Civil & Structural Engineering Design Services Pty. Ltd.

Client: **Extreme Marquees**

Project: Design check – 9m × 9m Function Crest Standard Tent Structure for 80km/hr
– 8m × 9m Function Crest Standard Tent Structure for 80km/hr
– 6m × 9m Function Crest Standard Tent Structure for 80km/hr

Reference: Extreme Marquees' data

Report by: KZ
Checked by: EAB
Date: 11/06/2015

JOB NO: D-11-263557-3

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1 Introduction

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The report examines the effect of 3s gust wind of 80 km/hr on 9m Span x 3m Bay Function Crest Standard Tent. 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.

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2 Design Restrictions and Limitations

2.1 The erected structure is for temporary use only and is limited to 6 months maximum at any one site establishment.

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 category 2 in AS. 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.

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 Wall Bracing and roof bracing are required at each end bay and every third bay in between to resist against lateral movement due to wind direction2 for multiple tent length.

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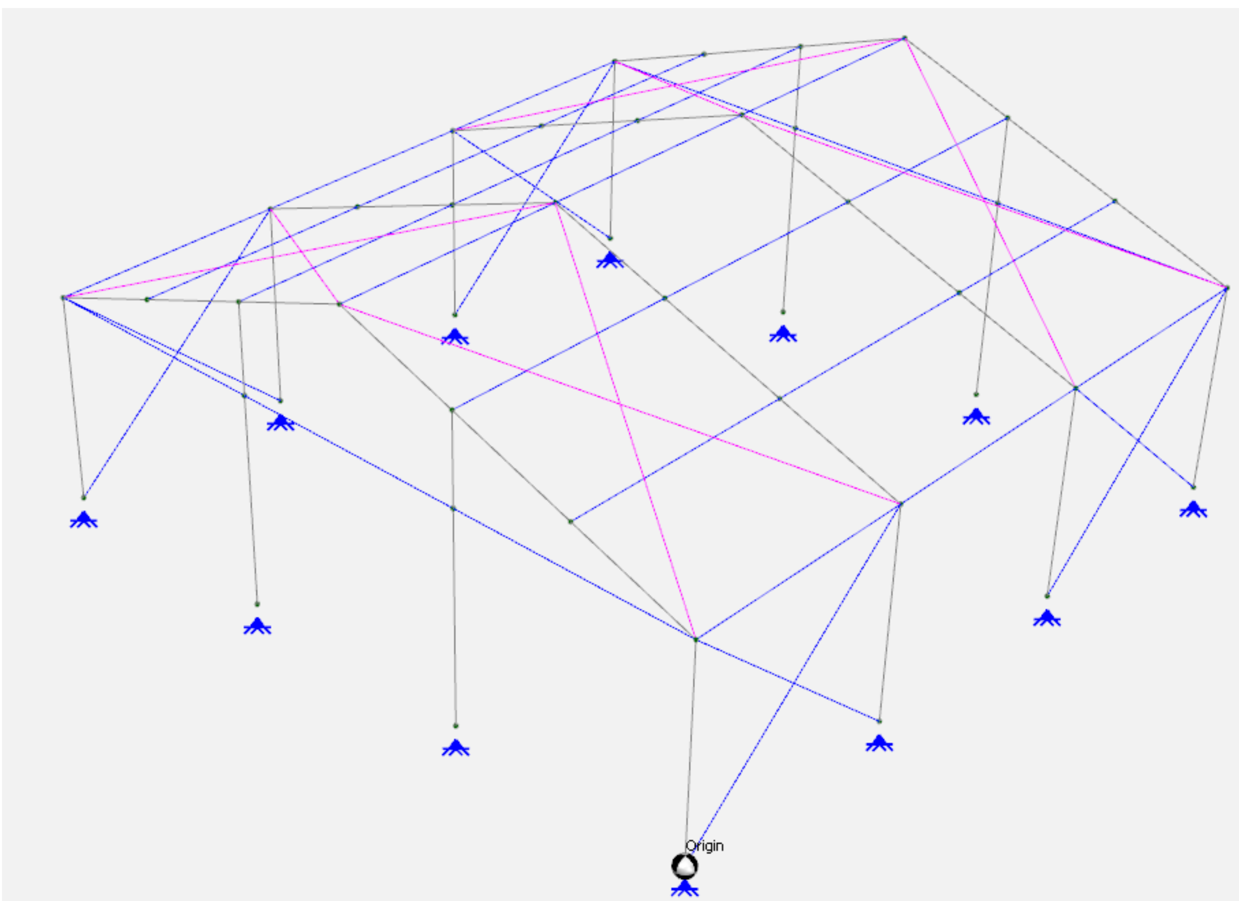
3 Specifications

3.1 General

Tent category	
Material	Aluminum 6061-T6

Size	**Model**
9m x 9m	Function Crest Standard



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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	yc	Ag	Zx	Zy	Sx	Sy	Ix	Iy	J	rx	ry
		mm	mm	mm	mm	mm2	mm3	mm3	mm3	mm3	mm4	mm4	mm4	mm	mm
Rafter	82x48x3	48	82	3	41	744	1.63E+04	1.19E+04	2.00E+04	1.37E+04	6.69E+05	2.86E+05	6.12E+05	30.0	19.6
Upright Support	82x48x3	48	82	3	41	744	1.63E+04	1.19E+04	2.00E+04	1.37E+04	6.69E+05	2.86E+05	6.12E+05	30.0	19.6
Gable Pole	82x48x3	48	82	3	41	744	1.63E+04	1.19E+04	2.00E+04	1.37E+04	6.69E+05	2.86E+05	6.12E+05	30.0	19.6
Ridge & Eave Purlin	40x40x2	40	40	2	20	304	3.67E+03	3.67E+03	4.34E+03	4.34E+03	7.34E+04	7.34E+04	1.10E+05	15.5	15.5
Gable Beam	40x40x2	40	40	2	20	304	3.67E+03	3.67E+03	4.34E+03	4.34E+03	7.34E+04	7.34E+04	1.10E+05	15.5	15.5
Intermediate Purlin	40x40x2	40	40	2	20	304	3.67E+03	3.67E+03	4.34E+03	4.34E+03	7.34E+04	7.34E+04	1.10E+05	15.5	15.5
Brace	40x40x2	40	40	2	20	304	3.67E+03	3.67E+03	4.34E+03	4.34E+03	7.34E+04	7.34E+04	1.10E+05	15.5	15.5

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

4.2.2 Ultimate

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

Upward = $0.9 \times G + W_u$
$0.9 \times G + W_u + W_{IP}$

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5 Wind Analysis

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

5.1 Parameters & 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		< 6 months			Table 3.3
Regional gust wind speed		**80**	Km/hr		Table 3.1 (AS1170.2)
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 (AS1170.2)
Shield Multiplier	M_S	1			4.3 (AS1170.2)
Topographic Multiplier	M_t	1			4.4 (AS1170.2)
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	20	Deg		
Pitch	α	0.349	rad		
Width	B	9	m		
Width Span	S_w	3	m		
Length	D	9	m		
Height	Z	3.4	m		
Bay Span		3	m		
Purlin Spacing		1.6	m		
Number of Intermediate Purlin		2			
	h/d	0.378			
	h/b	0.377777778			
Wind Pressure					
ρair	ρ	1.2	Kg/m^3		

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dynamic response factor	C_{dyn}	1			
Wind Pressure	ρ / 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 (Perpendicular to Length)

Internal Pressure

Opening Assumption: With Dominant Opening (Cpi= nCpe

Internal Pressure Coefficient (Without Dominant) **MIN**		-0.1			Table 5.1 A (AS1170.2)
Internal Pressure Coefficient (Without Dominant) **MAX**		0.2			
Internal Pressure Coefficient (With Dominant) **MIN**		-0.1			Table 5.1 B (AS1170.2)
Internal Pressure Coefficient (With Dominant) **MAX**		0.2			
N		**0.7**			
Combination Factor	$K_{C,i}$	1			
Internal Pressure Coefficient **MIN**	$C_{p,i}$	0.70			
Internal Pressure Coefficient **MAX**	$C_{p,i}$	0.70			

External Pressure

1. Windward Wall

External Pressure Coefficient	$C_{P,e}$	0.7			Table 5.2 A
Area Reduction Factor	K_a	0.8			Table 5.4
combination factor applied to internal pressures	$K_{C,e}$	1			
local pressure factor	K_l	1			
porous cladding reduction factor	K_p	1			
aerodynamic shape factor	$C_{fig,e}$	0.56			
Wind Wall Pressure	P	**0.14**	**kPa**		
Edge Column Force	F	**0.21**	**kN/m**		
Intermediate Column Force	F	**0.41**	**kN/m**		

2. Leeward Wall

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External Pressure Coefficient	$C_{P,e}$	-0.4			*Table 5.2 B*
Area Reduction Factor	K_a	0.8			*Table 5.4*
combination factor applied to internal pressures	$K_{C,e}$	1			
local pressure factor	K_l	1			
porous cladding reduction factor	K_p	1			
aerodynamic shape factor	$C_{fig,e}$	-0.32			
Lee Wall Pressure	P	**-0.08**	**kPa**		
Edge Column Force	F	**-0.12**	**kN/m**		
Intermediate Column Force	F	**-0.24**	**kN/m**		
3. Side Wall					*Table 5.2 C*
Area Reduction Factor	K_a	0.8			*Table 5.4*
combination factor applied to internal pressures	$K_{C,e}$	1			
local pressure factor	K_l	1			
porous cladding reduction factor	K_p	1			
External Pressure Coefficient	$C_{P,e}$	-0.65		*0 to 1h*	
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 Slop				$\alpha > 10^o$	
Area Reduction Factor	K_a	0.8			*Table 5.3 B*
combination factor applied to internal pressures	$K_{C,e}$	1			

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local pressure factor	K_l	1	
porous cladding reduction factor	K_p	1	
External Pressure Coefficient **MIN**	$C_{P,e}$	-0.35	
External Pressure Coefficient **MAX**	$C_{P,e}$	0.1	
aerodynamic shape factor **MIN**	$C_{fig,e}$	-0.28	
aerodynamic shape factor **MAX**	$C_{fig,e}$	0.08	
Pressure **MIN**	P	**-0.07**	**kPa**
Pressure **MAX**	P	**0.02**	**kPa**
Edge Rafter Force **MIN**	F	**-0.10**	**kN/m**
Edge Rafter Force **Max**	F	**0.03**	**kN/m**
Intermediate Rafter Force **MIN**	F	**-0.21**	**kN/m**
Intermediate Rafter Force **MAX**	F	**0.06**	**kN/m**

5. Roof Down Wind Slop

Area Reduction Factor	K_a	0.8	
combination factor applied to internal pressures	$K_{C,e}$	1	
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	
Pressure **MIN**	P	**-0.12**	**kPa**
Pressure **MAX**	P	**-0.12**	**kPa**
Edge Rafter Force **MIN**	F	**-0.18**	**kN/m**
Edge Rafter Force **MAX**	F	**-0.18**	**kN/m**
Intermediate Rafter Force **MIN**	F	**-0.35**	**kN/m**
Intermediate Rafter Force **MAX**	F	**-0.35**	**kN/m**

WIND DIRECTION 2 (Parallel to Length)

Internal Pressure

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Opening Assumption	With Dominant Opening (Cpi= nCpe				
Internal Pressure Coefficient (Without Dominant) **MIN**		-0.1			*Table 5.1 A (AS1170.2)*
Internal Pressure Coefficient (Without Dominant) **MAX**		0.2			
Internal Pressure Coefficient (With Dominant) **MIN**		-0.1			*Table 5.1 B (AS1170.2)*
Internal Pressure Coefficient (With Dominant) **MAX**		0.2			
N		**0.7**		*Cpi= N*Cpe*	
Combination Factor	$K_{C,i}$	1			
Internal Pressure Coefficient **MIN**	$C_{p,i}$	0.70			
Internal Pressure Coefficient **MAX**	$C_{p,i}$	0.70			

External Pressure

1. Windward Wall

External Pressure Coefficient	$C_{P,e}$	0.7		*Table 5.2 A*
Area Reduction Factor	K_a	0.8		*Table 5.4*
combination factor applied to internal pressures	$K_{C,e}$	1		
local pressure factor	K_l	1		
porous cladding reduction factor	K_p	1		
aerodynamic shape factor	$C_{fig,e}$	0.56		
Wind Wall Pressure	P	**0.14**	**kPa**	
Edge Column Force	F	**0.21**	**kN/m**	
Intermediate Column Force	F	**0.41**	**kN/m**	

2. Leeward Wall

External Pressure Coefficient	$C_{P,e}$	-0.4	*Table 5.2 B*
Area Reduction Factor	K_a	0.8	*Table 5.4*
combination factor applied to internal pressures	$K_{C,e}$	1	
local pressure factor	K_l	1	
porous cladding reduction factor	K_p	1	

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aerodynamic shape factor	$C_{fig,e}$	-0.32			
Lee Wall Pressure	P	**-0.08**	**kPa**		
Edge Column Force	F	**-0.12**	**kN/m**		
Intermediate Column Force	F	**-0.24**	**kN/m**		
3. Side Wall					*Table 5.2 C*
Area Reduction Factor	K_a	0.8			*Table 5.4*
combination factor applied to internal pressures	$K_{C,e}$	1			
local pressure factor	K_l	1			
porous cladding reduction factor	K_p	1			
External Pressure Coefficient	$C_{P,e}$	-0.65		*0 to 1h*	
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*	
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				$\alpha < 10^o$	
Area Reduction Factor	K_a	0.8			*Table 5.3 A*
combination factor applied to internal pressures	$K_{C,e}$	1			
local pressure factor	K_l	1			
porous cladding reduction factor	K_p	1			
External Pressure Coefficient **MIN**	$C_{P,e}$	-0.9		*0 to 0.5h*	
External Pressure Coefficient **MIN**	$C_{P,e}$	-0.9		*0.5 to 1h*	

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External Pressure Coefficient **MIN**	$C_{P,e}$	-0.50		*1h to 2h*
External Pressure Coefficient **MIN**	$C_{P,e}$	-0.30		*2h to 3h*
External Pressure Coefficient **MIN**	$C_{P,e}$	-0.2		*>3h*
External Pressure Coefficient **MAX**	$C_{P,e}$	-0.4		*0 to 0.5h*
External Pressure Coefficient **MAX**	$C_{P,e}$	-0.4		*0.5 to 1h*
External Pressure Coefficient **MAX**	$C_{P,e}$	0		*1h to 2h*
External Pressure Coefficient **MAX**	$C_{P,e}$	0.1		*2h to 3h*
External Pressure Coefficient **MAX**	$C_{P,e}$	0.2		*>3h*
aerodynamic shape factor **MIN**	$C_{fig,e}$	-0.72		*0 to 0.5h*
aerodynamic shape factor **MIN**	$C_{fig,e}$	-0.72		*0.5 to 1h*
aerodynamic shape factor **MIN**	$C_{fig,e}$	-0.4		*1h to 2h*
aerodynamic shape factor **MIN**	$C_{fig,e}$	-0.24		*2h to 3h*
aerodynamic shape factor **MIN**	$C_{fig,e}$	-0.16		*>3h*
aerodynamic shape factor **MAX**	$C_{fig,e}$	-0.32		*0 to 0.5h*
aerodynamic shape factor **MAX**	$C_{fig,e}$	-0.32		*0.5 to 1h*
aerodynamic shape factor **MAX**	$C_{fig,e}$	0		*1h to 2h*
aerodynamic shape factor **MAX**	$C_{fig,e}$	0.08		*2h to 3h*
aerodynamic shape factor **MAX**	$C_{fig,e}$	0.16		*>3h*
Pressure **MIN**	**P**	**-0.18**	**kPa**	*0 to 0.5h*
Pressure **MIN**	**P**	**-0.18**	**kPa**	*0.5 to 1h*
Pressure **MIN**	**P**	**-0.10**	**kPa**	*1h to 2h*
Pressure **MIN**	**P**	**-0.06**	**kPa**	*2h to 3h*
Pressure **MIN**	**P**	**-0.04**	**kPa**	*>3h*
Pressure **MAX**	**P**	**-0.08**	**kPa**	*0 to 0.5h*
Pressure **MAX**	**P**	**-0.08**	**kPa**	*0.5 to 1h*
Pressure **MAX**	**P**	**0.00**	**kPa**	*1h to 2h*
Pressure **MAX**	**P**	**0.02**	**kPa**	*2h to 3h*
Pressure **MAX**	**P**	**0.04**	**kPa**	*>3h*

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Edge Purlin Force **MIN**	**F**	**-0.14**	**kN/m**	*0 to 0.5h*
Edge Purlin Force **MIN**	**F**	**-0.14**	**kN/m**	*0.5 to 1h*
Edge Purlin Force **MIN**	**F**	**-0.08**	**kN/m**	*1h to 2h*
Edge Purlin Force **MIN**	**F**	**-0.05**	**kN/m**	*2h to 3h*
Edge Purlin Force **MIN**	**F**	**-0.03**	**kN/m**	*>3h*
Edge Purlin Force MAX	**F**	**-0.06**	**kN/m**	*0 to 0.5h*
Edge Purlin Force MAX	**F**	**-0.06**	**kN/m**	*0.5 to 1h*
Edge Purlin Force MAX	**F**	**0.00**	**kN/m**	*1h to 2h*
Edge Purlin Force MAX	**F**	**0.02**	**kN/m**	*2h to 3h*
Edge Purlin Force MAX	**F**	**0.03**	**kN/m**	*>3h*
Intermediate Purlin Force **MIN**	**F**	**-0.28**	**kN/m**	*0 to 0.5h*
Intermediate Purlin Force **MIN**	**F**	**-0.28**	**kN/m**	*0.5 to 1h*
Intermediate Purlin Force **MIN**	**F**	**-0.16**	**kN/m**	*1h to 2h*
Intermediate Purlin Force **MIN**	**F**	**-0.09**	**kN/m**	*2h to 3h*
Intermediate Purlin Force **MIN**	**F**	**-0.06**	**kN/m**	*>3h*
Intermediate Purlin Force **MAX**	**F**	**-0.13**	**kN/m**	*0 to 0.5h*
Intermediate Purlin Force **MAX**	**F**	**-0.13**	**kN/m**	*0.5 to 1h*
Intermediate Purlin Force **MAX**	**F**	**0.00**	**kN/m**	*1h to 2h*
Intermediate Purlin Force **MAX**	**F**	**0.03**	**kN/m**	*2h to 3h*
Intermediate Purlin Force **MAX**	**F**	**0.06**	**kN/m**	*>3h*

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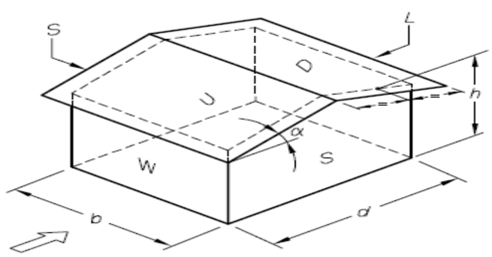
5.2 Pressure (P)

$C_{fig,i} = C_{p.i.}\, k_{c,i}$

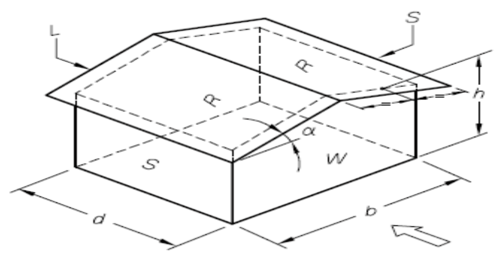
$C_{fig,e} = C_{p.e.}\, k_a\, k_{c,e}\, k_l\, k_p$

5.2.1 Pressure summary

WIND EXTERNAL PRESSURE			Direction1		Direction2				
Windward (kPa)			0.14		0.14				
Leeward (kPa)			-0.08		-0.08				
Sidewall (m)	Length	(m)	(m)	(Kpa)	(Kpa)				
	0 - 1h	0	3.4	-0.13	-0.13				
	1h - 2h	3.4	6.8	-0.10	-0.10				
	2h - 3h	6.8	10.2	-0.06	-0.06				
	>3h	10.2	-	-0.04	-0.04				
Roof			Min (Kpa)	Max (Kpa)	Length	(m)	(m)	Min (Kpa)	Max (Kpa)
	Upwind Slope		-0.07	0.02	0-0.5h	0.00	1.70	-0.18	-0.08
	Downwind Slope		-0.12	-0.12	0.5h-1h	1.70	3.40	-0.18	-0.08
					1h-2h	3.40	6.80	-0.10	0.00
					2h-3h	6.80	10.20	-0.06	0.02
					>3h	10.20	-	-0.04	0.04
Wind Internal Pressure (kPa)			Min (kPa)	Max (kPa)	Min (kPa)			Max (kPa)	
			Proportion of Cpe	Proportion of Cpe	Proportion of Cpe			Proportion of Cpe	



Direction 1



AS1170.2

Direction 2

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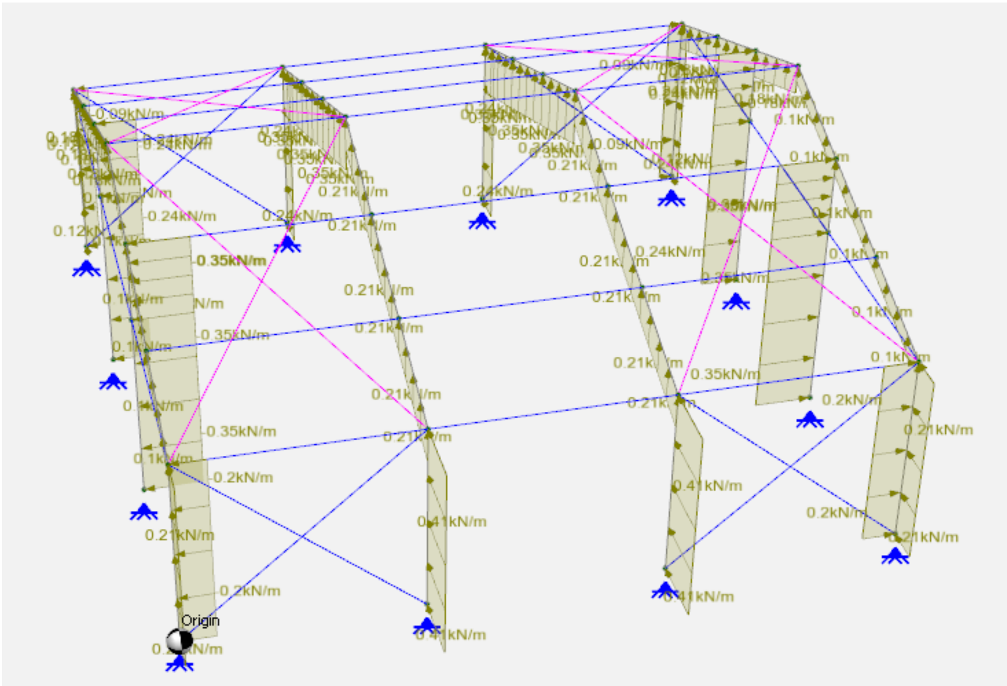
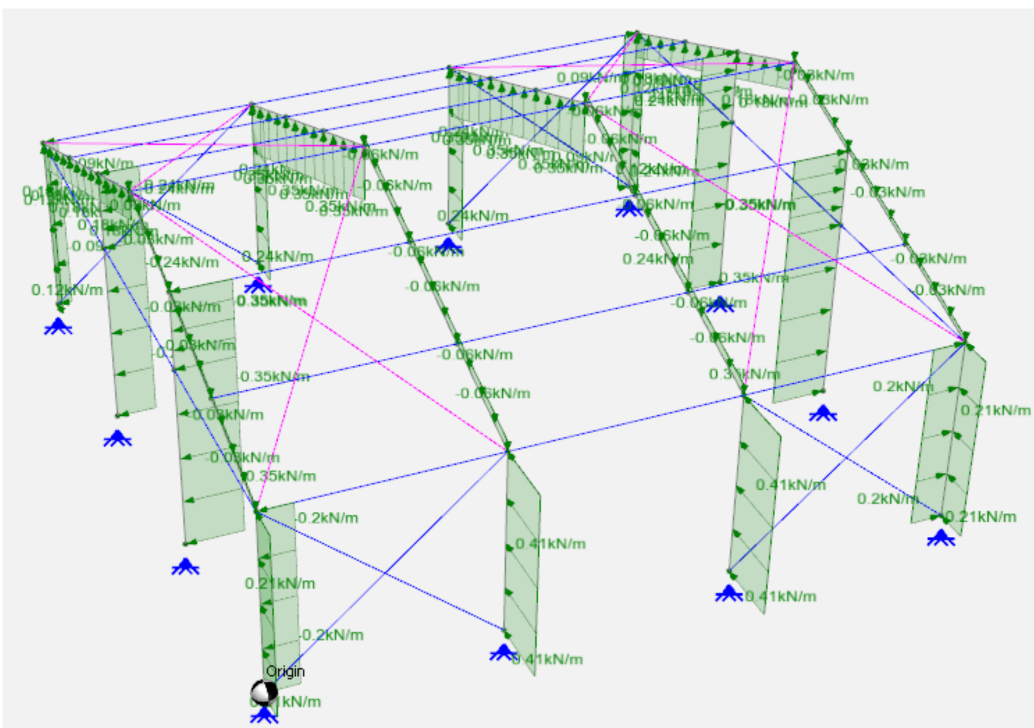
5.3 Wind Load Diagrams

5.3.1 Wind 1(case 1)



5.3.2 Wind 1(case 2)



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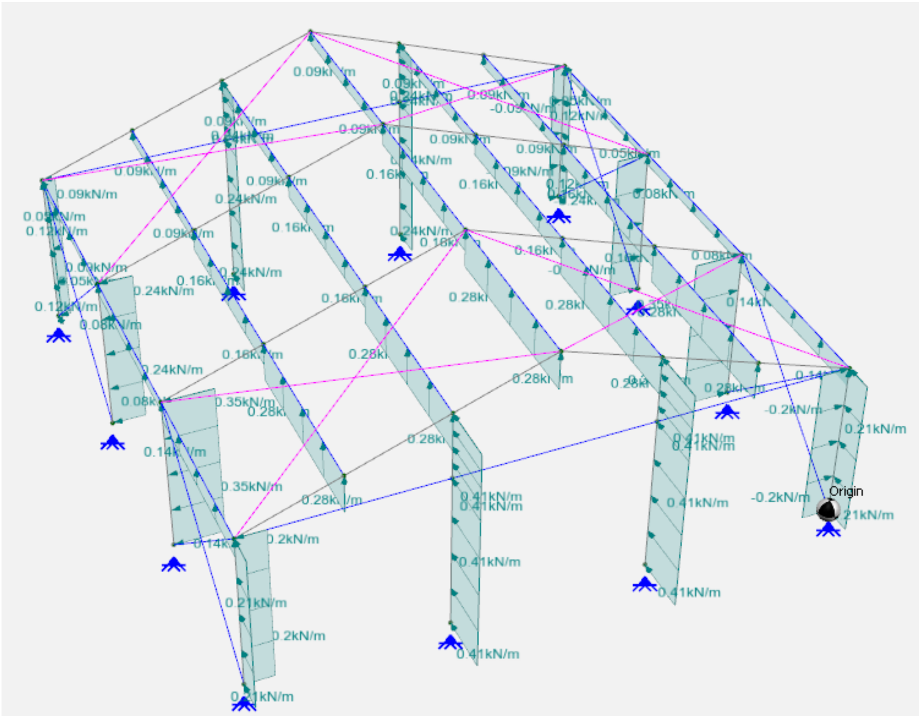
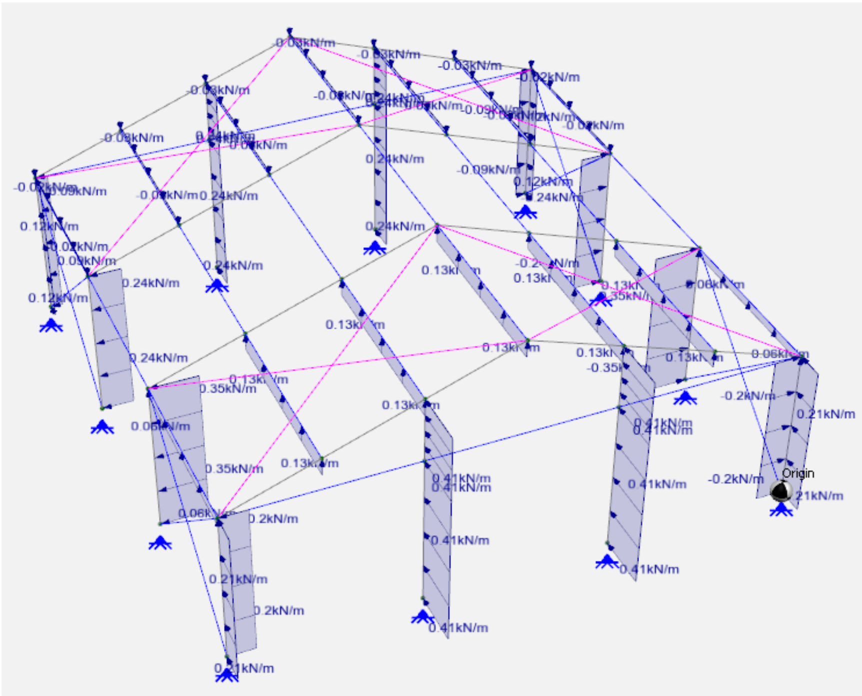
5.3.3 Wind 2(Case1)



5.3.4 Wind 2(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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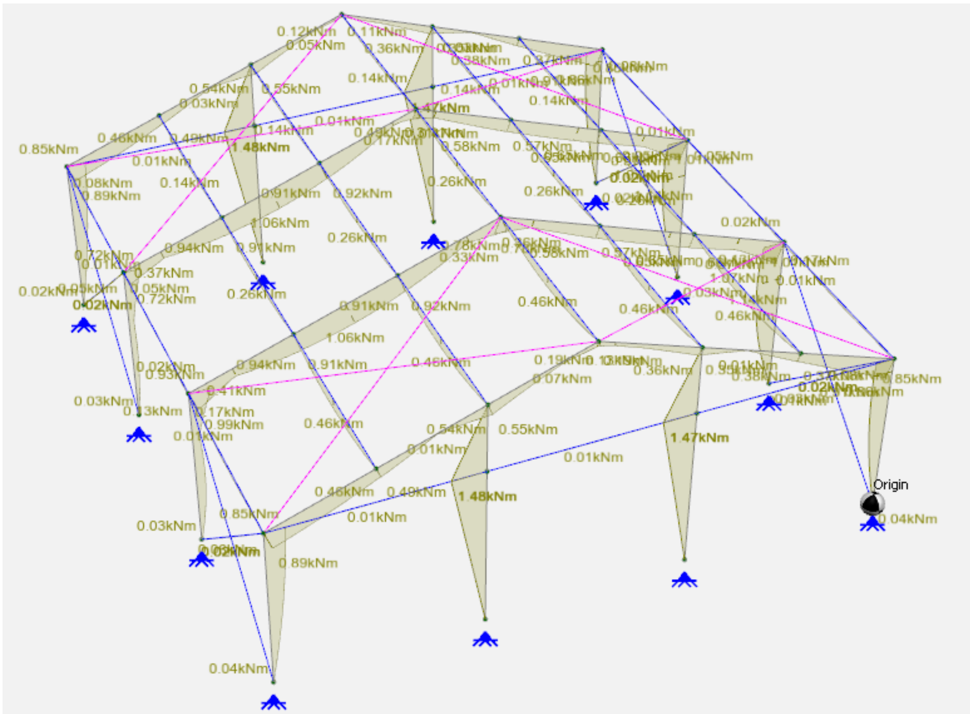
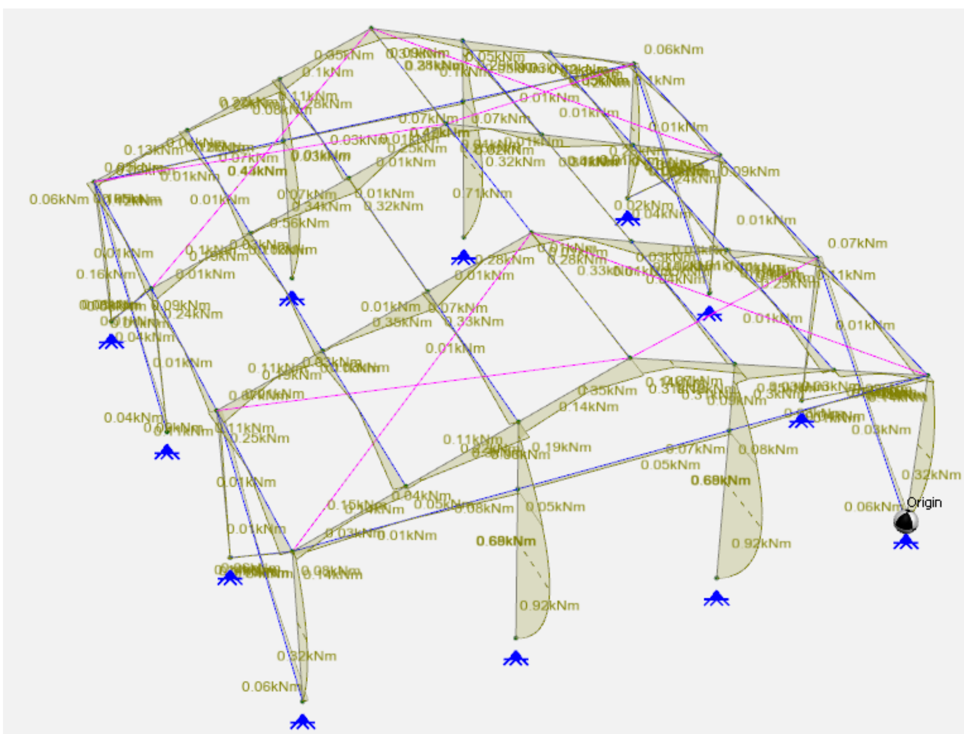
5.3.5 Max Bending Moment due to critical load combination in major axis



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



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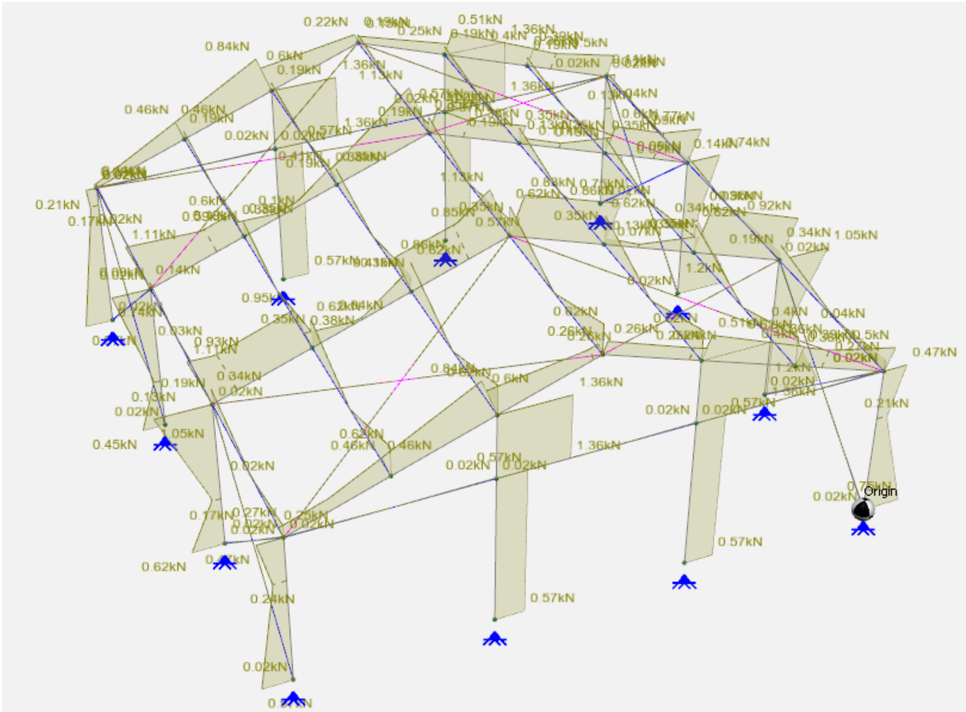
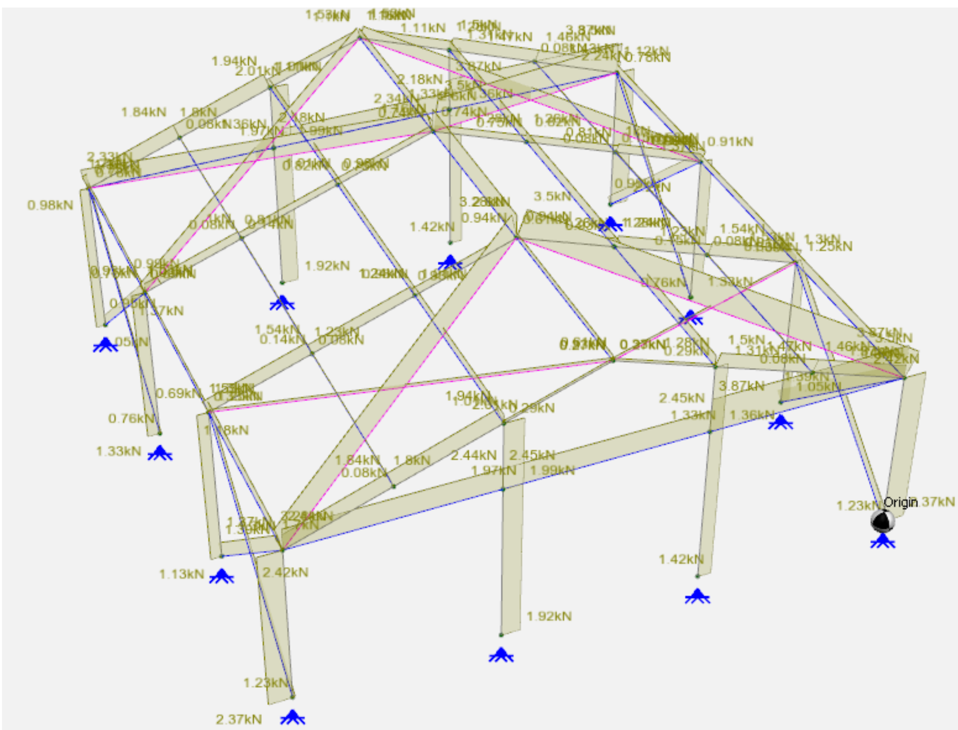
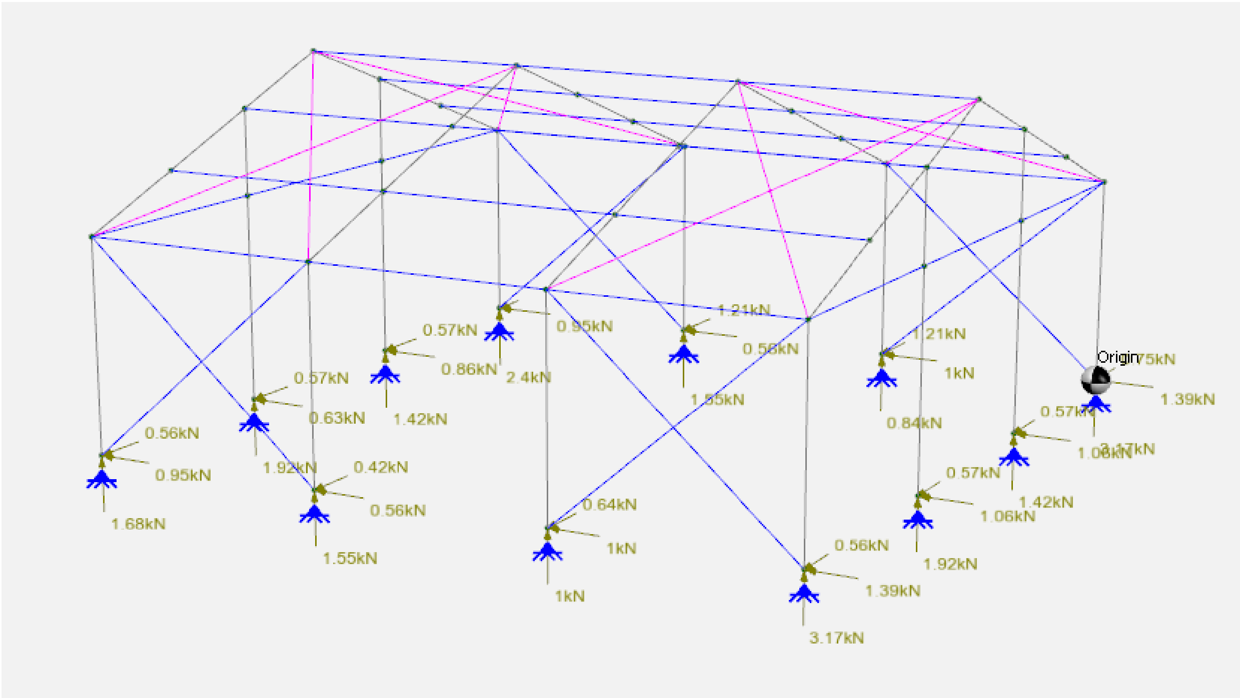
5.3.7 Max Shear in due to critical load combination



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



5.3.9 Max reactions



Max Reaction $N^* = 3.2$ kN

5.3.10 Summary Table:

MEMBER(S)	Section	b	d	t	P	Mx	My
		mm	mm	mm	kN	kN.m	kN.m
Rafter	82x48x3	48	82	3	2	1.07	0.35
Upright Support	82x48x3	48	82	3	2.42	1.14	0.32
Gable Pole	82x48x3	48	82	3	1.9	1.4	0.9
Ridge & Eave Purlin	40x40x2	40	40	2	2.6	0.26	0.01
Gable Beam	40x40x2	40	40	2	3.87	0.08	0.08
Intermediate Purlin	40x40x2	40	40	2	1.28	0.46	0.07
Brace	40x40x2	40	40	2	1.3	0.08	0.08

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6 Checking Members Based on AS1664.1 ALUMINIUM LSD

6.1 Upright Supports

NAME	SYMBOL		VALUE	UNIT	NOTES	REF
82x48x3	**(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	=	2.42	kN	*compression*	
In plane moment	M_x	=	1.14	kNm		
Out of plane moment	M_y	=	0.32	kNm		
DESIGN STRESSES						
Gross cross section area	A_g	**=**	744	mm^2		
In-plane elastic section modulus	Z_x	**=**	16318.439	mm^3		
Out-of-plane elastic section mod.	Z_y	**=**	11937	mm^3		
Stress from axial force	$\mathbf{f_a}$	**=**	P/A_g			
		=	**3.25**	**MPa**	*compression*	
Stress from in-plane bending	$\mathbf{f_{bx}}$	**=**	M_x/Z_x			
		=	**69.86**	**MPa**	*compression*	
Stress from out-of-plane bending	$\mathbf{f_{by}}$	**=**	M_y/Z_y			
		=	**26.81**	**MPa**	*compression*	
COMPRESSION						
3.4.8 *Compression in columns, axial, gross section*						
1. General						… 3.4.8.1

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Unsupported length of member	L	=	2600	mm		
Effective length factor	k	=	1			
Radius of gyration about buckling axis	r	=	19.62	mm		
Slenderness ratio	kL/r	=	132.50			
Slenderness parameter	λ	=	2.47			
	D_c*	=	90.3			
	S_1*	=	0.33			
	S_2*	=	1.23			
	ϕ_{cc}	=	0.926			
Factored limit state stress	**ϕF_L**	**=**	**36.46**	**MPa**		
2. Sections not subject to torsional or torsional-flexural buckling						… 3.4.8.2
Largest slenderness ratio for flexural buckling	kL/r	=	132.50			
***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'	=	42			
	t	=	3	mm		
Slenderness	b/t	=	14			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	32.87		*S1 < b/t < S2*	
Factored limit state stress	**ϕF_L**	**=**	**224.30**	**MPa**		
Most adverse compressive limit state stress	F_a	=	36.46	MPa		
Most adverse compressive capacity factor	f_a/F_a	=	0.09		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		

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Second moment of area (weak axis)	I_y	=	2.86E+05	mm^4		
Torsion modulus	J	=	6.12E+05	mm^3		
Elastic section modulus	Z	=	11937	mm^3		
Slenderness	S	=	148.30			
Limit 1	S_1	=	0.39			
Limit 2	S_2	=	1695.86		*S1 < S < S2*	
Factored limit state stress	**ϕF_L**	=	**202.45**	**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'	**=**	42	mm		
	t	**=**	3	mm		
Slenderness	b/t	**=**	14			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	46.95		*S1 < S < S2*	
Factored limit state stress	**ϕF_L**	=	**224.30**	**MPa**		
Most adverse in-plane bending limit state stress	F_{bx}	=	202.45	MPa		
Most adverse in-plane bending capacity factor	f_{bx}/F_{bx}	**=**	0.35		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**	=	**202.45**	**MPa**		
Most adverse out-of-plane bending limit state stress	**F_{by}**	=	202.45	MPa		
Most adverse out-of-plane bending capacity factor	**f_{by}/F_{by}**	**=**	0.13		PASS	
COMBINED ACTIONS						
***4.1.1** Combined compression and bending*						4.1.1(2)

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	F_a	=	36.46	MPa		… 3.4.8
	F_{ao}	=	224.30	MPa		… 3.4.10
	F_{bx}	=	224.30	MPa		… 3.4.17
	F_{by}	=	202.45	MPa		… 3.4.17
	f_a/F_a	=	0.089		Which is <0.15	
Check:	$f_a/F_a + f_{bx}/F_{bx} + f_{by}/F_{by} \leq 1.0$					… 4.1.1 (3)
i.e.	0.57	≤	1.0		PASS	

6.2 Rafter

NAME	SYMBOL		VALUE	UNIT	NOTES	REF
82x48x3	**(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	=	2	kN	*compression*	
In plane moment	M_x	=	1.07	kNm		
Out of plane moment	M_y	=	0.35	kNm		
DESIGN STRESSES						
Gross cross section area	A_g	**=**	744	mm^2		
In-plane elastic section modulus	Z_x	**=**	16318.439	mm^3		
Out-of-plane elastic section mod.	Z_y	**=**	11937	mm^3		
Stress from axial force	$\mathbf{f_a}$	**=**	P/A_g			
		=	**2.69**	**MPa**	*compression*	

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Stress from in-plane bending	f_{bx}	=	M_x/Z_x			
		=	**65.57**	**MPa**	*compression*	
Stress from out-of-plane bending	f_{by}	=	M_y/Z_y			
		=	**29.32**	**MPa**	*compression*	
COMPRESSION						
***3.4.8** Compression in columns, axial, gross section*						
1. General						… 3.4.8.1
Unsupported length of member	L	=	4790	mm		
Effective length factor	k	=	1			
Radius of gyration about buckling axis	r	=	19.62	mm		
Slenderness ratio	kL/r	=	244.10			
Slenderness parameter	λ	=	4.559			
	D_c^*	=	90.3			
	S_1^*	=	0.33			
	S_2^*	=	1.23			
	ϕ_{cc}	=	0.950			
Factored limit state stress	ϕF_L	=	**11.01**	**MPa**		
2. Sections not subject to torsional or torsional-flexural buckling						… 3.4.8.2
Largest slenderness ratio for flexural buckling	kL/r	=	244.10			
***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'	=	42			
	t	=	3	mm		
Slenderness	b/t	=	14			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	32.87		*S1 < b/t < S2*	
Factored limit state stress	ϕF_L	=	**224.30**	**MPa**		
Most adverse compressive limit state stress	F_a	=	11.01	MPa		

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Most adverse compressive capacity factor	f_a/F_a	=	0.24		PASS	
BENDING - IN-PLANE						
***3.4.15** Compression in beams, extreme fibre, gross section rectangular tubes, box sections*						
Unbraced length for bending	L_b	=	1600	mm		
Second moment of area (weak axis)	I_y	=	2.86E+05	mm^4		
Torsion modulus	J	=	6.12E+05	mm^3		
Elastic section modulus	Z	=	11937	mm^3		
Slenderness	S	=	91.26			
Limit 1	S_1	=	0.39			
Limit 2	S_2	=	1695.86		*S1 < S < S2*	
Factored limit state stress	**ϕF_L**	=	**208.47**	**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'	=	42	mm		
	t	=	3	mm		
Slenderness	b/t	=	14			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	46.95		*S1 < S < S2*	
Factored limit state stress	**ϕF_L**	=	**224.30**	**MPa**		
Most adverse in-plane bending limit state stress	F_{bx}	=	208.47	MPa		
Most adverse in-plane bending capacity factor	f_{bx}/F_{bx}	=	0.31		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**	=	**208.47**	**MPa**		

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Most adverse out-of-plane bending limit state stress	F_{by}	=	208.47	MPa		
Most adverse out-of-plane bending capacity factor	f_{by}/F_{by}	=	0.14		PASS	
COMBINED ACTIONS						
***4.1.1** Combined compression and bending*						… 4.1.1(2)
	F_a	=	11.01	MPa		… 3.4.8
	F_{ao}	=	224.30	MPa		… 3.4.10
	F_{bx}	=	224.30	MPa		… 3.4.17
	F_{by}	=	208.47	MPa		… 3.4.17
	f_a/F_a	=	0.244		Which is <0.15	
Check:	$f_a/F_a + f_{bx}/F_{bx} + f_{by}/F_{by} \leq 1.0$					… 4.1.1 (3)
i.e.	0.70	≤	1.0		PASS	

6.3 Gable Pole

NAME	SYMBOL		VALUE	UNIT	NOTES	REF
82x48x3	**(Gable pole)**					
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	=	1.9	kN	*compression*	
In plane moment	M_x	=	1.4	kNm		
Out of plane moment	M_y	=	0.9	kNm		

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DESIGN STRESSES						
Gross cross section area	A_g	=	744	mm^2		
In-plane elastic section modulus	Z_x	=	16318.439	mm^3		
Out-of-plane elastic section mod.	Z_y	=	11937	mm^3		
Stress from axial force	$\mathbf{f_a}$	=	P/A_g			
		=	**2.55**	**MPa**	*compression*	
Stress from in-plane bending	$\mathbf{f_{bx}}$	=	M_x/Z_x			
		=	**85.79**	**MPa**	*compression*	
Stress from out-of-plane bending	$\mathbf{f_{by}}$	=	M_y/Z_y			
		=	**75.40**	**MPa**	*compression*	
COMPRESSION						
***3.4.8** Compression in columns, axial, gross section*						
1. General						… 3.4.8.1
Unsupported length of member	L	=	4420	mm		
Effective length factor	k	=	1			
Radius of gyration about buckling axis	r	=	19.62	mm		
Slenderness ratio	kL/r	=	225.25			
Slenderness parameter	λ	=	4.21			
	D_c*	=	90.3			
	S_1*	=	0.33			
	S_2*	=	1.23			
	ϕ_{cc}	=	0.950			
Factored limit state stress	$\mathbf{\phi F_L}$	=	**12.94**	**MPa**		
2. Sections not subject to torsional or torsional-flexural buckling						… 3.4.8.2
Largest slenderness ratio for flexural buckling	kL/r	=	225.25			
***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'	=	42			

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	t	=	3	mm		
Slenderness	b/t	=	14			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	32.87		*S1 < b/t < S2*	
Factored limit state stress	**ϕF_L**	=	**224.30**	**MPa**		
Most adverse compressive limit state stress	F_a	=	12.94	MPa		
Most adverse compressive capacity factor	f_a/F_a	=	0.20		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	=	286488	mm^4		
Torsion modulus	J	=	611517.34	mm^3		
Elastic section modulus	Z	=	11937	mm^3		
Slenderness	S	=	148.30			
Limit 1	S_1	=	0.39			
Limit 2	S_2	=	1695.86		*S1 < S < S2*	
Factored limit state stress	**ϕF_L**	=	**202.45**	**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'	=	42	mm		
	t	=	3	mm		
Slenderness	b/t	=	14			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	46.95		*S1 < S < S2*	
Factored limit state stress	**ϕF_L**	=	**224.30**	**MPa**		

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Most adverse in-plane bending limit state stress	F_{bx}	=	202.45	MPa		
Most adverse in-plane bending capacity factor	f_{bx}/F_{bx}	=	0.42		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	$\boldsymbol{\phi F_L}$	=	**202.45**	**MPa**		
Most adverse out-of-plane bending limit state stress	$\mathbf{F_{by}}$	=	202.45	MPa		
Most adverse out-of-plane bending capacity factor	$\mathbf{f_{by}/F_{by}}$	=	0.37		PASS	
COMBINED ACTIONS						
***4.1.1** Combined compression and bending*						… 4.1.1(2)
	F_a	=	12.94	MPa		… 3.4.8
	F_{ao}	=	224.30	MPa		… 3.4.10
	F_{bx}	=	224.30	MPa		… 3.4.17
	F_{by}	=	202.45	MPa		… 3.4.17
	f_a/F_a	=	0.197		Which is <0.15	
Check:	$f_a/F_a + f_{bx}/F_{bx} + f_{by}/F_{by} \le 1.0$					… 4.1.1 (3)
i.e.	0.99	≤	1.0		PASS	

6.4 Ridge & Eave Purlin

NAME	SYMBOL		VALUE	UNIT	NOTES	REF
40x40x2	**(Ridge & Eave Purlin)**					
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*	

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Modulus of elasticity	E	=	70000	MPa	*Compressive*	
	k_t	=	1.0			T3.4(B)
	k_c	=	1.0			
FEM ANALYSIS RESULTS						
Axial force	P	=	2.6	kN	*compression*	
In plane moment	M_x	=	0.26	kNm		
Out of plane moment	M_y	=	0.01	kNm		
DESIGN STRESSES						
Gross cross section area	A_g	**=**	304	mm^2		
In-plane elastic section modulus	Z_x	**=**	3668.266 7	mm^3		
Out-of-plane elastic section mod.	Z_y	**=**	3668.266 7	mm^3		
Stress from axial force	$\mathbf{f_a}$	**=**	P/A_g			
		=	**8.55**	**MPa**	*compression*	
Stress from in-plane bending	$\mathbf{f_{bx}}$	**=**	M_x/Z_x			
		=	**70.88**	**MPa**	*compression*	
Stress from out-of-plane bending	$\mathbf{f_{by}}$	**=**	M_y/Z_y			
		=	**2.73**	**MPa**	*compression*	
COMPRESSION						
3.4.8 *Compression in columns, axial, gross section*						
1. General						… 3.4.8.1
Unsupported length of member	L	=	3000	mm		
Effective length factor	k	=	1			
Radius of gyration about buckling axis	r	=	15.53	mm		
Slenderness ratio	kL/r	=	193.11			
Slenderness parameter	λ	=	3.61			
	D_c*	=	90.3			
	S_1*	=	0.33			
	S_2*	=	1.23			
	ϕ_{cc}	=	0.950			
Factored limit state stress	$\mathbf{\phi F_L}$	**=**	**17.60**	**MPa**		

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2. Sections not subject to torsional or torsional-flexural buckling						… 3.4.8.2
Largest slenderness ratio for flexural buckling	kL/r	=	193.11			
***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'	=	36			
	t	=	2	mm		
Slenderness	b/t	=	18			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	32.87		*S1 < b/t < S2*	
Factored limit state stress	**ϕF_L**	=	**213.07**	**MPa**		
Most adverse compressive limit state stress	F_a	=	17.60	MPa		
Most adverse compressive capacity factor	f_a/F_a	=	0.49		PASS	
BENDING - IN-PLANE						
***3.4.15** Compression in beams, extreme fibre, gross section rectangular tubes, box sections*						
Unbraced length for bending	L_b	=	3000	mm		
Second moment of area (weak axis)	I_y	=	73365.33 3	mm^4		
Torsion modulus	J	=	109744	mm^3		
Elastic section modulus	Z	=	3668.266 7	mm^3		
Slenderness	S	=	245.29			
Limit 1	S_1	=	0.39			
Limit 2	S_2	=	1695.86		*S1 < S < S2*	
Factored limit state stress	**ϕF_L**	=	**194.46**	**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*						

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	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'	=	36	mm		
	t	=	2	mm		
Slenderness	b/t	=	18			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	46.95		*S1 < S < S2*	
Factored limit state stress	**ϕF_L**	=	**213.07**	**MPa**		
Most adverse in-plane bending limit state stress	F_{bx}	=	194.46	MPa		
Most adverse in-plane bending capacity factor	f_{bx}/F_{bx}	=	0.36		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**	=	**194.46**	**MPa**		
Most adverse out-of-plane bending limit state stress	**F_{by}**	=	194.46	MPa		
Most adverse out-of-plane bending capacity factor	**f_{by}/F_{by}**	=	0.01		PASS	
COMBINED ACTIONS						
4.1.1 *Combined compression and bending*						… 4.1.1(2)
	F_a	=	17.60	MPa		… 3.4.8
	F_{ao}	=	213.07	MPa		… 3.4.10
	F_{bx}	=	213.07	MPa		… 3.4.17
	F_{by}	=	194.46	MPa		… 3.4.17
	f_a/F_a	=	0.486		Which is <0.15	
Check: $f_a/F_a + f_{bx}/F_{bx} + f_{by}/F_{by} \leq 1.0$						… 4.1.1 (3)
i.e.	0.86	≤	1.0		PASS	

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6.5 Gable Beam

NAME	SYMBOL		VALUE	UNIT	NOTES	REF
40x40x2	**(Gable Beam)**					
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	=	3.87	kN	*compression*	
In plane moment	M_x	=	0.08	kNm		
Out of plane moment	M_y	=	0.08	kNm		
DESIGN STRESSES						
Gross cross section area	A_g	**=**	304	mm^2		
In-plane elastic section modulus	Z_x	**=**	3668.2667	mm^3		
Out-of-plane elastic section mod.	Z_y	**=**	3668.2667	mm^3		
Stress from axial force	$\mathbf{f_a}$	**=**	P/A_g			
		=	**12.73**	**MPa**	*compression*	
Stress from in-plane bending	$\mathbf{f_{bx}}$	**=**	M_x/Z_x			
		=	**21.81**	**MPa**	*compression*	
Stress from out-of-plane bending	$\mathbf{f_{by}}$	**=**	M_y/Z_y			
		=	**21.81**	**MPa**	*compression*	
COMPRESSION						
***3.4.8** Compression in columns, axial, gross section*						
1. General						… 3.4.8.1
Unsupported length of	L	=	3000	mm		

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member						
Effective length factor	k	=	1			
Radius of gyration about buckling axis	r	=	15.53	mm		
Slenderness ratio	kL/r	=	193.11			
Slenderness parameter	λ	=	3.61			
	D_c*	=	90.3			
	S_1*	=	0.33			
	S_2*	=	1.23			
	ϕ_{cc}	=	0.950			
Factored limit state stress	**ϕF_L**	=	**17.60**	**MPa**		
2. Sections not subject to torsional or torsional-flexural buckling						… 3.4.8.2
Largest slenderness ratio for flexural buckling	kL/r	=	193.11			
***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'	=	36			
	t	=	2	mm		
Slenderness	b/t	=	18			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	32.87		*S1 < b/t < S2*	
Factored limit state stress	**ϕF_L**	=	**213.07**	**MPa**		
Most adverse compressive limit state stress	F_a	=	17.60	MPa		
Most adverse compressive capacity factor	f_a/F_a	=	0.72		PASS	
BENDING - IN-PLANE						
***3.4.15** Compression in beams, extreme fibre, gross section rectangular tubes, box sections*						
Unbraced length for bending	L_b	=	3000	mm		
Second moment of area (weak axis)	I_y	=	73365.333	mm^4		

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Torsion modulus	J	=	109744	mm^3		
Elastic section modulus	Z	=	3668.2667	mm^3		
Slenderness	S	=	245.29			
Limit 1	S_1	=	0.39			
Limit 2	S_2	=	1695.86		*S1 < S < S2*	
Factored limit state stress	**ϕF_L**	=	**194.46**	**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'	=	36	mm		
	t	=	2	mm		
Slenderness	b/t	=	18			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	46.95		*S1 < S < S2*	
Factored limit state stress	**ϕF_L**	=	**213.07**	**MPa**		
Most adverse in-plane bending limit state stress	F_{bx}	=	194.46	MPa		
Most adverse in-plane bending capacity factor	f_{bx}/F_{bx}	=	0.11		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**	=	**194.46**	**MPa**		
Most adverse out-of-plane bending limit state stress	**F_{by}**	=	194.46	MPa		
Most adverse out-of-plane bending capacity factor	**f_{by}/F_{by}**	=	0.11		PASS	
COMBINED ACTIONS						
***4.1.1** Combined compression and bending*						4.1.1(2)

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	F_a	=	17.60	MPa		… 3.4.8
	F_{ao}	=	213.07	MPa		… 3.4.10
	F_{bx}	=	213.07	MPa		… 3.4.17
	F_{by}	=	194.46	MPa		… 3.4.17
	f_a/F_a	=	0.723		Which is <0.15	
Check:	$f_a/F_a + f_{bx}/F_{bx} + f_{by}/F_{by} \leq 1.0$					… 4.1.1 (3)
i.e.	0.95	≤	1.0		PASS	

6.6 Intermediate Purlin

NAME	SYMBOL		VALUE	UNIT	NOTES	REF
40x40x2	**(Intermediate Purlin)**					
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	=	1.28	kN	*compression*	
In plane moment	M_x	=	0.46	kNm		
Out of plane moment	M_y	=	0.07	kNm		
DESIGN STRESSES						
Gross cross section area	A_g	=	304	mm^2		
In-plane elastic section modulus	Z_x	=	3668.2667	mm^3		
Out-of-plane elastic section mod.	Z_y	=	3668.2667	mm^3		
Stress from axial force	$\mathbf{f_a}$	=	P/A_g			

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		=	**4.21**	**MPa**	*compression*	
Stress from in-plane bending	f_{bx}	=	M_x/Z_x			
		=	**125.40**	**MPa**	*compression*	
Stress from out-of-plane bending	f_{by}	=	M_y/Z_y			
		=	**19.08**	**MPa**	*compression*	
COMPRESSION						
***3.4.8** Compression in columns, axial, gross section*						
1. General						… 3.4.8.1
Unsupported length of member	L	=	3000	mm		
Effective length factor	k	=	1			
Radius of gyration about buckling axis	r	=	15.53	mm		
Slenderness ratio	kL/r	=	193.11			
Slenderness parameter	λ	=	3.61			
	D_c*	=	90.3			
	S_1*	=	0.33			
	S_2*	=	1.23			
	ϕ_{cc}	=	0.950			
Factored limit state stress	ϕF_L	=	**17.60**	**MPa**		
2. Sections not subject to torsional or torsional-flexural buckling						… 3.4.8.2
Largest slenderness ratio for flexural buckling	kL/r	=	193.11			
***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'	=	36			
	t	=	2	mm		
Slenderness	b/t	=	18			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	32.87		*S1 < b/t < S2*	
Factored limit state stress	ϕF_L	=	**213.07**	**MPa**		

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Most adverse compressive limit state stress	F_a	=	17.60	MPa		
Most adverse compressive capacity factor	f_a/F_a	=	0.24		PASS	
BENDING - IN-PLANE						
***3.4.15** Compression in beams, extreme fibre, gross section rectangular tubes, box sections*						
Unbraced length for bending	L_b	=	3000	mm		
Second moment of area (weak axis)	I_y	=	73365.333	mm^4		
Torsion modulus	J	=	109744	mm^3		
Elastic section modulus	Z	=	3668.2667	mm^3		
Slenderness	S	=	245.29			
Limit 1	S_1	=	0.39			
Limit 2	S_2	=	1695.86		*S1 < S < S2*	
Factored limit state stress	**ϕF_L**	=	**194.46**	**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'	=	36	mm		
	t	=	2	mm		
Slenderness	b/t	=	18			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	46.95		*S1 < S < S2*	
Factored limit state stress	**ϕF_L**	=	**213.07**	**MPa**		
Most adverse in-plane bending limit state stress	F_{bx}	=	194.46	MPa		
Most adverse in-plane bending capacity factor	f_{bx}/F_{bx}	=	0.64		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	=	**194.46**	**MPa**		
Most adverse out-of-plane bending limit state stress	F_{by}	=	194.46	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	=	17.60	MPa		… 3.4.8
	F_{ao}	=	213.07	MPa		… 3.4.10
	F_{bx}	=	213.07	MPa		… 3.4.17
	F_{by}	=	194.46	MPa		… 3.4.17
	f_a/F_a	=	0.239		Which is <0.15	
Check:	$f_a/F_a + f_{bx}/F_{bx} + f_{by}/F_{by} \leq 1.0$					… 4.1.1 (3)
i.e.	0.98	≤	1.0		PASS	

6.7 Cross Brace

NAME	SYMBOL		VALUE	UNIT	NOTES	REF
40x40x2	**(Brace)**					
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						

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Axial force	P	=	1.3	kN	*compression*	
In plane moment	M_x	=	0.08	kNm		
Out of plane moment	M_y	=	0.08	kNm		
DESIGN STRESSES						
Gross cross section area	A_g	**=**	304	mm^2		
In-plane elastic section modulus	Z_x	**=**	3668.2667	mm^3		
Out-of-plane elastic section mod.	Z_y	**=**	3668.2667	mm^3		
Stress from axial force	$\mathbf{f_a}$	**=**	P/A_g			
		=	**4.28**	**MPa**	*compression*	
Stress from in-plane bending	$\mathbf{f_{bx}}$	**=**	M_x/Z_x			
		=	**21.81**	**MPa**	*compression*	
Stress from out-of-plane bending	$\mathbf{f_{by}}$	**=**	M_y/Z_y			
		=	**21.81**	**MPa**	*compression*	
COMPRESSION						
***3.4.8** Compression in columns, axial, gross section*						
1. General						… 3.4.8.1
Unsupported length of member	L	=	4000	mm		
Effective length factor	k	=	1			
Radius of gyration about buckling axis	r	=	15.53	mm		
Slenderness ratio	kL/r	=	257.48			
Slenderness parameter	λ	=	4.81			
	D_c*	=	90.3			
	S_1*	=	0.33			
	S_2*	=	1.23			
	ϕ_{cc}	=	0.950			
Factored limit state stress	$\mathbf{\phi F_L}$	**=**	**9.90**	**MPa**		
2. Sections not subject to torsional or torsional-flexural buckling						… 3.4.8.2
Largest slenderness ratio for flexural buckling	kL/r	**=**	257.48			
***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

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	k_1	=	0.35			T3.3(D)
Max. distance between toes of fillets of supporting elements for plate	b'	=	36			
	t	=	2	mm		
Slenderness	b/t	=	18			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	32.87		*S1 < b/t < S2*	
Factored limit state stress	**ϕF_L**	=	**213.07**	**MPa**		
Most adverse compressive limit state stress	F_a	=	9.90	MPa		
Most adverse compressive capacity factor	f_a/F_a	=	0.43		PASS	
BENDING - IN-PLANE						
3.4.15 *Compression in beams, extreme fibre, gross section rectangular tubes, box sections*						
Unbraced length for bending	L_b	=	4000	mm		
Second moment of area (weak axis)	I_y	=	73365.333	mm^4		
Torsion modulus	J	=	109744	mm^3		
Elastic section modulus	Z	=	3668.2667	mm^3		
Slenderness	S	=	327.05			
Limit 1	S_1	=	0.39			
Limit 2	S_2	=	1695.86		*S1 < S < S2*	
Factored limit state stress	**ϕF_L**	=	**188.90**	**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'	=	36	mm		
	t	=	2	mm		
Slenderness	b/t	=	18			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	46.95		*S1 < S < S2*	

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Factored limit state stress	**ϕF_L**	=	**213.07**	**MPa**		
Most adverse in-plane bending limit state stress	F_{bx}	=	188.90	MPa		
Most adverse in-plane bending capacity factor	f_{bx}/F_{bx}	**=**	0.12		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**	=	**188.90**	**MPa**		
Most adverse out-of-plane bending limit state stress	**F_{by}**	=	188.90	MPa		
Most adverse out-of-plane bending capacity factor	**f_{by}/F_{by}**	**=**	0.12		PASS	
COMBINED ACTIONS						
***4.1.1** Combined compression and bending*						… 4.1.1(2)
	F_a	=	9.90	MPa		… 3.4.8
	F_{ao}	=	213.07	MPa		… 3.4.10
	F_{bx}	=	213.07	MPa		… 3.4.17
	F_{by}	=	188.90	MPa		… 3.4.17
	f_a/F_a	=	0.432		Which is <0.15	
Check:	$f_a/F_a + f_{bx}/F_{bx} + f_{by}/F_{by} \leq 1.0$					… 4.1.1 (3)
i.e.	0.66	≤	1.0		PASS	

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7 Summary

7.1 Conclusions

a. The 9m Span x 3m Bay Function Crest Standard 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. Wall Bracing and roof bracing are required at each end bay and every third bay in between to resist against lateral movement due to wind direction2 for multiple tent length.(refer to detail drawing)

d. Bracing cables are required to have minimum tensile strength equal to 6 kN.

e. For uplift due to 80km/hr, 3.5 kN (350Kg) holding down weight/per leg is required.

f. The bearing pressure of soil should be clarified and checked by an engineer prior to any construction for considering foundation and base plate.

g. Required Weight per leg for smaller tents:

Span Width	Required Weight Per Leg	
	(kN)	(Kg)
6	3	300
8	3.2	320
9	3.5	350

Yours faithfully,

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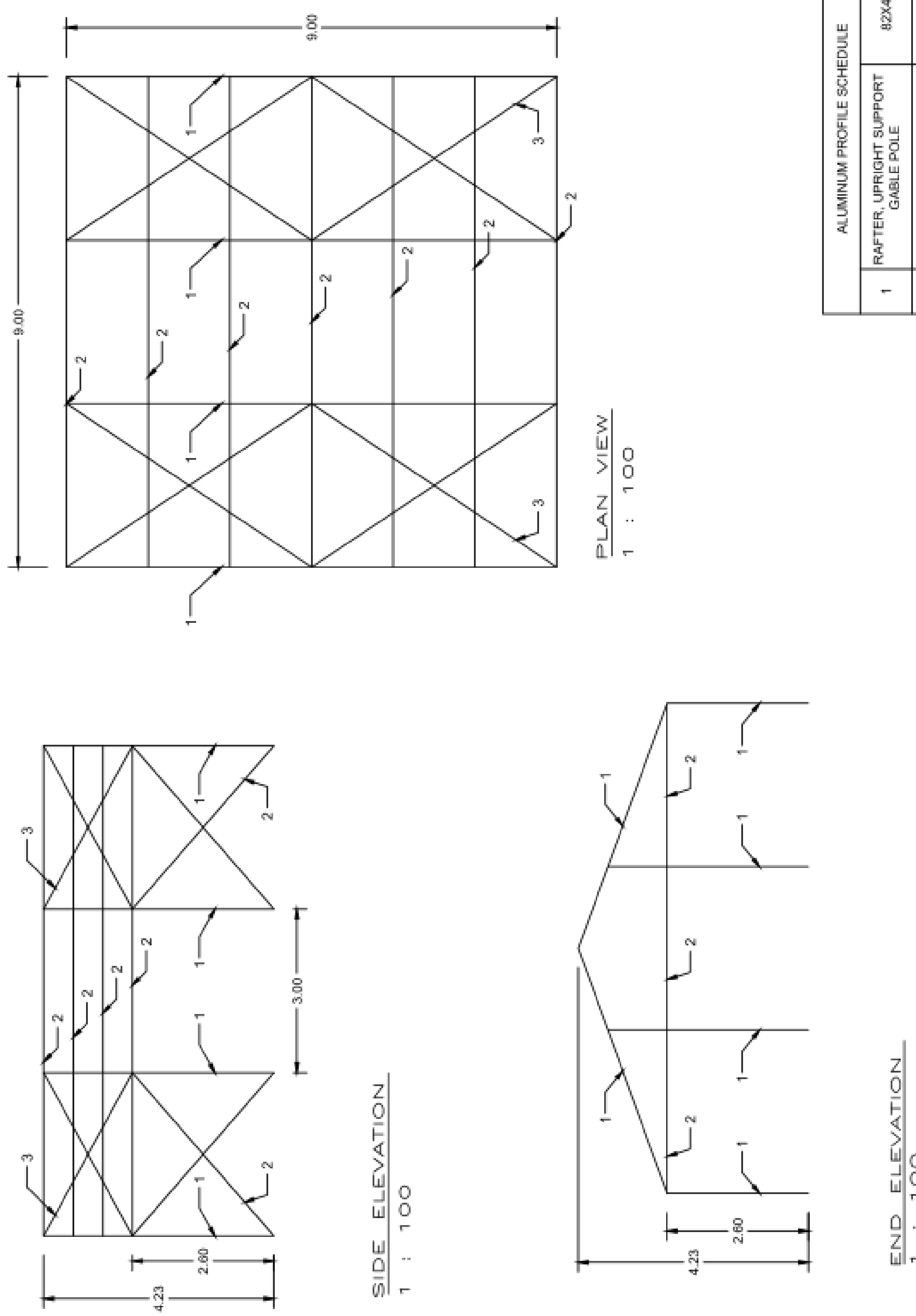
8 Appendix A – 9m x 9m Function Crest Tent

ALUMINUM PROFILE SCHEDULE

1	RAFTER, UPRIGHT SUPPORT GABLE POLE	82X48X3
2	EAVE, RIDGE & INTERMEDIATE PURLIN GABLE BEAM, CROSS BRACE	40X40X2
3	ROOF CABLE	D6



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