NATIONAL STANDARD
OF THE PEOPLE'S REPUBLIC OF CHINA
中华人民共和国国家标准

Load Code for the Design of Building Structures

建筑结构荷载规范

GB 50009—2001
(英 文 版)

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Notice of Promulgation for the National Standard "Load Code for the Design of Building Structures"

Document JB [2002] No.10

According to the requirements of "Notice of Printing and Distributing for the '1997 Preparation and Revision Plan of Engineering Construction Standards' (Document JB [1997] No.108)-Ministry of Construction", that the "Load Code for the Design of Building Structures" has been revised by Ministry of Construction together with the relevant departments, after a joint examination of relevant departments, hence the new code has been approved as a national standard with a serial number of GB50009—2001, and it shall come into force upon March 1, 2002. Herein, clauses 1.0.5, 3.1.2, 3.2.3, 3.2.5, 4.1.1, 4.1.2, 4.3.1 , 4.5.1, 4.5.2, 6.1.1, 6.1.2, 7.1.1 and 7.1.2 are mandatory clauses, which must be enforced strictly. The original "Load Code for the Design of Building Structures" GBJ 9—87 shall be abolished after December 31, 2002.

The Ministry of Construction is in charge of management and explanation of the mandatory clauses in the code, the China Academy of Building Research will be responsible for the explanation of specific technical contents and the Research Institute of Standards and Norms – Ministry of Construction will organize the China Architecture & Building Press to take on publishing and distributing works of this code.

Ministry of Construction of the People's Republic of China

January 10, 2002

Preface

According to the requirements of Document JB[1997] No.108-Ministry of Construction, "Notice of Printing and Distributing for the '1997 Preparation and Revision Plan of Engineering Construction Standards'" that the "Load Code for the Design of Building Structures" GBJ 9—87, which was approved by 1987 the State Capital Construction Commission of the People's Republic of China, has been revised by the China Academy of Building Research together with the relevant units.

In the period of revision, the code revision group carried out various studies on specific topics, summarized the recent domestic design experience and referred to the concerned contents of abroad codes and international standards, meanwhile, the various ways were used by the code revision group to solicit widespread comments from nation-wide relevant units, the code was born out through repeated revisions and finally, the new version of code was decided after examination.

The code includes 7 chapters and 7 appendices, the main revised contents in present code are as follows:

1. Based on the revised combination rule in the revised edition of "Unified Standard for Reliability Design of Building Structures", and cast away the old ideas for "combination of wind load"; the combinations, which are controlled by the permanent load effects, have been added into the fundamental combinations of loads; in the serviceability limit states design, two types of combinations including the characteristic combination and the frequent combination are given in the combinations of short term effects, in the mean time, the coefficients for frequent values for variable loads are increased; the respective coefficients of combinations values are given in the all combination values of variable loads.
2. Partial adjusted and supplemented to live loads on floors.
3. For uniform live loads on roofs, the live load on unmanned roof is adjusted and the stipulations for the loads of roof garden, helicopter parking apron are added.
4. The character of service for crane is changed to the working grade of crane.
5. Wind pressure and snow pressure have been considered anew respectively by their statistical data, according to the new observation records from nation-wide meteorological observatory, meanwhile, the mean recurrence interval for the reference values of wind load, snow load have been changed from a 30-year mean recurrence interval to a 50-year mean recurrence interval; the values of snow pressure and wind pressure from the main meteorological stations throughout the country, during a 10-year, a 50-year and a 100-year mean recurrence intervals respectively are given in the appendix of the code.
6. A category of terrain roughness is added.
7. The adjustment coefficients considering the topographic conditions have been given to the exposure factors of wind pressure for the buildings in mountain area.
8. A special stipulation for the wind load on the fencing structure is given.
9. The consideration for the influences of interference with each other between buildings in a ar-

chitectural complex has been put forward.

10. The requirement for checking calculation of crosswind direction wind excitation is added for the flexible structures.

The present code may be in need of local revised in the future, that the concerned information and contents of local revised clauses will be published on the magazine of "*Engineering Construction Standardization*".

Clauses marked with boldface letters in the code are mandatory clauses and must be enforced strictly.

In order to enhance the quality of code, all relevant units are kindly requested to sum up and accumulate their experiences in actual practices during the process for implementing this code, that the relevant opinions and advices, which may be available for reference to next revision, can be posted to the China Academy of Building Research (Postcode: 100013; No.30, Bei San Huan Dong Lu, Beijing, China).

Chief Editorial Unit: China Academy of Building Research

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Reviser (English edition of code):

Chen Dingwai Professor, China Academy of Building Research, Oct.,2004, Beijing, China

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1 General Principles

1.0.1 The code was drawn up to suit the needs for design of building structures, and to conform with the requirements for the safety, serviceability and the economy, rationality of building structures.

1.0.2 The code is applicable to the structural design of building engineering.

1.0.3 The code was drawn up in accordance with the principles stipulated in the "Unified Standard for Reliability Design of Building Structures" (GB 50068—2001).

1.0.4 Actions, which are dealt with the design of building structures, include direct actions (loads) and indirect actions (such as the actions may be caused by deformation of subsoil, shrinkage of concrete, distortion due to welding, variation of temperature, earthquake and etc.). Only the stipulations of concerned loads were dealt with the code.

1.0.5 A 50-year design reference period was adopted by the code.

1.0.6 Actions or loads, which are dealt with the design of building structures, besides they shall be implemented in accordance with the code, the stipulations of other current national standards shall still be conformed.

2 Terms and Symbols

2.1 Terms

2.1.1 Permanent load

In the service period of structure, the value of load is not varied with the time, or the variation of load, which is compared with the mean value, can be neglected, or the variation of load is in one sense and can attain some limiting value.

2.1.2 Variable load

In the service period of structure, the value of load is varied with time, or the variation of load, which is compared with the mean value, can not be neglected.

2.1.3 Accidental load

In the service period of structure, the load is not occured definitely, once it is occured, that the load is with a significant value and its continuous time is very short.

2.1.4 Representative values of a load

Measuring values of a load are adopted for the checking calculations of the limit states in design, such as, the characteristic value, the combination value, the frequent value and the quasi- permanent value.

2.1.5 Design reference period

The time parameter is selected for determing the representative values of the variable load.

2.1.6 Characteristic value

The fundamental representative value of a load, which denotes the characteristic value for the statistical distribution of the maximum load in the design reference period (such as, mean-value, mode, mid-value or certain fractile) .

2.1.7 Combination value

For the values of variable loads after combination, that their transcendental probability for the load effects in the design reference period can be tended toward indentical with the corresponding probability for the load effect of the appearance of single load alone; or the values of variable loads after combination, that the structure should has the unified stipulated reliability index.

2.1.8 Frequent value

For the value of variable load in the design reference period, that the transcendental total time is in small ratio of stipulated time, or the transcendental frequency is the stipulated frequency.

2.1.9 Quasi-permanent value

For the value of variable load in the design reference period, that the transcendental total time is about one-half of the design reference period.

2.1.10 Design value of a load

The design value of a load is the product of representative value of load and partial safety coefficient of load.

2.1.11 Load effect

The response of structure or structural member, such as internal force, deformation, crack and etc., is caused by load.

2.1.12 Combination of loads

When in the limit states design, the stipulations are used for the simultaneous occurrence of the design values of different loads to guarantee the reliability of structures.

2.1.13 Fundamental combination

When in the calculation of ultimate limit states, the combination of permanent loads and variable loads belongs to the fundamental combination.

2.1.14 Accidental combination

When in the calculation of ultimate limit states, the combination of permanent loads, variable loads and an accidental load belongs to accidental combination.

2.1.15 Characteristic combination

When in the calcutation of serviceability limit states, the characteristic values or the combination values are adopted as the representative values of loads for combination.

2.1.16 Frequent combination

When in the calculation of serviceability limit states, for the variable loads that their frequent values or quasi-permanent values are adopted as the representative values of loads for combination.

2.1.17 Quasi-permanent combination

When in the calculation of serviceability limit states, for the variable loads that their quasi-permanent values are adopted as the representative values for combination.

2.1.18 Equivalent uniform load

When in the design of structures, the actual loads are not distributed in succession, that they are commonly substituted by the uniform load; the equivalent uniform load denotes its load effects, which is sustained by structure, can keep identical with the actual load effects.

2.1.19 Tributary area

Tributary area is adopted for the calculation of beam, column members, it denotes the loading area for the flooring, which shall be divided by the zero line of shearing force in floor slab, it can be simplified appropriately in the actual application.

2.1.20 Dynamic coefficient

The coefficient is adopted for the structure or the structural member sustaining dynamic load, which is designed according to the static design, the value of coefficient is the ratio of the maximum dynamic force effects and the corresponding static force effects of the structure or the structural member.

2.1.21 Reference snow pressure

The reference pressure of snow load, its maximum value with a 50-year mean recurrence interval, can be commonly determined according to the observational data of the self-weight of snow cover on the open, plane terrain in locality through the probability statistics.

2.1.22 Reference wind pressure

The reference pressure of wind load, its maximum value of wind velocity with a 50-year mean recurrence interval, can be commonly determined according to the observational data of the 10 min mean wind velocity at the 10m height from the open, plane terrain in locality, through the probability statistics, meanwhile, considering the relative air density, hence, the reference wind pressure can be determined according to the equation (D.2.2-4).

2.1.23 Terrain roughness

The description of the grade for distribution conditions of the irregular obstacles on the terrain within the scope of 2km, where the wind blowed over before reaching the structural objects.

2.2 Symbols

G_k——characteristic value of permanent load;

Q_k——characteristic value of variable load;

S_{Gk}——characteristic value of permanent load effects;

S_{Qk}——characteristic value of variable load effects;

S——design value for combination of load effects;

R——design value for resistance of structural member;

S_A——along wind direction wind load effects;

S_C——cross wind direction wind load effects;

T——natural period of vibration for structure;

H——top height of structure;

B——width of windward side for structure;

Re——Reynolds number;

St——Strouhal number;

s_k——characteristic value of snow load;

s_0——reference snow pressure;

w_k——characteristic value of wind load;

w_0——reference wind pressure;

v_{cr}——critical wind velocity for cross wind direction resonance;

α——gradient angle;

β_z——dynamic wind effect factor at z height;

β_{gz}——gust factor;

γ_0——importance factor of structure;

γ_G——partial safety factor for permanent load;

γ_Q——partial safety factor for variable load;

ψ_c——combination value coefficient of variable loads;

ψ_f——frequent value coefficient of variable load;

ψ_q——quasi-permanent value coefficient of variable load;

μ_r——roofing snow cover distribution factor;

μ_z——exposure factor for wind pressure;

μ_s——shape factor for wind load;

η——terrain, geomorphic adjustment coefficient of wind load;

ξ——maginification factor for wind fluctuation;

ν——wind fluctuation factor;

φ_z——vibration mode factor of structure;

ζ——damp ratio of structure.

3 Classification of Loads and Combination of Load Effects

3.1 Classification of Loads and Representative Values of Loads

3.1.1 Loads on structures can be classified into the following three types:

1 Permanent loads, such as, self-weight of structure, earth pressure and prestressing force etc.

2 Variable loads, such as, live load on floors, live load on roofs, ash load, crane load, wind load, snow load etc.

3 Accidental loads, such as explosive force, collision force and etc.

Note: self-weight denotes the load produced by the weight of the material itself (gravity force).

3.1.2 Different representative values shall be adopted for different loads in the design of building structures.

The characteristic value shall be adopted as the representative value of permanent load.

The characteristic value, combination value, frequent value or quasi-permanent value shall be adopted as the representative value of variable load in accordance with the requirements of design.

The representative value of accidental load shall be determined in accordance with the distinguish features of service for building structures.

3.1.3 The characteristic value of permanent load: For the self-weight of structures can be determined by calculations for the design dimensions of structural members and the unit weight of materials. For various materials and structural members which have considerable variances in self-weight (such as thermal insulation materials fabricated on the site, thin-walled concrete members and etc.), the upper or lower characteristic value of self-weight shall be taken according to unfavorable situations for the structures.

Note: The unit weight for commonly used materials and structural members can be referred to the Appendix A of the Code.

3.1.4 The characteristic value of variable load shall be adopted in accordance with the stipulations in the relevant chapter of the Code.

3.1.5 When in the ultimate limit states design or in the serviceability limit states design according to the characteristic combination, that, the characteristic value or the combination value shall be adopted as the representative value of the variable load, in accordance with the stipulations of combination.

The combination value of variable loads shall be the characteristic values of variable loads multiplied by the coefficients for combination value of loads.

3.1.6 When in the serviceability limit states design according to the frequent combination, that, the frequent value, the quasi-permanent value shall be adopted as the representative value of the variable load; for the design according to the quasi-permanent combination, that, the quasi-permanent value

shall be adopted as the representative value of the variable load.

The frequent value of the variable load shall be the characteristic value of variable load multiplied by the coefficient for frequent value of load.

The quasi-permanent value of the variable load shall be the characteristic value of variable load multiplied by the coefficient for quasi-permanent value of load.

3.2 Combination of Loads

3.2.1 When design of building structures, the loads, which are possible occurrence simultaneously on structures during the service process of structures, shall be based on, hence, the combination of loads (effects) for the ultimate limit states and for the serviceability limit states shall be carried out respectively, and the most unfavourable combination of effects shall be taken in the each design.

3.2.2 For the ultimate limit states, the combination of loads (effects) shall be carried out in accordance with the fundamental combination or the accidental combination of loads effects, and the following design expression shall be adopted in the design.

$$\gamma_0 S \leqslant R \tag{3.2.2}$$

Where γ_0——importance factor of structures;

S——design value of combination of loads effects;

R——design value of the resistance of structural members, determined in accordance with the stipulations in relevant codes for the design of building structures.

3.2.3 For the fundamental combination, the design value S of the combination of loads effects shall be determined by the most unfavourable value taking from the following combination values:

1) The combination is controlled by the variable load effects:

$$S = \gamma_G S_{Gk} + \gamma_{Q1} S_{Q1k} + \sum_{i=2}^{n} \gamma_{Qi} \psi_{ci} S_{Qik} \tag{3.2.3-1}$$

Where γ_G——partial safety factor of permanent load, shall be adopted in accordance with the Clause 3.2.5;

γ_{Qi}——partial safety factor for the variable load of number i, herein, the γ_{Q1}, which shall be adopted in accordance with the Clause 3.2.5, is the partial safety factor of variable load Q_1;

S_{Gk}——the load effects value is calculated in accordance with the characteristic value of permanent load G_k;

S_{Qik}——load effects values are calculated in accordance with the characteristic values of variable load Q_{ik}, herein, the S_{Q1k} denotes the controlling one among all variable load effects;

ψ_{ci}——coefficients of combination values of the variable loads Q_i shall be adopted in accordance with the stipulations of the Clauses in the Chapters of the Code respectively;

n——number of the variable loads participated in the combinations.

2) **The combination is controlled by the permanent load effects:**

$$S = \gamma_G S_{Gk} + \sum_{i=1}^{n} \gamma_{Qi} \psi_{ci} S_{Qik} \quad (3.2.3\text{-}2)$$

Note: 1 The design values in the fundamental combination are suitable only for loads and load effects in the linear condition.

2 When the S_{Q1k} can not be clearly judged, taking each variable load effect as S_{Q1k} in turn, then the most unfavourable combination of load effect can be selected.

3 When the vertical permanent load effect is considered as the controlling combination, hence, only the vertical variable load is limited to participate in the combination.

3.2.4 For ordinary bent and frame structures, the simplified rule may be adopted for the fundamental combination, and it shall be determined in accordance with the following combination values, taking the most unfavourable value:

1) The combination is controlled by the variable load effects:

$$S = \gamma_G S_{Gk} + \gamma_{Q1} S_{Q1k}$$

$$S = \gamma_G S_{Gk} + 0.9 \sum_{i=1}^{n} \gamma_{Qi} S_{Qik} \quad (3.2.4)$$

2) The combination is controlled by the permanent load effects, it is still adopted in accordance with formula (3.2.3-2).

3.2.5 Partial safety factors for fundamental combination shall be adopted as follows:

1 partial safety factor for permanent load:

1) When the effect of permanent load is unfavourable to structures

—for the combination is controlled by the variable load effects, that the 1.2 shall be taken;

—for the combination is controlled by the permanent load effects, that the 1.35 shall be taken;

2) When the effect of permanent load is favourable to structures

—under ordinary condition that the 1.0 shall be taken;

—for the checking calculation for the overturning, sliding or floating of structure, that the 0.9 shall be taken.

2 partial safety factor for variable load:

—under ordinary condition that the 1.4 shall be taken;

—the characteristic value of variable load is greater than 4 kN/m^2 for floor structure of industrial building, that the 1.3 shall be taken.

Note: For the special conditions, it can be determined in accordance with the stipulations for the relevant design codes of building structures.

3.2.6 The design values for accidental combination, combination of load effects, may be determined according to the following stipulations: The representative value of accidental load is not multiplied by the partial safety factor; the proper representative values for other loads, which may occur simultaneously with the accidental load, may be adopted according to observation materials and engineering experiences. Formulas calculating the design value of load effects under different cases can be stipulated separately by the relevant codes.

3.2.7 For the serviceability limit states, the characteristic combination, the frequent combination or the quasi-permanent combination of loads shall be adopted in accordance with the different requirements of design, and the design shall be carried on according to the design expressions as follows:

$$S \leqslant C \quad (3.2.7)$$

Where C——The stipulated limiting values, which denote the structures or the structural members reaching the requirements of normal service, such as the limiting values of deformation, crack, amplitude of vibration, acceleration, stress and etc., shall be adopted according to the stipulations in the different relevant design codes of building structures.

3.2.8 The design values S for the characteristic combination, the combination of load effects shall be adopted in accordance with the following formula:

$$S = S_{Gk} + S_{Q1k} + \sum_{i=2}^{n} \psi_{ci} S_{Qik} \quad (3.2.8)$$

Note: The design values in the combination are suitable for the loads and load effects in the linear condition.

3.2.9 The design values S for the frequent combination, the combination of load effects shall be adopted in accordance with the following formula:

$$S = S_{Gk} + \psi_{f1} S_{Q1k} + \sum_{i=2}^{n} \psi_{qi} S_{Qik} \quad (3.2.9)$$

Where ψ_{f1}——coefficient for frequent value of variable load Q_1, shall be adopted according to the stipulations in the different Chapters of the Code;

ψ_{qi}——coefficient for quasi-permanent value of variable load Q_i, shall be adopted according to the stipulations in the different Chapters of the Code.

Note: The design values in the combination are suitable for the loads and load effects in the linear condition.

3.2.10 The design values S for the quasi-permanent combination, the combination of load effects shall be adopted in accordance with the following formula:

$$S = S_{Gk} + \sum_{i=1}^{n} \psi_{qi} S_{Qik} \quad (3.2.10)$$

Note: The design values in the combination are suitable for the loads and load effects in the linear condition.

4 Live Loads on Floors and Roofs

4.1 Uniform Live Loads on Floors in Civil Buildings

4.1.1 The characteristic value and the coefficients for combination value, frequent value and quasi-permanent value of uniform live loads on floors in civil buildings shall be taken according to the stipulations in the Table 4.1.1.

Table 4.1.1 The Characteristic Value and the Coefficients for Combination Value, Frequent Value and Quasi-Permanent Value of Uniform Live Loads on Floors in Civil Buildings

Item No.	Type	Characteristic value (kN/m²)	Coefficient for combination value ψ_c	Coefficient for frequent value ψ_f	Coefficient for quasi-permanent value ψ_q
1	(1) Dwelling, hostel, hotel, office, hospital ward, nursery, kindergarten (2) Classroom, laboratory, reading room, meeting room, hospital outpatient room	2.0	0.7	0.5 0.6	0.4 0.5
2	Canteen, dining-hall, ordinary archives	2.5	0.7	0.6	0.5
3	(1) Assembly hall, theater, cinema, grand-stands with fixed seats (2) Laundry	3.0 3.0	0.7 0.7	0.5 0.6	0.3 0.5
4	(1) Stores and shops, exhibition hall, station, port, airport hall and waiting room for passengers (2) Stands without fixed seat	3.5 3.5	0.7 0.7	0.6 0.5	0.5 0.3
5	(1) Gymnasium, arena (2) Dance hall	4.0 4.0	0.7 0.7	0.6 0.6	0.5 0.3
6	(1) Storehouse for collecting books, archieves, storeroom (2) Densely bookcase storehouse	5.0 12.0	0.9	0.9	0.8
7	Ventilator motor room, elevator motor room	7.0	0.9	0.9	0.8

(Continued)

Item No.	Type	Characteristic value (kN/m²)	Coefficient for combination value ψ_c	Coefficient for frequent value ψ_f	Coefficient for quasi-permanent value ψ_q
8	Automobile passage and garage: (1) with one-way slab floor, (span of slab is not less than 2m) passenger car fire truck (2) with two-way slab and flat slab floor, (column net work size is not less than 6m × 6m) passenger car fire truck	 4.0 35.0 2.5 20.0	 0.7 0.7 0.7 0.7	 0.7 0.7 0.7 0.7	 0.6 0.6 0.6 0.6
9	Kitchen (1) ordinary (2) for dining hall	2.0 4.0	0.7 0.7	0.6 0.7	0.5 0.7
10	Bathroom, toilet and washroom: (1) for civil buildings in Item No.1 (2) for other civil buildings	2.0 2.5	0.7 0.7	0.5 0.6	0.4 0.5
11	Passage, entrance hall, staircase: (1) Hostel, hotel, nursery, hospital ward, kindergartens, dwelling-house (2) Office, classroom, dining hall, hospital outpatient department (3) Fire dispersed staircase, other civil buildings	2.0 2.5 3.5	0.7 0.7 0.7	0.5 0.6 0.5	0.4 0.5 0.3
12	Balcony: (1) ordinary (2) when population may be concentrated	2.5 3.5	0.7	0.6	0.5

Note: 1 Live loads listed in this table are suitable for the ordinary usable conditions. When the service load is greater or the condition may be in an exceptional case, the values of actual loads shall be adopted.

2 In the item No.6, the live load of storehouse for collecting books, when the height of bookshelf is greater than 2m, the live load of storehouse for collecting books shall be determined according to the weight of per meter height of bookshelf not less than 2.5kN/m².

3 In the item No.8, the live load of passenger car is suitable to the passenger car, which is parked to carry less than 9 passengers only; the live load of fire truck is suitable to the total weight of full loaded with 300kN large-scale vehicle; when the demands of this table are not conformed, hence, the local load of truck wheel shall be converted into the equivalent uniform load according to the equivalent principles of structural effects.

4 In the item No.11, the live load of staircase, where the precast trade of staircase shall still be checking calculated by the 1.5 kN concentrated load.

5 The self-weight of partition wall and the second decorating load are not included in the loads listed in this table. For the self-weight of fixed partition wall shall be considered as dead load, when the positions of partition wall have a free and flexible arrangements, the self-weight of non-fixed partition wall shall take the weight for 1/3 per meter length of wall, which is counted as the additional value (kN/m³) of the live load on floors, the additional value is not less than 1.0 kN/m².

4.1.2 For design of floor beams, walls, columns and foundations, the characteristic values of the live load on floors listed in the Table 4.1.1 shall be multiplied by the following specified reduction coefficients.

1 Reduction coefficients for design of floor beams:

1) Item No.1 (1), when the tributary area of floor beams is larger than $25m^2$, the 0.9 shall be taken;

2) Item No.1(2) ~ 7, when the tributary area of floor beams is larger than $50m^2$, the 0.9 shall be taken;

3) Item No.8, for secondary beams of one-way slab floors and longitudinal ribs of channel slabs, the 0.8 shall be taken; for main beams of one-way slab floors, the 0.6 shall be taken; for beams of two-way slab floors, the 0.8 shall be taken;

4) Item No. 9 ~ 12 the reduction coefficients, which belong in same kind of buildings, shall be adopted.

2 Reduction coefficients for the design of walls, columns and foundations:

1) Item No.1 (1), the stipulations in the Table 4.1.2 shall be adopted;

2) Item No, 1 (2) ~ 7, the reduction coefficients, which belong in same as floor beams, shall be adopted;

3) Item No.8, for one-way slab floors, that the 0.5 shall be taken; for two-way slab floors and flat slab floors, the 0.8 shall be taken;

4) Item No.9 ~ 12 , the reduction coefficients, which belong in same kind of buildings, shall be adopted.

Note: The tributary area for floor beams denotes the actual area, which shall be determined in accordance with the range of the both sides of beam extending to one-half of spacing respectively along the adjacent beams.

Table 4.1.2 Reduction Coefficient of Live Load According to the Number of Storeys in a Building

The number of storeys above the calculated section of walls, columns and foundations	1	2 ~ 3	4 ~ 5	6 ~ 8	9 ~ 20	> 20
Reduction coefficients of the total live loads on each floor above the calculated section	1.00 (0.90)	0.85	0.70	0.65	0.6	0.55

Note: The value in brackets is adopted when the tributary area of the beam is larger then $25m^2$.

4.1.3 The local load on the floor structure can be converted to the equivalent uniform live load according to the stipulations in Appendix B of the Code.

4.2 Live Loads on Floors in Industrial Buildings

4.2.1 During the manufacturing, installation and maintenance periods, the local loads on floors in industrial buildings caused by equipment, pipes, conveyances and removable partitions shall be adopted in consideration of actual conditions, and can be replaced by equivalent uniform loads.

Note: 1 The equivalent uniform live loads on floors, including the live loads on floors for the calculation of secondary beam, main beam and foundation, can be determined according to the stipulations in Appendix B of the Code.

2 Values listed in Appendix C of the Code can be adopted when there are in lack of data for ordinary workshops for metals processing, instrument and meter manufacturing, semiconductor production, cotton spinning and weaving, food and grain processing and tire productions.

4.2.2 For operating loads on floors (including working platforms) in equipment free zones of industrial buildings, including the self-weight of operators, common tools, fragmentary materials and products, they all can be considered as a uniform live load of 2.0 kN/m^2.

Live loads on staircases in workshops can be adopted according to actual conditions, but cannot be less than 3.5 kN/m^2.

4.2.3 The coefficients for combination values, the coefficients for frequent values and the coefficients for quasi-permanent values of the live loads on floors in industrial buildings, besides they are given in the Appendix C of the Code, shall be adopted in accordance with the actual conditions, but in any cases, the coefficients for combination values and for frequent values shall not be less than 0.7, the coefficients for quasi-permanent values shall not be less than 0.6.

4.3 Live Loads on Roofs

4.3.1 Uniform live loads for horizontal projection of roofs on buildings shall be adopted according to the Table 4.3.1

Uniform live loads on roofs shall not be combined simultaneously with snow loads.

Table 4.3.1 Uniform Live Loads on Roofs

Item No.	Type	Characteristic value (kN/m^2)	Coefficient for combination value ψ_c	Coefficient for frequent value ψ_f	Coefficient for quasi-permanent value ψ_q
1	Unmanned roof	0.5	0.7	0.5	0
2	Manned roof	2.0	0.7	0.5	0.4
3	Roof garden	3.0	0.7	0.6	0.5

Note: 1 The unmanned roof, when the construction or maintenance loads are heavy, that the actual conditions shall be adopted; the stipulations of the relevant design codes shall be adopted for different structures, it is right to increase or decrease 0.2 kN/m^2 for characteristic values.

2 The manned roof, which takes account of other uses, its corresponding live load on floors shall be adopted.

3 The ponding load on the roof, which is caused due to the impeded drainage, drainage blocked up and etc., the detailing measures for precaution shall be taken; if necessary, its live load on roofing shall be determined by the possible depth of ponding.

4 The live load for roof garden is not including the self-weight of soil, stone, materials in the flower nursery and etc.

4.3.2 Helicopter park load on the roof, which is considered as the local load, shall be taken in accordance with the total weight of helicopter, meanwhile, its equivalent uniform load is not less than 5.0 kN/m^2.

The local load shall be determined by the actual maximum take-off weight of helicopter, when there is without the technical materials for the type of helicopter, generally, the different demands for the light, middle, heavy three types can be depended on to select the characteristic value and the acting area of local load according to the stipulations as follows:

—Light type, the maximum take-off weight is 2t, the characteristic value of local load is 20kN, the acting area is 0.20m × 0.20m;

—Middle type, the maximum take-off weight is 4t, the characteristic value of local load is 40kN, the acting area is 0.25 m × 0.25m;

—Heavy type, the maximum take-off weight is 6t, the characteristic value of local load is 60kN, the acting area is 0.30m × 0.30m.

Coefficient for combination value of loads, the 0.7 shall be taken, coefficient for frequent value, the 0.6 shall be taken, coefficient for quasi-permanent value, the 0 shall be taken.

4.4 Ash Load on Roofings

4.4.1 When in the design of industry plants and their adjacent buildings, of which a lot of ashes are ejected during the production process of plants, for the roofings of plants, such as mechanical plant, metallurgical plant, cement plant and etc., that are possessed of definite dedusting facilities and guaranteed clearing-off ash regulations, hence the ash load on the horizontal projection of their roofs shall be adopted respectively in accordance with the Table 4.4.1-1 and 4.4.1-2.

Table 4.4.1-1 Ash Load on Roofings

Item No.	Types	Characteristic value (kN/m^2)			Coefficient for combination value ψ_c	Coefficient for frequent value ψ_f	Coefficient for quasi-permanent value ψ_q
		Without wind shield	With wind shield				
			Inside the wind shield	Outside the wind shield			
1	Casting workshop for mechanical plant (cupola furnace)	0.5	0.75	0.30			
2	Steelmaking workshop (oxygen converter)	—	0.75	0.30	0.9	0.9	0.8
3	Manganese, chromium ferroalloy workshop	0.75	1.00	0.30			
4	Silicon, wolfram ferroalloy workshop	0.30	0.50	0.30			

(Continued)

Item No.	Types	Characteristic value (kN/m^2)			Coefficient for combination value ψ_c	Coefficient for frequent value ψ_f	Coefficient for quasi-permanent value ψ_q
		Without wind shield	With wind shield				
			Inside the wind shield	Outside the wind shield			
5	Sintering house and once-mixing house	0.50	1.00	0.20			
6	Passage corridor of sintering plant and other workshops	0.30	—	—			
7	Workshops with ash source in cement plant (kiln house, grinding house, combined store house, drying house, crushing house)	1.00	—	—	0.9	0.9	0.8
8	Workshops without ash source in cement plant (air compressor station, machine-repair workshop, materials store house, power distribution station)	0.50	—	—			

Note: 1 Uniform ash loads listed in the Table are applicable only for roofs with the slope $\alpha \leqslant 25°$; when $\alpha \geqslant 45°$, the ash load can be ignored; when $25° < \alpha < 45°$, the value can be obtained through interpolation.

2 The load for the facilities of clearing-off ash shall be considered separately.

3 Ash loads listed in Items No.1 to No.4 are applicable only for roofings within a radius of 20m from the center of a chimney. For the adjacent buildings within this range, the ash loads on roofs for types listed in Items No.1, No.3 and No.4 the values for without wind shield shall be adopted, in Items No.2, the values for outside the wind shield shall be adopted.

Table 4.4.1-2 Ash Loads on Roofings of Buildings Adjacent to Blast Furnace

Volume of blast furnace (m^3)	Characteristic value (kN/m^2)			Coefficient for combination value ψ_c	Coefficient for frequent value ψ_f	Coefficient for quasi-permanent value ψ_q
	Distance from roofing to furnace (m)					
	≤50	100	200			
< 255	0.50	—	—			
255 ~ 620	0.75	0.30	—	1.0	1.0	1.0
> 620	1.00	0.50	0.30			

Note: 1 Notes 1 and 2 in the Table 4.4.1-1 are also applicable to this table.

2 When the distance from the roofing to the furnace is between the values listed in the table, the value can be obtained through interpolation.

4.4.2 When designing the roof slabs, purlins, which are sited at the ash stacking place on the roofings, the characteristic value of ash load can be multiplied by increasing coefficients stipulated as follows:

When the height difference of multilevel roofs is twice the height difference of the roofs, but is not greater than 6m within the distribution width, the increasing coefficient 2.0 will be taken.

When at gutters on roofs are not greater than 3m within the distribution width, the increasing coefficient 1.4 will be taken.

4.4.3 Ash load shall be considered simultaneously with the larger one of the snow load or the live load of unmanned roof.

4.5 Construction and Maintenance Loads, and Horizontal Load on Railings

4.5.1 When designing the roof slabs, purlins, reinforced concrete eaves, canopies and precast beams, that the concentrated load 1.0 kN (self-weights of workers and small tools) of construction or maintenance shall be taken and the checking calculation shall be carried out at the most unfavourable locations.

Note: 1 When construction loads for the light or the widened structural members may exceed the above mentioned load, the checking calculation shall be carried out according to the actual conditions, or the temporary facilities, such as bearing plates, supports and etc., shall be adopted to sustain the loads.

2 When calculating the load-bearing capacity of eaves and canopies, a concentrated load shall be taken at interval of 1.0m along the plate width; when checking calculation for the overturning of eaves, canopies, a concentrated load shall be taken at interval of 2.5 ~ 3.0m along the plate width.

4.5.2 The horizontal load on the top of railings for staircase, stands, balconies, manned roofs, and etc., shall be adopted according to the stipulations as follows:

1 For dwelling houses, hostels, office buildings, hotels, hospitals, nurseries and kingdergartens, 0.5 kN/m² shall be taken.

2 For schools, canteens, theaters, cinemas, stations, halls, exhibition buildings and stadiums, 1.0kN/m² shall be taken.

4.5.3 When the combination for quasi-permanent loads is adopted, that the construction load, the maintenance load and the horizontal loads on railing can be neglected.

4.6 Dynamic Coefficient

4.6.1 The dynamic calculation for the design of building structures, when the ample evidence can be obtained, that the static calculation, which is expressed the self-weight of heavy articles or equipment multiplied by the dynamic coefficients, can be used instead.

4.6.2 The values of 1.1 ~ 1.3 can be adopted as the dynamic coefficients for transporting, loading or unloading heavy goods, as well as starting or stopping vehicles; their dynamic load is transmitting to the floors and beams only.

4.6.3 The helicopter load on the roof shall also be multiplied by the dynamic coefficients, the value of 1.4 can be taken for the helicopter with hydraulic pressure type landing gear; its dynamic load is transmitting to the floors and beams only.

5 Crane Load

5.1 Vertical and Horizontal Crane Loads

5.1.1 The characteristic value of vertical crane load, that the maximum or minimum wheel pressure of the crane shall be adopted.

5.1.2 Longitudinal and transverse horizontal crane load shall be adopted according to the following stipulations:

1 The characteristic value of the longitudinal horizontal crane load shall be adopted as 10% of the sum of maximum wheel pressure for all braking wheels acted on the one side of rail; the acting point of the load is situated at the contact point between the braking wheel and the rail, and its direction coincides with the direction of the rail.

2 The characteristic value of the transverse horizontal crane load that the following percentages for the sum of the weight of the transversely moving crab and the rated lifting weight shall be taken, and they are multiplied by the acceleration of gravity:

1) For flexible lifting hook crane,

—when the rated lifting weight is not greater than 10t, that the 12% shall be taken;

—when the rated lifting weight is 16 ~ 50t, that the 10% shall be taken;

—when the rated lifting weight is not less than 75t, that the 8% shall be taken.

2) For hard lifting hook crane, that the 20% shall be taken.

The transverse horizontal crane load shall be equally distributed at either end of the crane bridging support and shall be well transmitted on average with the direction perpendicular to the rail by wheels moving along the rail, meantime, the braking conditions for the forward and backward braking directions shall be considered.

Note: 1 The horizontal load for suspended crane shall be sustained by relevant bracing systems, hence, it can not be calculated.

2 The horizontal load for manual crane and electric hoist may be neglected.

5.2 Combination of Multi-crane

5.2.1 Considering the vertical loads for multi-crane in the calculation of bent structure, for every bent in single-span plant with one storey crane, the number of cranes, which participate in combination, may not be more than 2 cranes; for every bent in multi-span plant with one storey crane, the number of cranes may not be more than 4 cranes.

Considering the horizontal loads for multi-crane, for every bent in single-span or in multi-span plant, the number of cranes, which participate in combination, shall not be more than 2 cranes.

Note: When in the special case, the actual conditions shall be considered.

5.2.2 When calculating the bent, the characteristic values of the vertical and horizontal loads for multi-crane shall be multiplied by the reduction coefficients stipulated in Table the 5.2.2.

Table.5.2.2 Reduction Coefficients of Multi-Crane Loads

Number of cranes participating in combination	Working grades of cranes	
	A1 ~ A5	A6 ~ A8
2	0.90	0.95
3	0.85	0.90
4	0.80	0.85

Note: When calculating the bent for single-span or multi-span plant with multi-storey cranes, the number of cranes in combination and the reduction coefficients for loads shall be considered in accordance with actual conditions.

5.3 Dynamic Coefficients of Crane Loads

5.3.1 When calculating the strength of crane beams and their connections, the vertical crane load shall be multiplied by the dynamic coefficient. For suspended cranes (including electric hoist), as well as the working grades A1 ~ A5 flexible lifting hooks cranes, the dynamic coefficient 1.05 can be taken; for the working grades A6 ~ A8 flexible lifting hook cranes, hard lifting hook cranes and other special cranes, the dynamic coefficient 1.1 can be taken.

5.4 Combination Value, Frequent Value and Quasi-permanent Value of Crane Load

5.4.1 The coefficients for combination value, frequent value and quasi-permanent value of crane load can be adopted according to the stipulations in the Table 5.4.1.

Table 5.4.1 Coefficients for Combination Value, Frequent Value and Quasi-permanent Value of Crane Load

Working grades of cranes	Coefficient for combination value ψ_c	Coefficient for frequent value ψ_f	Coefficient for quasi-permanent value ψ_q
Flexible lifting hook cranes			
Working grades A1 ~ A3	0.7	0.6	0.5
Working grades A4、A5	0.7	0.7	0.6
Working grades A6、A7	0.7	0.7	0.7
Hard lifting hook cranes and flexible lifting hook cranes of working grade A8	0.95	0.95	0.95

5.4.2 When designing the bent in plant, the crane load is not considered in the combination of quasi-permanent value for load, but in the serviceability limit states design of crane beam, that the quasi-permanent value for crane load can be adopted.

6 Snow Load

6.1 Characteristic Value of Snow Load and Reference Snow Pressure

6.1.1 The characteristic value of snow load on the horizontal projecting roofing plane shall be calculated in accordance with the following equation:

$$s_k = \mu_r s_0 \quad (6.1.1)$$

Where s_k——characteristic value of snow load (kN/m^2);

μ_r——roofing snow cover distribution factor;

s_0——reference snow pressure (kN/m^2).

6.1.2 A 50-year mean recurrence interval snow pressures, which are given on the attached Table D.4 in the Appendix D.4 of the code, shall be adopted as the reference snow pressure.

When the structures are sensitive to the snow load, hence, the reference snow pressure shall be raised appropriately, and shall be stipulated in the relevant design codes.

6.1.3 When the values for reference snow pressures of a city or a construction site is not given in the Appendix D of the code, the value of reference snow pressure can be determined on the basis of the data of annual maximum snow pressure or snow depth in the locality, through the statistical analysis according to the definition of reference snow pressure, however, the influences for the amount of sample data shall be considered (see also Appendix D). When the data of snow pressure and snow depth are without in the locality, hence, they can be determined on the basis of the specified reference snow pressure or the data over a long period of time for the adjacent regions, through the contrast analysis with the meteological phenomena and topgraphy conditions; also, they can be determined approximately by the Nationwide Reference Snow Pressure Distribution Map in Appendix D (Attached Fig.D.5.1).

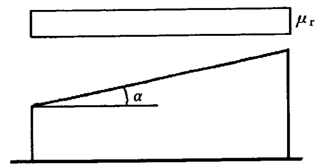
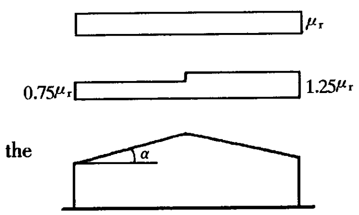
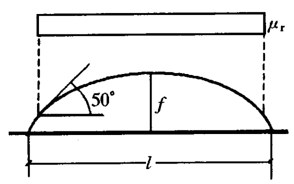
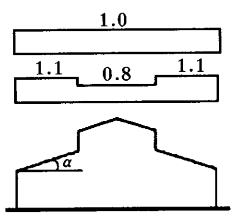
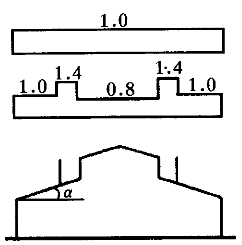
6.1.4 The snow load of mountainous regions shall be determined through the actual investigations. When they are without the measured data, that the values for snow load of adjacent open, smooth terrain along the locality multiplied the coefficient 1.2 can be adopted.

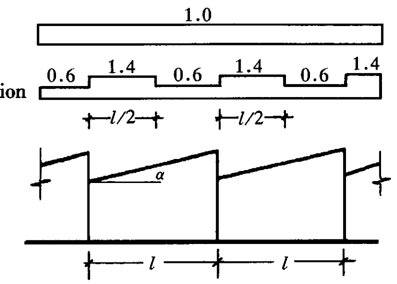
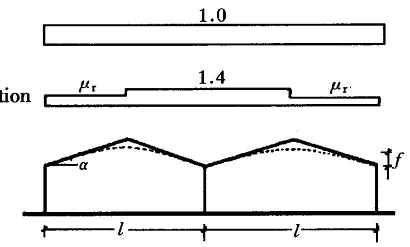
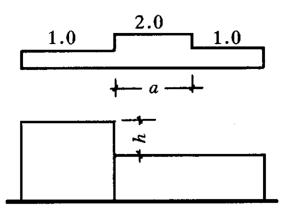
6.1.5 The coefficient for combination value of snow load that the 0.7 can be taken; the coefficient for frequent value of snow load that the 0.6 can be taken; the coefficient for quasi-permanent value of snow load that the 0.5, 0.2 and 0 can be taken respectively according to the difference for the zoning of snow loads zone Ⅰ, zone Ⅱ, zone Ⅲ; the values for snow loads are given in the Appendix D.4 or the specified values in the Attached Fig. D.5.2 shall be adopted for the zoning of snow loads.

6.2 Roofing Snow Cover Distribution Factor

6.2.1 The roofing snow cover distribution factor shall be adopted from Table 6.2.1 in accordance with the different categories for the shape of roofs.

Table 6.2.1 Roofing Snow Cover Distribution Factors

Item No.	Type	Shape of roofs and snow cover distribution factors μ_r
1	Single span monopitched roof	 α: ≤25°, 30°, 35°, 40°, 45°, ≥50° μ_r: 1.0, 0.8, 0.6, 0.4, 0.2, 0
2	Single span double pitched roof	Uniform distribution Non-uniform distribution  μ_r shall be adopted according to the stipulations in Item No.1
3	Arched roof	$\mu_r = \frac{l}{8f}$ $(0.4 \leqslant \mu_r \leqslant 1.0)$ 
4	Pitched roof with skylights	Uniform distribution Non-uniform distribution 
5	Pitched roof with skylights and wind shield	Uniform distribution Non-uniform distribution 

Item No.	Type	Shape of roofs and snow cover distribution factors μ_r
6	Multi-span monopitched roof (saw-tooth roof)	Uniform distribution Non-uniform distribution 
7	Double span double pitched or arched roof	Uniform distribution Non-uniform distribution  μ_r shall be adopted according to the stipulations in Items No.1 or No.3
8	High-low roof	 $a = 2h$, but not less than 4m, not more than 8m

Note: 1 Non-uniform distribution for single span double pitched roofs, as shown in Item No.2, may be considered only when the roof slope is $20° \leqslant \alpha \leqslant 30°$.

2 Values given in Items No.4 and No.5 are only applicable to ordinary industrial plants with a roof slope of $\alpha \leqslant 25°$.

3 Only uniform distribution may be considered for double span double pitched or arched roof, as shown in Item No.7, when $\alpha \leqslant 25°$ or $f/l \leqslant 0.1$.

4 The roofing snow cover distribution factor of multi-span roofs can refer to the stipulations in Item No.7.

6.2.2 When in the design of building structures and Load-bearing members on roofs, the distribution of snow cover should be adopted in accordance with the stipulations as follows:

1 The most unfavorable non-uniform distribution condition of snow cover should be adopted in

the design of roof slabs and purlins.

2 When in the design of roof truss or archy shell, that the full-span uniform distribution condition, the non-uniform distribution condition and the half-span uniform distribution condition of snow cover can be adopted.

3 Full-span uniform distribution of snow cover can be adopted in the design of frames and columns.

7 Wind Load

7.1 Characteristic Value of Wind Load and Reference Wind Pressure

7.1.1 Characteristic value of wind load vertical to building surfaces shall be calculated in accordance with the following equation:

1 When in the design of principal load-bearing structures

$$w_k = \beta_z \mu_s \mu_z w_0 \quad (7.1.1\text{-}1)$$

Where w_k——characteristic value of wind load (kN/m^2);

β_z——dynamic effect factor of wind at a height of z;

μ_s——shape factor of wind load;

μ_z——exposure factor for wind pressure;

w_0——reference wind pressure (kN/m^2);

2 When in the design of fencing structures

$$w_k = \beta_{gz} \mu_s \mu_z w_0 \quad (7.1.1\text{-}2)$$

Where β_{gz}——gust factor at a height of z.

7.1.2 A 50-year mean recurrence interval for wind pressure given in the Appendix D.4 Attached Table D.4 of the Code shall be adopted as the reference wind pressure, but it shall not be less than 0.3 kN/m^2.

The reference wind pressures, which are adopted for the high buildings, the high-rise structures and the other structures sensitive to wind load, shall be raised appropriately, and shall be specified in the relevant design codes.

7.1.3 When the value for reference wind pressure of a city or a construction site is not given on the Distribution Diagram of the Reference wind Pressure for Nation-Wide, the value for reference wind pressure can be determined on the basis of the data for annual maximum wind velocity in the locality, through the statistical analysis according to the definition of reference wind pressure, and the influence for the amount of sample data shall be considered (see also the Appendix D). When the data of wind velocity are without in the locality, hence, they can be determined on the basis of the specified reference wind pressure or the data over a long period of time for the adjacent regions, through the contrast analysis with the meteological phenomena and topography conditions; also they can be determined approximately by the Distribution Diagram of the Reference Wind Pressure for Nation-Wide in the Appendix D (Attached Fig D.5.3) of the Code.

7.1.4 The values of 0.6, 0.4 and 0 can be taken as the coefficients for combination value, frequent value and quasi-permanent value of wind load respectively.

7.2 Exposure Factor for Wind Pressure

7.2.1 For the smooth terrain or the slightly rising and falling topography, that the exposure factor for wind pressure shall be determined on the basis of the categories of terrain roughness according to the Table 7.2.1.

Terrain roughness can be classified into A, B, C and D four categories:

—Category A denotes in shore sea surfaces, islands, sea shores, lake shores and deserts;

—Category B denotes open fields, villages, forests, hills, sparsely-populated towns and city suburbs;

—Category C denotes urban districts in densely-populated cities.

—Category D denotes densely-populated cities with high building urban districts.

Table 7.2.1 Exposure Factor μ_z for Wind Pressure

Height above terrain or sea level (m)	Terrain roughness categories			
	A	B	C	D
5	1.17	1.00	0.74	0.62
10	1.38	1.00	0.74	0.62
15	1.52	1.14	0.74	0.62
20	1.63	1.25	0.84	0.62
30	1.80	1.42	1.00	0.62
40	1.92	1.56	1.13	0.73
50	2.03	1.67	1.25	0.84
60	2.12	1.77	1.35	0.93
70	2.20	1.86	1.45	1.02
80	2.27	1.95	1.54	1.11
90	2.34	2.02	1.62	1.19
100	2.40	2.09	1.70	1.27
150	2.64	2.38	2.03	1.61
200	2.83	2.61	2.30	1.92
250	2.99	2.80	2.54	2.19
300	3.12	2.97	2.75	2.45
350	3.12	3.12	2.94	2.68
400	3.12	3.12	3.12	2.91
≥450	3.12	3.12	3.12	3.12

7.2.2 For the mountainous buildings, besides the exposure factor for wind pressure can be determined on the basis of the categories of terrain roughness according to the Table 7.2.1, that the adjustment for the topography conditions shall still be considered, the adjustment coefficient η can be adopted in accordance with the following stipulations respectively:

1 For the mountain peak and the mountain slope, the adjustment coefficient at the top B can be adopted according to the following equation:

$$\eta_B = \left[1 + \kappa \mathrm{tg}\alpha\left(1 - \frac{z}{2.5H}\right)\right]^2 \qquad (7.2.2)$$

Where $\mathrm{tg}\alpha$——slope on the windward side of the mountain peak or the mountain slope; when $\mathrm{tg}\alpha > 0.3$, taking $\mathrm{tg}\alpha = 0.3$;

κ——coefficients, for the mountain peak taking 3.2, for the mountain slope taking 1.4;

H——full height of the mountain peak or the mountain slope (m);

z——height for the calculating position for buildings from the ground, m; when $z > 2.5H$, taking $z = 2.5H$.

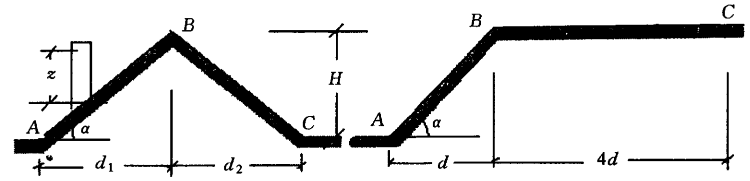


Fig.7.2.2 Sketch map for mountain peak and mountain slope

For the other parts of the mountain peak and the mountain slope can accord with the Fig.7.2.2, the value 1 can be taken for the adjustment coefficients η_A、η_C, then the adjustment coefficients between AB and BC can be determined by the linear interpolation value of η.

2 The closed terrain between the mountains, such as basin, valley and etc.,

$$\eta = 0.75 \sim 0.85;$$

The mountain valley pass, the mountain pass identical with wind direction,

$$\eta = 1.20 \sim 1.50.$$

7.2.3 For the buildings or structural constructions on the offshore sea surface, islands, besides the exposure factor for wind pressure can be determined by the category A terrain roughness according to the Table 7.2.1, that the adjustment coefficients given in the Table 7.2.3 shall still be considered.

Table 7.2.3 Adjustment coefficients η for offshore sea surfaces, islands

Distance from seashore (km)	η
< 40	1.0
40 ~ 60	1.0 ~ 1.1
60 ~ 100	1.1 ~ 1.2

7.3 Shape Factor of Wind Load

7.3.1 The shape factor of wind load for a building or a structural construction can be adopted according to the following stipulations:

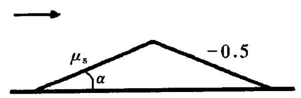
1 When the shape of a building or a structural construction is same as the shape shown in the Table 7.3.1, that the stipulations of the Table 7.3.1 can be adopted;

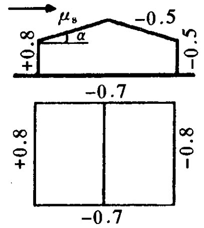
2 When the shape of a building or a structural construction is not same as the shape shown in the Table 7.3.1, that the relevant materials can be referenced;

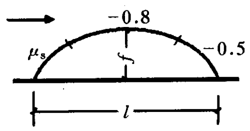
3 When the shape of a building or a structural construction is not only different with the shape shown in the Table 7.3.1, but also in lack of reference materials, then their shape factors may be determined by the wind tunnel test;

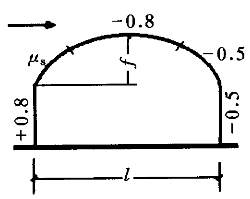
4 The shape factors for the important and the complicated shaped buildings or structural constructions shall be determined by the wind tunnel test.

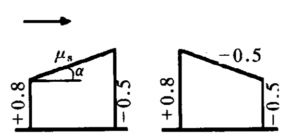
Table 7.3.1 Shape Factor of Wind Load

<table>
<tr><th>Item No.</th><th>Types</th><th>Shapes and shape factors μ_s</th></tr>
<tr><td>1</td><td>Enclosed double pitched roof on the ground</td><td>

<table><tr><th>α</th><th>μ_s</th></tr><tr><td>0°</td><td>0</td></tr><tr><td>30°</td><td>+0.2</td></tr><tr><td>≥60°</td><td>+0.8</td></tr></table>
For medium values, calculated by interpolation</td></tr>
<tr><td>2</td><td>Enclosed double pitched roof</td><td>

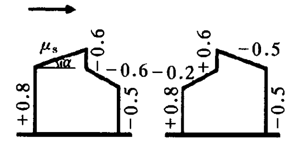
<table><tr><th>α</th><th>μ_s</th></tr><tr><td>≤15°</td><td>-0.6</td></tr><tr><td>30°</td><td>0</td></tr><tr><td>≥60°</td><td>+0.8</td></tr></table>
For medium values, calculated by interpolation</td></tr>
<tr><td>3</td><td>Enclosed arched roof on the ground</td><td>

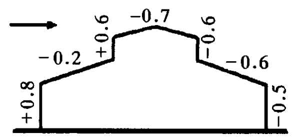
<table><tr><th>f/l</th><th>μ_s</th></tr><tr><td>0.1</td><td>+0.1</td></tr><tr><td>0.2</td><td>+0.2</td></tr><tr><td>0.5</td><td>+0.6</td></tr></table>
For medium values, calculated by interpolation</td></tr>
<tr><td>4</td><td>Enclosed arched roof</td><td>

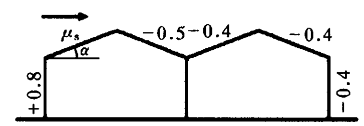
<table><tr><th>f/l</th><th>μ_s</th></tr><tr><td>0.1</td><td>-0.8</td></tr><tr><td>0.2</td><td>0</td></tr><tr><td>0.5</td><td>+0.6</td></tr></table>
For medium values, calculated by interpolation</td></tr>
<tr><td>5</td><td>Enclosed monopitched roof</td><td>

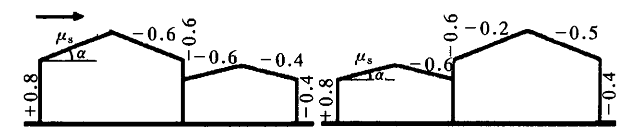
The μ_s of windward pitch, the values given in Item No.2 may be adopted</td></tr>
</table>

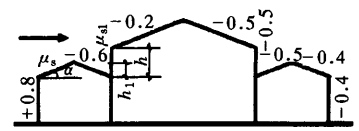
(Continued)

<table>
<tr><th>Item No.</th><th>Types</th><th>Shapes and shape factors μ_s</th></tr>
<tr><td>6</td><td>Enclosed high-low double pitched roof</td><td>

The μ_s of windward pitch, the values given in Item No.2 may be adopted.</td></tr>
<tr><td>7</td><td>Enclosed double pitched roof with skylight</td><td>

The μ_s listed herein may be adopted for arched roof with skylight</td></tr>
<tr><td>8</td><td>Enclosed double span double pitched roof</td><td>

The μ_s of windward pitch, the values given in the Item No. 2 may be adopted</td></tr>
<tr><td>9</td><td>Enclosed double span double pitched roof with unequal span and unequal height</td><td>

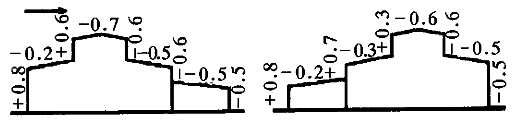
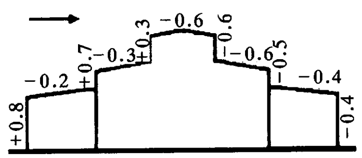
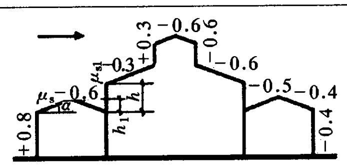
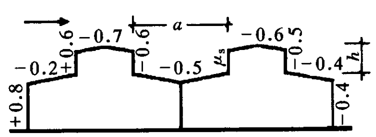
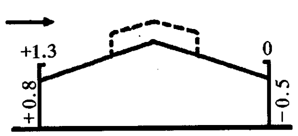
The μ_s of windward pitch, the values given in Item No.2 may be adopted</td></tr>
<tr><td>10</td><td>Enclosed triple span double pitched roof with unequal span and unequal height</td><td>

The μ_s of windward pitch, the values given in Item No.2 may be adopted, and the μ_{s1} of the upper part of windward wall for the middle span can be determined by the formula given below:

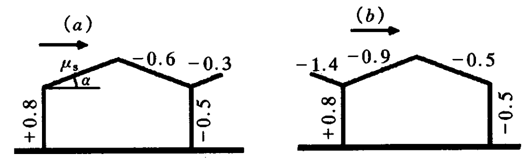
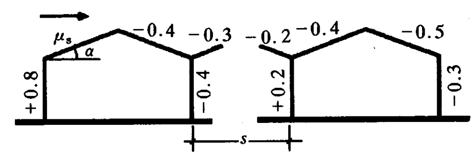
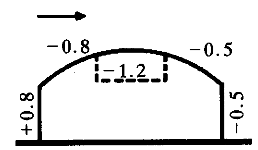
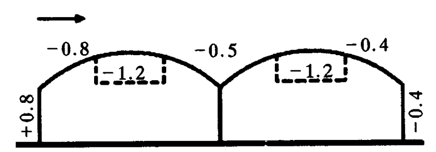
$$\mu_{s1} = 0.6(1 - 2h_1/h)$$

When $h_1 = h$, taking $\mu_{s1} = -0.6$</td></tr>
</table>

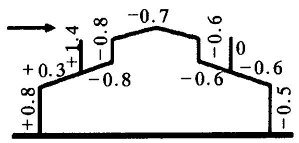
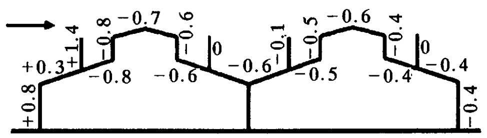
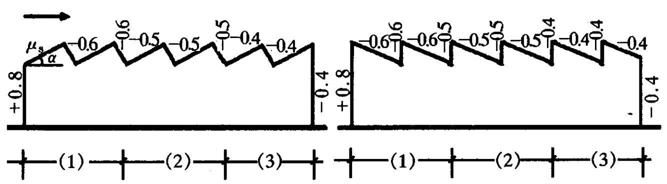
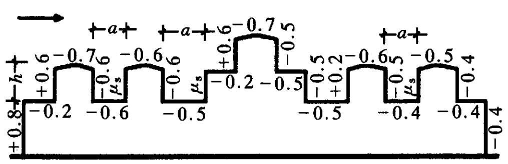
(Continued)

Item No.	Types	Shapes and shape factors μ_s
11	Enclosed double pitched roof with skylight, a pent roof leaned on one side of main house	
12	Enclosed double pitched roof with skylight, two pent roofs leaned on both sides of main house	
13	Enclosed triple span double pitched roof with unequal span and unequal height, and with skylight in middle span	 The μ_s of windward pitch, the values given in Item No.2 may be adopted, and the μ_{s1} of the upper part of windward wall for the middle span can be determined by the formula given below: $\mu_{s1} = 0.6(1 - 2h_1/h)$ When $h_1 = h$, taking $\mu_{s1} = -0.6$
14	Enclosed double span double pitched roofs with skylight	 The μ_s of windward skylight face on the second span, the values as follows may be adopted: When $a \leqslant 4h$, taking $\mu_s = 0.2$ When $a > 4h$, taking $\mu_s = 0.6$
15	Enclosed double pitched roof with parapet wall	 When the parapet wall is not so high, the roof shape factor of the roof without parapet can be adopted

(Continued)

Item No.	Types	Shapes and shape factors μ_s
16	Enclosed double pitched roof with canopy	 The μ_s of windward pitch, the values given in Item No.2 may be adopted
17	Opposite two enclosed double pitched roofs with canopy on each roof	 The figure is applicable to the conditions in which the s is 8 ~ 20m, the μ_s of windward pitch, the values given in Item No.2 may be adopted
18	Enclosed double pitched roof or arched roof with sunken skylight	
19	Enclosed double span, double pitched roof or arched roof with sunken skylights	

(Continued)

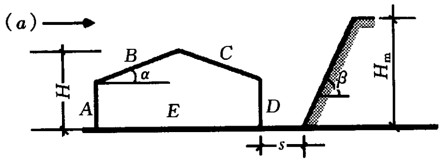
Item No.	Types	Shapes and shape factors μ_s
20	Enclosed pitched roof with skylight and wind shield	
21	Enclosed double span, double pitched roofs with skylights and wind shield	
22	Enclosed sawtooth roof	 The μ_s of windward pitch, the values given in Item No.2 may be adopted. When the number of tooth faces are increased or decreased, it can be evenly regulated within three sections of (1)、(2)and (3).
23	Enclosed multi-span complicated roof	 The μ_s of the skylight face may be adopted as follows: When $a \leqslant 4h$, $\mu_s = 0.2$ When $a > 4h$, $\mu_s = 0.6$

(Continued)

Item No.	Types	Shapes and shape factors μ_s
24	Enclosed double pitched roof situated aside mountain	(a) — see below; (b) — see below
25	Enclosed double pitched roof with skylight situated aside mountain	see below

Item 24

(a)

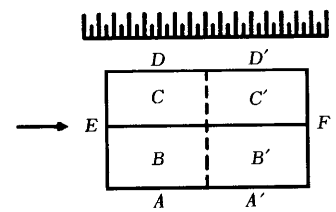


The figure is applicable to the conditions in which $H_m/H \geqslant 2$ and $s/H = 0.2 \sim 0.4$

Shape factor μ_s

β	α	A	B	C	D	
30°	15°	+0.9	-0.4	0	+0.2	-0.2
	30°	+0.9	+0.2	-0.2	-0.2	-0.3
	60°	+1.0	+0.7	-0.4	-0.2	-0.5
60°	15°	+1.0	+0.3	+0.4	+0.5	+0.4
	30°	+1.0	+0.4	+0.3	+0.4	+0.2
	60°	+1.0	+0.8	-0.3	0	-0.5
90°	15°	+1.0	+0.5	+0.7	+0.8	+0.6
	30°	+1.0	+0.6	+0.8	+0.9	+0.7
	60°	+1.0	+0.9	-0.1	+0.2	-0.4

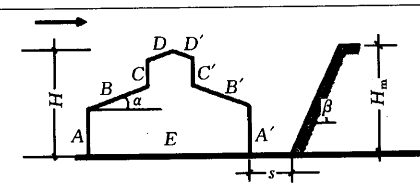
(b)



Shape factor μ_s

β	A B D	E	A′B′C′D′	F
15°	-0.8	+0.9	-0.2	-0.2
30°	-0.9	+0.9	-0.2	-0.2
60°	-0.9	+0.9	-0.2	-0.2

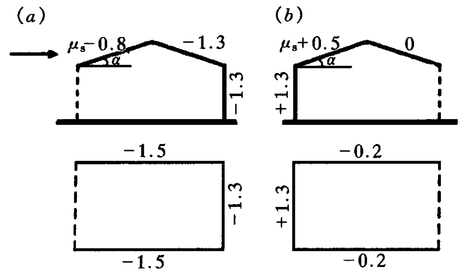
Item 25

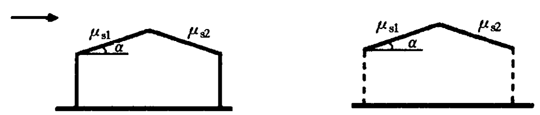


The figure is applicable to the conditions in which $H_m/H \geqslant 2$ and $s/H = 0.2 \sim 0.4$

Shape factor μ_s

β	A	B	C	D	D′	C′	B′	A′	E
30°	+0.9	+0.2	-0.6	-0.4	-0.3	-0.3	-0.3	-0.2	-0.5
60°	+0.9	+0.6	+0.1	+0.1	+0.2	+0.2	+0.2	+0.4	+0.1
90°	+1.0	+0.8	+0.6	+0.2	+0.6	+0.6	+0.6	+0.8	+0.6

<table>
<tr><th>Item No.</th><th>Types</th><th>Shapes and shape factors μ_s</th></tr>
<tr><td>26</td><td>Double pitched roof with one side open</td><td>


For the μ_s of windward pitch, the values given in Item No. 2 may be adopted
</td></tr>
<tr><td>27</td><td>Double pitched roof with two or four sides open</td><td>


(a) with gable walls in two ends (b) open in four sides

Shape factor μ_s

<table>
<tr><th>α</th><th>μ_{s1}</th><th>μ_{s2}</th></tr>
<tr><td>≤10°
30°</td><td>-1.3
+1.6</td><td>-0.7
+0.4</td></tr>
</table>

For medium values, calculated by interpolation

Note: 1 The roofs shown in the figure are wind-sensitive, the sign change of positive and negative of μ_s shall be considered in design;

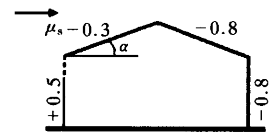
2 The total horizontal force on the roof caused by the longitudinal wind load is:

$0.05Aw_h$ for $\alpha \geq 30°$

$0.10Aw_h$ for $\alpha < 30°$

Where A is the horizontal projected area of the roof, w_h is the wind pressure on the roof at the roof height of h;

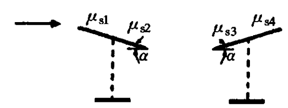
3 When a lot of articles are piled in the house or the building is situated aside mountain, that the suction of roofing shall be increased, the values of shape factor given in Item No. 26 (a) may be adopted
</td></tr>
</table>

<table>
<tr><th>Item No.</th><th>Types</th><th>Shapes and shape factors μ_s</th></tr>
<tr><td>28</td><td>Double pitched roof, the front and back longitudinal walls of house are half open</td><td>


The μ_s of windward pitch, the value as given in Item No.2 may be adopted

The figure is applicable to the building that the concentrated open area at upper part of house is ≥10% and <50%.

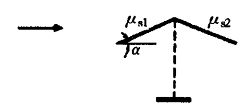
When the open area reaches 50%, the factor for the leeward wall can be changed to -1.1
</td></tr>
<tr><td>29</td><td>Monopitched and double pitched top cover of house</td><td>
(a)



<table>
<tr><th>α</th><th>μ_{s1}</th><th>μ_{s2}</th><th>μ_{s3}</th><th>μ_{s4}</th></tr>
<tr><td>≤10°
30°</td><td>-1.3
-1.4</td><td>-0.5
-0.6</td><td>+1.3
+1.4</td><td>+0.5
+0.6</td></tr>
</table>

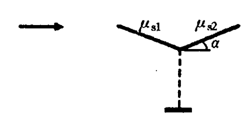
For medium values, calculated by interpolation

(b)



The values of shape factor given in Item No.27 may be adopted

(c)

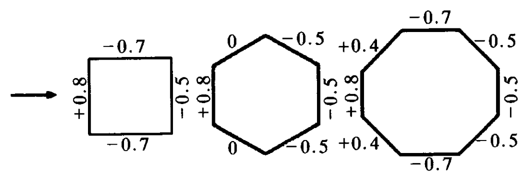
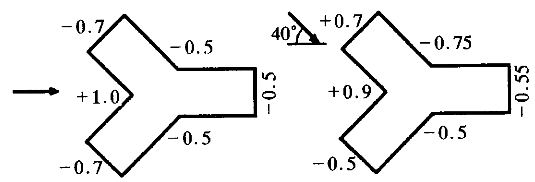
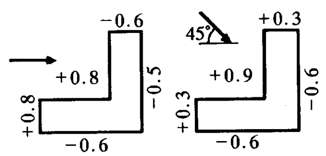
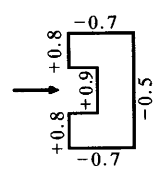
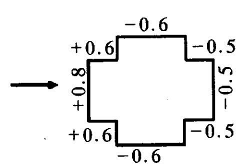
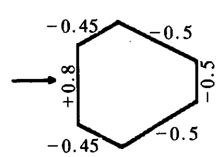


<table>
<tr><th>α</th><th>μ_{s1}</th><th>μ_{s2}</th></tr>
<tr><td>≤10°
30°</td><td>+1.0
-1.6</td><td>+0.7
-0.4</td></tr>
</table>

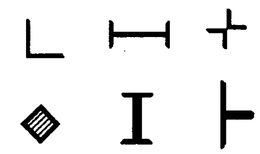
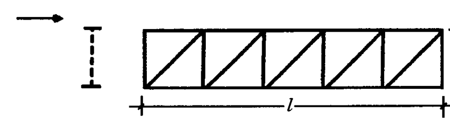
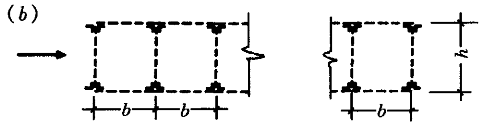
For medium values, calculated by interpolation

Note: for (b), (c), the Note 1,2 of Item No.27 shall be considered
</td></tr>
</table>

(Continued)

Item No.	Types	Shapes and shape factors μ_s
30	Enclosed typed buildings and structural constructions	(*a*) Regular polygonal (including rectangular) plan  (*b*) Y-shaped plan  (*c*) L-shaped plan  (*d*) Π-shaped plan  (*e*) crossed plan  (*f*) hexagonal plan 

(Continued)

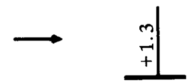
Item No.	Types	Shapes and shape factors μ_s
31	Members with various sections	 $\mu_s = +1.3$
32	Trusses	 For the shape factor of single-truss $\mu_{st} = \phi\mu_s$ Where μ_s is the shape factor of truss member; for shaped steel member, the values given in Item No. 31 may be adopted, for round pipe member, the values given in Item No. 36 (b) may be adopted $\phi = A_n/A$, is the wind shielding coefficient of the truss Where A_n is the net projected area of the wind shielding on the members and nodal points $A = hl$ is the outline area of the truss  The whole shape factor of the *n* paralleled trusses $\mu_{stw} = \mu_{st}\dfrac{1-\eta^n}{1-\eta}$ Where μ_{st} is the shape factor of single truss, η may be taken from the Table given below

ϕ \ b/h	≤1	2	4	6
≤0.1	1.00	1.00	1.00	1.00
0.2	0.85	0.90	0.93	0.97
0.3	0.66	0.75	0.80	0.85
0.4	0.50	0.60	0.67	0.73
0.5	0.33	0.45	0.53	0.62
0.6	0.15	0.30	0.40	0.50

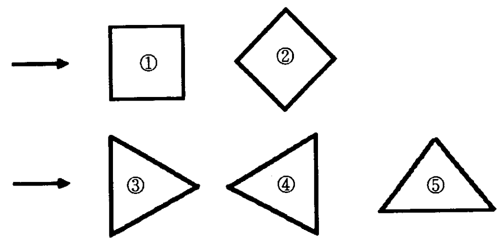
(Continued)

Item No.	Types	Shapes and shape factors μ_s
33	Independent wall and fencing wall	see below
34	Tower frame	see below
35	Revolving shell roof	see below

33 — Independent wall and fencing wall



34 — Tower frame



(*a*) Shape factor μ_s for integrated calculating the angle steel tower frame

wind shielding coefficient	square: wind direction ①	square: wind direction ②, single angle steel	square: wind direction ②, combined angle steel	triangular wind direction ③④⑤
≤0.1	2.6	2.9	3.1	2.4
0.2	2.4	2.7	2.9	2.2
0.3	2.2	2.4	2.7	2.0
0.4	2.0	2.2	2.4	1.8
0.5	1.9	1.9	2.0	1.6

(*b*) Shape factor μ_s for integrated calculating the pipe and round steel tower frame

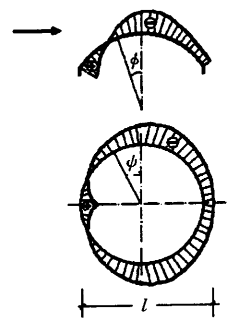
When $\mu_s w_0 d^2 \leqslant 0.002$, the value μ_s of angle steel tower frame multiplied by 0.8 can be used as μ_s;

When $\mu_s w_0 d^2 \geqslant 0.015$, the value μ_s of angle steel tower frame multiplied by 0.6 can be used as μ_s;

For medium value, calculated by interpolation

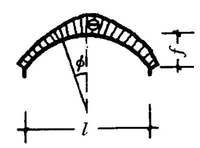
35 — Revolving shell roof

(*a*) $f/l > \frac{1}{4}$



$\mu_s = 0.5\sin^2\phi\sin\psi - \cos^2\phi$

(*b*) $f/l \leqslant \frac{1}{4}$

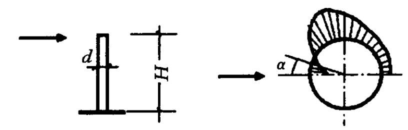


$\mu_s = -\cos^2\phi$

(Continued)

Item No.	Types	Shapes and shape factor μ_s
36	Structural constructions with circular section (including chimney, mast, etc.)	see below

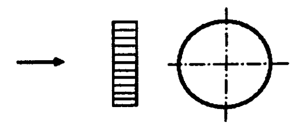
(*a*) For local calculation, the shape factors μ_s distributed around the surface



	$H/d \geqslant 25$	$H/d = 7$	$H/d = 1$
0°	+1.0	+1.0	+1.0
15°	+0.8	+0.8	+0.8
30°	+0.1	+0.1	+0.1
45°	−0.9	−0.8	−0.7
60°	−1.9	−1.7	−1.2
75°	−2.5	−2.2	−1.5
90°	−2.6	−2.2	−1.7
105°	−1.9	−1.7	−1.2
120°	−0.9	−0.8	−0.7
135°	−0.7	−0.6	−0.5
150°	−0.6	−0.5	−0.4
165°	−0.6	−0.5	−0.4
180°	−0.6	−0.5	−0.4

The values given above are applicable to the smooth surface with $\mu_s w_0 d^2 \geqslant 0.015$, where w_0 is measured by kN/m², and d is measured by m

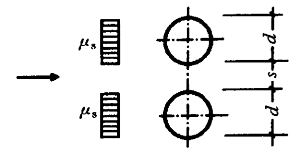
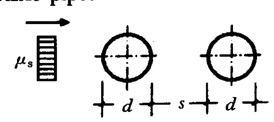
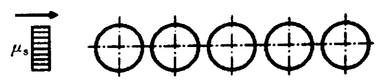
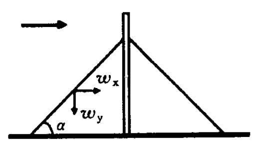
(*b*) The shape factors μ_s for integrated calculating



$\mu_s w_0 d^2$	Surface condition	$H/d \geqslant 25$	$H/d = 7$	$H/d = 1$
≥0.015	$\Delta \approx 0$	0.6	0.5	0.5
	$\Delta = 0.02d$	0.9	0.8	0.7
	$\Delta = 0.08d$	1.2	1.0	0.8
≤0.002		1.2	0.8	0.7

For medium value, calculated by interpolation; Δ denotes the surface convex height

(Continued)

<table>
<tr><th>Item No.</th><th>Types</th><th>Shapes and shape factors μ_s</th></tr>
<tr><td>37</td><td>Elevated pipe line</td><td>
The figures are applicable to condition in which $\mu_s w_0 d^2 \geqslant 0.015$
(a) Up and down double pipes

<table>
<tr><td>s/d</td><td>$\leqslant 0.25$</td><td>0.5</td><td>0.75</td><td>1.0</td><td>1.5</td><td>2.0</td><td>$\geqslant 3.0$</td></tr>
<tr><td>μ_s</td><td>+1.2</td><td>+0.9</td><td>+0.75</td><td>+0.7</td><td>+0.65</td><td>+0.63</td><td>+0.6</td></tr>
</table>
(b) Front and back double pipes

<table>
<tr><td>s/d</td><td>$\leqslant 0.25$</td><td>0.5</td><td>1.5</td><td>3.0</td><td>4.0</td><td>6.0</td><td>8.0</td><td>$\geqslant 10.0$</td></tr>
<tr><td>μ_s</td><td>+0.68</td><td>+0.86</td><td>+0.94</td><td>+0.99</td><td>+1.08</td><td>+1.11</td><td>+1.14</td><td>+1.20</td></tr>
</table>
The value of μ_s listed in table is the sum of μ_s of front and back pipes, in which the front pipe is 0.6
(c) Multi-pipe closely spaced

$\mu_s = +1.4$
The value of μ_s is the sum of the pipes
</td></tr>
<tr><td>38</td><td>Tension cables</td><td>

The shape factor μ_{sx} for the horizontal component of wind load w_x and the shape factor μ_{sy} for the vertical component of wind load w_y:
<table>
<tr><th>α</th><th>μ_{sx}</th><th>μ_{sy}</th><th>α</th><th>μ_{sx}</th><th>μ_{sy}</th></tr>
<tr><td>0°</td><td>0</td><td>0</td><td>50°</td><td>0.60</td><td>0.40</td></tr>
<tr><td>10°</td><td>0.05</td><td>0.05</td><td>60°</td><td>0.85</td><td>0.40</td></tr>
<tr><td>20°</td><td>0.10</td><td>0.10</td><td>70°</td><td>1.10</td><td>0.30</td></tr>
<tr><td>30°</td><td>0.20</td><td>0.25</td><td>80°</td><td>1.20</td><td>0.20</td></tr>
<tr><td>40°</td><td>0.35</td><td>0.40</td><td>90°</td><td>1.25</td><td>0</td></tr>
</table>
</td></tr>
</table>

7.3.2 When a lot of buildings, especially the high buildings are built-up crowded together, with closely spaced between buildings, that the population effects for the mutual interference of wind forces may be considered; in general, the shape factor for concerned singular building structure μ_s can multiply the mutual interference enlargement coefficient, which can be determined by the referenced experimental data of similar conditioned building, if necessary, it may be gained from the wind tunnel test.

7.3.3 When checking calculating the strength of the fencing members and their connections, that the shape factors for the local wind pressures can be adopted according to the stipulations as follows:

A. Outer surface

1 Positive compressive region adopted according to the Table 7.3.1;

2 Negative compressive region

—for wall surface, taking −1.0;

—for side at corner of wall, taking −1.8;

—for local position of roofing (the perimeters and the ridge of roof with roofing slope is greater than 10°), taking −2.2;

—for projecting members such as eaves gutter, canopy, sunshading board and etc. taking −2.0.

Note: The acting width on the side at corner of wall and the local position of roofing is 0.1 of building width or 0.4 of mean building height, taking the small one, but not less than 1.5m.

B. Inner surface

For the closed type buildings, taking −0.2 or 0.2 according to the negative or positive condition of wind pressure at outer surface.

7.4 Along Wind Direction Wind Excitation and Dynamic Wind Effect Factor

7.4.1 For the engineering structures, such as buildings, roofings and various high-rise buildings, with the fundamental natural period of vibration T_1 is greater than 0.25s, as well as, the high-flexible buildings with the height is greater than 30m and the height-width ratio is greater than 1.5, that the influence of the along wind direction wind excitation due to the fluctuation effects of wind pressure shall be considered. The random vibration theory shall be used for the calculation of the wind excitation, and the natural period of vibration for structures shall be calculated according to the dynamics of structures.

Note: The approximate fundamental natural period of vibration can be calculated according to the Appendix E.

7.4.2 For the common cantilever-type structures, such as the high-rise structures including the structural framing, tower frame, chimney and etc., as well as, the high buildings with the height is greater than 30 m, the height-width radio is greater than 1.5 and the influence of torsion can be neglected, that only the influence of first vibration mode may be considered and the wind load on such structures can be calculated through the dynamic wind effect factors according to the equation (7.1.1-1), the dynamic wind effect factor β_z at the height z of structure can be calculated according to the following equation:

$$\beta_z = 1 + \frac{\xi \nu \varphi_z}{\mu_z} \quad (7.4.2)$$

Where ξ——magnification factor of wind fluctuation;

ν——wind fluctuation factor;

φ_z——vibration mode factor;

μ_z——exposure factor for wind pressure.

7.4.3 The magnification factor of wind fluctuation can be determined according to the Table 7.4.3.

Table 7.4.3 Magnification Factor of Wind Fluctuation ξ

$w_0 T_1^2$ (kNs²/m²)	0.01	0.02	0.04	0.06	0.08	0.10	0.20	0.40	0.60
Steel structure	1.47	1.57	1.69	1.77	1.83	1.88	2.04	2.24	2.36
Steel structure buildings with filler wall	1.26	1.32	1.39	1.44	1.47	1.50	1.61	1.73	1.81
Concrete, masonary structures	1.11	1.14	1.17	1.19	1.21	1.23	1.28	1.34	1.38
$w_0 T_1^2$ (kNs²/m²)	0.80	1.00	2.00	4.00	6.00	8.00	10.00	20.00	30.00
Steel structure	2.46	2.53	2.80	3.09	3.28	3.42	3.54	3.91	4.14
Steel structure buildings with filler wall	1.88	1.93	2.10	2.30	2.43	2.52	2.60	2.85	3.01
Concrete, masonary structures	1.42	1.44	1.54	1.65	1.72	1.77	1.82	1.96	2.06

Note: When calculating the $w_0 T_1^2$, for category B terrain roughness region, that the reference wind pressure can be substituted directly, however, for categories A, C and D terrain roughness regions, before the substitution, their reference wind pressures in locality shall be multiplied by 1.38, 0.62 and 0.32 respectively.

7.4.4 The wind fluctuation factor can be determined according to the following conditions respectively.

1 The width of windward side of structure is more less than its height condition (such as high-rise structure, etc.):

1) if the appearance, the mass, may be rather uniform along the height of structure, hence, the fluctuation factors can be determined according to the Table 7.4.4-1.

Table 7.4.4-1 Wind Fluctuation Factor ν

Total height H(m)		10	20	30	40	50	60	70	80
Categories of terrain roughness	A	0.78	0.83	0.86	0.87	0.88	0.89	0.89	0.89
	B	0.72	0.79	0.83	0.85	0.87	0.88	0.89	0.89
	C	0.64	0.73	0.78	0.82	0.85	0.87	0.88	0.90
	D	0.53	0.65	0.72	0.77	0.81	0.84	0.87	0.89

Total height H(m)		90	100	150	200	250	300	350	400	450
Categories of terrain roughness	A	0.89	0.89	0.87	0.84	0.82	0.79	0.79	0.79	0.79
	B	0.90	0.90	0.89	0.88	0.86	0.84	0.83	0.83	0.83
	C	0.91	0.91	0.93	0.93	0.92	0.91	0.90	0.89	0.91
	D	0.91	0.92	0.97	1.00	1.01	1.01	1.01	1.00	1.00

2) When the width of the windward side and the lateral wind side of structure are varied in linearity or nearly linearity along the height, however, the mass is varied in continuous regularity, hence, the wind fluctuation factor in the Table 7.4.4-1 shall be multiplied again by the adjustment coefficients θ_B and θ_ν. The θ_B shall be the value for ratio of the width B_z at z height and the width of bottom B_0 of windward side for the structural constructions; the θ_ν can be determined according to the Table 7.4.4-2.

Table 7.4.4-2 Adjustment Coefficient θ_ν

B_H/B_0	1	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	≤0.1
θ_ν	1.00	1.10	1.20	1.32	1.50	1.75	2.08	2.53	3.30	5.60

Note: B_H、B_0 denote the top width, the bottom width of windward side respectively for the structural constructions.

2 When the width of windward side of structure is rather large, the condition for the space interrelation of wind pressure along the width direction shall be considered (such as tall buildings): if the appearance, the mass may be uniform along the height of structure, hence, the fluctuation factors on the basis of the value for ratio of the total height H and the width of windward side B can be determined according to the Table 7.4.4-3.

Table 7.4.4-3 Wind Fluctuation Factor ν

H/B	Categroies of terrain roughness	Total height H(m)							
		≤30	50	100	150	200	250	300	350
≤0.5	A	0.44	0.42	0.33	0.27	0.24	0.21	0.19	0.17
	B	0.42	0.41	0.33	0.28	0.25	0.22	0.20	0.18
	C	0.40	0.40	0.34	0.29	0.27	0.23	0.22	0.20
	D	0.36	0.37	0.34	0.30	0.27	0.25	0.24	0.22
1.0	A	0.48	0.47	0.41	0.35	0.31	0.27	0.26	0.24
	B	0.46	0.46	0.42	0.36	0.36	0.29	0.27	0.26
	C	0.43	0.44	0.42	0.37	0.34	0.31	0.29	0.28
	D	0.39	0.42	0.42	0.38	0.36	0.33	0.32	0.31
2.0	A	0.50	0.51	0.46	0.42	0.38	0.35	0.33	0.31
	B	0.48	0.50	0.47	0.42	0.40	0.36	0.35	0.33
	C	0.45	0.49	0.48	0.44	0.42	0.38	0.38	0.36
	D	0.41	0.46	0.48	0.46	0.46	0.44	0.42	0.39
3.0	A	0.53	0.51	0.49	0.42	0.41	0.38	0.38	0.36
	B	0.51	0.50	0.49	0.46	0.43	0.40	0.40	0.38
	C	0.48	0.49	0.49	0.48	0.46	0.43	0.43	0.41
	D	0.43	0.46	0.49	0.49	0.48	0.47	0.46	0.45

(Continued)

H/B	Categroies of terrain roughness	Total height H(m)							
		≤30	50	100	150	200	250	300	350
0.5	A	0.52	0.53	0.51	0.49	0.46	0.44	0.42	0.39
	B	0.50	0.53	0.52	0.50	0.48	0.45	0.44	0.42
	C	0.47	0.50	0.52	0.52	0.50	0.48	0.47	0.45
	D	0.43	0.48	0.52	0.53	0.53	0.52	0.51	0.50
8.0	A	0.53	0.54	0.53	0.51	0.48	0.46	0.43	0.42
	B	0.51	0.53	0.54	0.52	0.50	0.49	0.46	0.44
	C	0.48	0.51	0.54	0.53	0.52	0.52	0.50	0.48
	D	0.43	0.48	0.54	0.53	0.55	0.55	0.54	0.53

7.4.5 The vibration mode factor shall be determined in accordance with the calculation of structural dynamics. For the cantilever-type high-rise structures with the appearance, the mass and the rigidity are varied in continuous regularity along the height, as well as, the tall buildings are with rather uniform along the height, their vibration mode factors can also be determined on the basis of relative height z/H according to the Appendix F.

7.5 Gust Factor

7.5.1 The gust factor used for the calculation of wind load for the fencing structures shall be determined in accordance with the Table 7.5.1.

Table 7.5.1 Gust Factor β_{gz}

Height from ground (m)	Categories of terrain roughness			
	A	B	C	D
5	1.69	1.88	2.30	3.21
10	1.63	1.78	2.10	2.76
15	1.60	1.72	1.99	2.54
20	1.58	1.69	1.92	2.39
30	1.54	1.64	1.83	2.21
40	1.52	1.60	1.77	2.09
50	1.51	1.58	1.73	2.01
60	1.49	1.56	1.69	1.94
70	1.48	1.54	1.66	1.89
80	1.47	1.53	1.64	1.85
90	1.47	1.52	1.62	1.81
100	1.46	1.51	1.60	1.78
150	1.43	1.47	1.54	1.67
200	1.42	1.44	1.50	1.60
250	1.40	1.42	1.46	1.55
300	1.39	1.41	1.44	1.51

7.6 Cross Wind Direction Wind Excitation

7.6.1 For the structure with round section, the checking of the cross wind direction wind exciation (vortex shedding) shall be carried out on the basis of the different conditions for Reynolds number Re in accordance with the following stipulations:

1 When $Re < 3\times10^5$ (gentle breeze resonance of sub-critical), that the wind velocity at the top of structure v_H, which will not exceed the critical wind velocity v_{cr}, shall be controlled as follows, the v_{cr} and v_H can be determined by the following equations:

$$v_{cr} = \frac{D}{T_1 St} \quad (7.6.1\text{-}1)$$

$$v_H = \sqrt{\frac{2000\gamma_W \mu_H w_0}{\rho}} \quad (7.6.1\text{-}2)$$

Where T_1——fundamental natural period of vibration for structure;

St——Strouhal number, for the structure with round section, taking 0.2;

γ_W——partial safety factor of wind load, taking 1.4;

μ_H——exposure factor of wind pressure at the top of structure;

w_0——reference wind pressure (kN/m^2);

ρ——density of air (kg/m^3).

When the wind velocity at the top of structure exceeds v_{cr}, the precautions against vibration can be taken in the detailing requirements, or to control the critical wind velocity of structure v_{cr} will not be less than 15 m/s.

2 When $Re \geqslant 3.5\times10^6$ and the wind velocity at the top of structure is greater than v_{cr} (strong breeze resonance of trans-critical), that the load effects caused by cross wind direction wind load shall be considered in accordance with the Clause 7.6.2.

3 The Reynolds number can be determined according to the following equation:

$$Re = 69000vD \quad (7.6.1\text{-}3)$$

Where v——wind velocity at the calculating height (m/s);

D——diameter for the cross section of structure (m).

4 The sections of structure is reduced along the height (the gradient is not grater than 0.02), that the wind velocity and the diameter at the 2/3 height of structure can be taken approximately.

7.6.2 The equivalent wind load at z height with vibration mode j caused by strong breeze resonance of trans-critical can be determined according to the following equation:

$$w_{czj} = |\lambda_j| v_{cr}^2 \varphi_{zj}/12800\zeta_j \quad (\text{kN/m}^2) \quad (7.6.2\text{-}1)$$

Where λ_j——calculating coefficient, determined according to the Table 7.6.2;

φ_{zj}——j vibration mode factor at the top of structure, determined by calculation or with reference to the Appendix F;

ζ_j——damp ratio of the j vibration mode; for Number 1 vibration mode, steel structure taking 0.01, steel structure for buildings taking 0.02, concrete structure taking 0.05;

for damp ratio of the high vibration mode, if there are in lack of measured data, the values of Number 1 vibration mode can be taken approximately.

The H_1 in the Table 7.6.2 denotes the height for starting point of the critical wind velocity, which can be determined according to the following equation:

$$H_1 = H \times \left(\frac{v_{cr}}{v_H}\right)^{1/\alpha} \quad (7.6.2\text{-}2)$$

Where α——index of terrain roughness, for the four categories A, B, C and D taking 0.12, 0.16, 0.22 and 0.30 respectively;

v_H——wind velocity at the top of structure (m/s).

Note: The number for high vibration mode, which is considered in the checking of the cross wind direction wind excitation, will not be greater than 4, for the common cantilever-type structures, only the Number 1 or Number 2 vibration mode can be taken.

Table 7.6.2 Table for Calculation of λ_j

Type of structures	Number of vibration mode	H_1/H										
		0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
High-rise structures	1	1.56	1.55	1.54	1.49	1.42	1.31	1.15	0.94	0.68	0.37	0
	2	0.83	0.82	0.76	0.60	0.37	0.09	-0.16	-0.33	-0.38	-0.27	0
	3	0.52	0.48	0.32	0.06	-0.19	-0.30	-0.21	0.00	0.20	0.23	0
	4	0.30	0.33	0.02	-0.20	-0.23	0.03	0.16	0.15	-0.05	-0.18	0
Tall buildings	1	1.56	1.56	1.54	1.49	1.41	1.28	1.12	0.91	0.65	0.35	0
	2	0.73	0.72	0.63	0.45	0.19	-0.11	-0.36	-0.52	-0.53	-0.36	0

7.6.3 When checking the cross wind direction wind excitation, the total load effects for wind can be determined by the combination of the cross wind direction wind load effects S_c and the along wind direction wind load effects S_A as follows:

$$S = \sqrt{S_C^2 + S_A^2} \quad (7.6.3)$$

7.6.4 For the structure with non-round section, that the equivalent wind load of the cross wind direction wind excitation may be determined through the wind tunnel test with the aeroelastic model; it can also be determined with reference to the relevant materials.

Appendix A Self-weight of Commonly Used Materials and Structural Members

Table A.1 Table for Self-Weight of Commonly Used Materials and Structural Members

Name of materials	Self-weight	Remarks
1. Timber (kN/ m^3)		
China fir	4	vary with moisture content
Fir, dragon spruce, Korean pine, Huashan pine, camphor pine, Chinese hemlock, imitative alder, Chinese mahogany, polar, Chinese maple poplar	4~5	vary with moisture content
Masson pine, Yunnan pine, Chinese pine, Japanese red pine, Guangdong pine, alder, Chinese sweet gum, willow, sassafras, Qinling larch, Xingjiang larch	5~6	vary with moisture content
Northeastern larch, pink pine, elm, birch, northeast China ash, chinaberry, wood lotus, tree of heaven	6~7	vary with moisture content
Evergreen chinquapin, dry oak, Chinese scholartree, ebony	7~8	vary with moisture content
Paper mulberry, toothed oak, encalyptus, Chinese ephedra	8~9	vary with moisture content
Ordinary wood lath, wooden rafters and purlins	5	vary with moisture content
Saw dust	2~2.5	3kN/m^3, if anti-corrosive agent is added
Wood wool board	4~5	
Softwood board	2.5	
Shaving board	6	
2. Glued boards (kN/m^2)		
Three-ply board (poplar)	0.019	
Three-ply board (linden)	0.022	
Three-ply board (northeast China ash)	0.028	
Five-ply board (poplar)	0.03	
Five-ply board (linden)	0.034	
Five-ply board (northeast China ash)	0.04	
Cane fiber board (with thickness of 10 mm)	0.03	common thicknesses are 13, 15,19,25 mm