Civil & Structural Engineering Design Services Pty. Ltd.

Client: **Extreme Marquees Pty Ltd**
Project: Design check – 22m Double Pole Star Shade

Reference: Product Specification Sheets

Report by: KZ
Checked by: EAB
Date: 21/05/2015

JOB NO: E-11-263516

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Contents

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1 Introduction

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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 to analyse the temporary tent structures. The design wind speed and appropriate parameters such as wind action, terrain/height, shielding, topography and aerodynamic shape of structure are considered and reflected in the final design wind load on the structure.

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2 Design Restrictions and Limitations

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

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

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

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

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

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

2.6 The structures in no circumstances shall ever be erected in tropical or severe tropical cyclonic condition.

2.7 The free roof structure has not been designed to withstand additional snow loadings such as when erected in alpine regions.

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

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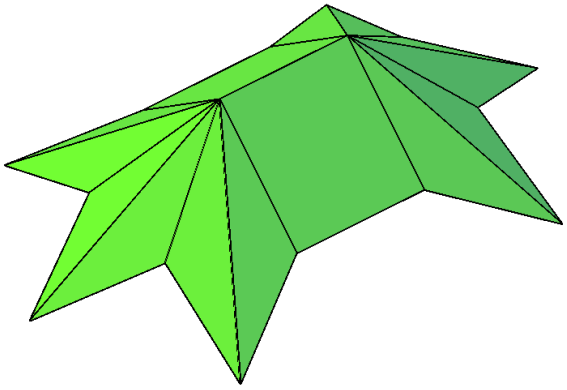
3 Specifications

3.1 General

Tent category	MEGAFRAME 42 HD (MF42HD)
Material	Aluminum Pole



Size	Model
22m	Double Pole Star Shades Tent

3.2 Aluminium Properties

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

3.3 Buckling Constants

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

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3.4 Section Properties

Section	Dimension	x	y	A	I_x	I_y	r_x	r_y	Z_x	Z_y
		mm	mm	mm^2	mm^4	mm^4	mm	mm	mm^3	mm^3
Pole Profile	ϕ 75x3	75	75	678.6	11746.3	11746.3	25.5	25.5	440485	440485

Design Loads

3.5 Serviceability

		Distributed load (kPa)	Design load factor (-)	Factored imposed load (kPa)
Superimposed live	Q	-	1	-
Self weight	G	self weight	1	Self weight
3s 91.8 km/hr gust	W	0.323 C_{fig}	1	0.323 C_{fig}

3.6 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 91.8km/hr gust	W	0.323 C_{fig}	1.0	0.323C_{fig}

3.7 Load Combinations

3.7.1 Serviceability

Gravity = $1.0 \times G$

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

3.7.2 Ultimate

Downward = $1.35 \times G$
= $1.2 \times G + W_u$

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

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4 Member Properties

4.1 Material Properties

		Thickness Range	Tension		Compression	Shear		Bearing		Compressive Modulus of Elasticity
		(mm)	(MPa)		(MPa)	(MPa)		(MPa)		(MPa)
Alloy	Product		Ftu	Fty	Fcy	Fsu	Fsy	Fbu	Fby	
6061-T6	Extrusions	Up to 25	262	241	241	165	138	551	386	70000

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 = 25.5 m/s (91.8 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)*

$V_{sit,\beta}$ = 23.205 m/s

Height of structure (h) = 6m *(mid of peak and eave)*
Width of structure (w) = 13.85 m
Length of structure (l) = 21.85 m

Pressure (P) = $0.5\rho_{air} (V_{sit,\beta})^2 C_{fig} C_{dyn}$
= $0.323 C_{fig}$ kPa

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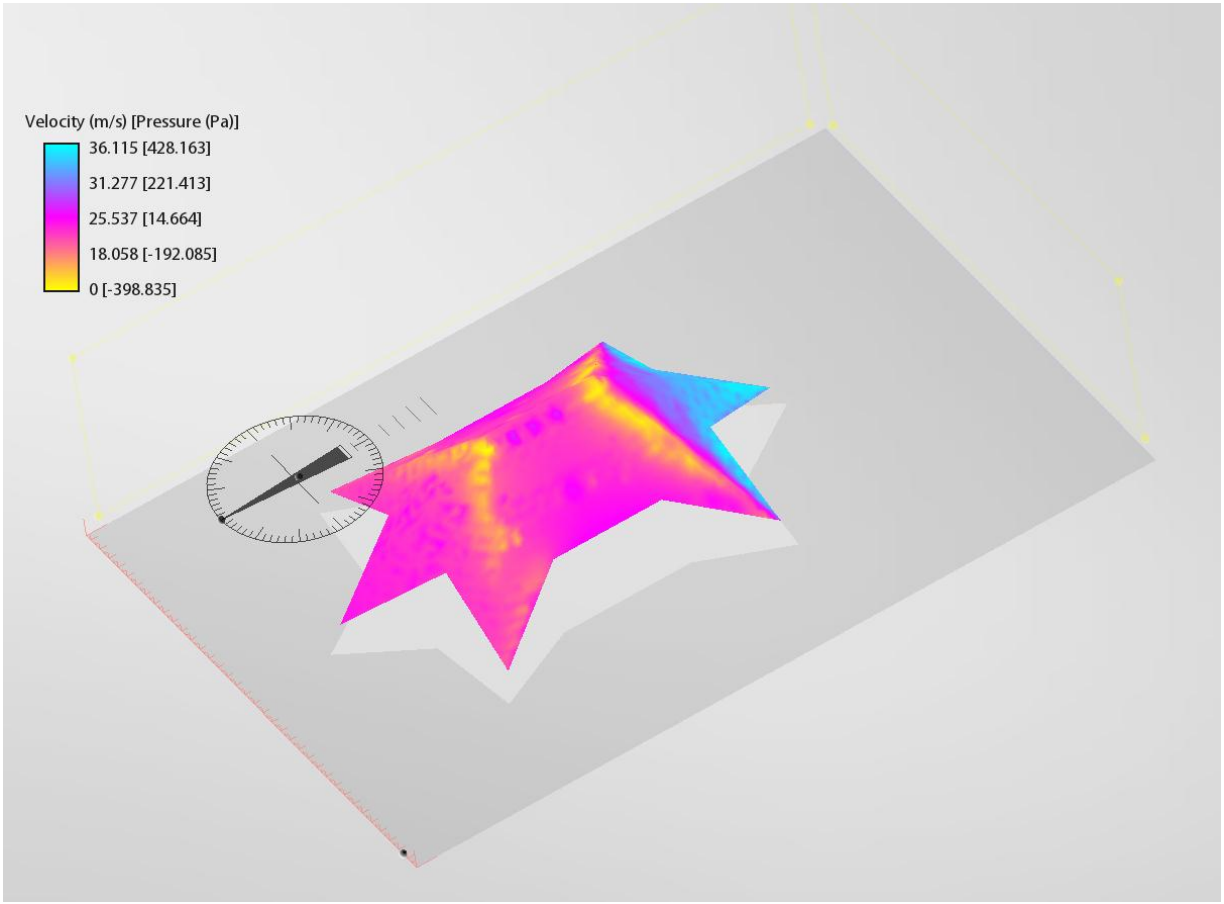
5.2 Wind Tunnel Simulation Results:

5.2.1 Wind Direction 0 degree



Max Pressure: 0.428 kPa
Maximum Suction: 0.4 kPa

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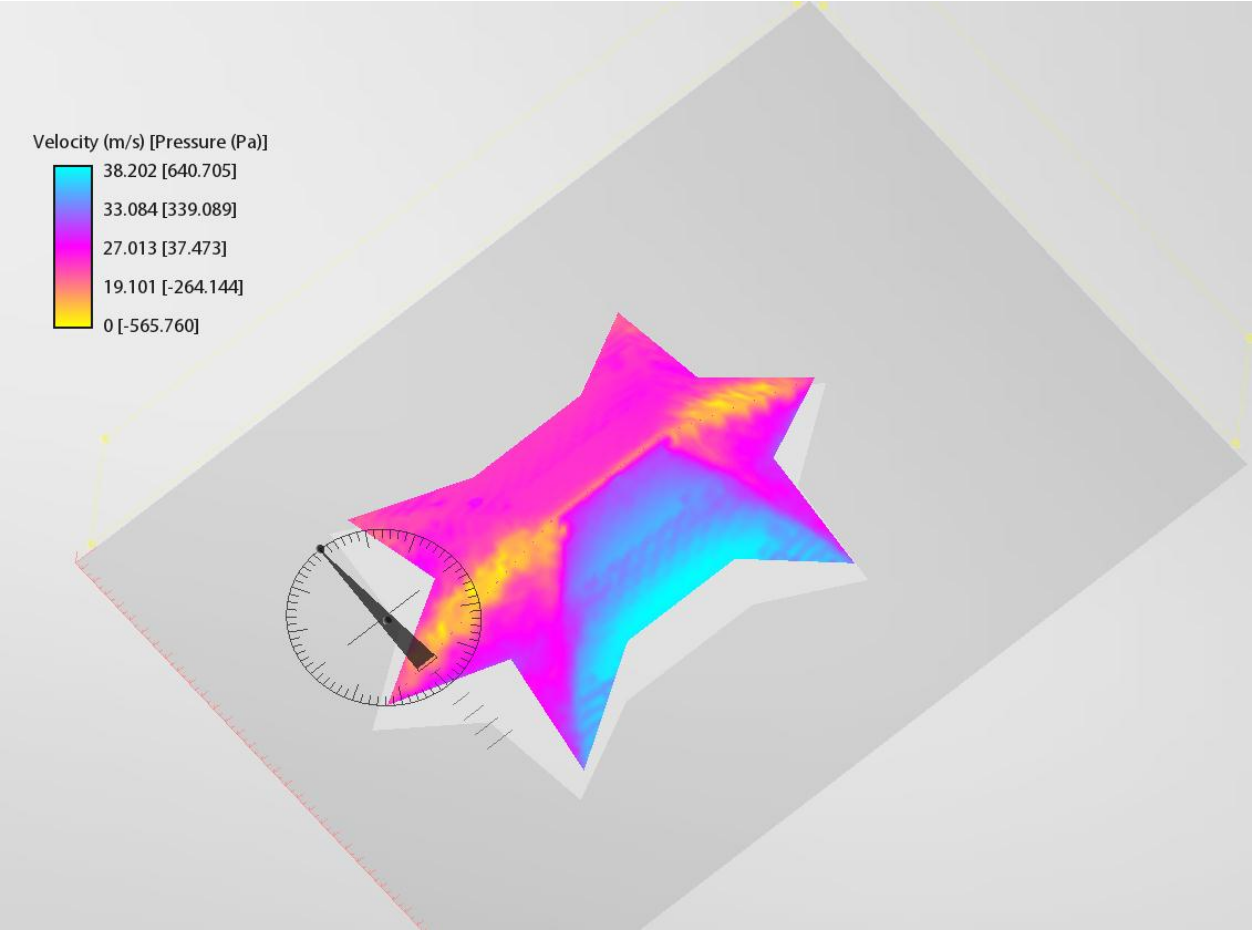
5.2.2 Wind Direction 90 degree



Max Pressure: 0.64 kPa
Maximum Suction: 0.565 kPa

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6 Summary

6.1 Conclusion

a. The 22m Double pole star shades Tents as specified has been analyzed with a conclusion that it has the capacity to withstand wind speeds up to and including **91.8km/hr.**

b. For forecast winds in excess of **90 km/hr** – the structure shall not be erected.

c. For resisting against uplift due to 91.8km/hr wind, 30kN (3Tonne) holding down weights per anchor are 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. Fabrics should have sufficient strength to resist against the mentioned pressure and suction due to 91.8km/hr wind speed.

Yours faithfully,

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APPENDIX "A" - Reduction in wind speed

Design wind speed for Temporary Structures

In accordance with AS 1170.2-2011:

For ultimate state design, $V_{des,\theta}$ shall be not less than 30 m/s for permanent structures (design life greater than 5 years), or less than 25 m/s for temporary structures (design life less than or equal to 5 years).

25*3.6= 90 Km/hr

In accordance with BCA:

Design wind speed:

Region	Probability of exceedance	Regional wind speed (in m/s) for a reference period of			
		1 year	6 months	1 Month	1 Week
A	1:100	41	39	34	30
	1:500	45	43	39	34

Reduction factor for temporary Structures:

Wind region	Reduction factor on regional wind speed for structures of		
	6-month duration	1 month duration	1 week duration
A	0.95	0.85	0.75

V= 34*0.75=25.5 m/s equal to 25.5*3.6=91.8 Km/hr

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