



Civil & Structural Engineering Design Services Pty. Ltd.

Client: Extreme Marquees Pty Ltd

Project: Design check – 8m x 4.64 High Pressure Inflatable Arches for 40km/hr Wind Speed

Reference: Extreme Marquees Technical Data

Report by: KZ
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1 Introduction

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

The report examines the effect of 3s gust wind of 40 km/hr on 8m x 4.64m High Pressure Inflatable arch 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.

2 Design Restrictions and Limitations

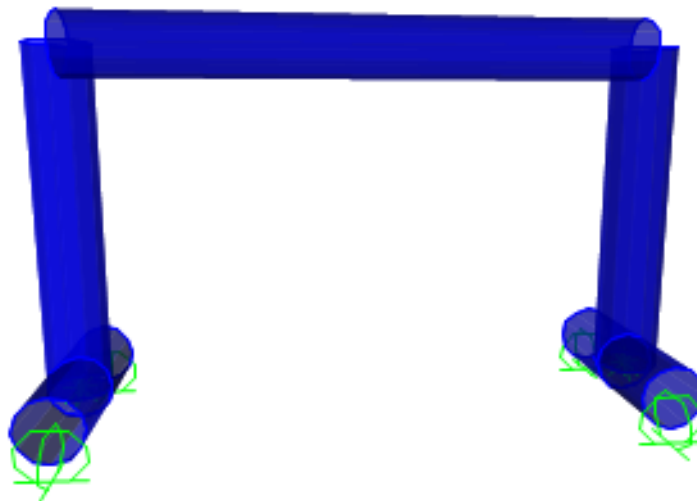
- 2.1 The erected structure is for temporary use only.
- 2.2 It should be noted that if high gust wind speeds are anticipated or forecast in the locality of the structure, the temporary erected structure should be deflated.
- 2.3 For forecast winds in excess of (**refer to summary**) the structure should be completely folded.
(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 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 shell by others.



3 Specifications

3.1 General

Size	Model
8m x 4.64m	Arch



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 C _{fig}	1.0	0.061 C _{fig}

4.2 Load Combinations

4.2.1 Serviceability

Gravity = 1.0 × G

Wind = 1.0 × G + 1.0 × 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 ($V_{sit,\beta}$) = $V_R M_d (M_{z,cat} M_s M_t)$

$V_R = 11.11$ m/s (40 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)

$V_{sit,\beta} = 10.11$ m/s

Height of structure (h) = 4.64 m

Width of structure (w) = 8 m

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

= 0.061 C_{fig} kPa

5.2 Pressure Coefficients (C_{fig})

Name	Symbol	Value	Unit	Notes	Ref.
Input					
Importance level		1			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
Regional gust wind speed	V_R	11.11	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)



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Site Wind Speed	$V_{Site,\beta}$	10.11	m/s	$V_{Site,\beta} = V_R * M_d * M_{z,cat} * M_s, M_t$
Width	B	8	m	
Height	Z	4.64	m	

Wind Pressure

ρ_{air}	ρ	1.2	Kg/m ³	$\rho = 0.5 \rho_{air} * (V_{des,\beta})^2 * C_{fig} * C_{dyn}$	2.4 (AS1170.2)
dynamic response factor	C_{dyn}	1			
Wind Pressure	$\rho * C_{fig}$	0.061	Kg/m ²		

WIND DIRECTION 1 External Pressure

1. Drag Force				<div style="border: 1px solid black; padding: 5px; display: inline-block;">Table 5.2 A</div> Table 5.4
Drag Force Coefficient	C_d	0.94		
Area Reduction Factor	K_a	1		
combination factor applied to internal pressures	$K_{c,e}$	1		
local pressure factor	K_l	1		
porous cladding reduction factor	K_p	1		
aerodynamic shape factor	C_{fig}	0.94		
Wind Wall Pressure	P	0.06	kPa	


5.2.1 Pressure summary

WIND PRESSURE	Direction1
Windward (kPa)	0.058



TABLE E3

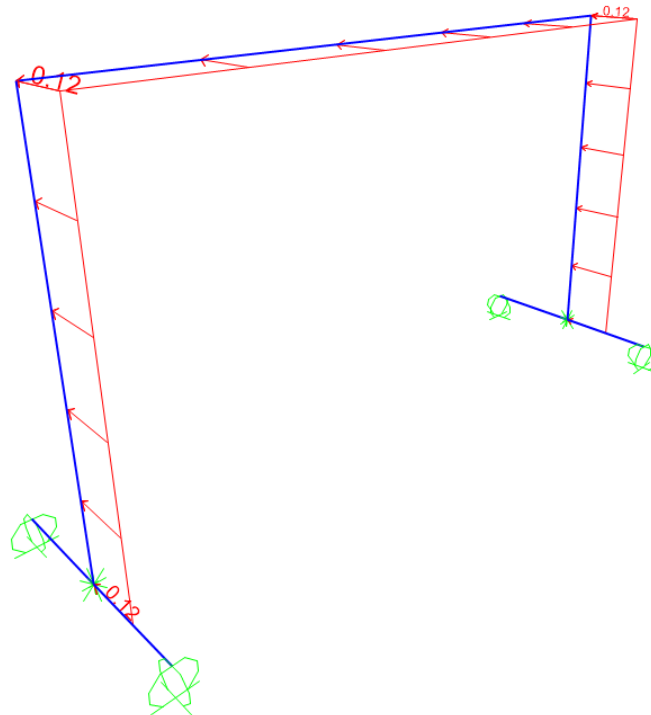
DRAG FORCE COEFFICIENTS (C_d) FOR ROUNDED CYLINDRICAL SHAPES

Cross-sectional shape	Description	Drag force coefficient (C_d) (see Note 1)	
		$bV_{des,\theta} < 4 \text{ m}^2/\text{s}$	$bV_{des,\theta} > 10 \text{ m}^2/\text{s}$
	Cylindrical	1.2	(see Note 2)

AS1170.2

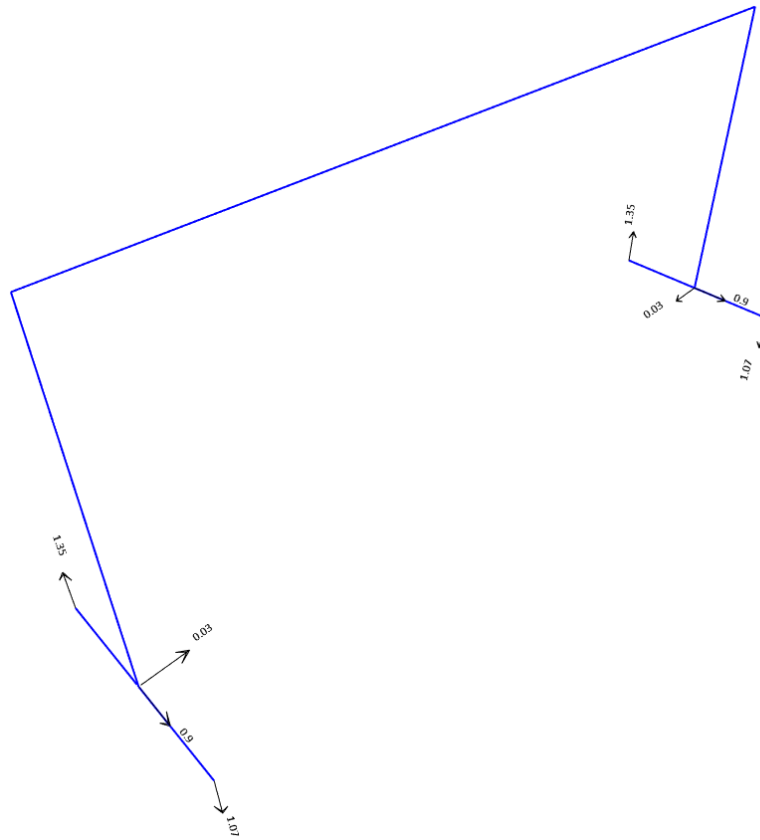
5.3 Wind Load Diagrams

5.3.1 Wind (case 1)





5.3.2 Max reactions



Max Reaction (Uplift) $N^* = 1.48$ kN

6 Summary

6.1 Conclusions

- The 8m x 4.64m high pressure inflatable arch as specified has been analyzed with a conclusion that for uplift due to **40km/hr**, 2.2kN (220kg) holding down weight at both ends of each foot is required (total is 440kg per leg or equivalent pegging system).
- For forecast winds in excess of **40km/hr** – the structure should be completely deflated.
- The bearing pressure of soil should be clarified.

Yours faithfully,

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