


<b>RICHARD COLEMAN AND PARTNERS LTD</b> 429-435 Ashley Road, Parkstone, Poole, Dorset, BH14 0AX Tel: (01202) 722022 Fax: (01202) 742809 E mail: design@richardcoleman.co.uk		<b>Project:</b> South Coast Domes	<b>Page No:</b> 1
		<b>Client:</b> Paul Bevan	<b>Rev:</b>
		<b>Element:</b> Wind Loading	<b>Job No:</b> 01
			<b>Calcs By:</b> MN
		<b>Date:</b> 28/04/2017	

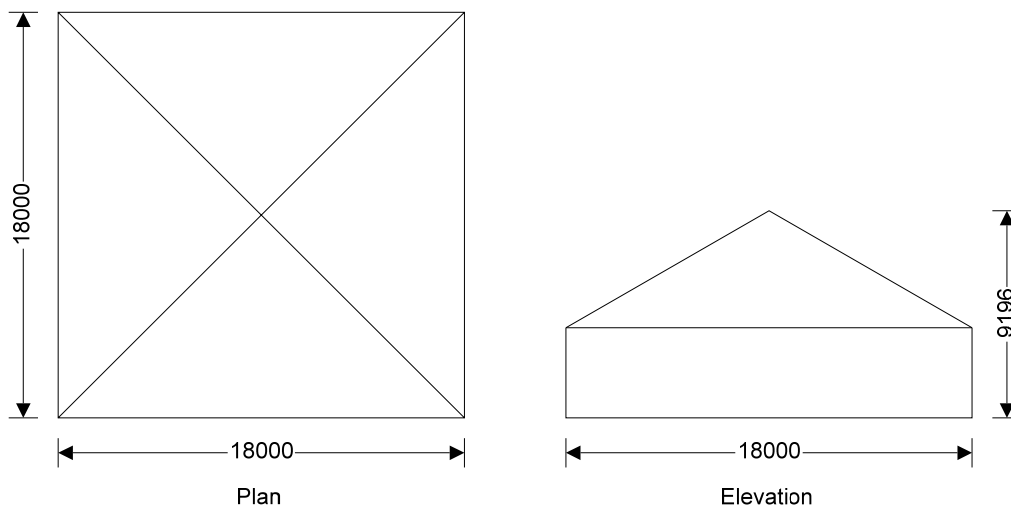
## 1. BALLAST REQUIREMENTS

### 1.1. Wind Loadings for 18m Geodome, 9m high, with wind speeds of 54m/s

#### WIND LOADING (BS6399)

##### WIND LOADING (BS6399)

TEDDS calculation version 3.0.15



#### **Building data**

Type of roof	Hipped
Length of building	L = 18000 mm
Width of building	W = 18000 mm
Height to eaves	H = 4000 mm
Pitch of main slope	$\alpha_0 = 30.0$ deg
Pitch of gable slope	$\alpha_{90} = 30.0$ deg
Reference height	H <sub>r</sub> = 9196 mm

#### **Dynamic classification**

Building type factor (Table 1)	K <sub>b</sub> = 8.0
Dynamic augmentation factor (1.6.1)	C <sub>r</sub> = $[K_b \times (H_r / (0.1 \text{ m}))^{0.75}] / (800 \times \log(H_r / (0.1 \text{ m}))) = 0.15$

#### **Site wind speed**

Location	Worst Case
Basic wind speed (Figure 6 BS6399:Pt 2)	V <sub>b</sub> = 54.0 m/s
Site altitude	Δ <sub>S</sub> = 20 m
Upwind distance from sea to site	d <sub>sea</sub> = 50 km
Direction factor	S <sub>d</sub> = 1.00
Seasonal factor	S <sub>s</sub> = 1.00
Probability factor	S <sub>p</sub> = 1.00

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Critical gap between buildings  $g = 50000$  mm  
Topography not significant  
Altitude factor  $S_a = 1 + 0.001 \times \Delta_s / 1m = 1.02$   
Site wind speed  $V_s = V_b \times S_a \times S_d \times S_s \times S_p = 55.1$  m/s  
Terrain category Country  
Displacement height (sheltering effect excluded)  $H_d = 0$ mm

**The velocity pressure for the windward face of the building with a 0 degree wind is to be considered as 1 part as the height h is less than b (cl.2.2.3.2)**

**The velocity pressure for the windward face of the building with a 90 degree wind is to be considered as 1 part as the height h is less than b (cl.2.2.3.2)**

**Dynamic pressure - windward wall - Wind 0 deg**


Reference height (at which q is sought)  $H_{ref} = 4000$ mm  
Effective height  $H_e = \max(H_{ref} - H_d, 0.4 \times H_{ref}) = 4000$ mm  
Fetch factor (Table 22)  $S_c = 0.860$   
Turbulence factor (Table 22)  $S_t = 0.200$   
Gust peak factor  $g_t = 3.44$   
Terrain and building factor  $S_b = S_c \times (1 + (g_t \times S_t) + S_h) = 1.45$   
Effective wind speed  $V_e = V_s \times S_b = 79.9$  m/s  
Dynamic pressure  $q_s = 0.613 \text{ kg/m}^3 \times V_e^2 = 3.913 \text{ kN/m}^2$

**Dynamic pressure - windward wall - Wind 90 deg**

Reference height (at which q is sought)  $H_{ref} = 4000$ mm  
Effective height  $H_e = \max(H_{ref} - H_d, 0.4 \times H_{ref}) = 4000$ mm  
Fetch factor (Table 22)  $S_c = 0.860$   
Turbulence factor (Table 22)  $S_t = 0.200$   
Gust peak factor  $g_t = 3.44$   
Terrain and building factor  $S_b = S_c \times (1 + (g_t \times S_t) + S_h) = 1.45$   
Effective wind speed  $V_e = V_s \times S_b = 79.9$  m/s  
Dynamic pressure  $q_s = 0.613 \text{ kg/m}^3 \times V_e^2 = 3.913 \text{ kN/m}^2$

**Dynamic pressure - roof**

Reference height (at which q is sought)  $H_{ref} = 9196$ mm  
Effective height  $H_e = \max(H_{ref} - H_d, 0.4 \times H_{ref}) = 9196$ mm  
Fetch factor (Table 22)  $S_c = 1.022$   
Turbulence factor (Table 22)  $S_t = 0.180$   
Gust peak factor  $g_t = 3.44$   
Terrain and building factor  $S_b = S_c \times (1 + (g_t \times S_t) + S_h) = 1.66$   
Effective wind speed  $V_e = V_s \times S_b = 91.2$  m/s  
Dynamic pressure  $q_s = 0.613 \text{ kg/m}^3 \times V_e^2 = 5.101 \text{ kN/m}^2$

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### Size effect factors

Diagonal dimension for gablewall	$a_{eg} = 7.3$ m
External size effect factor gablewall	$C_{aeg} = 0.972$
Diagonal dimension for side wall	$a_{es} = 7.3$ m
External size effect factor side wall	$C_{aes} = 0.972$
Diagonal dimension for roof	$a_{er} = 7.9$ m
External size effect factor roof	$C_{aer} = 0.965$
Room/storey volume for internal size effect factor	
Diagonal dimension for internal size effect factors	
Internal size effect factor	$C_{ai} = 1.000$

$$V_i = 0.125 \text{ m}^3$$

$$a_i = 10 \times (V_i)^{1/3} = 5.000 \text{ m}$$

### Pressures and forces

Net pressure	$p = q_s \times C_{pe} \times C_{ae} - q_s \times C_{pi} \times C_{ai}$
Net force	$F_w = p \times A_{ref}$

### Roof load case 1 - Wind 0, $c_{pi}$ 0.20, $-c_{pe}$

Zone	Ext pressure coefficient, $C_{pe}$	Dynamic pressure, $q_s$ (kN/m <sup>2</sup> )	External size factor, $C_{ae}$	Net Pressure, $p$ (kN/m <sup>2</sup> )	Area, $A_{ref}$ (m <sup>2</sup> )	Net force, $F_w$ (kN)
A (-ve)	-0.50	5.10	0.965	-3.48	33.67	-117.24
C (-ve)	-0.20	5.10	0.965	-2.00	59.86	-120.01
E (-ve)	-1.30	5.10	0.965	-7.42	29.93	-222.10
F (-ve)	-0.80	5.10	0.965	-4.96	3.74	-18.55
G (-ve)	-0.60	5.10	0.965	-3.97	59.86	-237.90
H (-ve)	-1.00	5.10	0.965	-5.94	35.54	-211.24
I (-ve)	-0.60	5.10	0.965	-3.97	151.52	-602.17

Total vertical net force  $F_{w,v} = -1324.34$  kN


Total horizontal net force  $F_{w,h} = 120.65$  kN

### Walls load case 1 - Wind 0, $c_{pi}$ 0.20, $-c_{pe}$

Zone	Ext pressure coefficient, $C_{pe}$	Dynamic pressure, $q_s$ (kN/m <sup>2</sup> )	External size factor, $C_{ae}$	Net Pressure, $p$ (kN/m <sup>2</sup> )	Area, $A_{ref}$ (m <sup>2</sup> )	Net force, $F_w$ (kN)
A	-1.30	3.91	0.972	-5.73	14.40	-82.45
B	-0.80	3.91	0.972	-3.82	57.60	-220.30
w	0.60	3.91	0.972	1.50	72.00	107.91
l	-0.50	3.91	0.972	-2.68	72.00	-193.24

### Overall loading

Equiv leeward net force for overall section  $F_l = F_{w,wl} = -193.2$  kN

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Net windward force for overall section

$$F_w = F_{w,ww} = 107.9 \text{ kN}$$

Overall loading overall section

$$F_{w,w} = 0.85 \times (1 + C_r) \times (F_w - F_l + F_{w,h}) = 412.8 \text{ kN}$$

**Roof load case 2 - Wind 0,  $c_{pi}$  -0.3,  $+c_{pe}$**

Zone	Ext pressure coefficient, $C_{pe}$	Dynamic pressure, $q_s$ (kN/m <sup>2</sup> )	External size factor, $C_{ae}$	Net Pressure, $p$ (kN/m <sup>2</sup> )	Area, $A_{ref}$ (m <sup>2</sup> )	Net force, $F_w$ (kN)
A (+ve)	0.80	5.10	0.965	5.47	33.67	184.15
C (+ve)	0.40	5.10	0.965	3.50	59.86	209.49
E (+ve)	-1.30	5.10	0.965	-4.87	29.93	-145.76
F (+ve)	-0.80	5.10	0.965	-2.41	3.74	-9.01
G (+ve)	-0.60	5.10	0.965	-1.42	59.86	-85.22
H (+ve)	-1.00	5.10	0.965	-3.39	35.54	-120.60
I (+ve)	-0.60	5.10	0.965	-1.42	151.52	-215.73

Total vertical net force

$$F_{w,v} = -158.21 \text{ kN}$$

Total horizontal net force

$$F_{w,h} = 316.81 \text{ kN}$$

**Walls load case 2 - Wind 0,  $c_{pi}$  -0.3,  $+c_{pe}$**

Zone	Ext pressure coefficient, $C_{pe}$	Dynamic pressure, $q_s$ (kN/m <sup>2</sup> )	External size factor, $C_{ae}$	Net Pressure, $p$ (kN/m <sup>2</sup> )	Area, $A_{ref}$ (m <sup>2</sup> )	Net force, $F_w$ (kN)
A	-1.30	3.91	0.972	-3.77	14.40	-54.27
B	-0.80	3.91	0.972	-1.87	57.60	-107.59
w	0.60	3.91	0.972	3.46	72.00	248.79
I	-0.50	3.91	0.972	-0.73	72.00	-52.36

**Overall loading**

Equiv leeward net force for overall section

$$F_l = F_{w,wl} = -52.4 \text{ kN}$$


Net windward force for overall section

$$F_w = F_{w,ww} = 248.8 \text{ kN}$$

Overall loading overall section

$$F_{w,w} = 0.85 \times (1 + C_r) \times (F_w - F_l + F_{w,h}) = 604.7 \text{ kN}$$

**Roof load case 3 - Wind 90,  $c_{pi}$  0.20,  $-c_{pe}$**

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Zone	Ext pressure coefficient, $C_{pe}$	Dynamic pressure, $q_s$ (kN/m <sup>2</sup> )	External size factor, $C_{ae}$	Net Pressure, $p$ (kN/m <sup>2</sup> )	Area, $A_{ref}$ (m <sup>2</sup> )	Net force, $F_w$ (kN)
A (-ve)	-0.50	5.10	0.965	-3.48	14.96	-52.11
B (-ve)	-0.50	5.10	0.965	-3.48	18.71	-65.13
C (-ve)	-0.20	5.10	0.965	-2.00	59.86	-120.01
E (-ve)	-1.30	5.10	0.965	-7.42	33.67	-249.86
G (-ve)	-0.60	5.10	0.965	-3.97	59.86	-237.90
H (-ve)	-1.00	5.10	0.965	-5.94	37.41	-222.36
I (-ve)	-0.60	5.10	0.965	-3.97	59.86	-237.90
J (-ve)	-0.50	5.10	0.965	-3.48	89.79	-312.64

Total vertical net force

$$F_{w,v} = -1297.22 \text{ kN}$$

Total horizontal net force

$$F_{w,h} = 125.25 \text{ kN}$$

#### Walls load case 3 - Wind 90, $c_{pi}$ 0.20, $-C_{pe}$

Zone	Ext pressure coefficient, $C_{pe}$	Dynamic pressure, $q_s$ (kN/m <sup>2</sup> )	External size factor, $C_{ae}$	Net Pressure, $p$ (kN/m <sup>2</sup> )	Area, $A_{ref}$ (m <sup>2</sup> )	Net force, $F_w$ (kN)
A	-1.30	3.91	0.972	-5.73	14.40	-82.45
B	-0.80	3.91	0.972	-3.82	57.60	-220.30
w	0.60	3.91	0.972	1.50	72.00	107.91
I	-0.50	3.91	0.972	-2.68	72.00	-193.24

#### Overall loading

Equiv leeward net force for overall section

$$F_l = F_{w,wl} = -193.2 \text{ kN}$$


Net windward force for overall section

$$F_w = F_{w,ww} = 107.9 \text{ kN}$$

Overall loading overall section

$$F_{w,w} = 0.85 \times (1 + C_r) \times (F_w - F_l + F_{w,h}) = 417.3 \text{ kN}$$

#### Roof load case 4 - Wind 90, $c_{pi}$ -0.3, $+c_{pe}$

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		<b>Date:</b> 28/04/2017	

Zone	Ext pressure coefficient, $C_{pe}$	Dynamic pressure, $q_s$ (kN/m <sup>2</sup> )	External size factor, $C_{ae}$	Net Pressure, $p$ (kN/m <sup>2</sup> )	Area, $A_{ref}$ (m <sup>2</sup> )	Net force, $F_w$ (kN)
A (+ve)	0.80	5.10	0.965	5.47	14.96	81.84
B (+ve)	0.50	5.10	0.965	3.99	18.71	74.67
C (+ve)	0.40	5.10	0.965	3.50	59.86	209.49
E (+ve)	-1.30	5.10	0.965	-4.87	33.67	-163.98
G (+ve)	-0.60	5.10	0.965	-1.42	59.86	-85.22
H (+ve)	-1.00	5.10	0.965	-3.39	37.41	-126.94
I (+ve)	-0.60	5.10	0.965	-1.42	59.86	-85.22
J (+ve)	-0.50	5.10	0.965	-0.93	89.79	-83.63

Total vertical net force  $F_{w,v} = -155.02$  kN

Total horizontal net force  $F_{w,h} = 307.60$  kN

**Walls load case 4 - Wind 90,  $C_{pi} -0.3$ ,  $+C_{pe}$**

Zone	Ext pressure coefficient, $C_{pe}$	Dynamic pressure, $q_s$ (kN/m <sup>2</sup> )	External size factor, $C_{ae}$	Net Pressure, $p$ (kN/m <sup>2</sup> )	Area, $A_{ref}$ (m <sup>2</sup> )	Net force, $F_w$ (kN)
A	-1.30	3.91	0.972	-3.77	14.40	-54.27
B	-0.80	3.91	0.972	-1.87	57.60	-107.59
w	0.60	3.91	0.972	3.46	72.00	248.79
I	-0.50	3.91	0.972	-0.73	72.00	-52.36

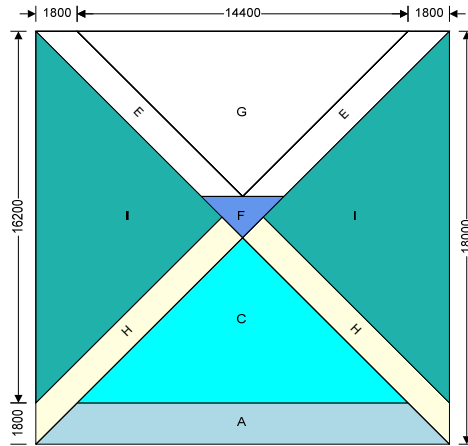
**Overall loading**

Equiv leeward net force for overall section  $F_l = F_{w,wl} = -52.4$  kN

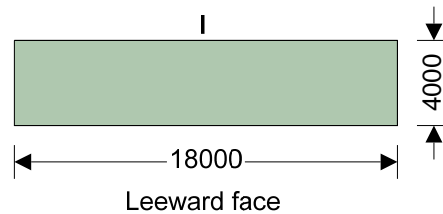
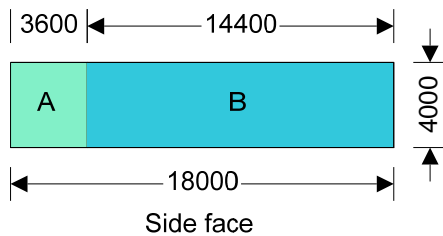
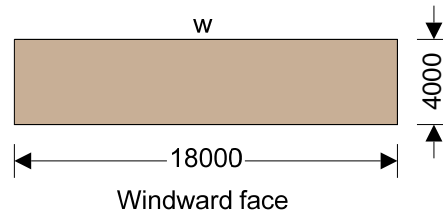
Net windward force for overall section  $F_w = F_{w,ww} = 248.8$  kN

Overall loading overall section  $F_{w,w} = 0.85 \times (1 + C_r) \times (F_w - F_l + F_{w,h}) = 595.7$  kN

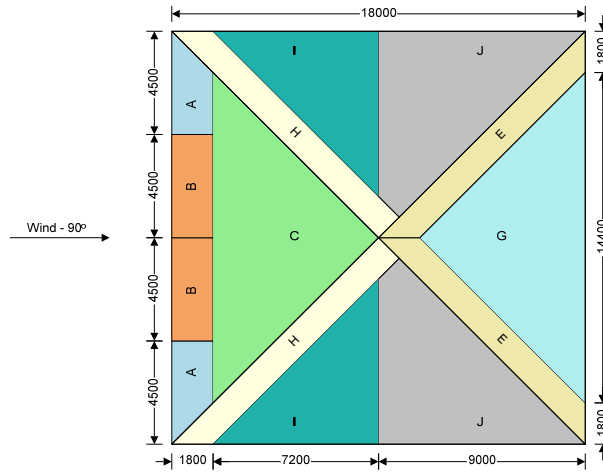
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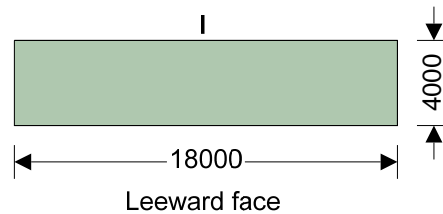
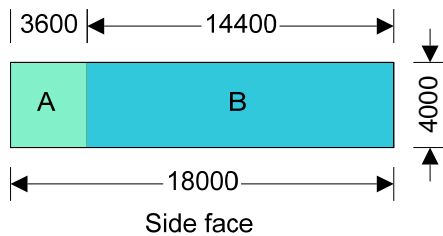
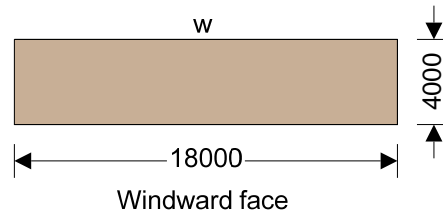
↑ Wind - 0°  
 Plan view - Hipped roof



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Plan view - Hipped roof



**MAXIMUM WIND LOADING IS 605kN or 61 ton force = 61m<sup>3</sup> Water Ballast**