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

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1 Introduction

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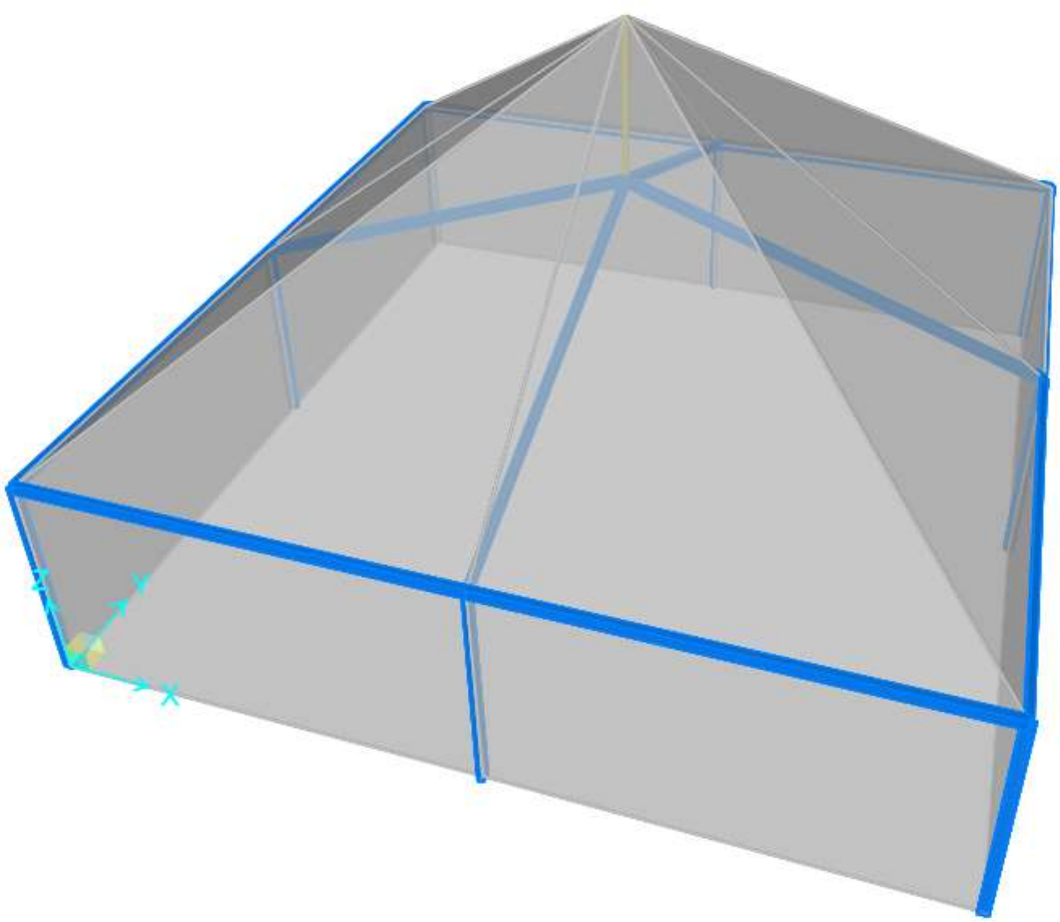
The following structural drawings and calculations are for the transportable tents supplied by Extreme Marquees.

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.



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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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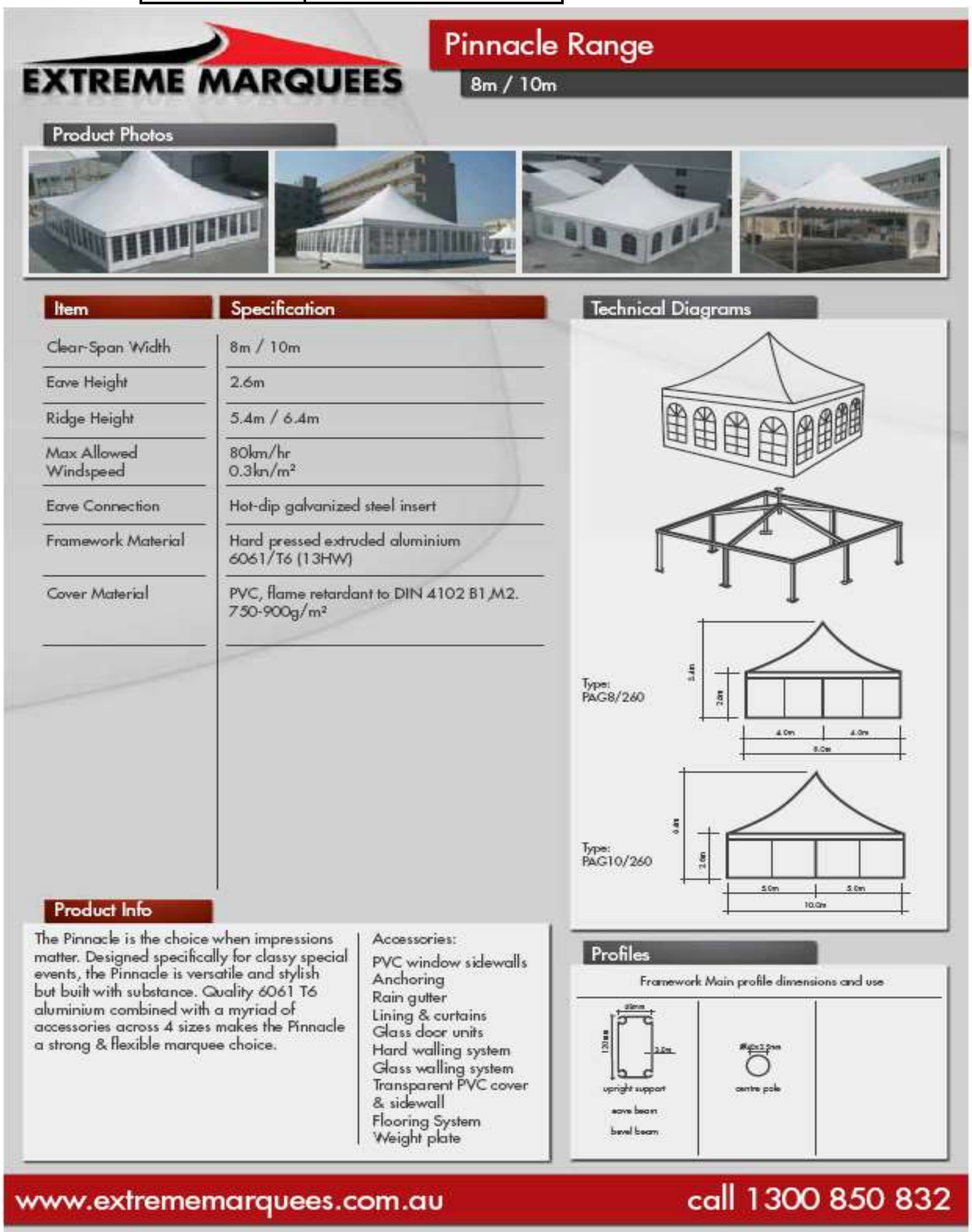
3 Specifications

3.1 General

Tent category	
Material	Aluminum 6061-T6 Steel Grade 250 mPa

Size	Model
10m x 10m	Pinnacle Range



EXTREME MARQUEES

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/m²
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/m²

Technical Diagrams

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

www.extrememarquees.com.au call 1300 850 832

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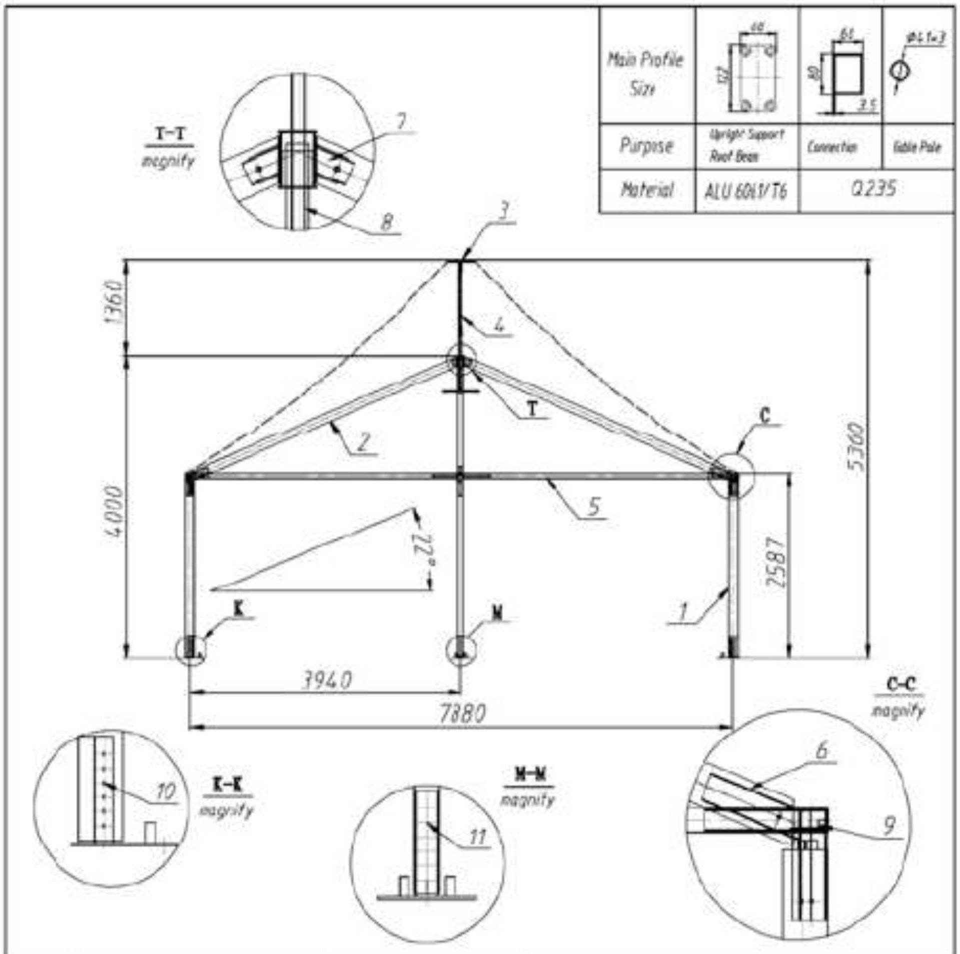
Main Profile Size			
Purpose	Upright Support Roof Beam	Connection	Gable Pole
Material	ALU 6061/T6	Q235	



11	Middle Base Plate	Q235	80×60×3.5×300	4pcs
10	Corner Base Plate	Q235	80×60×3.5×300	4pcs
9	End Eave Connection	Q235	80×60×3.5×350	4pcs
8	Rectangular Screw	45	M38×800	1pc
7	Top Connection &Nut	Q235	80×60×120	1set
6	Middle eave connection	Q235	80×60×800	4pcs
5	Eave beam	Alnica 6061/T6	122×68×3930	8pcs
4	Gable Pole	Q235	Φ41×900	1pc
3	Upper cap and lower	Q235	Φ360/Φ300	1set
2	Roof Beam	Alnica 6061/T6	122×68×4165	4pcs
1	Upright support	Alnica 6061/T6	122×68×2450	8pcs
Item	Name of part	Material	Size(mm)	Quantity

tag	item	change paper number	sign	date	type PAG0800/260/540	Part NO. PAG0800/260/540-002
design		standardization			title Structure	drawing tag / weight / scale / kg
drawing		approve				totals ( ) pages / page ( )
Auditing					material ALU 6061/T6	
technics		date				

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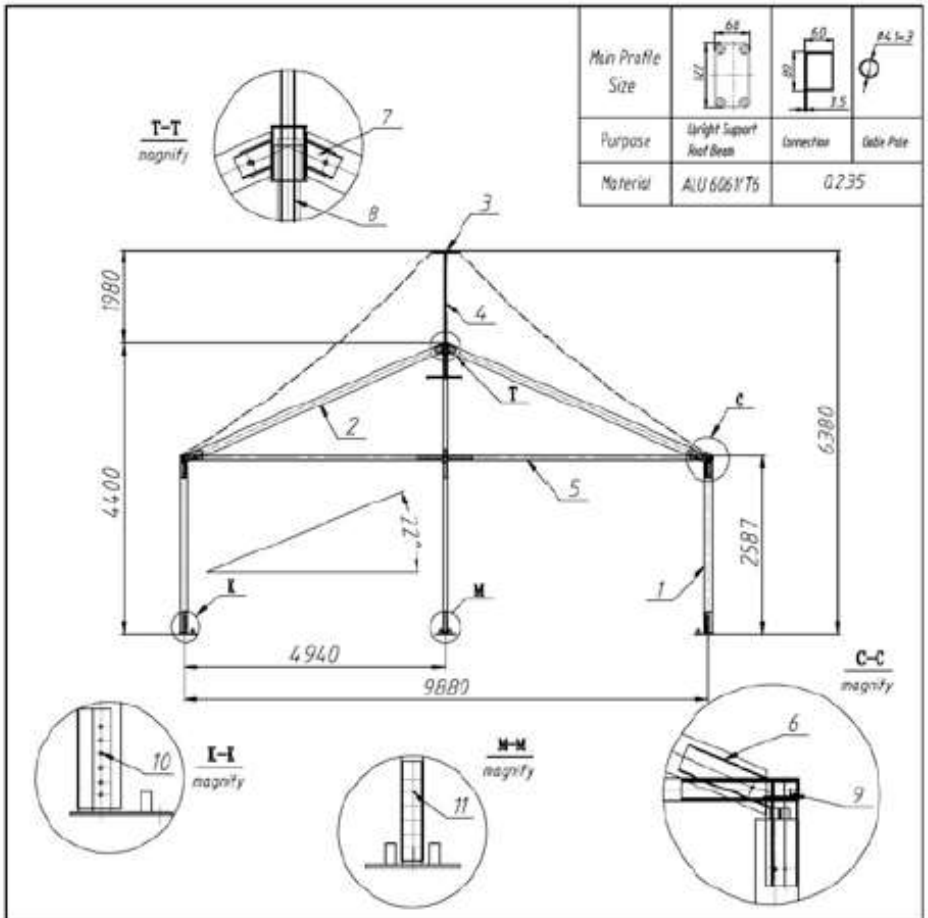

Item	Name of part	Material	Size(mm)	Quantity
11	Middle Base Plate	Q235	80×60×3.5×300	4pcs
10	Corner Base Plate	Q235	80×60×3.5×300	4pcs
9	End Eave Connection	Q235	80×60×3.5×350	4pcs
8	Rectangular Screw	45	M38×800	1pc
7	Top Connection &Nut	Q235	80×60×120	1set
6	Middle eave connection	Q235	80×60×800	4pcs
5	Eave beam	Alnico 6061/T6	122×69×4900	8pcs
4	Gable Pole	Q235	Φ4.1×1450	1pc
3	Upper cap and lower	Q235	Φ360/Φ300	1set
2	Roof Beam	Alnico 6061/T6	122×69×5245	4pcs
1	Upright support	Alnico 6061/T6	122×69×2450	8pcs

type	PAG1000/260/640
Part NO.	PAG1000/260/640-002
title	Structure
material	ALU 6061/T6

tag | item | change paper number | sign | date
design | standardization
drawing | approve
Auditing
technics | date
drawing tag | weight | scale
kg
totals( )pages | page( )

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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)	φy	0.95
Capacity factor (ultimate)	φu	0.85
Capacity factor (bending)	φb	0.85
Capacity factor (elastic shear buckling)	φv	0.8
Capacity factor (inelastic shear buckling)	φvp	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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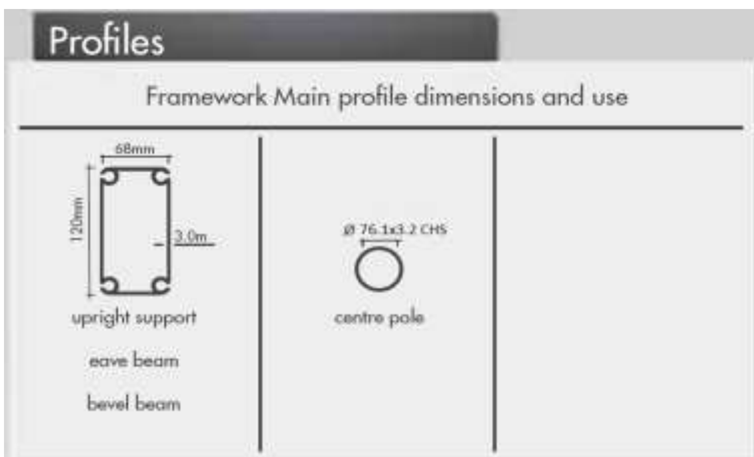
3.4 Section Properties

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

Downward	=	$1.35 \times G$
	=	$1.2 \times G + W_u$
	=	$1.2 \times G + W_u + W_{IS}$
Upward	=	$0.9 \times G + W_u$
		$0.9 \times G + W_u + W_{IP}$

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 = 22.22m/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 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) = $0.5\rho_{air} (V_{sit,\beta})^2 C_{fig} C_{dyn}$

= $0.245C_{fig}$ 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		
Wind Direction Multipliers	M_d	1			*Table 3.2 (AS1170.2)*
Terrain Category Multiplier	$M_{Z,Cat}$	0.91			Table 4.1
Shield Multiplier	M_S	1			*4.3 (AS1170.2)*
Topographic Multiplier	M_t	1			*4.4 (AS1170.2)*

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Site Wind Speed	$V_{Site,\beta}$	**20.22**	m/s	$V_{Site,\beta}=V_R*M_d*M_{z,cat}*M_S,M_t$	
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					
ρair	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 (Cpi= nCpe

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**		*Cpi= N*Cpe*	
Combination Factor	$K_{C,i}$	1			
Internal Pressure Coefficient	$C_{p,i}$	0.70			

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MIN Internal Pressure Coefficient **MAX**	$C_{p,i}$	0.70			
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					Table 5.2 B
External Pressure Coefficient	$C_{P,e}$	-0.5			
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

$\alpha > 10^o$

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		Table 5.3 B
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	Table 5.3C
aerodynamic shape factor	$C_{fig,e}$	-0.48	

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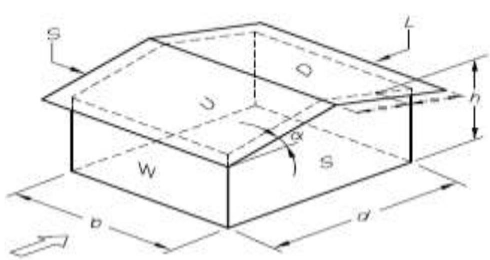
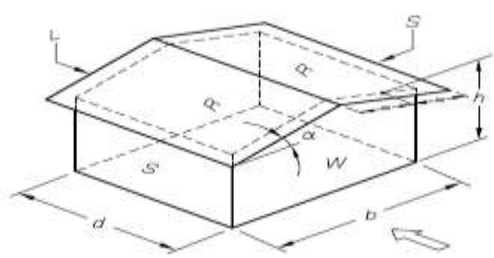
Pressure **MIN**	P	**-0.12**	**kPa**
Pressure **MAX**	P	**-0.12**	**kPa**
Edge Rafter Force **MIN**	F	**-0.29**	**kN/m**
Edge Rafter Force **MAX**	F	**-0.29**	**kN/m**
Intermediate Rafter Force **MIN**	F	**-0.59**	**kN/m**
Intermediate Rafter Force **MAX**	F	**-0.59**	**kN/m**

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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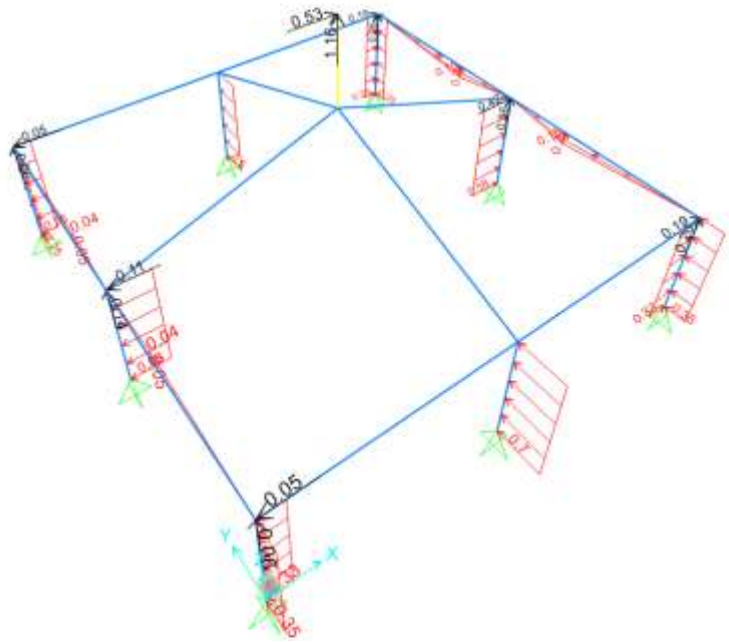
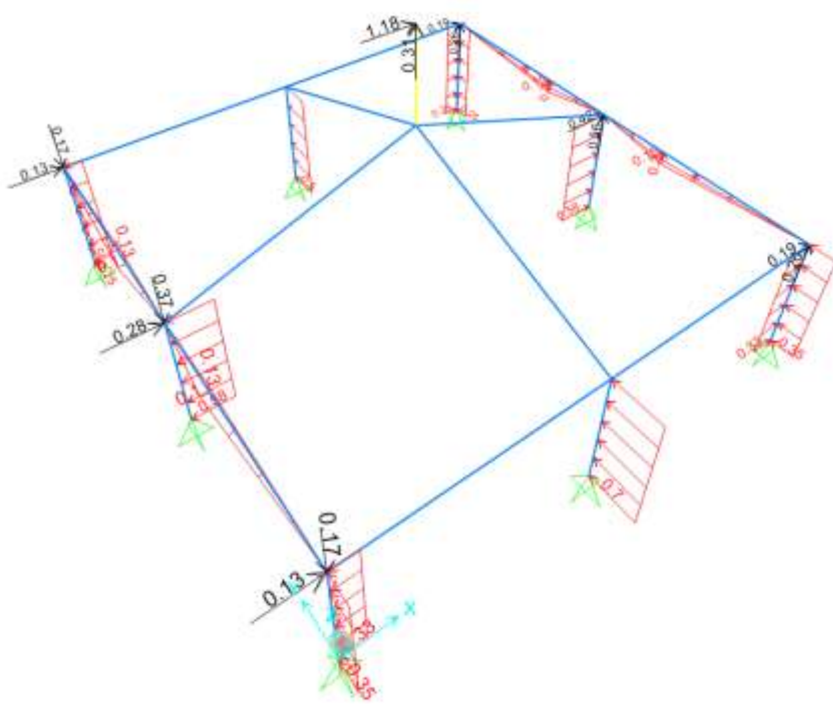
5.3 Wind Load Diagrams

5.3.1 Wind (case 1)



5.3.2 Wind (case 2)



After 3D model analysis, each member is checked based on adverse load combination.
In this regard the maximum bending moment, shear and axial force due to adverse load combinations for each member are presented as below:

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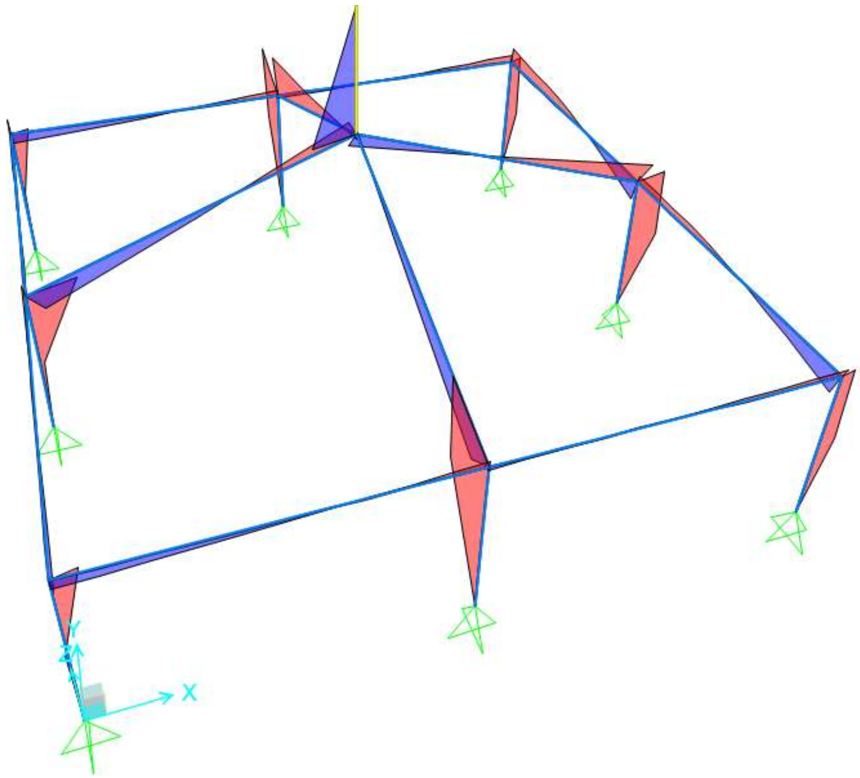
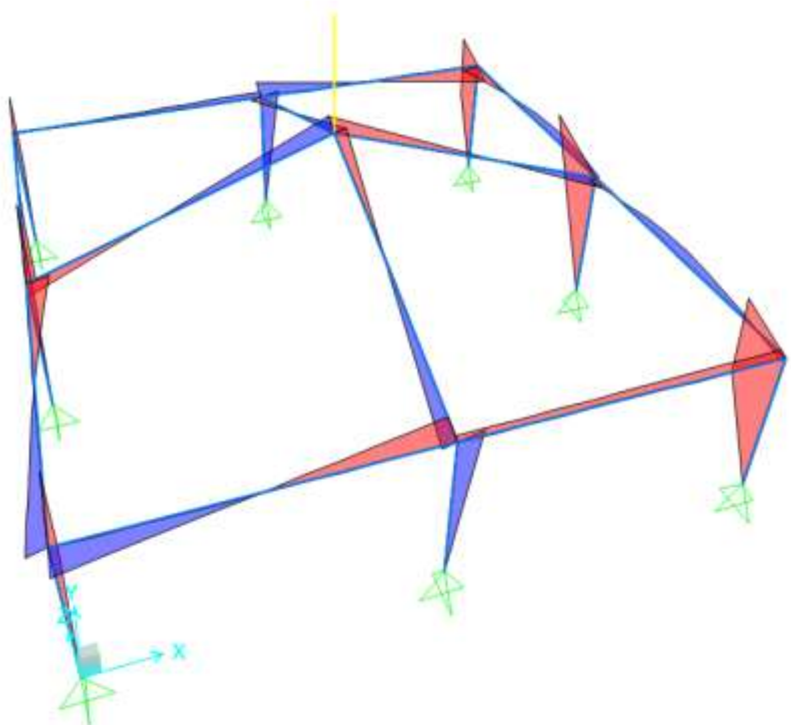
5.3.3 Max Bending Moment due to critical load combination in major axis



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



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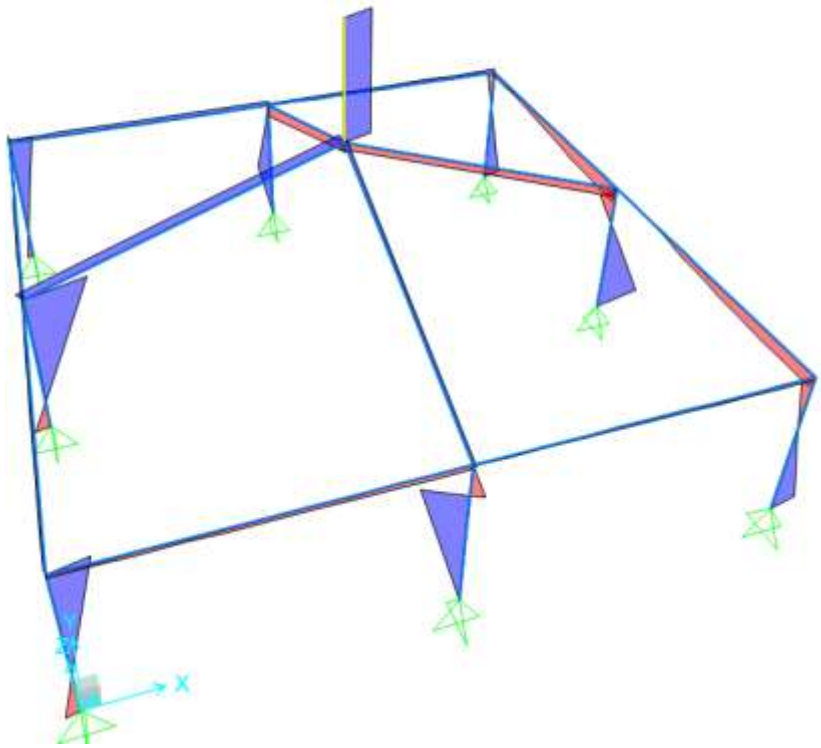
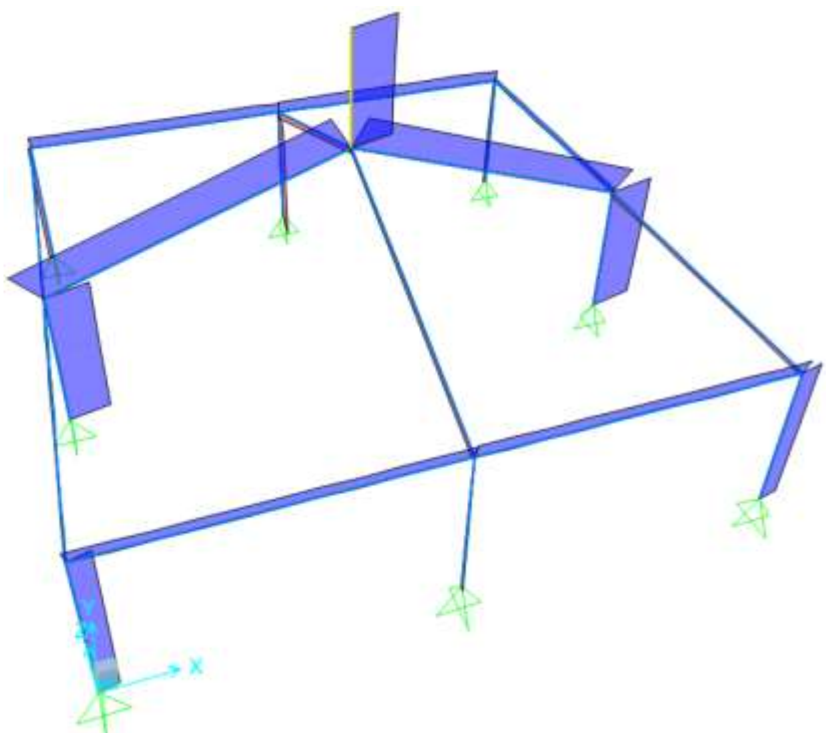
5.3.5 Max Shear in due to critical load combination



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



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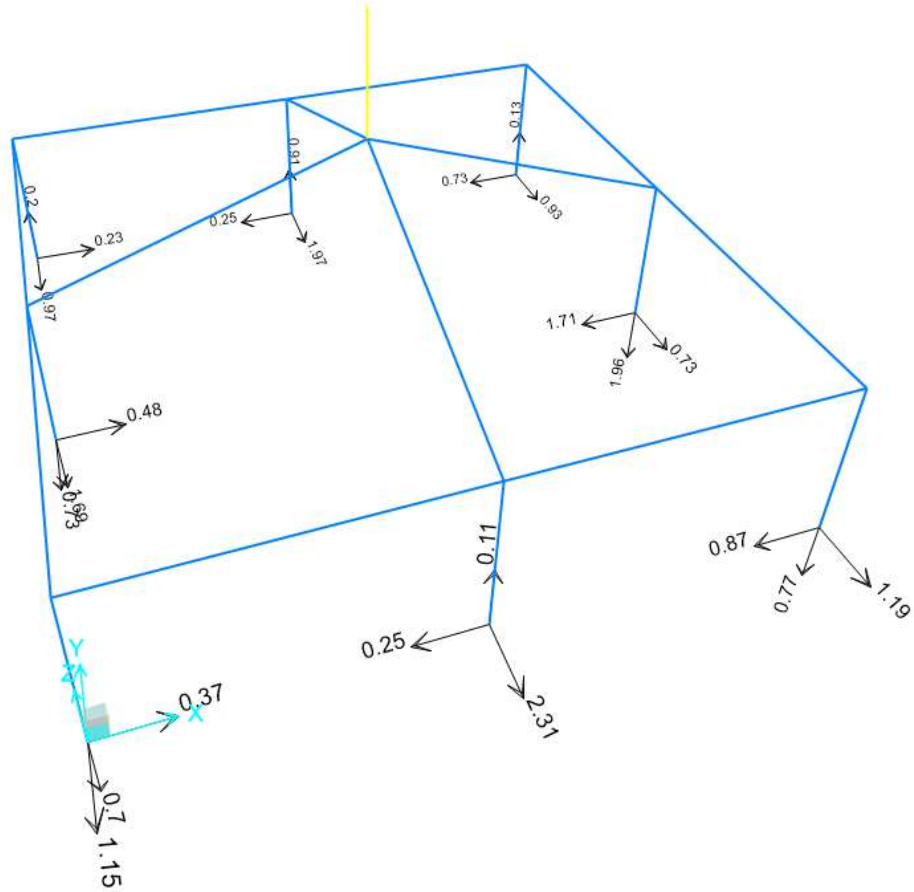
5.3.7 Max reactions



Max Reaction (Bearing) $N^* = 1.2$ kN
Max Reaction (Uplift) $N^* = 2$ 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	**=**	25888.353	mm^3		
Stress from axial force	$\mathbf{f_a}$	**=**	P/A_g			
		=	**0.00**	**MPa**	*compression*	
		=	**0.26**	**MPa**	*Tension*	
Stress from in-plane bending	$\mathbf{f_{bx}}$	**=**	M_x/Z_x			
		=	**93.60**	**MPa**	*compression*	
Stress from out-of-plane bending	$\mathbf{f_{by}}$	**=**	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**	
		OR			
	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/ry	=	187.03		
Slenderness ratio	kL/rx	=	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

	k_1	=	0.35		T3.3(D)
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**	

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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	ϕF_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*						… 4.1.1(2)
	F_a	=	18.76	MPa		… 3.4.8
	F_{ao}	=	205.58	MPa		… 3.4.10
	F_{bx}	=	191.19	MPa		… 3.4.17
	F_{by}	=	191.19	MPa		… 3.4.17
	f_a/F_a	=	0.001			
Check:	$f_a/F_a + f_{bx}/F_{bx} + f_{by}/F_{by} \leq 1.0$					… 4.1.1 (3)
i.e.	0.60	≤	1.0		PASS	

SHEAR

***3.4.24** Shear in webs (Major Axis)*						… 4.1.1(2)
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	ϕF_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	=	20.666667			
Factored limit state stress	ϕF_L	=	**131.10**	**MPa**		

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Stress From Shear force	f_{sy}	=	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	=	25888.353	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						

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***3.4.3** Tension in rectangular tubes*

	ϕF$_L$	**=**	**228.95**	**MPa**	
		OR			
	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					… 3.4.10.1
	k_1	**=**	0.35		T3.3(D)
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		

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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** Compression in beams, extreme fibre, gross section rectangular tubes, box sections*						
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** 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			
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*						… 4.1.1(2)
	F_a	=	67.51	MPa		… 3.4.8
	F_{ao}	=	205.58	MPa		… 3.4.10
	F_{bx}	=	202.96	MPa		… 3.4.17
	F_{by}	=	202.96	MPa		… 3.4.17
	f_a/F_a	=	0.003			
Check:	$f_a/F_a + f_{bx}/F_{bx} + f_{by}/F_{by} \leq 1.0$					… 4.1.1 (3)
i.e.	0.90	≤	1.0		PASS	
SHEAR						
***3.4.24** Shear in webs (Major Axis)*						… 4.1.1(2)
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	**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	**=**	20.666667			

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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	*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	=	0.461	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	**=**	25888.353	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**		
		OR				
	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
	k_1	=	0.35			T3.3(D)
Max. distance between toes of fillets of supporting elements for plate	b'	=	62			
	t	=	3	mm		

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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	=	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	=	20.666667			
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						
NOTE: Limit state stresses, ϕF_L are the same for out-of-plane bending (doubly symmetric section)						
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*						… 4.1.1(2)
	F_a	=	21.16	MPa		… 3.4.8
	F_{ao}	=	205.58	MPa		… 3.4.10
	F_{bx}	=	192.35	MPa		… 3.4.17
	F_{by}	=	192.35	MPa		… 3.4.17
	f_a/F_a	=	0.002			
Check:	$f_a/F_a + f_{bx}/F_{bx} + f_{by}/F_{by} \leq 1.0$					… 4.1.1 (3)
i.e.	0.42	$\leq$	1.0		PASS	
SHEAR						
***3.4.24** Shear in webs (Major Axis)*						… 4.1.1(2)
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	**ϕF_L**	**=**	**122.00**	**MPa**		

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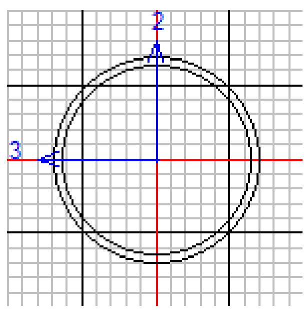
Stress From Shear force	f_{sx}	=	V/A_w	
			0.43	**MPa**
***3.4.25** Shear in webs (Minor Axis)*				
Clear web height	b	=	62	mm
	t	=	3	mm
Slenderness	b/t	=	20.666667	
Factored limit state stress	ϕF_L	=	**131.10**	**MPa**
Stress From Shear force	f_{sy}	=	V/A_w	
			1.74	**MPa**

7 Checking Members Based on AS4100-1998 Steel Structures

7.1 Centre Pole

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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)

D/C Ratio: 0.989 = 0.001 + 0.988 + 0.000
= (1/2)(Pr/Pc) + (Mr33/Mc33) + (Mr22/Mc22)

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

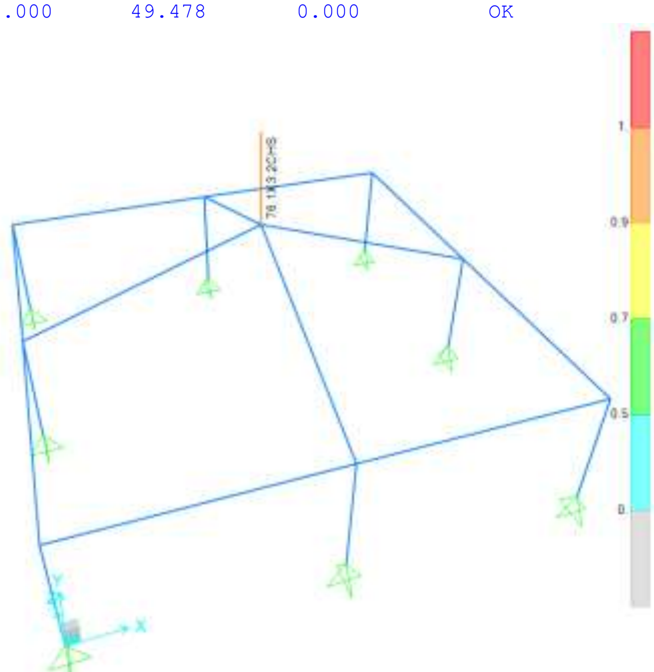
	Pu Force	phi*Pnc Capacity	phi*Pnt Capacity
Axial	0.396	119.931	164.925

	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.

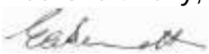
c. For uplift due to 80km/hr, 5 kN (0.5T) holding down weight/per leg for upright support is required.

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,



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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.

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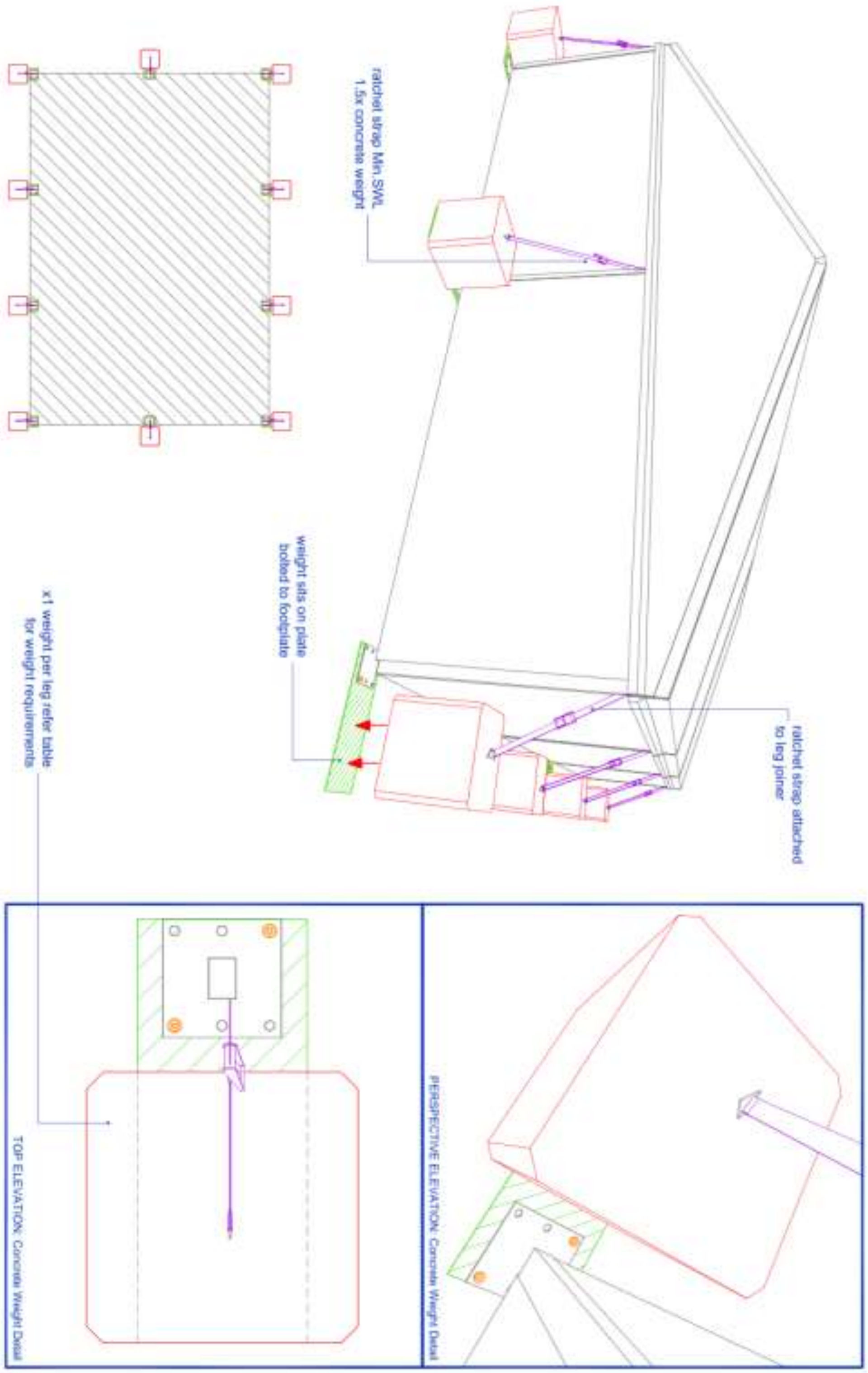
10 Appendix B – Hold Down Method Details



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