The National Building Code and the various parts or sections as well as other supplements may be obtained by writing to:

The Secretary,
Associate Committee on the National Building Code,
National Research Council,
Ottawa, Canada

HANDBOOK OF PRESSURE COEFFICIENTS FOR WIND LOADS
1961

SUPPLEMENT No. 3 TO THE NATIONAL BUILDING CODE OF CANADA

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(1960-1961)

HANDBOOK OF PRESSURE COEFFICIENTS FOR WIND LOADS

SUPPLEMENT No. 3

NATIONAL BUILDING CODE OF CANADA

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HANDBOOK OF PRESSURE COEFFICIENTS

for

WIND LOADS

By **W. R. Schriever* and W. A. Dalgliesh***

Introduction

The 1960 edition of the National Building Code of Canada no longer contains pressure coefficients (shape factors) for the calculation of wind loads. This change from the 1953 Code, based on a recommendation of the Revision Committee on Structural Loads and Procedures, is aimed at a broader coverage of building shapes and conditions relegating the pressure coefficients to a separate document.

The present handbook of pressure coefficients for wind loads is based mainly on the tables of the Standards of the Swiss Association of Engineers and Architects (SIA Normen No. 160, 1956) which are considered to be the best and most comprehensive data available at the present time. It is hoped that this handbook will allow designers to assess more accurately the magnitude and distribution of pressures and suctions developed by wind on various types of buildings and structures. Naturally, however, not even the present tables will permit coverage of *all* shapes and conditions that might occur in practice. Because of this and also in view of new information that might become available in the future, every designer should try to obtain the latest and most appropriate pressure coefficients for each case. For unusual types of structures, it may be necessary to resort to special wind tunnel experiments on scale models to obtain adequate design values.

Comments and suggestions on this handbook will be welcomed and should be addressed to the Secretary of the Associate Committee on the National Building Code, National Research Council, Ottawa.

***Research Officers with Building Structures Section, Division of Building Research, National Research Council.**

Extract from
National Building Code of Canada, 1960
Section 4.1 — Structural Loads and Procedures:

Loads Due to Wind

4.1.2.12.(1) The minimum design load, due to the pressure of wind on a surface is . . .* psf applied normal to the surface, decreased or increased as may be provided for in sentence (2) and article 4.1.2.13.

(2) Where a surface or part of a surface is located within any of the height increments listed in column 1 of table 4.1.2.F, the minimum design load on that surface or part of a surface is that provided for in sentence (1) multiplied by the appropriate factor in column 2.

*Climatic information applicable to any municipality can be obtained from the Secretary of the Associate Committee on the National Building Code and is published in a handbook of climatic information which is available from the National Research Council.

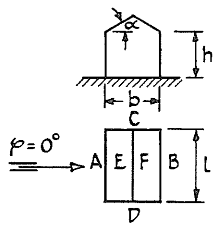
Table 4.1.2.F
Forming Part of Sentence 4.1.2.12.(2)

Height, ft	Factor
0 to 20	0.8
Over 20 to 40	1.0
Over 40 to 90	1.2
Over 90 to 180	1.5
Over 180 to 350	1.8
Over 350 to 650	2.2
Over 650	2.5
Column 1	Column 2

4.1.2.13. Where the sum of the pressure coefficients for a wall, roof or other element exposed to the wind determined differentially from the coefficients* for both sides of such an element is greater or smaller than 1, the minimum design load on that surface is that provided for in article 4.1.2.12 multiplied by this sum.

*Pressure coefficients applicable to many elements and surfaces can be obtained from the Secretary of the Associate Committee on the National Building Code and are published in a handbook available from the National Research Council.

"0" SIMPLIFIED TABLE



WALLS

C_{pe}: EXT. PRESS. COEFF.

ρ	A	B	C, D
0	+0·9	-0·5	-0·7

ROOF

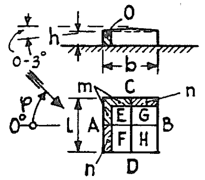
C_{pe}: EXT. PRESS. COEFF.

SLOPE α	E	F
0–20°	-1·0	-0·7
20°–50°	$+\frac{1}{100}(5\alpha-200)$	-0·7
50°–90°	$+\frac{\alpha}{100}$	-0·7

VALID ONLY IF

1. STRESS DUE TO WIND < 25% TOTAL STRESS
2. $2/3 < h/b < 3/2$
3. $2/5 < L/b < 5/2$
4. INT. PRESS. COEFF. C_{pi}: AND LOCAL MAXIMA C^{*}_{PE} (TABLES 1-13) ARE USED.

1 LOW SQUARE BLDG GABLE ROOF 0-3° h:b:l = 1:4:4



SHADED AREAS TO SCALE

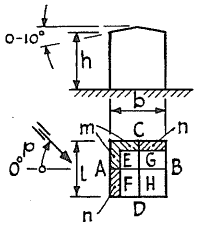
C_{pe}: EXTERNAL PRESSURE COEFFICIENTS

ρ	A	B	C	D	E	F	G	H
0°	+0.9	-0.3	-0.4	-0.4	-0.8	-0.8	-0.3	-0.3
15°	+0.8	-0.3	-0.1	-0.5	-0.7	-0.8	-0.2	-0.3
45°	+0.5	-0.4	+0.5	-0.4	-0.9	-0.6	-0.6	-0.3
15°	For section "o" (Side C) C_{pe}^{*}= -0.8							
45°	For section "m" C_{pe}^{*}=-2.0 "n" C_{pe}^{*}= -1.0							

C_{pi}: INTERNAL PRESSURE COEFFICIENTS

OPENINGS	ρ =0°	ρ =15°	ρ =45°
Uniformly distributed	±0.2	±0.2	±0.2
Predominating on side "A"	+0.8	+0.7	+0.4
Predominating on side "B"	-0.2	-0.3	-0.4
Predominating on side "C"	-0.3	-0.2	+0.4

2 MED. HT. SQUARE BLDG GABLE ROOF 0-10° h:b:l = 1:1:1



SHADED AREAS TO SCALE

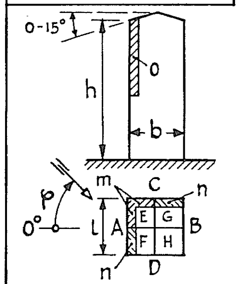
C_{pe}: EXTERNAL PRESSURE COEFFICIENTS

ρ	A	B	C	D	E	F	G	H
0°	+0.9	-0.5	-0.6	-0.6	-0.7	-0.7	-0.5	-0.5
15°	+0.8	-0.5	-0.7	-0.5	-0.7	-0.6	-0.5	-0.6
45°	+0.5	-0.5	+0.5	-0.5	-0.8	-0.5	-0.5	-0.4
45°	For section "m" C_{pe}^{*}= -1.2 "n" C_{pe}^{*}= -0.8							

C_{pi}: INTERNAL PRESSURE COEFFICIENTS

OPENINGS	ρ =0°	ρ =15°	ρ =45°
Uniformly distributed	±0.2	±0.2	±0.2
Predominating on side "A"	+0.8	+0.7	+0.4
Predominating on side "B"	-0.4	-0.4	-0.4
Predominating on side "C"	-0.5	-0.6	+0.4

3 HIGH SQUARE BLDG GABLE ROOF 0-15° h:b:l = 2·5:1:1



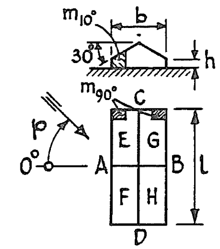
C_{pe}: EXTERNAL PRESSURE COEFFICIENTS

ρ	A	B	C	D	E	F	G	H
0°	+0.9	-0.6	-0.7	-0.7	-0.8	-0.8	-0.8	-0.8
15°	+0.8	-0.5	-0.9	-0.6	-0.8	-0.8	-0.7	-0.7
45°	+0.5	-0.5	+0.5	-0.5	-0.8	-0.7	-0.7	-0.5
45°	For section "m" C_{pe}^{*}= -1.0 "n" C_{pe}^{*}= -0.8							
0°	For section "o" (sides C and D) C_{pe}^{*}= -1.5							

C_{pi}: INTERNAL PRESSURE COEFFICIENTS

OPENINGS	ρ =0°	ρ =15°	ρ =45°
Uniformly distributed	±0.2	±0.2	±0.2
Predominating on side "A"	+0.8	+0.7	+0.4
Predominating on side "B"	-0.5	-0.5	-0.4

4 LOW BUILDING GABLE ROOF 30° h:b:l = 1:8:16



SHADED AREAS TO SCALE

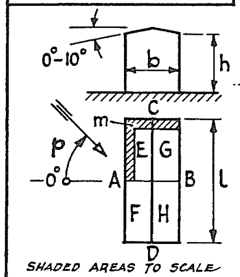
C_{pe}: EXTERNAL PRESSURE COEFFICIENTS

ρ	A	B	C	D	E	F	G	H
0°	+0.8	-0.5	-0.5	-0.5	+0.2	+0.2	-0.6	-0.6
45°	+0.5	-0.5	+0.4	-0.3	+0.1	-0.1	-0.8	-0.5
90°	-0.3	-0.3	+0.9	-0.3	-0.5	-0.1	-0.5	-0.1
10°&90°	For sections "m" C_{pe}^{*}= -1.0							

C_{pi}: INTERNAL PRESSURE COEFFICIENTS

OPENINGS	ρ =0°	ρ =45°	ρ =90°
Uniformly distributed	±0.2	±0.2	±0.2
Predominating on side "A"	+0.7	+0.4	-0.2
Predominating on side "B"	-0.4	-0.4	-0.2
Predominating on side "C"	-0.4	+0.3	+0.8

5 MEDIUM HT. BLDG GABLE ROOF 0-10° h:b:l = 2·5:2:5



SHADED AREAS TO SCALE

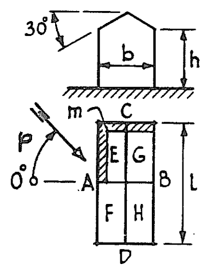
C_{pe}: EXTERNAL PRESSURE COEFFICIENTS

ρ	A	B	C	D	E	F	G	H
0°	+0.9	-0.5	-0.7	-0.7	-0.6	-0.6	-0.5	-0.5
45°	+0.6	-0.5	+0.4	-0.5	-0.9	-0.7	-0.6	-0.7
90°	-0.5	-0.5	+0.9	-0.4	-0.8	-0.2	-0.8	-0.2
45°	For section "m" C_{pe}^{*} = -1.5							

C_{pi}: INTERNAL PRESSURE COEFFICIENTS

OPENINGS	ρ =0°	ρ =45°	ρ =90°
Uniformly distributed	±0.2	±0.2	±0.2
Predominating on side "A"	+0.8	+0.5	-0.4
Predominating on side "B"	-0.4	-0.4	-0.4
Predominating on side "C"	-0.6	+0.3	+0.8

6 MEDIUM HT. BLDG GABLE ROOF 30° h:b:l = 2·5:2:5



SHADED AREAS TO SCALE

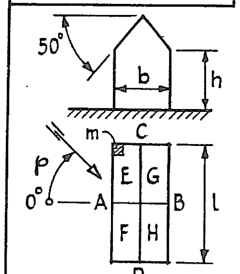
C_{pe}: EXTERNAL PRESSURE COEFFICIENTS

ρ	A	B	C	D	E	F	G	H
0°	+0.9	-0.5	-0.7	-0.7	-0.6	-0.6	-0.5	-0.5
45°	+0.6	-0.5	+0.4	-0.4	-0.4	-0.5	-0.6	-0.7
90°	-0.5	-0.5	+0.9	-0.4	-0.7	-0.2	-0.7	-0.2
45°	For section "m" C_{pe}^{*}= -1.2							

C_{pi}: INTERNAL PRESSURE COEFFICIENTS

OPENINGS	ρ =0°	ρ =45°	ρ =90°
Uniformly distributed	±0.2	±0.2	±0.2
Predominating on side "A"	+0.8	+0.5	-0.4
Predominating on side "B"	-0.4	-0.4	-0.4
Predominating on side "C"	-0.6	+0.3	+0.8

7 MEDIUM HT. BLDG GABLE ROOF 50° h:b:l = 2·5:2:5



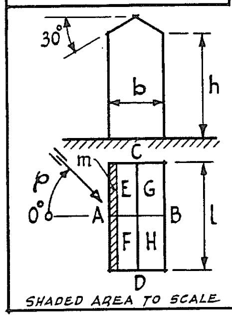
C_{pe}: EXTERNAL PRESSURE COEFFICIENTS

ρ	A	B	C	D	E	F	G	H
0°	+0.9	-0.5	-0.8	-0.8	+0.3	+0.3	-0.6	-0.6
45°	+0.6	-0.5	+0.4	-0.4	+0.3	-0.1	-0.5	-0.6
90°	-0.5	-0.5	+0.9	-0.4	-0.8	-0.2	-0.8	-0.2
75°	For section "m" C_{pe}^{*}= -1.2							

C_{pi}: INTERNAL PRESSURE COEFFICIENTS

OPENINGS	ρ =0°	ρ =45°	ρ =90°
Uniformly distributed	±0.2	±0.2	±0.2
Predominating on side "A"	+0.8	+0.5	-0.4

8 HIGH BUILDING GABLE ROOF 30° h:b:l = 2:1:2



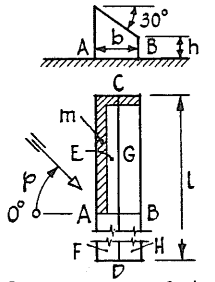
C_{pe}: EXTERNAL PRESSURE COEFFICIENTS

ρ	A	B	C	D	E	F	G	H
0°	+0.9	-0.5	-0.8	-0.8	-1.0	-1.0	-0.5	-0.5
45°	+0.6	-0.5	+0.4	-0.4	-0.3	-0.4	-0.5	-0.6
90°	-0.6	-0.6	+0.9	-0.4	-0.7	-0.5	-0.7	-0.5
0°	For section "m" $C_{pe}{}^{*}$ = -1.2							

C_{pi}: INTERNAL PRESSURE COEFFICIENTS

OPENINGS	ρ =0°	ρ=45°	ρ=90°
Uniformly distributed	±0.2	±0.2	±0.2
Predominating on side "A"	+0.8	+0.5	-0.5
Predominating on side "B"	-0.4	-0.4	-0.5
Predominating on side "C"	-0.7	+0.3	+0.8

9 LONG BUILDING SINGLE SLOPE ROOF h:b:l = 1:2·4:12



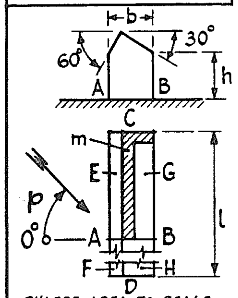
C_{pe}: EXTERNAL PRESSURE COEFFICIENTS

ρ	A	B	C	D	E	F	G	H
0°	+0.9	-0.5	-0.6	-0.6	-0.5	-0.5	-0.5	-0.5
45°	+0.5	-0.6	+0.4	-0.4	-1.2	-0.7	-1.1	-0.7
90°	-0.4	-0.3	+0.9	-0.2	-0.3	0	-0.3	0
180°	-0.4	+0.8	-0.7	-0.7	+0.1	+0.1	+0.2	+0.2
45°	For section "m" $C_{pe}{}^{*}$ = -1.4							

C_{pi}: INTERNAL PRESSURE COEFFICIENTS

OPENINGS	ρ =0°	ρ=45°	ρ=90°	ρ=180°
Uniformly distributed	±0.2	±0.2	±0.2	±0.2
Predominating on side "A"	+0.8	+0.4	-0.2	-0.3
Predominating on side "B"	-0.4	-0.5	-0.1	+0.7
Predominating on side "C"	-0.5	+0.3	+0.8	-0.6

10 LONG BUILDING SINGLE SHED ROOF h:b:l = 1:1:5



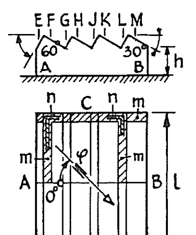
C_{pe}: EXTERNAL PRESSURE COEFFICIENTS

ρ	A	B	C	D	E	F	G	H
0°	+0.9	-0.5	-0.6	-0.6	+0.6	+0.6	-0.5	-0.5
45°	+0.5	-0.8	+0.4	-0.5	+0.2	-0.1	-1.0	-0.8
90°	-0.4	-0.4	+0.9	-0.3	-0.4	0	-0.4	0
180°	-0.5	+0.9	-0.6	-0.6	-0.5	-0.5	-0.1	-0.1
45°	For section "m" $C_{pe}{}^{*}$ = -1.3							

C_{pi}: INTERNAL PRESSURE COEFFICIENTS

OPENINGS	ρ =0°	ρ=45°	ρ=90°	ρ=180°
Uniformly distributed	±0.2	±0.2	±0.2	±0.2
Predominating on side "A"	+0.8	+0.4	-0.1	-0.4
Predominating on side "B"	-0.4	-0.7	-0.1	+0.8
Predominating on side "C"	-0.5	+0.3	+0.8	-0.5

11 LOW BUILDING MULTIPLE SHED ROOF h:b:l = 1:4:5



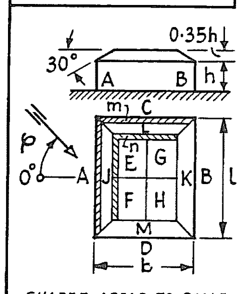
C_{pe}: EXTERNAL PRESSURE COEFFICIENTS

ρ	A	B	C	D	E	F	G	H	J	K	L	M
0°	+0.9	-0.3	-0.4	-0.4	+0.6	-0.6	-0.6	-0.5	-0.5	-0.4	-0.3	-0.3
45°	+0.5	-0.4	+0.5	-0.3	+0.2	-0.8	-0.5	-0.4	-0.2	-0.4	-0.2	-0.5
90°	-0.4	-0.4	+0.9	-0.3	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.3
180°	-0.3	+0.9	-0.3	-0.3	-0.2	-0.3	-0.3	-0.4	-0.4	-0.6	-0.6	-0.1
0°-180°	Section "m" $C_{pe}{}^{*}$ = -1.3 Section "n" $C_{pe}{}^{*}$ = -2.0											

C_{pi}: INTERNAL PRESSURE COEFFICIENTS

OPENINGS	ρ =0°	ρ=45°	ρ=90°	ρ=180°
Uniformly distributed	±0.2	±0.2	±0.2	±0.2
Predominating on side "A"	+0.8	+0.4	-0.3	-0.3

12 LOW BUILDING CLIPPED FLAT ROOF h:b:l = 1:3:4



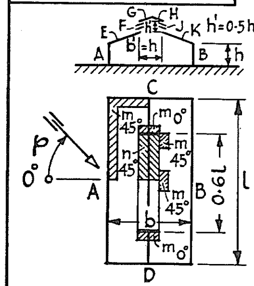
C_{pe}: EXTERNAL PRESSURE COEFFICIENTS

ρ	A	B	C	D	E	F	G	H	J	K	L	M
0°	+0.9	-0.5	-0.6	-0.6	-0.8	-0.8	-0.4	-0.4	-1.0	-0.4	-0.5	-0.5
45°	+0.5	-0.5	+0.5	-0.4	-0.6	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
90°	-0.5	-0.5	+0.9	-0.4	-0.8	-0.4	-0.8	-0.4	-0.4	-0.4	-1.0	-0.4
0°→90°	For section "m" $C_{pe}{}^{*}$ = -1.1 Section "n" $C_{pe}{}^{*}$ = -1.5											

C_{pi}: INTERNAL PRESSURE COEFFICIENTS

OPENINGS	ρ =0°	ρ=45°	ρ=90°
Uniformly distributed	±0.2	±0.2	±0.2
Predominating on side "A"	+0.8	+0.4	-0.4
Predominating on side "B"	-0.4	-0.4	-0.4
Predominating on side "C"	-0.5	+0.4	+0.8

13 BLDG WITH ROOF VENT ROOFS 20° h:b:l = 1:4:8



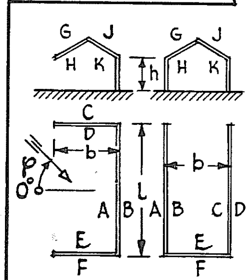
C_{pe}: EXTERNAL PRESSURE COEFFICIENTS

ρ	A	B	C	D	E	F	G	H	J	K
0°	+0.8	-0.5	-0.7	-0.7	-0.2	+0.6	-1.0	-0.6	-0.5	-0.6
45°	+0.4	-0.5	+0.4	-0.5	-0.3	+0.2	-1.3	-1.4	-1.0	-0.7
90°	-0.4	-0.4	+0.8	-0.3	-0.4	-0.2	-0.3	-0.3	-0.2	-0.4
0° & 45°	For section "m" $C_{pe}{}^{*}$ = -1.2 Section "n" $C_{pe}{}^{*}$ = -2.4									

C_{pi}: INTERNAL PRESSURE COEFFICIENTS

OPENINGS	ρ =0°	ρ=45°	ρ=90°
Vents at F and J closed	±0.2	±0.2	±0.2
Vents at F and J open	-0.2	-0.5	-0.3
Vents at F only open	+0.5	+0.1	-0.2
Vents at J only open	-0.4	-0.9	-0.2

14 BLDG OPEN ONE SIDE ROOF 30° h:b:l = 1:2:4



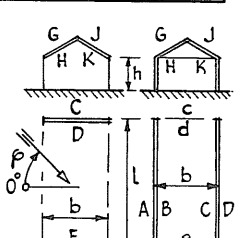
C_p: PRESSURE COEFFICIENTS, LONG WALL OPEN

ρ	A	B	C	D	E	F	G	H	J	K
0°	+0.8	-0.5	-0.7	+0.8	+0.8	-0.7	-0.3	+0.8	-0.4	+0.8
45°	+0.7	-0.6	+0.4	+0.6	+0.8	-0.4	-0.2	+0.6	-0.7	+0.7
60°	+0.3	-0.7	+0.7	+0.3	+0.4	-0.4	-0.3	+0.2	-0.6	+0.2
180°	-0.5	+0.9	-0.8	-0.5	-0.5	-0.8	-0.4	-0.5	-0.2	-0.5

C_p: PRESSURE COEFFICIENTS, END WALL OPEN

ρ	A	B	C	D	E	F	G	H	J	K
0°	+0.9	-0.7	-0.7	-0.4	-0.7	-0.8	-0.2	-0.7	-0.4	-0.7
45°	+0.5	+0.7	+0.8	-0.5	+0.7	-0.4	-0.3	+0.7	-0.6	+0.8
60°	+0.1	+0.9	+0.9	-0.6	+0.9	-0.4	-0.3	+0.9	-0.7	+0.9
90°	-0.5	+0.8	+0.8	-0.5	+0.8	-0.3	-0.4	+0.8	-0.4	+0.8

15 BLDG OPEN ON TWO SIDES ROOF 30° h:b:l = 1:2:4



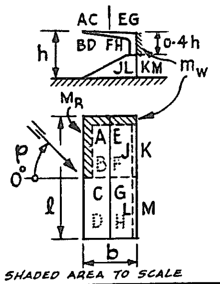
C_p: PRESSURE COEFFICIENTS, LONG WALLS OPEN

ρ	C	D	E	F	G	H	J	K
0°	-0.2	-0.7	-0.7	-0.2	+0.4	-0.9	-0.5	-0.8
45°	+0.5	-0.4	+0.5	-0.4	0	-0.3	-0.6	0
60°	+0.7	-0.6	+0.5	-0.4	-0.3	-0.1	-0.7	-0.3

C_p: PRESSURE COEFFICIENTS, END WALLS OPEN

ρ	A	B	C	D	G	H	J	K
0°	+0.9	-0.7	-0.7	-0.4	-0.2	-0.7	-0.4	-0.7

16 GRAND STANDS OPEN THREE SIDES ROOF - 5° h:b:l = 0.8:1:2.2



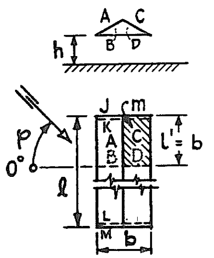
C_p: PRESSURE COEFFICIENTS FOR TOP AND BOTTOM OF ROOF

ρ	A	B	C	D	E	F	G	H
0°	-1.0	+0.9	-1.0	+0.9	-0.7	+0.9	-0.7	+0.9
45°	-1.0	+0.7	-0.7	+0.4	-0.5	+0.8	-0.5	+0.3
135°	-0.4	-1.1	-0.7	-1.0	-0.9	-1.1	-0.9	-1.0
180°	-0.6	-0.3	-0.6	-0.3	-0.6	-0.3	-0.6	-0.3
45°	"m_R" C_p* Top = -2.0							
45°	"m_R" C_p* Bottom = +1.0							

C_p: FRONT AND BACK OF WALL

ρ	J	K	L	M
0°	+0.9	-0.5	+0.9	-0.5
45°	+0.8	-0.6	+0.4	-0.4
135°	-1.1	+0.6	-1.0	+0.4
180°	-0.3	+0.9	-0.3	+0.9
60°	"m_W" C_p* K = -1.0			
60°	"m_W" C_p* J = +1.0			

17 ROOFS WITHOUT WALLS ROOF 30° h:b:l = 0.5:1:5



C_p: PRESSURE COEFF. FOR TOP AND BOTTOM OF ROOF

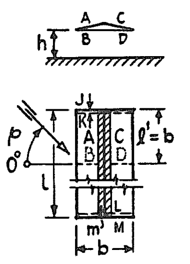
ρ	A	B	C	D
0°	+0.6	-1.0	-0.5	-0.9
45°	+0.1	-0.3	-0.6	-0.3
90°	-0.3	-0.4	-0.3	-0.4
45°	"m" C_p* Top = -1.0			
45°	"m" C_p* Bottom = -0.2			

C_p: FOR GABLE ENDS

ρ	J	K	L	M
90°	+0.8	-0.4	+0.3	-0.3

Note: At ρ = 90° Coeff. for A - D apply only to length l' = b, at ρ = 0° and 45° to l = 5b

18 ROOF WITHOUT WALLS ROOF 10° h:b:l = 0.5:1:5



C_p: PRESSURE COEFF. FOR TOP AND BOTTOM OF ROOF

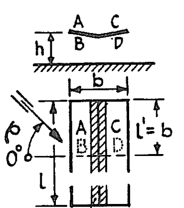
ρ	A	B	C	D
0°	-1.0	+0.3	-0.5	+0.2
45°	-0.3	+0.1	-0.3	+0.1
90°	-0.3	0	-0.3	0
0°	"m" C_p* Top = -1.0			
0°	"m" C_p* Bottom = +0.4			

C_p: FOR GABLE ENDS

ρ	J	K	L	M
90°	+0.8	-0.6	+0.3	-0.4

Note: At ρ = 90° Coeff. for A - D apply only to length l' = b, at ρ = 0° and 45° to l = 5b

19 ROOF WITHOUT WALLS ROOF -10° h:b:l = 0.5:1:5

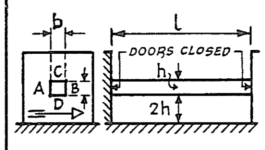


C_p: PRESSURE COEFF. FOR TOP AND BOTTOM OF ROOF

ρ	A	B	C	D
0°	+0.3	-0.7	+0.2	-0.9
45°	0	-0.2	+0.1	-0.3
90°	-0.1	+0.1	-0.1	+0.1
0°	"m" C_p* Top = +0.4			
0°	"m" C_p* Bottom = -1.5			

Note: At ρ = 90° Coeff. for A - D apply only to length l' = b, at ρ = 0° and 45° to l = 5b. These coeff. are valid only for relatively smooth underside B & D

20 CLOSED PASSAGE BETWEEN LARGE WALLS h:b:l = 1:1:10



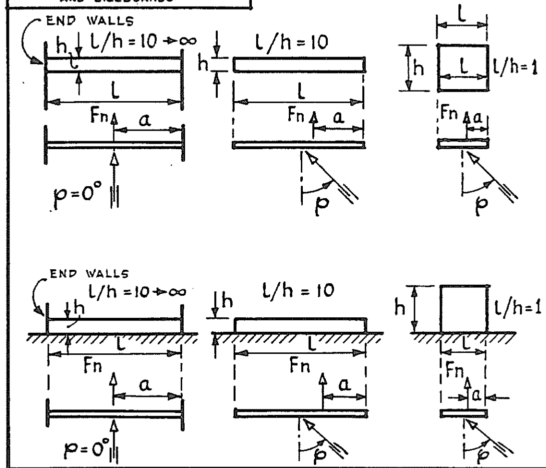
C_{pe}: EXTERNAL PRESSURE COEFFICIENTS

ρ	A	B	C	D
0°	+0.8	-1.2	-1.4	-1.5

C_{pi}: INTERNAL PRESSURE COEFFICIENTS

OPENINGS	ρ = 0°
Uniformly distributed	-0.5
Predominating on side "A"	+0.7
Predominating on side "B"	-1.1
Predominating on side "C"	-1.3

21 FREE STANDING PLATES, WALLS AND BILLBOARDS



$F_n = C_n \cdot q \cdot h \cdot l$

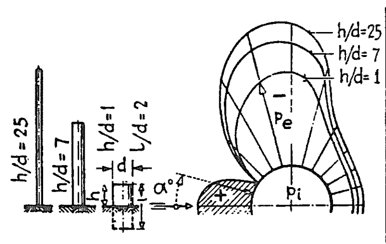
C_n - FORCE COEFF. FOR WALLS ABOVE GROUND

l/h	10 → ∞ (End walls)	10	1
ρ = 0°, a = .5l	2.0	1.3	1.15
ρ = 40°, a = .3l		1.6	
ρ = 50°, a = .4l			1.8

C_n - FORCE COEFF. FOR WALLS ON THE GROUND

l/h	10 → ∞ (End walls)	10	1
ρ = 0°, a = .5l	1.2	1.2	1.1
ρ = 40°, a = .3l		1.5	
ρ = 50°, a = .4l			1.5

22 CYLINDERS, CHIMNEYS, TANKS



TOTAL FORCE $F = C_n \cdot q \cdot A$ where $A = d \cdot h$

C_n, FORCE COEFFICIENT FOR $.67\, d\sqrt{q} > 1.5$

Slenderness h/d = →	25	7	1
Cross sect. and roughness	C_n	C_n	C_n
Moderately smooth, (metal, timber, concrete)	0.55	0.5	0.45
Rough surface (rounded ribs h = 2%d)	0.9	0.8	0.7
Very rough surface (sharp ribs h = 8%d)	1.2	1.0	0.8
Smooth and rough surface sharp edges	1.4	1.2	1.0

C_{pe}: EXTERNAL PRESS. COEFF. FOR $.67\, d\sqrt{q} > 1.5$ and moderately smooth surface

h/d	l/d	α =	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°
25	50	C_{pe}	+1.0	+0.8	+0.1	-0.9	-1.9	-2.5	-2.6	-1.9	-0.9	-0.7	-0.6	-0.6	-0.6
7	14	C_{pe}	+1.0	+0.8	+0.1	-0.8	-1.7	-2.2	-2.2	-1.7	-0.8	-0.6	-0.5	-0.5	-0.5
1	2	C_{pe}	+1.0	+0.8	+0.1	-0.7	-1.2	-1.6	-1.7	-1.2	-0.7	-0.5	-0.4	-0.4	-0.4

$\Delta P = P_i - P_e$ $P_i = C_{pi} \cdot q$ $P_e = C_{pe} \cdot q$

Stack fully operating $C_{pi} = +0.1$

Stack throttled $C_{pi} = -0.8$

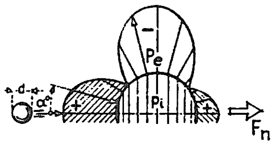
23 SPHERES

TOTAL FORCE $F = C_n \cdot q \cdot A$;

for $.67\, d\sqrt{q} > 7.5$ and moderately smooth surface

C_n: FORCE COEFFICIENT

$C_n = 0.2$



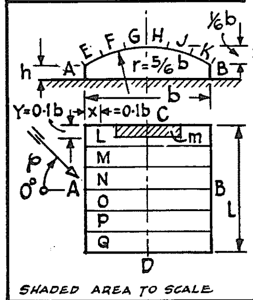
$p = p_i - p_e$ p_i for closed tanks = working press.

$p_e = C_{pe}\ q$

C_{pe}: EXTERNAL PRESSURE COEFF. for $.67\, d\sqrt{q} > 7.5$ and moderately smooth surface

α =	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°
C_{pe}	+1.0	+0.9	+0.5	-0.1	-0.7	-1.1	-1.2	-1.0	-0.6	-0.2	+0.1	+0.3	+0.4

24 HANGAR, CURVED ROOF MOD. SMOOTH SURFACE RAD. r = 5/6 b h:b:l = 1:12:12



SHADED AREA TO SCALE

C_{pe}: EXTERNAL PRESSURE COEFFICIENTS

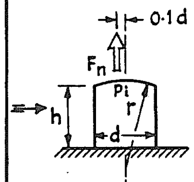
φ	A	B	C	D	E	F	G	H	J	K
0°	+0.7	-0.2	-0.3	-0.3	-0.1	-0.5	-0.8	-0.8	-0.4	-0.1
30°	+0.6	-0.3	+0.2	-0.4	-0.1	-0.4	-0.7	-0.9	-0.7	-0.4

φ	A	B	C	D	L	M	N	O	P	Q
90°	-0.3	-0.3	+0.9	-0.3	-0.8	-0.7	-0.5	-0.3	-0.1	-0.1
30°	Section "m" $C_{pe}{}^{*} = -1.8$ with $C_{pe}{}^{*} = -2.5$									

C_{pi}: INTERNAL PRESSURE COEFFICIENTS

OPENINGS	φ = 0°	φ = 30°	φ = 90°
Uniformly distributed	±0.2	±0.2	±0.2
Window Y open on side "A"	+0.4	+0.7	-1.0
All doors open on side "C"	-0.1	+0.6	+0.8
Only door X open on side "C"	-1.5	+0.7	+0.4

25 ROOF LOAD ON SMOOTH CLOSED TANK. h:d:r = 1:1:1.5



Total force on roof $F_n = (p_i - p_e)A$

p_i = working pressure in p.s.f.

$p_e = C_{pe} \cdot q$ C_{pe} external pressure coefficient = -1.0

$A = \frac{\pi}{4} d^2$

26 POLES, RODS & WIRES l/d > 100

C_n: FORCE COEFFICIENTS

Total force $F_n = C_n \cdot q \cdot A$

$A = d\ l$

	67 d q 1.5	67 d q 1.5
Smooth wires, rods, pipes	1.2	0.5
Mod. smooth wires and rods	1.2	0.7
Fine wire cables	1.2	0.9
Thick wire cables	1.3	1.1

27 STRUCTURAL MEMBERS SINGLE & ASSEMBLED SECTIONS

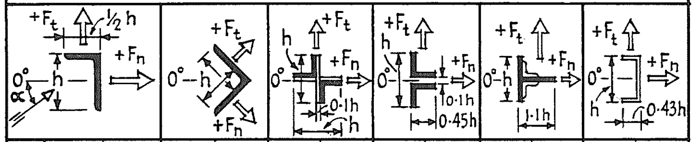
l = Length of member

$A = h \cdot l$ = Area

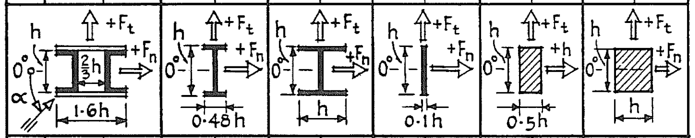
For wind normal to axis of member: Normal force $F_n = k \cdot C_{n\infty} \cdot q \cdot A$

Tangential force $F_t = k \cdot C_{t\infty} \cdot q \cdot A$

$C_{n\infty}$ and $C_{t\infty}$: Force coefficients for an infinitely long member

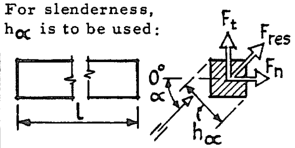


α	$C_{n\infty}$	$C_{t\infty}$	$C_{n\infty}$	$C_{t\infty}$	$C_{n\infty}$	$C_{t\infty}$	$C_{n\infty}$	$C_{t\infty}$	$C_{n\infty}$	$C_{t\infty}$	$C_{n\infty}$	$C_{t\infty}$
0°	+1.9	+0.95	+1.8	+1.8	+1.75	+0.1	+1.6	0	+2.0	0	+2.05	0
45°	+1.8	+0.8	+2.1	+1.8	+0.85	+0.85	+1.5	-0.1	+1.2	+0.9	+1.85	+0.6
90°	+2.0	+1.7	-1.9	-1.0	+0.1	+1.75	-0.95	+0.7	-1.6	+2.15	0	+0.6
135°	-1.8	-0.1	-2.0	+0.3	-0.75	+0.75	-0.5	+1.05	-1.1	+2.4	-1.6	+0.4
180°	-2.0	+0.1	-1.4	-1.4	-1.75	-0.1	-1.5	0	-1.7	±2.1	-1.8	0



α	$C_{n\infty}$	$C_{t\infty}$	$C_{n\infty}$	$C_{t\infty}$	$C_{n\infty}$	$C_{t\infty}$	$C_{n\infty}$	$C_{t\infty}$	$C_{n\infty}$	$C_{t\infty}$	$C_{n\infty}$	$C_{t\infty}$
0°	+1.4	0	+2.05	0	+1.6	0	+2.0	0	+2.1	0	+2.0	0
45°	+1.2	+1.6	+1.95	+0.6	+1.5	+1.5	+1.8	+0.1	+1.4	+0.7	+1.55	+1.55
90°	0	+2.2	±0.5	+0.9	0	+1.9	0	+0.1	0	+0.75	0	+2.0

For slenderness, h_α is to be used:



k: Reduction factor for members of finite length and slenderness

l/h_α	5	10	20	35	50	100	∞
k	0.60	0.65	0.75	0.85	0.90	0.95	1.0

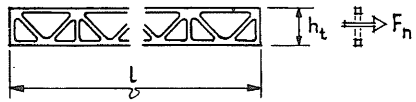
28 PLANE TRUSSES MADE FROM SHARP-EDGED SECTIONS

A_s = Section area

$A = h_t\ l$

A_s/A = Fullness ratio

For wind normal to surface A: Normal force $F_n = k \cdot C_{n\infty} \cdot q \cdot A_s$



$C_{n\infty}$: Force coeff. for an infinitely long truss, $0 \leqq A_s/A \leqq 1$

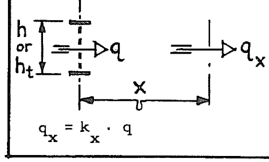
A_s/A	0	0.1	0.15	0.2	0.3 to 0.8	0.95	1.0
$C_{n\infty}$	2.0	1.9	1.8	1.7	1.6	1.8	2.0

k: Reduction factor for trusses of finite length and slenderness

l/h_t \ A_s/A	0.25	0.5	0.9	0.95	1.0
5	0.96	0.91	0.87	0.77	0.60
20	0.98	0.97	0.94	0.89	0.75
50	0.99	0.98	0.97	0.95	0.90
∞	1.0	1.0	1.0	1.0	1.0

29 SHIELDING FACTORS

PLANE OF MEMBER I	PLANE OF MEMBER II



$q_x = k_x \cdot q$

k_x SHIELDING FACTOR

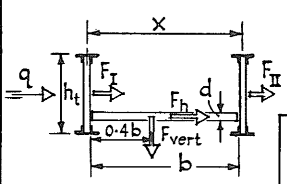
x/h \ A_s/A	0.1	0.2	0.3	0.4	0.5	0.6	0.8	1.0
0.5	0.93	0.75	0.56	0.38	0.19	0	0	0
1	0.99	0.81	0.65	0.48	0.32	0.15	0.15	0.15
2	1.00	0.87	0.73	0.59	0.44	0.30	0.30	0.30
4	1.00	0.90	0.78	0.65	0.52	0.40	0.40	0.40
6	1.00	0.93	0.83	0.72	0.61	0.50	0.50	0.50

30 TRUSS AND PLATE GIRDER BRIDGES

L_B = Length of bridge

k, $C_{n\infty}$, A_s, k_x from tables 28 and 29

CASE I WITHOUT VEHICLES



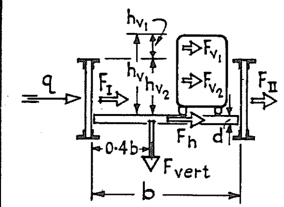
Windward girder $F_I = k\,C_{n\infty} \cdot q \cdot A_s$

Leeward girder $F_{II} = k\,C_{n\infty} \cdot k_x\,q \cdot A_s$

Deck horiz. load $F_h = 1.0 \cdot q \cdot d \cdot L_B$

Deck vert. load $F_{vert.} = 0.6 \cdot q \cdot b \cdot L_B$

CASE II WITH VEHICLES



L_v = Length of vehicle; $A_1 = h_{v_1} \cdot L_v$;

$A_2 = h_{v_2} \cdot L_v$

Windward girder $F_I = k\,C_{n\infty} \cdot q \cdot A_s$

Leeward girder $F_{II} = k\,C_{n\infty} \cdot k_x q \cdot A_s$

Deck horiz. load $F_h = 1.2 \cdot q \cdot d \cdot$ B

Deck vert. load $F_{vert.} = 0.8 \cdot q \cdot b \cdot L_B$

Traffic load $F_{v_1} = C_n\,q \cdot A_1$

$F_{v_2} = C_n \cdot 2/3\,q \cdot A_2$

Height and force coefficients	h_v	C_n
Railway vehicle	12.5'	1.5
Highway vehicle	10.0'	1.2
Pedestrian	5.6'	1.0

31 THREE-DIMENSIONAL TRUSSES $A_s/A \leq 0.3$

$A = d \cdot L$ or $h \cdot L$

L = true length of member

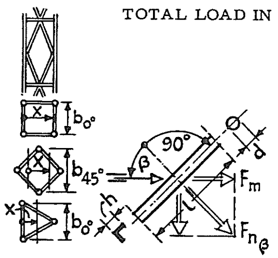
β = angle formed by wind direction and the normal to member axis

k_x - a function of A_s/A and x/b

TOTAL LOAD IN WIND DIRECTION $F = \Sigma F_m$

F_m = FORCE ON MEMBER

$F_m = k \cdot C_{\infty\beta} \cdot q \cdot A\cos\beta$



(Shielded member $F_m = k \cdot C_{\infty\beta} \cdot k_x q \cdot A\cos\beta$)

Coeff. $C_{\infty\beta}$: For sharp-edged members $C_{\infty\beta} = k_\beta \cdot C_{n\infty}$ and $k_\beta \cdot C_{t\infty}$

Coeff. $C_{\infty\beta}$, k_β, k, k_x: SEE TABLE 27 FOR $C_{n\infty}$ and $C_{t\infty}$ values

β	SHARP EDGED MEMBERS			ROUND MEMBERS, SMOOTH & ROUGH SURFACES $d\sqrt{q}<1.5$			ROUND MEMBERS, MODERATELY SMOOTH SURFACES $d\sqrt{q}<1.5$		
	k_β	k	k_x	$C_{\infty\beta}$	k	k_x	$C_{\infty\beta}$	k	k_x
0°	1.00			1.20			0.6		
15°	0.98	See	See	1.16	See	See	0.58	0.9	0.95
30°	0.93	table	table	1.04	table	table	0.53	for	constant

APPENDIX

EXPLANATION OF PRESSURE COEFFICIENT TABLES

By **W. R. Schriever and W. A. Dalgliesh**

q = 0.0027 v²

INTRODUCTION

The calculation of wind loads on structures is based on the "stagnation pressure" which is the pressure that the wind exerts when its kinetic energy is converted to pressure on a surface which obstructs the flow of air. If ρ is the mass density of the air and v is the wind velocity, then the stagnation or velocity pressure developed on an infinitely large, flat plate perpendicular to the velocity is $q = \frac{1}{2}\rho v^2$. For an air density corresponding to 15°C. at 760 mm of mercury and the velocity v expressed in miles per hour, the velocity pressure in psf. (pounds per square foot) is $q = 0.00256\ v^2$. In Canada, because of lower temperatures, the coefficient 0.00256 frequently used elsewhere, has been increased to 0.0027.

Maximum wind velocities vary according to climate and geographic location. In Canada, values of the maximum gust velocity pressures for design purposes are available, as explained later, in a handbook of climatic information issued as a supplement to the National Building Code, (Ref. (1)). The values given are pressures which are likely to be exceeded on the average once in thirty years.

In determining the design wind loads for a given building or structure, two other factors have to be considered, namely, the height above ground and the effect of the shape of the building itself.

Since wind velocity usually increases with height above the ground, the design pressure obtained from the climate handbook must be multiplied by a coefficient appropriate to the height of the structure using a suitable velocity-height relationship. The coefficients used in the National Building Code are based on the assumption that gust velocity varies as the 1/7th power of the height, (Ref. (1)). Although it is known that changes in "ground roughness" affect this relationship (Ref. (2)), which is fairly conservative, no allowance for such variations has been made at the moment by the Revision Committee because present information is not considered adequate for this refinement, quite apart from the difficulties in predicting any changes in shelter condition for the life of a given structure.

The final step in obtaining actual pressures on a structure or building is the selection of appropriate shape factors or pressure coefficients. The purpose of this Appendix is to present a brief discussion of the selection of pressure coefficients which may be used with the National Building Code, 1960. Other pressure coefficients, when known to be more applicable in a particular case, or the results of special model tests, may be used in lieu of those given in this handbook.

EFFECT OF SHAPE OF STRUCTURE

The relation between velocity pressure and actual pressures on a building, as a result of wind, cannot be expressed by a simple general rule or a mathematical equation. The variables are so many and the resulting relations so complex that the best approach developed so far has been to determine empirical constants for various situations by testing models in wind tunnels. Tests have also been made on full scale structures in natural wind, but these are so few as to serve to check model results rather than to replace them. Fortunately, however, for most sharp-edged structures, the results of wind tunnel tests on small models can be applied to full scale structures with reasonable confidence.

It is well known that suctions as well as pressures result from wind action on structures. Both model tests and full scale observations indicate that very high suctions can occur over small areas, and also that over-all uplift can be great enough to remove inadequately anchored lightweight roofs. When suctions are indicated in model tests, negative coefficients are applied to the velocity pressure. In general, the pressure distribution (negative or positive) is non-uniform even over a single plane surface of a building and, therefore, an average value is used for the pressure coefficient to simplify the design; local high pressures and suctions, however, should be noted in the design rules so that local damage can be prevented by proper design of fastenings, anchorages, etc. (Ref. (2), (3), (4)).

In addition to external pressure, internal pressure must also be considered since air leakage due to openings such as windows and doors and even small cracks will give rise to a net internal pressure or suction depending on whether the openings are chiefly on the windward or leeward side. Such internal pressures and suctions, therefore, must be considered by using appropriate total pressure effects. On the other hand, it is generally agreed that, in most cases, frictional forces acting tangentially, are small and can be neglected; in other words, forces acting only at right angles to surfaces are usually considered.

Over the years, pressure coefficients have become increasingly extensive and accurate as more and different structures have been tested. Strict attention, however, must be paid to the limitations and proper application of these coefficients, precisely because they are empirical and subject to so many variations. Some of the variables affecting shape coefficients which were not fully realized in early wind tunnel model tests (Ref. (2), (4), (5)) are as follows:

(a) Orientation of building to wind direction.

(b) Ratios of length and height to breadth of building.

(c) Variations in wind velocity profile found in nature.

(d) Small scale turbulence present in nature.

(e) Shielding from nearby structures.

Orientation and length: height: breadth ratio of the building, taken together, can cause great variations in pressures, especially with regard to local suctions on the roof pressures near windward corners. For example, a diagonally oriented wind on a long building can cause local suctions up to five times the velocity pressure, whereas, for a wind normal to the eaves (in which case length has little effect), the maximum suction coefficiency may not exceed 1.0, (Ref. (4)).

The wind velocity used in earlier model tests was constant over the height of the model and the variations in pressure over the height of an actual building was assumed to follow the square of the velocity according to a specified profile. More recent model tests, carried out with a simulated velocity profile and also some observations on full-scale structures, have shown that the effect is practically equivalent to a uniform pressure over the whole projected height, (paragraph (b), page 16).

Some research has been done to include small scale turbulence in model tests and also to compare laminar flow model tests with natural wind on full scale structures. The results of various investigators appear somewhat contradictory but they agree in that small scale turbulence, hitherto ignored, has significant effects on pressure coefficients, (Ref. (2)).

Shielding from nearby structures has important effects and, again, the relationships are complicated. The difficulties of making general observations and establishing design rules are obvious, but it might be said that suction over the whole roof section is frequently an undesirable aspect of a shielded location, (Ref. (2)).

PRESSURE COEFFICIENTS FOR THE NATIONAL BUILDING CODE, 1960

The pressure coefficients or shape factors contained in the 1953 National Building Code were based on model tests made when many of the above factors had not been investigated and were therefore very limited. They covered only wind perpendicular to the eaves of a simple rectangular building with varying slopes of gable roofs. The effect of velocity profile on buildings of varying heights was not considered, nor was the effect of small scale turbulence or shielding investigated. Since then, more extensive and accurate information has become available.

In the 1960 revision of the National Building Code, it was decided to remove to supplementary documents, whenever possible, lengthy discussions and design information and to make reference only to these supplements in the Code. Thus, all general climatic information will be contained in a climate supplement rather than in the Code itself. Correspondingly, the Revision Committee on Loads agreed that the pressure coefficients should be published in a separate supplement. This was considered desirable in order to provide enough space to cover, as much as possible, the many and varied building shapes and situations that occur in practice.

As a basis for the choice of a suitable set of pressure coefficients for the 1960 National Building Code, a comparison of several different building codes, with reference to their pressure coefficients, was made by the authors. This showed a good agreement in general for similar situations between the various codes, and showed that the 1956 Swiss Building Standards (S.I.A. Normen 1956) (Ref. (7)) had a far more detailed and extensive coverage of shape factors than any other code, including that published by the American Standards Association in 1955, (Ref. (3)).

The S.I.A. Standards make some provision for variations in wind direction and variable length: width: height ratios, and include many special types of structures, with specific information on rounded shapes. The information on internal pressures is more thoroughly treated than in any other Code, and differs considerably from that in the 1953 National Building Code. The coefficients for gable roofs of different slopes differ substantially from those for the windward slope of the 1953 National Building Code but, on the other hand, the American Standards Association Code values and some recent model tests agree closely with the S.I.A. Standards. The 1953 National Building Code coefficients for internal spans of a multiple shed roof differ from both the S.I.A. and A.S.A. Codes by a large factor but, as one would expect, recent model tests support the more recent codes.

These facts, coupled with the extensive coverage of pressure coefficients in the S.I.A. Standards, have led the authors to the conclusion that the S.I.A. tables form the best available basis for preparing a new set of shape factors for the National Building Code. This is in line with the opinions of others, notably T. W. Singell, (Ref. (6)) who states on p. 1710-4, "The Swiss data is the latest and best data that could be found". Naturally, the S.I.A. Standards do not satisfy all of the design questions that will occur in practice. One authority, for instance, although inferring that the S.I.A. Standards are a great improvement, states that no code as yet appears to make correct allowance for height, (Ref. (5)). It appears that a great deal of research in the field of wind action on structures is still required.

EXPLANATIONS ON THE USE OF PRESSURE COEFFICIENTS

The Pressure Coefficients C_p, shown in the Tables, give average pressures over the building surfaces to which they refer except in the cases of spheres and cylinders, where the pressure varies too much from point to point. Since calculation of total force on spheres and cylinders using such coefficients would require a laborious summation process, additional coefficients C_n are given, which can be used to calculate total force on the projected area.

The total force F, on a surface such as a wall, roof, or other element, is the product of the basic design pressure q (given in Article 4.1.2.12, Sentence (1)), the height factor C_h (given in Table 4.1.2.F), the total effect of external and internal pressure coefficients C_{pe} and C_{pi}, and area A of the surface considered.

$$F = q \cdot C_h \cdot C_p \cdot A$$

The various pressure coefficients are designated as follows:

- C_{pe} – external pressure coefficient.
- C_{pi} – internal pressure coefficient.
- C_{pe}^* – local pressure coefficient, maximum, referring to a shaded area drawn to scale in the sketches (not to be used for total forces).
- C_n – pressure coefficient supplied for spheres, and cylinders referring to the total force on the projected area, and for bill-boards and free-standing walls referring to the total force (front and back).
- $C_{n\infty}$, $C_{t\infty}$ – pressure coefficients for total forces in the "normal" and "tangential" direction (see Table 27) acting on structural members of infinite length or slenderness. For members of finite length or slenderness, a reduction factor k is introduced into the expression.
- $C_{\infty\beta}$ – Pressure coefficients for total forces of structural members in three dimensional truss constructions where the wind is not normal to the member axis, but acts at an angle β from the normal. For members of finite length or slenderness, a reduction factor k is again introduced.

Since the pressures developed can be positive or negative (pressure or suction), they are to be considered as *differential* pressures with regard to ambient atmospheric pressure. A positive sign in the value of C_{pe} or C_{pi} indicates pressure, a negative sign suction on the surface considered. To obtain the total effect, the total differential pressure has to be calculated. For example, if, for the windward wall of a building $C_{pe} = +0.9$ and $C_{pi} = \pm 0.2$, then the maximum total differential effect is $C_p = 1.1$. However, if the same building has a large opening on the windward side, then $C_{pi} = +0.8$ and the total coefficient is +0.1 (inward force), whereas for a flat roof on this building C_{pe} might be –0.7 so that, with $C_{pi} = +0.8$, the total coefficient is 1.5 (upward force).

In the Tables, the structures are classified according to height: breadth: length ratio (designated h:b:l) with different pressure coefficients for different ratios where appropriate. The horizontal angle of wind direction, measured from the normal to one side of a structure is designated by Q.

For ordinary small buildings of average height: breadth: length ratios (h:b:l), the external pressure coefficients C_{pe} can be taken from the simplified Table O, subject to the following conditions:

(a) The stress at any point in the building due to wind loads must not exceed 25 per cent of the total stress at that point.
(b) The height: breadth ratio must be in the range $2/3 < h/b < 3/2$.
(c) The length: breadth ratio must be in the range $2/5 < l/b < 5/2$.
(d) The table applies to sharp-edged closed structures only and, in the approximation, the wind has been assumed perpendicular to the eaves. Internal pressure coefficients and local pressure coefficient maxima must be obtained from the appropriate detailed Tables 1-13.

For other than ordinary small buildings with average h:b:l ratios, information will be found for many cases (see Table of Contents and Tables 1-21 which are considered self-explanatory).

For rounded structures (in contrast to sharp-edged structures) the pressures vary with the wind velocity, depending on Reynold's number. For practical purposes, this number can be expressed by $0.67\ d\sqrt{q}$ where d is the diameter of the sphere or cylinder in feet and, q is the velocity pressure in pounds per square foot. Tables 22, 23, and 26 contain appropriate limitations.

The roughness of rounded structures may be of considerable importance. Common well-laid brickwork without parging can be considered as having a "rough" surface (Table 22). Surfaces with ribs projecting more than 2 per cent of the diameter are considered as "very rough". In case of doubt, it is recommended to use those c_n values which result in the greater forces. For cylindrical and spherical objects with substantial stiffening ribs, supports and attached structural members, the pressure coefficients depend on the type, location and relative magnitude of these roughnesses.

In locations where the strongest winds and icing may occur simultaneously, structural members, cables and ropes must be calculated assuming an ice covering based on climatic and local experience. Values of C for a "rough" surface shall be used for the iced condition according to Table 26.

In Tables 27, 28, 30 and 31 pressure coefficients with subscripts ∞ are used to indicate that they apply to structural members of infinite lengths, and this is multiplied by a reduction factor k for finite lengths of members. If a member projects from a large plate or wall, the reduction factor k shall be calculated for a slenderness based on twice the actual length. If a member terminates with both ends in large plates or walls, the reduction factors for infinite length shall be used.

For members which are located behind each other in the direction of the wind, the shielding effect may be taken into account. The windward member and those parts of the leeward member which are not shielded shall be designed with the full pressure q, whereas the shielded parts of the leeward member shall be designed with the reduced pressure q_x according to Table 29.

For constructions made from circular sections with $.67d\sqrt{q} < 1.5$ and $A_s/A \leq 0.3$, the shielding factors can be taken by approximation from Table 29. If $.67d\sqrt{q} > 1.5$, the shielding effect is small and for a fullness ratios $A_s/A \leq 0.3$, it can be taken into account by a constant shielding factor $k_x = 0.95$.

In high buildings, the walls near corners may be subjected to high local suctions. Allowance for this has been made in Table 3 by indicating a local maximum. High suctions near corners may be particularly critical in high buildings with light walls such as curtain walls. Another factor to be considered, particularly in high buildings with light curtain walls, is that of excessive lateral deflection of the building as a whole under wind loads. Whereas in the past, massive and rather rigid walls provided much additional stiffness, preventing even moderate deflection, many of the more recent high-rise buildings derive little bracing from their walls, and rely to a much greater degree on the stiffness provided by the structural bracing of the frame. Designers are, therefore, cautioned to pay increased attention to this problem of deflection in their designs.

Structures which may be subject to vibration due to the wind must be investigated by theoretical and possibly experimental methods for the danger of dynamic overloading and vibration of critical frequencies. This is the case particularly for: church steeples and sightseeing towers, high chimneys, high buildings, antenna towers, power lines, aerial conveyors, cranes, etc. As a rough guide, it may be said that caution should be used if the period for a full cycle is more than one second.

It should also be noted that the shape of a structure may change during erection. The wind loads, therefore, may be temporarily higher during erection than after completion of the structure. These increased wind loads shall be taken into account using the appropriate coefficients from the Tables.

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The National Building Code is published by the National Research Council as an advisory document for use throughout Canada. It is advisory only and has no legal standing until and unless adopted for specific use by a provincial government or municipal administration. The Code is essentially a set of minimum regulations respecting the safety of buildings with reference to public health, fire protection and structural efficiency. It is not and is not intended to be a textbook of building design, advice upon which should be sought from professional sources. The Code relates to buildings and simple structures but it is not intended for use with specialized civil engineering structures. Its essential purpose is the promotion of public safety through the use of desirable building standards throughout Canada.