Civil & Structural Engineering Design Services Pty. Ltd.

Client: **EXTREME MARQUEES PTY. LTD.**
Project: Design check – 5m Pinnacle Range Square Pagoda Tents for **45km/hr** Wind Speed.
Reference: Extreme Marquees Pty Ltd Technical Data

Report by: KZ
Checked by: EAB
Date: 23/11/2016

JOB NO: E-11-264962-8

Civil & Structural Engineering Design Services Pty. Ltd.

Table of Contents

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

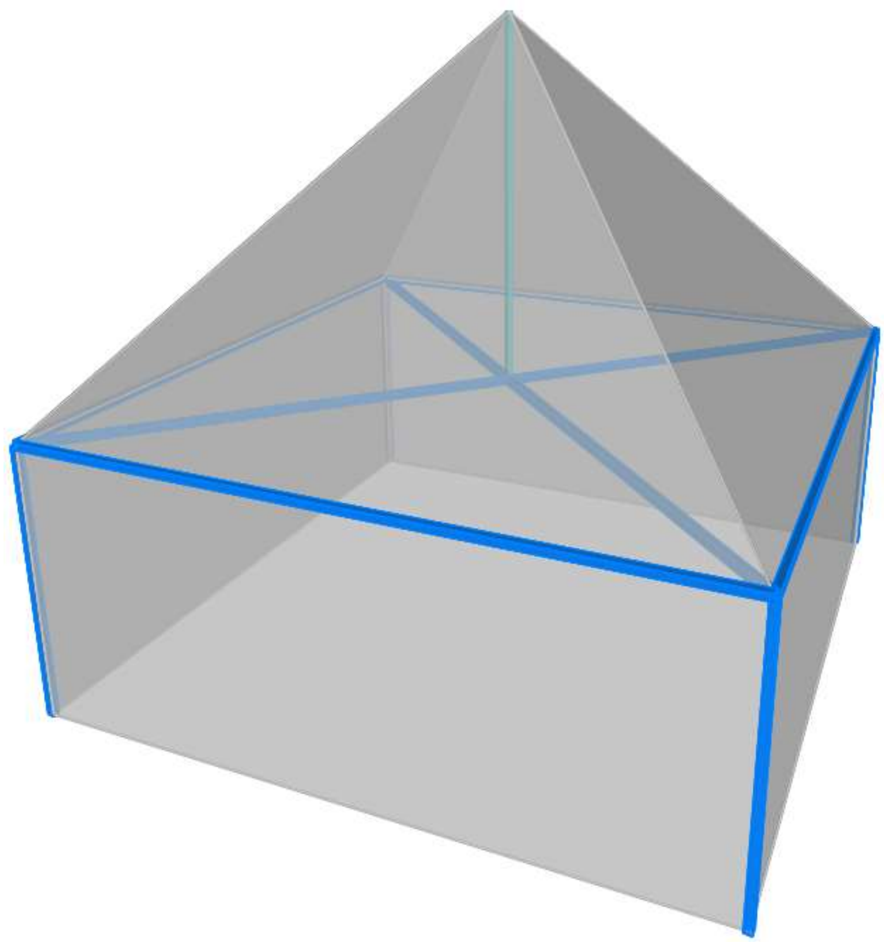
1 Introduction

This 'Certification' is the sole property for copyright to Mr. Ted Bennett of Civil & Structural Engineering Design Services Pty. Ltd.

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

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

The report examines the effect of 3s gust wind of 45 km/hr on 5m × 5m Pinnacle Range Pagoda Tent as the worst-case scenario. The relevant Australian Standards AS1170.0:2002 General principles, AS1170.1:2002 Permanent, imposed and other actions and AS1170.2:2011 Wind actions are used. The design check is in accordance with AS/NZS 1664.1:1997 Aluminum limit state design and AS4100-1998 Steel Structures.



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

2 Design Restrictions and Limitations

2.1 The erected structure is for temporary use only.

2.2 It should be noted that if high gust wind speeds are anticipated or forecast in the locality of the tent, the temporary erected structure should be dismantled.

2.3 For forecast winds in excess of **(refer to summary)** – all fabric shall be removed from the frames, and the structure should be completely dismantled.

(Please note that the locality squall or gust wind speed is affected by factors such as terrain exposure and site elevations.)

2.4 The structure may only be erected in regions with wind classifications no greater than the limits specified on the attached wind analysis.

2.5 The wind classifications are based upon Terrain Category 2. Considerations have also been made to the regional wind terrain category, topographical location and site shielding from adjacent structures. Please note that in many instances topographical factors such as a location on the crest of a hill or on top of an escarpment may yield a higher wind speed classification than that derived for a higher wind terrain category in a level topographical region. For this reason, particular regard shall be paid to the topographical location of the structure. For localities which do not conform to the standard prescribed descriptions for wind classes as defined above, a qualified Structural Engineer may be employed to determine an appropriate wind class for that the particular site.

2.6 The structures in no circumstances shall ever be erected in tropical or severe tropical cyclonic condition as defined on the Map of Australia in AS 1170.2-2011, Figure 3.1.

2.7 The tent structure has not been designed to withstand snow and ice loadings such as when erected in alpine regions.

2.8 For the projects, where the site conditions approach the design limits, extra consideration should be given to pullout tests of the stakes and professional assessment of the appropriate wind classification for the site.

2.9 The tents are stabilized as using rigid connections as shown on the drawings.

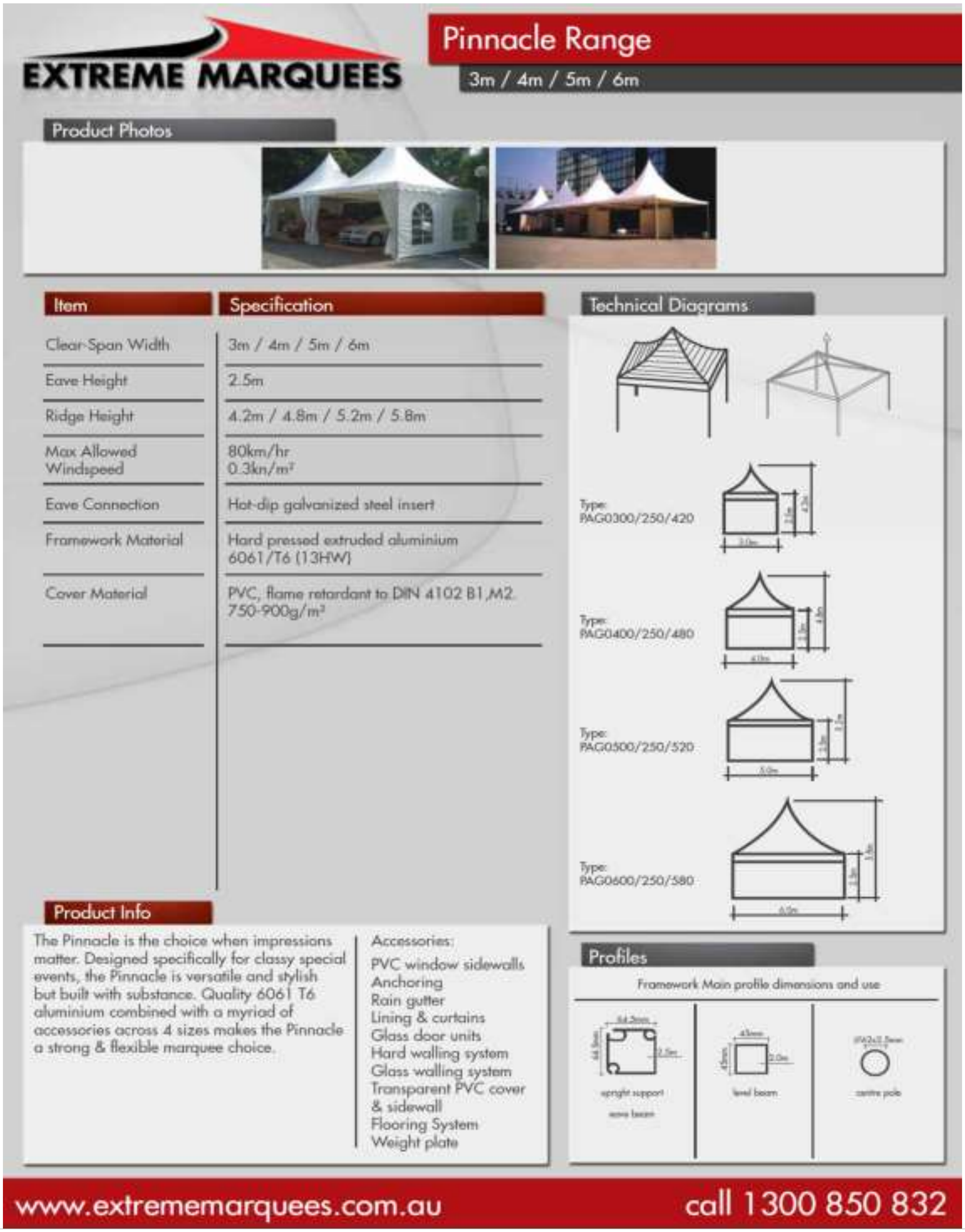
ABN: 62 051 307 852
3 Wanniti Road BELROSE NSW 2085 Tel: 02 9975 3899 Fax: 02 99751943
Email: hited@bigpond.net.au **Web:** www.civilandstructural.com.au

3 Specifications

3.1 General

Tent category	
Material	Aluminum 6061-T6

Size	Model
6m x 6m	Pinnacle Range



EXTREME MARQUEES

Pinnacle Range

3m / 4m / 5m / 6m

Product Photos

Item	Specification
Clear-Span Width	3m / 4m / 5m / 6m
Eave Height	2.5m
Ridge Height	4.2m / 4.8m / 5.2m / 5.8m
Max Allowed Windspeed	80km/hr 0.3kn/m²
Eave Connection	Hot-dip galvanized steel insert
Framework Material	Hard pressed extruded aluminium 6061/T6 (13HW)
Cover Material	PVC, flame retardant to DIN 4102 B1,M2 750-900g/m²

Technical Diagrams

Product Info

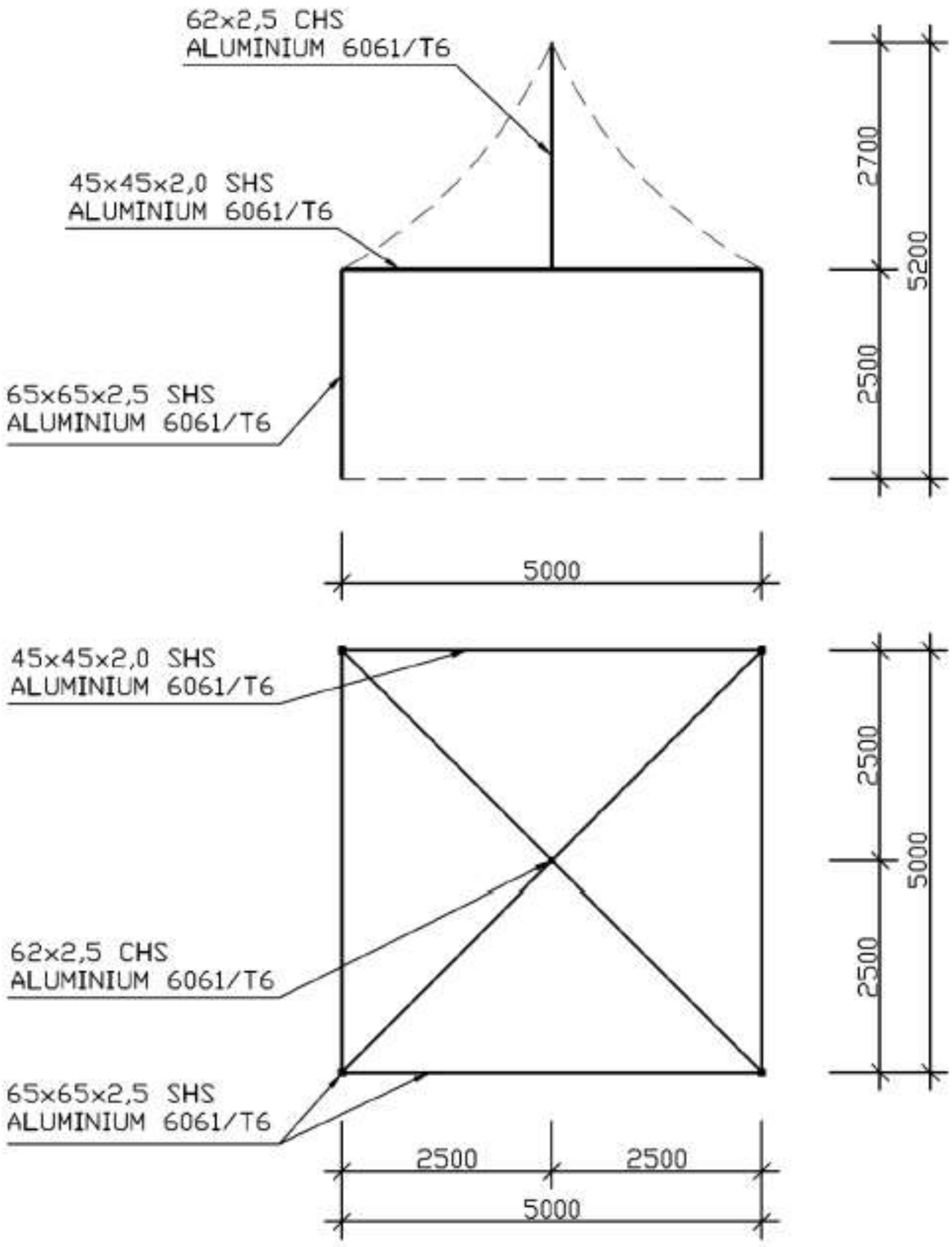
The Pinnacle is the choice when impressions matter. Designed specifically for classy special events, the Pinnacle is versatile and stylish but built with substance. Quality 6061 T6 aluminium combined with a myriad of accessories across 4 sizes makes the Pinnacle a strong & flexible marquee choice.

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

Profiles

Framework Main profile dimensions and use

www.extrememarquees.com.au call 1300 850 832



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

3.2 Aluminium Properties

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

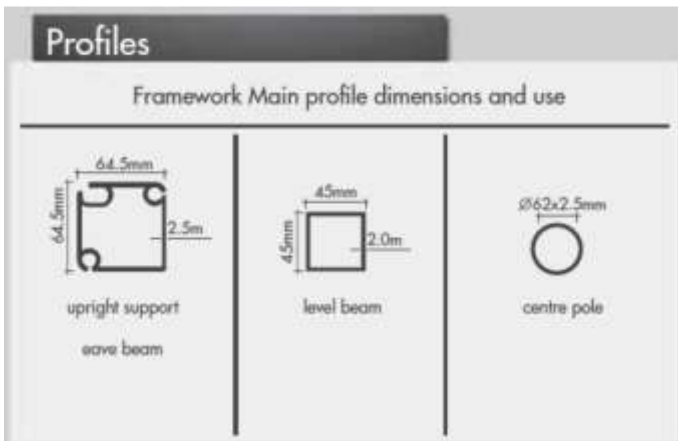
3.3 Buckling Constants

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

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

3.4 Section Properties

MEMBER(S)	Section	b	d	t	y_c	A_g	Z_x	Z_y	S_x	S_y	I_x	I_y	J	r_x	r_y
		mm	*mm*	*mm*	*mm*	*mm²*	*mm³*	*mm³*	*mm³*	*mm³*	*mm⁴*	*mm⁴*	*mm⁴*	*mm*	*mm*
Upright Support	64.5x64.5x2.5	64.5	64.5	2.5	32.3	620.0	12336.7	12336.7	14422.8	14422.8	397859.2	397859.2	595820.0	25.3	25.3
Centre Pole	62x2.5CHS	62	62	2.5	31.0	467.3	6682.8	6682.8	8855.8	8855.8	207165.2	207165.2	414330.4	21.1	21.1
Eave	45x45x2	45	45	2	22.5	344.0	4721.7	4721.7	5551.0	5551.0	106238.7	106238.7	159014.0	17.6	17.6



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 45km/hr gust	W	0.078 C_{fig}	1.0	0.078 C_{fig}

4.2 Load Combinations

4.2.1 Serviceability

Gravity = $1.0 \times G$

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

4.2.2 Ultimate

Downward = $1.35 \times G$

= $1.2 \times G + W_u$

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

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

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 = 12.5m/s (45 km/hr) *(regional 3 s gust wind speed)*
M_d = 1
M_s = 1
M_t = 1
$M_{z,cat}$ = 0.91 *(Table 4.1(B) AS1170.2)*

$V_{sit,\beta}$ = 11.38 m/s

Height of structure (h) = 3.85 m *(mid of peak and eave)*
Width of structure (w) = 5 m
Length of structure (l) = 5 m

Pressure (P) = $0.5\rho_{air} (V_{sit,\beta})^2 C_{fig} C_{dyn}$
= $0.078C_{fig}$ kPa

5.2 Pressure Coefficients (C_{fig})

Name	Symbol	Value	Unit	*Notes*	*Ref.*
		Input			
Importance level		2			*Table 3.1 - Table 3.2 (AS1170.0)*
Annual probability of exceedance		Temporary			*Table 3.3*
Regional gust wind speed		**45**	Km/hr		Table 3.1
Regional gust wind speed	V_R	**12.50**	m/s		
Wind Direction Multipliers	M_d	1			*Table 3.2 (AS1170.2)*
Terrain Category Multiplier	$M_{Z,Cat}$	0.91			Table 4.1
Shield Multiplier	M_S	1			*4.3 (AS1170.2)*
Topographic Multiplier	M_t	1			*4.4 (AS1170.2)*
Site Wind Speed	$V_{Site,\beta}$	**11.38**	m/s	$V_{Site,\beta}=V_R{*}M_d{*}M_{z,cat}{*}M_S,M_t$	
Pitch	α	45	Deg		

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

Pitch	α	0.785	rad		
Width	B	5	m		
Width Span	S_w	5	m		
Length	D	5	m		
Height	Z	3.85	m		
Bay Span		5	m		
Purlin Spacing		-	m		
Number of Intermediate Purlin		-			
	h/d	0.69			
	h/b	0.69			

Wind Pressure

ρair	ρ	1.2	Kg/m^3		
dynamic response factor	C_{dyn}	1			
Wind Pressure	$\rho{*}C_{fig}$	**0.078**	Kg/m^2	*$p=0.5\rho_{air}{*}(V_{des,\beta})^2{*}C_{fig}{*}C_{dyn}$*	*2.4 (AS1170.2)*

WIND DIRECTION 1 & 2

Internal Pressure

Opening Assumption: With Dominant Opening (Cpi= nCpe

Internal Pressure Coefficient (Without Dominant) **MIN**		-0.1		Table 5.1 A
Internal Pressure Coefficient (Without Dominant) **MAX**		0.2		
Internal Pressure Coefficient (With Dominant) **MIN**		-0.1		Table 5.1B
Internal Pressure Coefficient (With Dominant) **MAX**		0.2		
N		**0.6**	*Cpi= N*Cpe*	
Combination Factor	$K_{C,i}$	1		
Internal Pressure Coefficient **MIN**	$C_{p,i}$	0.60		
Internal Pressure Coefficient **MAX**	$C_{p,i}$	0.60		

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

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	**0.04**	**kPa**		
Edge Column Force	F	**0.13**	**kN/m**		
Intermediate Column Force	F	**0.26**	**kN/m**		
2. Leeward Wall					Table 5.2 B
External Pressure Coefficient	$C_{P,e}$	-0.5			
Area Reduction Factor	K_a	1			*Table 5.4*
combination factor applied to internal pressures	$K_{C,e}$	0.8			
local pressure factor	K_l	1			
porous cladding reduction factor	K_p	1			
aerodynamic shape factor	$C_{fig,e}$	-0.4			
Lee Wall Pressure	P	**-0.03**	**kPa**		
Edge Column Force	F	**-0.09**	**kN/m**		
Intermediate Column Force	F	**-0.19**	**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*	

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

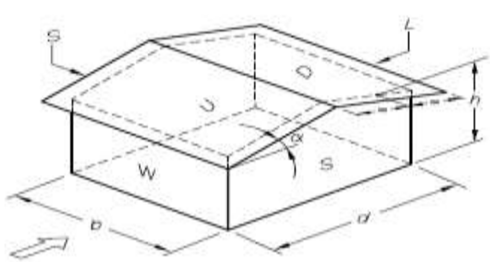
aerodynamic shape factor	$C_{fig,e}$	-0.52		*0 to 1h*	
aerodynamic shape factor	$C_{fig,e}$	-0.4		*1h to 2h*	
aerodynamic shape factor	$C_{fig,e}$	-0.24		*2h to 3h*	
aerodynamic shape factor	$C_{fig,e}$	-0.16		*>3h*	
Side Wall Pressure	P	**-0.04**	**kPa**	*0 to 1h*	
Side Wall Pressure	P	**-0.03**	**kPa**	*1h to 2h*	
Side Wall Pressure	P	**-0.02**	**kPa**	*2h to 3h*	
Side Wall Pressure	P	**-0.01**	**kPa**	*>3h*	
4. Roof Up Wind Slope				α *>10°*	
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			Table 5.3 B
External Pressure Coefficient **MAX**	$C_{P,e}$	0.565			
aerodynamic shape factor **MIN**	$C_{fig,e}$	0.00			
aerodynamic shape factor **MAX**	$C_{fig,e}$	0.45			
Pressure **MIN**	P	**0.00**	**kPa**		
Pressure **MAX**	P	**0.04**	**kPa**		
Edge Rafter Force **MIN**	F	**0.00**	**kN/m**		
Edge Rafter Force **Max**	F	**0.11**	**kN/m**		
Intermediate Rafter Force **MIN**	F	**0.00**	**kN/m**		
Intermediate Rafter Force **MAX**	F	**0.21**	**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	**-0.04**	**kPa**		
Pressure **MAX**	P	**-0.04**	**kPa**		

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

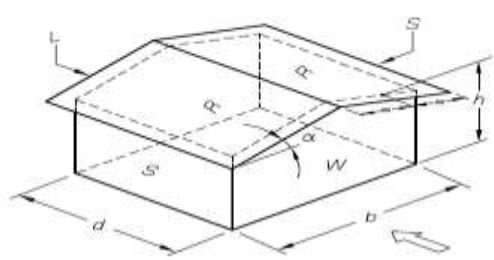
Edge Rafter Force **MIN**	F	**-0.11**	**kN/m**
Edge Rafter Force **MAX**	F	**-0.11**	**kN/m**
Intermediate Rafter Force **MIN**	F	**-0.22**	**kN/m**
Intermediate Rafter Force **MAX**	F	**-0.22**	**kN/m**

5.2.1 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">0.04</td><td colspan="5">0.00</td></tr>
<tr><td colspan="3">Leeward (kPa)</td><td colspan="2">-0.03</td><td colspan="5">0.00</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>4.15</td><td>-0.04</td><td colspan="5">0.00</td></tr>
<tr><td>1h - 2h</td><td>4.15</td><td>8.3</td><td>-0.03</td><td colspan="5">0.00</td></tr>
<tr><td>2h - 3h</td><td>8.3</td><td>12.45</td><td>-0.02</td><td colspan="5">0.00</td></tr>
<tr><td>>3h</td><td>12.45</td><td>-</td><td>-0.01</td><td colspan="5">0.00</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>0.00</td><td>0.04</td><td>0-0.5h</td><td>0.00</td><td>2.08</td><td>0.00</td><td>0.00</td></tr>
<tr><td colspan="2">Downwind Slope</td><td>-0.04</td><td>-0.04</td><td>0.5h-1h</td><td>2.08</td><td>4.15</td><td>0.00</td><td>0.00</td></tr>
<tr><td colspan="4" rowspan="3"></td><td>1h-2h</td><td>4.15</td><td>8.30</td><td>0.00</td><td>0.00</td></tr>
<tr><td>2h-3h</td><td>8.30</td><td>12.45</td><td>0.00</td><td>0.00</td></tr>
<tr><td>>3h</td><td>12.45</td><td>-</td><td>0.00</td><td>0.00</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>Proportion of Cpe</td><td>Proportion of Cpe</td><td colspan="3">Proportion of Cpe</td><td colspan="2">Proportion of Cpe</td></tr>
</table>



Direction 1



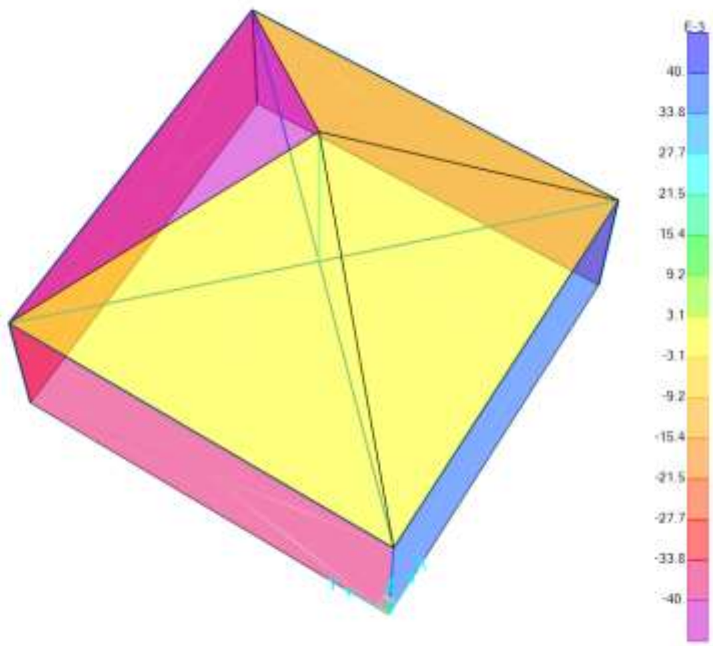
Direction 2

AS1170.2

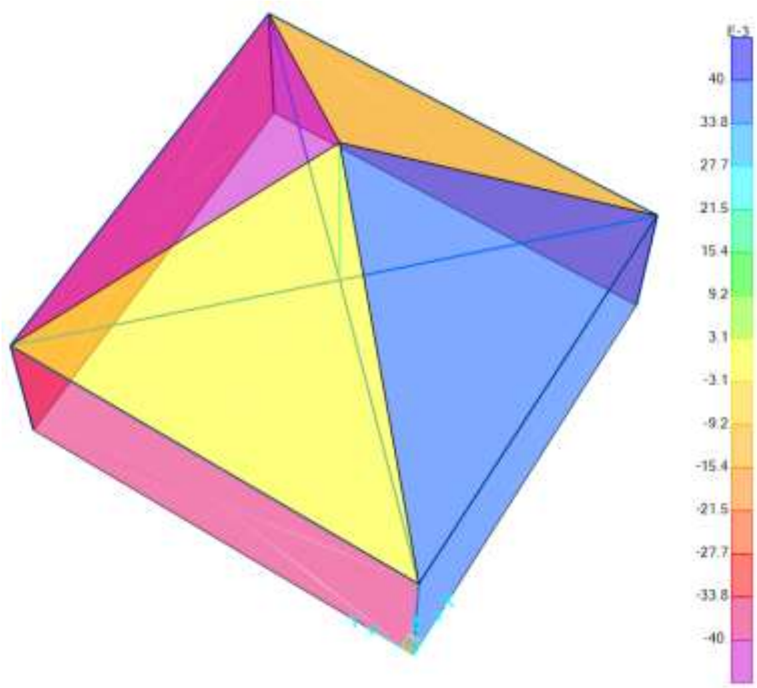
ABN: 62 051 307 852
3 Wanniti Road BELROSE NSW 2085
Tel: 02 9975 3899 Fax: 02 99751943
Email: hited@bigpond.net.au
Web: www.civilandstructural.com.au

5.3 Wind Load Diagrams

5.3.1 Wind (case 1)



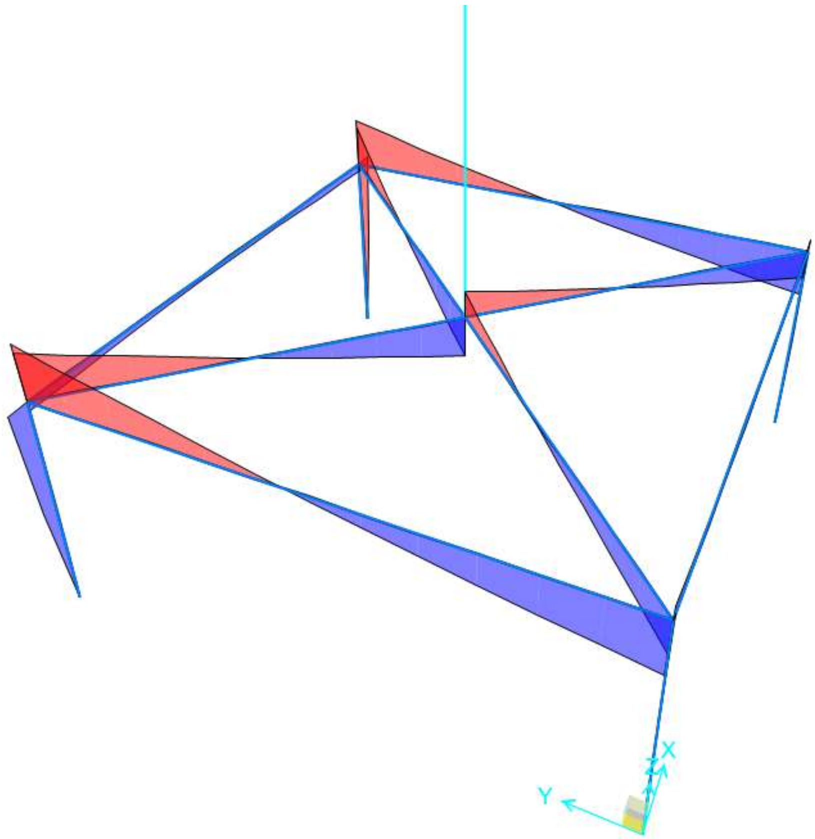
5.3.2 Wind (case 2)



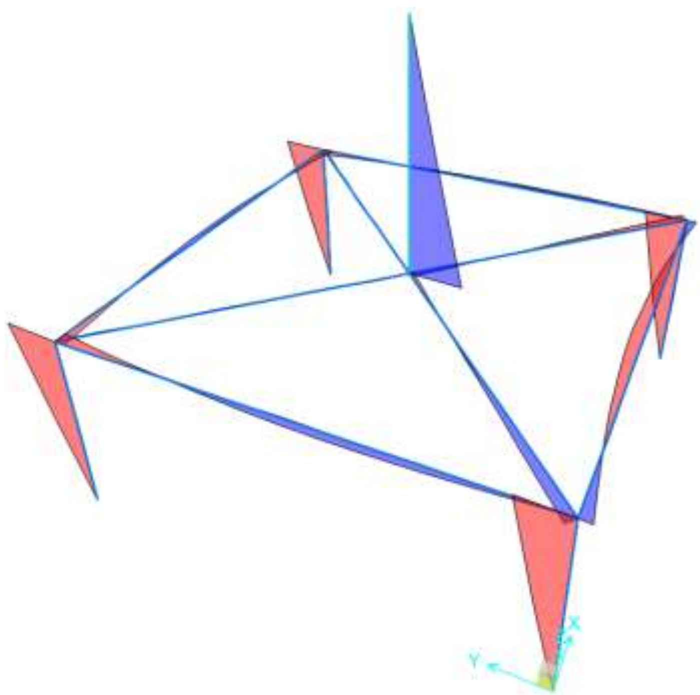
After 3D model analysis, each member is checked based on adverse load combination.
In this regard the maximum bending moment, shear and axial force due to adverse load combinations for each member are presented as below:

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

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

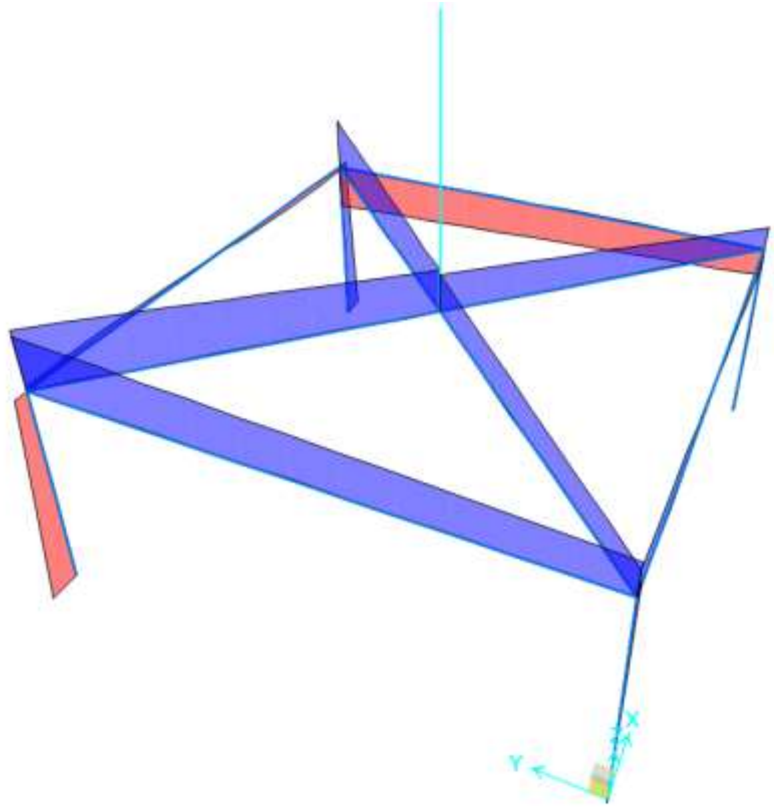


5.3.4 Max Bending Moment in minor axis due to critical load combination

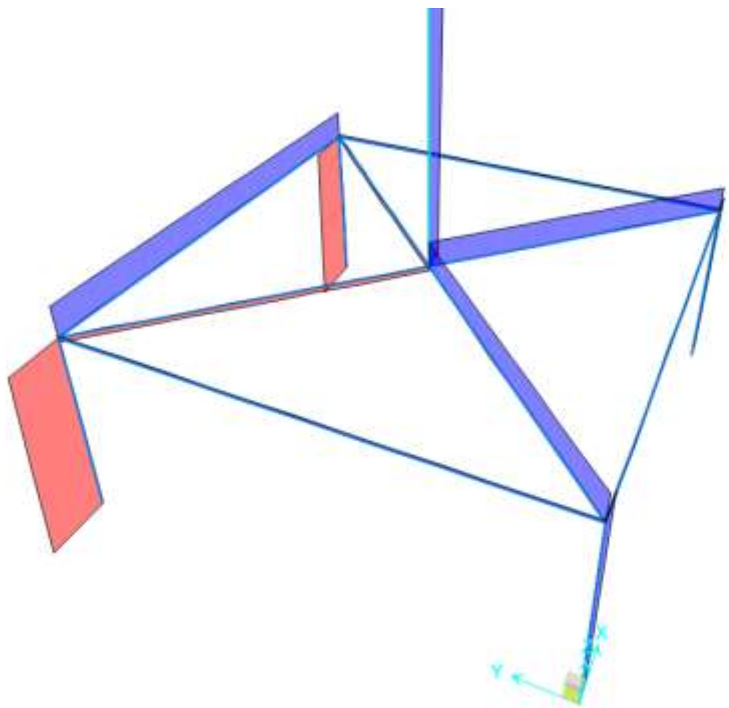


ABN: 62 051 307 852
3 Wanniti Road BELROSE NSW 2085 Tel: 02 9975 3899 Fax: 02 99751943
Email: **hited@bigpond.net.au** **Web:** **www.civilandstructural.com.au**

5.3.5 Max Shear in due to critical load combination

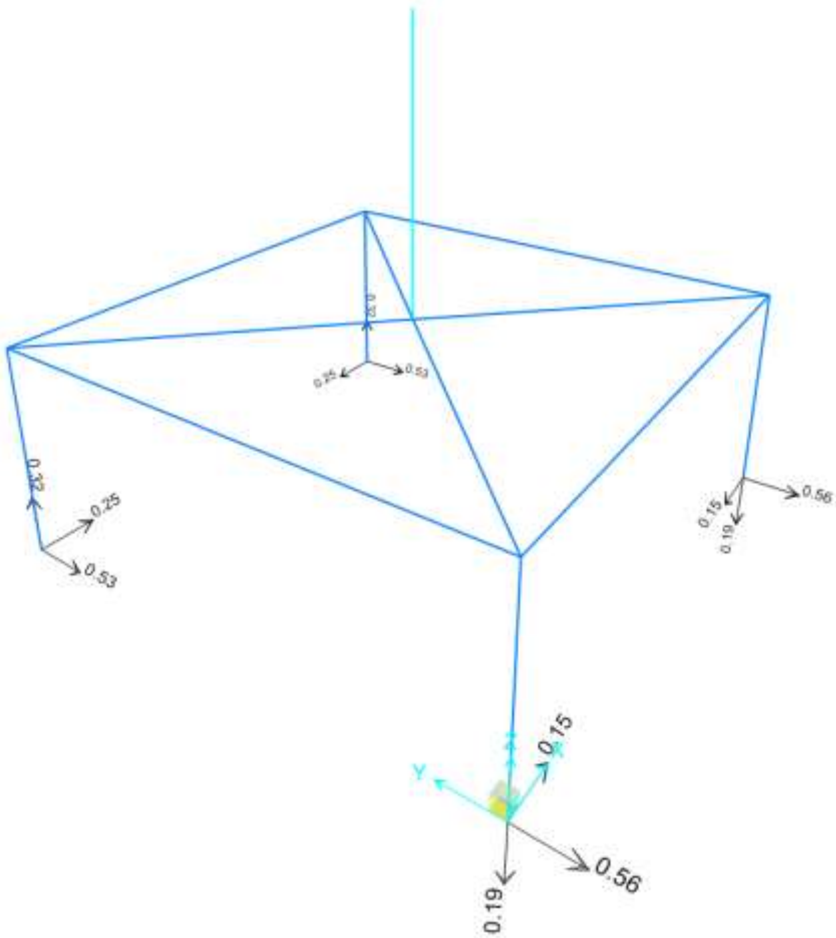


5.3.6 Max Axial force in upright support and roof beam due to critical load combination



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

5.3.7 Max reactions



Max Reaction (Bearing) $N^* = 0.61$ kN
Max Reaction (Uplift) $N^* = 0.19$ kN

5.3.8 Summary Table:

MEMBER(S)	Section	b	d	t	Vx	Vy	P (Axial) Negative -> Compression Positive -> Tension	Mx	My
		mm	mm	mm	kN	kN	kN	kN.m	kN.m
Upright Support	64.5x64.5x2.5	64.5	64.5	2.5	0.07	0.503	-0.561	-0.2843	-1.345
Centre Pole	62x2.5CHS	62	62	2.5	9E-19	0.407	-0.049	-2.451E-12	1.3
Eave	45x45x2	45	45	2	-0.29	-0.018	-0.087	-0.76	-0.0544

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

6 Checking Members Based on AS1664.1 ALUMINIUM LSD

6.1 Upright Supports

NAME	SYMBOL		VALUE	UNIT	NOTES	REF
64.5x64.5x2.5	**Upright Support**					
Alloy and temper	6061-T6					AS1664.1
Tension	F_{tu}	=	262	MPa	*Ultimate*	T3.3(A)
	F_{ty}	=	241	MPa	*Yield*	
Compression	F_{cy}	=	241	MPa		
Shear	F_{su}	=	165	MPa	*Ultimate*	
	F_{sy}	=	138	MPa	*Yield*	
Bearing	F_{bu}	=	551	MPa	*Ultimate*	
	F_{by}	=	386	MPa	*Yield*	
Modulus of elasticity	E	=	70000	MPa	*Compressive*	
	k_t	=	1.0			T3.4(B)
	k_c	=	1.0			
FEM ANALYSIS RESULTS						
Axial force	P	=	0.561	kN	*compression*	
	P	=	0	kN	*Tension*	
In plane moment	M_x	=	0.2843	kNm		
Out of plane moment	M_y	=	1.345	kNm		
DESIGN STRESSES						
Gross cross section area	A_g	**=**	620	mm^2		
In-plane elastic section modulus	Z_x	**=**	12336.718	mm^3		
Out-of-plane elastic section mod.	Z_y	**=**	12336.718	mm^3		
Stress from axial force	$\mathbf{f_a}$	**=**	P/A_g			
		=	**0.90**	**MPa**	*compression*	
		=	**0.00**	**MPa**	*Tension*	
Stress from in-plane bending	$\mathbf{f_{bx}}$	**=**	M_x/Z_x			
		=	**23.05**	**MPa**	*compression*	
Stress from out-of-plane bending	$\mathbf{f_{by}}$	**=**	M_y/Z_y			
		=	**109.02**	**MPa**	*compression*	
Tension						
***3.4.3** Tension in rectangular tubes*						

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

	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	=	2500	mm		
Effective length factor	k	=	1			
Radius of gyration about buckling axis (Y)	r_y	=	25.33	mm		
Radius of gyration about buckling axis (X)	r_x	=	25.33	mm		
Slenderness ratio	kLb/ry	=	98.69			
Slenderness ratio	kL/rx	=	98.69			
Slenderness parameter	λ	=	1.84			
	D_c*	=	90.3			
	S_1*	=	0.33			
	S_2*	=	1.23			
	ϕ_{cc}	=	0.838			
Factored limit state stress	**ϕF_L**	**=**	**59.45**	**MPa**		
2. Sections not subject to torsional or torsional-flexural buckling						… 3.4.8.2
Largest slenderness ratio for flexural buckling	kL/r	**=**	98.69			
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'	**=**	59.5			
	t	**=**	2.5	mm		
Slenderness	b/t	**=**	23.8			
Limit 1	S_1	**=**	12.34			
Limit 2	S_2	**=**	32.87			
Factored limit state stress	**ϕF_L**	**=**	**196.79**	**MPa**		

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

Most adverse compressive limit state stress	F_a	=	59.45	MPa		
Most adverse tensile limit state stress	F_a	=	222.70	MPa		
Most adverse compressive & Tensile capacity factor	f_a/F_a	=	0.02		PASS	
BENDING - IN-PLANE						
3.4.15 *Compression in beams, extreme fibre, gross section rectangular tubes, box sections*						
Unbraced length for bending	L_b	=	2500	mm		
Second moment of area (weak axis)	I_y	=	3.98E+05	mm^4		
Torsion modulus	J	=	5.96E+05	mm^3		
Elastic section modulus	Z	=	12336.718	mm^3		
Slenderness	S	=	126.69			
Limit 1	S_1	=	0.39			
Limit 2	S_2	=	1695.86			
Factored limit state stress	**ϕF_L**	=	**204.57**	**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'	=	59.5	mm		
	t	=	2.5	mm		
Slenderness	b/t	=	23.8			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	46.95			
Factored limit state stress	**ϕF_L**	=	**196.79**	**MPa**		
Most adverse in-plane bending limit state stress	F_{bx}	=	196.79	MPa		
Most adverse in-plane bending capacity factor	f_{bx}/F_{bx}	=	0.12		PASS	
BENDING - OUT-OF-PLANE						

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

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

Factored limit state stress	**ϕF_L**	=	**196.79**	**MPa**		
Most adverse out-of-plane bending limit state stress	**F_{by}**	=	196.79	MPa		
Most adverse out-of-plane bending capacity factor	**f_{by}/F_{by}**	=	0.55		PASS	

COMBINED ACTIONS

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

	F_a	=	59.45	MPa		… 3.4.8
	F_{ao}	=	196.79	MPa		… 3.4.10
	F_{bx}	=	196.79	MPa		… 3.4.17
	F_{by}	=	196.79	MPa		… 3.4.17
	f_a/F_a	=	0.015			
Check:	$f_a/F_a + f_{bx}/F_{bx} + f_{by}/F_{by} \leq 1.0$					… 4.1.1 (3)
i.e.	0.69	≤	1.0		PASS	

SHEAR

***3.4.24** Shear in webs (Major Axis)* … 4.1.1(2)

Clear web height	h	=	59.5	mm
	t	=	2.5	mm
Slenderness	h/t	=	23.8	
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	
			0.24	**MPa**

***3.4.25** Shear in webs (Minor Axis)*

Clear web height	b	=	59.5	mm
	t	=	2.5	mm
Slenderness	b/t	=	23.8	
Factored limit state stress	**ϕF_L**	=	**131.10**	**MPa**

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

Stress From Shear force	f_{sy}	=	V/A_w			
			1.69	**MPa**		

6.2 Eave

NAME	SYMBOL		VALUE	UNIT	NOTES	REF
45x45x2	**Eave**					
Alloy and temper	6061-T6					AS1664.1
Tension	F_{tu}	=	262	MPa	*Ultimate*	T3.3(A)
	F_{ty}	=	241	MPa	*Yield*	
Compression	F_{cy}	=	241	MPa		
Shear	F_{su}	=	165	MPa	*Ultimate*	
	F_{sy}	=	138	MPa	*Yield*	
Bearing	F_{bu}	=	551	MPa	*Ultimate*	
	F_{by}	=	386	MPa	*Yield*	
Modulus of elasticity	E	=	70000	MPa	*Compressive*	
	k_t	=	1.0			T3.4(B)
	k_c	=	1.0			
FEM ANALYSIS RESULTS						
Axial force	P	=	0.087	kN	*compression*	
	P	=	0	kN	*Tension*	
In plane moment	M_x	=	0.76	kNm		
Out of plane moment	M_y	=	0.0544	kNm		
DESIGN STRESSES						
Gross cross section area	A_g	**=**	344	mm^2		
In-plane elastic section modulus	Z_x	**=**	4721.7185	mm^3		
Out-of-plane elastic section mod.	Z_y	**=**	4721.7185	mm^3		
Stress from axial force	f_a	**=**	P/A_g			
		=	**0.25**	**MPa**	*compression*	
		=	**0.00**	**MPa**	*Tension*	
Stress from in-plane bending	f_{bx}	**=**	M_x/Z_x			
		=	**160.96**	**MPa**	*compression*	
Stress from out-of-plane	f_{by}	**=**	M_y/Z_y			

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

bending		=	**11.52**	**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	=	17.57	mm		
Radius of gyration about buckling axis (X)	r_x	=	17.57	mm		
Slenderness ratio	kLb/ry	=	341.42			
Slenderness ratio	kL/rx	=	341.42			
Slenderness parameter	λ	=	6.38			
	D_c*	=	90.3			
	S_1*	=	0.33			
	S_2*	=	1.23			
	ϕ_{cc}	=	0.950			
Factored limit state stress	**ϕF_L**	=	**5.63**	**MPa**		
2. Sections not subject to torsional or torsional-flexural buckling						… 3.4.8.2
Largest slenderness ratio for flexural buckling	kL/r	=	341.42			
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'	=	41			
	t	=	2	mm		
Slenderness	b/t	=	20.5			
Limit 1	S_1	=	12.34			

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

Limit 2	S_2	=	32.87			
Factored limit state stress	**ϕF_L**	=	**206.05**	**MPa**		
Most adverse compressive limit state stress	F_a	=	5.63	MPa		
Most adverse tensile limit state stress	F_a	=	222.70	MPa		
Most adverse compressive & Tensile capacity factor	f_a/F_a	=	0.04		PASS	
BENDING - IN-PLANE						
***3.4.15** Compression in beams, extreme fibre, gross section rectangular tubes, box sections*						
Unbraced length for bending	L_b	=	6000	mm		
Second moment of area (weak axis)	I_y	=	106238.67	mm^4		
Torsion modulus	J	=	159014	mm^3		
Elastic section modulus	Z	=	4721.7185	mm^3		
Slenderness	S	=	435.94			
Limit 1	S_1	=	0.39			
Limit 2	S_2	=	1695.86			
Factored limit state stress	**ϕF_L**	=	**182.49**	**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'	=	41	mm		
	t	=	2	mm		
Slenderness	b/t	=	20.5			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	46.95			
Factored limit state stress	**ϕF_L**	=	**206.05**	**MPa**		

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

Most adverse in-plane bending limit state stress	F_{bx}	=	182.49	MPa		
Most adverse in-plane bending capacity factor	f_{bx}/F_{bx}	=	0.88		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	$\boldsymbol{\phi F_L}$	=	**182.49**	**MPa**		
Most adverse out-of-plane bending limit state stress	$\mathbf{F_{by}}$	=	182.49	MPa		
Most adverse out-of-plane bending capacity factor	$\mathbf{f_{by}/F_{by}}$	=	0.06		PASS	
COMBINED ACTIONS						
***4.1.1** Combined compression and bending*						… 4.1.1(2)
	F_a	=	5.63	MPa		… 3.4.8
	F_{ao}	=	206.05	MPa		… 3.4.10
	F_{bx}	=	182.49	MPa		… 3.4.17
	F_{by}	=	182.49	MPa		… 3.4.17
	f_a/F_a	=	0.045			
Check:	$f_a/F_a + f_{bx}/F_{bx} + f_{by}/F_{by} \leq 1.0$					… 4.1.1 (3)
i.e.	0.99	≤	1.0		PASS	
SHEAR						
***3.4.24** Shear in webs (Major Axis)*						… 4.1.1(2)
Clear web height	h	=	41	mm		
	t	=	2	mm		
Slenderness	h/t	=	20.5			
Limit 1	S_1	=	29.01			
Limit 2	S_2	=	59.31			
Factored limit state stress	$\boldsymbol{\phi F_L}$	=	**131.10**	**MPa**		
Stress From Shear force	$\mathbf{f_{sx}}$	=	V/A_w			
			1.77	**MPa**		
***3.4.25** Shear in webs (Minor Axis)*						

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

Clear web height	b	=	41	mm		
	t	=	2	mm		
Slenderness	b/t	=	20.5			
Factored limit state stress	**ϕF_L**	=	**131.10**	**MPa**		
Stress From Shear force	**f_{sy}**	=	V/A_w			
			0.11	**MPa**		

6.3 Centre Pole

NAME	SYMBOL		VALUE	UNIT	NOTES	REF
62x2.5CHS	**Centre 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	=	0.049	kN	*compression*	
	P	=	0	kN	*Tension*	
In plane moment	M_x	=	2.451E-12	kNm		
Out of plane moment	M_y	=	1.3	kNm		
DESIGN STRESSES						
Gross cross section area	A_g	**=**	467.3	mm^2		
In-plane elastic section modulus	Z_x	**=**	6682.75	mm^3		
Out-of-plane elastic section mod.	Z_y	**=**	6682.75	mm^3		

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

Stress from axial force	**f_a**	**=**	P/A_g			
		=	**0.10**	**MPa**	*compression*	
		=	**0.00**	**MPa**	*Tension*	
Stress from in-plane bending	**f_{bx}**	**=**	M_x/Z_x			
		=	**0.00**	**MPa**	*compression*	
Stress from out-of-plane bending	**f_{by}**	**=**	M_y/Z_y			
		=	**194.53**	**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	=	2700	mm		
Effective length factor	k	=	2.2			
Radius of gyration about buckling axis (Y)	r_y	=	21.05	mm		
Radius of gyration about buckling axis (X)	r_x	=	21.05	mm		
Slenderness ratio	kLb/ry	=	344.89			
Slenderness ratio	kL/rx	=	344.89			
Slenderness parameter	λ	=	6.44			
	D_c*	=	90.3			
	S_1*	=	0.33			
	S_2*	=	1.23			
	ϕ_{cc}	=	0.950			
Factored limit state stress	**ϕF_L**	**=**	**5.52**	**MPa**		
2. Sections not subject to torsional or torsional-flexural buckling						… 3.4.8.2
Largest slenderness ratio for flexural buckling	kL/r	**=**	344.89			
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

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

	k_1	=	0.35			T3.3(D)
Max. distance between toes of fillets of supporting elements for plate	b'	=	57			
	t	=	2.5	mm		
Slenderness	b/t	=	22.8			
Limit 1	S_1	=	12.34			
Limit 2	S_2	=	32.87			
Factored limit state stress	**ϕF_L**	=	**199.59**	**MPa**		
Most adverse compressive limit state stress	F_a	=	5.52	MPa		
Most adverse tensile limit state stress	F_a	=	222.70	MPa		
Most adverse compressive & Tensile capacity factor	f_a/F_a	=	0.02		PASS	
BENDING - IN-PLANE						
***3.4.15** Compression in beams, extreme fibre, gross section rectangular tubes, box sections*						
Unbraced length for bending	L_b	=	3300	mm		
Second moment of area (weak axis)	I_y	=	207165.2	mm^4		
Torsion modulus	J	=	414330.4	mm^3		
Elastic section modulus	Z	=	6682.75	mm^3		
Slenderness	S	=	150.55			
Limit 1	S_1	=	0.39			
Limit 2	S_2	=	1695.86			
Factored limit state stress	**ϕF_L**	=	**202.24**	**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'	=	57	mm		
	t	=	2.5	mm		
Slenderness	b/t	=	22.8			

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

Limit 1	S_1	=	12.34			
Limit 2	S_2	=	46.95			
Factored limit state stress	**ϕF_L**	=	**199.59**	**MPa**		
Most adverse in-plane bending limit state stress	F_{bx}	=	199.59	MPa		
Most adverse in-plane bending capacity factor	f_{bx}/F_{bx}	=	0.00		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**	=	**199.59**	**MPa**		
Most adverse out-of-plane bending limit state stress	**F_{by}**	=	199.59	MPa		
Most adverse out-of-plane bending capacity factor	**f_{by}/F_{by}**	=	0.97		PASS	
COMBINED ACTIONS						
***4.1.1** Combined compression and bending*						… 4.1.1(2)
	F_a	=	5.52	MPa		… 3.4.8
	F_{ao}	=	199.59	MPa		… 3.4.10
	F_{bx}	=	199.59	MPa		… 3.4.17
	F_{by}	=	199.59	MPa		… 3.4.17
	f_a/F_a	=	0.019			
Check:	$f_a/F_a + f_{bx}/F_{bx} + f_{by}/F_{by} \leq 1.0$					… 4.1.1 (3)
i.e.	0.99	$\leq$	1.0		PASS	
SHEAR						
***3.4.24** Shear in webs (Major Axis)*						… 4.1.1(2)
Clear web height	h	=	57	mm		
	t	=	2.5	mm		
Slenderness	h/t	=	22.8			
Limit 1	S_1	=	29.01			
Limit 2	S_2	=	59.31			

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

Factored limit state stress	**ϕF_L**	**=**	**131.10**	**MPa**
Stress From Shear force	**f_{sx}**	**=**	V/A_w	
			0.00	**MPa**
***3.4.25** Shear in webs (Minor Axis)*				
Clear web height	b	=	57	mm
	t	=	2.5	mm
Slenderness	b/t	=	22.8	
Factored limit state stress	**ϕF_L**	**=**	**131.10**	**MPa**
Stress From Shear force	**f_{sy}**	**=**	V/A_w	
			1.43	**MPa**

7 Summary

7.1 Conclusions

a. The 5m x 5m Pinnacle Range Pagoda Tent structure as specified has been analyzed with a conclusion that it has the capacity to withstand wind speeds up to and including **45km/hr.**

b. For forecast winds in excess of **45km/hr** – all fabric shall be removed from the frames, and the structure should be completely dismantled.

c. For uplift due to 45km/hr, 1.1 kN (110kg) 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.

MEMBER(S)	Section	b	d	t
		mm	mm	mm
Upright Support	64.5x64.5x2.5	64.5	64.5	2.5
Centre Pole (Steel)	76.1x3.2CHS	76.1	-	3.2
Eave	64.5x64.5x2.5	64.5	64.5	2.5

Yours faithfully,

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

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

8 Appendix A – Base Anchorage Requirements

Tent Span	Sile Type	Required Weight Per Leg
5 m	A	110kg
	B	110kg
	C	110kg
	D	110kg
	E	110kg

Definition of Soil Types:

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

Type B : Medium to stiff clays or silty clays

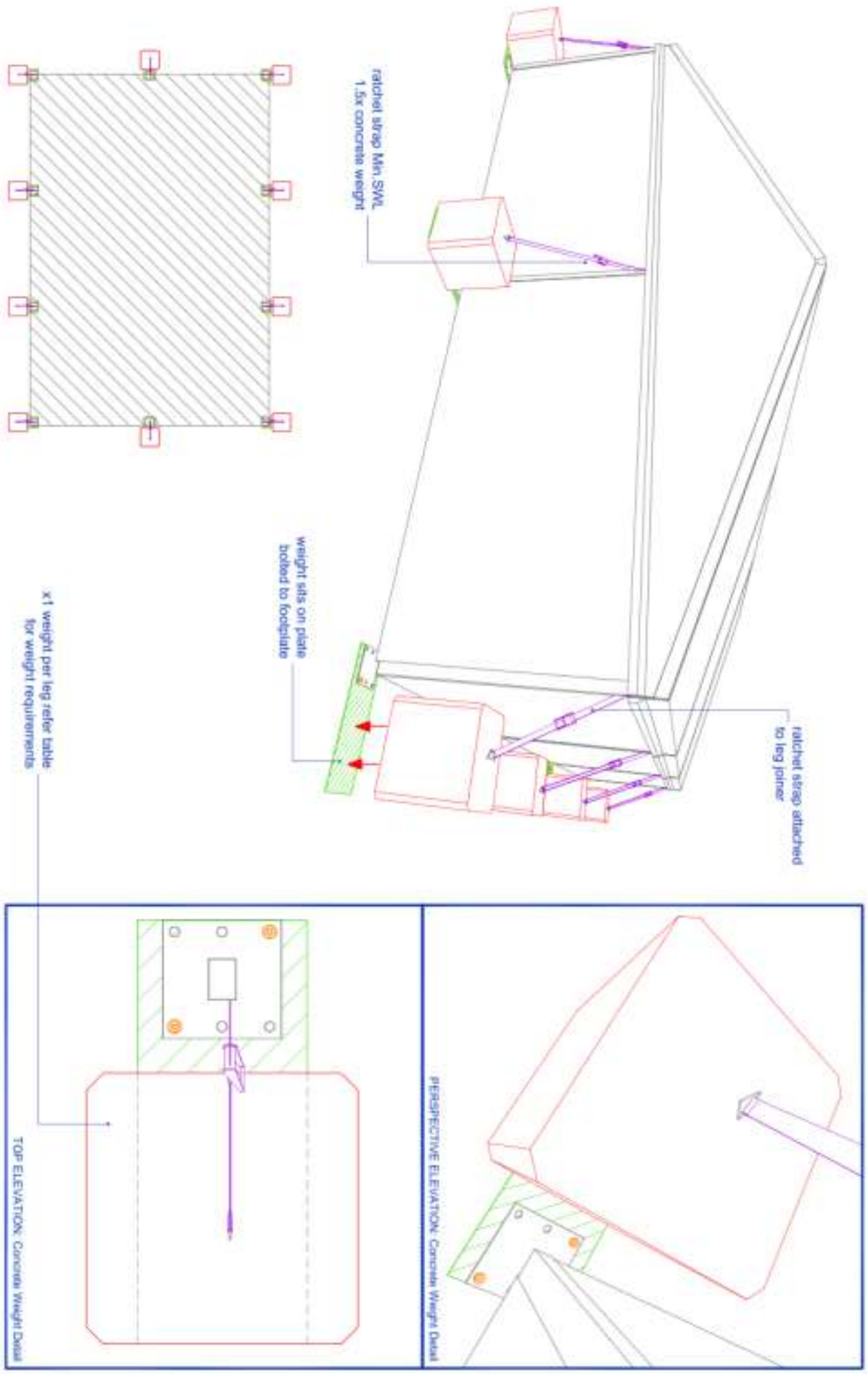
Type C: Moderately compact sand or gravel eg. of alluvial origin.

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

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

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

9 Appendix B – Hold Down Method Details



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