CODE OF PRACTICE
ON WIND EFFECTS
HONG KONG – 1983
(REPRINTED 1993)

BUILDING AUTHORITY
HONG KONG

FOREWORD

This Code of Practice on Wind Effects prepared under the direction of the Working Party on the Review of the Building (Construction) Regulations, revises and supersedes the 1976 edition.

An important change in this edition from the 1976 edition is the adoption of gust velocity as the basis for design and the re-assessment of the probable wind speeds on a statistical basis in accordance with records from the Hong Kong Royal Observatory.

This edition treats wind loading in more detail and takes account of the local variation in the ground surface in a similar manner to that used in BS CP 3: Chapter V: Part 2: 1972.

This edition also uses wind data that has become available since 1976 and it is intended that when further data becomes available the code will be reviewed and updated.

A draft of the code was circulated for general comment to selected practising engineers and Government Departments. All comments and views expressed have been taken into consideration in the preparation of the code now published.

CONTENTS

APPENDICES

1. SCOPE

1.1 This Code of Practice gives general methods for calculating the wind loads to be used in the structural design of buildings or parts of buildings. The Code does not apply to buildings of an unusual shape or buildings situated at locations where the local topography significantly affects the wind conditions. Experimental wind tunnel data with reference to local conditions, where available, may be used in place of the coefficients given in this Code.

1.2 The design wind pressures given in this Code have been determined from the peak gust velocities having a mean return period of 50 years and are the normal wind loads on completed buildings. Design wind pressures on buildings where a longer period of exposure to the wind is required or buildings where greater than normal safety is required shall be determined from peak gust velocities having a mean return period greater than 50 years.

2. DEFINITIONS

For the purposes of this Code, the following definitions apply:

"Breadth" means the horizontal dimension normal to the direction of the wind.

"Depth" means the horizontal dimension parallel to the direction of the wind.

"Frontal projected area" means the area of the shadow projection on a plane normal to the direction of the wind.

"Height of building" means the height of the building above the site-ground level in the immediate vicinity of the building.

3. DESIGN WIND PRESSURES

3.1 Except as provided in 3.3 and 3.4 the design wind pressure q at height z shall be taken as the value given in Table 1A.

3.2 The height z shall be measured from the artificial base level z_b determined in accordance with Appendix A.

3.3 Where the ground on the windward side of the building is a built-up terrain with closely spaced tall buildings (at least 30 per cent of the ground surface is covered with buildings and at least 50 per cent of the buildings in the terrain are over 25 m in height) the design wind pressure q for the direction under consideration may be taken as the value given in Table 1B for a height upto h_x above the artificial base level z_b. For any portion of a building at a level above h_x the design wind pressure given in Table 1A shall be used. The height h_x is given by the following equation according to the upwind distance x of the built-up terrain in front of the building:

$$h_x = 3.5\sqrt{x} \quad \text{(metres)} \qquad (1)$$

3.4 Temporary buildings or structures which will remain in position for a period of not more than one year may be designed with wind pressures equal to 70 per cent of the pressures given in Table 1A or Table 1B as appropriate to the terrain.

3.5 No allowance shall be made for the general or specific shielding of other buildings, structures or natural features.

Table 1A: Design wind pressure for general terrain

Height above artificial base level	Design wind pressure q (kPa)
0– 10 m	1.2
10– 30 m	2.2
30– 50 m	2.5
50–100 m	3.0
100–150 m	3.5
150–200 m	3.8
200–250 m	4.1
above 250 m	4.3

Table 1B: Design wind pressure for built-up terrain

Height above artificial base level	Design wind pressure q (kPa)
0– 30 m	1.2
30– 50 m	1.9
50–100 m	2.4
100–150 m	3.0
150–200 m	3.4
200–250 m	3.7
250–300 m	4.0
above 300 m	4.3

4. FORCES ON COMPLETE BUILDINGS

4.1 The total wind force F on a complete building shall be taken to be the summation of the pressures acting on the effective projected areas of the building and shall be determined by the following equation:

$$F = C_f \sum q_z A_z \qquad \text{.......(2)}$$

where C_f is the force coefficient for the building, determined in accordance with Appendix B;
q_z is the design wind pressure at height z, determined in accordance with section 3; and
A_z is the effective projected area of the part of the building corresponding to q_z.

4.2 The effective projected area of an enclosed building shall be the frontal projected area. The effective projected area of an open framework building such as sign frames and lattice towers shall be the aggregate projected area of all members on a plane normal to the direction of the wind.

5. FORCES ON BUILDING ELEMENTS

5.1 The total force F_p acting in a direction normal to the individual elements such as walls, roofs, cladding panels or members of open framework buildings shall be determined by the following equation:

$$F_p = C_p q_z A_m \qquad \text{.......(3)}$$

where C_p is the total pressure coefficient for individual elements, determined in accordance with Appendix C;
q_z is the design wind pressure corresponding to the height z of the element, determined in accordance with section 3; and
A_m is the surface area of the element.

5.2 Where the design wind pressure q_z operating on the surface of the element varies because of height, the surface area A_m of the element shall be subdivided so that the specified pressures are taken over the appropriate area.

6. DYNAMIC EFFECTS

6.1 Buildings whose light weight, low frequency and low damping properties make them susceptible to wind-induced oscillations or excitations shall be investigated to ascertain the significance of dynamic effects.

6.2 For the purpose of design of chimneys and similar structures it may be assumed that if the Strouhal critical velocity of the structure is greater than the maximum design wind velocity severe oscillation produced by vortex shedding is unlikely to occur. The maximum design wind velocity V is obtained from the design wind pressure q at the top of the structure by the following equation:

$$V = 40.4\sqrt{q} \qquad \text{.......(4)}$$

where V is the maximum design wind velocity in m/s; and
q is the design wind pressure in kPa as defined in section 3.

7. STABILITY OF BUILDINGS

The stability of the building or part of a building shall be investigated and the resistance to sliding, uplift and overturning shall be not less than 1.5 times the maximum sliding force, uplift force and over-turning moment due to the design wind load.

APPENDIX A: ARTIFICIAL BASE LEVEL

A1. In the case where within an upwind distance of 400 m in front of the building the variation of ground level is not more than 3 m in any 10 m horizontal distance, and in the case where the wind stream is downhill towards the building, the artificial base level z_b shall be taken as the average ground level adjacent to the windward face of the building.

A2. In all other cases the artificial base level shall be established from the ground profile in the direction of the wind as shown in Figure A1:

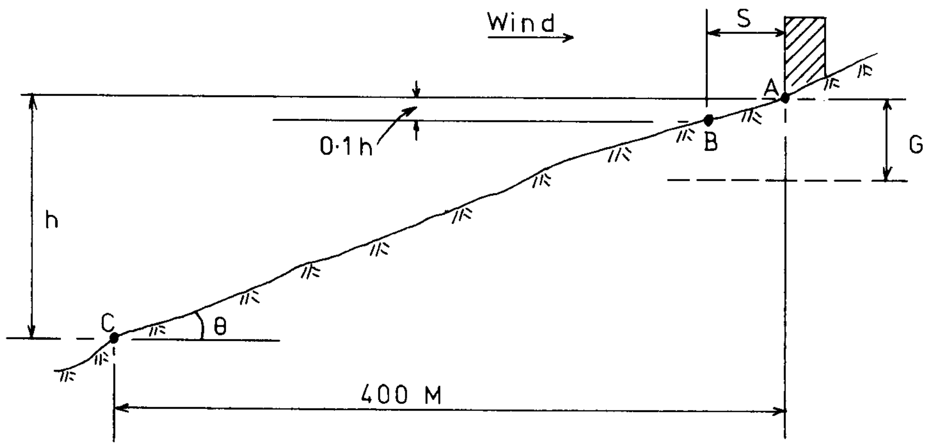


FIG. A 1

where A is the point adjacent to the windward face of the building;
B is the point on the windward side such that the difference in level between A and B is 0.1h;
C is a point on the windward side such that the horizontal distance from A to C is 400 m;
h is the difference in level between A and C;
s is the horizontal distance between A and B;
θ is the inclination of the mean slope between A and C;

$$k_s = \frac{4 - \frac{s}{h}}{3} \quad (\text{if } k_s < 0, k_s = 0; \text{ if } k_s > 1, k_s = 1);$$

$$k_\theta = \frac{\tan\theta - 0.3}{1.7} \quad (\text{if } k_\theta < 0, k_\theta = 0; \text{ if } k_\theta > 1, k_\theta = 1); \text{ and}$$

the artificial base level z_b shall be taken at a depth G below the average ground level adjacent to the windward face of the building, such that—

$$G = k_s k_\theta h:$$

Provided that where there are critical variations of slope inclination along AC the ground profile shall be subdivided so that individual coefficients are applied to the appropriate slope angles as illustrated by Figure A2, such that—

$$G = k_s(k_{\theta 1}h_1 + k_{\theta 2}h_2 + k_{\theta 3}h_3 + \ldots)$$

where

$$k_s = \frac{4 - \frac{s}{h}}{3} \quad (\text{if } k_s < 0, k_s = 0; \text{ if } k_s > 1, k_s = 1); \text{ and}$$

$$k_{\theta 1} = \frac{\tan\theta_1 - 0.3}{1.7} \quad (\text{if } k_{\theta 1} < 0, k_{\theta 1} = 0; \text{ if } k_{\theta 1} > 1, k_{\theta 1} = 1)$$

$$k_{\theta 2} = \frac{\tan\theta_2 - 0.3}{1.7} \quad (\text{if } k_{\theta 2} < 0, k_{\theta 2} = 0; \text{ if } k_{\theta 2} > 1, k_{\theta 2} = 1)$$

etc.

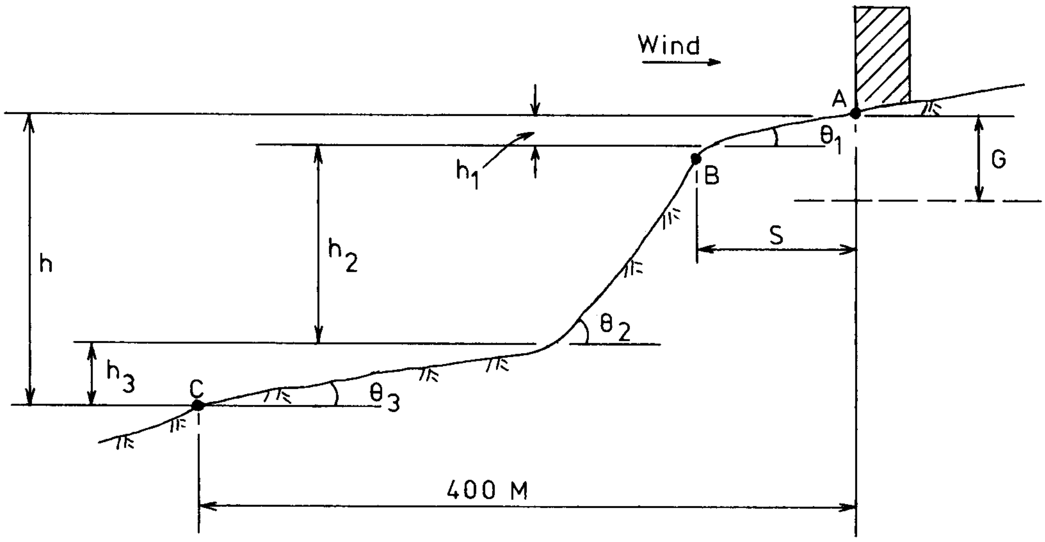


FIG. A2

A3. Where the calculated value of G determined by the method given in A2 is more than 100 m, the artificial base level may be taken at 100 m below the average ground level adjacent to the windward face of the building.

APPENDIX B: FORCE COEFFICIENTS

B1. Enclosed buildings

B1.1 The force coefficient C_f for an enclosed building shall be—

(*a*) the product of the height aspect factor C_h and the shape factor C_s given in Table B1 and Table B2 respectively; or

(*b*) the appropriate value specified in BS CP3: Chapter V: Part 2.

B1.2 The force coefficient shall be applied to the building as a whole:
Provided that in the case of a building with isolated blocks projecting above a general roof level individual force coefficients corresponding to the height and shape of each block shall be applied.

B1.3 If the frontal projected area of that part of the building for which C_f operates is greater than 500 m^2 the force coefficient determined by B1.1 may be multiplied by a reduction factor R_A given in Table B3.

B2. Open framework buildings

B2.1 The force coefficient C_f for an open framework building shall be—

(*a*) the value given in Table B4; or

(*b*) appropriate value specified in BS CP3: Chapter V: Part 2

Table B1: Height aspect factors C_h for enclosed buildings of generally uniform section

$\frac{\text{Height}}{\text{Breadth}}$	Height aspect factor C_h
1.0 or less	0.95
2.0	1.0
4.0	1.05
6.0	1.1
10.0	1.2
Note: Linear interpolation may be used to obtain intermediate values.	

Table B2: Shape factors C_s for enclosed buildings of generally uniform section

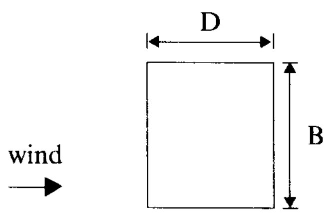
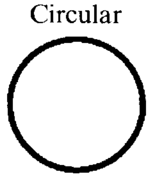
General plan shape		Shape factor C_s
Rectangular 	$\frac{B}{D}$ = 0.5 or less 0.7 1.0 2.0 3.0 4.0 and over	0.8 0.9 1.0 1.1 1.3 1.45 interpolate linearly
Circular 		0.75
Other shapes		Value of C_c for the enclosing rectangular shape in the direction of the wind.

Table B3: Reduction factor R_A for enclosed buildings according to frontal projected area

Frontal projected area, m^2	Reduction factor R_A
500 or less	1.00
800	0.97
1 000	0.96
3 000	0.92
5 000	0.89
8 000	0.86
10 000	0.84
15 000 and over	0.80
Note: Linear interpolation may be used to obtain intermediate values.	

Table B4: Force coefficients C_f for open framework buildings

Solidity ratio $\emptyset$	Force coefficient C_f
0.01	2.0
0.1	1.9
0.2	1.8
0.3	1.7
0.4	1.7
0.5	1.6
0.8	1.6
0.9	1.8
1.0	2.0

Note:
1. The solidity ratio $\emptyset$ is equal to the effective projected area of the open framework building divided by the area enclosed by the boundary of the frame normal to the direction of the wind.
2. Linear interpolation may be used to obtain intermediate values.

APPENDIX C: TOTAL PRESSURE COEFFICIENTS C_p FOR INDIVIDUAL ELEMENTS

C1. The total pressure coefficient C_p for individual elements in a particular area of an enclosed building shall be—

(*a*) in the case where there is only a negligible probability of a dominant opening occuring during a severe storm, the value given in Table C1; and

(*b*) in the case where a dominant opening is likely to occur during a severe storm, the value determined by the following equation:

$$C_p = C_{pe} - C_{pi}$$

where C_{pe} is the appropriate external pressure coefficient; and
C_{pi} is the appropriate internal pressure coefficient.

specified in BS CP 3: Chapter V: Part 2.

C2. The total pressure coefficient C_p for individual members of an open framework building shall be—

(*a*) 2.0; or

(*b*) appropriate value specified in BS CP 3: Chapter V: Part 2.

Table C1: Total pressure coefficients C_p for enclosed buildings with negligible probability of dominant opening occuring during a severe storm

Walls and claddings			
(*a*) edge zones of the building		−1.4 or + 1.0	
(*b*) other surfaces		−1.0 or + 1.0	
Flat roofs			
(*a*) edge zones of the roof		−2.2	
(*b*) other surfaces		−1.2	
	roof angle		
Pitched roofs	10°	30°	60°
(*a*) edge zones of the roof	−2.2	−1.7	−1.0
(*b*) ridge zones of the roof	−1.4	−1.3	−1.0
(*c*) other surfaces:			
(i) wind across ridge, windward surface	−1.4	−1.2 or +0.3	+1.0
(ii) wind across ridge, leeward surface	−0.8	−0.7	−0.8
(iii) wind parallel to ridge	−1.0	−1.0	−1.0
		(interpolate linearly)	

Note:
1. Negative value of C_p indicates that the resultant force is outwards.
2. Where alternative coefficients are given the element should be designed to accept both loading conditions.
3. Edge zones of the building are the areas within a distance from the edge of the building equal to 0.25 times the lesser horizontal dimension of the building.
4. Edge zones of the roof are the areas within a distance from the edge of the roof equal to 0.15 times the lesser horizontal dimension of the roof.
5. Ridge zones of the roof are the areas within a distance from the ridge of the roof equal to 0.15 times the span of the pitched roof.