		
Slenderness	S	=	292.02			
Limit 1	S_1	=	0.39			
Limit 2	S_2	=	1695.86			
Factored limit state stress	ϕF_L	=	191.19	MPa		3.4.15(2)
3.4.17 Compression in components of beams (component under uniform compression), gross section - flat plates with both edges supported						
	k_1	=	0.5			T3.3(D)
	k_2	=	2.04			T3.3(D)
Max. distance between toes of fillets of supporting elements for plate	b'	=	62	mm		
	t	=	3	mm		
Slenderness	b/t	=	20.666667			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	46.95			
Factored limit state stress	ϕF_L	=	205.58	MPa		
Most adverse in-plane bending limit state stress	F_{bx}	=	191.19	MPa		
Most adverse in-plane bending capacity factor	f_{bx}/F_{bx}	=	0.49		PASS	
BENDING - OUT-OF-PLANE						



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NOTE: Limit state stresses, ϕF_L are the same for out-of-plane bending (doubly symmetric section)

Factored limit state stress $\phi F_L = 191.19$ MPa

Most adverse out-of-plane bending limit state stress $F_{by} = 191.19$ MPa

Most adverse out-of-plane bending capacity factor $f_{by}/F_{by} = 0.10$ **PASS**

COMBINED ACTIONS

4.1.1 Combined compression and bending

$F_a = 18.76$ MPa

$F_{ao} = 205.58$ MPa

$F_{bx} = 191.19$ MPa

$F_{by} = 191.19$ MPa

$f_a/F_a = 0.001$

Check: $f_a/F_a + f_{bx}/F_{bx} + f_{by}/F_{by} \leq 1.0$

i.e. $0.60 \leq 1.0$ **PASS**

SHEAR

3.4.24 Shear in webs (Major Axis)

Clear web height $h = 114$ mm

$t = 3$ mm

Slenderness $h/t = 38$

Limit 1 $S_1 = 29.01$

Limit 2 $S_2 = 59.31$

Factored limit state stress $\phi F_L = 122.00$ MPa

Stress From Shear force $f_{sx} = V/A_w$
 1.68 MPa

3.4.25 Shear in webs (Minor Axis)

Clear web height $b = 62$ mm

$t = 3$ mm

Slenderness $b/t = 20.66666$
 7

Factored limit state stress $\phi F_L = 131.10$ MPa



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Stress From Shear force $f_{sy} = \frac{V}{A_w}$
0.59 MPa

6.2 Upright Supports

NAME	SYMBOL	VALUE	UNIT	NOTES	REF
120x68x3	Upright Support				
Alloy and temper	6061-T6				AS1664.1
Tension	F_{tu}	= 262	MPa	Ultimate	T3.3(A)
	F_{ty}	= 241	MPa	Yield	
Compression	F_{cy}	= 241	MPa		
Shear	F_{su}	= 165	MPa	Ultimate	
	F_{sy}	= 138	MPa	Yield	
Bearing	F_{bu}	= 551	MPa	Ultimate	
	F_{by}	= 386	MPa	Yield	
Modulus of elasticity	E	= 70000	MPa	Compressive	
	k_t	= 1.0			T3.4(B)
	k_c	= 1.0			
FEM ANALYSIS RESULTS					
Axial force	P	= 0	kN	compression	
	P	= 0.827	kN	Tension	
In plane moment	M_x	= 3.6046	kNm		
Out of plane moment	M_y	= 2.1023	kNm		
DESIGN STRESSES					
Gross cross section area	A_g	= 1092	mm ²		
In-plane elastic section modulus	Z_x	= 35622.6	mm ³		
Out-of-plane elastic section mod.	Z_y	= 25888.35	mm ³		
Stress from axial force	f_a	= P/A_g			
		= 0.00	MPa	compression	
		= 0.76	MPa	Tension	
Stress from in-plane bending	f_{bx}	= M_x/Z_x			
		= 101.19	MPa	compression	
Stress from out-of-plane bending	f_{by}	= M_y/Z_y			
		= 81.21	MPa	compression	
Tension					



3.4.3 Tension in rectangular tubes					
	ϕF_L	=	228.95	MPa	
		O			
		R			
	ϕF_L	=	222.70	MPa	
COMPRESSION					
3.4.8 Compression in columns, axial, gross section					
1. General					
					... 3.4.8.1
Unsupported length of member	L	=	2600	mm	
Effective length factor	k	=	1		
Radius of gyration about buckling axis (Y)	r_y	=	28.39	mm	
Radius of gyration about buckling axis (X)	r_x	=	44.24	mm	
Slenderness ratio	kLb/ry	=	91.58		
Slenderness ratio	kL/rx	=	58.77		
Slenderness parameter	λ	=	1.71		
	D_c^*	=	90.3		
	S_1^*	=	0.33		
	S_2^*	=	1.23		
	ϕ_{cc}	=	0.819		
Factored limit state stress	ϕF_L	=	67.51	MPa	
2. Sections not subject to torsional or torsional-flexural buckling					
					... 3.4.8.2
Largest slenderness ratio for flexural buckling	kL/r	=	91.58		
3.4.10 Uniform compression in components of columns, gross section - flat plates					
1. Uniform compression in components of columns, gross section - flat plates with both edges supported					
	k_1	=	0.35		... 3.4.10.1 T3.3(D)
Max. distance between toes of fillets of supporting elements for plate	b'	=	62		
	t	=	3	mm	
Slenderness	b/t	=	20.66666 7		
Limit 1	S_1	=	12.34		
Limit 2	S_2	=	32.87		



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Factored limit state stress	ϕF_L	=	205.58	MPa		
Most adverse compressive limit state stress	F_a	=	67.51	MPa		
Most adverse tensile limit state stress	F_a	=	222.70	MPa		
Most adverse compressive & Tensile capacity factor	f_a/F_a	=	0.00		PASS	
BENDING - IN-PLANE						
3.4.15 <i>Compression in beams, extreme fibre, gross section rectangular tubes, box sections</i>						
Unbraced length for bending	L_b	=	2600	mm		
Second moment of area (weak axis)	I_y	=	8.80E+05	mm ⁴		
Torsion modulus	J	=	1.91E+06	mm ³		
Elastic section modulus	Z	=	35622.6	mm ³		
Slenderness	S	=	142.99			
Limit 1	S_1	=	0.39			
Limit 2	S_2	=	1695.86			
Factored limit state stress	ϕF_L	=	202.96	MPa		3.4.15(2)
3.4.17 <i>Compression in components of beams (component under uniform compression), gross section - flat plates with both edges supported</i>						
	k_1	=	0.5			T3.3(D)
	k_2	=	2.04			T3.3(D)
Max. distance between toes of fillets of supporting elements for plate	b'	=	62	mm		
	t	=	3	mm		
Slenderness	b/t	=	20.666667			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	46.95			
Factored limit state stress	ϕF_L	=	205.58	MPa		
Most adverse in-plane bending limit state stress	F_{bx}	=	202.96	MPa		
Most adverse in-plane bending capacity factor	f_{bx}/F_{bx}	=	0.50		PASS	



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BENDING - OUT-OF-PLANE						
NOTE: Limit state stresses, ϕF_L are the same for out-of-plane bending (doubly symmetric section)						
Factored limit state stress	ϕF_L	=	202.96	MPa		
Most adverse out-of-plane bending limit state stress	F_{by}	=	202.96	MPa		
Most adverse out-of-plane bending capacity factor	f_{by}/F_{by}	=	0.40		PASS	
COMBINED ACTIONS						
4.1.1 Combined compression and bending						...
	F_a	=	67.51	MPa		4.1.1(2)
	F_{ao}	=	205.58	MPa		... 3.4.8
	F_{bx}	=	202.96	MPa		... 3.4.10
	F_{by}	=	202.96	MPa		... 3.4.17
	f_a/F_a	=	0.003			... 3.4.17
Check:	$f_a/F_a + f_{bx}/F_{bx} + f_{by}/F_{by} \leq 1.0$					... 4.1.1
i.e.	0.90	$\leq$	1.0		PASS	(3)
SHEAR						
3.4.24 Shear in webs (Major Axis)						...
Clear web height	h	=	114	mm		4.1.1(2)
	t	=	3	mm		
Slenderness	h/t	=	38			
Limit 1	S_1	=	29.01			
Limit 2	S_2	=	59.31			
Factored limit state stress	ϕF_L	=	122.00	MPa		
Stress From Shear force	f_{sx}	=	V/A_w			
			0.28	MPa		
3.4.25 Shear in webs (Minor Axis)						
Clear web height	b	=	62	mm		
	t	=	3	mm		
Slenderness	b/t	=	20.66666			
			7			



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Factored limit state stress	ϕF_L	=	131.10	MPa
Stress From Shear force	f_{sy}	=	V/A_w	
			2.17	MPa

6.3 Eave

NAME	SYMBOL	VALUE	UNIT	NOTES	REF
120x68x3	Eave				
Alloy and temper	6061-T6				AS1664.1
Tension	F_{tu}	=	262	MPa	T3.3(A)
	F_{ty}	=	241	MPa	
Compression	F_{cy}	=	241	MPa	
Shear	F_{su}	=	165	MPa	Ultimate
	F_{sy}	=	138	MPa	Yield
Bearing	F_{bu}	=	551	MPa	Ultimate
	F_{by}	=	386	MPa	Yield
Modulus of elasticity	E	=	70000	MPa	Compressive
	k_t	=	1.0		T3.4(B)
	k_c	=	1.0		
FEM ANALYSIS RESULTS					
Axial force	P	=	0	kN	compression
	P	=	0.461	kN	Tension
In plane moment	M_x	=	1.311	kNm	
Out of plane moment	M_y	=	1.147	kNm	
DESIGN STRESSES					
Gross cross section area	A_g	=	1092	mm ²	
In-plane elastic section modulus	Z_x	=	35622.6	mm ³	
Out-of-plane elastic section mod.	Z_y	=	25888.35	mm ³	
Stress from axial force	f_a	=	P/A_g		
		=	0.00	MPa	compression
		=	0.42	MPa	Tension
Stress from in-plane bending	f_{bx}	=	M_x/Z_x		
		=	36.80	MPa	compression



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Stress from out-of-plane bending	f_{by}	=	M_y/Z_y		
		=	44.31	MPa	compression
Tension					
3.4.3 Tension in rectangular tubes					
	ϕF_L	=	228.95	MPa	
		O			
	ϕF_L	=	222.70	MPa	
COMPRESSION					
3.4.8 Compression in columns, axial, gross section					
1. General					... 3.4.8.1
Unsupported length of member	L	=	5000	mm	
Effective length factor	k	=	1		
Radius of gyration about buckling axis (Y)	r_y	=	28.39	mm	
Radius of gyration about buckling axis (X)	r_x	=	44.24	mm	
Slenderness ratio	kLb/ry	=	176.11		
Slenderness ratio	kL/rx	=	113.02		
Slenderness parameter	λ	=	3.29		
	D_c^*	=	90.3		
	S_1^*	=	0.33		
	S_2^*	=	1.23		
	ϕ_{cc}	=	0.950		
Factored limit state stress	ϕF_L	=	21.16	MPa	
2. Sections not subject to torsional or torsional-flexural buckling					... 3.4.8.2
Largest slenderness ratio for flexural buckling	kL/r	=	176.11		
3.4.10 Uniform compression in components of columns, gross section - flat plates					
1. Uniform compression in components of columns, gross section - flat plates with both edges supported					... 3.4.10.1 T3.3(D)
	k_1	=	0.35		
Max. distance between toes of fillets of supporting elements for plate	b'	=	62		
	t	=	3	mm	



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Slenderness	b/t	=	20.66666 7		
Limit 1	S ₁	=	12.34		
Limit 2	S ₂	=	32.87		
Factored limit state stress	ϕF_L	=	205.58	MPa	
Most adverse compressive limit state stress	F _a	=	21.16	MPa	
Most adverse tensile limit state stress	F _a	=	222.70	MPa	
Most adverse compressive & Tensile capacity factor	f _a /F _a	=	0.00		PASS
BENDING - IN-PLANE					
3.4.15 Compression in beams, extreme fibre, gross section rectangular tubes, box sections					
Unbraced length for bending	L _b	=	5000	mm	
Second moment of area (weak axis)	I _y	=	880204	mm ⁴	
Torsion modulus	J	=	1906682. 1	mm ³	
Elastic section modulus	Z	=	35622.6	mm ³	
Slenderness	S	=	274.98		
Limit 1	S ₁	=	0.39		
Limit 2	S ₂	=	1695.86		
Factored limit state stress	ϕF_L	=	192.35	MPa	3.4.15(2)
3.4.17 Compression in components of beams (component under uniform compression), gross section - flat plates with both edges supported					
	k ₁	=	0.5		T3.3(D)
	k ₂	=	2.04		T3.3(D)
Max. distance between toes of fillets of supporting elements for plate	b'	=	62	mm	
	t	=	3	mm	
Slenderness	b/t	=	20.66666 7		
Limit 1	S ₁	=	12.34		
Limit 2	S ₂	=	46.95		



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Factored limit state stress	ϕF_L	=	205.58	MPa		
Most adverse in-plane bending limit state stress	F_{bx}	=	192.35	MPa		
Most adverse in-plane bending capacity factor	f_{bx}/F_{bx}	=	0.19		PASS	
BENDING - OUT-OF-PLANE						
<i>NOTE: Limit state stresses, ϕF_L are the same for out-of-plane bending (doubly symmetric section)</i>						
Factored limit state stress	ϕF_L	=	192.35	MPa		
Most adverse out-of-plane bending limit state stress	F_{by}	=	192.35	MPa		
Most adverse out-of-plane bending capacity factor	f_{by}/F_{by}	=	0.23		PASS	
COMBINED ACTIONS						
4.1.1 Combined compression and bending						...
	F_a	=	21.16	MPa		4.1.1(2)
	F_{ao}	=	205.58	MPa		... 3.4.8
	F_{bx}	=	192.35	MPa		... 3.4.10
	F_{by}	=	192.35	MPa		... 3.4.17
	f_a/F_a	=	0.002			... 3.4.17
Check: $f_a/F_a + f_{bx}/F_{bx} + f_{by}/F_{by} \leq 1.0$						... 4.1.1
i.e. 0.42 ≤ 1.0					PASS	(3)
SHEAR						
3.4.24 Shear in webs (Major Axis)						...
Clear web height	h	=	114	mm		4.1.1(2)
	t	=	3	mm		
Slenderness	h/t	=	38			
Limit 1	S_1	=	29.01			
Limit 2	S_2	=	59.31			
Factored limit state stress	ϕF_L	=	122.00	MPa		

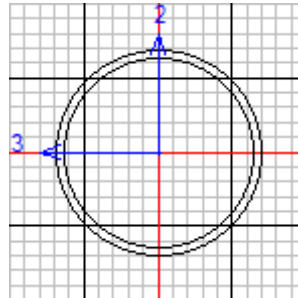


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Stress From Shear force	f_{sx}	=	V/A_w	
			0.43	MPa
3.4.25 Shear in webs (Minor Axis)				
Clear web height	b	=	62	mm
	t	=	3	mm
Slenderness	b/t	=	20.66666 7	
Factored limit state stress	ϕF_L	=	131.10	MPa
Stress From Shear force	f_{sy}	=	V/A_w	
			1.74	MPa

7 Checking Members Based on AS4100-1998 Steel Structures

7.1 Centre Pole



AISC 360-10 STEEL SECTION CHECK (Summary for Combo and Station)
Units : KN, m, C

Frame : 23 X Mid: 5.000 Combo: COMB9 Design Type: Column
Length: 2.000 Y Mid: 5.000 Shape: 76.1X3.2CHS Frame Type: SMF
Loc : 0.000 Z Mid: 5.400 Class: Compact Princpl Rot: 0.000 degrees

Provision: LRFD Analysis: Direct Analysis
D/C Limit=1.000 2nd Order: General 2nd Order Reduction: Tau-b Fixed
AlphaPr/Py=0.002 AlphaPr/Pe=0.002 Tau_b=1.000 EA factor=0.800 EI factor=0.800

PhiB=0.900 PhiC=0.900 PhiTY=0.900 PhiTF=0.750
PhiS=0.900 PhiS-RI=1.000 PhiST=0.900

A=7.330E-04 I33=0.000 r33=0.026 S33=1.283E-05 Av3=6.597E-04
J=0.000 I22=0.000 r22=0.026 S22=1.283E-05 Av2=6.597E-04
E=199947978.8 fy=250000.000 Ry=1.000 z33=1.700E-05
RLLF=1.000 Fu=320000.000 z22=1.700E-05

HSS Welding: ERW Reduce HSS Thickness? No



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STRESS CHECK FORCES & MOMENTS (Combo COMB9)

Location	Pu	Mu33	Mu22	Vu2	Vu3	Tu
0.000	0.396	3.778	0.000	1.889	0.000	0.000

PMM DEMAND/CAPACITY RATIO (H1.2,H1-1b)

$$\begin{aligned} \text{D/C Ratio: } 0.989 &= 0.001 + 0.988 + 0.000 \\ &= (1/2) (\text{Pr}/\text{Pc}) + (\text{Mr33}/\text{Mc33}) + (\text{Mr22}/\text{Mc22}) \end{aligned}$$

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1.2,H1-1b)

Factor	L	K1	K2	B1	B2	Cm
Major Bending	1.000	1.000	1.000	1.000	1.000	1.000
Minor Bending	1.000	1.000	1.000	1.000	1.000	1.000

	Lltb	Kltb	Cb
LTB	1.000	1.000	1.668

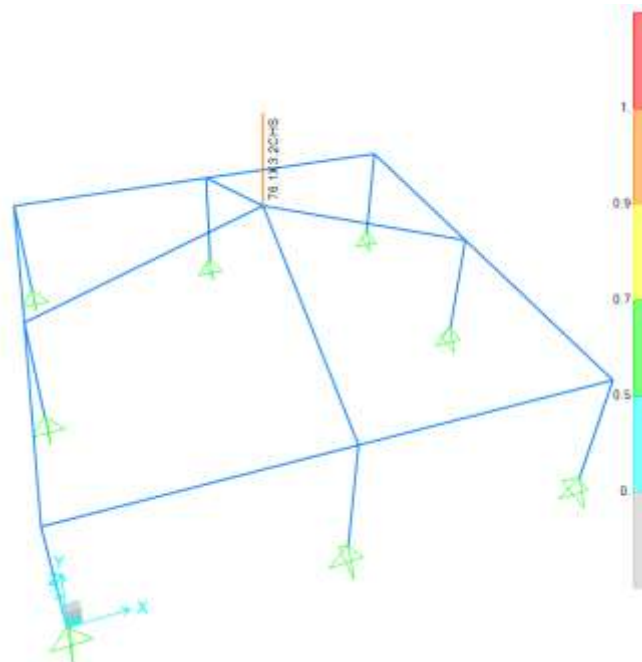
	Pu Force	phi*Pnc Capacity	phi*Pnt Capacity
Axial	0.396	119.931	164.925

	Mu Moment	phi*Mn Capacity	phi*Mn No LTB
Major Moment	3.778	3.825	3.825
Minor Moment	0.000	3.825	

	Tu Moment	Tn Capacity	phi*Tn Capacity
Torsion	0.000	4.007	3.606

SHEAR CHECK

	Vu Force	phi*Vn Capacity	Stress Ratio	Status Check
Major Shear	1.889	49.478	0.038	OK
Minor Shear	0.000	49.478	0.000	OK





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8 Summary

8.1 Conclusions

- a. The 10m x 10m Pinnacle Range Pagoda Tent structure as specified has been analyzed with a conclusion that it has the capacity to withstand wind speeds up to and including **80km/hr**.
- b. For forecast winds in excess of **80km/hr** – all fabric shall be removed from the frames, and the structure should be completely dismantled.
- c. For uplift due to 80km/hr, 5 kN (0.5T) holding down weight/per leg for upright support is required.
- d. The bearing pressure of soil should be clarified and checked by an engineer prior to any construction for considering foundation and base plate.
- e. **It is important to use 76.1x3.2 CHS Steel made (Grade 250) for Centre Pole.**

MEMBER(S)	Section	b	d	t
		mm	mm	mm
Rafter	120x68x3	68	120	3
Upright Support	120x68x3	68	120	3
Centre Pole (Steel)	76.1x3.2CHS	76.1	-	3.2
Eave	120x68x3	68	120	3

Yours faithfully,

E.A. Bennett M.I.E. Aust. NPER 198230



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9 Appendix A – Base Anchorage Requirements

Tent Span	Sile Type	Required Weight Per Leg
10 m	A	500kg
	B	500kg
	C	500kg
	D	500kg
	E	500kg
8 m	A	450kg
	B	450kg
	C	450kg
	D	450kg
	E	450kg

Definition of Soil Types:

Type A : Loose sand such as dunal sand. Uncompacted site filling may also be included in this soil type.

Type B : Medium to stiff clays or silty clays

Type C: Moderately compact sand or gravel eg. of alluvial origin.

Type D : Compact sand and gravel eg. Weathered sandstone or compacted quarry rubble hardstand

Type E : Concrete slab on ground. Number of dyna bolts and slab thickness to be designed.



10 Appendix B – Hold Down Method Details

