Civil & Structural Engineering Design Services Pty. Ltd.

Client: **Extreme Marquees Pty. Ltd.**
Project: Design check – 25m x 50m x 5m Bay Tent Structure for **80km/hr** Wind Speed.
Reference: Extreme Marquees Pty Ltd Technical Data

Report by: KZ
Checked by: EAB
Date: 18/10/2019

JOB NO: E-11-267583

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ABN: 62 051 307 852
3 Wanniti Road BELROSE NSW 2085
Email: hited@bigpond.net.au
Tel: 02 9975 3899 Fax: 02 99751943
Web: https://cseds.com.au/

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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 Pty. Ltd.

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 25m × 50m tent structure 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.

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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 2.5. 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 tent structure is stabilized by using wall cross bracing at each end bay and every third bay in between (as shown below).

2.10 Knee brace as well as ridge strut is required for all internal frames.

2.11 It is important to use 60x60x2.5 profile for all intermediate purlins with spacing not exceeding 1900 mm. This means 12 intermediate purlins are required per bay for the 25m tent structure.

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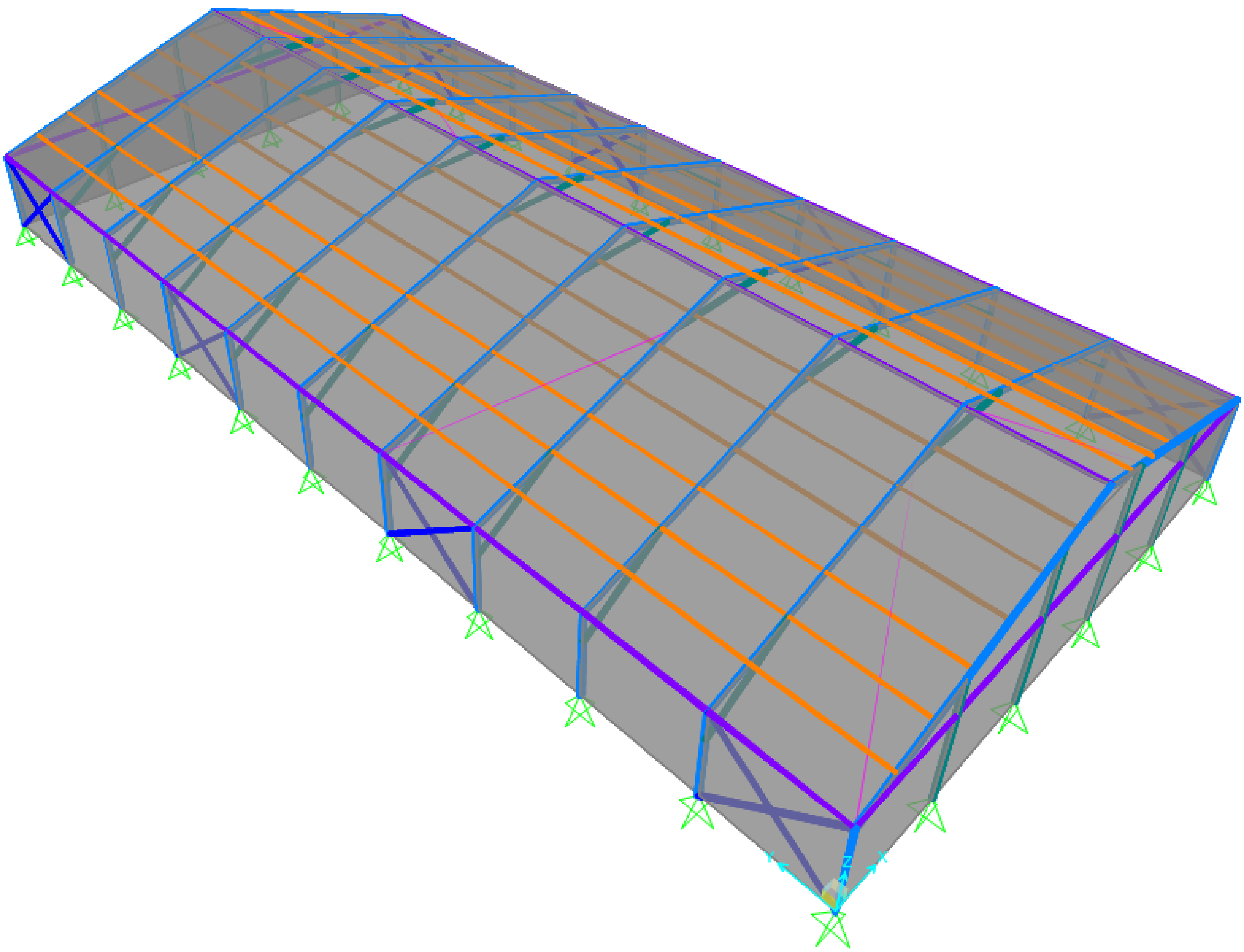
4 Specifications

4.1 General

Tent category	
Material	Aluminum 6061-T6



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4.2 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

4.3 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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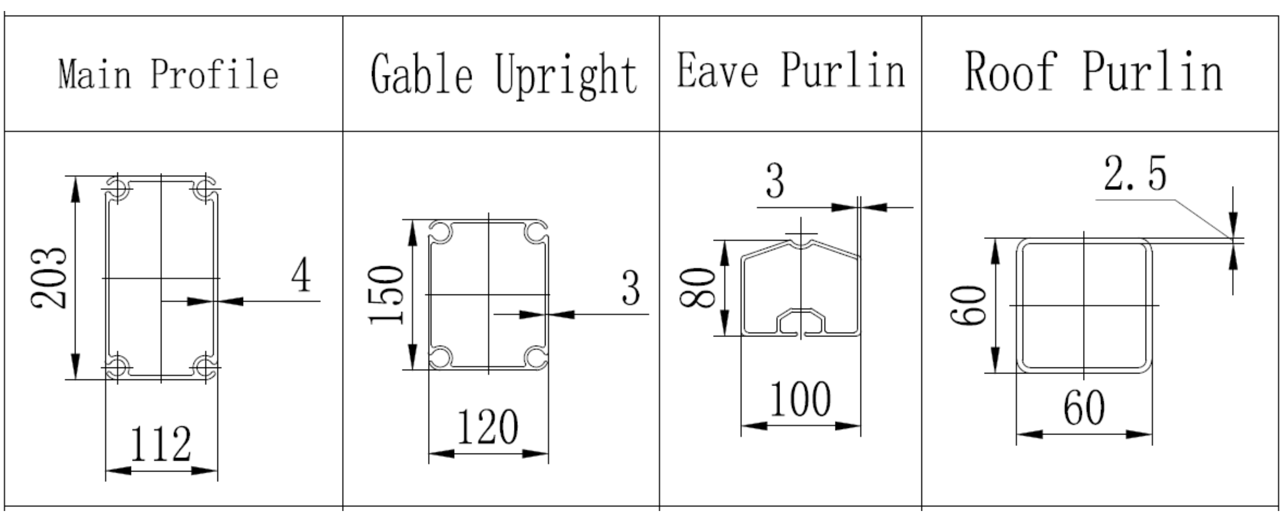
4.4 Section Properties

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*	*mm²*	*mm³*	*mm³*	*mm³*	*mm³*	*mm⁴*	*mm⁴*	*mm⁴*	*mm*	*mm*
Rafter	203x112x4	112	203	4	101.5	2456.0	136109.1	97993.9	165202.0	109328.0	13815068.7	5487658.7	12036640.1	75.0	47.3
Upright Support	203x112x4	112	203	4	101.5	2456.0	136109.1	97993.9	165202.0	109328.0	13815068.7	5487658.7	12036640.1	75.0	47.3
Gable Pole	150x120x3	120	150	3	75.0	1584.0	71775.4	63691.2	84024.0	72144.0	5383152.0	3821472.0	6722854.6	58.3	49.1
Ridge & Eave Purlin	80x100x3	100	80	3	40.0	1044.0	27310.3	30894.6	31314.0	36534.0	1092412.0	1544732.0	1923653.8	32.3	38.5
Gable Beam	80x100x3	100	80	3	40.0	1044.0	27310.3	30894.6	31314.0	36534.0	1092412.0	1544732.0	1923653.8	32.3	38.5
Intermediate Purlin	60x602.5	60	60	2.5	30.0	575.0	10581.6	10581.6	12406.3	12406.3	317447.9	317447.9	475273.4	23.5	23.5
Ridge Struts	150x120x3	120	150	3	75.0	1584.0	71775.4	63691.2	84024.0	72144.0	5383152.0	3821472.0	6722854.6	58.3	49.1
Knee Brace	150x120x3	120	150	3	75.0	1584.0	71775.4	63691.2	84024.0	72144.0	5383152.0	3821472.0	6722854.6	58.3	49.1



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5 Design Loads

5.1 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	0.229 C_{fig}	1.0	0.229 C_{fig}

5.2 Load Combinations

5.2.1 Serviceability

Gravity = $1.0 \times G$

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

5.2.2 Ultimate

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

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

6 Wind Analysis

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

6.1 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)*
$M_d = 1$
$M_s = 1$
$M_t = 1$
$M_{z,cat} = 0.88$ *(Table 4.1(B) AS1170.2)*

$V_{sit,\beta} = 19.56$ m/s

Height of structure (h) = 6.05 m *(mid of peak and eave)*
Width of structure (w) = 25 m
Length of structure (l) = 50 m

Pressure (P) = $0.5\rho_{air} (V_{sit,\beta})^2 C_{fig} C_{dyn}$
= $0.229 C_{fig}$ kPa

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6.2 Pressure Coefficients (C_{fig})

Name	Symbol	Value	Unit	Notes	Ref.
Input					
Importance level		3			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	$M_{Z,Cat}$	0.88			Table 4.1
Shield Multiplier	M_S	1			4.3 (AS1170.2)
Topographic Multiplier	M_t	1			4.4 (AS1170.2)
Site Wind Speed	$V_{Site,\beta}$	**19.56**	m/s	$V_{Site,\beta}=V_R*M_d*M_{z,cat}*M_S,M_t$	
Pitch	α	18.5	Deg		
Pitch	α	0.323	rad		
Width	B	25	m		
Width Span	S_w	5	m		
Length	D	50	m		
Height	Z	6	m		
Bay Span		5	m		
Purlin Spacing		1.9	m		
Number of Intermediate Purlin		12			
	h/d	0.12			
	h/b	0.24			
Wind Pressure					
ρair	ρ	1.2	Kg/m^3		
dynamic response factor	C_{dyn}	1			
Wind Pressure	$\rho*C_{fig}$	**0.229**	Kg/m^2	$p=0.5\rho_{air}*(V_{des,\beta})^2*C_{fig}*C_{dyn}$	2.4 (AS1170.2)

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WIND DIRECTION 1 (Perpendicular to Length)
Internal Pressure

Opening Assumption: Without Dominant Opening

Internal Pressure Coefficient (Without Dominant) **MIN**		**-0.3**		Table 5.1 A
Internal Pressure Coefficient (Without Dominant) **MAX**		**0**		
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 **MIN**	$C_{p,i}$	-0.30		
Internal Pressure Coefficient **MAX**	$C_{p,i}$	0.00		

External Pressure

1. Windward Wall

External Pressure Coefficient	$C_{P,e}$	0.7		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	$C_{fig,e}$	0.56		
Wind Wall Pressure	P	**0.13**	**kPa**	
Edge Column Force	F	**0.32**	**kN/m**	
Intermediate Column Force	F	**0.64**	**kN/m**	

2. Leeward Wall

External Pressure Coefficient	$C_{P,e}$	-0.37		Table 5.2 B
Area Reduction Factor	K_a	1		*Table 5.4*

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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	$C_{fig,e}$	-0.296			
Lee Wall Pressure	P	**-0.07**	**kPa**		
Edge Column Force	F	**-0.17**	**kN/m**		
Intermediate Column Force	F	**-0.34**	**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*	
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	**-0.12**	**kPa**	*0 to 1h*	
Side Wall Pressure	P	**-0.09**	**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				*α>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**	$C_{P,e}$	-0.36			
External Pressure Coefficient **MAX**	$C_{P,e}$	0.14			Table 5.3 B
aerodynamic shape factor **MIN**	$C_{fig,e}$	-0.29			
aerodynamic shape factor **MAX**	$C_{fig,e}$	0.11			

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Pressure **MIN**	P	**-0.07**	**kPa**
Pressure **MAX**	P	**0.03**	**kPa**
Edge Rafter Force **MIN**	F	**-0.17**	**kN/m**
Edge Rafter Force **Max**	F	**0.06**	**kN/m**
Intermediate Rafter Force **MIN**	F	**-0.33**	**kN/m**
Intermediate Rafter Force **MAX**	F	**0.13**	**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	

Pressure **MIN**	P	**-0.11**	**kPa**
Pressure **MAX**	P	**-0.11**	**kPa**
Edge Rafter Force **MIN**	F	**-0.28**	**kN/m**
Edge Rafter Force **MAX**	F	**-0.28**	**kN/m**
Intermediate Rafter Force **MIN**	F	**-0.55**	**kN/m**
Intermediate Rafter Force **MAX**	F	**-0.55**	**kN/m**

WIND DIRECTION 2 (Parallel to Length)

Internal Pressure

Opening Assumption: Without Dominant Opening

Internal Pressure Coefficient (Without Dominant) **MIN**	**-0.3**	Table 5.1A
Internal Pressure Coefficient (Without Dominant) **MAX**	**0**	
Internal Pressure Coefficient (With Dominant) **MIN**	-0.1	Table 5.1B
Internal Pressure Coefficient (With Dominant) **MAX**	0.2	

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N		0.7		*Cpi= N*Cpe*	
Combination Factor	$K_{C,i}$	1			
Internal Pressure Coefficient **MIN**	$C_{p,i}$	-0.30			
Internal Pressure Coefficient **MAX**	$C_{p,i}$	0.00			
External Pressure					
1. Windward Wall					Table 5.2 A
External Pressure Coefficient	$C_{P,e}$	0.7			
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	$C_{fig,e}$	0.56			
Wind Wall Pressure	P	**0.13**	**kPa**		
Edge Column Force	F	**0.32**	**kN/m**		
Intermediate Column Force	F	**0.64**	**kN/m**		
2. Leeward Wall					Table 5.2 B
External Pressure Coefficient	$C_{P,e}$	-0.3			
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	$C_{fig,e}$	-0.24			
Lee Wall Pressure	P	**-0.06**	**kPa**		
Edge Column Force	F	**-0.14**	**kN/m**		
Intermediate Column Force	F	**-0.28**	**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			

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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**	**-0.12**	**kPa**	*0 to 1h*
Side Wall Pressure	**P**	**-0.09**	**kPa**	*1h to 2h*
Side Wall Pressure	**P**	**-0.06**	**kPa**	*2h to 3h*
Side Wall Pressure	**P**	**-0.04**	**kPa**	*>3h*

4. Roof

			α<10º	
Area Reduction Factor	K_a	1		Table 5.3 A
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**	$C_{P,e}$	-0.90	*0 to 0.5h*	
External Pressure Coefficient **MIN**	$C_{P,e}$	-0.90	*0.5 to 1h*	
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**	$C_{P,e}$	-0.20	*>3h*	
External Pressure Coefficient **MAX**	$C_{P,e}$	-0.40	*0 to 0.5h*	
External Pressure Coefficient **MAX**	$C_{P,e}$	-0.40	*0.5 to 1h*	
External Pressure Coefficient **MAX**	$C_{P,e}$	0.00	*1h to 2h*	
External Pressure Coefficient **MAX**	$C_{P,e}$	0.10	*2h to 3h*	
External Pressure Coefficient **MAX**	$C_{P,e}$	0.20	*>3h*	

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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**	**-0.17**	**kPa**	*0 to 0.5h*
Pressure **MIN**	**P**	**-0.17**	**kPa**	*0.5 to 1h*
Pressure **MIN**	**P**	**-0.09**	**kPa**	*1h to 2h*
Pressure **MIN**	**P**	**-0.06**	**kPa**	*2h to 3h*
Pressure **MIN**	**P**	**-0.04**	**kPa**	*>3h*
Pressure **MAX**	**P**	**-0.07**	**kPa**	*0 to 0.5h*
Pressure **MAX**	**P**	**-0.07**	**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*
Edge Purlin Force **MIN**	**F**	**-0.16**	**kN/m**	*0 to 0.5h*
Edge Purlin Force **MIN**	**F**	**-0.16**	**kN/m**	*0.5 to 1h*
Edge Purlin Force **MIN**	**F**	**-0.09**	**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**	**-0.07**	**kN/m**	*0 to 0.5h*
Edge Purlin Force MAX	**F**	**-0.07**	**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**	**-0.31**	**kN/m**	*0 to 0.5h*
Intermediate Purlin Force **MIN**	**F**	**-0.31**	**kN/m**	*0.5 to 1h*
Intermediate Purlin Force **MIN**	**F**	**-0.17**	**kN/m**	*1h to 2h*
Intermediate Purlin Force **MIN**	**F**	**-0.10**	**kN/m**	*2h to 3h*
Intermediate Purlin Force **MIN**	**F**	**-0.07**	**kN/m**	*>3h*
Intermediate Purlin Force **MAX**	**F**	**-0.14**	**kN/m**	*0 to 0.5h*
Intermediate Purlin Force **MAX**	**F**	**-0.14**	**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*

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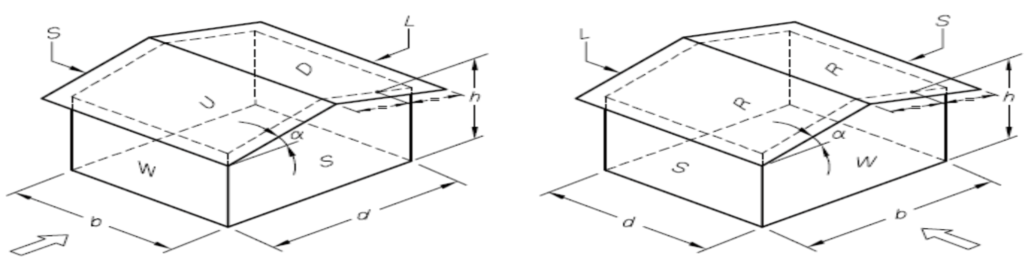
Intermediate Purlin Force **MAX** **F** **0.07** **kN/m** *>3h*

6.2.1 Pressure summary

<table>
<tr><th colspan="3">WIND EXTERNAL PRESSURE</th><th colspan="2">Direction1 (Perpendicular to Length)</th><th colspan="5">Direction2 (Parallel to Length)</th></tr>
<tr><td colspan="3">Windward (kPa)</td><td colspan="2">0.13</td><td colspan="5">0.13</td></tr>
<tr><td colspan="3">Leeward (kPa)</td><td colspan="2">-0.07</td><td colspan="5">-0.06</td></tr>
<tr><td rowspan="5">Sidewall (m)</td><td>Length</td><td>(m)</td><td>(m)</td><td>(Kpa)</td><td colspan="5">(Kpa)</td></tr>
<tr><td>0 - 1h</td><td>0</td><td>6</td><td>-0.12</td><td colspan="5">-0.12</td></tr>
<tr><td>1h - 2h</td><td>6</td><td>12</td><td>-0.09</td><td colspan="5">-0.09</td></tr>
<tr><td>2h - 3h</td><td>12</td><td>18</td><td>-0.06</td><td colspan="5">-0.06</td></tr>
<tr><td>>3h</td><td>18</td><td>-</td><td>-0.04</td><td colspan="5">-0.04</td></tr>
<tr><td rowspan="6">Roof</td><td colspan="2"></td><td>Min (Kpa)</td><td>Max (Kpa)</td><td>Length</td><td>(m)</td><td>(m)</td><td>Min (Kpa)</td><td>Max (Kpa)</td></tr>
<tr><td colspan="2">Upwind Slope</td><td>-0.07</td><td>0.03</td><td>0-0.5h</td><td>0.00</td><td>3.00</td><td>-0.17</td><td>-0.07</td></tr>
<tr><td colspan="2">Downwind Slope</td><td>-0.11</td><td>-0.11</td><td>0.5h-1h</td><td>3.00</td><td>6.00</td><td>-0.17</td><td>-0.07</td></tr>
<tr><td colspan="4" rowspan="3"></td><td>1h-2h</td><td>6.00</td><td>12.00</td><td>-0.09</td><td>0.00</td></tr>
<tr><td>2h-3h</td><td>12.00</td><td>18.00</td><td>-0.06</td><td>0.02</td></tr>
<tr><td>>3h</td><td>18.00</td><td>-</td><td>-0.04</td><td>0.04</td></tr>
<tr><td colspan="3" rowspan="2">Wind Internal Pressure (kPa)</td><td>Min (kPa)</td><td>Max (kPa)</td><td colspan="3">Min (kPa)</td><td colspan="2">Max (kPa)</td></tr>
<tr><td>-0.07</td><td>0.00</td><td colspan="3">-0.07</td><td colspan="2">0.00</td></tr>
</table>



Direction 1 Direction 2

AS1170.2

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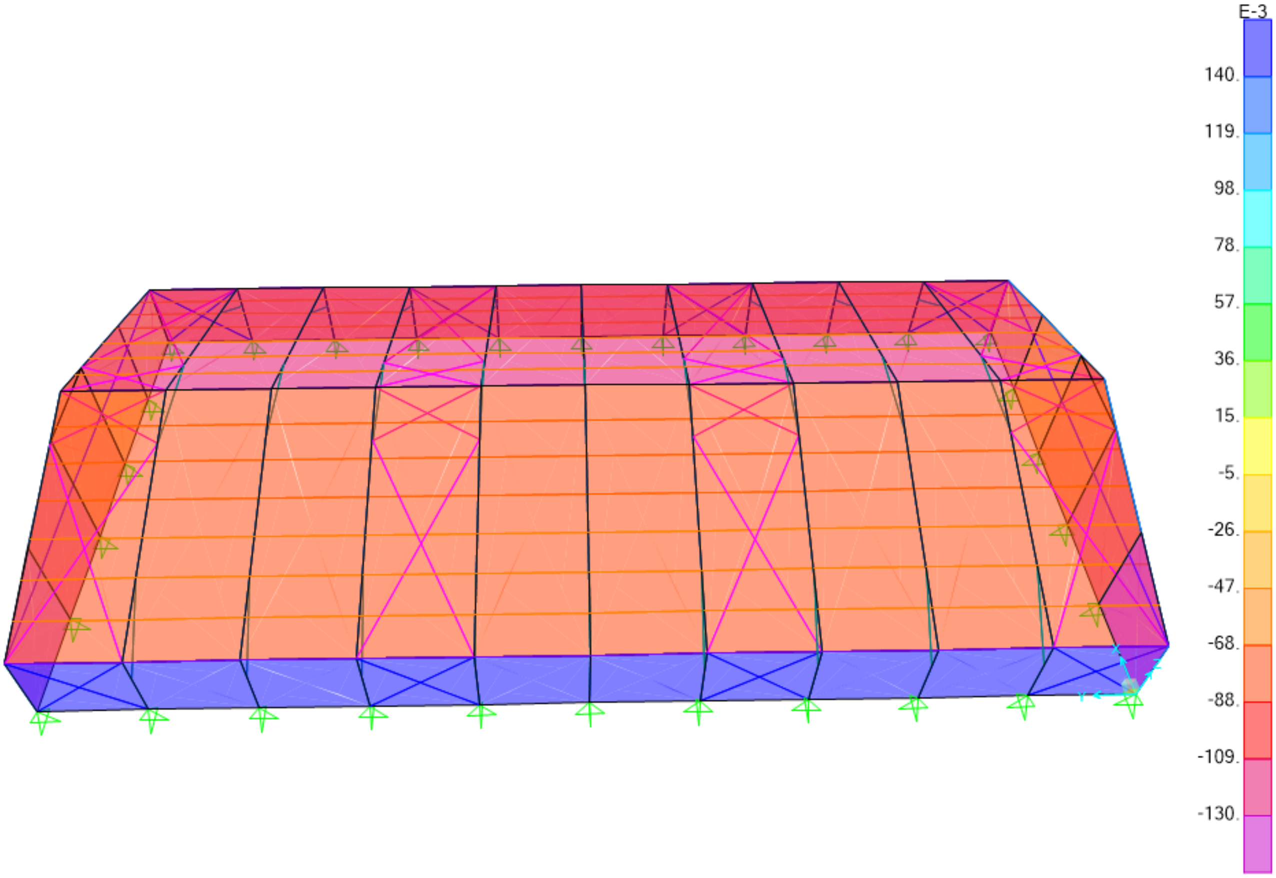
6.3 Wind Load Diagrams

6.3.1 Wind 1(case 1)



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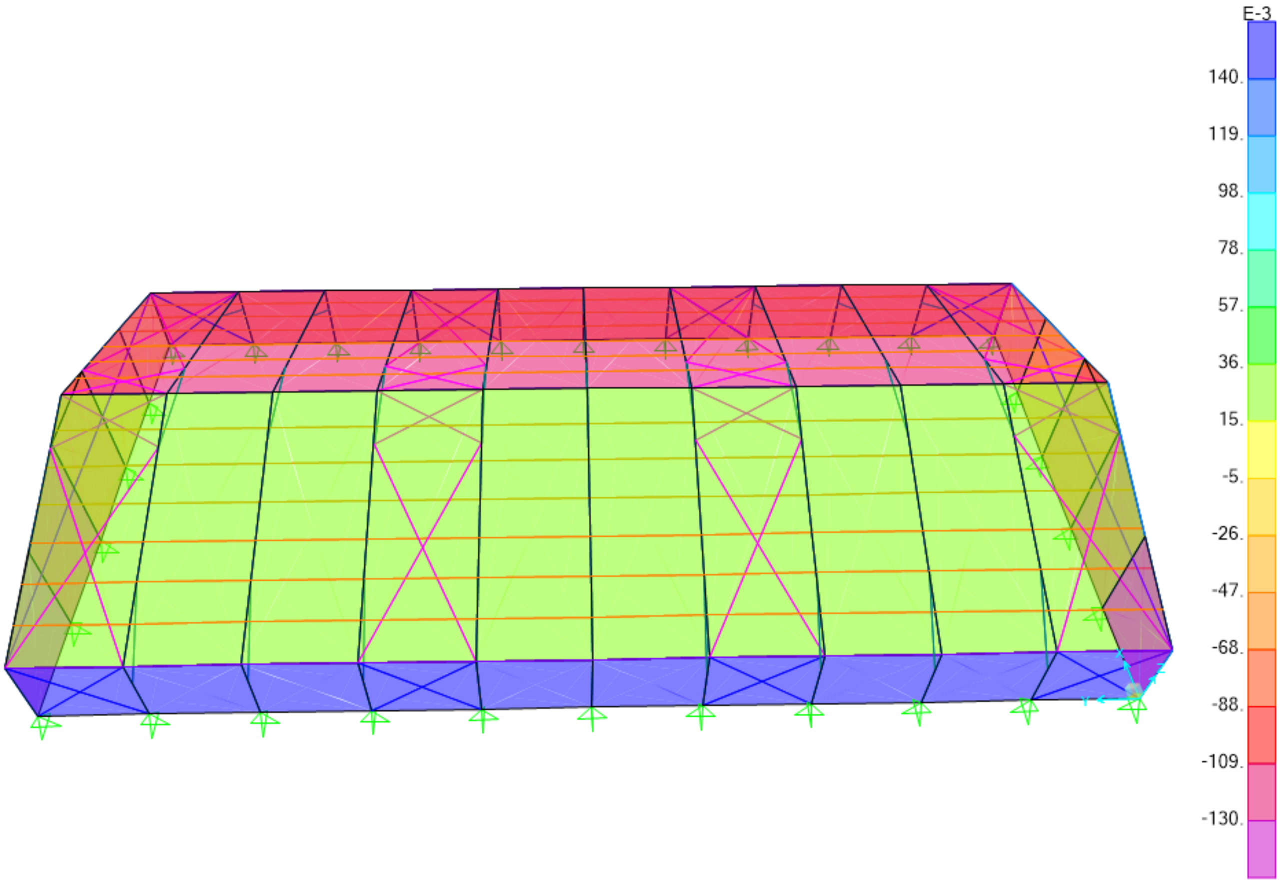
6.3.2 Wind 1(case 2)



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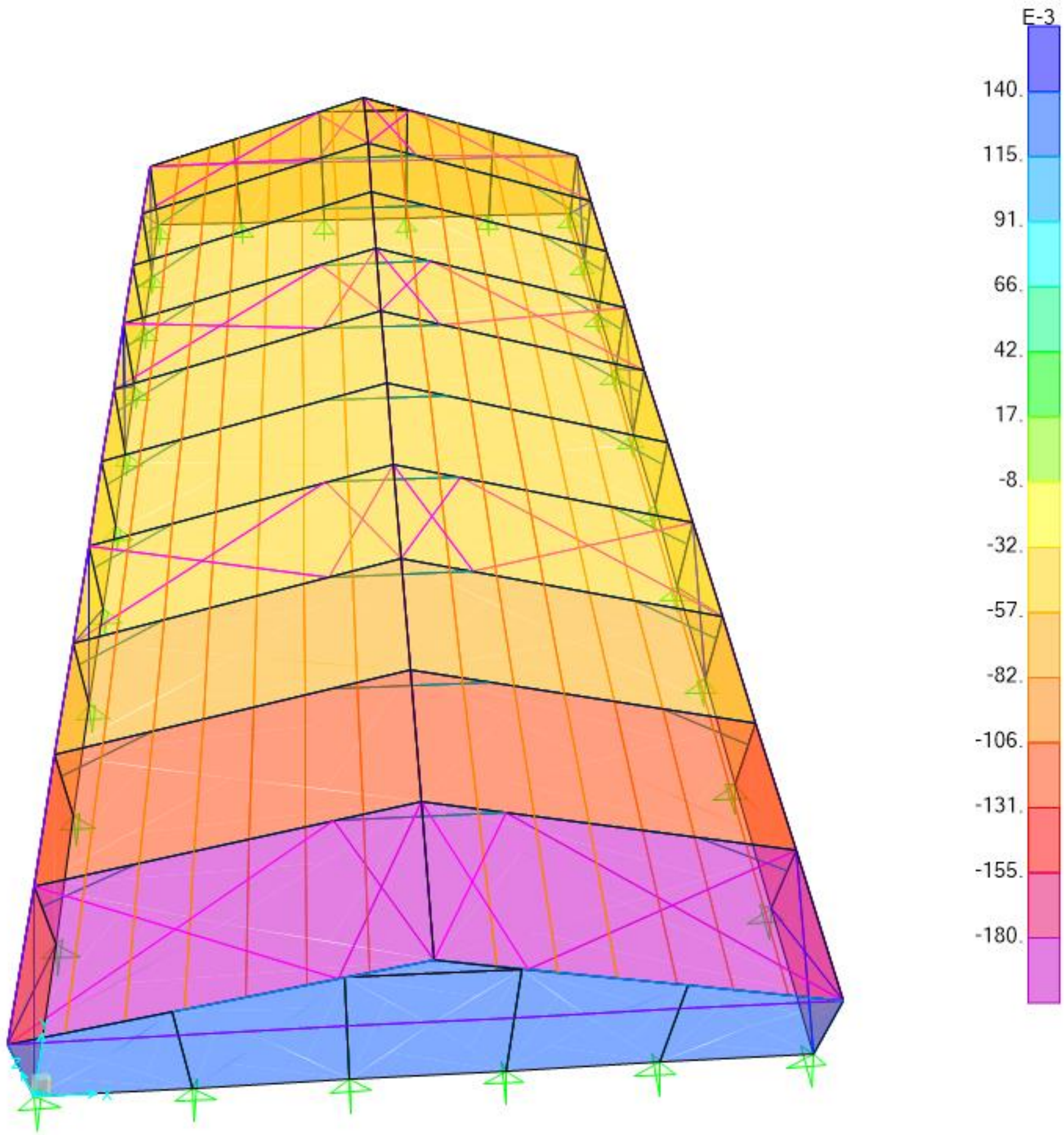
6.3.3 Wind 2(Case1)



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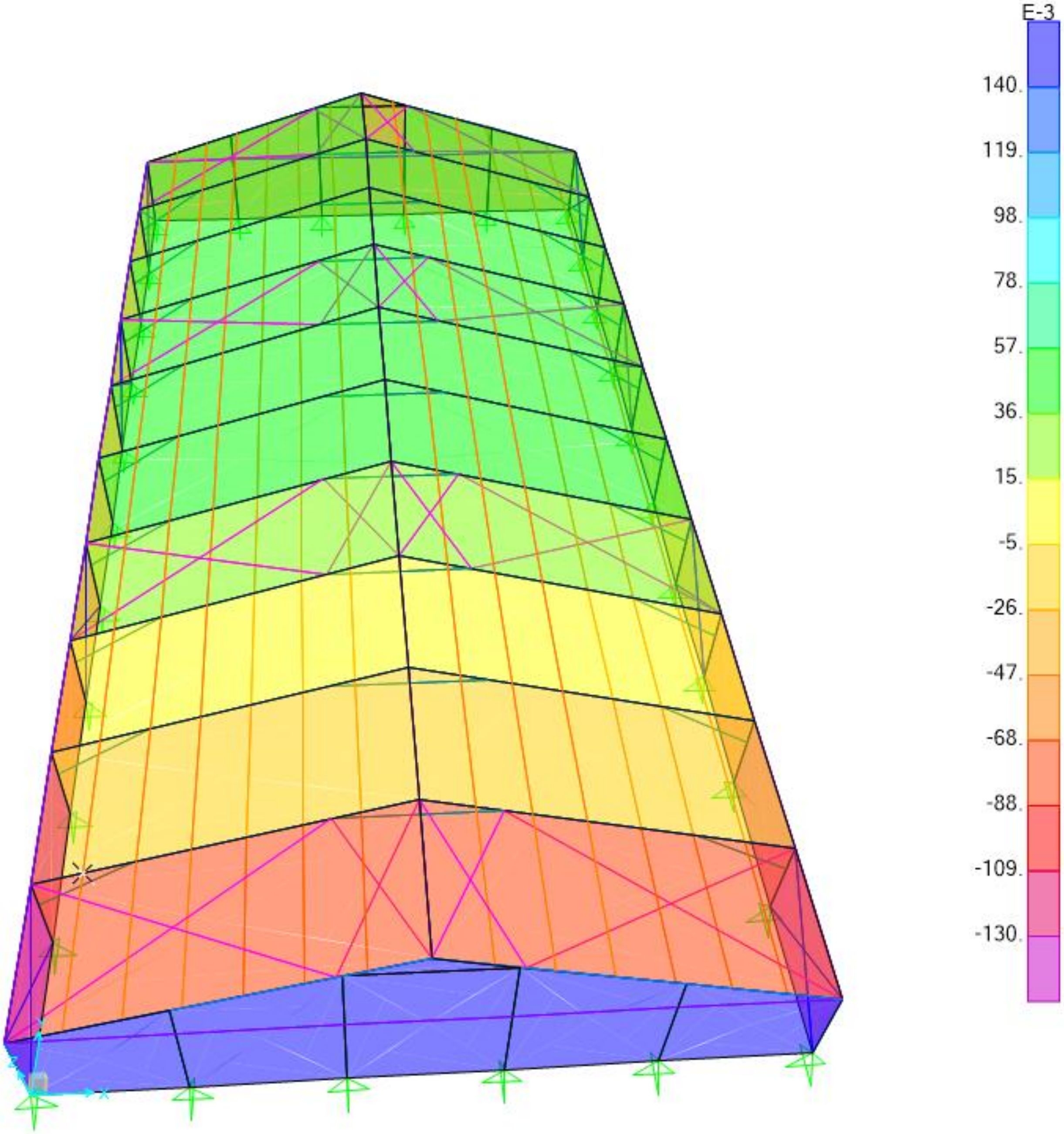
6.3.4 Wind 2(case 2)



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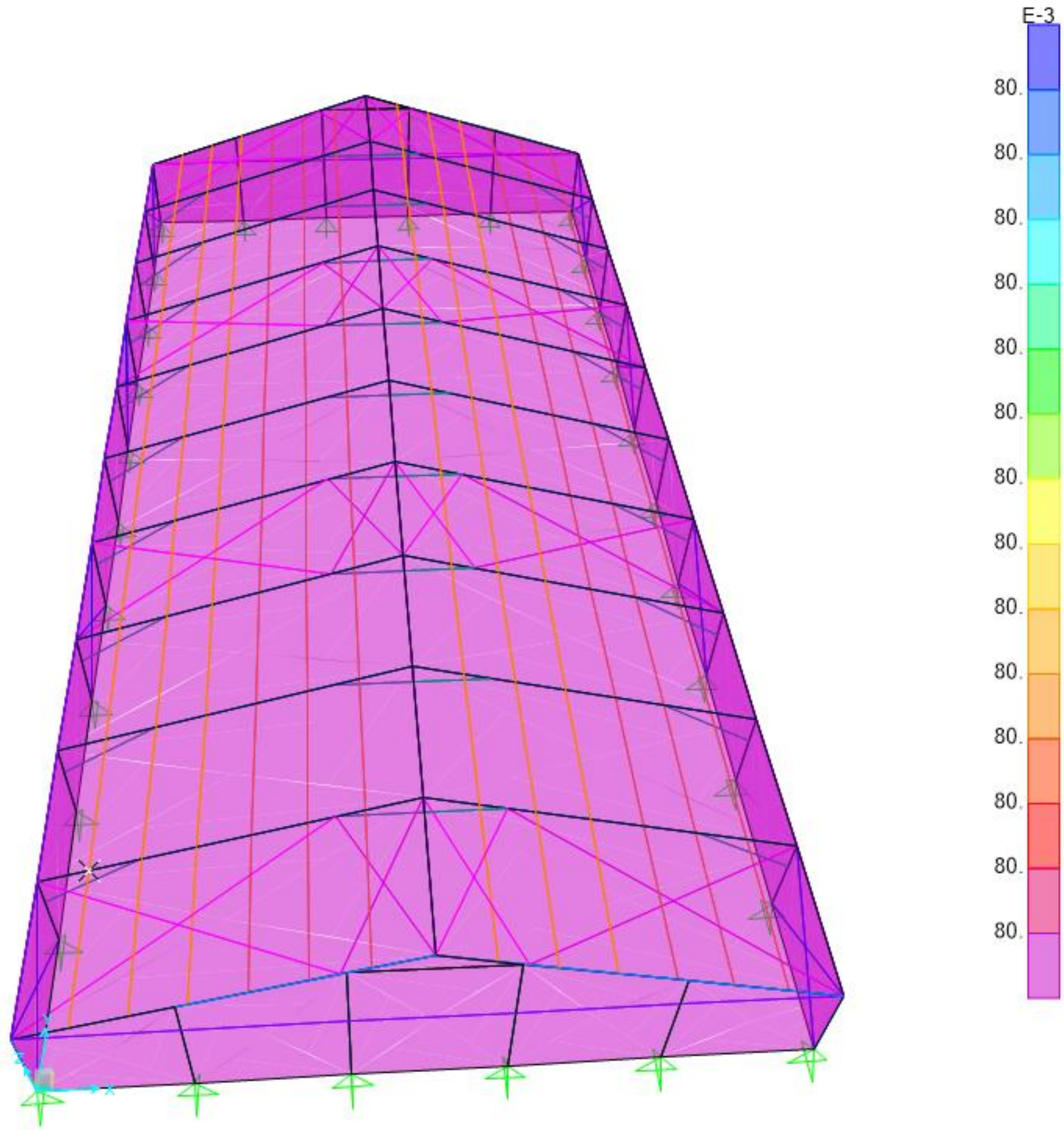
6.3.5 Wind Internal Suction



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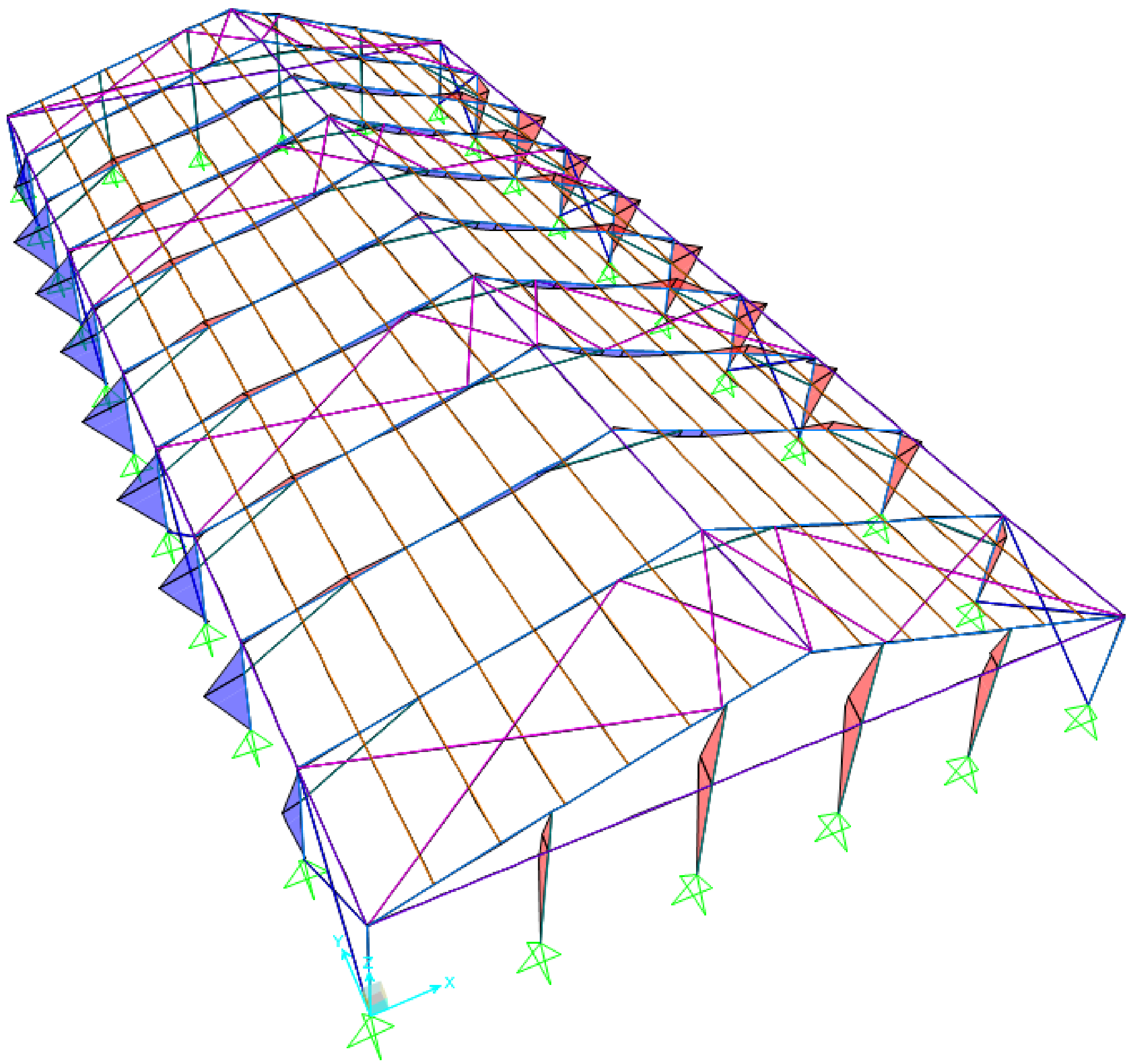
6.3.6 Max Bending Moment due to critical load combination in major axis



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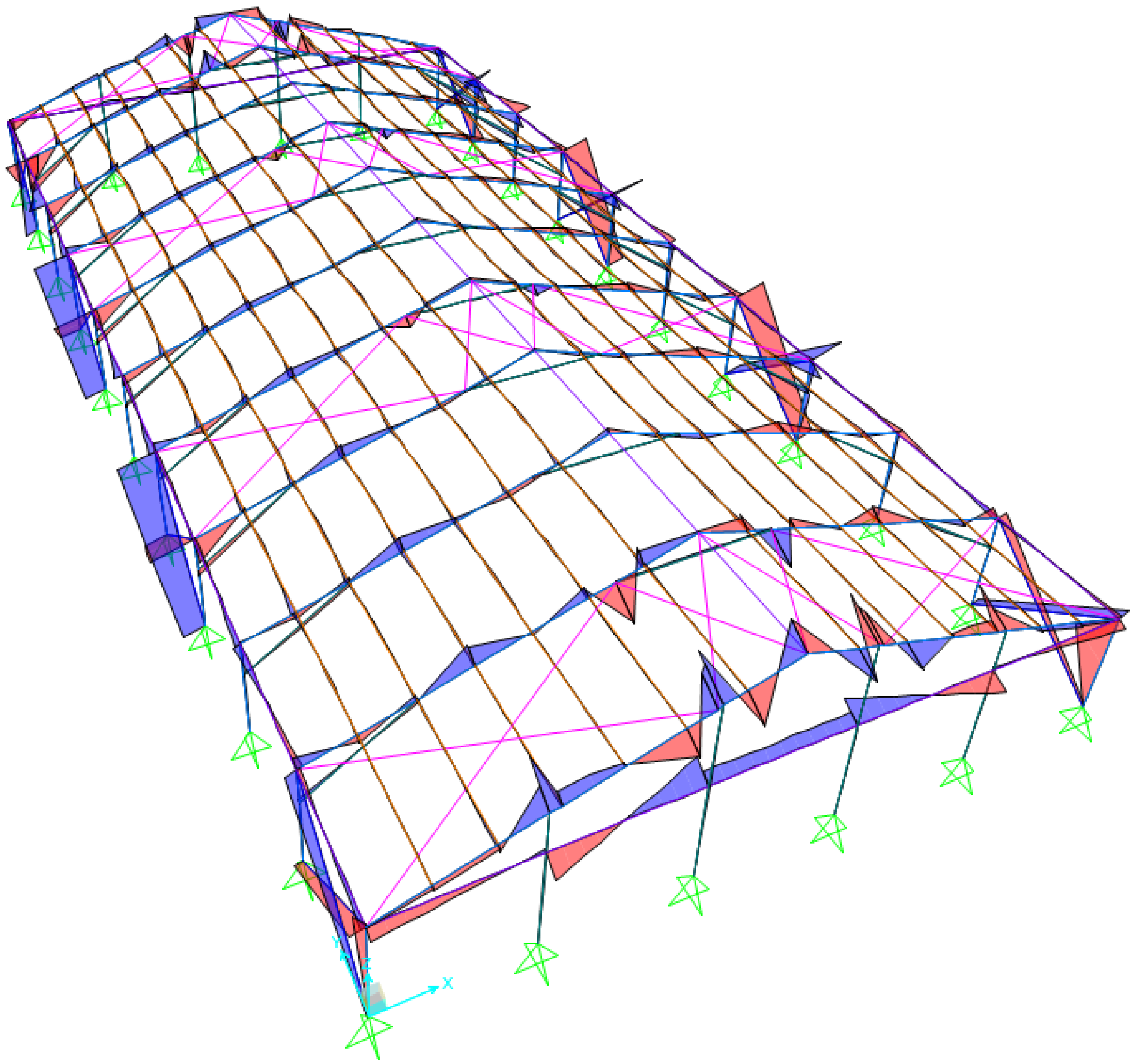
6.3.7 Max Bending Moment in minor axis due to critical load combination



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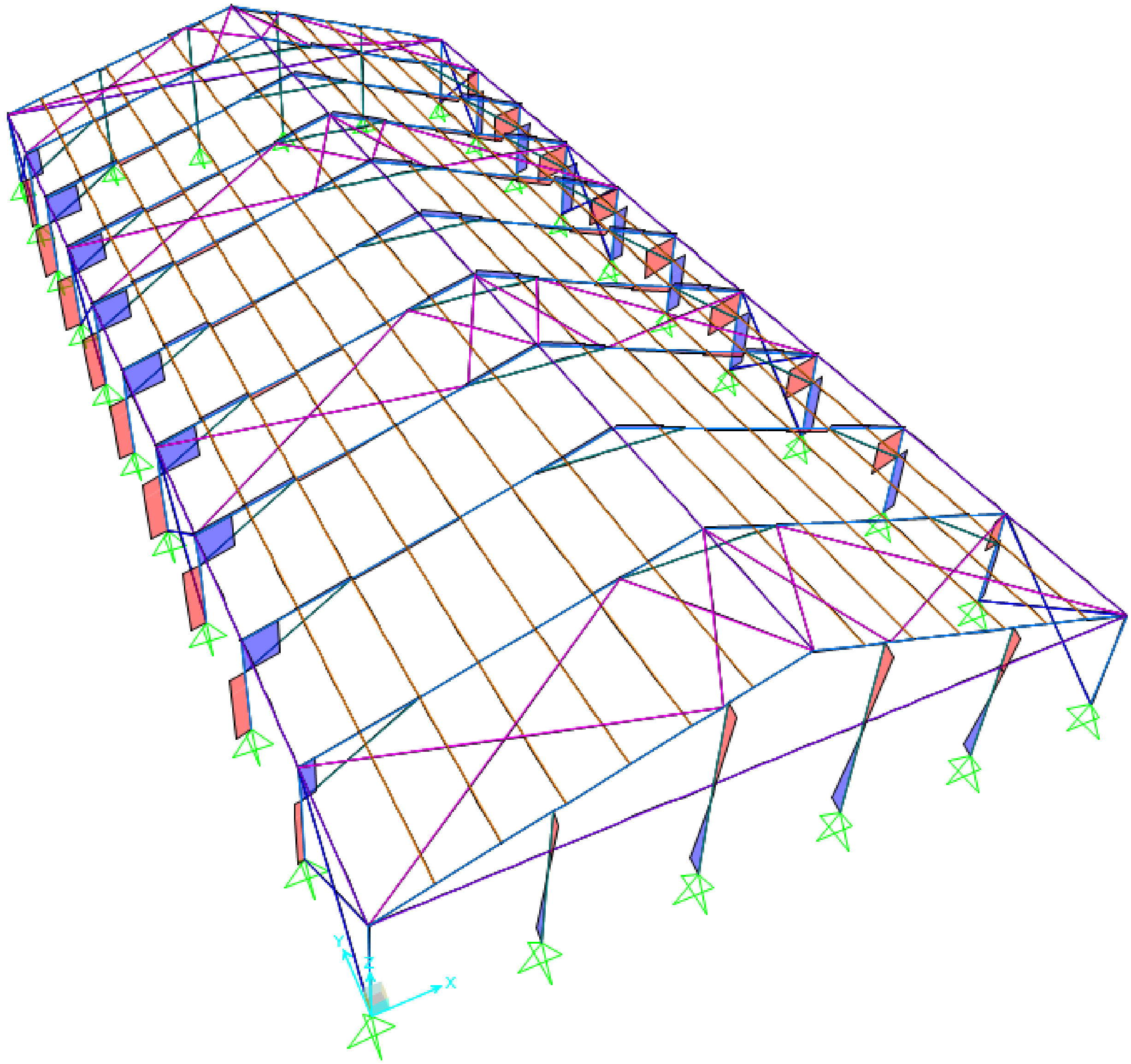
6.3.8 Max Shear in due to critical load combination



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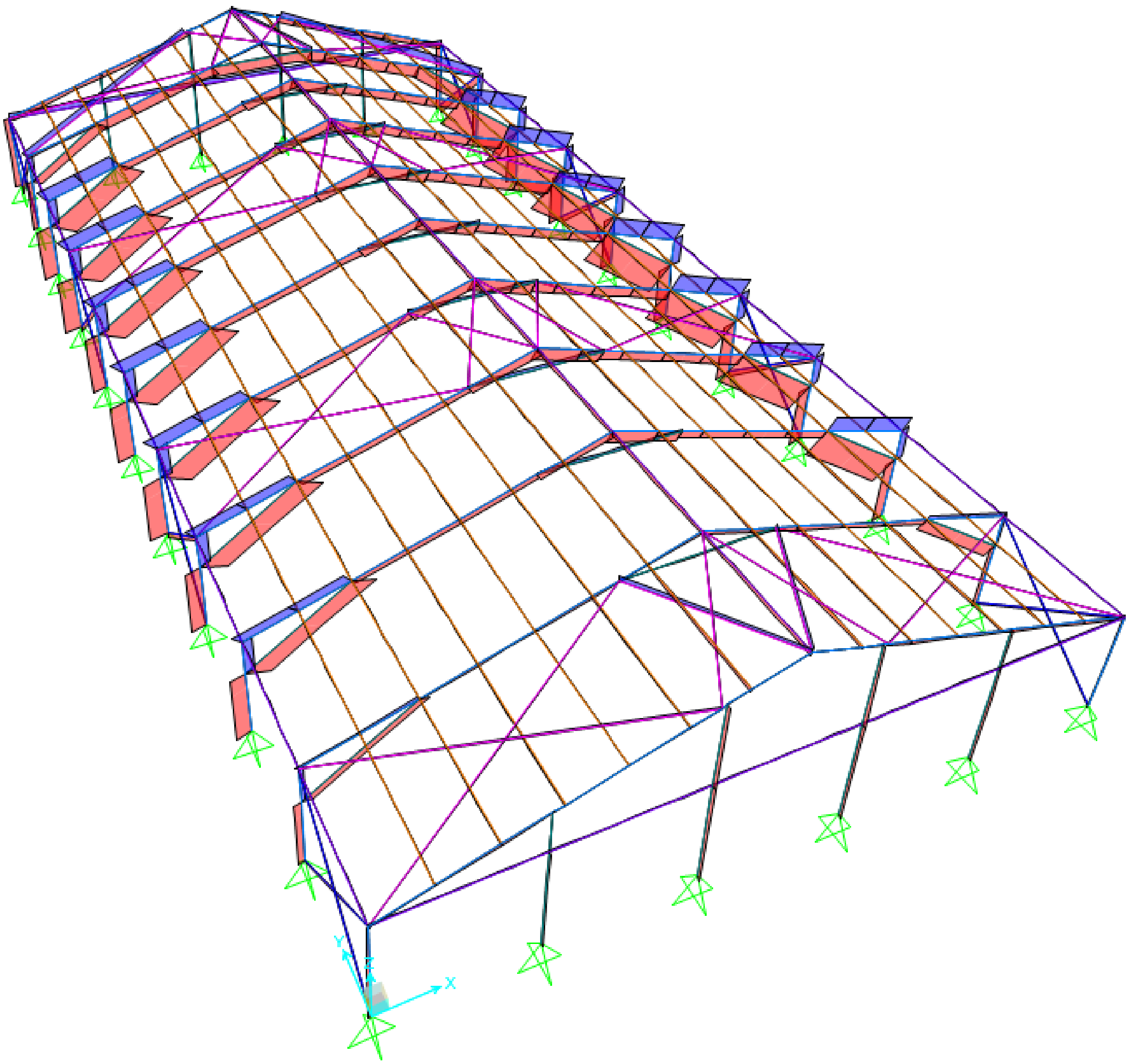
6.3.9 Max Axial force in upright support and roof beam due to critical load combination



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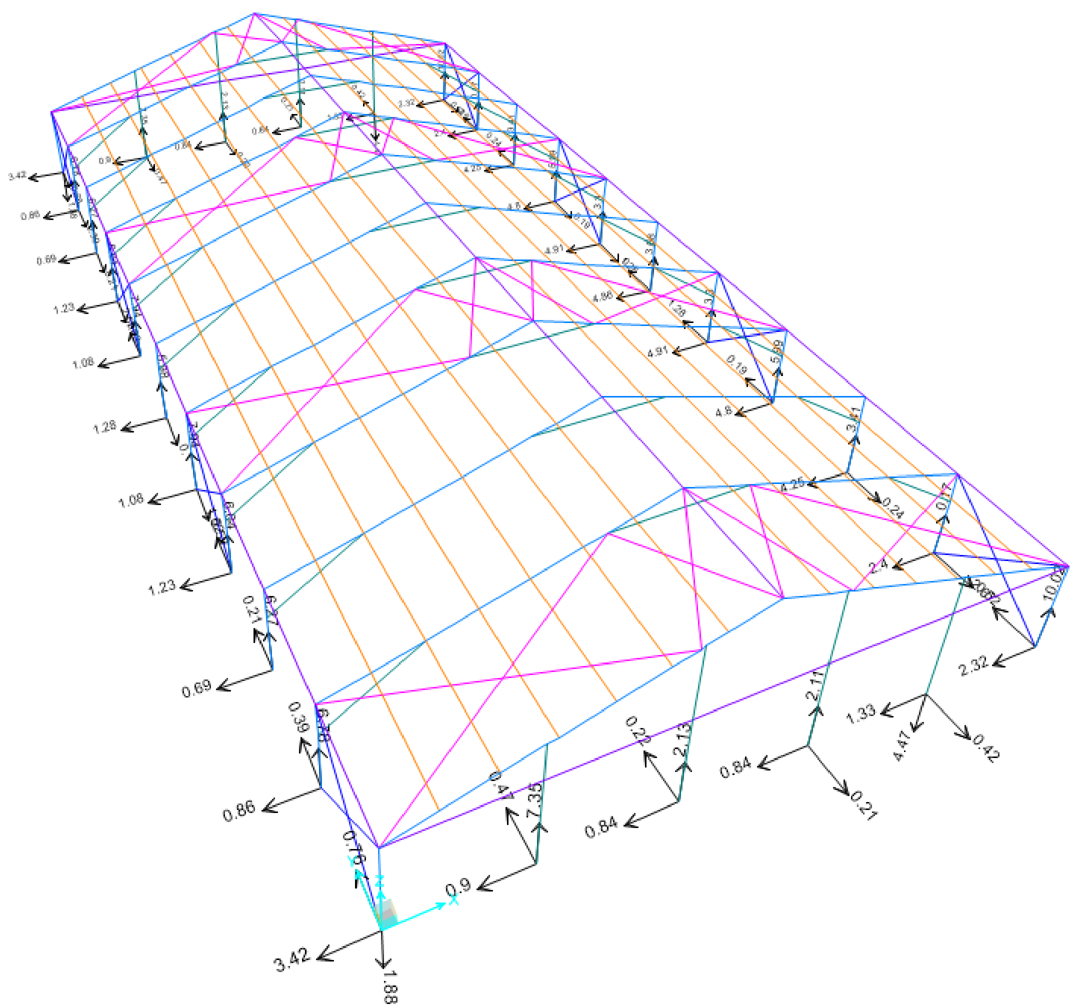
6.3.10 Max reactions



Max Reaction (Bearing) N* = 12.3 kN
Max Reaction (Uplift) N* = 6.8kN

6.3.11 Summary Table:

MEMBER(S)	Section	b	d	t	Vx	Vy	P (Axial)	Mx	My
		mm	mm	mm	kN	kN	kN	kN.m	kN.m
Rafter	203x112x4	112	203	4	-4.63	-2.1E-15	-16.533	15.2236	6.576E-15
Upright Support	203x112x4	112	203	4	-6.47	-0.122	-9.436	16.902	0.3312
Gable Pole	150x120x3	120	150	3	0.293	-1.006	-0.519	3.0739	4.1137
Ridge & Eave Purlin	80x100x3	100	80	3	0.138	-0.565	-2.634	0.1076	1.3831
Gable Beam	80x100x3	100	80	3	-0.05	0.059	-7.36	0.0281	0.2815
Intermediate Purlin	60x602.5	60	60	2.5	-0	0.0073	-3.368	-1.0297	0.1215
Ridge Struts	150x120x3	120	150	3	-0.01	2.5E-16	-13.609	0.1799	-0.0454
Gable Rafter	203x112x4	112	203	4	-2.93	-0.594	-10.643	-13.0709	-0.9948
Gable pole	150x120x3	120	150	3	0.864	3.217	-6.794	2.2025	5.1419
Knee Brace	150x120x3	120	150	3	0.18	0.00352	-25.857	0.0984	-0.1262

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7 Checking Members Based on AS1664.1 ALUMINIUM LSD

7.1 Rafter

NAME	SYMBOL		VALUE	UNIT	NOTES	REF
203x112x4	**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	=	16.533	kN	*compression*	
	P	=	0	kN	*Tension*	
In plane moment	M_x	=	15.2236	kNm		
Out of plane moment	M_y	=	6.576E-15	kNm		
DESIGN STRESSES						
Gross cross section area	A_g	**=**	2456	mm^2		
In-plane elastic section modulus	Z_x	**=**	136109.05	mm^3		
Out-of-plane elastic section mod.	Z_y	**=**	97993.905	mm^3		
Stress from axial force	$\mathbf{f_a}$	**=**	P/A_g			
		=	**6.73**	**MPa**	*compression*	
		=	**0.00**	**MPa**	*Tension*	
Stress from in-plane bending	$\mathbf{f_{bx}}$	**=**	M_x/Z_x			
		=	**111.85**	**MPa**	*compression*	
Stress from out-of-plane bending	$\mathbf{f_{by}}$	**=**	M_y/Z_y			
		=	**0.00**	**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	=	13120	mm		
Effective length factor	k	=	1			
Radius of gyration about buckling axis (Y)	r_y	=	47.27	mm		
Radius of gyration about buckling axis (X)	r_x	=	75.00	mm		
Slenderness ratio	kLb/ry	=	40.20			
Slenderness ratio	kL/rx	=	174.93			
Slenderness parameter	λ	=	3.267			
	D_c*	=	90.3			
	S_1*	=	0.33			
	S_2*	=	1.23			
	ϕ_{cc}	=	0.950			
Factored limit state stress	**ϕF_L**	**=**	**21.45**	**MPa**		
2. Sections not subject to torsional or torsional-flexural buckling						… 3.4.8.2
Largest slenderness ratio for flexural buckling	kL/r	**=**	174.93			
***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'	**=**	104			
	t	**=**	4	mm		
Slenderness	b/t	**=**	26			
Limit 1	S_1	**=**	12.34			
Limit 2	S_2	**=**	32.87			

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Factored limit state stress	**ϕF_L**	=	**190.61**	**MPa**		
Most adverse compressive limit state stress	F_a	=	21.45	MPa		
Most adverse tensile limit state stress	F_a	=	222.70	MPa		
Most adverse compressive & Tensile capacity factor	f_a/F_a	=	0.31		PASS	
BENDING - IN-PLANE						
***3.4.15** Compression in beams, extreme fibre, gross section rectangular tubes, box sections*						
Unbraced length for bending	L_b	=	1900	mm		
Second moment of area (weak axis)	I_y	=	5.49E+06	mm^4		
Torsion modulus	J	=	1.20E+07	mm^3		
Elastic section modulus	Z	=	136109.05	mm^3		
Slenderness	S	=	63.64			
Limit 1	S_1	=	0.39			
Limit 2	S_2	=	1695.86			
Factored limit state stress	**ϕF_L**	=	**212.09**	**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'	=	104	mm		
	t	=	4	mm		
Slenderness	b/t	=	26			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	46.95			
Factored limit state stress	**ϕF_L**	=	**190.61**	**MPa**		
Most adverse in-plane bending limit state stress	F_{bx}	=	190.61	MPa		
Most adverse in-plane bending capacity factor	f_{bx}/F_{bx}	=	0.59		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**	=	**190.61**	**MPa**		
Most adverse out-of-plane bending limit state stress	**F_{by}**	=	190.61	MPa		
Most adverse out-of-plane bending capacity factor	**f_{by}/F_{by}**	=	0.00		PASS	
COMBINED ACTIONS						
***4.1.1** Combined compression and bending*						… 4.1.1(2)
	F_a	=	21.45	MPa		… 3.4.8
	F_{ao}	=	190.61	MPa		… 3.4.10
	F_{bx}	=	190.61	MPa		… 3.4.17
	F_{by}	=	190.61	MPa		… 3.4.17
	f_a/F_a	=	0.314			
Check:	$f_a/F_a + f_{bx}/F_{bx} + f_{by}/F_{by} \leq 1.0$					… 4.1.1 (3)
i.e.	0.90	$\leq$	1.0		PASS	
SHEAR						
***3.4.24** Shear in webs (Major Axis)*						… 4.1.1(2)
Clear web height	h	=	195	mm		
	t	=	4	mm		
Slenderness	h/t	=	48.75			
Limit 1	S_1	=	29.01			
Limit 2	S_2	=	59.31			
Factored limit state stress	**ϕF_L**	=	**111.11**	**MPa**		
Stress From Shear force	**f_{sx}**	=	V/A_w			
			2.26	**MPa**		
***3.4.25** Shear in webs (Minor Axis)*						
Clear web height	b	=	104	mm		
	t	=	4	mm		
Slenderness	b/t	=	26			

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

7.2 Upright Supports

NAME	SYMBOL		VALUE	UNIT	NOTES	REF
203x112x4	**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	=	9.436	kN	*compression*	
	P	=	0	kN	*Tension*	
In plane moment	M_x	=	16.902	kNm		
Out of plane moment	M_y	=	0.3312	kNm		
DESIGN STRESSES						
Gross cross section area	A_g	**=**	2456	mm^2		
In-plane elastic section modulus	Z_x	**=**	136109.05	mm^3		
Out-of-plane elastic section mod.	Z_y	**=**	97993.905	mm^3		
Stress from axial force	f_a	**=**	P/A_g			
		=	**3.84**	**MPa**	*compression*	
		=	**0.00**	**MPa**	*Tension*	
Stress from in-plane bending	f_{bx}	**=**	M_x/Z_x			
		=	**124.18**	**MPa**	*compression*	

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Stress from out-of-plane bending	f_{by}	=	M_y/Z_y			
		=	**3.38**	**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	=	4000	mm		
Effective length factor	k	=	1			
Radius of gyration about buckling axis (Y)	r_y	=	47.27	mm		
Radius of gyration about buckling axis (X)	r_x	=	75.00	mm		
Slenderness ratio	kLb/ry	=	84.62			
Slenderness ratio	kL/rx	=	53.33			
Slenderness parameter	λ	=	1.58			
	D_c*	=	90.3			
	S_1*	=	0.33			
	S_2*	=	1.23			
	ϕ_{cc}	=	0.801			
Factored limit state stress	**ϕF$_L$**	**=**	**77.31**	**MPa**		
2. Sections not subject to torsional or torsional-flexural buckling						… 3.4.8.2
Largest slenderness ratio for flexural buckling	kL/r	=	84.62			
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'	=	104			
	t	=	4	mm		

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Slenderness	b/t	=	26			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	32.87			
Factored limit state stress	**ϕF_L**	=	**190.61**	**MPa**		
Most adverse compressive limit state stress	F_a	=	77.31	MPa		
Most adverse tensile limit state stress	F_a	=	222.70	MPa		
Most adverse compressive & Tensile capacity factor	f_a/F_a	=	0.05		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	=	5.49E+06	mm^4		
Torsion modulus	J	=	1.20E+07	mm^3		
Elastic section modulus	Z	=	136109.0 5	mm^3		
Slenderness	S	=	133.98			
Limit 1	S_1	=	0.39			
Limit 2	S_2	=	1695.86			
Factored limit state stress	**ϕF_L**	=	**203.84**	**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'	=	104	mm		
	t	=	4	mm		
Slenderness	b/t	=	26			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	46.95			
Factored limit state stress	**ϕF_L**	=	**190.61**	**MPa**		

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Most adverse in-plane bending limit state stress	F_{bx}	=	190.61	MPa		
Most adverse in-plane bending capacity factor	f_{bx}/F_{bx}	=	0.65		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	$\boldsymbol{\phi F_L}$	=	**190.61**	**MPa**		
Most adverse out-of-plane bending limit state stress	$\mathbf{F_{by}}$	=	190.61	MPa		
Most adverse out-of-plane bending capacity factor	$\mathbf{f_{by}/F_{by}}$	=	0.02		PASS	
COMBINED ACTIONS						
***4.1.1** Combined compression and bending*						… 4.1.1(2)
	F_a	=	77.31	MPa		… 3.4.8
	F_{ao}	=	190.61	MPa		… 3.4.10
	F_{bx}	=	190.61	MPa		… 3.4.17
	F_{by}	=	190.61	MPa		… 3.4.17
	f_a/F_a	=	0.050			
Check:	$f_a/F_a + f_{bx}/F_{bx} + f_{by}/F_{by} \leq$ 1.0					… 4.1.1 (3)
i.e.	0.72	≤	1.0		PASS	
SHEAR						
***3.4.24** Shear in webs (Major Axis)*						… 4.1.1(2)
Clear web height	h	=	195	mm		
	t	=	4	mm		
Slenderness	h/t	=	48.75			
Limit 1	S_1	=	29.01			
Limit 2	S_2	=	59.31			
Factored limit state stress	$\boldsymbol{\phi F_L}$	=	**111.11**	**MPa**		
Stress From Shear force	$\mathbf{f_{sx}}$	=	V/A_w			
			2.26	**MPa**		
***3.4.25** Shear in webs (Minor Axis)*						

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Clear web height	b	=	104	mm		
	t	=	4	mm		
Slenderness	b/t	=	26			
Factored limit state stress	**ϕF_L**	=	**131.10**	**MPa**		
Stress From Shear force	**f_{sy}**	=	V/A_w			
			0.00	**MPa**		

7.3 Gable Pole

NAME	SYMBOL		VALUE	UNIT	NOTES	REF
150x120x3	**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	=	0.519	kN	*compression*	
	P	=	0	kN	*Tension*	
In plane moment	M_x	=	3.0739	kNm		
Out of plane moment	M_y	=	4.1137	kNm		
DESIGN STRESSES						
Gross cross section area	A_g	=	1584	mm^2		
In-plane elastic section modulus	Z_x	=	71775.36	mm^3		
Out-of-plane elastic section mod.	Z_y	=	63691.2	mm^3		

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Stress from axial force	f_a	=	P/A_g			
		=	**0.33**	**MPa**	*compression*	
		=	**0.00**	**MPa**	*Tension*	
Stress from in-plane bending	f_{bx}	=	M_x/Z_x			
		=	**42.83**	**MPa**	*compression*	
Stress from out-of-plane bending	f_{by}	=	M_y/Z_y			
		=	**64.59**	**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	=	7200	mm		
Effective length factor	k	=	1			
Radius of gyration about buckling axis (Y)	r_y	=	49.12	mm		
Radius of gyration about buckling axis (X)	r_x	=	58.30	mm		
Slenderness ratio	kLb/ry	=	81.44			
Slenderness ratio	kL/rx	=	123.51			
Slenderness parameter	λ	=	2.31			
	D_c^*	=	90.3			
	S_1^*	=	0.33			
	S_2^*	=	1.23			
	ϕ_{cc}	=	0.903			
Factored limit state stress	ϕF_L	=	**40.90**	**MPa**		
2. Sections not subject to torsional or torsional-flexural buckling						… 3.4.8.2
Largest slenderness ratio for flexural buckling	kL/r	=	123.51			
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'	=	114			
	t	=	3	mm		
Slenderness	b/t	=	38			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	32.87			
Factored limit state stress	**ϕF_L**	=	**147.86**	**MPa**		
Most adverse compressive limit state stress	F_a	=	40.90	MPa		
Most adverse tensile limit state stress	F_a	=	222.70	MPa		
Most adverse compressive & Tensile capacity factor	f_a/F_a	=	0.01		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	=	3821472	mm^4		
Torsion modulus	J	=	6722854.6	mm^3		
Elastic section modulus	Z	=	71775.36	mm^3		
Slenderness	S	=	113.29			
Limit 1	S_1	=	0.39			
Limit 2	S_2	=	1695.86			
Factored limit state stress	**ϕF_L**	=	**205.97**	**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'	=	114	mm		
	t	=	3	mm		

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Slenderness	b/t	=	38			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	46.95			
Factored limit state stress	**ϕF_L**	=	**156.92**	**MPa**		
Most adverse in-plane bending limit state stress	F_{bx}	=	156.92	MPa		
Most adverse in-plane bending capacity factor	f_{bx}/F_{bx}	=	0.27		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**	=	**156.92**	**MPa**		
Most adverse out-of-plane bending limit state stress	**F_{by}**	=	156.92	MPa		
Most adverse out-of-plane bending capacity factor	**f_{by}/F_{by}**	=	0.41		PASS	
COMBINED ACTIONS						
***4.1.1** Combined compression and bending*						… 4.1.1(2)
	F_a	=	40.90	MPa		… 3.4.8
	F_{ao}	=	147.86	MPa		… 3.4.10
	F_{bx}	=	156.92	MPa		… 3.4.17
	F_{by}	=	156.92	MPa		… 3.4.17
	f_a/F_a	=	0.008			
Check:	$f_a/F_a + f_{bx}/F_{bx} + f_{by}/F_{by} \leq 1.0$					… 4.1.1 (3)
i.e.	0.69	$\leq$	1.0		PASS	
SHEAR						
***3.4.24** Shear in webs (Major Axis)*						… 4.1.1(2)
Clear web height	h	=	144	mm		
	t	=	3	mm		
Slenderness	h/t	=	48			
Limit 1	S_1	=	29.01			

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Limit 2	S_2	=	59.31			
Factored limit state stress	**ϕF_L**	=	**111.87**	**MPa**		
Stress From Shear force	**f_{sx}**	=	V/A_w			
			3.51	**MPa**		
3.4.25 *Shear in webs (Minor Axis)*						
Clear web height	b	=	114	mm		
	t	=	3	mm		
Slenderness	b/t	=	38			
Factored limit state stress	**ϕF_L**	=	**122.00**	**MPa**		
Stress From Shear force	**f_{sy}**	=	V/A_w			
			0.00	**MPa**		

7.4 Ridge & Eave Purlin

NAME	SYMBOL		VALUE	UNIT	NOTES	REF
80x100x3	**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*	
Modulus of elasticity	E	=	70000	MPa	*Compressive*	
	k_t	=	1.0			T3.4(B)
	k_c	=	1.0			
FEM ANALYSIS RESULTS						
Axial force	P	=	2.634	kN	*compression*	
	P	=	0	kN	*Tension*	
In plane moment	M_x	=	0.1076	kNm		
Out of plane moment	M_y	=	1.3831	kNm		

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DESIGN STRESSES						
Gross cross section area	A_g	=	1044	mm^2		
In-plane elastic section modulus	Z_x	=	27310.3	mm^3		
Out-of-plane elastic section mod.	Z_y	=	30894.64	mm^3		
Stress from axial force	$\mathbf{f_a}$	=	P/A_g			
		=	**2.52**	**MPa**	*compression*	
		=	**0.00**	**MPa**	*Tension*	
Stress from in-plane bending	$\mathbf{f_{bx}}$	=	M_x/Z_x			
		=	**3.94**	**MPa**	*compression*	
Stress from out-of-plane bending	$\mathbf{f_{by}}$	=	M_y/Z_y			
		=	**44.77**	**MPa**	*compression*	
Tension						
3.4.3 *Tension in rectangular tubes*						
	$\mathbf{\phi F_L}$	=	**228.95**	**MPa**		
		OR				
	$\mathbf{\phi F_L}$	=	**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	=	38.47	mm		
Radius of gyration about buckling axis (X)	r_x	=	32.35	mm		
Slenderness ratio	kLb/ry	=	129.99			
Slenderness ratio	kL/rx	=	154.57			
Slenderness parameter	λ	=	2.89			
	D_c*	=	90.3			
	S_1*	=	0.33			
	S_2*	=	1.23			
	ϕ_{cc}	=	0.950			
Factored limit state stress	$\mathbf{\phi F_L}$	=	**27.47**	**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	=	154.57			
***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'	=	94			
	t	=	3	mm		
Slenderness	b/t	=	31.333333			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	32.87			
Factored limit state stress	**ϕF_L**	=	**175.64**	**MPa**		
Most adverse compressive limit state stress	F_a	=	27.47	MPa		
Most adverse tensile limit state stress	F_a	=	222.70	MPa		
Most adverse compressive & Tensile 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	=	5000	mm		
Second moment of area (weak axis)	I_y	=	1544732	mm^4		
Torsion modulus	J	=	1923653.8	mm^3		
Elastic section modulus	Z	=	27310.3	mm^3		
Slenderness	S	=	158.43			
Limit 1	S_1	=	0.39			
Limit 2	S_2	=	1695.86			
Factored limit state stress	**ϕF_L**	=	**201.51**	**MPa**		3.4.15(2)

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***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'	=	94	mm		
	t	=	3	mm		
Slenderness	b/t	=	31.333333			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	46.95			
Factored limit state stress	**ϕF_L**	=	**175.64**	**MPa**		
Most adverse in-plane bending limit state stress	F_{bx}	=	175.64	MPa		
Most adverse in-plane bending capacity factor	f_{bx}/F_{bx}	=	0.02		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**	=	**175.64**	**MPa**		
Most adverse out-of-plane bending limit state stress	**F_{by}**	=	175.64	MPa		
Most adverse out-of-plane bending capacity factor	**f_{by}/F_{by}**	=	0.25		PASS	

COMBINED ACTIONS

***4.1.1** Combined compression and bending* … 4.1.1(2)

	F_a	=	27.47	MPa		… 3.4.8
	F_{ao}	=	175.64	MPa		… 3.4.10
	F_{bx}	=	175.64	MPa		… 3.4.17
	F_{by}	=	175.64	MPa		… 3.4.17
	f_a/F_a	=	0.092			

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	Check:	$f_a/F_a + f_{bx}/F_{bx} + f_{by}/F_{by} \le 1.0$				… 4.1.1 (3)
	i.e.	0.37	≤	1.0	PASS	
SHEAR						
***3.4.24** Shear in webs (Major Axis)*						… 4.1.1(2)
Clear web height	h	=	74	mm		
	t	=	3	mm		
Slenderness	h/t	=	24.666667			
Limit 1	S_1	=	29.01			
Limit 2	S_2	=	59.31			
Factored limit state stress	**ϕF_L**	=	**131.10**	**MPa**		
Stress From Shear force	**f_{sx}**	=	V/A_w			
			5.32	**MPa**		
***3.4.25** Shear in webs (Minor Axis)*						
Clear web height	b	=	94	mm		
	t	=	3	mm		
Slenderness	b/t	=	31.333333			
Factored limit state stress	**ϕF_L**	=	**128.74**	**MPa**		
Stress From Shear force	**f_{sy}**	=	V/A_w			
			0.00	**MPa**		

7.5 Gable Beam

NAME	SYMBOL		VALUE	UNIT	NOTES	REF
80x100x3	**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*	

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	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	=	7.36	kN	*compression*	
	P	=	0	kN	*Tension*	
In plane moment	M_x	=	0.0281	kNm		
Out of plane moment	M_y	=	0.2815	kNm		
DESIGN STRESSES						
Gross cross section area	A_g	**=**	1044	mm²		
In-plane elastic section modulus	Z_x	**=**	27310.3	mm³		
Out-of-plane elastic section mod.	Z_y	**=**	30894.64	mm³		
Stress from axial force	$\mathbf{f_a}$	**=**	P/A_g			
		=	**7.05**	**MPa**	*compression*	
		=	**0.00**	**MPa**	*Tension*	
Stress from in-plane bending	$\mathbf{f_{bx}}$	**=**	M_x/Z_x			
		=	**1.03**	**MPa**	*compression*	
Stress from out-of-plane bending	$\mathbf{f_{by}}$	**=**	M_y/Z_y			
		=	**9.11**	**MPa**	*compression*	
Tension						
3.4.3 *Tension in rectangular tubes*						
	$\mathbf{\phi F_L}$	**=**	**228.95**	**MPa**		
		OR				
	$\mathbf{\phi F_L}$	**=**	**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	=	38.47	mm		

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Radius of gyration about buckling axis (X)	r_x	=	32.35	mm		
Slenderness ratio	kLb/ry	=	129.99			
Slenderness ratio	kL/rx	=	154.57			
Slenderness parameter	λ	=	2.89			
	D_c*	=	90.3			
	S_1*	=	0.33			
	S_2*	=	1.23			
	ϕ_{cc}	=	0.950			
Factored limit state stress	**ϕF_L**	**=**	**27.47**	**MPa**		
2. Sections not subject to torsional or torsional-flexural buckling						… 3.4.8.2
Largest slenderness ratio for flexural buckling	kL/r	=	154.57			
***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'	=	94			
	t	=	3	mm		
Slenderness	b/t	=	31.333333			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	32.87			
Factored limit state stress	**ϕF_L**	**=**	**175.64**	**MPa**		
Most adverse compressive limit state stress	F_a	=	27.47	MPa		
Most adverse tensile limit state stress	F_a	=	222.70	MPa		
Most adverse compressive & Tensile capacity factor	f_a/F_a	=	0.26		PASS	
BENDING - IN-PLANE						
***3.4.15** Compression in beams, extreme fibre, gross section rectangular tubes, box sections*						

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Unbraced length for bending	L_b	=	5000	mm		
Second moment of area (weak axis)	I_y	=	1544732	mm^4		
Torsion modulus	J	=	1923653.8	mm^3		
Elastic section modulus	Z	=	27310.3	mm^3		
Slenderness	S	=	158.43			
Limit 1	S_1	=	0.39			
Limit 2	S_2	=	1695.86			
Factored limit state stress	**ϕF_L**	=	**201.51**	**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'	=	94	mm		
	t	=	3	mm		
Slenderness	b/t	=	31.333333			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	46.95			
Factored limit state stress	**ϕF_L**	=	**175.64**	**MPa**		
Most adverse in-plane bending limit state stress	F_{bx}	=	175.64	MPa		
Most adverse in-plane bending capacity factor	f_{bx}/F_{bx}	=	0.01		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**	=	**175.64**	**MPa**		
Most adverse out-of-plane bending limit state stress	**F_{by}**	=	175.64	MPa		
Most adverse out-of-plane bending capacity factor	**f_{by}/F_{by}**	=	0.05		PASS	

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COMBINED ACTIONS						
***4.1.1** Combined compression and bending*						… 4.1.1(2)
	F_a	=	27.47	MPa		… 3.4.8
	F_{ao}	=	175.64	MPa		… 3.4.10
	F_{bx}	=	175.64	MPa		… 3.4.17
	F_{by}	=	175.64	MPa		… 3.4.17
	f_a/F_a	=	0.257			
Check:	$f_a/F_a + f_{bx}/F_{bx} + f_{by}/F_{by} \leq 1.0$					… 4.1.1 (3)
i.e.	0.31	≤	1.0		PASS	
SHEAR						
***3.4.24** Shear in webs (Major Axis)*						… 4.1.1(2)
Clear web height	h	=	74	mm		
	t	=	3	mm		
Slenderness	h/t	=	24.666667			
Limit 1	S_1	=	29.01			
Limit 2	S_2	=	59.31			
Factored limit state stress	**ϕF_L**	=	**131.10**	**MPa**		
Stress From Shear force	**f_{sx}**	=	V/A_w			
			5.32	**MPa**		
***3.4.25** Shear in webs (Minor Axis)*						
Clear web height	b	=	94	mm		
	t	=	3	mm		
Slenderness	b/t	=	31.333333			
Factored limit state stress	**ϕF_L**	=	**128.74**	**MPa**		
Stress From Shear force	**f_{sy}**	=	V/A_w			
			0.00	**MPa**		

7.6 Intermediate Purlin

NAME	SYMBOL	VALUE	UNIT	NOTES	REF

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Tel: 02 9975 3899 Fax: 02 99751943
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60x602.5	**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	=	3.368	kN	*compression*	
	P	=	0	kN	*Tension*	
In plane moment	M_x	=	1.0297	kNm		
Out of plane moment	M_y	=	0.1215	kNm		
DESIGN STRESSES						
Gross cross section area	A_g	**=**	575	mm^2		
In-plane elastic section modulus	Z_x	**=**	10581.597	mm^3		
Out-of-plane elastic section mod.	Z_y	**=**	10581.597	mm^3		
Stress from axial force	$\mathbf{f_a}$	**=**	P/A_g			
		=	**5.86**	**MPa**	*compression*	
		=	**0.00**	**MPa**	*Tension*	
Stress from in-plane bending	$\mathbf{f_{bx}}$	**=**	M_x/Z_x			
		=	**97.31**	**MPa**	*compression*	
Stress from out-of-plane bending	$\mathbf{f_{by}}$	**=**	M_y/Z_y			
		=	**11.48**	**MPa**	*compression*	
Tension						
3.4.3 *Tension in rectangular tubes*						
	$\mathbf{\phi F_L}$	**=**	**228.95**	**MPa**		
		OR				

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	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	=	23.50	mm		
Radius of gyration about buckling axis (X)	r_x	=	23.50	mm		
Slenderness ratio	kLb/ry	=	212.80			
Slenderness ratio	kL/rx	=	212.80			
Slenderness parameter	λ	=	3.97			
	D_c*	=	90.3			
	S_1*	=	0.33			
	S_2*	=	1.23			
	ϕ_{cc}	=	0.950			
Factored limit state stress	**ϕF_L**	**=**	**14.49**	**MPa**		
2. Sections not subject to torsional or torsional-flexural buckling						… 3.4.8.2
Largest slenderness ratio for flexural buckling	kL/r	=	212.80			
***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'	=	55			
	t	=	2.5	mm		
Slenderness	b/t	=	22			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	32.87			
Factored limit state stress	**ϕF_L**	**=**	**201.84**	**MPa**		

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Most adverse compressive limit state stress	F_a	=	14.49	MPa		
Most adverse tensile limit state stress	F_a	=	222.70	MPa		
Most adverse compressive & Tensile capacity factor	f_a/F_a	=	0.40		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	=	317447.92	mm^4		
Torsion modulus	J	=	475273.44	mm^3		
Elastic section modulus	Z	=	10581.597	mm^3		
Slenderness	S	=	272.42			
Limit 1	S_1	=	0.39			
Limit 2	S_2	=	1695.86			
Factored limit state stress	**ϕF_L**	=	**192.53**	**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'	=	55	mm		
	t	=	2.5	mm		
Slenderness	b/t	=	22			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	46.95			
Factored limit state stress	**ϕF_L**	=	**201.84**	**MPa**		
Most adverse in-plane bending limit state stress	F_{bx}	=	192.53	MPa		
Most adverse in-plane bending capacity factor	f_{bx}/F_{bx}	=	0.51		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**	=	**192.53**	**MPa**			
Most adverse out-of-plane bending limit state stress	**F_{by}**	=	192.53	MPa			
Most adverse out-of-plane bending capacity factor	**f_{by}/F_{by}**	**=**	0.06			PASS	
COMBINED ACTIONS							
4.1.1 *Combined compression and bending*							… 4.1.1(2)
	F_a	=	14.49	MPa			… 3.4.8
	F_{ao}	=	201.84	MPa			… 3.4.10
	F_{bx}	=	192.53	MPa			… 3.4.17
	F_{by}	=	192.53	MPa			… 3.4.17
	f_a/F_a	=	0.404				
Check:	$f_a/F_a + f_{bx}/F_{bx} + f_{by}/F_{by} \leq 1.0$						… 4.1.1 (3)
i.e.	0.97	≤	1.0			PASS	
SHEAR							
3.4.24 *Shear in webs (Major Axis)*							… 4.1.1(2)
Clear web height	h	=	55	mm			
	t	=	2.5	mm			
Slenderness	h/t	=	22				
Limit 1	S_1	=	29.01				
Limit 2	S_2	=	59.31				
Factored limit state stress	**ϕF_L**	=	**131.10**	**MPa**			
Stress From Shear force	**f_{sx}**	=	V/A_w				
			9.66	**MPa**			
3.4.25 *Shear in webs (Minor Axis)*							
Clear web height	b	=	55	mm			
	t	=	2.5	mm			

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Slenderness	b/t	=	22			
Factored limit state stress	**ϕF_L**	**=**	**131.10**	**MPa**		
Stress From Shear force	**f_{sy}**	**=**	V/A_w			
			0.00	**MPa**		

7.7 Ridge Strut

NAME	SYMBOL		VALUE	UNIT	NOTES	REF
60x602.5	**Ridge Struts**					
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	=	13.609	kN	*compression*	
	P	=	0	kN	*Tension*	
In plane moment	M_x	=	0.1799	kNm		
Out of plane moment	M_y	=	0.0454	kNm		
DESIGN STRESSES						
Gross cross section area	A_g	**=**	1584	mm^2		
In-plane elastic section modulus	Z_x	**=**	71775.36	mm^3		
Out-of-plane elastic section mod.	Z_y	**=**	63691.2	mm^3		
Stress from axial force	**f_a**	**=**	P/A_g			
		=	**8.59**	**MPa**	*compression*	
		=	**0.00**	**MPa**	*Tension*	
Stress from in-plane bending	**f_{bx}**	**=**	M_x/Z_x			

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		=	**2.51**	**MPa**	*compression*	
Stress from out-of-plane bending	f_{by}	=	M_y/Z_y			
		=	**0.71**	**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	=	49.12	mm		
Radius of gyration about buckling axis (X)	r_x	=	58.30	mm		
Slenderness ratio	kLb/ry	=	101.80			
Slenderness ratio	kL/rx	=	85.77			
Slenderness parameter	λ	=	1.90			
	D_c*	=	90.3			
	S_1*	=	0.33			
	S_2*	=	1.23			
	ϕ_{cc}	=	0.846			
Factored limit state stress	**ϕF_L**	=	**56.41**	**MPa**		
2. Sections not subject to torsional or torsional-flexural buckling						… 3.4.8.2
Largest slenderness ratio for flexural buckling	kL/r	**=**	101.80			
***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'	**=**	114			

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	t	=	3	mm		
Slenderness	b/t	=	38			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	32.87			
Factored limit state stress	**ϕF_L**	**=**	**147.86**	**MPa**		
Most adverse compressive limit state stress	F_a	=	56.41	MPa		
Most adverse tensile limit state stress	F_a	=	222.70	MPa		
Most adverse compressive & Tensile capacity factor	f_a/F_a	=	0.15		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	=	3821472	mm^4		
Torsion modulus	J	=	6722854.6	mm^3		
Elastic section modulus	Z	=	71775.36	mm^3		
Slenderness	S	=	141.61			
Limit 1	S_1	=	0.39			
Limit 2	S_2	=	1695.86			
Factored limit state stress	**ϕF_L**	=	**203.09**	**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'	=	114	mm		
	t	=	3	mm		
Slenderness	b/t	=	38			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	46.95			

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Factored limit state stress	ϕF_L	=	**156.92**	**MPa**		
Most adverse in-plane bending limit state stress	F_{bx}	=	156.92	MPa		
Most adverse in-plane bending capacity factor	f_{bx}/F_{bx}	=	0.02		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	=	**156.92**	**MPa**		
Most adverse out-of-plane bending limit state stress	F_{by}	=	156.92	MPa		
Most adverse out-of-plane bending capacity factor	f_{by}/F_{by}	=	0.00		PASS	
COMBINED ACTIONS						
***4.1.1** Combined compression and bending*						… 4.1.1(2)
	F_a	=	56.41	MPa		… 3.4.8
	F_{ao}	=	147.86	MPa		… 3.4.10
	F_{bx}	=	156.92	MPa		… 3.4.17
	F_{by}	=	156.92	MPa		… 3.4.17
	f_a/F_a	=	0.152			
Check:	$f_a/F_a + f_{bx}/F_{bx} + f_{by}/F_{by} \leq 1.0$					… 4.1.1 (3)
i.e.	0.17	$\leq$	1.0		PASS	
SHEAR						
***3.4.24** Shear in webs (Major Axis)*						… 4.1.1(2)
Clear web height	h	=	144	mm		
	t	=	3	mm		
Slenderness	h/t	=	48			
Limit 1	S_1	=	29.01			
Limit 2	S_2	=	59.31			
Factored limit state stress	ϕF_L	=	**111.87**	**MPa**		
Stress From Shear force	f_{sx}	=	V/A_w			

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			3.51	**MPa**		
***3.4.25** Shear in webs (Minor Axis)*						
Clear web height	b	=	114	mm		
	t	=	3	mm		
Slenderness	b/t	=	38			
Factored limit state stress	**ϕF_L**	=	**122.00**	**MPa**		
Stress From Shear force	**f_{sy}**	=	V/A_w			
			0.00	**MPa**		

7.8 Knee Brace

NAME	SYMBOL		VALUE	UNIT	NOTES	REF
150x120x3	**Knee 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						
Axial force	P	=	25.857	kN	*compression*	
	P	=	0	kN	*Tension*	
In plane moment	M_x	=	0.0984	kNm		
Out of plane moment	M_y	=	0.1262	kNm		
DESIGN STRESSES						
Gross cross section area	A_g	**=**	1584	mm^2		
In-plane elastic section modulus	Z_x	**=**	71775.36	mm^3		

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Out-of-plane elastic section mod.	Z_y	=	63691.2	mm^3		
Stress from axial force	f_a	=	P/A_g			
		=	**16.32**	**MPa**	*compression*	
		=	**0.00**	**MPa**	*Tension*	
Stress from in-plane bending	f_{bx}	=	M_x/Z_x			
		=	**1.37**	**MPa**	*compression*	
Stress from out-of-plane bending	f_{by}	=	M_y/Z_y			
		=	**1.98**	**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	=	4400	mm		
Effective length factor	k	=	1			
Radius of gyration about buckling axis (Y)	r_y	=	49.12	mm		
Radius of gyration about buckling axis (X)	r_x	=	58.30	mm		
Slenderness ratio	kLb/ry	=	89.58			
Slenderness ratio	kL/rx	=	75.48			
Slenderness parameter	λ	=	1.67			
	D_c^*	=	90.3			
	S_1^*	=	0.33			
	S_2^*	=	1.23			
	ϕ_{cc}	=	0.814			
Factored limit state stress	**ϕF_L**	**=**	**70.10**	**MPa**		
2. Sections not subject to torsional or torsional-flexural buckling						… 3.4.8.2
Largest slenderness ratio for flexural buckling	kL/r	=	89.58			
3.4.10 *Uniform compression in components of columns, gross section - flat plates*						

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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'	=	114			
	t	=	3	mm		
Slenderness	b/t	=	38			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	32.87			
Factored limit state stress	**ϕF_L**	=	**147.86**	**MPa**		
Most adverse compressive limit state stress	F_a	=	70.10	MPa		
Most adverse tensile limit state stress	F_a	=	222.70	MPa		
Most adverse compressive & Tensile capacity factor	f_a/F_a	=	0.23		PASS	
BENDING - IN-PLANE						
***3.4.15** Compression in beams, extreme fibre, gross section rectangular tubes, box sections*						
Unbraced length for bending	L_b	=	4400	mm		
Second moment of area (weak axis)	I_y	=	3821472	mm^4		
Torsion modulus	J	=	6722854.6	mm^3		
Elastic section modulus	Z	=	71775.36	mm^3		
Slenderness	S	=	124.61			
Limit 1	S_1	=	0.39			
Limit 2	S_2	=	1695.86			
Factored limit state stress	**ϕF_L**	=	**204.78**	**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)

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Max. distance between toes of fillets of supporting elements for plate	b'	=	114	mm		
	t	=	3	mm		
Slenderness	b/t	=	38			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	46.95			
Factored limit state stress	**ϕF_L**	=	**156.92**	**MPa**		
Most adverse in-plane bending limit state stress	F_{bx}	=	156.92	MPa		
Most adverse in-plane bending capacity factor	f_{bx}/F_{bx}	=	0.01		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**	=	**156.92**	**MPa**		
Most adverse out-of-plane bending limit state stress	**F_{by}**	=	156.92	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	=	70.10	MPa		… 3.4.8
	F_{ao}	=	147.86	MPa		… 3.4.10
	F_{bx}	=	156.92	MPa		… 3.4.17
	F_{by}	=	156.92	MPa		… 3.4.17
	f_a/F_a	=	0.233			
Check:	$f_a/F_a + f_{bx}/F_{bx} + f_{by}/F_{by} \leq 1.0$					… 4.1.1 (3)
i.e.	0.25	$\leq$	1.0		PASS	
SHEAR						
***3.4.24** Shear in webs (Major Axis)*						… 4.1.1(2)
Clear web height	h	=	144	mm		

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	t	=	3	mm
Slenderness	h/t	=	48	
Limit 1	S_1	=	29.01	
Limit 2	S_2	=	59.31	
Factored limit state stress	**ϕF_L**	=	**111.87**	**MPa**
Stress From Shear force	**f_{sx}**	=	V/A_w	
			2.22	**MPa**
***3.4.25** Shear in webs (Minor Axis)*				
Clear web height	b	=	114	mm
	t	=	3	mm
Slenderness	b/t	=	38	
Factored limit state stress	**ϕF_L**	=	**122.00**	**MPa**
Stress From Shear force	**f_{sy}**	=	V/A_w	
			0.45	**MPa**

8 Checking Members Based on AS4100 STEEL STRUCTURES

8.1 60x60x4 (Brace)

```
AS 4100-1998 STEEL SECTION CHECK    (Summary for Combo and Station)
Units  :  KN, m, C

Frame :  322        X Mid:  0.        Combo:  COMB15          Design Type:  Brace
Length:  6.403      Y Mid:  47.5      Shape:  60x60x4         Frame Type:   Braced Frame
Loc   :  0.         Z Mid:  2.        Class:  Compact         Princpl Rot: 0. degrees

PhiB=0.9           PhiC=0.9           PhiTY=0.9          PhiTF=0.9          PhiS=0.9

A=8.960E-04        I33=4.707E-07      r33=0.023          Z33=1.569E-05      Av3=4.800E-04
J=7.025E-07        I22=4.707E-07      r22=0.023          Z22=1.569E-05      Av2=4.800E-04
E=206000000.       Fy=235000.         Ry=1.106           S33=1.885E-05
RLLF=1.            Fu=370000.         SteelType=SR       S22=1.885E-05


STRESS CHECK FORCES & MOMENTS  (Combo COMB15)
    Location              N*          M33*        M22*          V2*          V3*          T*
    0.                -4.885          0.        0.155       -0.207        0.063      -0.046

PMM DEMAND/CAPACITY RATIO    (6.1b)
    D/C Ratio:     0.244 = 0.244                                     <    0.95          OK
                       = N*/(phi*Nc)
```


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BASIC FACTORS

Buckling Mode	K Factor	L Factor	KL/r
Major Flexure	1.	1.	279.367
Minor Flexure	1.	1.	279.367
Major Braced	1.	1.	279.367
Minor Braced	1.	1.	279.367
LTB	1.4	1.	391.113

AXIAL FORCE & BIAXIAL MOMENT DESIGN (6.1b)

Factor	L	Braced ke	Sway ke	Delta_b	Delta_s	Cm	Betam
Major Bending	1.	1.	1.	1.265	1.	1.	-1.
Minor Bending	1.	1.	1.	1.	1.	0.381	0.547

	Lltb	Kt	Kl	Kr	Alpha_m	Alpha_s
LTB Factors	1.	1.	1.4	1.	1.388	0.941

	Steel Type	Kf	Kt	Alpha_a	Alpha_b	Alpha_c
Axial Factors	SR	1.	1.	7.583	-1.	0.106

Slenderness	Lambda_e	Lambda_ep	Lambda_ey	Lambda_ew	Lambda_e/ey	Compactness
Major/Flange	12.604	30.	45.	180.	0.28	Compact
/Web	12.604	82.	115.	180.	0.11	Compact
Minor/Flange	12.604	82.	115.	180.	0.11	Compact
/Web	12.604	30.	45.	180.	0.28	Compact
Axial/Flange	12.604		45.		0.28	Compact
/Web	12.604		45.		0.28	Compact

	ZeMajor	ZeMinor	b-be	d-de	Aeff
Effective Pro	1.885E-05	1.885E-05	0.	0.	8.960E-04

	M*	Ms	Mr	Mi	Nc
Major Moment	0.	4.429	4.429	3.348	22.24
Minor Moment	0.155	4.429	4.429	3.902	22.24

	Mo,cr	Mb	Mo	Mc	Mt
Major Moment	25.745	4.429	3.348	3.348	3.348

	N*	Ns	Nc	Nt	Noz
Axial	-4.885	210.56	22.24	210.56	52972.807

SHEAR CHECK

	V* Force	Vv Capacity	Stress Ratio	Status Check
Major Shear	0.207	60.912	0.003	OK
Minor Shear	0.063	60.912	0.001	OK

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9 Summary

9.1 Conclusions

a. The 25m x 50m x 5m bay 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 bracings are required at each end bay and every third bay in between to resist against lateral movement due to wind direction1. Moreover, **ridge struts as well as knee braces are required for all internal frames** to resist against lateral movement due to wind direction2.

d. The bracing cables are required to have minimum 15kN SWL.

e. For uplift due to 80km/hr, 1m x 1m 1 0.5m pad footing per leg for upright support 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. It is important to use 60x60x2.5 profile for all intermediate purlins with spacing not exceeding 1900mm. This means 12 intermediate purlins are required per each bay.

h. Design of fabric by others.

Yours faithfully,

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

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10 Appendix A – Pad Footing design

FTG 1.1.3 INDUCTA Pty Ltd

FTG Design Report

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Company:
Client:
Project:
Job:
Location:

Calculation:
Footing Self Weight Included: 12.5 kN Soil Pressure: 12.5 kPa
Total Service Axial Load (Ng+Nq): 25 kN (Load Factors = 1)
No Moment Load in X direction.
No Moment Load in Y direction.

Maximum Soil Pressure: 25 < 100 kPa (OK)

M* & N* (factored design load = 1.00*G + 1.50*Q)
N* Factored Axial Load: 25 kN
No Moment Load in X direction.
No Moment Load in Y direction.
------ Mx (bending moment in x direction)
Mx at Left column face: 1.8 kNm (distance from left edge 375 mm)
Mx at Right column face: 1.8 kNm (distance from left edge 625 mm)
Mx max: 1.8 kNm (used in steel design)
------ My (bending moment in y direction)
My at Btm column face: 1.7 kNm (distance from btm edge 375 mm)
My at Top column face: 1.7 kNm (distance from btm edge 625 mm)
My max: 1.7 kNm (used in steel design)

Check as plain concrete member.
Nominal height of the footing taken as:
h = h - 50 mm = 450 mm (Cl. 15.4.1)
0.6*Mcrx = 68.7 kNm
0.6*Mcry = 68.7 kNm
Can design as plain concrete member without reinforcement.
(Mx max < 0.6*Mcrx, My max < 0.6*Mcry)

------ Reinforcement Flexure (use average cover)
Calculated Reinf. Cross Sect. Area in X: 13 mm² / m (0%)
*** Use Minimum Reinforcement in X762mm² / m. ***
Reinforcement Cross Section Area in X: 762 mm² / m (0.18%)
Reinforcement Bars in X direction: total 7L12 or L12@143
Calculated Reinf. Cross Sect. Area in Y: 13 mm² / m (0%)
*** Use Minimum Reinforcement in Y762mm² / m. ***
Reinforcement Cross Section Area in Y: 762 mm² / m (0.18%)
Reinforcement Bars in Y direction: total 7L12 or L12@143

------ Vx* (beam shear force in plane parallel to y)
Vx* at Left column face: 0 kN (distance from left edge -48 mm)
Vx* at Right column face: 0 kN (distance from left edge 1,048 mm)
ϕVuc, Shear Strength of Concrete: 149 kN (0.7*Vuc > V* OK)

------ Vy* (beam shear force in plane parallel to x)
Vy* at Btm column face: 0 kN (distance from btm edge -48 mm)
Vy* at Top column face: 0 kN (distance from btm edge 1,048 mm)
ϕVuc, Shear Strength of Concrete: 149 kN (0.7*Vuc > V* OK)

------ Punching Shear Check
Total design load on soil: 25 kN
Punching shear perimeter: 2,692 mm
dom/2 = 212 mm
Soil contact outside punching shear perimeter: 55%
Vuo = 2,190 kN (punching shear ultimate shear strength)
V* = 14 kN (punching shear design load)
ϕVuo X-X, Punching Shear Strength of Concrete: 1,533 kN (0.7*Vuo > V* OK)

Footing dimensions are OK. Steel Class: L Bars: End Plate
Can design as plain concrete member without reinforcement.

Type: Isolated
Shape: Rectangular

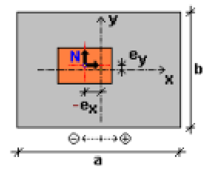
Dimension a, mm: 250
Dimension b, mm: 250
Eccentricity, ex, mm: 0
Eccentricity ey, mm: 0
Concrete Cover, mm: 65

Concrete Strength, MPa: 32
Steel Strength, MPa: 500
Bar Size: L 12 End Plate

Height h, mm: 500 (footing geometry)
Side a, mm: 1000 (footing geometry)
Side b, mm: 1000 (footing geometry)

Load (unfactored)
N, Axial Load, kN, Dead Load: 12.4
N, Axial Load, kN, Live Load:
Mx, (about y), kNm, Dead Load:
Mx, (about y), kNm, Live Load:
My, (about x), kNm, Dead Load:
My, (about x), kNm, Live Load:

Soil Allowable Pressure, kPa: 100



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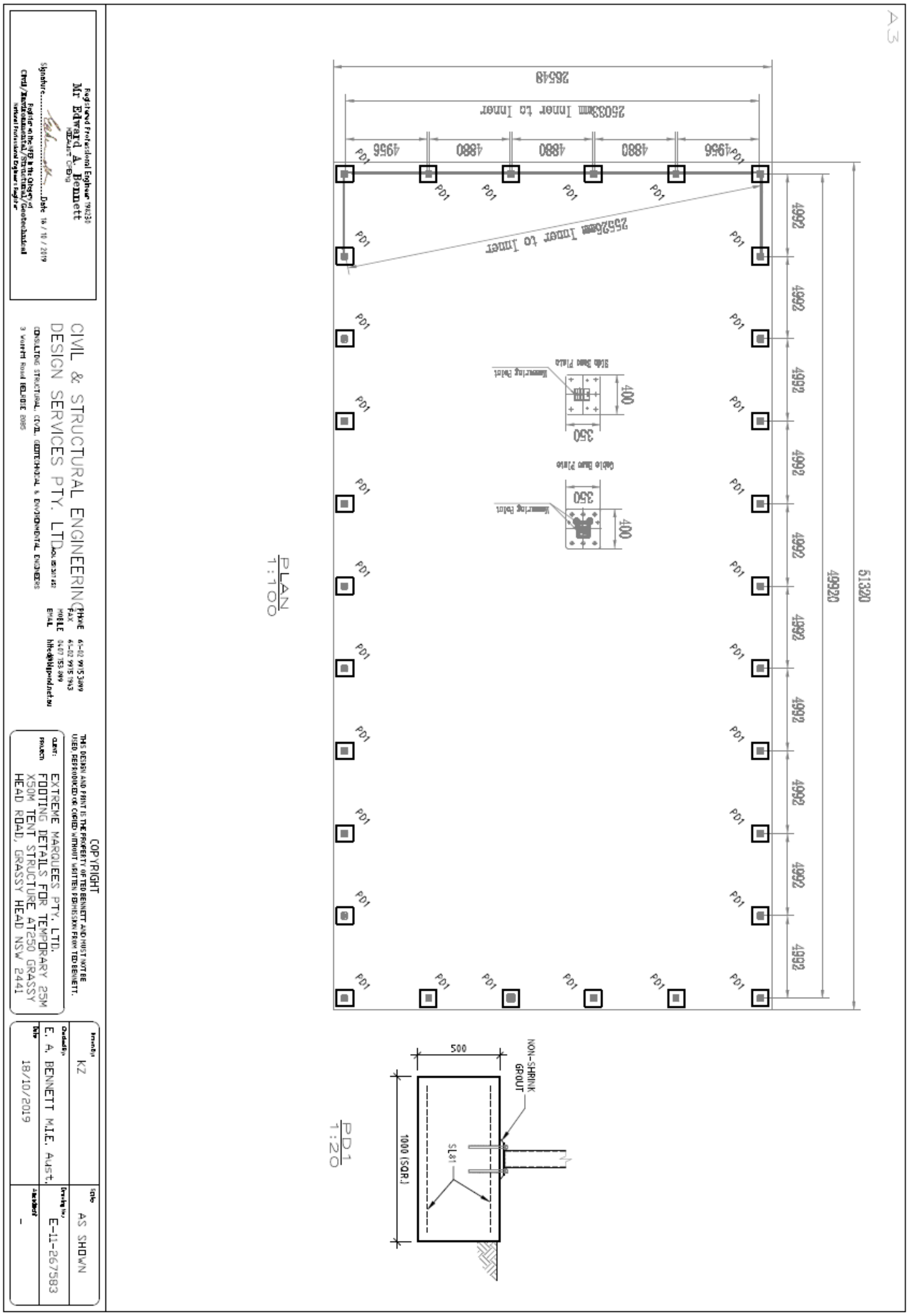

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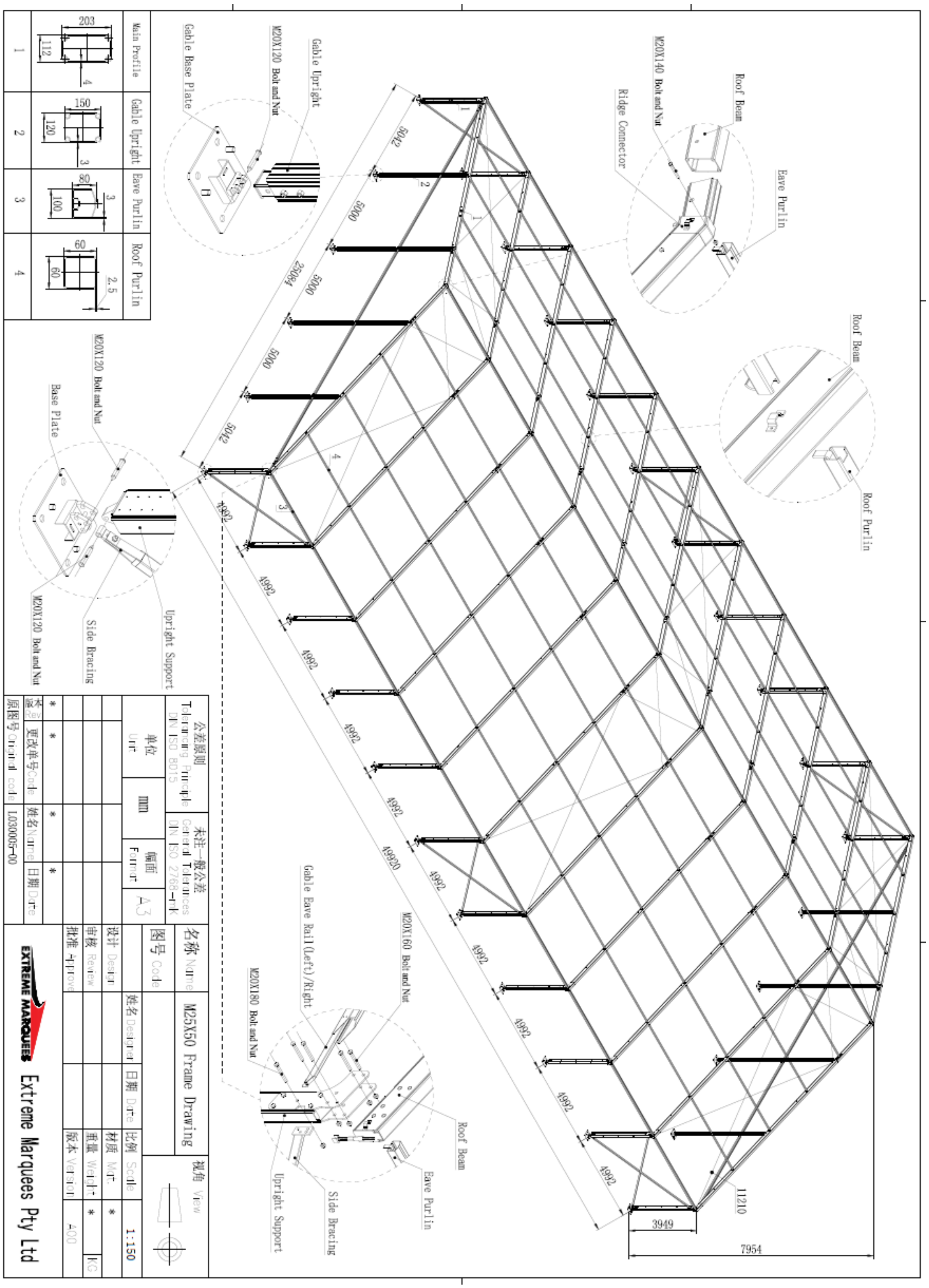
11 Appendix B – Detail Drawing



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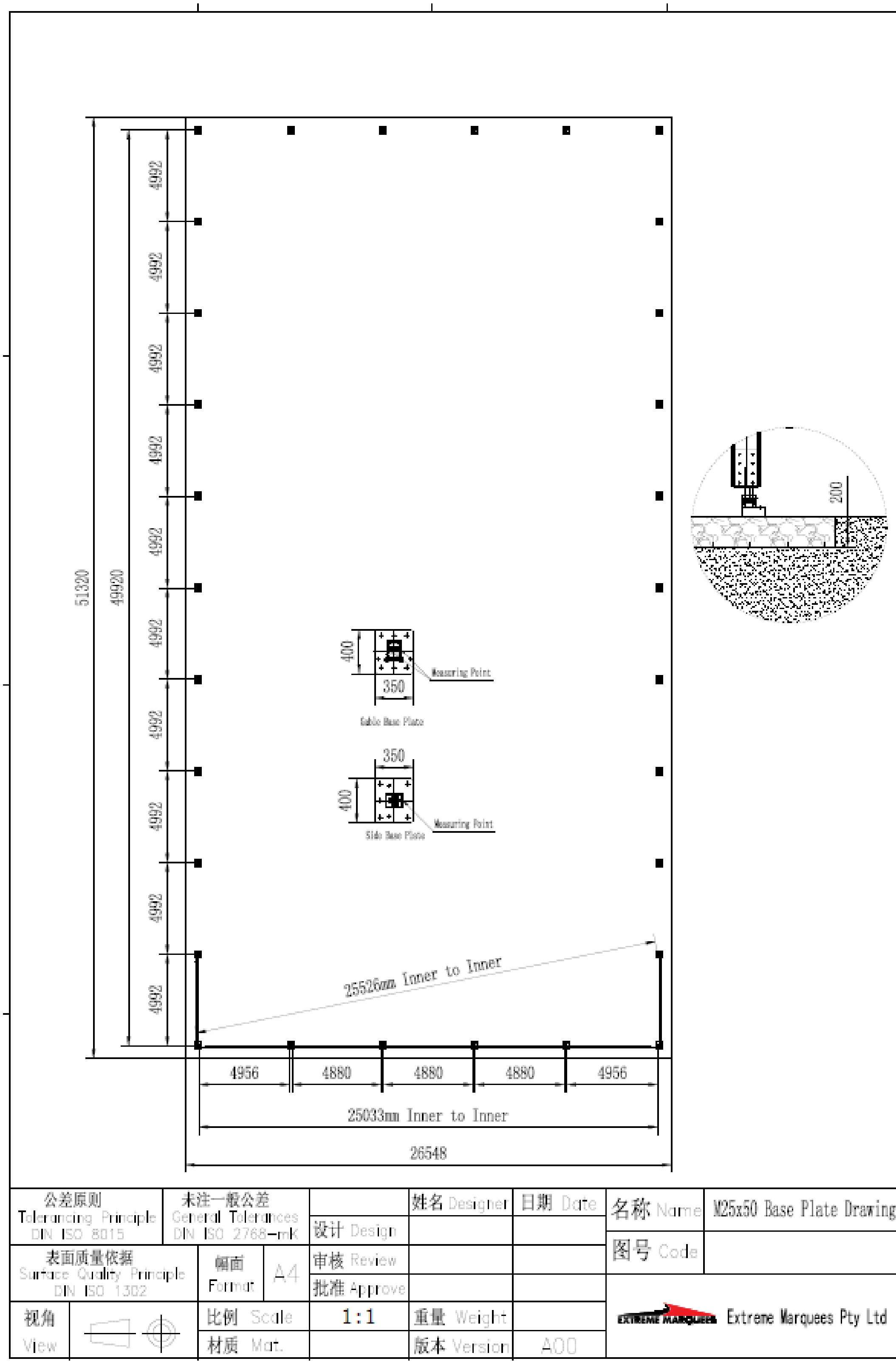

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