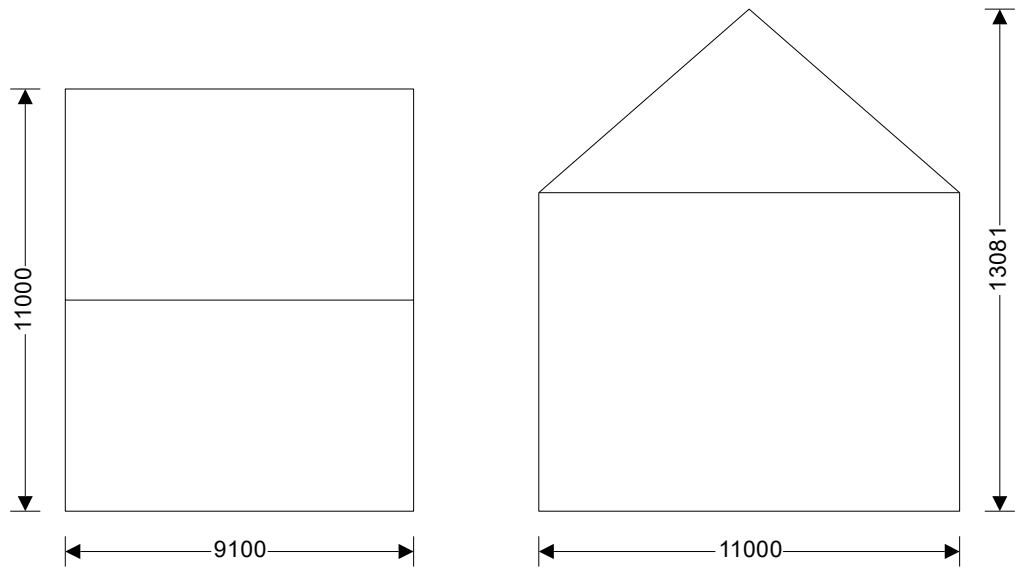
RP DESIGNS 61 BARNES WALLIS COURT BARNHILL ROAD HA9 9DW WEMBLEY	Project 163 Sumatra Road , London NW6 1PW				Job no. 1870
	Calcs for WIND LOADING				Start page no./Revision APP 1 1
	Calcs by RN	Calcs date 01/08/2019	Checked by NH	Checked date	Approved by	Approved date

WIND LOADING (EN1991-1-4)

TEDDS calculation version 3.0.15



Plan Elevation

Building data

Type of roof	Duopitch
Length of building	L = **9100** mm
Width of building	W = **11000** mm
Height to eaves	H = **8300** mm
Pitch of roof	α_0 = **41.0** deg
Total height	h = **13081** mm

Basic values

Location	London
Wind speed velocity (FigureNA.1)	$v_{b,map}$ = **21.4** m/s
Distance to shore	L_{shore} = **66.00** km
Altitude above sea level	A_{alt} = **20.0**m
Altitude factor	$c_{alt} = A_{alt} \times 0.001m^{-1} + 1$ = **1.020**
Fundamental basic wind velocity	$v_{b,0} = v_{b,map} \times c_{alt}$ = **21.8** m/s
Direction factor	c_{dir} = **1.00**
Season factor	c_{season} = **1.00**
Shape parameter K	K = **0.2**
Exponent n	n = **0.5**
Probability factor	$c_{prob} = [(1 - K \times \ln(-\ln(1-p)))/(1 - K \times \ln(-\ln(0.98)))]^n$ = **1.00**
Basic wind velocity (Exp. 4.1)	$v_b = c_{dir} \times c_{season} \times v_{b,0} \times c_{prob}$ = **21.8** m/s
Reference mean velocity pressure	$q_b = 0.5 \times \rho \times v_b^2$ = **0.292** kN/m^2

Orography

Orography factor not significant	c_o = 1.0

Terrain category	Town
Average height of surrounding buildings	h_{ave} = **11000** mm
Distance to nearest building	x_{dis} = **5000** mm
Distance upwand to shoreline	L_{shore} = **66.0** km
Distance inside town terrain	L_{town} = **1.0** km
Average height of surrounding buildings	h_{ave} = **11000** mm
Distance to nearest building	x_{dis} = **5000** 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.7.2.2)

The velocity pressure for the windward face of the building with a 90 degree wind is to be considered as 2 parts as the height h is greater than b but less than 2b (cl.7.2.2)

Peak velocity pressure - windward wall - Wind 0 deg and roof

Reference height (at which q is sought)	z = **8300**mm
Displacement height (Annex A.2)	$h_{dis} = \min(0.8 \times h_{ave}, 0.6 \times z)$ = **4980** mm
Exposure factor (Figure NA.7)	c_e = **1.69**
Exposure correction factor (Figure NA.8)	$c_{e,T}$ = **0.78**
Peak velocity pressure	$q_p = c_e \times c_{e,T} \times q_b$ = **0.38** kN/m^2

Structural factor

Structural damping	δ_s = **0.100**
Height of element	h_{part} = **8300** mm
Size factor (Table NA.3)	c_s = **0.85**
Dynamic factor (Figure NA.9)	c_d = **1.04**
Structural factor	$c_sC_d = c_s \times c_d$ = **0.882**

Peak velocity pressure - windward wall (lower part) - Wind 90 deg

Reference height (at which q is sought)	z = **11000**mm
Displacement height (Annex A.2)	$h_{dis} = \min(0.8 \times h_{ave}, 0.6 \times z)$ = **6600** mm
Exposure factor (Figure NA.7)	c_e = **1.85**
Exposure correction factor (Figure NA.8)	$c_{e,T}$ = **0.82**
Peak velocity pressure	$q_p = c_e \times c_{e,T} \times q_b$ = **0.44** kN/m^2

Structural factor

Structural damping	δ_s = **0.100**
Height of element	h_{part} = **11000** mm
Size factor (Table NA.3)	c_s = **0.83**
Dynamic factor (Figure NA.9)	c_d = **1.03**
Structural factor	$c_sC_d = c_s \times c_d$ = **0.862**

Peak velocity pressure - windward wall (upper part) - Wind 90 deg and roof

Reference height (at which q is sought)	z = **13081**mm
Displacement height (Annex A.2)	$h_{dis} = \min(0.8 \times h_{ave}, 0.6 \times z)$ = **7849** mm
Exposure factor (Figure NA.7)	c_e = **1.95**
Exposure correction factor (Figure NA.8)	$c_{e,T}$ = **0.84**
Peak velocity pressure	$q_p = c_e \times c_{e,T} \times q_b$ = **0.48** kN/m^2

Structural factor

Structural damping	δ_s = **0.100**

Height of element h_{part} = **2081** mm
Size factor (Table NA.3) c_s = **0.87**
Dynamic factor (Figure NA.9) c_d = **1.03**
Structural factor $c_{sCd} = c_s \times c_d$ = **0.897**

Structural factor

Structural damping δ_s = **0.100**
Height of element h_{part} = **13081** mm
Size factor (Table NA.3) c_s = **0.83**
Dynamic factor (Figure NA.9) c_d = **1.03**
Structural factor $c_{sCd} = c_s \times c_d$ = **0.855**

Structural factor - roof 0 deg

Structural damping δ_s = **0.100**
Height of element h_{part} = **13081** mm
Size factor (Table NA.3) c_s = **0.83**
Dynamic factor (Figure NA.9) c_d = **1.04**
Structural factor $c_{sCd} = c_s \times c_d$ = **0.865**

Peak velocity pressure for internal pressure

Peak velocity pressure – internal (as roof press.) $q_{p,i}$ = **0.48** kN/m^2

Pressures and forces

Net pressure $p = c_{sCd} \times q_p \times c_{pe} - q_{p,i} \times c_{pi}$
Net force $F_w = p_w \times A_{ref}$

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

Zone	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p, (kN/m^2)	Net pressure p (kN/m^2)	Area A_{ref} (m^2)	Net force F_w (kN)
F (-ve)	-0.13	0.48	-0.15	5.49	-0.83
G (-ve)	-0.13	0.48	-0.15	5.49	-0.83
H (-ve)	-0.05	0.48	-0.12	55.34	-6.53
I (-ve)	-0.50	0.48	-0.30	55.34	-16.77
J (-ve)	-0.83	0.48	-0.44	10.97	-4.81

Total vertical net force $F_{w,v}$ = **-22.47** kN
Total horizontal net force $F_{w,h}$ = **8.78** kN

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

Zone	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p, (kN/m^2)	Net pressure p (kN/m^2)	Area A_{ref} (m^2)	Net force F_w (kN)
A	-1.20	0.48	-0.60	16.55	-9.98
B	-0.80	0.48	-0.43	83.71	-36.34
C	-0.50	0.48	-0.31	17.34	-5.33
D	0.80	0.38	0.18	75.53	13.26
E	-0.51	0.38	-0.27	75.53	-20.29

Overall loading

Equiv leeward net force for overall section $F_l = F_{w,wE}$ = **-20.3** kN

Net windward force for overall section $F_w = F_{w,wD}$ = **13.3** kN

Lack of correlation (cl.7.2.2(3) – Note) f_{corr} = **0.86** as h/W is 1.189

Overall loading overall section $F_{w,D} = f_{corr} \times (F_w - F_l + F_{w,h})$ = **36.3** kN

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

Zone	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p, (kN/m^2)	Net pressure p (kN/m^2)	Area A_{ref} (m^2)	Net force F_w (kN)
F (+ve)	0.80	0.48	0.48	5.49	2.61
G (+ve)	0.57	0.48	0.38	5.49	2.09
H (+ve)	0.62	0.48	0.40	55.34	22.18
I (+ve)	-0.50	0.48	-0.06	55.34	-3.51
J (+ve)	-0.83	0.48	-0.20	10.97	-2.18

Total vertical net force $F_{w,v}$ = **15.99** kN

Total horizontal net force $F_{w,h}$ = **21.37** kN

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

Zone	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p, (kN/m^2)	Net pressure p (kN/m^2)	Area A_{ref} (m^2)	Net force F_w (kN)
A	-1.20	0.48	-0.36	16.55	-6.02
B	-0.80	0.48	-0.19	83.71	-16.28
C	-0.50	0.48	-0.07	17.34	-1.17
D	0.80	0.38	0.42	75.53	31.36
E	-0.51	0.38	-0.03	75.53	-2.20

Overall loading

Equiv leeward net force for overall section $F_l = F_{w,wE}$ = **-2.2** kN

Net windward force for overall section $F_w = F_{w,wD}$ = **31.4** kN

Lack of correlation (cl.7.2.2(3) – Note) f_{corr} = **0.86** as h/W is 1.189

Overall loading overall section $F_{w,D} = f_{corr} \times (F_w - F_l + F_{w,h})$ = **47.1** kN

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

Zone	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p, (kN/m^2)	Net pressure p (kN/m^2)	Area A_{ref} (m^2)	Net force F_w (kN)
F (-ve)	-1.20	0.48	-0.59	8.02	-4.71
G (-ve)	-1.17	0.48	-0.58	8.02	-4.62
H (-ve)	-0.60	0.48	-0.34	64.13	-21.92
I (-ve)	-0.43	0.48	-0.27	52.47	-14.21

Total vertical net force $F_{w,v}$ = **-34.31** kN

Total horizontal net force $F_{w,h}$ = **0.00** kN

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

Zone	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p, (kN/m^2)	Net pressure p (kN/m^2)	Area A_{ref} (m^2)	Net force F_w (kN)
A	-1.20	0.38	-0.49	18.26	-8.96
B	-0.80	0.38	-0.36	57.27	-20.56
D_b	0.80	0.44	0.21	112.61	23.52
D_u	0.80	0.48	0.25	4.98	1.24
E	-0.52	0.48	-0.31	117.60	-36.43

Overall loading

Equiv leeward net force for upper section $F_l = F_{w,wE} / A_{ref,wE} \times A_{ref,wu}$ = **-1.5** kN

Net windward force for upper section $F_w = F_{w,wu}$ = **1.2** kN

Lack of correlation (cl.7.2.2(3) – Note) f_{corr} = **0.87** as h/L is 1.437

Overall loading upper section $F_{w,u} = f_{corr} \times (F_w - F_l + F_{w,h})$ = **2.4** kN

Equiv leeward net force for bottom section $F_l = F_{w,wE} / A_{ref,wE} \times A_{ref,wb}$ = **-34.9** kN

Net windward force for bottom section $F_w = F_{w,wb}$ = **23.5** kN

Lack of correlation (cl.7.2.2(3) – Note) f_{corr} = **0.87** as h/L is 1.437

Overall loading bottom section $F_{w,b} = f_{corr} \times (F_w - F_l)$ = **50.6** kN

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

Zone	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p, (kN/m^2)	Net pressure p (kN/m^2)	Area A_{ref} (m^2)	Net force F_w (kN)
F (+ve)	0.57	0.48	0.38	8.02	3.04
G (+ve)	0.47	0.48	0.34	8.02	2.71
H (+ve)	0.37	0.48	0.30	64.13	19.03
I (+ve)	0.27	0.48	0.26	52.47	13.42

Total vertical net force $F_{w,v}$ = **28.83** kN

Total horizontal net force $F_{w,h}$ = **0.00** kN

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

Zone	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p, (kN/m^2)	Net pressure p (kN/m^2)	Area A_{ref} (m^2)	Net force F_w (kN)
A	-1.20	0.38	-0.25	18.26	-4.58
B	-0.80	0.38	-0.12	57.27	-6.84
D_b	0.80	0.44	0.45	112.61	50.50
D_u	0.80	0.48	0.49	4.98	2.43
E	-0.52	0.48	-0.07	117.60	-8.25

Overall loading

Equiv leeward net force for upper section $F_l = F_{w,wE} / A_{ref,wE} \times A_{ref,wu}$ = **-0.3** kN

Net windward force for upper section $F_w = F_{w,wu}$ = **2.4** kN

Lack of correlation (cl.7.2.2(3) – Note) f_{corr} = **0.87** as h/L is 1.437

Overall loading upper section $F_{w,u} = f_{corr} \times (F_w - F_l + F_{w,h})$ = **2.4** kN

Equiv leeward net force for bottom section $F_l = F_{w,wE} / A_{ref,wE} \times A_{ref,wb}$ = **-7.9** kN

Net windward force for bottom section $F_w = F_{w,wb}$ = **50.5** kN

Lack of correlation (cl.7.2.2(3) – Note) f_{corr} = **0.87** as h/L is 1.437

Overall loading bottom section $F_{w,b} = f_{corr} \times (F_w - F_l)$ = **50.6** kN

Roof load case 5 - Wind 90, c_{pi} -0.30, + c_{pe}

Zone	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p, (kN/m^2)	Net pressure p (kN/m^2)	Area A_{ref} (m^2)	Net force F_w (kN)
F (+ve)	0.57	0.48	0.38	8.02	3.04
G (+ve)	0.47	0.48	0.34	8.02	2.71
H (+ve)	0.37	0.48	0.30	64.13	19.03
I (+ve)	0.27	0.48	0.26	52.47	13.42

Total vertical net force $F_{w,v}$ = **28.83** kN

Total horizontal net force $F_{w,h}$ = **0.00** kN

Walls load case 5 - Wind 90, c_{pi} -0.30, + c_{pe}

Zone	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p, (kN/m^2)	Net pressure p (kN/m^2)	Area A_{ref} (m^2)	Net force F_w (kN)
A	-1.20	0.38	-0.25	18.26	-4.58
B	-0.80	0.38	-0.12	57.27	-6.84
D_b	0.80	0.44	0.45	112.61	50.50
D_u	0.80	0.48	0.49	4.98	2.43
E	-0.52	0.48	-0.07	117.60	-8.25

Overall loading

Equiv leeward net force for upper section $F_l = F_{w,wE} / A_{ref,wE} \times A_{ref,wu}$ = **-0.3** kN

Net windward force for upper section $F_w = F_{w,wu}$ = **2.4** kN

Lack of correlation (cl.7.2.2(3) – Note) f_{corr} = **0.87** as h/L is 1.437

Overall loading upper section $F_{w,u} = f_{corr} \times (F_w - F_l + F_{w,h})$ = **2.4** kN

Equiv leeward net force for bottom section $F_l = F_{w,wE} / A_{ref,wE} \times A_{ref,wb}$ = **-7.9** kN

Net windward force for bottom section $F_w = F_{w,wb}$ = **50.5** kN

Lack of correlation (cl.7.2.2(3) – Note) f_{corr} = **0.87** as h/L is 1.437

Overall loading bottom section $F_{w,b} = f_{corr} \times (F_w - F_l)$ = **50.6** kN

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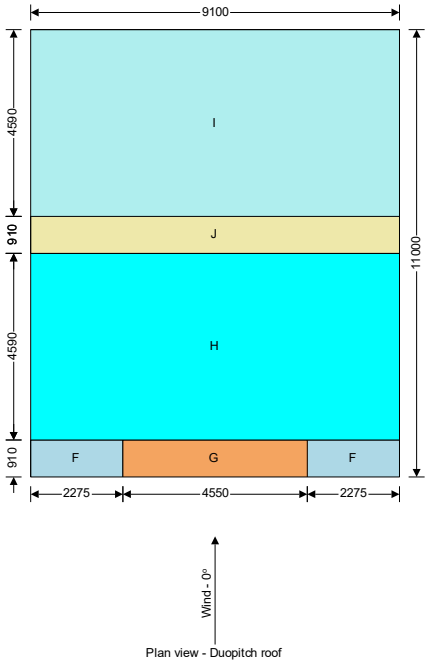
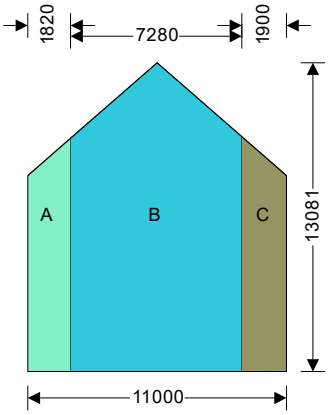
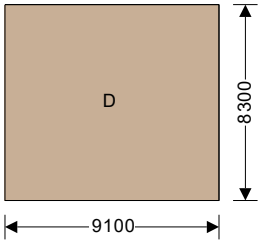


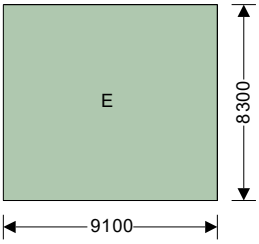
Plan view - Duopitch roof



Side face



Windward face



Leeward face

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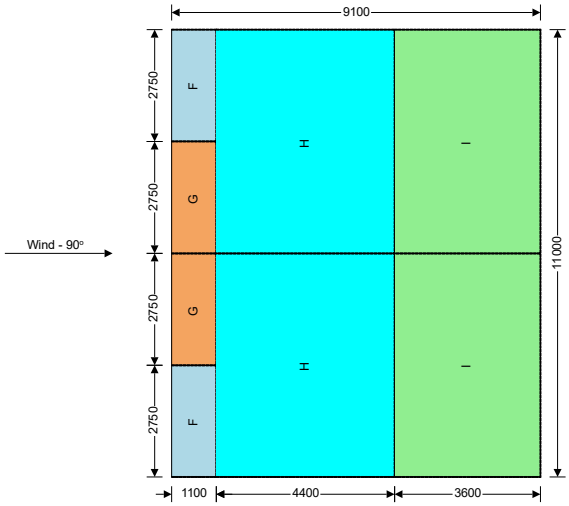

Plan view - Duopitch roof