# Eurocode standards

## „Philosophy" of Eurocode

The Eurocode standards provide **common structural design rules** for everyday use for the design of

- whole structures and
- component products of both a traditional and an innovative nature.

**Unusual** forms of construction or design conditions are not specifically covered and **additional expert consideration** will be required by the designer in such cases.

The **National Standards** implementing Eurocodes will comprise the full text of the Eurocode and may be followed by a National annex.

The **National annex** may only contain information on those parameters which are left open in the Eurocode for national choice, known as Nationally Determined Parameters, to be used for the design of buildings and civil engineering works to be constructed in the country concerned, *i.e.* :

– values and/or classes where **alternatives** are given in the Eurocode,
– values to be used where **a symbol only is given** in the Eurocode,
– **country specific data** (geographical, climatic, etc.), e.g. wind map,
– the procedure to be used **where alternative procedures** are given in the Eurocode.

**Design assisted by testing and measurements**
- With the approval of the appropriate Authority, **wind tunnel tests and proven and/or properly validated numerical methods** may be used to obtain load and response information, using appropriate models of the structure and of the natural wind.
- With the approval of the appropriate Authority, **load and response information** and **terrain parameters** may be obtained by appropriate full scale data.

**Design situations**
- The wind action is represented by **a simplified set of pressures or forces** whose effects are equivalent to the extreme effects of the turbulent wind.
- Other actions (such as **snow, traffic or ice**) which will modify the effects due to wind **should be taken into account**.
- **Changes to the structure during stages of execution** (such as different stages of the form of the structure, dynamic characteristics, etc.), which may modify the effects due to wind, should be taken into account.
- Where in design windows and doors are assumed to be shut under storm conditions, the effect of these **being open should be treated** as an accidental design situation.
- **Fatigue due to the effects of wind actions** should be considered for susceptible structures.

**Nature**
- Wind actions **fluctuate with time** and **act directly as pressures on the external surfaces** of enclosed structures.
- Because of **porosity** of the external surface, also **act indirectly on the internal surfaces**. They may also act directly on the internal surface of **open structures**.

- Pressures act on areas of the surface **resulting in forces normal to the surface** of the structure or of individual cladding components.
- Additionally, when **large areas of structures are swept** by the wind, **friction forces** acting tangentially to the surface **may be significant**.

**Characteristic values**
The wind actions are determined from the **basic values of wind velocity or the velocity pressure**. The basic values are **characteristic values having annual probabilities of exceedence of 0,02, which is equivalent to a mean return period of 50 years**.

**pressure coefficient**
external or internal **pressure coefficients** give the **effect of the wind** on the external or internal surfaces of buildings. The external pressure coefficients are divided into **overall coefficients and local coefficients**. Local coefficients give the pressure coefficients for loaded areas of 1 $m^2$ or less e.g. for the design of small elements and fixings; overall coefficients give the pressure coefficients for loaded areas larger than 10 $m^2$. Net pressure coefficients give the **resulting effect of the wind** on a structure, structural element or component **per unit area**.

**force coefficient**
force coefficients give the **overall effect of the wind on a structure**, structural element or component as a whole, including friction, if not specifically excluded

# Basic values

## Fundamental value of the basic wind velocity

The **fundamental value of the basic wind velocity**, $v_{b,0}$, is the characteristic **10 minutes mean wind velocity**, irrespective of wind direction and time of year, **at 10 m above ground level in open country terrain** with low vegetation such as grass (terrain category II) and isolated obstacles with separations of at least 20 obstacle heights, with an **annual risk of being exceeded of 0,02** (mean return period of 50 years). (Hungary $v_{b,0}$ = 23,6 m/s)

## Basic wind velocity

The **basic wind velocity** is the fundamental basic wind velocity modified to account for
- the **direction** of the wind being considered and
- the **season**, if required.

It shall be calculated:

$$v_b = c_{dir} \times c_{season} \times c_{prob} \times v_{b,0}$$

where:
$v_b$ is the **basic wind velocity**, defined **as a function of wind direction and time of year** at 10 m above ground of terrain category II
$v_{b,0}$ is the fundamental value of the basic wind velocity

$c_{dir}$ is the **directional factor** (in Belgium at wind direction East $c_{dir}$=0.894, other directions In Hungarian NA $c_{dir}$ = 0,85, (the probability of a wind of a specific direction is smaller than the probability of a wind of optional direction)

$c_{season}$ is the **season factor** (for temporary structures and for all structures in the execution phase, the seasonal factor $c_{season}$ may be used). For transportable structures, which may be used at any time in the year, $c_{season}$ should be taken equal to 1,0. (In Germany structure for 1 day $c_s$ = 0,5, lifetime < 4 years $c_s$ = 0,8. In Belgium structures lifetime < 1 month in May-August $c_s$=0,671, in november 0,806), for Hungary $c_s$ = 1. So $v_b$= 20 m/s for Hungary.

## Mean wind velocity

**mean wind velocity** $v_m(z)$ at a height $z$ is the basic wind velocity modified to account for

- the effect of terrain roughness and
- orography and height.

The mean wind velocity $v_m(z)$ **at a height** $z$ **above the terrain** depends on the **terrain roughness** and **orography** and on the basic wind velocity, $v_b$, and should be determined by using

$$v_m(z) = c_r(z) \times c_o(z) \times v_b \qquad \textbf{(4.3)}$$

where:
$c_r(z)$ is the **roughness factor**
$c_o(z)$ is the **orography factor**, taken as 1,0 unless otherwise specified in the National Annex

**Terrain roughness**
(1) The roughness factor, $c_r(z)$, accounts for the **variability of the mean wind velocity** at the site of the structure due to:
– the **height above ground level**
– the **ground roughness of the terrain upwind of the structure** in the wind direction considered

The recommended procedure for the determination of the roughness factor at height $z$ is based on a **logarithmic velocity profile**.

$$c_r(z) = k_r \cdot \ln\left(\frac{z}{z_0}\right) \quad \text{for} \quad z_{min} \leq z \leq z_{max}$$
$$c_r(z) = c_r(z_{min}) \quad \text{for} \quad z \leq z_{min} \qquad (4.4)$$

where:

$z_0$ is the roughness length

$k_r$ terrain factor depending on the roughness length $z_0$ calculated using

$$k_r = 0{,}19 \cdot \left(\frac{z_0}{z_{0,II}}\right)^{0{,}07} \qquad (4.5)$$

where:

$z_{0,II}$ = 0,05 m (terrain category II, Table 4.1)

$z_{min}$ is the minimum height defined in Table 4.1

$z_{max}$ is to be taken as 200 m, unless otherwise specified in the National Annex

$z_0$, $z_{min}$ depend on the terrain category. Recommended values are given in Table 4.1 depending on five representative terrain categories.

Expression (4.4) is valid when the upstream distance with uniform terrain roughness is long enough to stabilise the profile sufficiently. See (2).

**Table 4.1 — Terrain categories and terrain parameters**

| Terrain category | | $z_0$ m | $z_{min}$ m |
|---|---|---|---|
| 0 | Sea or coastal area exposed to the open sea | 0,003 | 1 |
| I | Lakes or flat and horizontal area with negligible vegetation and without obstacles | 0,01 | 1 |
| II | Area with low vegetation such as grass and isolated obstacles (trees, buildings) with separations of at least 20 obstacle heights | 0,05 | 2 |
| III | Area with regular cover of vegetation or buildings or with isolated obstacles with separations of maximum 20 obstacle heights (such as villages, suburban terrain, permanent forest) | 0,3 | 5 |
| IV | Area in which at least 15 % of the surface is covered with buildings and their average height exceeds 15 m | 1,0 | 10 |
| The terrain categories are illustrated in Annex A.1. | | | |

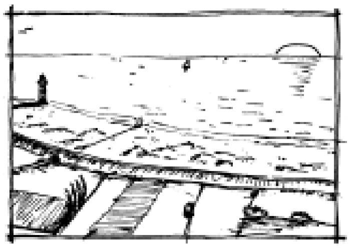
# Annex A
(informative)

# Terrain effects

## A.1 Illustrations of the upper roughness of each terrain category

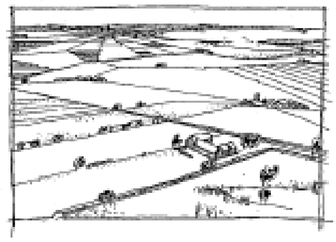
**Terrain category 0**

Sea, coastal area exposed to the open sea



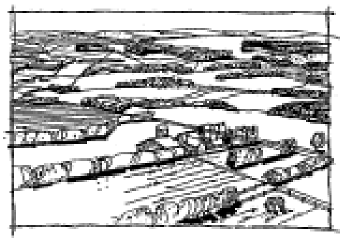
**Terrain category I**

Lakes or area with negligible vegetation and without obstacles



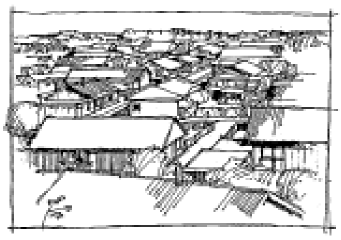
**Terrain category II**

Area with low vegetation such as grass and isolated obstacles (trees, buildings) with separations of at least 20 obstacle heights



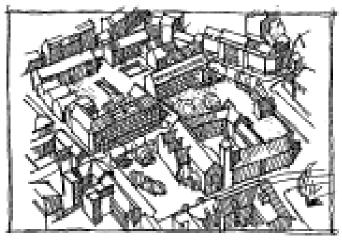
**Terrain category III**

Area with regular cover of vegetation or buildings or with isolated obstacles with separations of maximum 20 obstacle heights (such as villages, suburban terrain, permanent forest)



**Terrain category IV**

Area in which at least 15 % of the surface is covered with buildings and their average height exceeds 15 m



## Terrain roughness

The terrain roughness to be used **for a given wind direction** depends on the **ground roughness** and the **distance with uniform terrain roughness** in an angular sector around the wind direction. Small areas (less than 10% of the area under consideration) with deviating roughness may be ignored. See Figure 4.1.

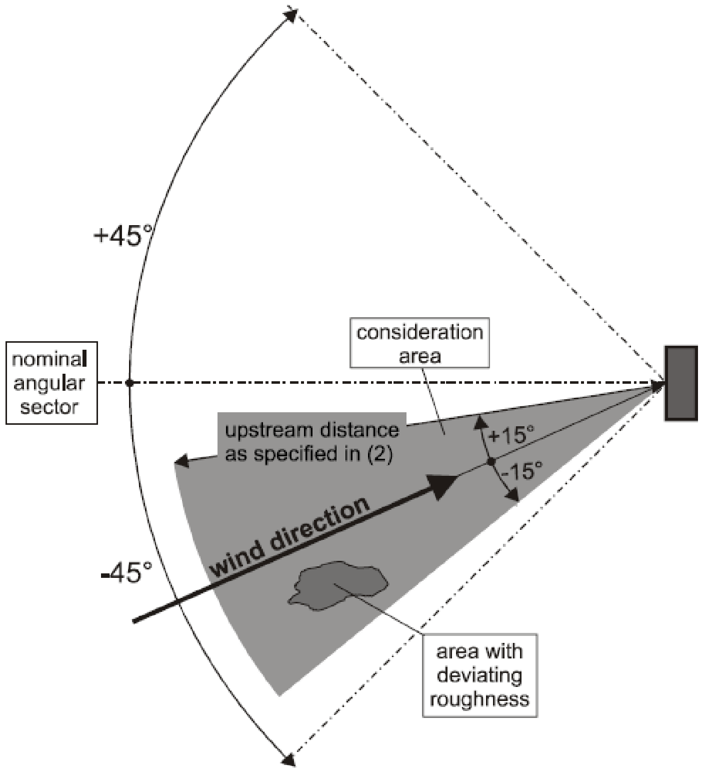



**Figure 4.1 — Assessment of terrain roughness**

The **recommended value of the angular sector** may be taken as the 30º angular sector within ±15° from the wind direction.

The transition between different roughness categories has to be considered when calculating $q_p$ and $c_s c_d$ .

The procedure to be used may be given in the National Annex. Recommended procedure:
If the structure is situated near a change of terrain roughness at a distance:
– less than 2 km from the smoother category 0
– less than 1 km from the smoother categories I to III
the **smoother terrain category in the upwind direction should be used**.
Small areas (less than 10 % of the area under consideration) with deviating roughness can be ignored.

# Terrain orography

Where orography (e.g. hills, cliffs etc.) increases wind velocities by more than 5% the effects should be taken into account using the **orography factor $c_O$.**

The effects of orography may be neglected when the **average slope of the upwind terrain is less than 3°**. The upwind terrain may be considered up to a distance of 10 times the height of the isolated orographic feature.

## Numerical calculation of orography coefficients

(1) At isolated hills and ridges or cliffs and escarpments different wind velocities occur dependent on the upstream slope $\Phi = H/L_u$ in the wind direction, where the height $H$ and the length $L_u$ are defined in Figure A. 1.

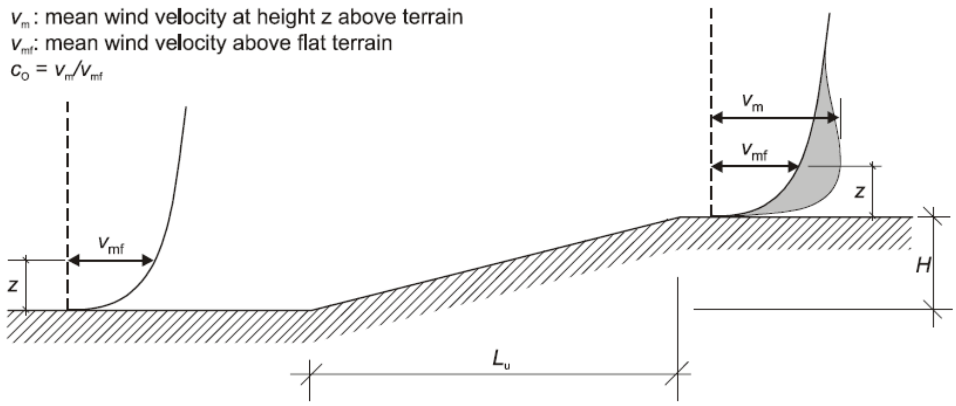



**Figure A.1 — Illustration of increase of wind velocities over orography**

(2) The largest increase of the wind velocities occurs near the top of the slope and is determined from the orography factor $c_o$, see Figure A.1. The slope has no significant effect on the standard deviation of the turbulence defined in 4.4 (1).

NOTE The turbulence intensity will decrease with increasing wind velocity and equal value for the standard deviation

(3) The orography factor, $c_O(z) = v_m/v_{mf}$ accounts for the increase of mean wind speed over isolated hills and escarpments (not undulating and mountainous regions). It is related to the wind velocity at the base of the hill or escarpment. The effects of orography should be taken into account in the following situations:

– For sites on upwind slopes of hills and ridges:
  where $0{,}05 < \Phi \leq 0{,}3$ and $|x| \leq L_u / 2$

– For sites on downwind slopes of hills and ridges:
  where $\Phi < 0{,}3$ and $x < L_d/2$
  where $\Phi \geq 0{,}3$ and $x < 1{,}6\,H$

– For sites on upwind slopes of cliffs and escarpments:
  where $0{,}05 < \Phi \leq 0{,}3$ and $|x| \leq L_u / 2$

– For sites on downwind slopes of cliffs and escarpments:
  where $\Phi < 0{,}3$ and $x < 1{,}5\,L_e$
  where $\Phi \geq 0{,}3$ and $x < 5\,H$

It is defined by:

$c_o = 1$ for $\Phi < 0{,}05$ (A.1)

$c_o = 1 + 2 \cdot s \cdot \Phi$ for $0{,}05 < \Phi < 0{,}3$ (A.2)

$c_o = 1 + 0{,}6 \cdot s$ for $\Phi > 0{,}3$ (A.3)

where:

$s$ is the orographic location factor, to be obtained from Figure A.2 or Figure A.3 scaled to the length of the effective upwind slope length, $L_e$

$\Phi$ is the upwind slope $H/L_u$ in the wind direction (see Figure A.2 and Figure A.3)

$L_e$ is the effective length of the upwind slope, defined in Table A.2

$L_u$ is the actual length of the upwind slope in the wind direction

$L_d$ is the actual length of the downwind slope in the wind direction

$H$ is the effective height of the feature

$x$ is the horizontal distance of the site from the top of the crest

$z$ is the vertical distance from the ground level of the site

**Table A.2 — Values of the effective length $L_e$.**

| **Type of slope ($\Phi = H/L_u$)** | |
|---|---|
| **Shallow** ($0{,}05 < \Phi < 0{,}3$) | **Steep** ($\Phi > 0{,}3$) |
| $L_e = L_u$ | $L_e = H/0{,}3$ |

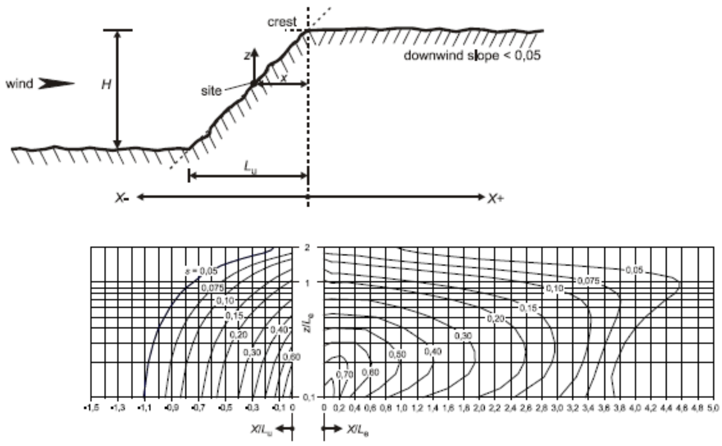
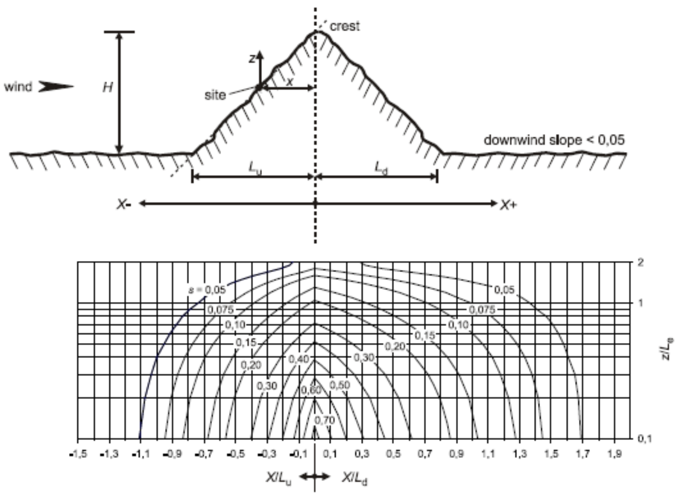



Figure A.2 — Factor $s$ for cliffs and escarpments



## Large and considerably higher neighbouring structures

(1) If the structure is to be located **close to another structure**, that is at least **twice as high as the average height of its neighbouring structures**, then it could be exposed (dependent on the properties of the structure) to **increased wind velocities** for certain wind directions. Such cases should be taken into account.

### A.4 Neighbouring structures

(1) If a building is more than twice as high as the average height $h_{ave}$ of the neighbouring structures then, as a first approximation, the design of any of those nearby structures may be based on the peak velocity pressure at height $z_n$ ($z_e = z_n$) above ground (Expression A.14), see Figure A.4.

$$x \le r: \qquad z_n = \frac{1}{2} \cdot r$$

$$r < x < 2 \cdot r: \qquad z_n = \frac{1}{2}\left(r - (1 - \frac{2 \cdot h_{low}}{r}) \cdot (x - r)\right) \qquad \text{(A.14)}$$

$$x \ge 2 \cdot r: \qquad z_n = h_{low}$$

in which the radius $r$ is:

$r = h_{high}$ if $h_{high} \le 2 \cdot d_{large}$

$r = 2 \cdot d_{large}$ if $h_{high} > 2 \cdot d_{large}$

The structural height $h_{low}$, the radius $r$, the distance $x$ and the dimensions $d_{small}$ and $d_{large}$ are illustrated in Figure A.4 Increased wind velocities can be disregarded when $h_{low}$ is more than half the height $h_{high}$ of the high building, i.e. $z_n = h_{low}$.

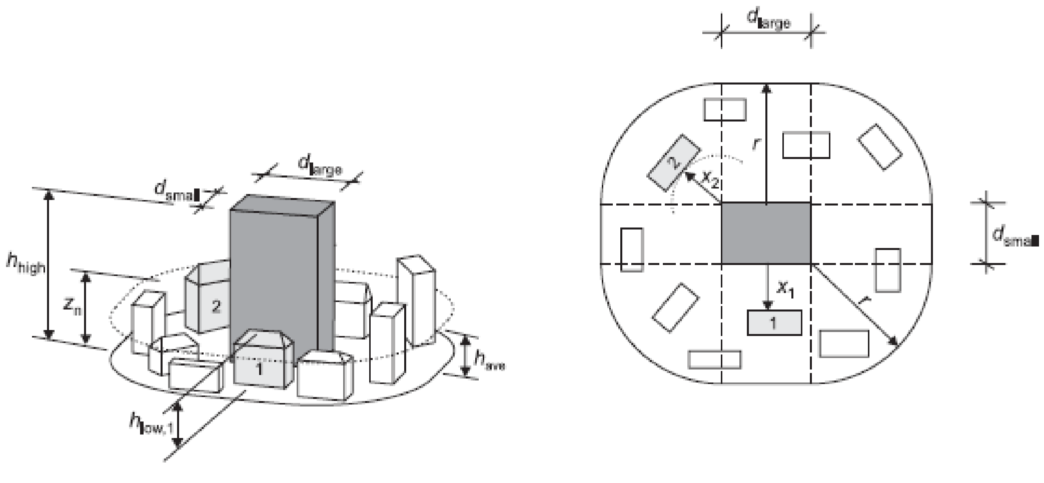



Figure A.4 — Influence of a high rise building, on two different nearby structures (1 and 2)

## Closely spaced buildings and obstacles

### Displacement height

The effect of closely spaced buildings and other obstacles may be taken into account.
In rough terrain closely spaced buildings modify the mean wind flow near the ground, as if the ground level was raised to a height called displacement height $h_d$ is.

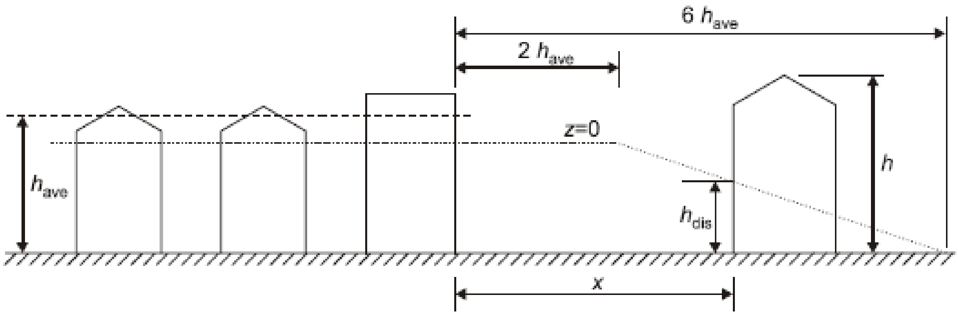



**Figure A.5 — Obstruction height and upwind spacing**

| | | |
|---|---|---|
| $x \leq 2 \cdot h_{ave}$ | $h_{dis}$ is the lesser of $0,8 \cdot h_{ave}$ or $0,6 \cdot h$ | |
| $2 \cdot h_{ave} < x < 6 \cdot h_{ave}$ | $h_{dis}$ is the lesser of $1,2 \cdot h_{ave} - 0,2 \cdot x$ or $0,6 \cdot h$ | (A.15) |
| $x \geq 6 \cdot h_{ave}$ | $h_{dis} = 0$ | |

In the absence of more accurate information the obstruction height may be taken as $h_{ave}$ = 15 m for terrain category IV.

These rules are direction dependent, the values of $h_{ave}$ and $x$ should be established for each 30° sector as described in 4.3.2.

# Wind turbulence

(1) The turbulence intensity $I_v(z)$ at height $z$ is defined as the standard deviation of the turbulence divided by the mean wind velocity.

NOTE 1 The turbulent component of wind velocity has a mean value of 0 and a standard deviation $\sigma_v$. The standard deviation of the turbulence $\sigma_v$ may be determined using Expression (4.6).

$$\sigma_v = k_r \cdot v_b \cdot k_I \qquad (4.6)$$

For the terrain factor $k_r$ see Expression (4.5), for the basic wind velocity $v_b$ see Expression (4.1) and for turbulence factor $k_I$ see Note 2.

NOTE 2 The recommended rules for the determination of $I_v(z)$ are given in Expression (4.7)

$$\begin{aligned} I_v(z) &= \frac{\sigma_v}{v_m(z)} = \frac{k_I}{c_o(z) \cdot \ln(z/z_0)} && \text{for} \quad z_{min} \leq z \leq z_{max} \\ I_v(z) &= I_v(z_{min}) && \text{for} \quad z < z_{min} \end{aligned} \qquad (4.7)$$

where:

$k_I$ is the turbulence factor. The value of $k_I$ may be given in the National Annex. The recommended value is $k_I$ = 1,0.

$c_0$ is the orography factor as described in 4.3.3

$z_0$ is the roughness length, given in Table 4.1

## Peak velocity pressure

(1) The peak velocity pressure $q_p(z)$ at height $z$, which includes mean and short-term velocity fluctuations, should be determined.

NOTE 1 The National Annex may give rules for the determination of $q_p(z)$. The recommended rule is given in Expression (4.8).

$$q_p(z) = [1 + 7 \cdot I_v(z)] \cdot \frac{1}{2} \cdot \rho \cdot v_m^2(z) = c_e(z) \cdot q_b \quad (4.8)$$

where:

$\rho$ is the air density, which depends on the altitude, temperature and barometric pressure to be expected in the region during wind storms

$c_e(z)$ is the exposure factor given in Expression (4.9)

$$c_e(z) = \frac{q_p(z)}{q_b} \quad (4.9)$$

$q_b$ is the basic velocity pressure given in Expression (4.10)

$$q_b = \frac{1}{2} \cdot \rho \cdot v_b^2 \quad (4.10)$$

The value 7 in Expression (4.8) is based on a peak factor equal to 3,5 and is consistent with the values of the pressure and force coefficients in Section 7.

For flat terrain where $c_O(z)$ = 1,0 (see 4.3.3), the exposure factor $c_e(z)$ is illustrated in Figure 4.2 as a function of height above terrain and a function of terrain category as defined in Table 4.1.


$$q_b = \frac{1}{2} \cdot \rho \cdot v_b^2 \quad (4.10)$$

The value 7 in Expression (4.8) is based on a peak factor equal to 3,5 and is consistent with the values of the pressure and force coefficients in Section 7.

For flat terrain where $c_O(z)$ = 1,0 (see 4.3.3), the exposure factor $c_e(z)$ is illustrated in Figure 4.2 as a function of height above terrain and a function of terrain category as defined in Table 4.1.


NOTE 2 The values for $\rho$ may be given in the National Annex. The recommended value is 1,25 kg/m$^3$.

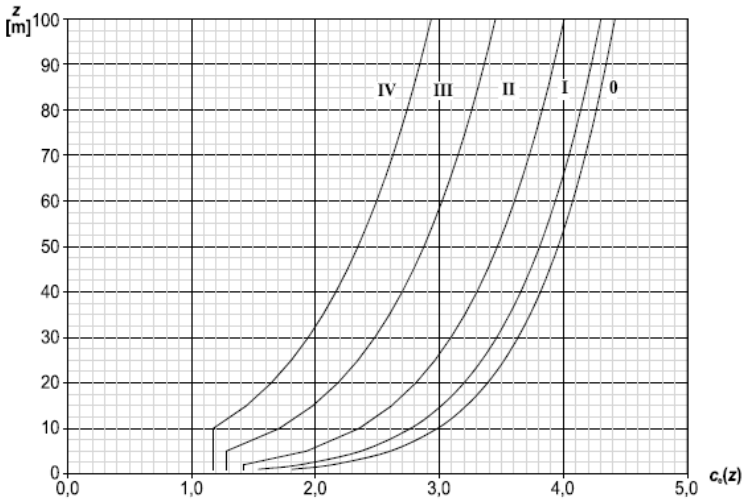



Figure 4.2 — Illustrations of the exposure factor $c_e(z)$ for $c_O$=1,0, $k_I$=1,0

## Structural factor $c_sc_d$

### General

The structural factor $c_sc_d$ should take into account the **effect on wind actions from the non-simultaneous occurrence** of peak wind pressures on the surface together with the effect of the vibrations of the structure due to turbulence.
NOTE The structural factor $c_sc_d$ may be separated into a size factor $c_s$ and a dynamic factor $c_d$. Information on whether the structural factor should be separated or not may be given in the National Annex.

### Determination of $c_sc_d$

$c_sc_d$ should be determined as follows:
a) For buildings with a height less than 15 m the value of $c_sc_d$ may be taken as 1.
b) For facade and roof elements having a natural frequency greater than 5 Hz, the value of $c_sc_d$ may be taken as 1.
c) For framed buildings which have structural walls and which are less than 100 m high and whose height is less than 4 times the in-wind depth, the value of $c_sc_d$ may be taken as 1.
d) For chimneys with circular cross-sections whose height is less than 60 m and 6,5 times the diameter, the value of $c_sc_d$ may be taken as 1.
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## Wind pressures on surfaces

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(1) The wind pressure acting on the external surfaces, $w_e$, should be obtained from Expression (5.1).

$$w_e = q_p(z_e) \cdot c_{pe} \tag{5.1}$$

where:

$q_p(z_e)$ is the peak velocity pressure

$z_e$ is the reference height for the external pressure given in Section 7

$c_{pe}$ is the pressure coefficient for the external pressure, see Section 7.

NOTE $q_p(z)$ is defined in 4.5

(2) The wind pressure acting on the internal surfaces of a structure, $w_i$, should be obtained from Expression (5.2)

$$w_i = q_p(z_i) \cdot c_{pi} \tag{5.2}$$

where:

$q_p(z_i)$ is the peak velocity pressure

$z_i$ is the reference height for the internal pressure given in Section 7

$c_{pi}$ is the pressure coefficient for the internal pressure given in Section 7

NOTE $q_p(z)$ is defined in 4.5

(3) The net pressure on a wall, roof or element is the difference between the pressures on the opposite surfaces taking due account of their signs. Pressure, directed towards the surface is taken as positive, and suction, directed away from the surface as negative. Examples are given in Figure 5.1.

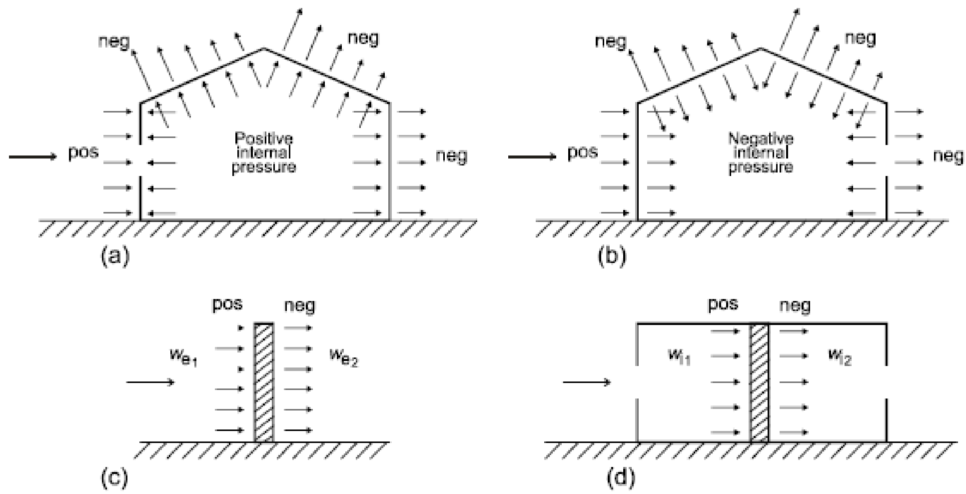


**Figure 5.1 — Pressure on surfaces**

### 5.3 Wind forces

(1) The wind forces for the whole structure or a structural component should be determined:

– by calculating forces using force coefficients (see (2)) or

– by calculating forces from surface pressures (see (3))

(2) The wind force $F_w$ acting on a structure or a structural component may be determined directly by using Expression (5.3)

$$F_w = c_s c_d \cdot c_f \cdot q_p(z_e) \cdot A_{ref} \tag{5.3}$$

or by vectorial summation over the individual structural elements (as shown in 7.2.2) by using Expression (5.4)

$$F_w = c_s c_d \cdot \sum_{elements} c_f \cdot q_p(z_e) \cdot A_{ref} \quad (5.4)$$

where:

$c_s c_d$ is the structural factor as defined in Section 6

$c_f$ is the force coefficient for the structure or structural element, given in Section 7 or Section 8

$q_p(z_e)$ is the peak velocity pressure (defined in 4.5) at reference height $z_e$ (defined in Section 7 or Section 8)

$A_{ref}$ is the reference area of the structure or structural element, given in Section 7 or Section 8

NOTE Section 7 gives $c_f$ values for structures or structural elements such as prisms, cylinders, roofs, signboards, plates and lattice structures etc. These values include friction effects. Section 8 gives $c_f$ values for bridges.

(3) The wind force, $F_w$ acting on a structure or a structural element may be determined by vectorial summation of the forces $F_{w,e}$, $F_{w,i}$ and $F_{fr}$ calculated from the external and internal pressures using Expressions (5.5) and (5.6) and the frictional forces resulting from the friction of the wind parallel to the external surfaces, calculated using Expression (5.7).

external forces:

$$F_{w,e} = c_s c_d \cdot \sum_{surfaces} w_e \cdot A_{ref} \quad (5.5)$$

internal forces:

$$F_{w,i} = \sum_{surfaces} w_i \cdot A_{ref} \quad (5.6)$$

friction forces:

$$F_{fr} = c_{fr} \cdot q_p(z_e) \cdot A_{fr} \quad (5.7)$$

where:

$c_s c_d$ is the structural factor as defined in Section 6

$w_e$ is the external pressure on the individual surface at height $z_e$, given in Expression (5.1)

$w_i$ is the internal pressure on the individual surface at height $z_i$, given in Expression (5.2)

$A_{ref}$ is the reference area of the individual surface

$c_{fr}$ is the friction coefficient derived from 7.5

$A_{fr}$ is the area of external surface parallel to the wind, given in 7.5.

NOTE 1 For elements (e.g. walls, roofs), the wind force becomes equal to the difference between the external and internal resulting forces.

NOTE 2 Friction forces $F_{fr}$ act in the direction of the wind components parallel to external surfaces.

(4) The effects of wind friction on the surface can be disregarded when the total area of all surfaces parallel with (or at a small angle to) the wind is equal to or less than 4 times the total area of all external surfaces perpendicular to the wind (windward and leeward).

(5) In the summation of the wind forces acting on building structures, the lack of correlation of wind pressures between the windward and leeward sides may be taken into account.

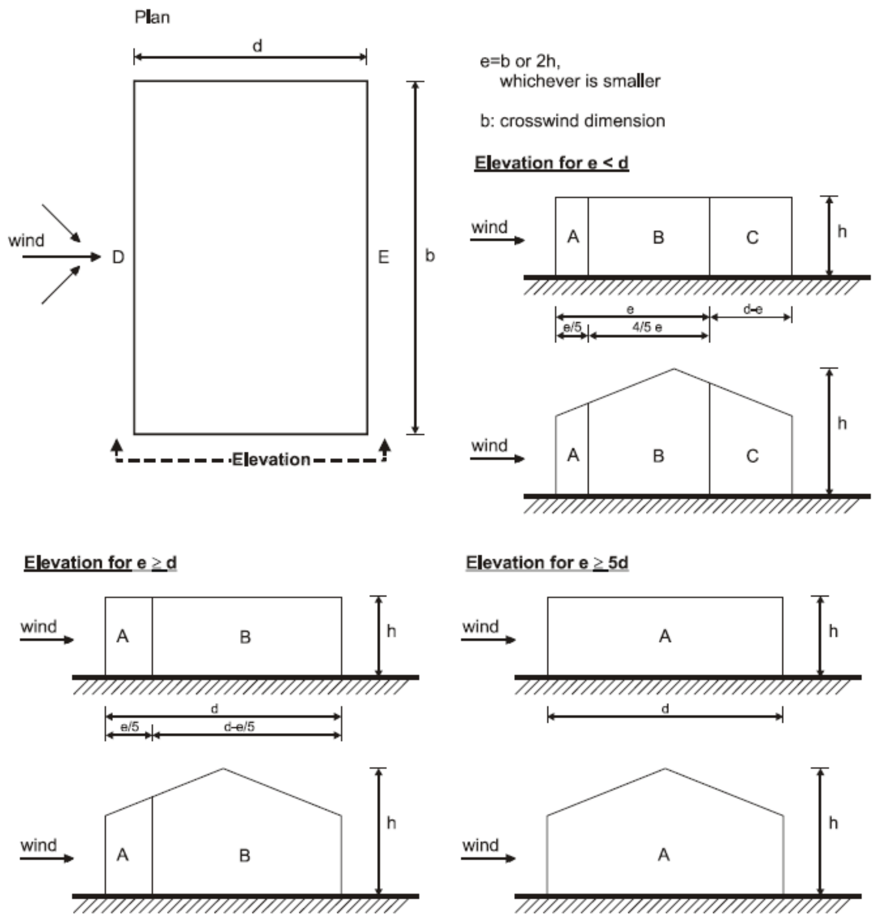


**Figure 7.5 — Key for vertical walls**

**Table 7.1 — Recommended values of external pressure coefficients for vertical walls of rectangular plan buildings**

| Zone | A | | B | | C | | D | | E | |
|---|---|---|---|---|---|---|---|---|---|---|
| $h/d$ | $c_{pe,10}$ | $c_{pe,1}$ | $c_{pe,10}$ | $c_{pe,1}$ | $c_{pe,10}$ | $c_{pe,1}$ | $c_{pe,10}$ | $c_{pe,1}$ | $c_{pe,10}$ | $c_{pe,1}$ |
| 5 | -1,2 | -1,4 | -0,8 | -1,1 | -0,5 | | +0,8 | +1,0 | -0,7 | |
| 1 | -1,2 | -1,4 | -0,8 | -1,1 | -0,5 | | +0,8 | +1,0 | -0,5 | |
| ≤ 0,25 | -1,2 | -1,4 | -0,8 | -1,1 | -0,5 | | +0,7 | +1,0 | -0,3 | |

NOTE 2 For buildings with $h/d > 5$, the total wind loading may be based on the provisions given in Sections 7.6 to 7.8 and 7.9.2.

(3) In cases where the wind force on building structures is determined by application of the pressure coefficients $c_{pe}$ on windward and leeward side (zones D and E) of the building simultaneously, the lack of correlation of wind pressures between the windward and leeward side may have to be taken into account.

NOTE The lack of correlation of wind pressures between the windward and leeward side may be considered as follows. For buildings with $h/d \geq 5$ the resulting force is multiplied by 1. For buildings with $h/d \leq 1$, the resulting force is multiplied by 0,85. For intermediate values of $h/d$, linear interpolation may be applied.

### 7.2.3 Flat roofs

(1) Flat roofs are defined as having a slope ($\alpha$) of $-5° < \alpha < 5°$

(2) The roof should be divided into zones as shown in Figure 7.6.

(3) The reference height for flat roof and roofs with curved or mansard eaves should be taken as h. The reference height for flat roofs with parapets should be taken as $h + h_p$, see Figure 7.6.

(4) Pressure coefficients for each zone are given in Table 7.2.

(5) The resulting pressure coefficient on the parapet should be determined using 7.4.