

Client: Extreme Marquees Pty Ltd

**Project:** Design check – 6m × 6m Pavilion Marquees Structure for 40km/hr Wind Spead

Reference: Extreme Marquees Technical Data

Report by: KZ Checked by: EAB Date: 22/03/2017

JOB NO: E-11-265231-1



### Table of Contents

1	Intr	oduction	3
2	Des	ign Restrictions and Limitations	4
3	Spe	cifications	5
	3.1	General	5
	3.2	Section Properties	6
4	Des	ign Loads	6
	4.1	Ultimate	
	4.2	Load Combinations	6
	4.2.	1 Serviceability	6
	4.2.	2 Ultimate	6
5	Wir	nd Analysis	6
	5.1	Parameters	6
	5.2	Pressure Coefficients (C <sub>fig</sub> )	7
	5.2.	1 Pressure summary	8
	5.3	Wind Load Diagrams	9
	5.3.	1 Wind 1(case 1)	9
	5.3.	2 Wind 1(case 2)	9
	5.3.	3 Wind 2(Case1)	10
	5.3.	4 Wind 2(case 2)	10
	5.3.	5 Max Bending Moment due to critical load combination in major axis	11
	5.3.	6 Max Bending Moment in minor axis due to critical load combination	11
	5.3.	7 Max Shear in due to critical load combination	12
	5.3.	8 Max Axial force in upright support and roof beam due to critical load combination	12
	5.3.		
6	$Ch\epsilon$	ecking Members Based on AS1664.1 ALUMINIUM LSD	
	6.1	Upright Support	13
	6.2	Rafter	17
	6.3	Gable Beam	21
	6.4	Summary Forces	25
7	Sun	ımary	26
	7.1	Conclusions	26
8	App	pendix A – Base Anchorage Requirements	27
9	App	pendix "B" – Hold Down Method Details	28

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#### 1 Introduction

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

The report examines the effect of 3s gust wind of 40 km/hr on 6m x6 m Pavilion Marquees 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 AS1664.1 ALUMINIUM 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 folded.
- 2.3 For forecast winds in excess of (refer to summary) 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 Design of fabric by others.
- 2.10 No Fabrics or doors should be used for covering the sides of <u>unbraced</u> Pavilion Marquees due to the lack of bracing within the system and insufficient out-of-plane stiffness of framing.

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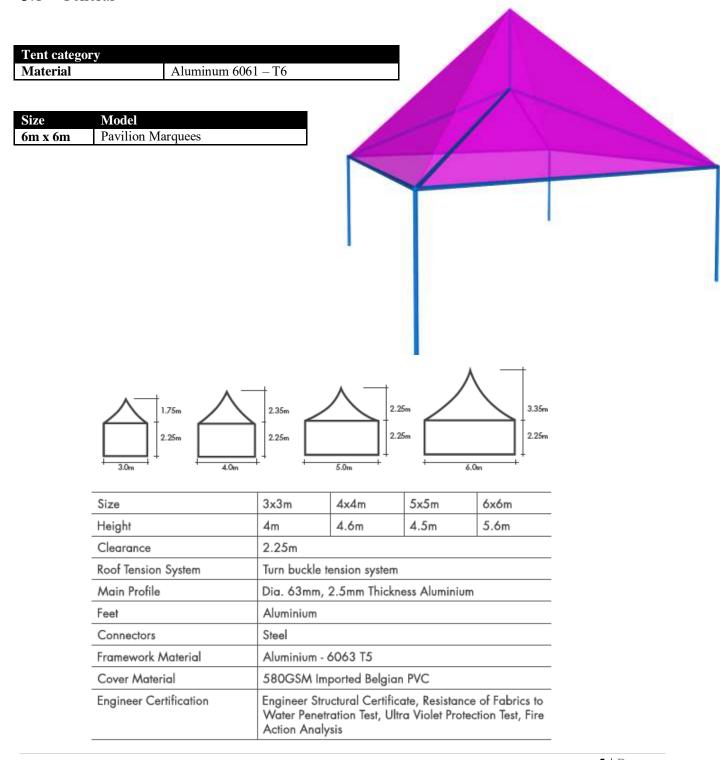
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### **Specifications**

#### 3.1 General



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#### 3.2 Section Properties

MEMBER(S)	Section	d	t	Уc	Ag	Z <sub>x</sub>	Zy	S <sub>x</sub>	Sy	l <sub>x</sub>	ly	J	r <sub>x</sub>	ry
		mm	mm	mm	mm²	mm³	mm³	mm³	mm³	mm⁴	mm⁴	mm⁴	mm	mm
Rafter	D63x2.5	63	2.5	31.5	475.2	6913.5	6913.5	9155.8	9155.8	217774.5	217774.5	435548.9	21.4	21.4
Upright Support	D63x2.5	63	2.5	31.5	475.2	6913.5	6913.5	9155.8	9155.8	217774.5	217774.5	435548.9	21.4	21.4
Gable Beam	D63x2.5	63	2.5	31.5	475.2	6913.5	6913.5	9155.8	9155.8	217774.5	217774.5	435548.9	21.4	21.4

### 4 Design Loads

#### 4.1 Ultimate

		Distributed load (kPa)	Design load factor (-)	Factored imposed load (kPa)
Live	Q	-	1.5	-
Self weight	G	self weight	1.35, 1.2, 0.9	1.2 self weight, 0.9 self weight
3s 40km/hr gust	W	$0.061~\mathrm{C_{fig}}$	1.0	0.061

#### 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 =  $1.35 \times G$ 

 $= 1.2 \times G + W_{u}$ 

 $Upward = 0.9 \times G + W_u$ 

### 5 Wind Analysis

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

5.1 Parameters

Terrain category = 2

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

 $V_R = 11.11 \text{m/s} (40 \text{ km/hr})$ 

(regional 3 s gust wind speed)

6 | P a g e

 $M_d = 1$ 

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$$\begin{split} &M_s=1\\ &M_t=1\\ &M_{z,cat}=0.91\\ &V_{sit,\beta}=10.11~m/s \end{split}$$

(Table 4.1(B) AS1170.2)

$$\begin{split} & \text{Height of structure (h)} = 3.9 \text{ m} \\ & \text{Width of structure (w)} = 6 \text{ m} \\ & \text{Length of structure (l)} = 6 \text{ m} \\ & \text{Pressure (P)} = 0.5 \rho_{air} \, (V_{sit,\beta})^2 \, C_{fig} \, C_{dyn} \\ & = 0.061 C_{fig} \, kPa \end{split}$$

(mid of peak and eave)

5.2 Pressure Coefficients (C<sub>fig</sub>)

Name	Symbol	Value	Unit	Notes	Ref.						
			Input								
Importance level		2			Table 3.1 - Table 3.2 (AS1170.0)						
Annual probability of exceedance		Temporary			Table 3.3						
Regional gust wind speed		40	Km/hr		Table 3.1 (AS1170.2)						
Regional gust wind speed	$V_{R}$	11.11	m/s								
Wind Direction Multipliers	$M_{\text{d}}$	1			Table 3.2 (AS1170.2)						
Terrain Category Multiplier	$M_{Z,Cat}$	0.91			Table 4.1 (AS1170.2)						
Shield Multiplier	Ms	1			4.3 (AS1170.2)						
Topographic Multiplier	$M_{t}$	1			4.4 (AS1170.2)						
Site Wind Speed	$V_{\text{Site},\beta}$	10.11	m/s	$V_{Site,\beta}=V_R*M_d*M_{z,cat}*M_S,M_t$							
Pitch	α	45	Deg								
Pitch	α	0.79	rad								
Width	В	6	m								
Length	D	6	m								
Height	Z	3.9	m								
			•								
	Wind Pressure										
hoair	ρ	1.2	Kg/m <sup>3</sup>								
dynamic response factor	$C_{dyn}$	1									
Wind Pressure	$ ho$ * $C_{fig}$	0.061	Kg/m <sup>2</sup>	$\rho=0.5\rho_{air}*(V_{des,\beta})^2*C_{fig}*C_{dyn}$	2.4 (AS1170.2)						
		WIND D	IRECTIC	DN 1&2							

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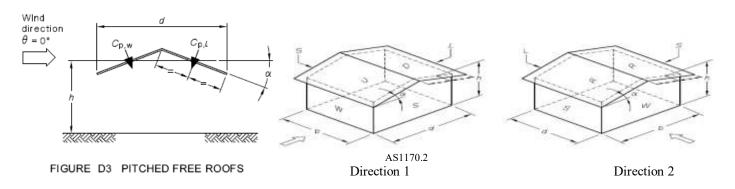
7 | P a g e



4. Free Roof			_
Area Reduction Factor	$K_{a}$	1	
local pressure factor	K <sub>I</sub>	1	
porous cladding reduction factor	K <sub>p</sub>	1	
External Pressure Coefficient MIN	$C_{P,w}$	-0.3	
External Pressure Coefficient MAX	$C_{P,w}$	0.8	
External Pressure Coefficient MIN	$C_{\text{P,I}}$	-0.7	
External Pressure Coefficient MAX	$C_{P,I}$	0	
aerodynamic shape factor MIN	$C_{fig,w}$	-0.30	
aerodynamic shape factor MAX	$C_{\text{fig,w}}$	0.80	
aerodynamic shape factor MIN	$C_{\text{fig,I}}$	-0.70	
aerodynamic shape factor <b>MAX</b>	$C_{fig,I}$	0.00	
Pressure Windward MIN	Р	-0.02	kPa
Pressure Windward MAX	Р	0.05	kPa
Pressure Leeward MIN	Р	-0.04	kPa
Pressure Leeward MAX	Р	0.00	kPa

#### 5.2.1 Pressure summary

WIND EXTERNAL PRESSURE	Direc	ction1
	Min (Kpa)	Max (Kpa)
W	-0.018	0.049
L	-0.043	0.000



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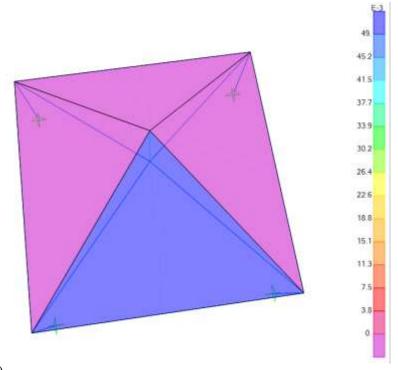
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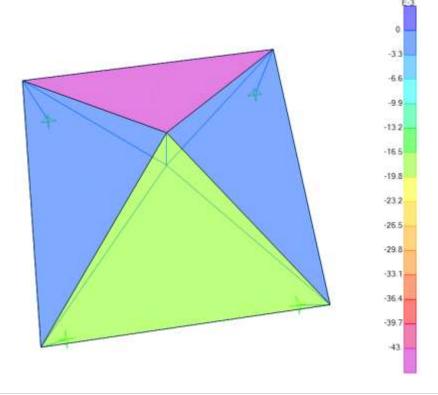


### 5.3 Wind Load Diagrams

#### 5.3.1 Wind 1(case 1)

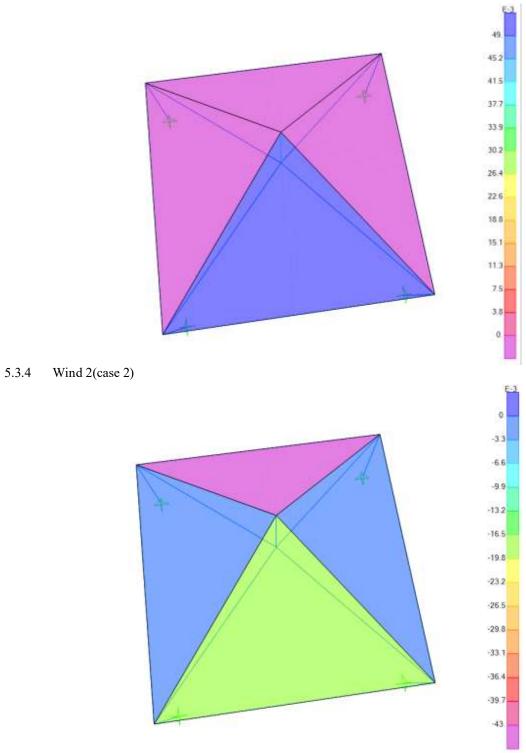


#### 5.3.2 Wind 1(case 2)



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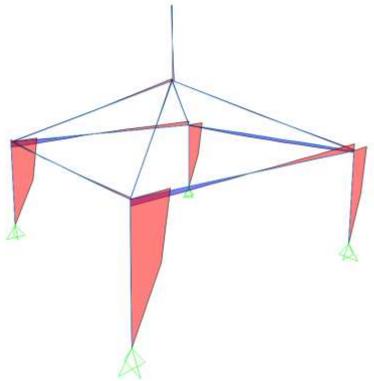
After 3D model analysis, each member is checked based on adverse load combination. In this regard the maximum bending moment, shear and axial force due to adverse load combinations for each member are presented as below:

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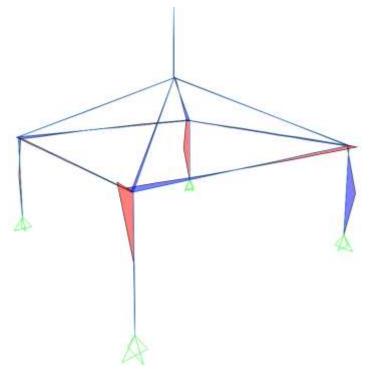
10 | Page



#### 5.3.5 Max Bending Moment due to critical load combination in major axis



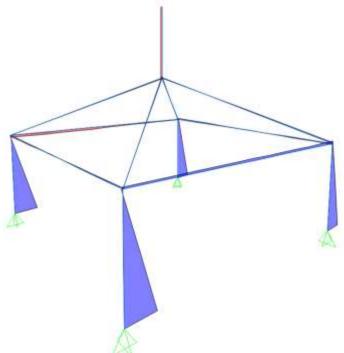
#### 5.3.6 Max Bending Moment in minor axis due to critical load combination



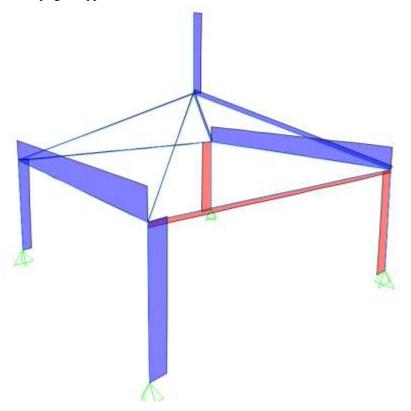
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#### 5.3.7 Max Shear in due to critical load combination

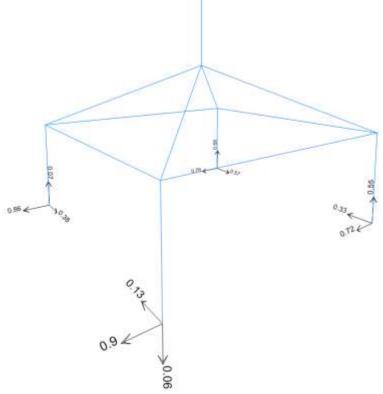


#### 5.3.8 Max Axial force in upright support and roof beam due to critical load combination



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Max Reaction  $N^* = 0.68kN$ 

### 6 Checking Members Based on AS1664.1 ALUMINIUM LSD

#### 6.1 Upright Support

SYMBOL		VALUE	UNIT	NOTES	REF
Upright Support					
6061-T6					AS1664.
Ftu	=	262	MPa	Ultimate	T3.3(A)
$F_{ty}$	=	241	MPa	Yield	
F <sub>cy</sub>	=	241	MPa		
$F_{su}$	=	165	MPa	Ultimate	
$F_{sy}$	=	138	MPa	Yield	
$F_bu$	=	551	MPa	Ultimate	
F <sub>by</sub>	=	386	MPa	Yield	
E	=	70000	MPa	Compressive	
	Upright Support  6061-T6  Ftu Fty Fcy Fsu Fsu Fsy Fbu Fby	Upright Support  6061-T6  Ftu = Fty = Fcy = Fsu = Fsy = Fby Fby Fby Fby = Fby	Upright Support  6061-T6  Ftu = 262 Fty = 241 Fcy = 241 Fsu = 165 Fsy = 138 Fbu = 551 Fby = 386	Upright Support         6061-T6         Ftu = 262 MPa         Fty = 241 MPa         Fcy = 241 MPa         Fsu = 165 MPa         Fsy = 138 MPa         Fbu = 551 MPa         Fby = 386 MPa	$\begin{array}{cccccccccccccccccccccccccccccccccccc$

13 | P a g e

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Recompression   Faster   Fas		$k_{t}$	=	1.0			
Axial force $\begin{array}{cccccccccccccccccccccccccccccccccccc$			=				T3.4(B)
Axial force $\begin{array}{cccccccccccccccccccccccccccccccccccc$							
P	FEM ANALYSIS RESULTS						
P	Axial force	Р	=	0	kN	compression	
In plane moment	, mai roroo					-	
Out of plane moment         My         =         0.67         kNm           DESIGN STRESSES         Gross cross section area         Ag         =         475.1658 g mm² g mm² g mm² g mm³ mm³ mm³ mm³ mm³ mm³ mm³ mm³ mm³ m	In plane moment	$M_{x}$	=		kNm		
Gross cross section area   Ag		$M_{y}$	=	0.67	kNm		
Gross cross section area   Ag							
In-plane elastic section modulus	DESIGN STRESSES			475 4050			
modulus Out-of-plane elastic section mod. Stress from axial force  fa = P/Ag	Gross cross section area	$A_g$	=		mm²		
mod. Stress from axial force  Stress from axial force  Fa = P/Ag  = 0.00 MPa compression  Tension  Stress from in-plane bending  Fbx = My/Zx  = 122.95 MPa compression  Stress from out-of-plane  Bending = My/Zy  bending = Compression  Tension  3.4.3 Tension in round or oval tubes		$Z_{x}$	=	1	mm³		
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	mod.		=		mm³		
Stress from in-plane bending $ \begin{array}{ccccccccccccccccccccccccccccccccccc$	Stress from axial force	fa	=	=			
Stress from in-plane bending $f_{bx} = M_y/Z_x$ $= 122.95 \text{ MPa}$ compression  Stress from out-of-plane $f_{by} = M_y/Z_y$ bending $= 96.91 \text{ MPa}$ compression  Tension  3.4.3 Tension in round or oval tubes							
Stress from out-of-plane $f_{by} = M_{y}/Z_{y}$ bending $= 96.91$ MPa compression  Tension  3.4.3 Tension in round or oval tubes	Stress from in-plane hending	fhy			IVIPA	rension	
Stress from out-of-plane bending = $M_y/Z_y$ = $M_y/Z_y$ compression  Tension  3.4.3 Tension in round or oval tubes	Offices from in plane bending	•DX			MPa	compression	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Stress from out-of-plane	$\mathbf{f}_{by}$	=			,	
COMPRESSION   3.4.8 Compression in columns, axial, gross section   1. General   Unsupported length of member L = 2250 mm   Effective length factor k = 1   Radius of gyration about buckling axis (Y) ry = 21.41 mm   Radius of gyration about buckling axis (X) rx = 21.41 mm   Slenderness ratio kLb/ry = 105.10   Slenderness ratio kL/rx = 105.10	bending		=	96.91	MPa	compression	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		,					
COMPRESSION  3.4.8 Compression in columns, axial, gross section 1. General  Unsupported length of member  Effective length factor k = 1  Radius of gyration about buckling axis (Y)  Radius of gyration about buckling axis (X)  Slenderness ratio kLb/ry = 105.10  Slenderness ratio kLb/ry = 105.10  Slenderness ratio	3.4.3 Tension in round or oval to			267.07	MDe		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		φг∟		207.87	WPa		
COMPRESSION  3.4.8 Compression in columns, axial, gross section  1. General  Unsupported length of member  Effective length factor k = 1  Radius of gyration about buckling axis (Y)  Radius of gyration about buckling axis (X)  Slenderness ratio kLb/ry = 105.10  Slenderness ratio kL/rx = 105.10							
3.4.8 Compression in columns, axial, gross section  1. General  Unsupported length of member  Effective length factor k = 1  Radius of gyration about buckling axis (Y)  Radius of gyration about buckling axis (X)  Slenderness ratio kLb/ry = 105.10  Slenderness ratio kL/rx = 105.10		φF∟	=	276.15	MPa		
Unsupported length of member  Effective length factor  Radius of gyration about buckling axis (Y)  Radius of gyration about buckling axis (X)  Slenderness ratio  L = 2250 mm  ry = 1  21.41 mm  rx = 21.41 mm  Slenderness ratio kLb/ry = 105.10  Slenderness ratio kL/rx = 105.10	COMPRESSION						
member  Effective length factor  Radius of gyration about buckling axis (Y)  Radius of gyration about buckling axis (X)  Slenderness ratio  Slenderness ratio  Fraction in the problem of		axial, gross s	ection				3.4.8.1
Effective length factor k = 1  Radius of gyration about buckling axis (Y)  Radius of gyration about buckling axis (X)  Slenderness ratio kLb/ry = 105.10  Slenderness ratio kL/rx = 105.10		L	=	2250	mm		
Radius of gyration about buckling axis (Y)  Radius of gyration about buckling axis (X)  Slenderness ratio  Slenderness ratio  Radius of gyration about rx  = 21.41 mm  slenderness ratio kLb/ry = 105.10  Slenderness ratio kL/rx = 105.10	i				1		
buckling axis (Y)  Radius of gyration about buckling axis (X)  Slenderness ratio  Slenderness ratio  kLb/ry = 105.10  Slenderness ratio  kL/rx = 105.10	_		-		J		
buckling axis (X)  Slenderness ratio  Slenderness ratio  kLb/ry = 105.10  Slenderness ratio  kL/rx = 105.10	buckling axis (Y)	<b>r</b> y	=	21.41	mm		
Slenderness ratio kL/rx = 105.10		r <sub>x</sub>	=	21.41	mm		
		•	=				
Slenderness parameter λ = 1.96	Slenderness ratio	kL/rx	=	105.10			
11/ I D a g a	Slenderness parameter	λ	=	1.96			

14 | P a g e

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•						
	$D_c^*$	=	90.3			
	S <sub>1</sub> *	=	0.33			
	$S_2^*$	=	1.23			
	фсс	=	0.855			
Factored limit state stress	φF <sub>L</sub>	=	53.46	MPa		
2. Sections not subject to torsion	nal or torsion	al-flexu	ral buckling			3.4.8
Largest slenderness ratio for flexural buckling	kL/r	=	105.10			
<b>3.4.11</b> Uniform compression in c Uniform compression in compon plates with both edges, walls of	ents of colu	mns, gro	-			3.4.10. T3.3([
mid-thickness radius of round tubular column or maximum mid-thickness radius	R <sub>m</sub>	=	30.25			
raulus	t	=	2.5	mm		
Slenderness	R <sub>m</sub> /t	=	12.1			
Limit 1	S <sub>1</sub>	=	0.24			
Limit 2	$S_2$	=	672.46			
Factored limit state stress	φF <sub>L</sub>	=	221.14	MPa		
Most adverse compressive limit state stress	Fa	=	53.46	MPa		
Most adverse tensile limit state stress	Fa	=	267.87	MPa		
Most adverse compressive & Tensile capacity factor	f <sub>a</sub> /F <sub>a</sub>	=	0.00		PASS	
BENDING - IN-PLANE						
<b>3.4.13</b> Compression in beams, etubes	extreme fibre	e, gross	section round	d or oval		
Unbraced length for bending	$L_b$	=	2250	mm		
Second moment of area (weak axis)	ly	=	2.18E+05	mm <sup>4</sup>		
Torsion modulus	J	=	4.36E+05	$\text{mm}^3$		
Elastic section modulus	Z	=	6913.475 1	mm <sup>3</sup>		
	R <sub>b</sub> /t	=	12.10			
	I VD/ L	_				

15 | Page

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Limit 2	$S_2$	=	78.23			
	32		7 0.20			
-actored limit state stress	фҒ∟	=	267.87	MPa		3.4.15(2
<b>3.4.18</b> Compression in compoiedges supported	nents of beam	s - curv	erd plates v	vith both		
3.5.5.4	$\mathbf{k}_1$	=	0.5			T3.3(D
	<b>k</b> <sub>2</sub>	=	2.04			T3.3(D
mid-thickness radius of						
round tubular column or maximum mid-thickness radius	$R_b$	=	30.25	mm		
darao	t	=	2.5	mm		
Slenderness	R <sub>b</sub> /t	=	12.1			
Limit 1	S <sub>1</sub>	=	2.75			
Limit 2	$S_2$	=	78.23			
Factored limit state stress	фГ∟	=	221.14	MPa		
Most adverse in-plane	F <sub>bx</sub>	=	221.14	MPa		
bending limit state stress	· bx					
Most adverse in-plane bending capacity factor	f <sub>bx</sub> /F <sub>bx</sub>	=	0.56		PASS	
Most adverse in-plane	f <sub>bx</sub> /F <sub>bx</sub>		0.56	ending MPa	PASS	
Most adverse in-plane bending capacity factor  BENDING - OUT-OF-PLANE NOTE: Limit state stresses, \$\phi F(\text{doubly symmetric section})\)  Factored limit state stress	f <sub>bx</sub> /F <sub>bx</sub> F <sub>L</sub> are the same <b>φF</b> <sub>L</sub>	e for out =	0.56 -of-plane be 221.14	МРа	PASS	
Most adverse in-plane bending capacity factor  BENDING - OUT-OF-PLANE NOTE: Limit state stresses, \$\phi F(\text{doubly symmetric section})\$  Factored limit state stress  Most adverse out-of-plane bending limit state stress	$f_{bx}/F_{bx}$ $F_L$ are the same	e for out	0.56 -of-plane be	-	PASS	
Most adverse in-plane bending capacity factor  BENDING - OUT-OF-PLANE NOTE: Limit state stresses, \$\phi F (doubly symmetric section)  Factored limit state stress  Most adverse out-of-plane	f <sub>bx</sub> /F <sub>bx</sub> F <sub>L</sub> are the same <b>φF</b> <sub>L</sub>	e for out =	0.56 -of-plane be 221.14	МРа	PASS	
Most adverse in-plane bending capacity factor  BENDING - OUT-OF-PLANE NOTE: Limit state stresses, \$\phi F (doubly symmetric section)  Factored limit state stress  Most adverse out-of-plane bending limit state stress  Most adverse out-of-plane	f <sub>bx</sub> /F <sub>bx</sub> F <sub>L</sub> are the same  ΦF <sub>L</sub>	e for out = =	0.56 -of-plane be 221.14	МРа		
Most adverse in-plane bending capacity factor  BENDING - OUT-OF-PLANE NOTE: Limit state stresses, \$\phi F (doubly symmetric section)  Factored limit state stress  Most adverse out-of-plane bending limit state stress  Most adverse out-of-plane bending capacity factor	f <sub>bx</sub> /F <sub>bx</sub> F <sub>L</sub> are the same  φF <sub>L</sub> F <sub>by</sub> f <sub>by</sub> /F <sub>by</sub>	e for out = =	0.56 -of-plane be 221.14	МРа		4.1.1(2
Most adverse in-plane bending capacity factor  BENDING - OUT-OF-PLANE NOTE: Limit state stresses, \$\phi F (doubly symmetric section)  Factored limit state stress  Most adverse out-of-plane bending limit state stress  Most adverse out-of-plane bending capacity factor	f <sub>bx</sub> /F <sub>bx</sub> F <sub>L</sub> are the same  φF <sub>L</sub> F <sub>by</sub> f <sub>by</sub> /F <sub>by</sub>	e for out = =	0.56 -of-plane be 221.14	MPa MPa		4.1.1(2
Most adverse in-plane bending capacity factor  BENDING - OUT-OF-PLANE NOTE: Limit state stresses, \$\phi F (doubly symmetric section)  Factored limit state stress  Most adverse out-of-plane bending limit state stress  Most adverse out-of-plane bending capacity factor	f <sub>bx</sub> /F <sub>bx</sub> F <sub>L</sub> are the same  \$\phi F_L\$  \$f_{by}\$  \$f_{by}/F_{by}\$  and bending  \$F_a\$	e for out = =	0.56 -of-plane be 221.14 221.14 0.44	MPa  MPa		3.4.
Most adverse in-plane bending capacity factor  BENDING - OUT-OF-PLANE NOTE: Limit state stresses, \$\phi F (doubly symmetric section)  Factored limit state stress  Most adverse out-of-plane bending limit state stress  Most adverse out-of-plane bending capacity factor	f <sub>bx</sub> /F <sub>bx</sub> F <sub>L</sub> are the same  φF <sub>L</sub> F <sub>by</sub> f <sub>by</sub> /F <sub>by</sub>	e for out = = =	0.56 -of-plane be 221.14 221.14 0.44	MPa MPa		
Most adverse in-plane pending capacity factor  BENDING - OUT-OF-PLANE NOTE: Limit state stresses, \$\phi F (doubly symmetric section)  Factored limit state stress  Most adverse out-of-plane pending limit state stress  Most adverse out-of-plane pending capacity factor	f <sub>bx</sub> /F <sub>bx</sub> F <sub>L</sub> are the same  \$\phi F_L\$  \$f_{by}\$  \$f_{by}/F_{by}\$  and bending  \$F_a\$	e for out = = = =	0.56 -of-plane be 221.14 221.14 0.44	MPa  MPa		3.4. 3.4.1
Most adverse in-plane bending capacity factor  BENDING - OUT-OF-PLANE NOTE: Limit state stresses, \$\phi F (doubly symmetric section)  Factored limit state stress  Most adverse out-of-plane bending limit state stress  Most adverse out-of-plane bending capacity factor	f <sub>bx</sub> /F <sub>bx</sub> F <sub>L</sub> are the same  \$\phi F_L\$  \$f_{by}/F_{by}\$  and bending  \$F_a\$  \$F_{ao}\$	e for out = = = = =	0.56  -of-plane be 221.14  221.14  0.44  53.46 221.14	MPa MPa MPa MPa		3.4.

16 | P a g e

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Check:	$f_a/F_a + f_{bx}/F_{bx}$	+ f <sub>by</sub> /F <sub>by</sub>	≤ 1.0			
i.e.	1.00	≤	1.0		PASS	
SHEAR						
3.4.24 Shear in webs (Major Axis)						Т
Clear web height	h	=	30.25	mm		
	t	=	2.5	mm		
Slenderness	h/t	=	12.1			
Limit 1	S <sub>1</sub>	=	29.01			
Limit 2	$S_2$	=	59.31			
Factored limit state stress	φF <sub>L</sub>	=	131.10	MPa		
Stress From Shear force	f <sub>sx</sub>	=	V/A <sub>w</sub>			
	o.		0.31	MPa		
<b>3.4.25</b> Shear in webs (Minor Axis)						
Clear web height	b	=	58	mm		
-	t	=	2.5	mm		
Slenderness	b/t	=	23.2			
Factored limit state stress	φF∟	=	131.10	MPa		
Stress From Shear force	$f_{sy}$	=	$V/A_w$			
	•		2.56	MPa		

#### 6.2 Rafter

NAME	SYMBO L		VALUE	UNIT	NOTES	REF
D63x2.5	Rafter					
Alloy and temper	6061-T6					AS1664.
Tanaian	F <sub>tu</sub>	=	262	MPa	Ultimate	T3.3(A)
Tension	$F_{ty}$	=	241	MPa	Yield	
Compression	F <sub>cy</sub>	=	241	MPa		
Chass	$F_su$	=	165	MPa	Ultimate	
Shear	$F_{sy}$	=	138	MPa	Yield	
Danier	F <sub>bu</sub>	=	551	MPa	Ultimate	
Bearing	$F_by$	=	386	MPa	Yield	
Modulus of elasticity	E	=	70000	MPa	Compressive	

17 | Page

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	$\mathbf{k}_{t}$	=	1.0			T3.4(B
	<b>k</b> c	=	1.0			
FEM ANALYSIS RESULTS						
Axial force	Р	=	0	kN	compression	
	Р	=	0.076	kN	Tension	
In plane moment	$M_{x}$	=	0.0411	kNm		
Out of plane moment	$M_{y}$	=	0.1265	kNm		
DESIGN STRESSES						
Gross cross section area	$A_g$	=	475.1658 9	$\mathrm{mm}^2$		
In-plane elastic section modulus	$Z_{x}$	=	6913.475 1	$\text{mm}^3$		
Out-of-plane elastic section mod.	$Z_{y}$	=	6913.475 1	$\text{mm}^3$		
Stress from axial force	fa	=	P/A <sub>g</sub>			
		=	0.00	MPa	compression	
		=	0.16	MPa	Tension	
Stress from in-plane bending	$f_{bx}$	=	$M_x/Z_x$			
		=	5.94	MPa	compression	
Stress from out-of-plane bending	<b>f</b> <sub>by</sub>	=	M <sub>y</sub> /Z <sub>y</sub> 18.30	MPa	aampraaajan	
Tension		=	10.30	IVIFA	compression	
3.4.3 Tension in rectangular tube	s					
Ç	φF∟	=	267.87	MPa		
	•	O R				
	φF <sub>L</sub>	=	276.15	MPa		
COMPRESSION						
3.4.8 Compression in columns, a	xial, gross	section	า			
1. General						3.4.8.
Unsupported length of member	L	=	4535	mm		
Effective length factor	k	=	1			
Radius of gyration about buckling axis (Y)	r <sub>y</sub>	=	21.41	mm		
Radius of gyration about buckling axis (X)	$r_{x}$	=	21.41	mm		
Slenderness ratio	kLb/ry	=	211.83			
Slenderness ratio	kL/rx	=	211.83			

18 | P a g e

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•						
	$D_c^*$	=	90.3			
	S <sub>1</sub> *	=	0.33			
	S <sub>2</sub> *	=	1.23			
	фсс	=	0.950			
Factored limit state stress	φFL	=	14.63	MPa		
2. Sections not subject to torsion	al or torsio	nal-flex	kural buckling	1		3.4.8.2
Largest slenderness ratio for flexural buckling	kL/r	=	211.83			
3.4.11 Uniform compression in co	omponents	of colu	umns, gross s	section -		
flat plates Uniform compression in component	ents of colu	ımns. d	aross section	- curved		
plates with both edges, walls of r						3.4.10.1
	<b>k</b> <sub>1</sub>	=	0.35			T3.3(D)
mid-thickness radius of round tubular column or maximum mid-thickness radius	$R_{m}$	=	30.25			
Tina tribitioss radias	t	=	2.5	mm		
Slenderness	R <sub>m</sub> /t	=	12.1			
Limit 1	$S_1$	=	0.24			
Limit 2	$S_2$	=	32.87			
Factored limit state stress	φF <sub>L</sub>	=	229.63	MPa		
Most adverse compressive limit state stress	Fa	=	14.63	MPa		
Most adverse tensile limit state stress	Fa	=	267.87	MPa		
Most adverse compressive & Tensile capacity factor	f <sub>a</sub> /F <sub>a</sub>	=	0.00		PASS	
BENDING - IN-PLANE						
3.4.13 Compression in beams, e. tubes	xtreme fibr	e, gros	s section rou	nd or oval		
Unbraced length for bending	$L_b$	_	4535	mm		
Second moment of area (weak		=				
axis)	l <sub>y</sub>	=	2.18E+05	mm <sup>4</sup>		
Torsion modulus	J	=	4.36E+05	${\rm mm^3}$		
Elastic section modulus	Z	=	6913.475 1	$\text{mm}^3$		
	R <sub>b</sub> /t	=	12.10			
Limit 1	S <sub>1</sub>	=	44.07			

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Limit 2	$S_2$	=	78.23			
Factored limit state stress	φFL	=	267.87	MPa		3.4.15(2)
3.4.18 Compression in componer edges supported	nts of bean	ns - cu	rverd plates	with both		
	$\mathbf{k}_1$	=	0.5			T3.3(D)
	<b>k</b> 2	=	2.04			T3.3(D)
mid-thickness radius of round tubular column or maximum mid-thickness radius	$R_b$	=	30.25	mm		
	t	=	2.5	mm		
Slenderness	R <sub>b</sub> /t	=	12.1			
Limit 1	S <sub>1</sub>	=	2.75			
Limit 2	$S_2$	=	78.23			
Factored limit state stress	φF <sub>L</sub>	=	221.14	MPa		
Most adverse in-plane bending limit state stress	F <sub>bx</sub>	=	221.14	MPa		
Most adverse in-plane bending capacity factor	$f_{bx}/F_{bx}$	=	0.03		PASS	
DENDING OUT OF DIANE						
BENDING - OUT-OF-PLANE NOTE: Limit state stresses, φF <sub>L</sub> a (doubly symmetric section)	are the san	ne for o	ut-of-plane i	bending		
Factored limit state stress	φF <sub>L</sub>	=	221.14	MPa		
Most adverse out-of-plane bending limit state stress	F <sub>by</sub>	=	221.14	MPa		
Most adverse out-of-plane bending capacity factor	f <sub>by</sub> /F <sub>by</sub>	=	0.08		PASS	
COMBINED ACTIONS						
4.1.1 Combined compression and	d bending					
·	3					4.1.1(2)
	Fa	=	14.63	MPa		3.4.8
	$F_{ao}$	=	229.63	MPa		3.4.10
	$F_bx$	=	221.14	MPa		3.4.17
	$F_{by}$	=	221.14	MPa		3.4.17
	f <sub>a</sub> /F <sub>a</sub>	=	0.001			

20 | P a g e

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Check:	fa/Fa + fbx	/F <sub>bx</sub> + f <sub>by</sub>	$/F_{by} \le 1.0$			
i.e.	0.11	≤	1.0		PASS	
SHEAR						
<b>3.4.24</b> Shear in webs (Major Axis)						
Clear web height	h	=	30.25	mm		
	t	=	2.5	mm		
Slenderness	h/t	=	12.1			
Limit 1	$S_1$	=	29.01			
Limit 2	$S_2$	=	59.31			
Factored limit state stress	φF∟	=	131.10	MPa		
Stress From Shear force	f <sub>sx</sub>	=	V/A <sub>w</sub>			
			0.27	MPa		
<b>3.4.25</b> Shear in webs (Minor Axis)						
Clear web height	b	=	58	mm		
Ç	t	=	2.5	mm		
Slenderness	b/t	=	23.2			
Factored limit state stress	φF∟	=	131.10	MPa		
Stress From Shear force	$\mathbf{f}_{sy}$	=	$V/A_w$			
	•		0.14	MPa		

#### 6.3 Gable Beam

SYMBOL		VALUE	UNIT	NOTES	REF
Gable Beam					
6061-T6					AS1664.1
Ftu	=	262	MPa	Ultimate	T3.3(A)
$F_{ty}$	=	241	MPa	Yield	
$F_{cy}$	=	241	MPa		
$F_su$	=	165	MPa	Ultimate	
$F_{sy}$	=	138	MPa	Yield	
$F_bu$	=	551	MPa	Ultimate	
$F_by$	=	386	MPa	Yield	
E	=	70000	MPa	Compressive	
	Gable Beam 6061-T6  Ftu Fty Fcy Fsu Fsy Fbu Fby	Gable Beam         6061-T6         Ftu       =         Fty       =         Fcy       =         Fsu       =         Fsy       =         Fbu       =         Fby       =	Gable Beam 6061-T6  Ftu = 262 Fty = 241 Fcy = 241 Fsu = 165 Fsy = 138 Fbu = 551 Fby = 386	Gable Beam         6061-T6         Ftu       =       262       MPa         Fty       =       241       MPa         Fcy       =       241       MPa         Fsu       =       165       MPa         Fsy       =       138       MPa         Fbu       =       551       MPa         Fby       =       386       MPa	$\begin{array}{cccccccccccccccccccccccccccccccccccc$

21 | Page

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	$\mathbf{k}_{t}$	=	1.0			TO 4/5)
	<b>k</b> c	=	1.0			T3.4(B)
FEM ANALYSIS RESULTS						
Axial force	Р	=	0.038	kN	compression	
7 Mai 10100	Р	=	0.038	kN	Tension	
In plane moment	M <sub>x</sub>	=	0.3444	kNm	7 6716/6/7	
Out of plane moment	M <sub>y</sub>	=	0.322	kNm		
out of plane moment	···y		0.322			
DESIGN STRESSES						
Gross cross section area	$A_g$	=	475.16589	$\text{mm}^2$		
In-plane elastic section modulus	$Z_{x}$	=	6913.4751	${\rm mm^3}$		
Out-of-plane elastic section mod.	$Z_y$	=	6913.4751	mm³		
Stress from axial force	fa	=	P/A <sub>g</sub>			
		=	0.08	MPa	compression	
		=	0.00	MPa	Tension	
Stress from in-plane bending	$f_{bx}$	=	M <sub>x</sub> /Z <sub>x</sub>			
		=	49.82	MPa	compression	
Stress from out-of-plane bending	f <sub>by</sub>	=	M <sub>y</sub> /Z <sub>y</sub> 46.58	MPa	compression	
Tension		=	40.30	IVIPA	compression	
3.4.3 Tension in rectangular tube	es es					
<b>Cine</b> reneser mreetangalar tabl	φF <sub>L</sub>	=	267.87	MPa		
	7 -	OR				
	φF <sub>L</sub>	=	276.15	MPa		
COMPRESSION						
3.4.8 Compression in columns, a	axial. gross	section	7			
1. General	, <b>G</b>					3.4.8.1
Unsupported length of	L	=	6000	mm		
member		=		mm		
member Effective length factor Radius of gyration about	L k r <sub>y</sub>		6000 1 21.41	mm		
member Effective length factor Radius of gyration about buckling axis (Y) Radius of gyration about	k r <sub>y</sub>	=	21.41	mm		
member Effective length factor Radius of gyration about buckling axis (Y) Radius of gyration about buckling axis (X)	k r <sub>y</sub> r <sub>x</sub>	=	1 21.41 21.41			
member Effective length factor Radius of gyration about buckling axis (Y) Radius of gyration about buckling axis (X) Slenderness ratio	k r <sub>y</sub> r <sub>x</sub> kLb/ry	=	1 21.41 21.41 280.27	mm		
member Effective length factor Radius of gyration about buckling axis (Y) Radius of gyration about buckling axis (X)	k r <sub>y</sub> r <sub>x</sub>	=	1 21.41 21.41	mm		

22 | P a g e

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•						
	$D_c^*$	=	90.3			
	S <sub>1</sub> *	=	0.33			
	$S_2^*$	=	1.23			
	фсс	=	0.950			
Factored limit state stress	φF <sub>L</sub>	=	8.36	MPa		
2. Sections not subject to torsion	al or torsio	nal-flex	kural buckling	1		3.4.8.2
Largest slenderness ratio for flexural buckling	kL/r	=	280.27			
3.4.11 Uniform compression in coflat plates	omponents	s of colu	umns, gross s	section -		
Uniform compression in compone plates with both edges, walls of n				- curved		3.4.10.1
	$\mathbf{k}_1$	=	0.35			T3.3(D)
mid-thickness radius of round tubular column or maximum mid-thickness radius	R <sub>m</sub>	=	30.25			
	t	=	2.5	mm		
Slenderness	R <sub>m</sub> /t	=	12.1			
Limit 1	$S_1$	=	0.24			
Limit 2	$S_2$	=	672.46			
Factored limit state stress	фГ∟	=	229.63	MPa		
Most adverse compressive limit state stress	Fa	=	8.36	MPa		
Most adverse tensile limit state stress	Fa	=	267.87	MPa		
Most adverse compressive & Tensile capacity factor	f <sub>a</sub> /F <sub>a</sub>	=	0.01		PASS	
BENDING - IN-PLANE						
3.4.13 Compression in beams, extubes	xtreme fibi	e, gros	s section rou	nd or oval		
Unbraced length for bending	L <sub>b</sub>	=	6000	mm		
Second moment of area (weak axis)	ly	=	217774.47	mm <sup>4</sup>		
Torsion modulus	J	=	435548.93	$\text{mm}^3$		
Elastic section modulus	Z	=	6913.4751	$\text{mm}^3$		
	R <sub>b</sub> /t	=	12.10			
	1 (6)		_			

23 | P a g e

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Limit 2	$S_2$	=	78.23			
Factored limit state stress	φF <sub>L</sub>	=	267.87	MPa		3.4.15(2)
<b>3.4.18</b> Compression in componedges supported	ents of bean	ns - cu	rverd plates	with both		
	$\mathbf{k}_1$	=	0.5			T3.3(D
	$k_2$	=	2.04			T3.3(D
mid-thickness radius of round tubular column or maximum mid-thickness radius	$R_b$	=	30.25	mm		
	t	=	2.5	mm		
Slenderness	R <sub>b</sub> /t	=	12.1			
Limit 1	S <sub>1</sub>	=	2.75			
Limit 2	$S_2$	=	78.23			
Factored limit state stress	φFL	=	221.14	MPa		
Most adverse in-plane bending limit state stress	F <sub>bx</sub>	=	221.14	MPa	-	
Most adverse in-plane bending capacity factor	$f_{bx}/F_{bx}$	=	0.23		PASS	
BENDING - OUT-OF-PLANE						
NOTE: Limit state stresses, $\phi F_L$ (doubly symmetric section)	are the sam	ne for o	ut-of-plane	bending		
Factored limit state stress	φFL	=	221.14	MPa		
	φF <sub>L</sub>	=	<b>221.14</b> 221.14	<b>MPa</b> MPa		
Most adverse out-of-plane bending limit state stress					PASS	
Most adverse out-of-plane bending limit state stress Most adverse out-of-plane	F <sub>by</sub>	=	221.14		PASS	
Most adverse out-of-plane bending limit state stress Most adverse out-of-plane bending capacity factor	F <sub>by</sub>	=	221.14		PASS	4.1.1(2
Most adverse out-of-plane bending limit state stress Most adverse out-of-plane bending capacity factor	F <sub>by</sub>	=	221.14		PASS	
Most adverse out-of-plane bending limit state stress Most adverse out-of-plane bending capacity factor	F <sub>by</sub> f <sub>by</sub> /F <sub>by</sub>	=	221.14 0.21	MPa	PASS	3.4.8
bending limit state stress Most adverse out-of-plane bending capacity factor  COMBINED ACTIONS	F <sub>by</sub> f <sub>by</sub> /F <sub>by</sub> and bending	= =	221.14 0.21 8.36	MPa MPa	PASS	4.1.1(2) 3.4.8 3.4.10 3.4.17

24 | P a g e

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	$f_a/F_a$	=	0.010			
Check:	$f_a/F_a + f_{bx}/$	F <sub>bx</sub> + f <sub>by</sub> /	$F_{by} \leq 1.0$			
i.e.	0.45	≤	1.0		PASS	
SHEAR						
<b>3.4.24</b> Shear in webs (Major Axis)						
Clear web height	h	=	30.25	mm		
-	t	=	2.5	mm		
Slenderness	h/t	=	12.1			
Limit 1	S <sub>1</sub>	=	29.01			
Limit 2	$S_2$	=	59.31			
Factored limit state stress	φF∟	=	131.10	MPa		
Stress From Shear force	f <sub>sx</sub>	=	V/A <sub>w</sub>			
			1.20	MPa		
<b>3.4.25</b> Shear in webs (Minor Axis)						
Clear web height	b	=	58	mm		
	t	=	2.5	mm		
Slenderness	b/t	=	23.2			
Factored limit state stress	фҒ∟	=	131.10	MPa		
Stress From Shear force	$\mathbf{f}_{sy}$	=	$V/A_w$			
	-		0.51	MPa		

#### 6.4 Summary Forces

MEMBER(S)	Section	d	t	Vx	Vy	P (Axial) Negative -> Compression Positive -> Tension	Mx	My
		mm	mm	kN	kN	kN	kN.m	kN.m
Rafter	D63x2.5	63	2.5	0.041	0.04	0.076	-0.0411	-0.1265
Upright Support	D63x2.5	63	2.5	-0.05	0.743	0.135	-0.85	-0.67
Gable Beam	D63x2.5	63	2.5	0.181	0.147	-0.038	-0.3444	-0.322



#### 7 Summary

#### 7.1 Conclusions

- a. The 6m x 6m Pavilion Marquees as specified has been analyzed with a conclusion that it has the capacity to withstand wind speeds up to and including **40km/hr**.
- b. For forecast winds in excess of 40km/hr the structure should be completely dismantled.
- c. For uplift due to 40km/hr, 1.5 kN (150kg) holding down weight/per leg for upright support is required.
- d. The bearing pressure of soil should be clarified and checked by an engineer prior to any construction for considering foundation and base plate.
- e. No Fabrics or doors should be used for covering the sides of <u>unbraced</u> Pavilion Marquees due to the lack of bracing within the system and insufficient out-of-plane stiffness of framing.

Yours faithfully,

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26 | Page



### 8 Appendix A – Base Anchorage Requirements

6m x 6m Pavilion Marquees:

Tent Span	Sile	Required
	Type	Weight Per Leg
	Α	150kg
	В	150kg
6 m	С	150kg
	D	150kg
	E	150kg

#### <u>Definition of Soil Types:</u>

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

Type B: Medium to stiff clays or silty clays

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

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

Type E: Concrete slab on ground.

ABN: 62 051 307 852

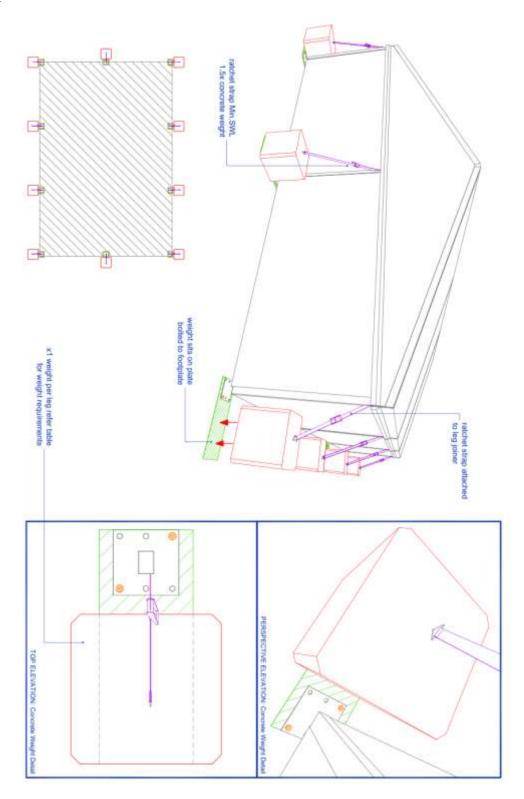
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Appendix "B" - Hold Down Method Details



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