2nd Revision

Loads and Actions-Design Code

1. Scope

1.1. This code specifies loads and actions to be used in designing building constructions and foundations.

1.2. The following loads are not prescribed in this code but shall be subject to particular regulations : loads caused by railways and roads, by seawaves and currents, by earthquake, by storms and whirlwinds, by temperature, by dynamic components of manufacturing equipment and transport means, etc.

1.3. Design loads when repairing structures are to be determined on the basis of actual investigation of the structure.

1.4. Atmospheric actions are to taken from Construction design meteorological data or by the data from National Hydrometeorological Service.

1.5. Loads for extremely important buildings are not prescribed in this code but to be determined by relevant authority.

1.6. Loads for specific buildings and structures (transport, water works, electricity, post and telecommunications, etc) are to be dealt in special regulations, elaborated by relevant organizations

2. Basic principles

2.1. General provisions

2.1.1. A building or structure must be so designed to take into account loads that are generated during the construction, service and use and in manufacturing, storage and transport of their components.

2.1.2. The standard values of loads given in this code are the basic characteristics of loads.

The design loads (or calculated loads) are the product of standard loads multiplied by the coefficient of load reliability γ (also called coefficient of surplus load). This coefficient takes into account unfavourable difference in actual loads and their standard values and is determined according to the limit state under consideration.

2.1.3. When suitable statistical data are available, design loads may be determined directly from previously given probability of surplus load.

2.1.4. When a structure bears simultaneously two or more temporary loads, it must be calculated based on the most disadvantageous combination of loads or of their correspondent efforts.

These combinations of loads are based on various ways of simultaneous actions of different loads, with regarding to the possible change of their actions on the structure.

A coefficient of load combination will be used.

2.2. Coefficient of load reliability γ (or coefficient of surplus load).

2.2.1. The coefficient of load reliability γ used in structure and foundation design is to be taken as follows:

2.2.1.1. In calculating the strength and stability: according to 3.2, 4.2.2, 4.3.3, 4.4.2, 5.8, 6.3, 6.1.7.

2.2.1.2. In calculating the fatigue strength : equal to 1. For crane beams, after guide of 5.16

2.2.1.3. In calculating the deformations and displacement, equal 1 if not determined otherwise by design codes.

2.2.1.4. When designing in other limit states not quoted in 2.2.1.1, 2.2.1.2, 2.2.1.3, to be taken after design codes of structures and foundations

Note :

1) In calculating structures and foundations with loads generated in erection phase, the values of wind loads are reduced by 20%.

2) In calculating the strength and stability under the impact of cranes on the bumpers, the coefficient of load reliability equals 1 for every kinds of loads.

2.3. Classification of loads.

2.3.1. Loads are classified in to permanent (dead) loads, temporary loads (long term, short term and special) according to their duration.

2.3.2. Permanent loads (standard or designed) are loads that do not vary through out the construction and exploitation process. Temporary loads are loads that may not be present at a certain time of the construction and exploitation process.

2.3.3. Permanent loads comprise :

2.3.3.1. Weight of load-bearing and covering structures of a building ;

2.3.3.2. Weight and pressure of soil (filled, or embanked), and pressure caused by mining activities.

Notes : *Self-induced stress or that existing in the structure or foundation, including prestress, shall be taken in calculation as stress caused by permanent loads.*

2.3.4. Temporary long-term loads comprise :

2.3.4.1. Weight of temporary partitions, soil and concrete lining under equipment ;

2.3.4.2. Weight of fixed equipment : machines, engines, tanks, pipework with accessories, supports, isolations, conveyors, driven chains, fixed hoisting machines including cables and controllers, weight of liquid and solid substances contained in the equipment, in the whole operation process.

2.3.4.3. Pressure of gas, liquid and loose materials in storage tanks and pipe work during operation, surplus pressure and air depression arising as a result of ventilation in mining shafts and in other places ;

2.3.4.4. Loads acting on floors by contained materials and equipment supports of storage rooms, refrigerating stores, grain barns ;

2.3.4.5. Actions of industrial heat caused by fixed equipment

2.3.4.6. Water contained in roof for insulation purpose ;

2.3.4.7. Dust layer clinging to the structure ;

2.3.4.8. Vertical loads caused by overhead cranes or underhung cranes at an building aisle, multiplied by :

0.5 for cranes with moderate service class,

0.6 for cranes with severe service class,

0.7 for cranes with very severe service class.

2.3.4.9 Evenly distributed loads on floors of dwelling houses, public buildings, production and agricultural buildings quoted in column 5 of Table 3 ;

2.3.4.10. Action caused by foundation soil deformation without accompanying change of soil structure ;

2.3.4.11. Action caused by moisture change, shrinkage and creep of materials.

2.3.5. Temporary short-term loads comprise :

2.3.5.1. Weight of people, materials, equipment and tools for repairing works and maintenance ;

2.3.5.2. Loads generated in manufacturing, transport, erection of structures, in assembling and installation of equipment, including loads caused by weight of components and materials temporarily stored (excluding loads at places designated for warehouses or storing purpose), temporary loads caused by filled-up soil ;

2.3.5.3. Loads generated in periods of starting, stopping, transition and testing of machines, including the displacement or replacement of them.

2.3.5.4. Loads of mobile hoisting machines (overhead cranes, underhung cranes, electric tackles, loading machines, etc) used in the construction and exploitation of building, loads from handling works in warehouses and refrigerating storage ;

2.3.5.5. Evenly distributed loads on floors of dwelling houses, public buildings, production and agricultural buildings quoted in column 4 of Table 3.

2.3.5.6. Wind load

2.3.6. Special loads comprise :

2.3.6.1. Earthquake ;

2.3.6.2. Explosion

2.3.6.3. Loads caused by production incidents, or mechanical break-downs ;

2.3.6.4. Actions caused by foundation deformation as a result of changing of soil structure (sliding, collapses, wet sagging), actions caused by soil surface deformation in area having ground cracks, caster phenomena or mining activities.

2.4. Load combinations

2.4.1. There are two types of load combinations : basic load combination and special load combination.

2.4.1.1. Basic load combination comprises : permanent loads, temporary long-term loads and temporary short-term loads.

2.4.1.2. Special load combination comprises : permanent loads, temporary long-term loads , potential temporary short-term loads and one of the special loads.

In special load combination with explosion or collision by transport means, the temporary short-term loads quoted in 2.3.5 may be excluded.

In special load combination with earthquake, wind loads are excluded.

Loads used in determination of structure fire resistance are comprised in special load combination.

2.4.2. In basic load combination, when the number of temporary loads is 1, the full value of this temporary load is taken.

2.4.3. In basic load combination, when the number of temporary loads is 2 and more, the value of these temporary loads used in calculation or the efforts caused by them must be multiplied by the coefficient of load combination ψ as follows :

2.4.3.1. For temporary long-term loads and temporary short-term loads, $\psi = 0.9$.

2.4.3.2. When the influence of each temporary short-term load on the efforts and displacement of the structure can be analyzed separately: $\psi = 1$ for the dominating load, $\psi = 0.8$ for the second dominating and $\psi = 0.6$ for other remaining loads.

2.4.4. In special load combination with only one temporary load, the full value of this load is taken.

2.4.5. In special load combination with two or more temporary loads, the full value of the special load is taken. The value of the temporary loads used in calculation or the efforts caused by them must be multiplied by the coefficient of load combination as follows : for temporary long-term loads $\psi_1 = 0.95$; for temporary short-term loads $\psi_2 = 0.8$, unless otherwise stipulated in Earthquake resistance design codes or other design regulations.

2.4.6. In the strength and stability calculation of structures and foundations under basic and special load combinations comprising at least two temporary loads (long-term or short-term), the efforts may be determined after the guide of Appendix A.

2.4.7. The dynamical load of equipment, in combination with other loads, shall be specified in standard documents on the design of machine foundations and structures under machine dynamical loads.

3. Weight of structures and soil

3.1. The standard loads caused by the weight of structures are determined in accordance with Standard data, catalogues or designed dimensions and the density of materials where actual moisture content must be taken into account in the process of construction, service and use of the building.

3.2. The coefficient of reliability for loads caused by the weight of structures and soil are prescribed in Table 1.

Table 1. Coefficient of reliability for loads caused by the weight of structures and soil

Types of structure and soil	Coefficient
1. Steel	1.05
2. Concrete with density over 1600 kg/m^3, reinforced concrete, masonry, reinforced masonry, timber	1.1
3. Concrete with density not over 1600 kg/m^3, isolation material, plastering and finition materials (board, coil, coating, lining), manufactured at	
- the factory	1.2
- on the site	1.3
4. Weight of undisturbed soil	1.1
5. Filled-up soil	1.15

Note :

1) In checking the stability against overturning, if the reducing of weight of structure and soil may lead to unfavourable results, the coefficient is taken equal 0.9

2) When determining soil load, actual moisture, load of stored materials, impact on soil by transport vehicles must be taken into account.

3) For steel structures, if stress caused by their proper weight exceeds 50% of total stress, the coefficient of load reliability is taken as 1.1

4. Loads caused by equipment, people, stored goods

4.1. This part deals with standard values of loads caused by people, animals, equipment, products, materials, temporary partitions, acting on floors of dwelling, public and agricultural production houses.

The conditions of loading on floors must be preplanned before the construction and use of the building. If the data of these conditions are not sufficient for the design and calculation of structures and foundations , the loading conditions for each individual floor shall be chosen as follows :

4.1.1. No temporary load on floor ;

4.1.2. Partial loading on floor which is disadvantageous for the structure and foundation ;

4.1.3. Full loading on floor by selected loads.

The total load on floor in disadvantageous partial loading shall not exceed the full total load multiplied by the coefficient ψ_n taken according to 4.3.5.

4.2. Determination of loads caused by equipment and stored materials

4.2.1. Loads caused by equipment, stored materials and transport means shall be determined after the design task, where the most disadvantageous cases must be taken into consideration and where must be clearly indicated the schema of possible locations of equipment, locations of permanent and temporary storage of materials and products ; number and positions of transport means on each floor. Must be given on the schema : the occupancy dimensions of equipment and transport means ; dimensions of the storage of materials ; potential displacement of equipment in the use process, the rearrangement of the plane and other loading conditions (dimensions of each equipment peace, distances between them).

4.2.2. The values of standard loads and the coefficient of surplus load are to be taken according to this code. The standard values and the coefficient of surplus load of inertia forces from machines are to be taken according to relevant codes on dynamical actions.

4.2.3. When actual loads imposing on floors are replaced by equivalent evenly distributed loads, theses equivalent loads shall be determined separately for each floor component (slabs, beams, girders). The strength and rigidity of structures under equivalent loads remain the same as that under actual loads. The minimum equivalent evenly distributed loads for industrial and warehouses are : 300 daN/m^2 for calculating slabs and beams, at least 200 daN/m^2 for calculating girders, columns and foundations.

4.2.4. Weight of equipment (including pipework) is determined from standard data and catalogues. Weight of non-standard items is determined from shop drawings.

4.2.4.1. Loads from equipment weight comprise : proper weight of equipment or machines (including cables, supports and fixtures) ; weight of isolation layer ; weight of substances contained in service ; weight of the heaviest piece to be fabricated ; handled goods after the nominal capacity of the hoisting machines.

4.2.4.2. Loads from equipment shall be based on its arrangement for operation. Means shall be taken to avoid the consolidation of bearing structures when moving and installing of equipment.

4.2.4.3. The number and position of handling and installing machines which simultaneously act on the floor are to be taken according to the design task.

4.2.4.4. Dynamical action of vertical loads from handling equipment or vehicles may be calculated equal to standard static loads multiplied by a dynamical factor of 1.2.

4.2.4.5. Coefficients of surplus loads caused by equipment weight are given in Table 2.

Table 2. Coefficient of surplus loads caused by equipment weight

Types of load	Coefficient
1. Weight of fixed equipment	1.05
2. Weight of isolation layer of fixed equipment	1.2
3. Weight of substances contained in equipment, tanks and pipelines :	
Fluid	1.0
Suspended substances, sludge, loose materials	1.1
4. Weight of handling machines and vehicles	1.2
5. Weight of materials adsorbing moisture or water (cotton, stuff, foods)	1.3

4.3. Uniformly distributed loads

4.3.1. Uniformly standard distributed loads on floors and stairs are given in Table 3.

Table 3. Uniformly standard distributed loads on floors and stairs

Types of rooms	Building types and features	Standard loads daN/m²	
		Total	Long-term acting
1. Bedrooms	a) Hotels, hospitals, prisons	200	70
	b) Dwelling house, kindergartens, maternity schools, boarding schools, resort houses, sanitarium	150	30
2. Dining rooms, lounge rooms, bathrooms, toilets, billiard rooms	a) In dwelling houses	150	300
	b) In kindergartens, schools, resort houses, old people homes, sanatoria, hotels, hospitals, prisons, office buildings, factories	200	70
3. Kitchens, laundry rooms	a) In dwelling houses	150	130
	b) In kindergartens, schools, resort houses, old people homes, sanatoria, hotels, hospitals, prisons, factories	300	100
4. Offices, laboratories	Office buildings, schools, hospitals, banks, research institutions	200	100
5. Boiler rooms, engine and fan rooms, including mass of machines	Multi-story buildings, office buildings, schools, resort houses, old people homes, sanatorium, hotels, hospitals, prisons, research institutions	750	750
6. Reading rooms	a) with bookshelves	400	140
	b) without bookshelves	200	70
7. Shops and restaurants	a) restaurants	300	100
	b) shops, showrooms, exhibitions	400	140
8. Meeting rooms, dancing halls, waiting rooms, auditoriums, concert halls, gymnasiums, spectator stands	a) with fixed seats	400	140
	b) without fixed seats	500	180
9. Stages		750	270
10. Warehouses	Load per meter high of stored materials :		
	a) Archives (full loaded)	480daN/m	480daN/m
	b) Bookstores in a library	240daN/m	240daN/m
	c) Paper stores	400daN/m	400daN/m
	d) Freezing stores	500daN/m	500daN/m
11. Classrooms	In schools	200	70
12. Factories, workshops	a) Foundry	2000	-
	b) Workshops servicing vehicles with weight ≤ 2500 kg	500	-
	c) Large workshops with machines and paths inside	400	-

Table 3. (next)

Types of rooms	Building types and features	Standard loads daN/m^2	
		Total	Long-term acting
13. Attic rooms	In every kind of building	70	-
14. Balcony, loggia	a) Loads evenly distributed on bands of 0.8 m wide along balustrade, balcony, loggia	400	140
	b) Loads evenly distributed on the whole area of balcony, loggia (to be taken in consideration if their action is more disadvantageous than that specified in point a)	200	70
15. Entrance hall, lobby, stairs, corridors connecting to other rooms	a) Bedrooms, offices, laboratories, kitchens, laundries, toilets, technical servicing rooms	300	100
	b) Reading rooms, restaurants, meeting halls, dancing halls, lounge rooms, auditoria, concert halls, gymnasia, stores, balconies, loggias.	400	140
	c) Stages	500	180
16. Mezzanine		75	-
17. Livestock farms	a) Small livestock	≥ 200	≥ 70
		≥ 500	≥ 180
18. Flatroofs which can be used	a) the part of roof that can accommodate a crowd of people (coming from production workshops, auditoriums or large halls)	400	140
	b) part of roof used for relaxation	150	50
	c) other parts	50	-
19. Non-use roof	a) Tile roof, fibrocement roof, steel sheeting roof and similar, straw-and-mortar ceiling, cast concrete ceiling not for people walking but only repairing, excluding water and power, ventilation equipment if any.	30	-
	b) Reinforced concrete deck roof and sloped roof, gutter, canopy, not for people walking but only repairing, excluding water, power, and ventilation equipment if any.	75	-
20. Platforms of railway and subway stations		400	140
21. Garages	Motorways with ramps used for cars, buses and light trucks with total weight under 2500 kg	500	180

Note :

1. *Loads stated in item 13 of this table are to be accounted for the area without equipment and materials.*
2. *Loads stated in item 14 of this table are used for calculating bearing structure of balconies and loggias. When calculating structure of walls, columns, foundations that support balconies or*

loggias, the loads imposing on balconies and loggias for analysis are equal to those on the main adjoining rooms and they could be reduced according to the instructions of 4.3.5.

3. *Eaves, canopies, gutters that are of console type are calculated with concentrated vertical load on outer edge with its standard value equal to 75 daN/m² along the wall. When the length along the wall of these structures are less than 1m, the concentrated load remains 75 daN. The coefficient of surplus load equals 1.3. After, they must be rechecked with the even loads taken from item 19b of this table.*

4. *The long-term temporary part of load stated in items 12, 13, 16, 17, 18c, and 19 are to be taken as per technology designs.*

5. *The values of loads for livestock farms at item 17 are to be taken as per technology designs.*

4.3.2. Loads from the weight of temporary partitions are determined by their constitutions, positions and particularities of the bearing on floors or suspension on walls. They can be taken as :

4.3.2.1. Their actual weight ;

4.3.2.1. An even load, determined by their arrangement on plane, but not less than 75 daN/m^2.

4.3.3. The coefficient of surplus load for loads evenly distributed on floors and stairs is taken as 1.3 when standard loads are less than 200 daN/m^2 and 1.2 when standard loads are equal or more than 200 daN/m^2. The coefficient of surplus load for loads caused by the weight of temporary partitions is taken according to article 3.2.

4.3.4. When calculating main girders, beams, slabs, columns and foundations, the full loads prescribed in Table 3 are permitted to be reduced by multiplication by a factor of load reduction ψ taken as follows:

4.3.4.1. For rooms stated in items 1, 2, 3, 4, 5 of Table 3, when the loaded area A (in m^2) is such that $A > A_1 = 9\ m^2$:

$$\psi_{A1} = 0.4 + 0.6 / \sqrt{A/A_1} \qquad (1)$$

4.3.4.2. For rooms stated in items 6, 7,8, 10, 12, 14 of Table 3, when the loaded area A (in m^2) is such that $A > A_2 = 36\ m^2$:

$$\psi_{A2} = 0.5 + 0.5 / \sqrt{A/A_2} \qquad (2)$$

Note :

1. *Load for calculating a wall supporting a floor can be reduced depending on the loaded area A of the structure (slab, beam) resting on the wall.*

2. *In warehouses, garages and production workshop, the loads are permitted to be reduced according to relevant regulations.*

4.3.5. When determining longitudinal force of columns, walls and foundations bearing loads of two floors and more, the full loads prescribed in Table 3 are permitted to be reduced by multiplication by a factor of load reduction ψ taken as follows:

4.3.5.1. For rooms stated in items 1, 2, 3, 4, 5 of Table 3 :

$$\psi_{n1} = 0.4 + (\psi_{A1} - 0.4) / \sqrt{n} \qquad (3)$$

4.3.4.2. For rooms stated in items 6, 7,8, 10, 12, 14 of Table 3, when the loaded area A (in m^2) is such that $A > A_2 = 36\ m^2$:

$$\psi_{n2} = 0.5 + (\psi_{A2} - 0.5)/\sqrt{n} \quad (4)$$

where ψ_{A1}, ψ_{A2} are determined from 4.3.4 ; n : number of loaded floors situated above the section under consideration.

Note : When calculating the bending moment in a column or a wall, the loads on girders and beams resting on them can be reduced according to 4.3.4

4.4. Concentrated loads and loads imposing on balustrade.

4.4.1. The strength of floors, roof, stairs, balcony, and loggia must be checked with a conventional concentrated vertical force applied anywhere at disadvantageous places, on a square less than 10 x 10 cm (not simultaneously with other temporary loads).

This concentrated load is taken as follows, if not otherwise prescribed :

4.4.1.1. 150 N for floors and stairs ;

4.4.1.2. 100 N for attic floors, roofs, terraces and balconies ;

4.4.1.3. 50 N for roofs accessible by a ladder leaning against the wall ;

The components that are already checked with local loads caused by equipment and transport means acting in construction and service phases do not need to be checked with this concentrated load.

4.4.2. Standard lateral loads acting on handrails of stairs, loggias and balconies are taken as follows :

4.4.2.1. 30 daN/m for dwelling houses, kindergartens, sanitarium, hospitals ;

4.4.2.2. 150 daN/m for spectator stands, gymnasiums ;

4.4.2.3. 80 daN/m for houses and rooms with special use.

For operating platforms, gangways and roof extensions designed to withstand only a few people, standard lateral concentrated load acting on handrails and parapets (at any place along the handrails) are taken equal 30 daN, if not prescribed by the design requirements to be larger.

The coefficient of surplus load for cases quoted in 4.41, 4.4.2 is 1.2.

5. Loads caused by overhead cranes and underhung cranes

5.1. Loads caused by overhead cranes and underhung cranes are determined depending on their service regimes as determined in Appendix B.

5.2. Vertical loads which transmit through crane wheels to runway beams and other design data of cranes are to be taken from National Standards for Cranes or from the specifications of the crane manufacturers.

Note : the term runway is understood as the two beams supporting an overhead cranes or all the beams supporting a underhung crane (two beams for a one-span underhung crane, three beams for a two-span one)

5.3. The standard longitudinal horizontal force caused by braking of crane is calculated as 0.1 times the standard vertical forces acting on the braked wheels.

5.4. The standard lateral horizontal force caused by braking of trolley is calculated as 0.05 times the sum of the rated hoisting capacity and the trolley weight, in case of a flexible hook, or 0.1 times this sum in case of a rigid hook.

This force, used for analyzing main building frames and runway beams, is evenly distributed to all wheels on a runway beam in either direction perpendicular to the runway beam.

5.5. The standard lateral horizontal force caused by the crane sway movement and the non alignment of runways (called the thrust), applied on each wheel is taken equal to 0.1 times the vertical wheel load. This force is used in analyzing the strength and stability of the runway beams and their connections to the frames only in case of severe and very severe service regimes of cranes. Each of all the wheels on one side of the cranes are affected by this force, in either direction to the left or the right. The loads stated in 5.4 are not considered simultaneously with this thrust.

5.6. The lateral loads caused by braking of crane and trolley are applied at the points of contact between the wheels and the rail.

5.7. The standard longitudinal horizontal force produced by a crane striking a runway stop is determined in Appendix C. This force is used only in calculating a runway stop and its connection to the beam.

5.8. The coefficient of surplus load for cranes is 1.1

Note :

1) When analyzing the strength of runway beams under local and dynamical action of vertical wheel loads, the values of these load shall be multiplied by a factor γ_l *equal :*

1.6- for cranes of very severe service regime and equipped with rigid hook ;

1.4- for cranes of very severe service regime and equipped with flexible hook ;

1.3- for cranes of severe service regime ;

1.1- for cranes of other service regime ;

2) When checking the local stability of runway beam web, $\gamma_l = 1.1$

5.9. When checking the strength and stability of a runway beam and its connections to the structure,

5.9.1. Vertical crane loads must be increased by a dynamical factor, which equals :

In buildings with bay spacing not larger than 12 m:

1.2- for cranes of very severe service regime

1.1- for cranes of severe and moderate service regime and for underhung cranes.

In buildings with bay spacing larger than 12 m : 1.1 for cranes of very severe service regime.

5.9.2. Horizontal crane loads must be increased by a dynamical factor, which equals 1.1 for cranes of very severe service regime.

5.9.3. In other cases, the dynamical factor equals 1.

5.9.4. The dynamical factor is not to be considered in calculating the strength of the structures, or the deflection of the runway beam, or the displacement of columns and the local action of each vertical wheel load.

5.10. The strength and stability of a runway beam shall be checked with the most unfavourable effect of vertical loads from two cranes.

5.11. The strength and stability of the frames, columns and foundations of a one-story building with some crane aisles shall be checked with the most unfavourable effect of vertical loads from two cranes on one runway. When taking in account of the combined action of cranes in different aisles, the unfavourable effect of vertical loads from four cranes shall be considered.

5.12. The strength and stability of the frames, columns, rafters, jack beams and foundations of a one-story building equipped with underhung cranes in one or many aisles shall be checked with the most unfavourable effect of vertical loads from two underhung cranes on one runway. When taking in account of the combined action of cranes in different aisles, the following vertical loads shall be considered :

from 2 underhung cranes : for columns, rafters, jack beams and foundations of the edge row, when there are two runways in the aisle.

from 4 underhung cranes :

+ for columns, jack beams and foundations of the interior row,

+ for columns, rafters, jack beams and foundations of the edge row, when there are three runways in the aisle,

+ for rafters when there are two or three runways in the aisle.

5.13. The number of cranes to be considered when checking the strength and stability under the action of vertical and horizontal loads of cranes on two or three runways in an aisle, the action of overhead cranes and underhung cranes operating at the same time in an aisle, or the action of jib cranes to move things from one aisle to another shall be taken from design requirements.

5.14. When calculating the strength and stability of the frames, columns, rafters, jack beams and foundations, the most unfavourable effect of horizontal loads from not more than two cranes on one runway or on different runways in one line shall be considered. In this case, in one crane, only one horizontal force (longitudinal or lateral) shall be considered.

5.15. When calculating the vertical and horizontal deflection of a runway beam and the drift of a column, the most unfavourable effect from only one crane is considered.

5.16. When calculating with one crane, the value of vertical and horizontal load is taken fully, not reduced. When calculating with two cranes, this value shall be multiplied by the coefficient of load combination as follows:

n_{comb} = 0.85 for cranes of light and moderate service regime

n_{comb} = 0.95 for cranes of severe and very severe service regime.

When calculating with four cranes, their loads shall be multiplied by the coefficient of load combination as follows:

n_{comb} = 0.7 for cranes of light and moderate service regime

n_{comb} = 0.8 for cranes of severe and very severe service regime.

5.17. If in an aisle, only a crane is operating, the other remains standby in the exploitation period, the loads produced only by one crane are taken in account.

5.18. In calculating the fatigue strength of a runway beam and its connections to the bearing structure, the standard loads are reduced according to 2.3.4.8. By fatigue checking of web in the action zone of a concentrated vertical wheel load, the value of the vertical wheel load, after being reduced as stated above, shall be increased by a factor as determined in the note of article 5.8.

The crane service regime used for calculating the structure fatigue strength shall be specified by structure design codes.

6. Wind loads

6.1. Wind loads applied on buildings include : normal pressure W_e, friction force W_f and normal pressure W_i. Winds loads on buildings can also be converted into two normal pressure components W_x and W_y.

6.1.1. Normal pressure W_e applies on external surface of the buildings and elements .

6.1.2. Friction force W_f is tangential to the external surface and is proportional to the projection on the plan (for shed roofs, or roofs with monitors) and the elevation projection (for walls with lodge and similar elements).

6.1.3. Normal pressure W_i applies to the internal surfaces of partially closed buildings or buildings with openings.

6.1.4. Normal pressures W_x and W_y are determined by the projections of the building on the plan which is respectively perpendicular to axes x and y .

6.2. Wind loads have two components : static and dynamic.

The dynamic component is not to be considered when analyzing multistory buildings not higher than 40m, singlestorey industrial buildings not higher than 36m with height/span ratio under 1.5 and built in terrain exposures A and B.

6.3. The standard value of wind load static component W at the height Z above the reference level is determined by the formula :

$$W = W_o \times k \times c$$

where W_o = the velocity pressure, according to the map in Appendix D and Article 6.4 ;

k = factor of wind pressure variation with height, from Table 5

c = aerodynamic factor, from Table 6.

Coefficient of surplus load (reliability factor of wind load) is taken equal to 1.2

6.4. W_o, the velocity pressure is taken from Table 4.

In the map of Appendix D, the wind regions of Vietnam are shown. The border between regions with strong and weak hurricane winds are shown by discontinued lines (with symbols A and B for these regions).

Table 4 Velocity pressure of wind regions of Vietnam

Wind regions (see Map)	I	II	III	IV	V
W_o (daN/ m^2)	65	95	125	155	185

6.4.1. For regions with weak hurricane winds, (Map D), the value W_o is reduced as following : 10 daN/cm^2 for I-A region, 12 daN/cm^2 for II-A region, 15 daN/cm^2 for III-A region.

6.4.2. For region I, the value W_0 from Table 4 is used in calculating buildings and structures in mountains, hills, valleys and plains. Other places with complex terrain are to be considered particularly according to Article 6.4.4.

6.4.3. For buildings and structures constructed in mountain regions and islands, having the same height, same profile and being close to meteorological observation posts stated in Appendix F , the design wind pressure, depending on their service lifetime, shall be taken from the independent observation data of these posts (Table F1 and F2 of Appendix F)

6.4.4. For buildings and structures constructed in regions with complex topography (valleys, col gate, etc), the design wind pressure shall be taken from the data of the National Hydro meteorological Service or from in-situ statistically treated investigation results. So, the wind pressure value (daN/m^2) is calculated using the formula :

$$W_o = 0.0613 \times V_o^2 \quad (6)$$

where V_o is the wind velocity (m/s) at 10m height from reference level (average velocity in 3 second time, occurring once in 20 years), relative to exposure B.

6.4.5. Factor k of wind load variation with height and terrain is given in Table 5.

Exposure A : open terrain, with no obstructions higher than 1.5m (coasts, large fields without plants, lake surfaces, etc.) ;

Exposure B : terrain with scattered obstructions not higher than 10 m (villages, small towns, forests , no- crowded suburb areas) ;

Exposure C : terrain with numerous closely spaced obstructions having height more than 10m (urban areas, densely wooded areas).

Exposure category of each building is determined when the terrain is unchanged within the distance from the building as follows : 30 h when h≤ 60m and 2 km when h>60 m, where h is the building height.

Table 5. Factor k of wind load variation with height and terrain

Level Z,m \ Exposure	A	B	C
3	1,00	0,80	0,47
5	1,07	0,88	0,54
10	1,18	1,00	0,66
15	1,24	1,08	0,74
20	1,29	1,13	0,80
30	1,37	1,22	0,89
40	1,43	1,28	0,97
50	1,47	1,34	1,03
60	1,51	1,38	1,08
80	1,57	1,45	1,18
100	1,62	1,51	1,25
150	1,72	1,63	1,40
200	1,79	1,71	1,52
250	1,84	1,78	1,62
300	1,84	1,84	1,70
350	1,84	1,84	1,78
≥ 400	1,84	1,84	1,84

Note :

1) For intermediary heights, it is allowed to interpolate between the table values.

2) There may be different exposures for different directions of wind, when determining wind load on a building.

6.6. When the terrain around the buildings is not even, the reference level for defining heights is to be taken in accordance with Appendix G.

6.7. The distribution of wind load on buildings and their elements and aerodynamic coefficient c are given after Table 6. The intermediary values can be obtained by interpolation.

The arrow in Table 6 shows the wind direction. The aerodynamic coefficient is determined as follows :

6.7.1. For separated surfaces or points of buildings, accordance with schemes 1 to 33, Table 6. The positive values of the aerodynamic coefficient correspond to the wind direction on to the building surface, the negative ones correspond to the direction out of the building surface.

6.7.2. For structures and elements shown on schemes 34 to 43, Table 6, when calculating the wind force component on the direction of wind and the direction perpendicular to the wind, it is taken as the frontal obstructing coefficient c_x and c_y ; when calculating the vertical component of the force corresponding to the horizontal projection of the buildings, it is taken as the uplift coefficient C_z.

6.7.3. For structures with a windward surface forming an angle α with the wind direction , when calculating the wind force of the object along its axis applying to the windward surface, it is taken as coefficient c_{an} and C_T .

For other cases not given in Table 6, the aerodynamic coefficient shall be taken according to specific instructions or by experiences.

6.8. For buildings shown in schemes 2 to 26 Table 6, having openings (windows, doors, louvers) distributed uniformly along the perimeter, or for buildings with sheet walls that allow the wind to pass (whether with openings or not), when calculating wall frames, wall columns and wall joists, the aerodynamic coefficient shall be taken as being equal :

$c = +1$ for positive pressure,

$c = -0.8$ for negative pressure

The design wind load on internal walls is taken as being equal to 0.4 W_o, on light partitions weighting under 100 daN/m² - 0.2 W_o, but in any case not inferior to 10 daN/m².

6.9. When calculating main frames of buildings having longitudinal monitor or zenith monitor $a \geq 4h$ (schemes 9, 10, 25 Table 6), one must consider the wind load on the windward leeward columns and also the horizontal component of wind load on monitors.

For shed roof buildings (scheme 24), or zenith monitors $a \leq 4h$, one must consider the friction force W_f in substitution to horizontal components applying on 2nd monitor and the remaining ones. The friction force is determined by the formula

$$W_t = W_o \times c_f \times k \times S \qquad (7)$$

where

W = velocity pressure, daN/m², from Table 4

c_f = friction coefficient, from Table 6

k = from Table 5

S = area (m²) of the horizontal projection (for shed roofs, monitor roofs) or of the elevation projection (for walls having loggia and similar).

6.10. On areas next to ridges, eaves, or wall corners, if the wind pressure has a negative value, then the local pressures must be considered (Fig. 1).

The local pressure coefficient is given in Table 7

Table 7. Local pressure coefficient D

Areas having local pressure	Coefficient D
Area 1 : having width a from ridge, eave, corner	2
Area 2 : having width a from area 1	1.5

Note :

1) *At areas having local pressure, the aerodynamic coefficient shall be multiplied by local pressure coefficient D.*

2) *These local pressure coefficients must not be used for calculating the total wind force on a building, a wall or a roof ;*

3) *Width a is taken as being equal to the smallest of the 3 values : 0.1b ; 0.1l and 0.1 h, but not larger than 1.5 m. See Fig. 1 for b, l, h.*

4) *The local pressure coefficient is to be used only for buildings having roof pitch $\alpha > 10°$.*

5) *For roof extension, the roof area includes the extension area. The pressure on extension is taken as being equal to that of the part of the wall under this extension.*

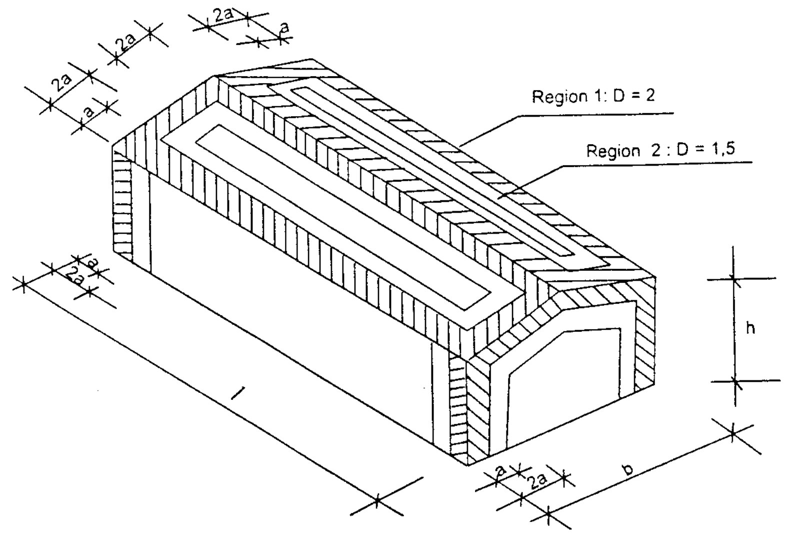


***Fig .1.** Areas having local pressure on roof*

6.11. The dynamic component of wind load must be determined when calculating guyed mast, tower, chimney, bridge conveyor corridor, exposed scaffolding, high-rised buildings over 40 m, frames of one-story industrial building over 36m high and with a height-width ratio over 1.5.

6.12. For high and flexible structures such as mast, chimney, tower, the aerodynamic stability must be checked. This calculation, as well as the means of reducing their vibration, shall be carried out on the basis of special studies and aerodynamic test results.

6.13. The standard value of the dynamic component of wind load W_p, at the height z is determined as follows :

6.13.1. For structure and structural component having proper basic vibration frequency f_1 (Hz) greater than the limit frequency f_L, given in Art. 6.14, W_p shall be determined by the formula :

$$W_p = W \times \zeta \times \nu \quad (8)$$

where W = the standard value of static component of wind load at the height z, determined as in 6.3

ζ = the dynamical pressure factor at the height z, determined by table 8

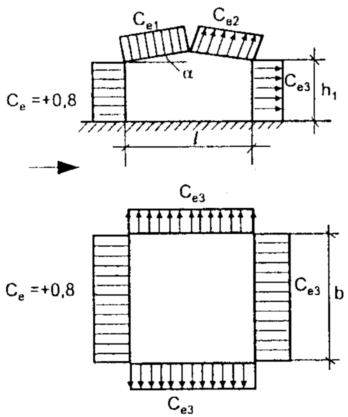
ν = the space correlation coefficient of the dynamical wind load, determined after 6.15.

Table 6. Guide for determining aerodynamical coefficient

Building and structure schemes and wind load distribution	Aerodynamic coefficient	Note
1.		
a. Vertical planes :		
windward	c = + 0.8	
leeward	c = – 0.6	
b. Vertical planes or planes inclined not more than 15° relative to the vertical direction, in building with many monitors or buildings having complex profile that is not shown in this table :		
- Extreme surface or rised intermediate surfaces		
windward	c = + 0.7	
leeward	c = – 0.6	
- Other intermediate surfaces		
windward	c = – 0.5	
leeward	c = – 0.5	

Building and structure schemes and wind load distribution	Aerodynamic coefficient	Note

2. Building with gable roof



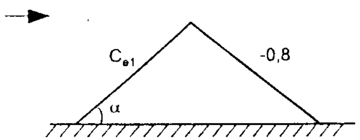
Coefficient	α degree	h_1/l 0	0.5	1	≥2
c_{e1}	0	0	− 0.6	− 0.7	− 0.8
	20	+ 0.2	− 0.4	− 0.7	− 0.8
	40	+ 0.4	+ 0.3	− 0.2	− 0.4
	60	+ 0.8	+ 0.8	+ 0.8	+ 0.8
c_{e2}	≤ 60	− 0.4	− 0.4	− 0.5	− 0.8

b/l	c_{e3} when h_1/l equals ≤ 0.5	1	≥ 2
≤ 1	− 0.4	− 0.5	− 0.6
≥ 2	− 0.5	− 0.6	− 0.6

Note:

- When wind direction is perpendicular to gable, $c_e = 0.7$ for all roof faces.
- When v is defined after Art. 6.15, so $h = h_1 + 0.2 \times l \times tg\alpha$

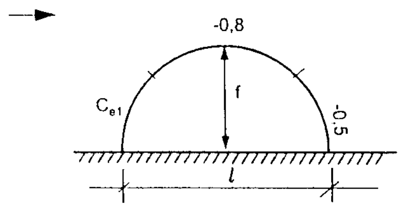
3. Gable roof at the ground level



α degree	0	30	≥ 60
c_{e1}	0	+0.2	+0.8

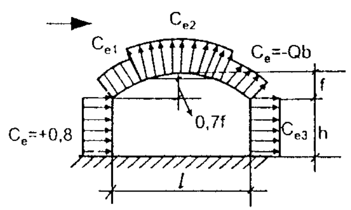
Building and structure schemes and wind load distribution	Aerodynamic coefficient	Note

4. Curved roof on the ground



f/l	C_{e1}
0.1	+ 0.1
0.2	+ 0.2
0.5	+ 0.6

5. Arch roof or similar (such as roof with circular truss)

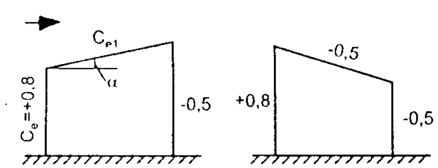


Coefficient	h_1/l	f/l				
		0.1	0.2	0.3	0.4	0.5
c_{e1}	0	+ 0.1	+ 0.2	+ 0.4	+ 0.6	+ 0.7
	0.2	− 0.2	− 0.1	+ 0.2	+ 0.5	+ 0.7
	≥ 1	− 0.8	− 0.7	− 0.3	+ 0.3	+ 0.7
c_{e2}		− 0.8	− 0.9	− 1	− 1.1	− 1.2

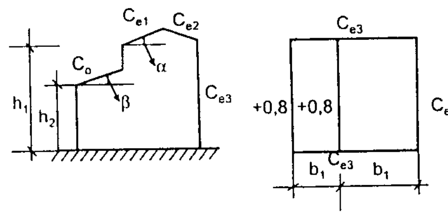
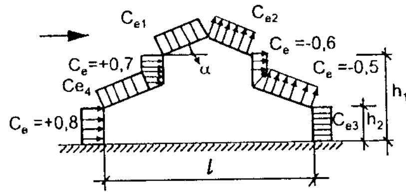
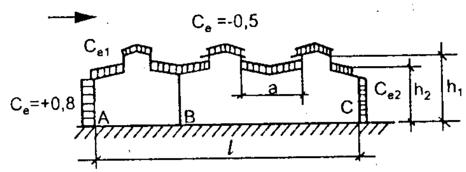
The value of C_{e3} is the same as in scheme 2

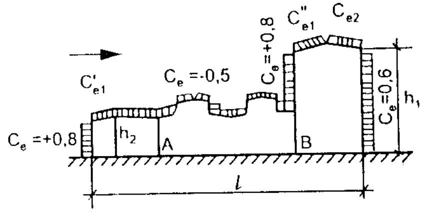
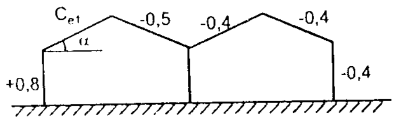
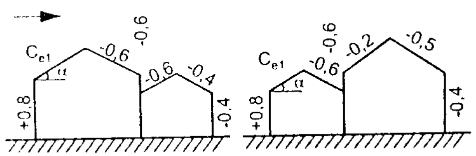
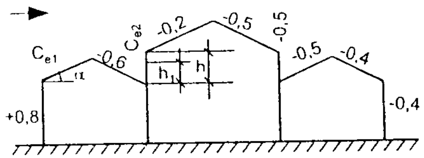
Note: – When ν is defined after Art. 6.15, so $h = h_1 + 0.7f$

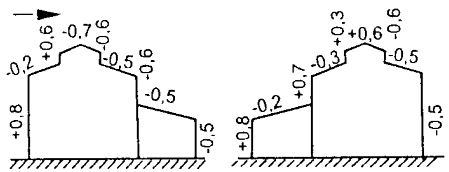
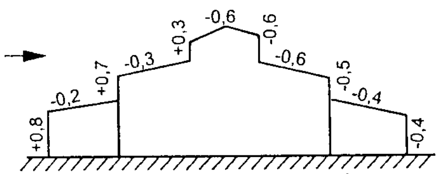
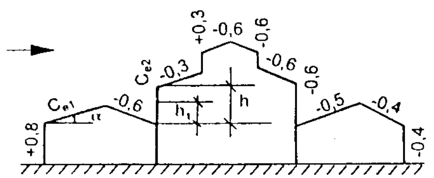
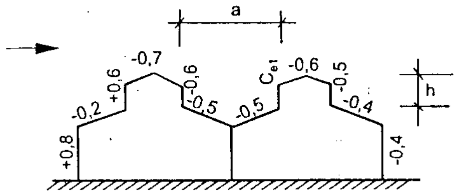
6. Closed building with one-pitch roof

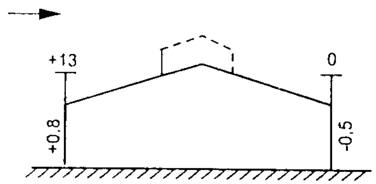
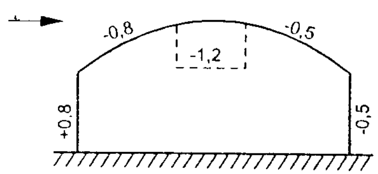
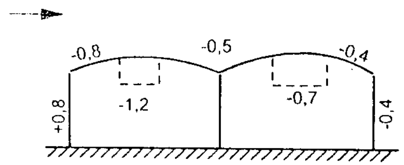
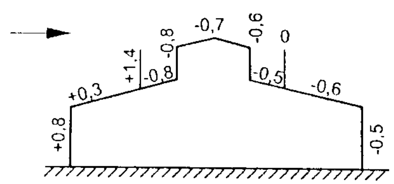


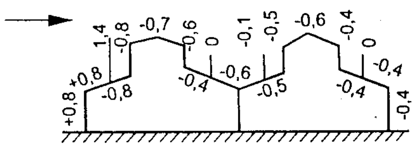
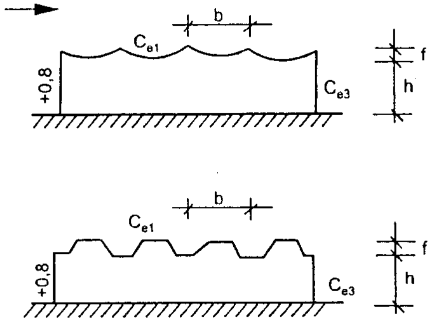
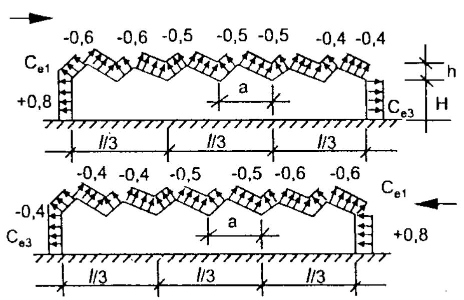
α degree	c_{e1}
≤ 15	− 0.6
30	0
≥ 60	+ 0.8

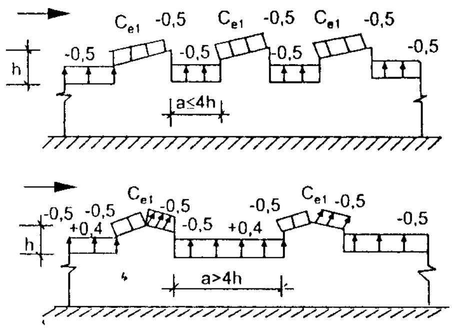
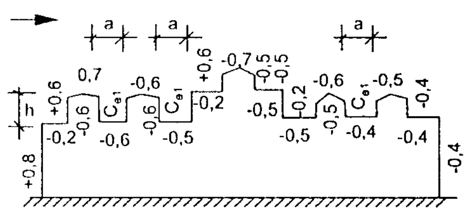
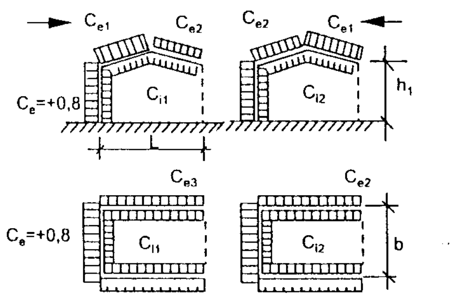
<table>
<tr><th>Building and structure schemes and wind load distribution</th><th>Aerodynamic coefficient</th><th>Note</th></tr>
<tr><td>7. Closed building with lean-to

Plan</td><td><table><tr><th>h_1/h_2</th><th>c_o</th></tr><tr><td>1.2</td><td>– 0.5</td></tr><tr><td>1.4</td><td>– 0.3</td></tr><tr><td>1.6</td><td>– 0.1</td></tr><tr><td>1.8</td><td>0.0</td></tr><tr><td>2.0</td><td>+ 0.2</td></tr><tr><td>2.5</td><td>+ 0.4</td></tr><tr><td>3.0</td><td>+ 0.6</td></tr><tr><td>≥ 4.0</td><td>+ 0.8</td></tr></table></td><td>- When $b_1 \leq b_2$ and $0 \leq \beta \leq 30^o$, c_o is taken from this table
- When $b_1 > b_2$, c_o taken from scheme 2
- C_{e1}, C_{e2}, C_{e3} taken as in scheme 2</td></tr>
<tr><td>8. Single-span building having longitudinal monitor
</td><td>- C_{e1}, C_{e2}, C_{e3} taken as in scheme 2
- Aerodynamic coefficient for monitor surfaces = 0.6
- Aerodynamic coefficient for monitor windward surfaces, for pitch under 20°, equals –0.8</td><td>- When calculating main frames of building in scheme 8 with wind leaves, the aerodynamic coefficient for the whole system monitor-leaves is taken as being equal to 1.4
- When ν is defined after Art..6.15, so $h = h_1$</td></tr>
<tr><td>9. Multi-span building having longitudinal monitor
</td><td>- See scheme 8 for aerodynamic coefficients
- For roof on span AB, c_e taken as in scheme 8
- For roof on span BC :
when $\lambda \leq 2$ so $c_x = 0.2$
when $2 < \lambda \leq 8$ so $c_x = 0.1\lambda$
when $\lambda > 8$ so $c_x = 0.8$
where $\lambda = a / (h_1 - h_2)$
- For remaining roofs : $c_e = -0.5$</td><td>- Aerodynamic coefficient for windward walls, leeward walls and any walls : as in scheme 2.
- When ν is defined after Art. 6.15, so $h = h_1$</td></tr>
</table>

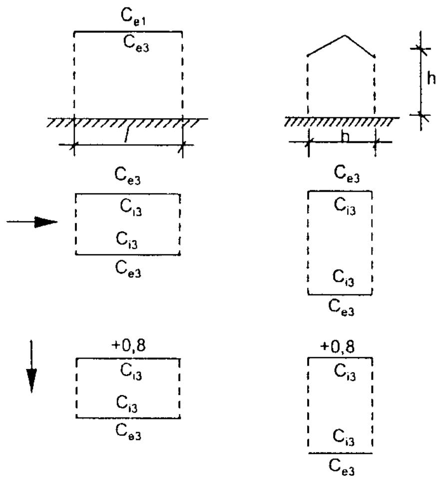
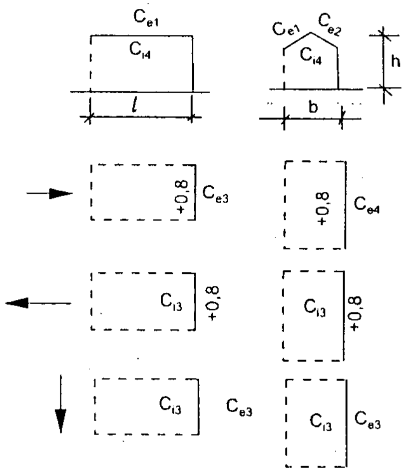
Building and structure schemes and wind load distribution	Aerodynamic coefficient	Note
10. Multi-span building having longitudinal monitor and different heights  	- See scheme 8 for aerodynamic coefficients - c_{e1}', c_{e1}'', c_{e2} are taken after scheme 2 when defining c_{e1} by h_1 (which is the height of windward wall) - For span AB, C_e is defined as for span BC of scheme 9, when the monitor height is equal to $(h_1 - h_2)$	- See note on scheme 9
11. Closed building having gable roof and two spans  	- c_{e1} is taken after scheme 2	
12. Closed building having gable roof and two spans, different heights  	- c_{e1} is taken after scheme 2	
13. Closed building having gable roof and three spans, different heights  	- c_{e1} is taken after scheme 2 - c_{e2} is equal to: $c_{e2} = 0.6 \quad (1 - 2h_1/h)$. When $h_1 > h$ so $c_{e2} = -0.6$	

Building and structure schemes and wind load distribution	Aerodynamic coefficient	Note
14. Closed building having monitor and lean-to 	Aerodynamic coefficient : see scheme nearby	
15. Closed building having monitor and two lean-to 	Aerodynamic coefficient : see scheme nearby	
16. Closed building having 3 spans and central monitor 	- Aerodynamic coefficient c_{e1} taken after scheme 2 - c_{e2} is equal to: $c_{e2} = 0.6\ (1 - 2h_1/h)$. When $h_1 > h$ so $c_{e2} = -0.6$	
17. Closed building, two spans and longitudinal monitor 	c_{e1} is equal to: When $a \leq 4h$ so $c_{e1} = +0.2$ When $a > 4h$ so $c_{e1} = +0.6$	

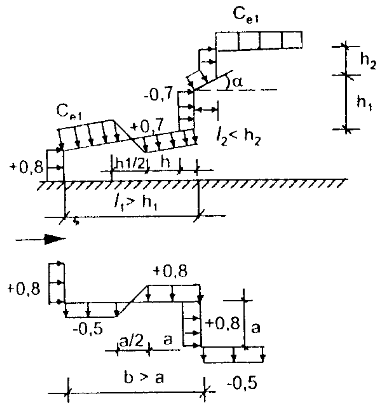
Building and structure schemes and wind load distribution	Aerodynamic coefficient	Note
18. Closed building having gable roof, parapet walls 	Aerodynamic coefficient : see scheme nearby	
19. Closed building having arch roof, hidden monitor 	Aerodynamic coefficient : see scheme nearby	
20. Closed building having two spans, arch roof, hidden monitor 	Aerodynamic coefficient : see scheme nearby	
21. Closed building having one span, monitor, wind leaves 	Aerodynamic coefficient : see scheme nearby	

Building and structure schemes and wind load distribution	Aerodynamic coefficient	Note
22. Closed building, two spans, monitor and wind leaves 	Aerodynamic coefficient : see scheme nearby	
23. Closed building, with shell roof or folded roof 	Coefficient c_{e1} and c_{e2} are the same in : - scheme 2 if $f/b \le 0.25$ - scheme 9 if $f/b > 0.25$	
24. Building with shed roof 	- Coefficient c_{e1} and c_{e2} are taken according to scheme 2 - Friction force W_f is calculated for the case that the wind direction is along the arrow as well as perpendicular to the drawing plan	- Friction force W_f is calculated for the wind direction with $c_f = 0.04$. - See note on scheme 9

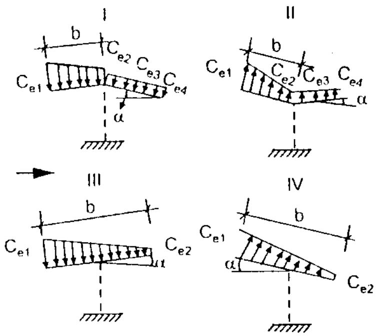
<table>
<tr><th>Building and structure schemes and wind load distribution</th><th>Aerodynamic coefficient</th><th>Note</th></tr>
<tr><td>25. Building having zenith monitors

</td><td>- Coefficient c_{e1} and c_{e2} are taken according to scheme 2
- Friction force W_f is calculated as in scheme 24</td><td>See note on scheme 9</td></tr>
<tr><td>26. Closed building with many complex spans

</td><td>- c_{e1} is equal :
When a ≤ 4h so c_{e1}= + 0.2
When a > 4h so c_{e1}= + 0.6</td><td></td></tr>
<tr><td>27. Building having a permanent open side (totally or partially)

</td><td>μ is the ratio of the opening areas in the wall and the wall area.
- When μ ≤ 5%, $c_{i1} = c_{i2} = \pm 0.2$ depending from the position which is windward or leeward.
- When μ ≥ 30%, $c_{i1} = c_{e3}$ defined according to scheme 3 and $c_{i2} = + 0.8$
- When the side is totally open : considered as the case μ ≥ 30%.</td><td>Coefficient c_e taken after scheme 2.
- With enclosed building, $c_i = 0$. For building quoted in Art. 6.1.2, the standard value of extern pressure on light partitions (when their surface density is < 100kg/m^2), is taken equal 0.2W_o, but not less than 10 kg/m^2.
- With any wall, the sign + or – of c_{i1} when μ ≤ 5% is taken from experiences with the most disadvantageous combination of loads</td></tr>
</table>

Building and structure schemes and wind load distribution	Aerodynamic coefficient	Note
28. Building open on two opposite sides 	c_{e1}, c_{e2}, c_{e3} are taken according to scheme 2	
29. Building open on three sides 	c_{e1}, c_{e2}, c_{e3} are taken according to scheme 2 $c_{e4} = +0.8$ for windward side and $c_{e4} = c_{e3}$ for leeward side.	

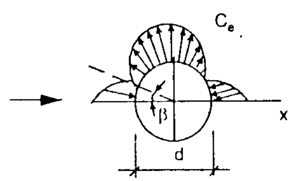
Building and structure schemes and wind load distribution	Aerodynamic coefficient	Note
30. Building having steps		- For horizontal or inclined ($\alpha<15^o$) roof, aerodynamical coefficients on heights h_1 and h_2 are taken as on the vertical ones. - When $l_1 > h_1$, the transition length (where the pressure becomes negative) is equal $h_1/2$. - Aerodynamical coefficients on concave corner face (on the length a) parallel to the wind are taken as for the face perpendicular to the wind. - When b > a, the transition length (where the pressure becomes negative) is equal a/2.



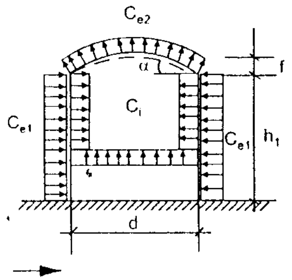
Building and structure schemes and wind load distribution	Aerodynamic coefficient	Note
31. Overhang	(see table below)	- The values of c_{e1}, c_{e2}, c_{e3}, , c_{e4} are used for calculating the total pressure on the upper and lower surfaces of the overhang. - For the negative values of c_{e1}, c_{e2}, c_{e3}, , c_{e4} the direction of pressure shown on the scheme is inverse. - For the wave form roof, when the wind follows its longitudinal line, the friction force W_f is to be considered, with $c_f = 0.04$.

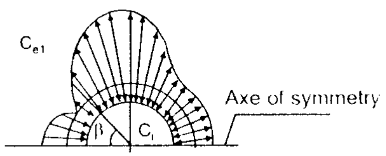


Scheme	α degree	c_{e1}	c_{e2}	c_{e3}	c_{e4}
I	10	0.5	−1.3	−1.1	0
	20	1.1	0	0	−0.4
	30	2.1	0.9	0.6	0
II	10	0	−1.1	−1.5	0
	20	1.5	0.5	0	0
	30	2	0.8	0.4	0.4
III	10	1.4	0.4		
	20	1.8	0.5		
	30	2.2	0.6		
IV	10	1.3	0.2		
	20	1.4	0.3		
	30	1.6	0.4		

<table>
<tr><th>Building and structure schemes and wind load distribution</th><th>Aerodynamic coefficient</th><th>Note</th></tr>
<tr><td>32. Sphere
</td><td>
<table>
<tr><td>β°</td><td>0</td><td>15</td><td>30</td><td>45</td><td>60</td><td>75</td><td>90</td></tr>
<tr><td>c_e</td><td>+1.0</td><td>+0.8</td><td>+0.4</td><td>−0.2</td><td>−0.8</td><td>−1.2</td><td>−1.25</td></tr>
<tr><td>β°</td><td>105</td><td>120</td><td>135</td><td>150</td><td>175</td><td>180</td><td></td></tr>
<tr><td>c_e</td><td>−1.0</td><td>0.6</td><td>−0.2</td><td>+0.2</td><td>+0.3</td><td>+0.4</td><td></td></tr>
</table>
$c_x = 1.3$ when $Re < 10^5$
$c_x = 0.6$ when $2 \times 10^5 \le Re \le 3 \times 10^5$
$c_x = 0.2$ when $4 \times 10^5 > Re$
where Re is the Reynolds number :
$Re = 0.88 \times d \times (W_o \times k(z) \times \gamma)^{1/2} \times 10^5$.
where ;
d - the sphere diameter (m),
W_o - wind pressure taken from Table 4 (daN/m^2),
k(z) - factor of wind load variation in height, from Table 5 ,
γ - reliability factor, after Art. 6.3
</td><td>c_e is used when $Re > 4 \times 10^5$.
When ν is defined after Art. 6.15, so
$b = h = 0.7 \times d$</td></tr>
<tr><td>33. Structure with cylindrical peripheral face (e.g. tank, cooling tower, chimney stack), with or without roof</td><td>
$c_{e1} = k_1 \times c_\beta$, where
$k_1 = 1$ when $c_\beta > 0$
<table>
<tr><td>h_1/d</td><td>0.2</td><td>0.5</td><td>1</td><td>2</td><td>5</td><td>10</td><td>25</td></tr>
<tr><td>k_1 when $c_\beta < 0$</td><td>0.8</td><td>0.9</td><td>0.95</td><td>1.0</td><td>1.1</td><td>1.15</td><td>1.2</td></tr>
</table>
c_β is taken from the following graphic when $Re > 4 \times 10^5$:
</td><td></td></tr>
</table>

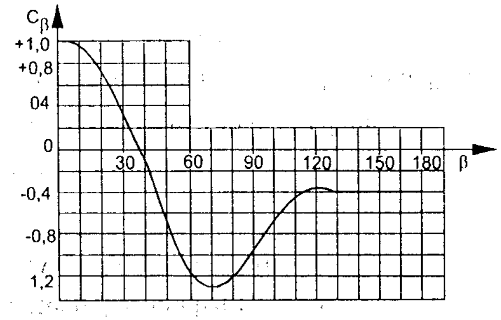
Building and structure schemes and wind load distribution	Aerodynamic coefficient	Note
(continued from scheme 33)	see below	- Number Re is defined by the formula of scheme 32, with $z = h_1$. - c_i is taken for both cases with roof and without roof. - When v is defined after Art. 6.15, so $b = 0.7 \times d$ and $h = h_1 + 0.7f$



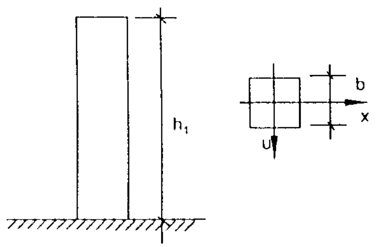


Roof form	c_{e2} when h_1/d equals		
	1/6	1/3	≥ 1
plane, conical with $\alpha \le 5°$, spherical with $f/d \le 0.1$	–0.5	–0.6	–0.8

h_1/d	1/6	1/4	1/2	1	2	≥ 5
c_i	–0.5	–0.55	–0.7	–0.8	–0.9	–1.05



34. Prismatic structure with square and polygonal plan



The frontal resistance coefficients are taken as follows :

$c_x = k \times c_{x\infty}$; $c_v = k \times c_{x\infty}$

Table 6.1

λ_e	5	10	20	35	50	100	∞
k	0.6	0.65	0.75	0.85	0.9	0.95	1

λ_e is defined after table 6.2. In this table $\lambda = l/b$ where l and b are respectively the largest and smallest dimension of the structure or its component, in the plan perpendicular to the wind direction.

Building and structure schemes and wind load distribution	Aerodynamic coefficient	Note
continued scheme 34		

Table 6.2

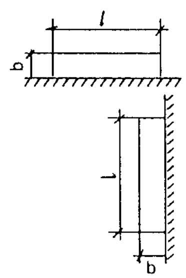
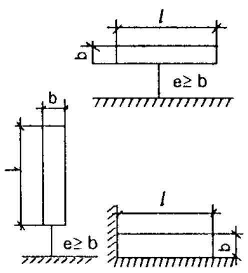
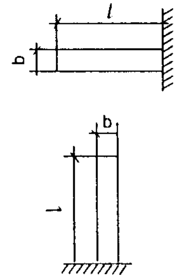
$\lambda_c = \lambda/2$	$\lambda_c = \lambda$	$\lambda_c = 2\lambda$
		

Table 6.3

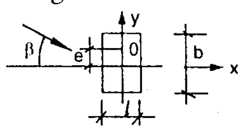
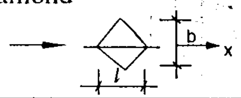
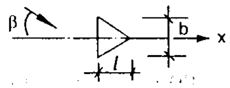
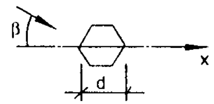
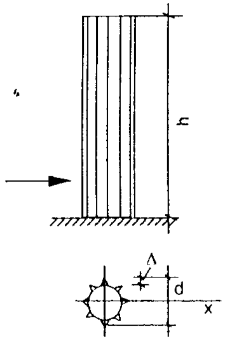
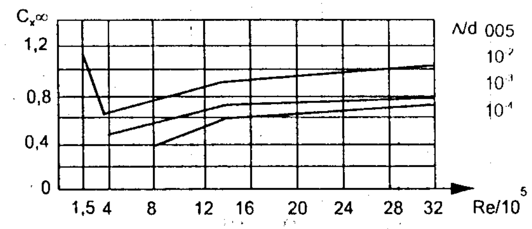
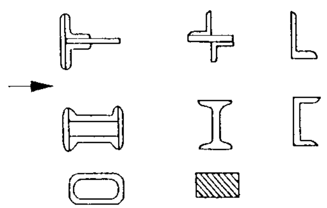
Section-Wind direction	β degree	l/b	$c_{x\infty}$
Rectangle 	0	≤1.5	2.1
		≥3	1.6
	40 - 50	≤0.2	2.0
		≥0.5	1.7
Diamond 	0	≤0.5	1.9
		1	1.6
		≥2	1.1
Triangle equilateral 	0		2
	180		1.2

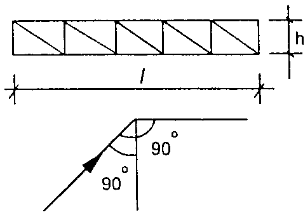
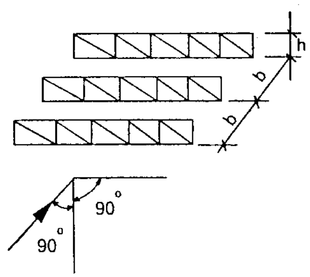
Table 6.4

Section-Wind direction	β degree	number of sides n	$c_{x\infty}$ when $Re > 4 \times 10^5$
	any	5	1.8
		6 - 8	1.5
		10	1.2
		12	1.0

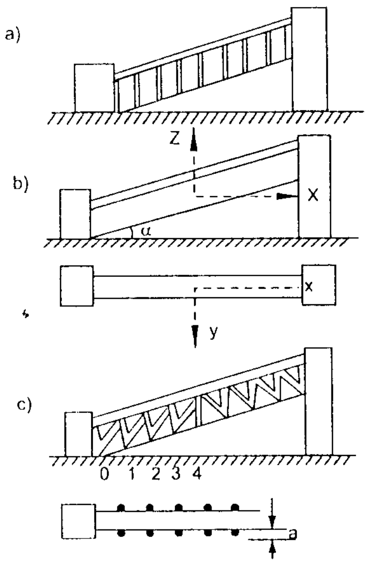
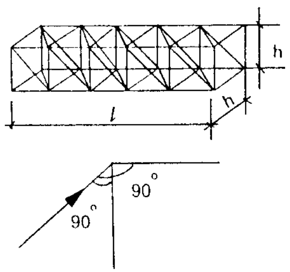
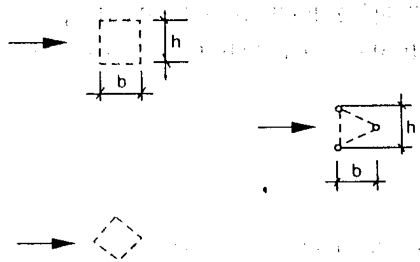
Note:

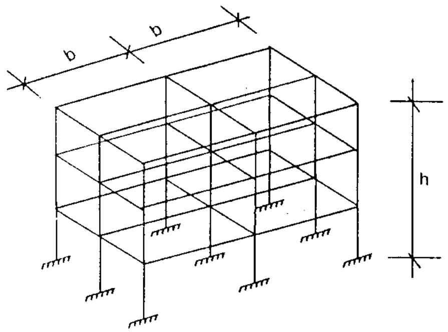
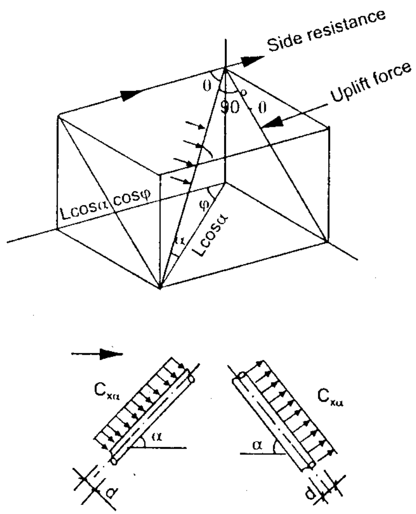
- Number Re is defined by the formula of scheme 32, with $z = h_1$ and d is the diameter of the circumscribed circle
- When ν is defined after Art. 6.15, so h is the structure height and b is the dimension in plan along the y axis

Building and structure schemes and wind load distribution	Aerodynamic coefficient	Note
35. Structure with cylindrical peripheral face (e.g. tank, cooling tower, chimney stack), cable, conduct wire and structural component of closed tubular form  	$c_x = k \times c_{x\infty}$ where : k is defined after Table 6.1 of scheme 34 ; $c_{x\infty}$ is defined according to the graphic hereunder depending the surface roughness (concrete, timber, steel ...)  	- Number Re is defined by the formula of scheme 32, with $z = h_1$ and d is the diameter of the structure - Values of Δ : for timber construction Δ = 0.005m for brick masonry Δ = 0.01m for concrete construction Δ = 0.005m for steel construction Δ = 0.001m for wire and cable of diameter d : Δ = 0.1d for surface with rib height b Δ = b for waveform roof $c_f = 0.04$ for electricity transmission line with wire and cable bigger than 20mm, the value of c_x may be reduced 10%.
36. Lattice structure steel sections of various shapes 	$c_x = 1.4$ when the wind direction perpendicular is to the element axis	

Building and structure schemes and wind load distribution	Aerodynamic coefficient	Note
37. Separate plane truss 	$c_x = (1/A)\Sigma C_{xi}A_i$ where C_{xi} is the aerodynami coefficient of the i^{th} element ; for section bars $C_{xi} = 1.4$; for tubular element, C_{xi} is taken according to graphic of scheme 35 where $\lambda_e = \lambda$ (table 6.2 of scheme 34) ; A_i is the area of the projection of the i^{th} element on the windward truss plane. A is the area limited by the peripheral border of the truss.	- The schemes 37, 38, 40 are applied for truss having whatever peripheral border and $\varphi = \Sigma A_i / A \leq 0.8$ - Wind load depends on A, the area limited by the peripheral border of the truss. - Axis x direction is the same of wind direction and perpendicular to the truss plane
38. A row of parallel plane trusses 	- For a row of parallel plane trusses, C_{xi} of the first truss is taken after scheme 37. - C_{xi} of the second and other following trusses : $C_{x2} = C_{x1} \times \eta$ - For tubular truss when $Re \geq 4 \times 10^5$ so $\eta = 0.95$	- See note on scheme 37. - Number Re is computed by the formula of scheme 32, with d is the average diameter of the tubes and z is the distance from the ground level to the top chord of the truss. - In the structure, h is the smallest dimension of its sides. For rectangular and polygonal trusses, h is the smallest dimension of its sides ; for circular trusses, h is its outer diameter ; for elliptic trusses and similar, h is the smallest of its axes. b is the spacing of adjacent trusses.

φ	Values of η for shape bar truss and tubular truss when $Re \leq 4 \times 10^5$ and b/h is equal				
	1/2	1	2	4	6
0.1	0.93	0.99	1	1	1
0.2	0.75	0.81	0.87	0.9	0.93
0.3	0.56	0.65	0.73	0.78	0.83
0.4	0.38	0.48	0.59	0.65	0.72
0.5	0.19	0.32	0.44	0.52	0.61
≥ 0.6	0	0.15	0.3	0.4	0.5

<table>
<tr><th>Building and structure schemes and wind load distribution</th><th>Aerodynamic coefficient</th><th>Note</th></tr>
<tr><td>39. Bridge conveyor corridor
</td><td>a) Exterior wall is closed and smooth; $\alpha \leq 20^o$.
- Along axis y : after scheme 2
- Along axis x : 5% of windload for axis y.
b) Exterior wall is open, floor and roof are closed
- Along axis y : after scheme 2
- Along axis x : on the windward area of the longitudinal lattice system or beam of the bridge, to be taken c_t = 1.2 for tubular element , c = 1.4 for shape element, where the area of the lattice system $F = \Sigma f_i$ and the area of the beam $F = \Sigma a \times b$
c) Exterior wall is closed, the structural elements (column, beam, diagonal) are outside of the closed wall :
- Along axis y : after scheme 2
- Along axis x : the biggest values from items a and b.
d) Exterior wall is open on one side : c is taken after scheme 27.</td><td>- When the bridge conveyor corridor is totally closed on all sides, the force component along axis z may be neglected.
- When the bridge conveyor corridor is partially open, c is to taken after scheme 27.</td></tr>
<tr><td>40. Space truss and lattice tower
</td><td>The frontal resistance coefficient is calculated by the formula :
$c_t = c_x \times (1+\eta) \times k_1$
where c_x is defined as in scheme 37 ; η as in scheme 38 ; k_1 by the following table :
<table><tr><th>Cross section and wind direction</th><th>k_1</th></tr><tr><td rowspan="3"></td><td>1.0</td></tr><tr><td>0.9</td></tr><tr><td>1.2</td></tr></table></td><td>- See notes on scheme 37
- In any case, c_t is defined with the condition that the wind is perpendicular to the windward plan of truss or tower.
- If the wind direction is diagonal relative to the tower having square plan, c_t is to be multiplied by the following factor : 0.9 for steel tower with single elements, 1.1 for wooden tower made from compound elements.</td></tr>
</table>

Building and structure schemes and wind load distribution	Aerodynamic coefficient	Note
41. Multistory frames connected one to another 	- This scheme applies to the case of multistory frames connected one to another. - Coefficient c is taken according to scheme 38.	
42. Guys and cylindrical element , inclined in the plane of wind stream 	$C_{x\alpha} = c_x \times \sin^2\alpha$ where c_x is as in scheme 35	

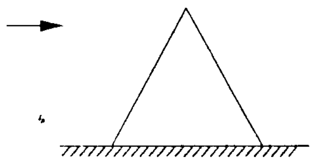
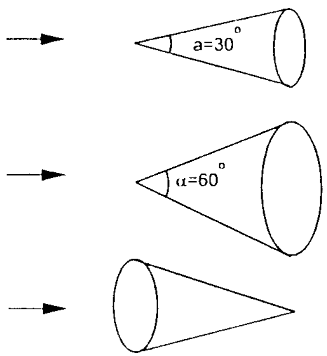
Building and structure schemes and wind load distribution	Aerodynamic coefficient	Note
43. Conical and prismatic structure having circular base 1) Conical and prismatic structure having circular base, resting on the ground level 	1. Conical and prismatic structure having circular base, resting on the ground level Cone : $c_x = 0.7$ $c_z = 0.3$ Prism having circular base, resting on the ground level $c_x = 1.2$ $c_z = -0.3$	
2) Conical and prismatic structure in space 	2. Cone in space : a) The top in the windward side - Cone without base and $\alpha = 30^o$ --> $c_x = 0.35$ - Cone without base and $\alpha = 60^o$ --> $c_x = 0.5$ b) The top in the leeward side and $Re > 10^5$ - Cone without base $c_x = 1.4$ - Cone with base $c_x = 1.2$	

Table 8. Dynamical pressure factor of wind load ζ

Height z, m	Dynamical pressure factor for terrain		
	A	B	C
≤5	0.318	0.517	0.754
10	0.303	0.486	0.684
20	0.189	0.457	0.621
40	0.275	0.429	0.563
60	0.267	0.414	0.532
80	0.262	0.403	0.511
100	0.258	0.395	0.496
150	0.251	0.381	0.468
200	0.246	0.371	0.450
250	0.242	0.364	0.436
300	0.239	0.358	0.425
350	0.236	0.353	0.416
≥ 480	0.231	0.343	0.398

6.13.2. For structures and structural components having their analysis scheme as a one·freedom degree system (such as industrial building frame, water tower) and having $f_l < f_L$, W_p shall be calculated by the formula :

$$W_p = W \times \zeta \times \xi \times \nu \qquad (9)$$

where :

ξ = dynamical factor, determined from the graphic of fig.2, in function of parameter ε and the logarithmic decrease δ of vibrations :

$$\varepsilon = (\gamma W_o)^{1/2} / 940 f_l \qquad (10)$$

γ = the load surplus coefficient of windload, equals 1.2 ;

W_o = wind pressure (N/m^2), determined after art. 6.4

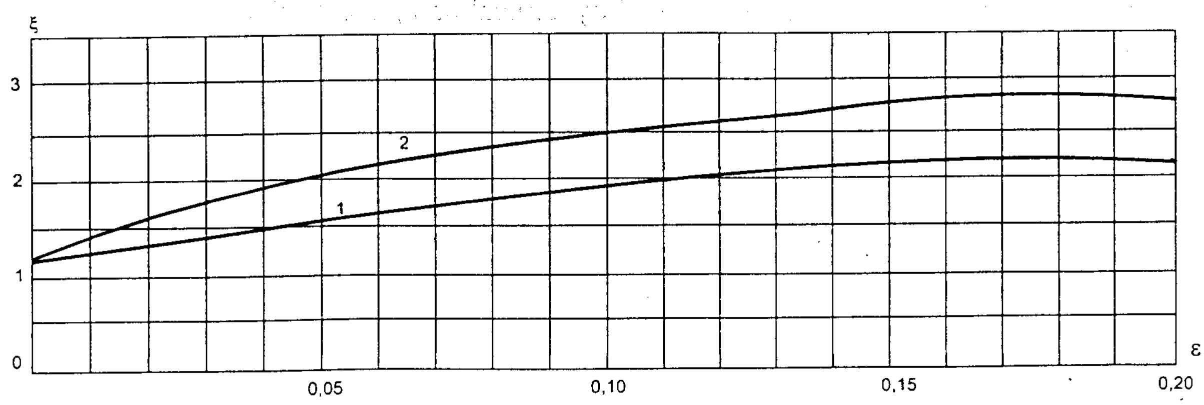


Fig.2. Dynamical factor ξ

Curve 1 : for reinforced concrete and masonry structures, including building with steel frames and cladding (δ = 0.3)

Curve 2 : for towers, masts, chimneys, cylindrical structures on concrete basement (δ = 0.15)

6.13.3. For buildings with a symmetrical plan having $f_1<f_L$ and for every structure having $f_1<f_L <f_2$ where f_2 is their second frequency of proper vibration, W_p is computed by the formula :

$$W_p = m \times \xi \times \psi \times y \qquad (11)$$

where

m = mass of the structure part the center of gravity of which is at the height z

ξ = dynamical factor, see 6.13.2.

y = the horizontal displacement of the structure at the height z, corresponding to the first mode of its proper vibration. (For buildings with a symmetrical plan, it is permitted to consider y as being equal to the displacement caused by a horizontal statically uniformly distributed load).

ψ = coefficient obtained by the formula (12), where the structure is divided in r parts and the wind load is constant for this part.

$$\psi = \frac{\sum_{k=1}^{r} y_k \times W_{pk}}{\sum_{k=1}^{r} y_k^2 \times M_{pk}} \qquad (12)$$

where :

M_k = mass of the k^{th} part of the structure

y_k = horizontal displacement of the center of gravity of the k^{th} part, corresponding to the first mode of its proper vibration.

W_{pk} = uniformly distributed dynamical component of wind load on the k^{th} part, determined after formula (8).

For multistory building with rigidity, mass and windward area constant along the height, it is permitted to determine the standard dynamical component of wind load at the height z by the formula :

$$W_p = 1.4 \times Z/h \times \xi \times W_{ph} \qquad (13)$$

where W_{ph} is the standard dynamical component of wind load at the level of structure top h, determined by the formula (8).

6.14. The limit frequency f_L (in Hz) of the proper vibration where the force of inertia generated in the vibration can be neglected, is given in Table 9, depending from the logarithmic decrease δ of vibrations.

6.14.1. For reinforced concrete and masonry structures, or buildings with steel frames and cladding $\delta = 0.3$.

6.14.2. For towers, masts, chimneys, or cylindrical structures on concrete basement $\delta = 0.15$.

Table 9. The limit frequency f_L (in Hz) of the proper vibration

Region of wind pressure	f_L (in Hz)	
	$\delta = 0.3$	$\delta = 0.15$
I	1.1	3.4
II	1.3	4.1
III	1.6	5.0
IV	1.7	5.6
V	1.9	5.9

For cylindrical structures where $f_1 < f_L$, the aerodynamic stability must be checked.

6.15. The space correlation coefficient of the dynamical windload ν is dependent upon the calculated surface where the dynamical component is determined.

The calculated surface comprises the windward surface, leeward surface, side walls, roof and similar parts through which the wind pressure is transmitted to the structure.

If the calculated surface is rectangular and oriented along the basic axes (see Fig.3), the coefficient ν is provided by table 10. depending on parameters ρ and χ. These parameters ρ and χ are found in Table 11.

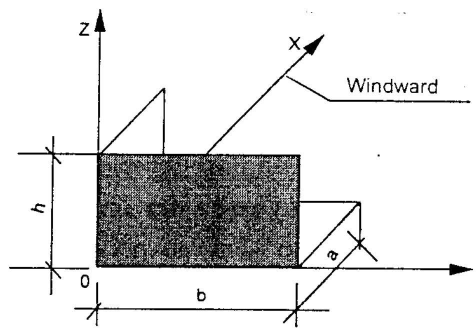


Fig 3. Coordinate axes in determining the space correlation coefficient ν

Table 10. The space correlation coefficient of the dynamical windload ν

ρ (m)	The coefficient of the dynamical windload ν when χ (m) equals						
	5	10	20	40	80	160	350
0.1	0.95	0.92	0.88	0.83	0.76	0.67	0.56
5	0.89	0.87	0.84	0.80	0.73	0.65	0.54
10	0.85	0.84	0.81	0.77	0.71	0.64	0.53
20	0.80	0.78	0.76	0.73	0.68	0.61	0.51
40	0.72	0.72	0.70	0.67	0.63	0.57	0.48
80	0.63	0.63	0.61	0.59	0.56	0.51	0.44
160	0.53	0.53	0.52	0.50	0.47	0.44	0.38

Table 11. Parameters ρ and χ

Basic coordinate plans, parallel to the calculated plan	ρ	χ
ZOY	b	h
ZOX	0.4a	h
ZOY	b	a

6.16. For structure having $f_s<f_L$, s first modes of vibrations must be taken in account in dynamical analysis where s is defined from the condition

$$f_s < f_L < f_{s+1}$$

6.17. The coefficient of wind load reliability is taken as being 1.2, where buildings and structures are assumed to have a service life of 50 years. When the assumed service life is not 50 years, the calculated wind load must be multiplied by a factor given in Table 12.

Table 12. Factor of wind load for various assumed service life of structure

Assumed service life (year)	5	10	20	30	40	50
Factor	0.61	0.72	0.83	0.91	0.96	1

APPENDIX A

DETERMINATION OF DESIGN STRESS IN BASIC AND SPECIAL COMBINATION OF LOADS

A.1. When at least 2 loads are considered in basic combination, the total design stress caused by these loads (bending or torsion moment, axial force or shear) is determined by the formula

$$X = \sum_{i=1}^{m} X_{tci} + \sqrt{\sum_{i=1}^{m} X_{tci}^{2} \times (\gamma_i - 1)^2} \qquad (A.1)$$

where :

X_{tci} = stress calculated from the standard values of each load, including corresponding coefficient of load combination as required in 2.4.3.

γ_i = coefficient of reliability for each load.

m = number of simultaneously acting loads.

A.2. If loads generate 2 or 3 different stresses X, Y, Z taken in account at the same time (e.g. normal force, bending moment in one or two directions), then in each load combination, one must consider 3 cases of design stress ($X, \overline{Y}, \overline{Z}$), ($Y, \overline{Z}, \overline{X}$) and ($Z, \overline{X}, \overline{Y}$) when there are 3 stresses and 2 cases of design stress (X, Y), (Y, X) when there are 2 stresses.

For the case (X, Y, Z), these stresses are calculated by the formulas :

$$X = \sum_{i=1}^{m} X_{tci} \pm \sqrt{\sum_{i=1}^{m} X_{tci}^{2} \times (\gamma_i - 1)^2} \qquad (A.2)$$

$$\overline{Y} = \sum_{i=1}^{m} Y_{tci} \pm \frac{\sum_{i=1}^{m} X_{tci} \times Y_{tci} \times (\gamma_i - 1)^2}{\sqrt{\sum_{i=1}^{m} X_{tci}^{2} \times (\gamma_i - 1)^2}} \qquad (A.3)$$

$$\overline{Z} = \sum_{i=1}^{m} Z_{tci} \pm \frac{\sum_{i=1}^{m} X_{tci} \times Z_{tci} \times (\gamma_i - 1)^2}{\sqrt{\sum_{i=1}^{m} X_{tci}^{2} \times (\gamma_i - 1)^2}}$$

where :

$X, \overline{Y}, \overline{Z}$ = total design stress generated by the simultaneous acting of some temporary loads ;

$X_{tci}, Y_{tci}, Z_{tci}$ = stresses determined by the standard value of each load including load combination factor, as said in 2.4.3 for short-term temporary loads and as required in 5.13 for dynamical component of wind load

m, γ_i = the same in formula (A.1).

For cases ($Y, \overline{Z}, \overline{X}$) and ($Z, \overline{X}, \overline{Y}$), the stresses are coputed by formulas (A.2), (A.3), (A.4) with the circular permutation of symbols X, Y, Z.

In formulas (A.2), (A.3), (A.4), the minus sign is taken in cases that the stress with its reduced absolute value determined by formula (A.2) becomes more dangerous, then the same sign is taken for all 3 formulas.

In combinations of stresses, when the temporary loads are chosen in the way that the maximal value of one stress appears in the section and other stresses are obtained as results of this calculation, the design stress should be determined by formula (A.2), and other corresponding stresses are determined by formula (A.3), (A.4). For example, in combination (N_{min}, $M_{corresp.}$), the value of N_{min} should be computed by formula (A.2), and $M_{corresp.}$ by formula (A.3).

***Note** : Depending on the forms of load combinations, should be added the stresses from permanent loads with surplus load coefficients (greater or lesser than 1 - See 3.2).*

APPENDIX B

TYPES OF CRANES WITH VARIOUS SERVICE CLASSES

Service class	Type of crane	Typical workshops using cranes with above mentioned service class
Light	Cranes with hook	Repair shops, generator shops of a heat power station
Medium	Cranes with hook, including cranes with electrical hoisting tackle	Mechanical and assembling workshops of medium serial production factories, mechanical repair workshops, packed goods handling yards.
Heavy	Cranes with hook, including cranes used for metal casting, forging and quenching	Workshops of large serial production factories, loose goods handling yard, some workshops of metallurgy factories.
Very heavy	Cranes with grabbing bucket, cranes with lifting electrical magnet, or with magnetic bucket for castings, cranes for breaking materials	Workshops of metallurgy factories.

Note : *Underhung electrical cranes are of medium service class ; manual underhung cranes are of light service class.*

APPENDIX C

LOAD CAUSED BY IMPACT ON CRANE STOPS

The standard value of horizontal force P_y (10 kN) along the runway, caused by the striking against the crane stop at the end of rails, is obtained by the formula :

$$P_y = (m \times v^2) / f \qquad (C.1)$$

where

v = the velocity (m/s) of crane at the striking time, taken as being equal half of nominative velocity.
f = the maximal settlement of the bumper, taken as being equal 0.1 m for cranes with a flexible hook, a capacity under 500 kN and of light, medium and heavy service class ; 0.2 m for other cases

m = equivalent mass of the crane (in Ton or 10 kN), determined by :

$$m = (1/g) \times P_M/2 + (P_T + KQ) \times (L_k - l)/L_k \qquad (C.2)$$

where :

g = gravity acceleration, equal to 9.81 m/s^2

P_M = weight of the crane bridge, in Ton (10 kN)

P_T = weight of the trolley, in Ton (10 kN)

Q = hoisting capacity, in Ton (10 kN)

k = coefficient, equal 0 for cranes with flexible hook, and 1 for cranes with rigid hook

L_k = crane span, in m

l = distance from trolley to crane stop, in m.

The design value of this load, including surplus load coefficient as in 5.8, shall not exceed ones given in the table C.1

Table C-1

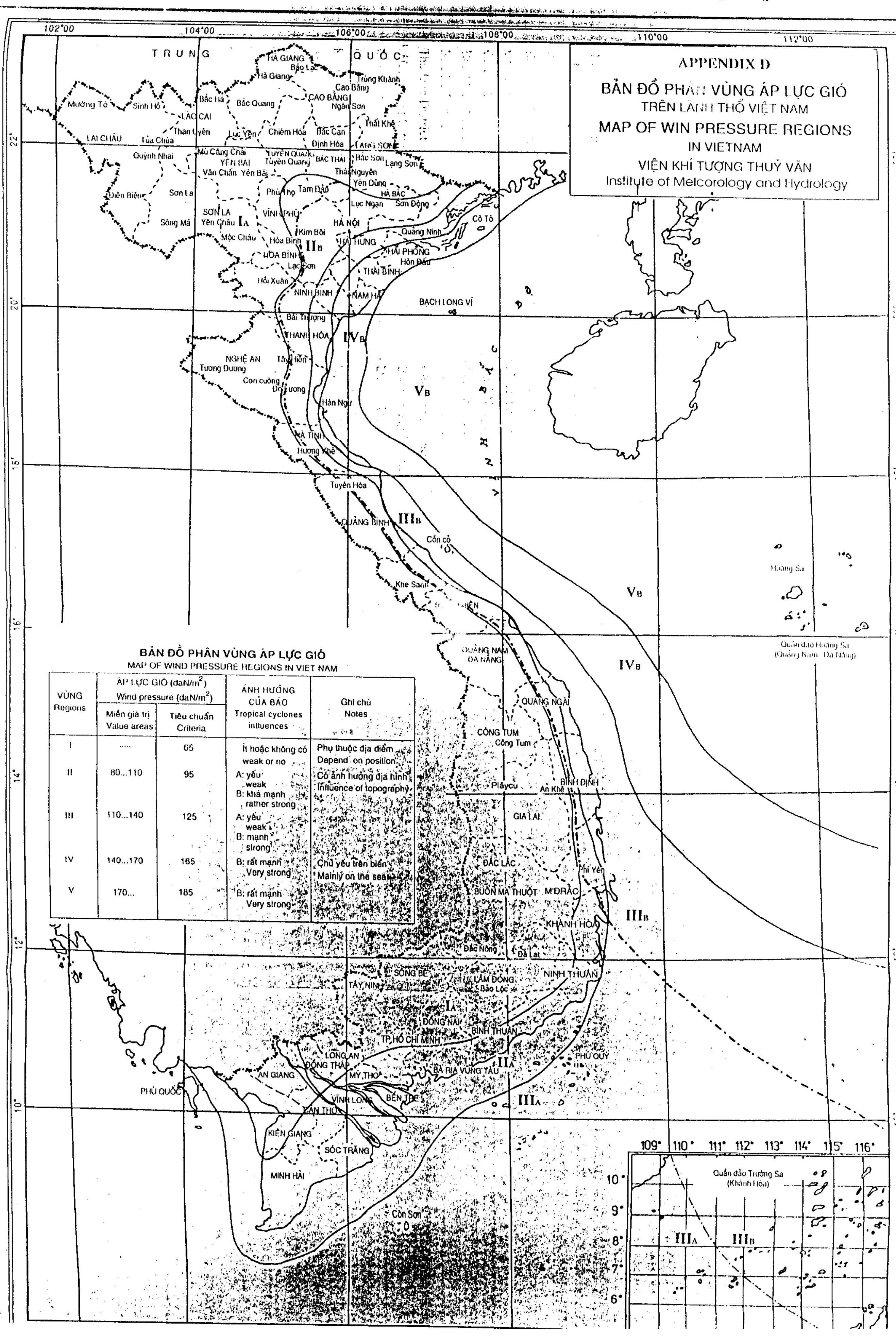
Crane characteristics	Limit load, 10kN
1. Hand operated or electrical cranes	1
2. Universal electrical cranes of medium and heavy service class, cranes used in foundry	15
3. Universal electrical cranes of light service class	5
4. Electrical cranes of very heavy service class, used in metallurgy and other special jobs	
- With flexible hook	25
- With rigid hook	50

APPENDIX D

BẢN ĐỒ PHÂN VÙNG ÁP LỰC GIÓ TRÊN LÃNH THỔ VIỆT NAM

MAP OF WIN PRESSURE REGIONS IN VIETNAM

VIỆN KHÍ TƯỢNG THUỶ VĂN
Institute of Melcorology and Hydrology



BẢN ĐỒ PHÂN VÙNG ÁP LỰC GIÓ
MAP OF WIND PRESSURE REGIONS IN VIET NAM

VÙNG Regions	ÁP LỰC GIÓ (daN/m^2) Wind pressure (daN/m^2) Miền giá trị Value areas	Tiêu chuẩn Criteria	ẢNH HƯỞNG CỦA BÃO Tropical cyclones influences	Ghi chú Notes
I	.....	65	Ít hoặc không có weak or no	Phụ thuộc địa điểm Depend on position
II	80...110	95	A: yếu weak B: khá mạnh rather strong	Có ảnh hưởng địa hình Influence of topography
III	110...140	125	A: yếu weak B: mạnh strong	
IV	140...170	165	B: rất mạnh Very strong	Chủ yếu trên biển Mainly on the sea
V	170...	185	B: rất mạnh Very strong	

APPENDIX E

WIND REGIONS BY ADMINISTRATION DIVISION NAME

Table E.1

Administration division name	Region	Administration division name	Region
1. HaNoi City:		- Tan Chau District	I.A
- Inner City	II.B	- Tinh Bien District	I.A
- Dong Anh District	II.B	- Thoai Son District	I.A
- Gia Lam District	II.B	- Tri Ton District	I.A
- Soc Son District	II.B	**5. Ba Ria - Vung Tau City:**	
- Thanh Tri District	II.B	- Vung Tau City	II.A
- Tu Liem District	II.B	- Chau Thanh District	II.A
2. HoChiMinh City:		- Con Dao District	III.A
- Inner City	II.A	- Long Dat District	II.A
- Binh Chanh District	II.A	- Xuyen Moc District	II.A
- Can Gio District	II.A	**6. Bac Thai :**	
- Cu Chi District	I.A	- Thai Nguyen City	II.B
- Hoc Mon District	II.A	- Bac Can Town	I.A
- Nha Be District	II.A	- Song Cong Town	II.B
- Thu Duc District	II.A	- Cho Don District	I.A
3. Hai Phong City:	II.A	- Bach Thong District	I.A
- Inner City	IV.B	- Dai Tu District	II.A
- Do Son Town	IV.B	- Dinh Hoa District	I.A
- Kien An Town	IV.B	- Dong Hy District	I.A
- An Hai District	IV.B	- Na Ri District	I.A
- An Lao District	IV.B	- Pho Yen District	II.B
- Cat Hai District	IV.B	- Phu Binh District	II.B
- Dao Bach Long Vi District	V.B	- Phu Luong District	I.A
- Kien Thuy District	IV.B	- Vo Nhai District	I.A
- Thuy Nguyen District	III.B	**7. Ben Tre City:**	
- Tien Lang District	IV.B	- Ben Tre Town	II.A
- Vinh Bao District	IV.B	- Ba Tri District	II.A
4. An Giang :		- Binh Dai District	II.A
- Chau Doc Town	I.A	- Chau Thanh District	II.A
- An Phu District	I.A	- Cho Lach District	II.A
- Chau Thanh District	I.A	- Giong Trom District	II.A
- Chau Phu District	I.A	- Mo Cay District	II.A
- Cho Moi District	I.A	- Thanh Phu District	II.A

Administration division name	Region	Administration division name	Region
8. Binh Dinh City:		- Chau Thanh District	II.A
- Quy Nhon City	III.B	- Long My District	II.A
- An Nhon District	III.B	- O Mon District	II.A(I.A)
- An Lao District	II.B (I.A)	- Phung Hiep District	II.A
- Hoai An District	II.B	- Thot Not District	I.A
- Hoai Nhon District	III.B	- Vi Thanh District	II.A
- Phu Cat District	III.B	**12. Dac Lac :**	
- Phu My District	III.B	- Buon Ma Thuot Town	I.A
- Tay Son District	II.B (I.A)	- Cu Giut District	I.A
- Tuy Phuoc District	III.B	- Cu M'ga District	I.A
- Van Canh District	II.B	- Dac Min District	I.A
- Vinh Thanh District	I.A	- Dac Nong District	I.A
9. Binh Thuan :		- Dac Rlap District	I.A
- Phan Thiet Town	II.A	- Ea Ca District	I.A
- Bac Binh District	II.A (I.A)	- Ea H' leo District	I.A
- Duc Linh District	I.A	- Ea Sup District	I.A
- Ham Tan District	II.A	- Krong Ana District	I.A
- Ham Thuan Nam District	II.A	- Krong Bong District	I.A
- Ham Thuan Bac District	I.A (II.A)	- Kong Buc District	I.A
- Phu Quy District	III.A	- Krong Nang District	I.A
- Tanh Linh District	I.A	- Krong No District	I.A
- Tuy Phong District	II.A	- Krong Pac District	I.A
10. Cao Bang :		- Lac District	I.A
- Cao Bang Town	I.A	- Mo Drac District	I.A
- Ba Be District	I.A	**13. Dong Nai :**	
- Bao Lac District	I.A	- Bien Hoa City	I.A
- Ha Quang District	I.A	- Vinh An Town	I.A
- Ha Lang District	I.A	- Dinh Quan District	I.A
- Hoa An District	I.A	- Long Khanh District	I.A(II.A)
- Ngan Son District	I.A	- Long Thanh District	II.A
- Nguyen Binh District	I.A	- Tan Phu District	I.A
- Quang Hoa District	I.A	- Thong Nhat District	I.A
- Thach An District	I.A	- Xuan Loc District	I.A
- Thong Nong District	I.A	**14. Dong Thap :**	
- Tra Linh District	I.A	- Cao Lanh Town	I.A
- Trung Khanh District	I.A	- Cao Lanh District	I.A
11. Can Thơ :		- Chau Thanh District	II.A
- Can Thơ City	II.A	- Hong Ngu District	I.A

Administration division name	Region	Administration division name	Region
- Lai Vung District	I.A	- Dong Van District	I.A
- Tam Nong District	I.A	- Hoang Su Phi District	I.A
- Tan Hong District	I.A	- Meo Vac District	I.A
- Thanh Binh District	I.A	- Quan Ba District	I.A
- Thanh Hung District	I.A	- Vi Xuyen District	I.A
- Thap muoi District	I.A	- Xin Man District	I.A
15. Gia Lai :		- Yen Minh District	I.A
- Play Cu Town	I.A	**18. Ha Tay :**	
- A Dun Pa District	I.A	- Ha Dong Town	II.B
- An Khe District	I.A	- Son Tay Town	II.B
- Chu Pa District	I.A	- Ba Vi District	II.B
- Chu Prong District	I.A	- Chuong My District	II.B
- Chu Se District	I.A	- Dan Phuong District	II.B
- Duc Co District	I.A	- Hoai Duc District	II.B
- K Bang District	I.A	- My Duc District	II.B
- Krong Chro District	I.A	- Phu Xuyen District	II.B
- Krong Pa District	I.A	- Phuc Tho District	II.B
- Mang Giang District	I.A	- Quoc Oai District	II.B
16. Ha Bac :		- Thach That District	II.B
- Bac Giang Town	II.B	- Thanh Oai District	II.B
- Bac Ninh Town	II.B	- Thuong Tin District	II.B
- Gia Luong District	II.B	- Ung Hoa District	II.B
- Hiep Hoa Town	II.B	**19. Ha Tinh :**	
- Lang Giang District	II.B	- Ha Tinh Town	IV.B
- Luc Nam District	II.B	- Hong Linh Town	IV.B
- Luc Ngan District	II.B	- Can Loc District	IV.B
- Que Vo District	II.B	- Cam Xuyen District	III.B(IV.B)
- Son Dong District	II.B	- Duc Tho District	II.B
- Tan Yen District	II.B	- Huong Khe District	I.A (II.B)
- Tien Son District	II.B	- Huong Son District	I.A (II.B)
- Thuan Thanh District	II.B	- Ky Anh District	III.B(IV.B)
- Viet Yen District	II.B	- Nghi Xuan District	IV.B
- Yen Dung District	II.B	- Thach Ha District	IV.B
- Yen Phong District	II.B	**20. Hai Hung :**	
- Yen The District	I.A	- Hai Duong Town	III.B
17. Ha Giang :		- Hung Yen Town	III.B
- Ha Giang Town	I.A	- Cam Binh District	III.B
- Bac Me District	I.A	- Chau Giang District	II.B
- Bac Quang District	I.A	- Kim Mon District	II.B

Administration division name	Region	Administration division name	Region
- Kim Thi District	III.B	**24. Kon Tum :**	
- My Van District	II.B	- Kon Tum Town	I.A
- Chi Linh District	II.B	- Dac Glay District	I.A
- Nam Thanh District	III.B	- Vinh Thuan District	II.A
- Ninh Thanh District	III.B	- Dac To District	I.A
- Phu Tien District	III.B	- Kon Plong District	I.A
- Tu Loc District	III.B	- Ngoc Hoi District	I.A
21. Hoa Binh :		- San Thay District	I.A
- Hoa Binh Town	I.A	**25. Lai Chau :**	
- Da Bac District	I.A	- Dien Bien Phu Town	I.A
- Kim Boi District	II.B	- Lai Chau Town	I.A
- Ky Son District	I.A	- Dien Bien District	I.A
- Lac Thuy District	II.B	- Muong Lay District	I.A
- Lac Son District	II.B	- Muong Te District	I.A
- Luong Son District	II.B	- Phong Tho District	I.A
- Mai Chau District	I.A	- Tua Chua District	I.A
- Tan Lac District	I.A	- Tuan Giao District	I.A
- Yen Thuy District	II.B	- Sin Ho District	I.A
22. Khanh Hoa :		**26. Lam Dong :**	
- Nha Trang City	II.A	- Da Lat City	I.A
- Cam Ranh District	II.A	- Bao Loc District	I.A
- Dien Khanh District	II.A	- Cat Tien District	I.A
- Khanh Son District	I.A	- Di Linh District	I.A
- Khanh Vinh District	I.A	- Da Hoai District	I.A
- Ninh Hoa District	II.A	- Da Te District	I.A
- Truong Sa District	III.B	- Don Duong District	I.A
23. Kien Giang :		- Duc Trong District	I.A
- Rach Gia Town	I.A	- Lac Duong District	I.A
- An Bien District	I.A	- Lam Ha District	I.A
- An Minh District	I.A	**27. Lang Son :**	
- Chau Thanh District	I.A	- Lang Son Town	I.A
- Giong Rieng District	II.A	- Bac Son District	I.A
- Go Quao District	II.A	- Binh Gia District	I.A
- Ha Tien District	I.A	- Cao Loc District	I.A
- Hon Dat District	I.A	- Chi Lang District	I.A
- Kien Hai District	II.A	- Dinh Lap District	I.A
- Phu Quoc District	III.A	- Huu Lung District	I.A
- Tan Hiep District	I.A	- Loc Binh District	I.A

Administration division name	Region	Administration division name	Region
- Trang Dinh District	I.A	**31. Nam Ha :**	
- Van Lang District	I.A	- Nam Dinh City	IV.B
- Van Quan District	I.A	- Ha Nam Town	III.B
28. Lao Cai :		- Binh Luc District	III.B (IV.B)
- Lao Cai Town	I.A	- Duy Tien District	III.B
- Bac Ha District	I.A	- Hai Hau District	IV.B
- Bao Thang District	I.A	- Kim Bang District	III.B
- Bao Yen District	I.A	- Li Nhan District	III.B
- Bat Xat District	I.A	- Nam Ninh District	IV.B
- Muong Khuong District	I.A	- Nghia Hung District	IV.B
- Sa Pa District	I.A	- Thanh Liem District	III.B
- Than Uyen District	I.A	- Vu Ban District	IV.B
- Van Ban District	I.A	- Xuan Thuy District	IV.B
29. Long An :		- Y Yen District	IV.B
- Tan An Town	II.A	**32. Nghệ An :**	
- Ben Luc District	II.A	- Vinh City	III.B
- Can Duoc District	II.A	- Anh Son District	I.A
- Can Giuoc District	II.A	- Con Cuong District	I.A
- Chau Thanh District	II.A	- Dien Chau District	III.B
- Duc Hoa District	I.A	- Do Luong District	II.B
- Duc Hue District	I.A	- Hung Nguyen District	III.B
- Moc Hoa District	I.A	- Ki Son District	I.A
- Tan Thanh District	I.A	- Nam Dan District	II.B
- Tan Tru District	II.A	- Nghi Loc District	III.B
- Thach Hoa District	I.A	- Nghia Dan District	II.B
- Thu Thua District	II.A	- Que Phong District	I.A
- Vinh Hung District	I.A	- Quy Chau District	I.A
30. Minh Hai :		- Quy Hop District	I.A
- Bac Lieu Town	II.A	- Quynh Luu District	III.B
- Ca Mau Town	II.A	- Tan Ki District	I.A
- Cai Nuoc District	II.A	- Thanh Chuong District	II.B
- Dam Doi District	II.A	- Tuong Duong District	I.A
- Gia Rai District	II.A	- Yen Thanh District	II.B
- Hong Dan District	II.A	**33. Ninh Binh :**	
- Ngoc Hien District	II.A	- Ninh Binh Town	IV.B
- Thoi Binh District	II.A	- Tam Diep Town	IV.B
- Tran Van Thoi District	II.A	- Gia Vien District	III.B
- U Minh District	II.A	- Hoa Lu District	III.B
- Vinh Loi District	II.A	- Hoang Long District	III.B

Administration division name	Region	Administration division name	Region
- Kim Son District	IV.B	- Tien Phuoc District	II.B
- Tam Diep District	IV.B	- Thang Binh District	III.B
34. Ninh Thuan :		- Tra My District	I.A
- Phan Rang - Thap Cham Town	II.A	**38. Quang Ngai :**	
- Ninh Hai District	II.A	- Quang Ngai Town	III.B
- Ninh Phuoc District	II.A	- Ba To District	I.A
- Ninh Son District	I.A	- Binh Son District	III.B
35. Phu Yen :		- Duc Pho District	III.B
- Tuy Hoa Town	III.B	- Minh Long District	II.B
- Dong Xuan District	II.B	- Mo Duc District	III.B
- Song Cau District	III.B	- Nghia Hanh District	II.B
- Song Hinh District	I.A	- Son Ha District	I.A
- Son Hoa District	I.A	- Son Tinh District	II.B
- Tuy An District	III.B	- Tra Bong District	I.A
- Tuy Hoa District	II.B (III.B)	- Tu Nghia District	II.B
36. Quang Binh :		**39. Quang Ninh :**	
- Dong Hoi Town	III.B	- Cam Pha Town	III.B
- Bo Trach District	I.A (II.B)	- Hon Gai Town	III.B
- Le Thuy District	I.A (II.B, III.B)	- Uong Bi Town	II.B
- Minh Hoa District	I.A	- Ba Che District	II.B
- Quang Ninh District	I.A (II.B, III.B)	- Binh Lieu District	II.B
- Quang Trach District	III.B	- Cam Pha District	IV.B
- Tuyen Hoa District	II.B	- Dong Trieu District	II.B
37. Quang Nam - Da Nang City:		- Hai Ninh District	III.B
- Da Nang City	II.B	- Hoanh Bo District	II.B
- Tam Ky Town	II.B	- Quang Ha District	III.B
- Hoi An Town	III.B	- Tien Yen District	II.B
- Duy Xuyen District	II.B	- Yen Hung District	IV.B
- Dai Loc District	II.B	**40. Quang Tri :**	
- Dien Ban District	II.B	- Dong Ha Town	II.B
- Giang District	I.A	- Quang Tri Town	II.B
- Hien District	I.A	- Cam Lo District	II.B
- Hiep Duc District	II.B	- Gio Linh District	II.B
- Hoang Sa District	V.B	- Hai Lang District	II.B
- Hoa Vang District	II.B	- Huong Hoa District	I.A
- Nui Thanh District	III.B	- Trieu Phong District	III.B
- Phuoc Son District	I.A	- Vinh Linh District	II.B
- Que Son District	II.B		

Administration division name	Region	Administration division name	Region
41. Soc Trang :		- Trang Bang District	I.A
- Soc Trang Town	II.A	**45. Thai Binh :**	
- Ke Sach District	II.A	- Thai Binh Town	IV.B
- Long Phu District	II.A	- Dong Hung Town	IV.B
- My Tu District	II.A	- Kien Xuong District	IV.B
- My Xuyen District	II.A	- Hung Ha District	IV.B
- Tranh Tri District	II.A	- Quynh Phu District	IV.B
- Vinh Chau District	II.A	- Thai Thuy District	IV.B
42. Song Be :		- Tien Hai District	IV.B
- Thu Dau Mot Town	I.A	- Vu Thu District	IV.B
- Ben Cat District	I.A	**46. Thanh Hoa :**	
- Binh Long District	I.A	- Bim Son Town	IV.B
- Bu Dang District	I.A	- Thanh Hoa Town	III.B
- Dong Phu District	I.A	- Sam Son District	IV.B
- Loc Ninh District	I.A	- Ba Thuoc District	II.B
- Phuoc Long District	I.A	- Cam Thuy District	II.B
- Tan Uyen District	I.A	- Dong Son District	III.B
- Thuan An District	I.A	- Ha Trung District	III.B
- Lang Chanh District	I.A	- Hau Loc District	IV.B
43. Son La :		- Hoang Hoa District	IV.B
- Son La Town	I.A	- Lang Chanh District	II.B
- Bac Yen District	I.A	- Nga Son District	IV.B
- Mai Son District	I.A	- Ngoc Lac District	II.B
- Moc Chau District	I.A	- Nong Cong District	III.B
- Muong La District	I.A	- Nhu Xuan District	II.B
- Phu Yen District	I.A	- Quan Hoa District	I.A
- Quynh Nhai District	I.A	- Quang Xuong District	III.B
- Thuan Chau District	I.A	- Tinh Gia District	III.B
- Song Ma District	I.A	- Thach Thanh District	III.B
- Yen Chau District	I.A	- Trieu Yen District	III.B
44. Tay Ninh :		- Tho Xuan District	II.B
- Tay Ninh Town	I.A	- Thuong Xuan District	II.B
- Ben Cau District	I.A	- Trieu Son District	II.B
- Chau Thanh District	I.A	- Vinh Loc District	III.B
- Duong Minh Chau District	I.A	**47. Thua Thien - Hue City:**	
- Go Dau District	I.A	- Hue City	II.B
- Hoa Thanh District	I.A	- A Luoi District	I.A
- Tan Bien District	I.A	- Huong Tra District	II.B
- Tan Chau District	I.A	- Huong Thuy District	II.B

Administration division name	Region	Administration division name	Region
- Nam Dong District	I.A	- Binh Minh District	II.A
- Phong Dien District	III.B	- Long Ho District	II.A
- Phu Loc District	II.B	- Mang Thit District	II.A
- Phu Vang District	III.B	- Tam Binh District	II.A
- Quang Dien District	III.B	- Tra On District	II.A
48. Tien Giang :		- Vung Liem District	II.A
- My Tho City	II.A	**52. Vinh phu :**	
- Go Cong Town	II.A	- Viet Tri City	II.A
- Cai Lay District	II.A	- Phu Tho Town	II.A
- Cai Be District	II.A	- Vinh Yen Town	II.B
- Chau Thanh District	II.A	- Doan Hung District	I.A
- Cho Gao District	II.A	- Me Linh District	II.B
- Go Cong Dong District	II.A	- Lap Thach District	II.A
- Go Cong Tay District	II.A	- Phong Chau District	II.A
49. Tra Vinh :	II.A	- Song Thao District	I.A
- Tra Vinh Town	II.A	- Tam Dao District	II.B
- Cang Long District	II.A	- Tam Thanh District	II.B
- Cau Ke District	II.A	- Thanh Hoa District	I.A
- Cau Ngang District	II.A	- Thanh Son District	I.A
- Chau Thanh District	II.A	- Vinh Lac District	II.B
- Duyen Hai District	II.A	- Yen Lap District	I.A
- Tieu Can District	II.A	**53. Yen Bai :**	
- Trạ Cu District	II.A	- Yen Bai Town	I.A
50. Tuyen Quang :		- Luc Yen District	I.A
- Tuyen QuangTown	I.A	- Mu Cang Chai District	I.A
- Chiem Hoa District	I.A	- Tram Tau District	I.A
- Ham Yen District	I.A	- Tran Yen District	I.A
- Na Hang District	I.A	- Van Chan District	I.A
- Son Duong District	I.A	- Van Yen District	I.A
- Yen Son District	I.A	- Yen Binh District	I.A
51. Vinh Long :			
- Vinh Long Town	II.A		

Note : For districts appertaining to two or three wind regions (in parentheses), it should be need to consult with Norm and Standard Agency in defining the value of W_o.

APPENDIX F

WIND PRESSURE AT METEOROLOGICAL STATIONS IN MOUNTAIN REGIONS AND ISLANDS

The values given in Appendix F (Table F1 and F2) by meteorological stations are the design wind pressure for structure working life of 5 years, 10 years, 20 years and 50 years.

Table F1 : Wind pressure at meteorological stations in mountain regions. Applied to 6.4.3

Stations	Wind pressure at repetitive periods, daN/m^2			
	5 years	10 years	20 years	50 years
1. An Khe	59	69	80	95
2. Bac Can	67	78	90	107
3. Bac Son	49	57	65	76
4. Bao Loc	45	52	59	69
5. Chiem Hoa	60	70	81	97
6. Con Cuong	42	47	54	63
7. Da Lat	47	53	60	70
8. Dac Nong	48	54	60	69
9. Ha Giang	58	68	79	94
10. Hoa Binh	55	65	74	88
11. Hoi Xuan	57	66	76	91
12. Huong Khe	58	67	77	91
13. Kon Tum	40	46	53	61
14. Lac Son	59	69	79	94
15. Luc Ngan	70	83	97	117
16. Luc Yen	65	76	88	104
17. M'D rac	70	81	93	109
18. Playku	61	70	79	93
19. Phu Ho	60	69	79	92
20. Sinh Ho	64	75	87	104
21. Tua Chua	41	47	53	62
22. Than Uyen	62	73	85	102
23. That Khe	60	73	87	107
24. Tuyen hoa	62	72	83	98
25. Tuong Duong	52	61	71	86
26. Yen Bai	58	68	77	91

Table F2: Wind pressure at meteorological stations on islands. Applied to 6.4.3

Stations	Wind pressure at repetitive periods, daN/m^2			
	5 years	10 years	20 years	50 years
1. Bach Long Vi	147	173	201	241
2. Co To	130	153	177	213
3. Con Co	95	114	135	165
4. Con Son	81	94	108	128
5. Hon Dau	131	154	178	214
6. Hon Ngu	94	110	128	153
7. Hoang Sa	86	102	120	145
8. Phu Quoc	103	123	145	175
9. Phu Quy	83	97	110	130
10. Truong Sa	103	119	136	160

APPENDIX G

METHOD OF DETERMINING THE REFERENCE LEVEL FOR BUILDING AND STRUCTURE HEIGHT

In determining the height factor k from Table 5, if the ground around the building and structure is not flat, then the reference level is taken as following :

G.1. When the ground slope is small $i \leq 0.3$, the height z is calculated from the ground level of the building or structure to the considered point.

G.2. When the ground slope is $0.3 < i < 2$, the height z is calculated from the conventional level which is lower the ground level of the building or structure to the considered point.

The conventional level Z_o is determined according to Fig. G1.

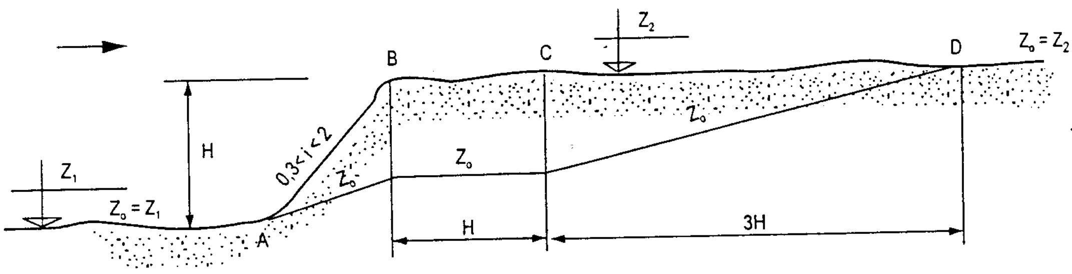


Fig. G1

On the left of A : $Z_0 = Z_1$

On the part BC : $Z_0 = H(2-i)/1.7$

On the right of D : $Z_0 = Z_2$

On the parts AB and CD : Z_0 is determined by linear interpolation

G.3. When the ground slope is $i \geq 2$, the conventional level Z_0 which is lower the ground level is determined after Fig. G2

On the left of C : $Z_0 = Z_1$

On the right of D : $Z_0 = Z_2$

On the part CD : Z_0 is determined by linear interpolation

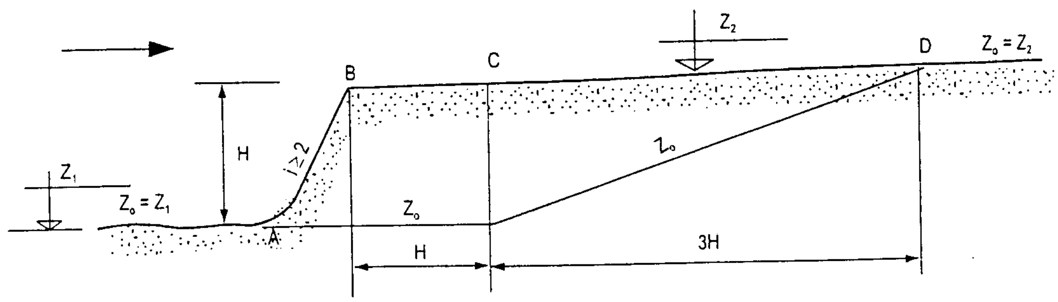


Fig. G2